Patuxent Wildlife Research Center

# AN ANNOTATED BIBLIOGRAPHY ON PETROLEUM POLLUTION

by

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## INTRODUCTION

Petroleum has been recognized as a potential environmental contaminant since shortly after the beginning of the Twentieth Century. Reports of the biological consequences of ship wrecks involving cargos of crude and fuel oil began to appear in the popular and scientific press. Scientific literature on the subject was sparse until after World War II when reports of the effects of oil pollution began to appear with greater frequency. The wreck of the Torrey Canyon off the coast of England in 1967 stimulated worldwide interest in the effects of petroleum and cleanup methods on environmental resources. Research on the environmental effects of petroleum peaked during the 1970s and early 1980s. A recent surge of interest in North America was induced by the 1989 Exxon Valdez oil spill in Prince William Sound, Alaska. The accumulated literature on this well-studied contaminant is vast, covering topics as diverse as analytical chemistry, chemical fate, oil spill prevention and response, mitigation and restoration, economic and social analysis, and biological effects on all forms of plant and animal life in saltwater, freshwater, and terrestrial environments. A small amount of literature on shale oil, synthetic (coal) oil, oil sands crude oil, and non-petroleum oils (animal and plant) are also included in this bibliography.

The bibliography is based on a personal reference collection exceeding 2,000 citations and growing at an approximate rate of 50 citations per year. It is primarily a collection of published and readily accessible scientific reports appearing in journals, conference proceedings, serial publications, and books. Unpublished or poorly distributed reports are few. The collection is divided into13 categories and all categories receive new references on an annual basis. Presently, there are 2,107 references in the database. The collection does not contain everything published on the subjects represented by the 13 categories, but it is representative of the published English-language literature. Books, international meetings, workshops, handbooks, government reports, published bibliographies, or non-technical books dealing with various aspects of oil pollution are not well represented in this bibliography; the emphasis is on original reports and a selection of review articles and book chapters. As such, it is most useful for persons seeking detailed technical references or specialized reviews.

Each record consists of the full citation, a list of keywords, and one or more lines of text describing the contents of the reference. The keywords will assist with retrieval of references specified by the search

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option. The "Notes" text describes the content of the reference. The 13 categories and their primary category identifier (a keyword) are Bird (Oone), Mammal (Otwo), Fish (Othree), Amphibian (OthreeA), Reptile (OthreeR), Marine Invertebrate (Ofour), Freshwater Invertebrate (Ofive), Marine Plant (Osix), Freshwater Plant (Oseven), General Effect (Oeight), Technical (Onine), Microbes (Oten), and Miscellaneous (Oeleven). If a reference contains information on chemical oil dispersants, it will have a "D" next to the "O"; for example, ODone is a petroleum and chemical dispersant reference with primary emphasis on birds. References on biodegradation of oil or bioremediation of oil spills have become abundant in recent years; these are classified as Microbes (Oten).

| Category | Primary ID | Secondary ID |
|---|---|---|
| Bird | Oone | bird |
| Mammal | Otwo | mammal |
| Fish | Othree | fish |
| Amphibian | OthreeA | amphibian |
| Reptile | OthreeR | reptile |
| Marine Invertebrate | Ofour | marine invertebrate |
| Freshwater Invertebrate | Ofive | freshwater invertebrate |
| Marine Plant | Osix | marine plant |
| Freshwater Plant | Oseven | freshwater plant |
| General Effect | Oeight | general effect |
| Technical | Onine | technical |
| Microbes | Oten | microbes |
| Miscellaneous | Oeleven | miscellaneous |

References only have one primary category identifier; references containing relevant information but present in other primary categories can be retrieved by using the category name (also a keyword) which is used as a secondary category identifier for all references. Examples: (1) Retrieval of all references that have any information about petroleum, dispersants, and mammals will be accomplished with the search combination of "Otwo or ODtwo or mammal" or just the word "mammal". (2) Retrieval of all primary references that have information about petroleum and reptiles will be accomplished with the word "OthreeR "; if just the word "reptile" is used, all references presenting information on reptiles will be included. Retrievals based solely on keywords that are not primary or secondary identifiers are likely to miss relevant references. Consequently, it is recommended that the primary category identifiers and secondary category identifiers (category names) be used to help with your search.

In addition to the references in this topical bibliography, the user should consider the following collections of papers and publication series. Except for Item 1, very few of the individual papers are listed in the bibliography.

1. The biennial “Oil spill conference” series has been published since 1973 by the American Petroleum Institute, Washington, DC. Each conference publication contains many articles on a wide range of topics relevant to worldwide petroleum contamination.

2. Proceedings of the international conferences on “Effects of oil on wildlife” are published by Tri-State Bird Rescue & Research, Inc., Newark, DE, and other wildlife rehabilitation organizations. The first

conference proceedings was published in 1982; the 9th conference will be held in 2007. This series contains articles oriented toward the effects of petroleum on air-breathing vertebrates.

3. 1990. Sea otter symposium: proceedings of a symposium to evaluate the response effort on behalf of sea otters after the T/V Exxon Valdez oil spill into Prince William Sound, Anchorage, Alaska, 17-19 April 1990. K. Bayha and J. Kormendy (Eds.). Biological. Report. 90(12), U.S. Fish and Wildlife Service, Washington, DC. A collection of 43 reports describing the capture, rehabilitation, and release of sea otters affected by the Exxon Valdez oil spill in Prince William sound, Alaska.

4. 1994. Marine mammals and the Exxon Valdez. T.R. Loughlin (Ed.). Academic Press, Inc., New York, NY. Contains 21 chapters.

5. 1995. Exxon Valdez oil spill: fate and effects in Alaskan waters. P.G. Wells, J.N. Butler, and J.S. Hughes (Eds.). STP 1219, American Society for Testing and Materials, Conshohocken, PA. Contains an introduction and 25 papers from a symposium dealing with the fate and effects of the Exxon Valdez oil spill in Prince William Sound and the Gulf of Alaska. Most of the papers are by scientists employed by Exxon Corporation.

6. 1996. Proceedings of the Exxon Valdez oil spill symposium. S.D. Rice, R.B. Spies, D.A. Wolfe, and B.A. Wright (Eds.). American Fisheries Society Symposium 18, American Fisheries Society, Bethesda, MD. Contains 62 papers from a symposium sponsored by the American Fisheries Society. Most of the papers are by scientists representing Trustees of the natural resources affected by the Exxon Valdez oil spill.

7. 1997. Exxon Valdez oil spill seabird restoration workshop. K.I. Warheit, C.S. Harrison, and G.J. Divoky (Eds.). Pacific Seabird Group, Seattle, WA, 1995. Thirteen chapters describing the results of a workshop on restoration of seabirds affected by the 1989 Alaskan oil spill. The workshop was held in Girdwood, AK; participants wrote all or portions of the chapters. The workshop resulted in policy, research, and specific restoration recommendations.

8. 2000. Bioremediation of contaminated soils. D.L. Wise (Ed.). Environmental science and pollution control series, Vol. 22. Marcel Dekker, Inc., New York. Contains 12 papers on remediation of soils contaminated with petroleum hydrocarbons.

9. 2002. Environmental Forensics 3(3-4). A special issue containing 14 technical papers on the chemical analysis of petroleum, and three introductory articles.

10. 2003. Oil and California's Seabirds Symposium Issue. Marine Ornithology 31(1):1-70. Contains nine papers on the status of oil pollution and seabirds along coastal California. http://www.marineornithology.org/

11. 2006. Marine Pollution Bulletin 53(5-7). The entire issue (13 articles, one editorial) is devoted to the 2003 Prestige oil spill off the coast of Spain.

## BIBLIOGRAPHY

**Aarab, N., C. Minier, S. Lemaire, E. Unruh, P.-D. Hansen, B. K. Larsen, O.-K. Andersen, J.-F. Narbonne**, 2004. Biochemical and histological responses in mussel (*Mytilus edulis*) exposed to North Sea oil and to a mixture of North Sea oil and alkylphenols. Marine Environmental Research **58**:437-441.
**Keywords:** abnormalities/ biochemical/ bivalve/ crude oil/ flow-through/ marine invertebrate/ mussel/ North Sea/ North Sea crude oil/ Norway/ Ofour/ oil/ PAH/ protein/ salt water/ tissue
**Notes:** Blue mussels from coastal Norway were exposed to 0.5 ppm North Sea crude oil, with or without a mixture of 0.1 ppm alkylphenols and 0.1 ppm extra PAH (undefined) for 3 weeks in a continuous flow-through system. Removed gonadal tissue at the end of the study; examined for tissue abnormalities and the presence of vitellin and vitellin-like proteins.

**Abdullah, A. R., N. M. Tahir, L. K. Wei**, 1994. Hydrocarbons in seawater and sediment from the west coast of Peninsular Malaysia. Bulletin of Environmental Contamination and Toxicology **53**:618-626.
**Keywords:** aromatic hydrocarbons/ coast/ concentration/ Malaysia/ miscellaneous/ Oeleven/ salt water/ sediment
**Notes:** Samples of seawater (29) from a depth of 1 m and sediments (21) were collected along the west coast of Malayasia. Samples were analyzed for total aromatic hydrocarbons and compared to sites throughout the world.

**Abdullah, A. R., W. C. Woon, R. A. Bakar**, 1996. Distribution of oil and grease and petroleum hydrocarbons in the Straits of Johor Penninsular Malaysia. Bulletin of Environmental Contamination and Toxicology **57**:155-162.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ crude oil/ Malaysia/ miscellaneous/ Oeleven/ petroleum hydrocarbons/ salt water/ sediment/ Singapore
**Notes:** Samples of seawater (31) from a depth of 1 m and sediment (19) were collected from the Straits of Johor between Malaysia and Singapore. Samples were analyzed for aromatic hydrocarbons and expressed as chrysene, crude oil, and oil and gas equivalents. Aliphatic hydrocarbons were analyzed for presence but not quantified.

**Abraham, K. F.** 1975. Waterbirds and oil-contaminated ponds at Point Storkersen, Alaska. Iowa State University. M.S. thesis. i-ii-39 leaves.
**Keywords:** Alaska/ bird/ crude oil/ discharges/ effects/ fresh water/ freshwater invertebrate/ general effect/ invertebrate/ macroinvertebrate/ Oeight/ oil/ oil field/ oiled/ petroleum/ physical characteristics/ population/ Prudhoe Bay/ sampling/ sediment/ time/ tundra/ water column
**Notes:** A Master's thesis dealing with an assessment of potential adverse effects of petroleum contamination in the Prudhoe Bay oil field of Alaska. Two years of field work consisting of oiling six tundra ponds, censusing birds, sampling macroinvertebrates in the water column and in the sediment, measuring the physical characteristics and some water chemistry characteristics of all ponds, and comparing the results to those from three reference ponds. Also sampled a pond contaminated by oil well discharges.

**Abu-Ashour, J., A. B. Shahalam**, 2002. Water infiltration through diesel-contaminated soil. Journal of Environmental Science and Health **A37**:1041-1049.
**Keywords:** clay/ concentration/ diesel fuel/ distribution/ miscellaneous/ No.2 fuel oil/ Oeleven/ sand/ soil/ time
**Notes:** Two soil types (clay loam and sand) were used in a laboratory assessment of the movement rates of water through soil columns containing varying proportions of diesel fuel. The diesel fuel proportions were 0, 1, 5, 10, and 15 % of the soil mass. Infiltration time was 3 hr. The diesel concentration distribution in the soil columns also was determined after the 3 hr period.

**Abu-Hilal, A. H., H. K. Khordagui**, 1994. Petroleum hydrocarbons in the nearshore marine sediments of the United Arab Emirates. Environmental Pollution **85**:315-319.
**Keywords:** Arabian Gulf/ coast/ miscellaneous/ Oeleven/ organic carbon/ PAH/ petroleum hydrocarbons/ salt water/ sediment/ United Arab Emirates
**Notes:** Sediment samples (46 ) from the coast of the United Arab Emirates were analyzed for total petroleum hydrocarbons (PAHs) and total organic carbon. Results were compared to sites throughout the world.

**Adam, G, H. Duncan**, 2003. The effect of diesel fuel on common vetch (*Vicia sativa* L.) plants. Environmental Geochemistry and Health **25**:123-130.
**Keywords:** biomass/ diesel/ diesel fuel/ freshwater plant/ germination/ nitrogen/ Oseven/ plant/ rate/ roots/ ryegrass/ seed/ soil/ species/ time
**Notes:** Seeds of the common vetch and a ryegrass species were planted in soil mixed with diesel fuel at a rate of 0, 5, 10, or 15 g /kg for 4 months. The number of root nodules was determined for the common vetch at 2 months. At 4 months, percent germination, shoot biomas, root biomass, plant height, and percent of diesel fuel remaining in the soil were determined.

**Adam, G., K. Gamoh, D. G. Morris, H. Duncan**, 2002. Effect of alcohol addition on the movement of petroleum hydrocarbon fuels in soil. Science of the Total Environment **286**:15-25.
**Keywords:** aromatic hydrocarbons/ concentration/ diesel/ diesel fuel/ ground water/ hydrocarbons/ leachate/ movement/ No.2 fuel oil/ Onine/ petroleum/ soil/ technical
**Notes:** A soil column was treated with diesel fuel and leached by the continuous addition of distilled water for a period of 5 da. The process was repeated with the addition of 5% ethanol additive. The leached water was analyzed for the concentration of several aromatic hydrocarbons.

**Adams, G. G., P. L. Klerks, S. E. Belanger, D. Dantin**, 1999. The effect of the oil dispersant Omni-Clean$^R$ on the toxicity of fuel oil No. 2 in two bioassays with the sheepshead minnow *Cyprinodon variegatus*. Chemosphere **39**:2141-2157.
**Keywords:** acute/ bioassay/ concentration/ dispersant/ fish/ fuel oil/ No.2 fuel oil/ ODthree/ oil/ ratio/ salt water/ sheepshead minnow/ static/ toxicity
**Notes:** A series of toxicity tests employing the sheepshead minnow to determine toxicity of the chemical dispersant Omni-Clean. Experimental mixtures were No. 2 fuel oil alone, dispersant alone, and dispersant:oil ratios of 1:10, 1:5, 1:3, 1:2, and 1:1. Concentrations of mixtures were 0, 37.5, 75, 150, 300, and 600 ppm. Performed a 7-da early life stage bioassay (static renewal) and a 96-hr acute bioassay (static without renewal).

**Adams, N. J.**, 1994. Patterns and impacts of oiling of African penguins *Spheniscus demersus*: 1981-1991. Biological Conservation **68**:35-41.
**Keywords:** bird/ distribution/ evaluation/ oiled/ Oone/ penguin/ population/ rehabilitation/ salt water/ seasonal/ size
**Notes:** Evaluation of the oiling of African penguins during the period 1981-91. Information on distribution of penguins, distribution of oiled penguins, annual and seasonal patterns of oiling, frequency and size of oiling events, and an assessment of the consequences of the oiling.

**Addy, J. M., J. P. Hartley, P. J. C. Tibbetts**, 1984. Ecological effects of low toxicity oil-based mud drilling in the Beatrice oilfield. Marine Pollution Bulletin **15**:429-436.
**Keywords:** aromatic hydrocarbons/ benthic/ coast/ concentration/ drilling mud/ effects/ evaluation/ general effect/ hydrocarbons/ Oeight/ oil-based/ physical characteristics/ salt water/ sampling/ saturated hydrocarbons/ Scotland/ sediment/ toxicity/ transect/ water-based
**Notes:** An evaluation of the effects of water-based and low-toxicity oil-based drilling muds off the northeast coast of Scotland. Four sampling transects were established radiating outward from the core drilling area; 20 sampling stations were established. Seabed sediments were sampled and analyzed for saturated and aromatic hydrocarbons, physical characteristics, the number of benthic taxa, and the number of benthic individuals.

**Adeniyi, A. A., J. A. Afolabi**, 2002. Determination of total petroleum hydrocarbons and heavy metals in soils within the vicinity of facilities handling refined petroleum products in Lagos metropolis. Environment International **28**:79-82.
**Keywords:** concentration/ hydrocarbons/ metals/ miscellaneous/ Nigeria/ Oeleven/ petroleum/ petroleum hydrocarbons/ petroleum products/ pollution/ soil
**Notes:** Soil samples were collected from two petroleum fueling stations, two auto mechanics shops, an electric power station, and two non-industrial locations in Nigeria. The soil was analyzed for total petroleum hydrocarbons (gravimetrically) and metals (AAS).

**Agard, J. B. R., M. Boodoosingh, J. Gobin**, 1988. Petroleum residues in surficial sediments from the Gulf of Paria, Trinidad. Marine Pollution Bulletin **19**:231-233.
**Keywords:** aromatic hydrocarbons/ coast/ concentration/ miscellaneous/ Oeleven/ petroleum hydrocarbons/ salt water/ sediment/ Trinidad
**Notes:** Surface sediments were collected from 80 sites along the west coast of Trinidad and analyzed for concentrations of total petroleum hydrocarbons (aromatic hydrocarbons). Results were plotted as a concentration map along the coast and compared to several international sites.

**Ahsanullah, M., R. R. C. Edwards, D. G. Kay, D. S. Negilski**, 1982. Acute toxicity to the crab *Paragrapsus quadridentatus* (H. Milne Edwards), of Kuwait light crude oil, BP/AB dispersant, and an oil-dispersant mixture. Australian Journal of Marine and Freshwater Research **33**:459-464.
**Keywords:** acute/ Australia/ combination/ crab/ crude oil/ dispersant/ Kuwait/ Kuwait crude oil/ light/ marine invertebrate/ ODfour/ oil/ salt water/ species/ survival/ toxicity
**Notes:** One species of crab exposed to Kuwait crude oil, BP/AB dispersant, or a combination for 96 hr; calculation of 96 hr $LC_{50s}$.

**Ainley, D., C. R. Grau, S. Morrell, T. Roudybush, and J. Dobbs** 1978. Reproductive responses of Cassin's auklets to orally administered Bunker C oil and eliminative responses in seabirds. Pages 36-37 *in* Fourth Annual Meeting, Pacific Seabird Group. Pacific Seabird Group.
**Keywords:** bird/ Bunker C/ capsule/ Cassin's auklet/ dosed/ elimination/ female/ fuel oil/ hatching/ numbers/ oil/ Oone/ Pacific/ rate/ reproduction/ salt water/ species/ structure/ western gull
**Notes:** Female Cassin's auklets fed capsules containing 0, 300, or 600 mg Bunker C fuel oil. Comparisons made with undosed controls for laying, hatching, yolk structure, and fledging success. Subsequently dosed small numbers of six species of birds with Bunker C in capsules to determine rates of regurgitation or fecal elimination.

**Ainley, D. G., C. R. Grau** 1978. Influence of petroleum on egg formation and embryonic development in seabirds. Pages 188-198 *in* D. A. Wolfe, editor. Marine Biological Effects of OCS Petroleum Development: a program review of research supported under the NOAA Outer Continental Shelf Environmental Assessment Program, November 29 - December 1, 1977. NOAA technical memorandum ERL OCSEAP. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, Environmental Research Laboratories, Boulder, Colorado.
**Keywords:** biological effects/ bird/ Bunker C/ capsule/ Cassin's auklet/ development/ effects/ eggs/ ingestion/ oil/ Oone/ petroleum/ petroleum development/ reproduction/ salt water/ species/ western gull/ review/ technical
**Notes:** Effect of ingested Bunker C oil on reproduction in several species of birds.

**Ainley, D. G., C. R. Grau, T. E. Roudybush, S. H. Morrell, J. M. Utts**, 1981. Petroleum ingestion reduces reproduction in Cassin's auklet. Marine Pollution Bulletin **12**:314-317.
**Keywords:** bird/ Bunker C/ capsule/ Cassin's auklet/ crude oil/ eggs/ ingestion/ oil/ Oone/ petroleum/ Prudhoe Bay/ Prudhoe Bay crude oil/ reproduction/ salt water
**Notes:** Effect of ingested Bunker C and Prudhoe Bay crude oil on reproduction in Cassin's auklet.

**Aisien, F. A., F. K. Hymore, R. O. Ebewele**, 2003. Potential application of recycled rubber in oil pollution control. Environmental Monitoring and Assessment **85**:175-190.
**Keywords:** cleaning/ crude oil/ miscellaneous/ Oeleven/ oil/ particle size/ petroleum/ pollution/ temperature
**Notes:** Used tires, minus the steel threads, were ground up into particles, sorted by particle size, and used in a test of their ability to absorb spilled crude oil. The trials were performed at temperatures varying from 5 to 40 C and lasted 60 min.

**Aislabie, J., M. Balks, N. Astori, G. Stevenson, R. Symons**, 1999. Polycyclic aromatic hydrocarbons in fuel-oil contaminated soils, Antarctica. Chemosphere **39**:2201-2207.
**Keywords:** Antarctica/ aromatic hydrocarbons/ concentration/ depth/ fresh water/ fuel oil/ hydrocarbons/ miscellaneous/ Oeleven/ oil/ soil
**Notes:** Determination of the aromatic hydrocarbons in the soil from three locations in Antarctica contaminated with fuel oil; the spilled fuel oil was up to 30 yrs old. Measured 18 aromatic hydrocarbons from two or three soil depths.

**Aislabie, J. M., M. R. Balks, J. M. Foght, E. J. Waterhouse**, 2004. Hydrocarbon spills on Antarctic soils: effects and management. Environmental Science and Technology **38**:1265-1274.
**Keywords:** Antarctica/ microbes/ Oten/ petroleum hydrocarbons/ pollution/ remediation/ review/ soil/ spill
**Notes:** A review of hydrocarbon contamination in Antarctica. Sections on soils, hydrocarbons in soils,

effects of hydrocarbons on soil properties and biota, management of polluted sites, and gaps in current knowledge.

**Akaishi, F. M., H. C. Silva de Assis, S. C. G. Jakobi, D. R. Eiras-Stofella, S. D. St-Jean, S. C. Courtenay, E. F. Lima, A. L. R. Wagener, A. L. Scofield, C. A. Oliveira Ribeiro**, 2004. Morphological and neurotoxicological findings in tropical freshwater fish (*Astyanax* sp.) after waterborne and acute exposure to water soluble fraction (WSF) of crude oil. Archives of Environmental Contamination and Toxicology **46**:244-253.
**Keywords:** activity/ acute/ assay/ crude oil/ fish/ fresh water/ gill/ liver/ muscle/ oil/ Othree/ static/ tissue/ total hydrocarbons
**Notes:** Water-soluble fractions (WSF; 15, 33, 50 %) of crude oil were used in a static laboratory assay lasting for 96 hrs. Fish were collected at 12, 24, and 96 hrs of exposure. Removed liver and gill tissue for histopathological assessment and muscle tissue for acetylcholinesterase activity. The WSF was measured for total hydrocarbons.

**Akintonwa, A., A. G. Ebere**, 1990. Toxicity of Nigerian crude oil and chemical dispersants to *Barbus* Sp. and *Clarias* Sp. Bulletin of Environmental Contamination and Toxicology **45**:729-733.
**Keywords:** crude oil/ dispersant/ effects/ eggs/ fingerling/ fish/ fresh water/ Nigeria/ Nigerian crude oil/ ODthree/ oil/ species/ toxicity
**Notes:** Effects on fingerlings and eggs of two species of fish from experimental exposure to local Nigerian crude oil and two chemical dispersants.

**Al-Abdali, F., M. S. Massoud, A. N. Al-Ghadban**, 1996. Bottom sediments of the Arabian Gulf -- III. Trace metal contents as indicators of pollution and implications for the effect and fate of the Kuwait oil slick. Environmental Pollution **93**:285-301.
**Keywords:** Arabian Gulf/ crude oil/ fate/ Gulf oil spill/ indicator/ Kuwait/ metals/ miscellaneous/ Oeleven/ oil/ oil slick/ pollution/ sediment
**Notes:** Trace metals in sediments of the Arabian Gulf as an indicator of oil pollution.

**Al-Ghadban, A. N., P. G. Jacob, F. Abdali**, 1994. Total organic carbon in the sediments of the Arabian Gulf and need for biological productivity investigations. Marine Pollution Bulletin **28**:356-362.
**Keywords:** Arabian Gulf/ carbon/ grain/ hydrocarbons/ inorganic/ miscellaneous/ Oeleven/ organic/ organic carbon/ productivity/ salt water/ sediment/ size/ total hydrocarbons
**Notes:** Surface sediment samples from 78 sites in the Arabian Gulf were sampled and analyzed for grain size, total hydrocarbons, and inorganic and organic hydrocarbons.

**Al-Hadhrami, M. N., H. M. Lappin-Scott, P. J. Fisher**, 1996. Effects of the addition of organic carbon sources on bacterial respiration and *n*-alkane biodegradation of Omani crude oil. Marine Pollution Bulletin **32**:351-357.
**Keywords:** aliphatic hydrocarbons/ alkane/ bacteria/ biodegradation/ carbon/ composition/ Corexit 9130/ Corexit 9527/ crude oil/ degradation/ effects/ fertilizer/ hydrocarbons/ microbes/ molasses/ ODten/ oil/ organic/ organic carbon/ respiration/ salt water/ sources/ species
**Notes:** Biodegradation of Omani crude oil by one bacterium or a mixture of eight species of bacteria after addition of fertilizer, cane sugar molasses, Corexit 9527, or Corexit 9130. Measured respiration during degradation and hydrocarbon composition after 16 to 30 hr.

**Al-Hadhrami, M. N., H. M. Lappin-Scott, P. J. Fisher**, 1997. Studies on the biodegradation of three groups of pure *n*-alkanes in the presence of molasses and mineral fertilizer by *Pseudomonas aeruginosa*. Marine Pollution Bulletin **34**:969-974.
**Keywords:** alkane/ bacteria/ biodegradation/ degradation/ evaluation/ fertilizer/ microbes/ molasses/ Oten/ species
**Notes:** Laboratory evaluation of the influence of molasses and mineral fertilizer on the degradation of pure alkanes by a species of bacteria.

**Al-Hasan, R. H., D. A. Al-Bader, N. A. Sorkhoh, S. S. Radwan**, 1998. Evidence for *n*-alkane consumption and oxidation by filamentous cyanobacteria from oil-contaminated coasts of the Arabian

Gulf. Marine Biology **130**:521-527.
**Keywords:** alkane/ Arabian Gulf/ bacteria/ coast/ consumption/ evaluation/ incubation/ microbes/ Oten/ petroleum hydrocarbons/ reduction/ salt water/ species
**Notes:** Laboratory evaluation of the ability of two species of cyanobacteria from the Arabian Gulf to consume and oxidize *n*-alkanes. The contribution of associated organotrophic bacteria to the overall reduction of *n*-alkanes was assessed and compared to that of the cyanobacteria. Incubation periods of up to 7 da were utilized.

**Al-Hassan, J. M., M. Afzal, C. V. N. Rao, S. Fayad**, 2000. Time-related increase of hydrocarbons in barnacles in the north-western waters of the Arabian Gulf. Bulletin of Environmental Contamination and Toxicology **65**:646-653.
**Keywords:** alkane/ Arabian Gulf/ barnacle/ hydrocarbons/ marine invertebrate/ Ofour/ PAH/ petroleum hydrocarbons/ salt water/ species/ time
**Notes:** Two species of barnacles were collected during 1996-99 from five locations in the northwestern part of the Gulf. Samples were analyzed for alkanes and PAHs. Authors compare results between years and infer temporal changes over the 3-yr collection period (two locations only); and provide causal explanations for some sites based on recent events in the Gulf.

**Al-Hassan, J. M., M. Afzal, C. V. N. Rao, S. Fayad**, 2000. Petroleum hydrocarbon pollution in sharks in the Arabian Gulf. Bulletin of Environmental Contamination and Toxicology **65**:391-398.
**Keywords:** alkane/ analysis/ Arabian Gulf/ fish/ gill/ liver/ muscle/ Othree/ PAH/ petroleum/ petroleum hydrocarbons/ pollution/ salt water/ shark/ tissue
**Notes:** Twelve sharks, including three newly born and one unborn, were collected at various locations in the Arabian Gulf and the gills, liver, and muscle tissue were removed for petroleum analysis. All sharks were analyzed for 15 PAHs and seven sharks were analyzed for 18 alkanes.

**Al-Hassan, J. M., M. Afzal, V. N. R. Chava, S. Fayad**, 2001. Hydrocarbon pollution in the Arabian Gulf catfish (*Arius bilineatus* Val.). Bulletin of Environmental Contamination and Toxicology **66**:646-652.
**Keywords:** alkane/ Arabian Gulf/ catfish/ concentration/ fish/ gill/ liver/ muscle/ Othree/ PAH/ pollution/ salt water/ tissue
**Notes:** Arabian Gulf catfish were collected from seven sites in the northwestern part of the Gulf during 1997 and 1999. Liver, gills, and muscle were analyzed for alkane and PAH concentrations. [Tables 1 & 2 have a summed total for the concentrations of the three tissue types (makes no sense) as well as totals for all analytes within each tissue].

**Al-Hassan, J. M., M. Afzal, C. V. N. Rao, S. Fayad**, 2003. Polycyclic aromatic hydrocarbons (PAHs) and aliphatic hydrocarbons (AHs) in edible fish from the Arabian Gulf. Bulletin of Environmental Contamination and Toxicology **70**:205-212.
**Keywords:** aliphatic hydrocarbons/ alkane/ Arabian Gulf/ aromatic hydrocarbons/ fish/ gill/ hydrocarbons/ Kuwait/ liver/ marine invertebrate/ muscle/ offshore/ Othree/ PAH/ salt water/ shrimp/ species/ tissue
**Notes:** Eleven species of fish and a species of shrimp were collected from three areas in offshore Kuwait and a Kuwaiti fish market. Tissues (liver, muscle, gills) were analyzed for 14 PAHs and 20 alkanes.

**Al-Hubail, J., K. El-Dash**, 2006. Managing disposal of water produced with petroleum in Kuwait. Journal of Environmental Management **79**:43-50.
**Keywords:** cost/ effluent/ injection/ Kuwait/ methods/ miscellaneous/ Oeleven/ oil field/ petroleum/ pollution/ pressure/ produced water/ rate/ water
**Notes:** A questionnaire was sent to petroleum field managers requesting them to rate four methods of produced water disposal (seepage pits, sealed pits, underground effluent injection, underground injection to recover reservoir pressure). Ratings were based on a sliding scale of 1-5 for categories of cost, pollution, and efficiency.

**Al-Lihaibi, S. S., L. Al-Omran**, 1996. Petroleum hydrocarbons in offshore sediments from the Gulf. Marine Pollution Bulletin **32**:65-69.
**Keywords:** analysis/ Arabian Gulf/ carbon/ grain/ hydrocarbons/ miscellaneous/ Oeleven/ offshore/ organic/ organic carbon/ petroleum/ petroleum hydrocarbons/ region/ salt water/ sampling/ sediment/ size/

transect
**Notes:** Surface sediments were collected from five transects containing 21 sampling sites in the Arabian Gulf and analyzed for grain size, organic carbon, and total petroleum hydrocarbons. Results were compared with similar studies in the Gulf region.

**Al-Lihaibi, S. S., S. J. Ghazi**, 1997. Hydrocarbon distributions in sediments of the open area of the Arabian Gulf following the 1991 Gulf War oil spill. Marine Pollution Bulletin **34**:941-948.
**Keywords:** analysis/ Arabian Gulf/ distribution/ hydrocarbons/ miscellaneous/ Oeleven/ oil/ oil spill/ petroleum/ petroleum hydrocarbons/ salt water/ saturated hydrocarbons/ sediment/ spill/ survey/ total hydrocarbons/ war
**Notes:** Survey of petroleum hydrocarbons in the surface sediments of the off shore portions of the central Arabian Gulf. Measured total hydrocarbons and performed detailed analysis of the saturated hydrocarbons.

**Al-Saad, H.**, 1987. Distribution of polycyclic aromatic hydrocarbons (PAH) in surficial sediments from Shatt Al-Arab River and the north-west region of the Arabian Gulf. Marine Pollution Bulletin **18**:248-251.
**Keywords:** Arabian Gulf/ aromatic hydrocarbons/ carbon/ distribution/ hydrocarbons/ miscellaneous/ Oeleven/ organic/ organic carbon/ PAH/ region/ river/ salt water/ sediment
**Notes:** Surface sediments from 29 sites in the northwest Arabian Gulf and the Shatt Al Arab River were collected and analyzed for nine PAHs and total organic carbon.

**Al-Saad, H. T., A. Ak.Al-Timari**, 1993. Seasonal variations of dissolved normal alkanes in the water marshes of Iraq. Marine Pollution Bulletin **26**:207-212.
**Keywords:** aliphatic hydrocarbons/ alkane/ concentration/ dissolved/ distribution/ fresh water/ hydrocarbons/ Iraq/ miscellaneous/ Oeleven/ seasonal/ sources
**Notes:** An assessment of the distribution and seasonal variation of n-alkanes (C13-C34 plus squalene, pristane and phytane) in the marshes of southern Iraq. Water samples were collected from seven locations during the winter, spring, and summer of 1987. Results were interpreted in terms of the likely sources of these hydrocarbons.

**Al-Saad, H. T., A. Ak.Al-Timari**, 1993. Sources of hydrocarbons and fatty acids in sediment from Hor Al-Hammar marsh, Shatt Al-Arab, and north-west Arabian Gulf. Marine Pollution Bulletin **26**:559-564.
**Keywords:** aliphatic hydrocarbons/ Arabian Gulf/ concentration/ fatty acids/ fresh water/ hydrocarbons/ Iraq/ miscellaneous/ Oeleven/ origin/ salt water/ sediment/ sources
**Notes:** An assessment of n-alkanes in sediments of the lower Hor Al-Hammar marsh, the Shat Al-Arab River, and two locations in the northern end of the Arabian Gulf. The four locations were sampled during 1988-89 and analyzed for n-alkanes (C11-C36 plus squalene, phytane, and pristane) and a range of fatty acids (C6-C36). Results were interpreted in terms of the likely origin of the hydrocarbons and fatty acids.

**Al-Saad, H. T., S. M. Shamshoom, J. K. Abaychi**, 1998. Seasonal distribution of dissolved and particulate hydrocarbons in Shatt Al-Arab estuary and the north-west Arabian Gulf. Marine Pollution Bulletin **36**:850-855.
**Keywords:** analysis/ Arabian Gulf/ aromatic hydrocarbons/ concentration/ dissolved/ distribution/ estuary/ hydrocarbons/ miscellaneous/ Oeleven/ particulate/ petroleum/ petroleum hydrocarbons/ salt water/ sampling/ seasonal/ time
**Notes:** Water was sampled at seven locations in the Shatt Al-Arab estuary and the north-west portion of the Arabian Gulf and analyzed for total petroleum hydrocarbons (aromatics via UVF analysis) in the dissolved and particulate phases. Sampling conducted five times between June 1993 and July 1994.

**Al-Saleh, E. S, C. Obuekwe**, 2005. Inhibition of hydrocarbon bioremediation by lead in a crude oil-contaminated soil. International Biodeterioration and Biodegradation **56**:1-7.
**Keywords:** activity/ bacteria/ bioremediation/ concentration/ crude oil/ degradation/ hydrocarbons/ Kuwait/ lead/ metals/ microbes/ mineralization/ naphthalene/ nitrate/ oil/ Oten/ petroleum/ petroleum hydrocarbons/ pollution/ soil/ war
**Notes:** Soil from petroleum-contaminated and uncontaminated areas in Kuwait were used in an assessment of the effect of lead on the degradation of petroleum hydrocarbons. Determined the amount

of lead and lead-tolerant bacteria capable of degrading naphthalene, hexadecane, and overall crude oil in the soils. Added lead nitrate (0, 0.1, 0.5, or 1 mg/g) to clean soil and cultured each concentration for 14 da in the presence of either naphthalene, hexadecane, or crude oil. Measured total residual hydrocarbons at study termination. Determined effect of lead on hydrocarbon mineralization and dehydrogenase activity in the naphthalene and hexadecane soils.

**Al-Sarawi, M., M. S. Massoud, S. A. Wahba**, 1998. Physical properties as indicators of oil penetration in soils contaminated with oil lakes in the greater Burgan oil fields, Kuwait. Water, Air, and Soil Pollution **102**:1-15.
**Keywords:** crude oil/ indicator/ Kuwait/ miscellaneous/ Oeleven/ oil/ oil field/ oil lakes/ soil/ soil profile
**Notes:** Eight soil profiles were dug in oil contaminated and oil-free portions of the Burgan oil fields of Kuwait. Sixty soil samples were taken from the profiles and analyzed for soil characteristics.

**Al-Sarawi, M., M. S. Massoud, F. Al-Abdali**, 1998. Preliminary assessment of oil contamination levels in soils contaminated with oil lakes in the Greater Burgan oil fields, Kuwait. Water, Air, and Soil Pollution **106**:493-504.
**Keywords:** carbon/ crude oil/ hydrocarbons/ Kuwait/ metals/ miscellaneous/ Oeleven/ oil/ oil field/ oil lakes/ organic/ organic carbon/ petroleum/ petroleum hydrocarbons/ region/ soil/ soil profile
**Notes:** Assessment of the extent of petroleum contamination in the soils of the Southen Oil Lakes region of Kuwait. Two sites sampled and analyzed for total petroleum hydrocarbons, total organic carbon, and trace metals. Oil penetration through soil profiles measured also.

**Al-Senafy, M. N., M. N. Viswanathan, Y. Senay, A. Sumait** , 1997. Soil contamination from oil lakes in northern Kuwait. Journal of Soil Contamination **6**:481-494.
**Keywords:** depth/ fresh water/ ground water/ Kuwait/ miscellaneous/ Oeleven/ oil/ oil lakes/ petroleum/ soil/ war
**Notes:** An assessment of the petroleum contamination of soil in northern Kuwait that resulted from the 1991 Gulf War. Soil was sampled in 1992 and 1995 at surface, 4 m, and 10 m depths. Much concern about oil penetration to the important subsurface freshwater lenses.

**Al-Thukair, A. A., K. Al-Hinai**, 1993. Preliminary damage assessment of algal mats sites located in the western Gulf following the 1991 oil spill. Marine Pollution Bulletin **27**:229-238.
**Keywords:** algae/ Arabian Gulf/ damage assessment/ estimate/ Gulf oil spill/ marine plant/ oil/ oil spill/ Osix/ salt water/ spill/ war
**Notes:** Algal mats in the western portion of the Arabian Gulf were surveyed prior to (1990) and after (1991) the Gulf War. Satellite images were used to locate the mats and estimate damage. Six major sites were visited for sample collection in 1992.

**Al-Thukair, A. A.**, 2002. Effect of oil pollution on euendolithic cyanobacteria of the Arabian Gulf. Environmental Microbiology **4**:125-129.
**Keywords:** Arabian Gulf/ bacteria/ coast/ community/ crude oil/ depth/ microbes/ oil/ oil spill/ Oten/ pollution/ population/ salt water/ Saudi Arabia/ species/ spill/ survey/ war
**Notes:** A survey of the presence of euendolithic (boring) cyanobacteria in the Arabian Gulf. Sample of ooids (spherical calcium carbonate nodules) were collected in 1989 and 1992 at three depths from four locations along the Gulf coast of Saudi Arabia and examined for the presence of bore holes and live bacteria. Identified the species of bacteria and focused on six common species. Results were compared between years and the changes attributed to the Gulf War oil spill of 1991.

**Al-Wadae, A. E. J., E. Raveendran**, 1993. Determination of petroleum hydrocarbons in sediment, fish and air following the Gulf crisis in 1991. Environmental Technology **14**:673-679.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ Bahrain/ concentration/ fish/ hydrocarbons/ Othree/ petroleum/ petroleum hydrocarbons/ salt water/ sediment/ war
**Notes:** Concentration of aliphatic and aromatic hydrocarbons in fish caught in the waters around Bahrain in 1991, shortly after the Gulf War ended.

**Al-yakoob, S., T. Saeed, H. Al-hashash**, 1993. Polycyclic aromatic hydrocarbons in edible tissue of fish from the Gulf after the 1991 oil spill. Marine Pollution Bulletin **27**:297-301.
**Keywords:** Arabian Gulf/ aromatic hydrocarbons/ concentration/ fish/ hydrocarbons/ muscle/ oil/ oil spill/ Othree/ salt water/ species/ spill/ tissue
**Notes:** Concentrations of selected aromatic hydrocarbons in muscle of six species of fish collected from the Arabian Gulf in 1992.

**Al-Yakoob, S. N., T. Saeed**, 1994. Potential hazards associated with polycyclic aromatic hydrocarbons in weathered crude oil from Kuwait's oil lakes. Journal of Environmental Science and Health **A29**:1777-1787.
**Keywords:** aromatic hydrocarbons/ concentration/ crude oil/ hazard/ hydrocarbons/ Kuwait/ miscellaneous/ Oeleven/ oil/ oil lakes/ PAH/ rate/ time/ weathered
**Notes:** Four oil lakes in Kuwait were sampled for crude oil between 9/92 and 6/93 at 3 mo intervals. The samples were analyzed for PAHs and the rates of change in PAH concentration were calculated for the 8 mo period. Confusing data presentation.

**Al-Yakoob, S. N., D. Gundersen, L. Curtis**, 1996. Effects of the water-soluble fraction of partially combusted crude oil from Kuwait's oil fires (from Desert Storm) on survival and growth of the marine fish *Menidia beryllina*. Ecotoxicology and Environmental Safety **35**:142-149.
**Keywords:** crude oil/ effects/ fish/ growth/ Kuwait/ Kuwait crude oil/ oil/ Othree/ salt water/ survival/ war
**Notes:** Effects on a marine fish of the water-soluble fraction of Kuwaiti crude oil or partially combusted crude oil from the oil well fires of the Gulf War.

**Al-Yamani, F. Y., K. Al-Rifaie, W. Ismail**, 1993. Post-spill zooplankton distribution in the NW Gulf. Marine Pollution Bulletin **27**:239-243.
**Keywords:** abundance/ Arabian Gulf/ composition/ distribution/ marine invertebrate/ Ofour/ oil/ oil spill/ salt water/ sampling/ spill/ war/ zooplankton
**Notes:** Sampling of zooplankton in the Arabian Gulf during April-May, 1992. Objective was to determine if oil spills from the Gulf War had affected zooplankton distribution, abundance, and composition.

**Al Bakri, D., W. Kittaneh**, 1998. Physicochemical characteristics and pollution indicators in the intertidal zone of Kuwait: implications for benthic ecology. Environmental Management **22**:415-424.
**Keywords:** benthic/ carbon/ dissolved/ indicator/ intertidal/ Kuwait/ miscellaneous/ Oeleven/ organic/ organic carbon/ pH/ pollution/ salinity/ salt water/ sediment/ structure/ sulfide/ temperature/ transect/ war
**Notes:** Assessment of the intertidal zone of coastal Kuwait during 1984; serves as a pre-Gulf War benchmark. Used 35 transects perpendicular to the coastline. Measured sediment structure, temperature, salinity, pH, interstitial water, total organic carbon, and total dissolved sulfide.

**Albaiges, J., M. R. Cuberes**, 1980. On the degradation of petroleum residues in the marine environment. Chemosphere **9**:539-545.
**Keywords:** Arabian crude oil/ aromatic hydrocarbons/ asphaltene/ crude oil/ degradation/ environment/ hydrocarbons/ marine environment/ oil/ Onine/ petroleum/ resin/ salt water/ saturated hydrocarbons/ tar ball/ technical/ weathered/ Mediterranean
**Notes:** Weathered Arabian crude oil was used in a laboratory assessment of the degradation of crude oil residues. The subsurface water was sampled after 15, 30, 60, and 120 da and analyzed for saturated hydrocarbons, aromatics, resins, and asphaltines. Tar balls were collected from the Mediterranean Sea and similarly analyzed.

**Albers, P. H.** 1977. Effects of oil on aquatic birds. Pages 61-67 *in* P. L. Fore, editor. 1977 Oil Spill Response Workshop, FWS/OBS/77-24. U.S. Fish and Wildlife Service, Washington, DC.
**Keywords:** bird/ effects/ No.2 fuel oil/ oil/ oil spill/ Oone/ overview/ South Louisiana crude oil/ spill/ spill response
**Notes:** Overview of effects of oil on birds and recent research at the Patuxent Wildlife Research Center.

**Albers, P. H.** 1977. Effects of external applications of fuel oil on hatchability of mallard eggs. Pages 158-163 *in* D. A. Wolfe, editor. Fate and Effects of Petroleum Hydrocarbons in Marine Organisms and

Ecosystems. Pergamon Press, Inc., New York, N.Y.
**Keywords:** age/ bird/ development/ duckling/ ecosystem/ effects/ egg shell/ eggs/ embryo/ fate/ fresh water/ fuel oil/ hatchability/ hatching/ hydrocarbons/ incubation/ mallard/ No.2 fuel oil/ oil/ Oone/ paraffin/ petroleum/ petroleum hydrocarbons/ reproduction/ weight
**Notes:** Assessment of the effects of eggshell applications of No. 2 fuel oil (first publ. of this method). Exposed artificially-incubated mallard eggs to 1, 5, 10, 20, or 50 *u*l of No. 2 fuel oil, 50 *u*l of paraffin mixture, or 50 *u*l of propylene glycol on the day 8 of incubation. Measured hatching success, age at death, and weight of ducklings.

**Albers, P. H.**, 1978. Effects of petroleum on different stages of incubation in bird eggs. Bulletin of Environmental Contamination and Toxicology **19**:624-630.
**Keywords:** bird/ crude oil/ development/ duck/ effects/ eggs/ embryo/ fresh water/ fuel oil/ hatchability/ hatching/ incubation/ Louisiana/ Louisiana crude oil/ mallard/ No.2 fuel oil/ oil/ Oone/ petroleum/ South Louisiana crude oil/ survival/ weight
**Notes:** Effects of No. 2 fuel oil and South Louisiana crude oil on stages of embryo development in the mallard duck. Artificially-incubated eggs exposed to oil on days 2, 6, 10, 14, 18, or 22. Measured survival, days to death of embryo, and hatching weight.

**Albers, P. H., R. C. Szaro**, 1978. Effects of No. 2 fuel oil on common eider eggs. Marine Pollution Bulletin **9**:138-139.
**Keywords:** bird/ common eider/ effects/ egg shell/ eggs/ eiders/ embryo/ fuel oil/ Maine/ No.2 fuel oil/ oil/ Oone/ reproduction/ salt water/ survival
**Notes:** Assessment of field applications of No. 2 fuel oil to naturally-incubated common eider eggs in Maine. Eggs were exposed by eggshell applications to either 5 *u*l No. 2 fuel oil or 20 *u*l No. 2 fuel oil and opened 7 da later. Measured survival of embryos.

**Albers, P. H.**, 1979. Effects of Corexit 9527 on the hatchability of mallard eggs. Bulletin of Environmental Contamination and Toxicology **23**:661-668.
**Keywords:** bird/ Corexit 9527/ crude oil/ development/ dispersant/ duckling/ effects/ egg shell/ eggs/ embryo/ fresh water/ hatchability/ hatching/ mallard/ ODone/ oil/ Prudhoe Bay/ Prudhoe Bay crude oil/ weight
**Notes:** Effects of Prudhoe Bay crude oil and Corexit 9527 on mallard eggs. Artificially-incubated eggs were exposed by eggshell application to varying amounts of either Prudhoe Bay crude oil, Corexit 9527, a 30:1 oil-dispersant mixture, or a 5:1 oil-dispersant mixture. Measured hatching success, stage of development at death, and hatching weight of ducklings.

**Albers, P. H.** 1979. Oil dispersants and wildlife. Pages 67-72 *in* C. H. Brown, editor. 1979 U.S. Fish and Wildlife Service Pollution Response Workshop. U.S. Fish and Wildlife Service, Washington, D.C.
**Keywords:** bird/ dispersant/ effects/ fish/ fresh water/ ODone/ oil/ pollution/ salt water
**Notes:** Presentation of the pros and cons of chemical dispersant use with particular reference to effects on birds.

**Albers, P. H.**, 1980. Transfer of crude oil from contaminated water to bird eggs. Environmental Research **22**:307-314.
**Keywords:** age/ bird/ crude oil/ duckling/ eggs/ embryo/ female/ fresh water/ hatchability/ hatching/ incubation/ mallard/ oil/ Oone/ Prudhoe Bay/ Prudhoe Bay crude oil/ sources/ survival/ temperature/ transfer
**Notes:** Demonstration of the feasibility of parental transfer of surface oil by female mallards to their eggs. Incubating females exposed to water sources covered with either 5 or 100 ml of Prudhoe Bay crude oil. Thermocouple probes were used to monitor egg temperature. Measured hatching success, incubation temperature, and survival of ducklings to 1 wk of age.

**Albers, P. H., M. L. Gay**, 1982. Unweathered and weathered aviation kerosine: chemical characterization and effects on hatching success of duck eggs. Bulletin of Environmental Contamination and Toxicology **28**:430-434.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ aviation kerosine/ bird/ duck/ effects/ egg

shell/ eggs/ fresh water/ hatchability/ hatching/ incubation/ mallard/ Oone/ pipeline/ reproduction/ spill/ weathered
**Notes:** Effects of weathered aviation kerosine from a pipeline rupture in northern Virginia on mallard egg hatchability. Artificially-incubated mallard eggs were exposed by eggshell application to several amounts of weathered and unweathered aviation kerosine on day 6 of incubation. Measured hatching success of eggs and characterized the kerosine according to 14 aliphatic and 9 aromatic compounds.

**Albers, P. H., M. L. Gay**, 1982. Effects of a chemical dispersant and crude oil on breeding ducks. Bulletin of Environmental Contamination and Toxicology **29**:404-411.
**Keywords:** age/ bird/ combination/ Corexit 9527/ crude oil/ development/ dispersant/ duck/ duckling/ effects/ embryo/ female/ fresh water/ hatchability/ hatching/ incubation/ mallard/ ODone/ oil/ Prudhoe Bay/ Prudhoe Bay crude oil/ reproduction/ survival/ temperature
**Notes:** Effects of chemically dispersed crude oil on mallard reproduction. Incubating female mallards were exposed to a water source treated with either Prudhoe Bay crude oil, Corexit 9527, or a combination of oil and dispersant during the first 10 da of development. Used thermocouple probes to monitor incubation temperature. Measured hatching success, incubation temperature, and survival of ducklings to 1 wk of age.

**Albers, P. H., G. H. Heinz**, 1983. FLIT-MLO and No. 2 fuel oil: effects of aerosol applications to mallard eggs on hatchability and behavior of ducklings. Environmental Research **30**:381-388.
**Keywords:** age/ avoidance/ behavior/ bird/ development/ duckling/ effects/ eggs/ embryo/ FLIT-MLO/ fuel oil/ hatchability/ hatching/ larvicide/ mallard/ mosquito/ No.2 fuel oil/ oil/ Oone/ salt water
**Notes:** Effects of mosquito larvicide on mallard embryo development and behavior of ducklings. Exposed artificially-incubated mallard eggs on days 3, 6, 12, or 18 to sprayed applications of either No. 2 fuel oil or FLIT-MLO. Ducklings were tested for behavior avoidance at 2 da of age. Measured hatching success, stage of development at death, and avoidance response.

**Albers, P. H.** 1983. Effects of oil on avian reproduction: a review and discussion. Pages 78-96 *in* The Effects of Oil on Birds. A Multi-discipline Symposium. Tri-State Bird Rescue & Research, Inc., Newark, DE.
**Keywords:** bird/ effects/ embryo/ fresh water/ oil/ Oone/ petroleum/ reproduction/ review/ salt water
**Notes:** A review of the effects of petroleum on avian reproduction.

**Albers, P. H.** 1984. Effects of oil and dispersants on birds. Pages 101-110 *in* 1984 Region 9 Oil Dispersants Workshop. U.S. Coast Guard, Santa Barbara, CA.
**Keywords:** bird/ dispersant/ effects/ fresh water/ ODone/ oil/ region/ salt water/ vulnerability
**Notes:** General discussion of the effects of oil and dispersants on birds.

**Albers, P. H., A. A. Belisle, D. M. Swineford, R. J. Hall**, 1985. Environmental contamination in the oil fields of western Pennsylvania. Oil & Petrochemical Pollution **2**:265-280.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ conductivity/ discharges/ effluent/ fish/ fresh water/ freshwater invertebrate/ hydrocarbons/ invertebrate/ mammal/ metals/ Oeight/ oil/ oil field/ Pennsylvania/ petroleum hydrocarbons/ salamander/ stream/ tissue
**Notes:** Assessment of the contamination of wildlife in the oil fields of western Pennsylvania. Collected effluent discharges, stream water conductivity, aquatic invertebrates, fish, salamanders, and small mammals during May 1980, August 1980, and June-July 1981. Analyzed all samples for a suite of 14 aliphatic and nine aromatic hydrocarbons and analyzed fish tissue for metals. Aquatic invertebrates were classified to family.

**Albers, P. H.** 1991. Oil spills and the environment: a review of chemical fate and biological effects of petroleum. Pages 1-11 *in* J. White, L. Frink, T. M. Williams, and R. W. Davis, editors. The Effects of Oil on Wildlife. Sheridan Press, Hanover, PA.
**Keywords:** amphibian/ biological effects/ bird/ composition/ effects/ environment/ fate/ fish/ fresh water/ freshwater invertebrate/ freshwater plant/ general effect/ habitat/ invertebrate/ mammal/ marine invertebrate/ marine plant/ Oeight/ oil/ oil spill/ petroleum/ plant/ reptile/ review/ salt water/ spill
**Notes:** A general discussion of the environmental fate and biological effects of petroleum. Author

presents material on composition and characteristics of petroleum, environmental fate, biological effects (plants, invertebrates, fish, amphibians and reptiles, birds, mammals), and habitat considerations.

**Albers, P. H.** 1995. Oil, biological communities and contingency planning. Pages 1-9 *in* L. Frink, K. Ball-Weir, and C. Smith, editors. Wildlife and Oil Spills. Response, Research, and Contingency Planning. Sheridan Press, Hanover, PA.
**Keywords:** amphibian/ biological effects/ bird/ community/ contingency/ diversity/ effects/ fate/ fish/ fresh water/ freshwater invertebrate/ freshwater plant/ general effect/ mammal/ marine invertebrate/ marine plant/ miscellaneous/ natural resource/ Oeleven/ oil/ oil spill/ oiled/ petroleum/ pollution/ population/ rehabilitation/ reptile/ restoration/ salt water/ spill
**Notes:** A discussion of contingency planning for oil spills with regard to the requirements of the Oil Pollution Act of 1990. Author presents information on characteristics and fate of petroleum, biological effects of petroleum, and several special issues for contingency planners (natural resource restoration, biological diversity, oiled wildlife rehabilitation).

**Albers, P. H.** 1995. Petroleum and individual polycyclic aromatic hydrocarbons. Pages 330-355 *in* D. J. Hoffman, B. A. Rattner, G. A. Burton, Jr., J. Cairns, Jr., editors. Handbook of Ecotoxicology. Lewis Publishers, Boca Raton, Florida.
**Keywords:** amphibian/ aromatic hydrocarbons/ bird/ composition/ effects/ fate/ fish/ fresh water/ freshwater invertebrate/ freshwater plant/ general effect/ hydrocarbons/ invertebrate/ mammal/ marine invertebrate/ marine plant/ microbes/ miscellaneous/ Oeight/ PAH/ petroleum/ petroleum hydrocarbons/ plant/ reptile/ salt water/ sources/ treatment
**Notes:** A general treatment of petroleum and PAHs including presentations on composition and characteristics, sources, environmental fate, and effects on plants, invertebrates, fish, reptiles and amphibians, birds, and mammals.

**Albers, P. H.** 2003. Petroleum and individual polycyclic aromatic hydrocarbons. Pages 341-371 *in* D. J. Hoffman, B. A. Rattner, G. A. Burton, Jr., J. Cairns, Jr., editors. Handbook of Ecotoxicology. Lewis Publishers, Boca Raton, Florida.
**Keywords:** amphibian/ aromatic hydrocarbons/ bird/ composition/ effects/ fate/ fish/ fresh water/ freshwater invertebrate/ freshwater plant/ general effect/ hydrocarbons/ invertebrate/ mammal/ marine invertebrate/ marine plant/ microbes/ miscellaneous/ Oeight/ PAH/ petroleum/ plant/ reptile/ salt water/ sources/ treatment
**Notes:** A general treatment of petroleum and PAHs including presentations on composition and characteristics, sources, environmental fate, and effects on plants, invertebrates, fish, reptiles and amphibians, birds, and mammals. A revision of the 1995 book chapter of the same title.

**Albers, P. H., D. J. Hoffman, D. M. Buscemi, M. J. Melancon**, 2003. Effects of the mosquito larvicide GB-1111 on red-winged blackbird embryos. Environmental Pollution **125**:447-451.
**Keywords:** activity/ bird/ effects/ eggs/ embryo/ fresh water/ hatching/ larvicide/ liver/ microsome/ monooxygenase/ mosquito/ Oone/ salt water/ survival/ time/ weight
**Notes:** Eggs of the red-winged blackbird were collected, treated with external applications of GB-1111 equivalent to 0, 0.33, 1, 3, or 10 times the expected exposure from the maximum recommended field application, and artificially incubated. Measured hatching success; weights of embryo, yolk, and liver; and five skeletal dimensions. Also, measured the induction of microsomal P450-associated monooxygenase activity (EROD) in the liver.

**Alexander, M. M., P. Longabucco, and D. M. Phillips** 1981. The impact of oil on marsh communities in the St. Lawrence River. Pages 333-340 *in* 1981 Oil Spill Conference. American Petroleum Institute, Washington, D.C.
**Keywords:** bird/ Bunker C/ community/ effects/ fish/ fresh water/ freshwater plant/ fuel oil/ general effect/ growth/ No.6 fuel oil/ Oeight/ oil/ oil spill/ oiled/ population/ spill/ vegetation/ wetland
**Notes:** A 2-year assessment of the effects of a spill of No. 6 fuel oil on a freshwater wetland community in the St. Lawrence River. Four wetlands (heavy, moderate, slight, and no oiling) were sampled for fish, birds, and vegetation. Fish were collected, identified, and marked. Birds were observed, captured and marked, and examined for evidence of oiling. Cattail growth after cutting was measured.

**Alexander, S. K. and J. W. Webb, Jr.** 1985. Oil in the salt marsh: what have we learned? Pages 49-62 *in* C. F. Bryan, P. J. Zwank, and R. H. Chabreck, editors. Proceedings of the Fourth Coastal Marsh and Estuary Management Symposium. Louisiana Cooperative Fish and Wildlife Research Unit, Baton Rouge, LA.
**Keywords:** activity/ cleaning/ effects/ estuary/ fate/ marine plant/ oil/ oil spill/ Osix/ petroleum/ review/ salt marsh/ salt water/ spill
**Notes:** A review of the literature on fate and effects of petroleum in salt marshes and the consequences of oil spill cleanup activities.

**Alexander, S. K. and J. W. Webb, Jr.** 1987. Relationship of *Spartina alterniflora* growth to sediment oil content following an oil spill. Pages 445-449 *in* Proceedings 1987 Oil Spill Conference, API Publication 4452. American Petroleum Institute, Washington, D.C.
**Keywords:** concentration/ crude oil/ density/ growth/ light/ marine plant/ oil/ oil spill/ Osix/ petroleum/ pipeline/ salt water/ sediment/ Spartina/ spill/ Texas/ transfer/ vegetation
**Notes:** An underwater transfer pipeline ruptured and discharged light crude oil into a coastal bayou in Texas, USA. Vegetation was measured and sediment sampled 4-5, 7-8, and 16 mos post-spill. Measured live stem density of *Spartina alterniflora* and total petroleum content of the sediment. Sediment samples from bare and vegetated areas were collected and analyzed for petroleum 17-18 mos post-spill. A final visual assessment was made 32 mos post-spill.

**Allard, A.-S., M. Malmberg, A. H. Neilson, M. Remberger**, 2005. Accumulation of polycyclic aromatic hydrocarbons from creosote-contaminated soil in selected plants and the oligochaete worm *Enchytraeus crypticus*. Journal of Environmental Science and Health **40**:2057-2072.
**Keywords:** accumulation/ aromatic/ aromatic hydrocarbon/ aromatic hydrocarbons/ clover/ concentration/ creosote/ earthworm/ freshwater invertebrate/ freshwater plant/ germination/ hydrocarbons/ oligochaete/ Oseven/ PAH/ plant/ radish/ root/ roots/ ryegrass/ seed/ soil/ species
**Notes:** Soil samples were collected from two locations (high and low contamination) at a site contaminated with creosote. Individual soil samples were used to determine their effect on germination of ryegrass, clover, and radish seeds. Soils mixed together were used to grow the three plant species and to expose earthworms for 42 da. Analyzed soils and the soil mixture, with and without azide added, for 13 PAHs. Analyzed plant roots, a stem-leaf mixture, and the earthworms for the same PAHs.

**Alton, L. S.**, 1995. Survival of *Penicillium* species in marine and river water contaminated with diesel oil, nitrogen, and phosphorus compounds. Archives of Environmental Contamination and Toxicology **29**:39-44.
**Keywords:** diesel/ fresh water/ fungi/ microbes/ nitrate/ nitrogen/ oil/ Oten/ phosphate/ phosphorus/ salt water/ species/ survival/ temperature/ tolerance
**Notes:** Exposure of four species of Penicillium fungi for 1-2 years, at different temperatures, to salt or fresh water containing diesel oil, nitrates, nitrites, or phosphates; an attempt to establish tolerance limits.

**Alvarez-Legorreta, T., G. Gold-Bouchot, O. Zapata-Perez**, 1994. Hydrocarbon concentrations in sediments and clams (*Rangia cuneata*) in Laguna de Pom, Mexico. Bulletin of Environmental Contamination and Toxicology **52**:39-45.
**Keywords:** aliphatic hydrocarbons/ analysis/ aromatic hydrocarbons/ clam/ coast/ concentration/ hydrocarbons/ marine invertebrate/ Mexico/ Ofour/ oil/ salt water/ sediment/ unresolved complex mixture
**Notes:** Analysis of hydrocarbons (aliphatics, aromatics, unresolved complex mixture) in the sediment and clams of a lagoon on the east coast of Mexico; an oil well and several oil-processing facilities located in and around the lagoon.

**Amadi, A., A. A. Dickson, G. O. Maate**, 1993. Remediation of oil polluted soils: 1. Effect of organic and inorganic nutrient supplements on the performance of maize (*Zea may* L.). Water, Air, and Soil Pollution **66**:59-76.
**Keywords:** corn/ crude oil/ freshwater plant/ growth/ inorganic/ Nigeria/ nutrients/ oil/ organic/ Oseven/ remediation/ soil
**Notes:** Growth of corn in oil-contaminated (crude oil) soil supplemented with organic and inorganic nutrients.

**Amadi, A., S. D. Abbey, A. Nma**, 1996. Chronic effects of oil spill on soil properties and microflora of a rainforest ecosystem in Nigeria. Water, Air, and Soil Pollution **86**:1-11.
**Keywords:** chronic/ crude oil/ ecosystem/ effects/ fresh water/ freshwater invertebrate/ microbes/ Nigeria/ Ofive/ oil/ oil spill/ pipeline/ soil/ spill/ transect
**Notes:** Measurement of soil and microbial characteristics along a transect line extending 2.5 km from a 1971 oil pipeline rupture in Nigeria.

**Ameijeiras, A. H., J. S. Gandara, J. L. Hernandez, J. S. Lozano**, 1994. Classification of the coastal waters of Galicia (NW Spain) on the basis of total aliphatic hydrocarbon concentrations in mussels (*Mytilus galloprovincialis*). Marine Pollution Bulletin **28**:396-398.
**Keywords:** aliphatic hydrocarbons/ coast/ concentration/ hydrocarbons/ marine invertebrate/ mussel/ Ofour/ petroleum hydrocarbons/ salt water/ sampling/ Spain/ species/ tissue
**Notes:** Background classification of the coastal waters of Galicia province in Spain according to the concentration of aliphatic hydrocarbons in soft tissue of a species of mussel. Sampled wild mussels from 11 sampling areas along the coast and four mussel raft farms located within the 11 natural sampling areas. Analyzed for selected aliphatic hydrocarbons.

**Amodio-Cocchieri, R., T. Cirillo**, 2003. Aliphatic hydrocarbons in biota from the Gulf of Naples (Italy). Marine Pollution Bulletin **46**:362-377.
**Keywords:** aliphatic hydrocarbons/ analysis/ bivalve/ chemical analysis/ fish/ hydrocarbons/ marine invertebrate/ miscellaneous/ muscle/ mussel/ Oten/ salt water/ tissue
**Notes:** Mussels and fish were collected from three portions of coastline in the greater Gulf of Naples. Samples were collected monthly from May through November but the samples were combined for chemical analysis. Analyzed mussel tissue and fish muscle for nine aliphatic hydrocarbons.

**Anderlini, V. C., L. Al-Harmi, B. W. DeLappe, R. W. Risebrough, W. Walker, II, B. R. T. Simoneit, A. S. Newton**, 1981. Distribution of hydrocarbons in the oyster, *Pinctada margaratifera*, along the coast of Kuwait. Marine Pollution Bulletin **12**:57-62.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ coast/ concentration/ distribution/ hydrocarbons/ Kuwait/ marine invertebrate/ Ofour/ oil terminal/ oyster/ petroleum/ refinery/ salt water/ survey/ unresolved complex mixture
**Notes:** Survey of aliphatic (most data), aromatic, and unresolved hydrocarbons in oysters from the Gulf coast of Kuwait. Effort made to related concentrations to petroleum production, refining, and shipping areas.

**Anderson, C. M., R. P. LaBelle**, 1994. Comparative occurrence rates for offshore oil spills. Spill Science Technology Bulletin **1**:131-141.
**Keywords:** crude oil/ estimate/ evaluation/ North Slope crude oil/ offshore/ oil/ oil spill/ Onine/ pipeline/ rate/ salt water/ spill/ tanker/ technical/ transport
**Notes:** An evaluation of rates of spill incidence and characteristics of oil spills from U.S. OCS drilling platforms and pipelines (1964-1992) and worldwide tanker spills (1974-1992). Special estimates for tanker and barge spill rates in U.S. waters and spill rates for tankers carrying North Slope crude oil.

**Anderson, D. W., F. Gress, D. M. Fry**, 1996. Survival and dispersal of oiled brown pelicans after rehabilitation and release. Marine Pollution Bulletin **32**:711-718.
**Keywords:** activity/ bird/ brown pelican/ coast/ dispersal/ evaluation/ oiled/ Oone/ pelican/ rehabilitation/ release/ reproduction/ salt water/ survival
**Notes:** Evaluation of the survival, dispersal, and reproductive activities of rehabilitated oiled brown pelicans on the west coast of the US.

**Anderson, D. W., S. H. Newman, P. R. Kelly, S. K. Herzog, K. P. Lewis**, 2000. An experimental soft-release of oil-spill rehabilitated American coots (*Fulica americana*): I. Lingering effects on survival, condition and behavior. Environmental Pollution **107**:285-294.
**Keywords:** behavior/ bird/ blood/ condition/ crude oil/ effects/ fresh water/ index/ injury/ oil/ oil spill/ Oone/ rehabilitation/ release/ spill/ survival/ weight/ wetland
**Notes:** Rehabilitated (crude oil spill) and reference coots were placed in two experimental wetlands and

monitored for 3 mos. Used 37 rehabilitated and 38 reference birds. All birds were marked with neck collars and radio transmitters and wing clipped. Measured survival, a variety of behaviors, weight, foot injuries, blood chemistries, and a body condition index.

**Anderson, J. W., S. L. Kiesser, J. W. Blaylock**, 1980. The cumulative effect of petroleum hydrocarbons on marine crustaceans during constant exposure. Rapports et Proces-Verbaux des Reunions Conseil International pour l'Exploration de la Mer **179**:62-70.
**Keywords:** aromatic hydrocarbons/ concentration/ crude oil/ crustacean/ experiment/ hydrocarbons/ index/ marine invertebrate/ monoaromatic/ Ofour/ oil/ petroleum/ petroleum hydrocarbons/ Prudhoe Bay/ Prudhoe Bay crude oil/ salt water/ species/ survival/ time/ toxicity/ toxicity index
**Notes:** Exposure of three species of marine crustaceans for 4-11 da to an extract of Prudhoe Bay crude oil in laboratory experiments. The extract was 98% aromatics, mostly monoaromatics; the remainder were di- and triaromatics. Calculation of a toxicity index based on $LC_{50}$ and time of exposure; survival and water and crustacean concentrations of aromatics.

**Anderson, J. W., S. L. Kiesser, D. L. McQuerry, and G. W. Fellingham** 1985. Effects of oil and chemically dispersed oil in sediments on clams. Pages 349-353 *in* 1985 Oil Spill Conference (Prevention, Behavior, Control, Cleanup). American Petroleum Institute, Washington, DC.
**Keywords:** amino acids/ behavior/ biochemical/ clam/ concentration/ Corexit 9527/ crude oil/ dispersant/ effects/ growth/ marine invertebrate/ ODfour/ oil/ oil spill/ Prudhoe Bay/ Prudhoe Bay crude oil/ salt water/ sediment/ species/ spill/ survival/ tissue
**Notes:** Exposure of two species of clams to sediment containing Prudhoe Bay crude oil with or without Corexit 9527 dispersant for 1 to 6 mo. Measured oil concentrations in sediments and clam tissue, and survival, growth, and amino acid concentrations in clam tissue.

**Anderson, J. W., D. L. McQuerry, S. L. Klesser**, 1985. Laboratory evaluation of chemical dispersants for use on oil spills at sea. Environmental Science and Technology **19**:454-457.
**Keywords:** dispersant/ effectiveness/ evaluation/ mixing/ ODnine/ oil/ oil spill/ procedure/ spill/ technical/ temperature/ toxicity
**Notes:** Authors test the effectiveness and toxicity of 14 chemical dispersants and make recommendations for a procedure to help decide what to use and when to use it. A decision tree is presented as well as discussing the issues of effectiveness during mixing and after mixing, and the influence of water temperature.

**Anderson, J. W., R. Riley, S. Kiesser, and J. Gurtisen** 1987. Toxicity of dispersed and undispersed Prudhoe Bay crude oil fractions to shrimp and fish. Pages 235-240 *in* 1987 Oil Spill Conference (Prevention, Behavior, Control, Cleanup). American Petroleum Institute, API Publication 4452, Washington, DC.
**Keywords:** behavior/ crude oil/ dispersant/ distillation fraction/ fish/ marine invertebrate/ ODthree/ oil/ oil spill/ Prudhoe Bay/ Prudhoe Bay crude oil/ shrimp/ solubility/ species/ spill/ toxicity
**Notes:** Determination of the toxicity to a shrimp and a fish species of Prudhoe Bay crude oil and two distillation fractions of the crude oil. Chemically dispersed and water soluble fractions of each were used in the exposure trials.

**Anderson, R. D.** 1975. Petroleum hydrocarbons and oyster resources of Galveston Bay, Texas. Pages 541-548 *in* 1975 Conference on Prevention and Control of Oil Pollution. American Petroleum Institute, Washington, DC.
**Keywords:** accumulation/ aromatic hydrocarbons/ bivalve/ Bunker C/ crude oil/ depuration/ experiment/ fuel oil/ hydrocarbons/ Kuwait/ Louisiana/ Louisiana crude oil/ marine invertebrate/ No.2 fuel oil/ Ofour/ oil/ oyster/ petroleum/ petroleum hydrocarbons/ pollution/ salt water/ saturated hydrocarbons/ South Louisiana crude oil/ Texas
**Notes:** Field collections and experiments to assess the ability of oysters from the Galveston Bay area to accumulate and eliminate petroleum hydrocarbons. Field collected oysters were analyzed for hydrocarbons at collection and after a summer in clean water. Experiments exposed oysters to 1 or 5% oil-water mixtures of Kuwait or South Louisiana crude oils, No. 2 fuel oil, or Bunker C fuel oil for up to 7

da; oysters analyzed periodically for saturated and non-saturated hydrocarbons up to 52 da after exposure ended.

**Anderson, R. D., J. W. Anderson**, 1975. Effects of salinity and selected petroleum hydrocarbons on the osmotic and chloride regulation of the American oyster, *Crassostrea virginica*. Physiological Zoology **48**:420-430.
**Keywords:** bivalve/ chloride/ crude oil/ effects/ fuel oil/ hydrocarbons/ Louisiana/ Louisiana crude oil/ marine invertebrate/ No.2 fuel oil/ Ofour/ oil/ osmoregulation/ oyster/ petroleum/ petroleum hydrocarbons/ regulation/ salinity/ salt water/ South Louisiana crude oil
**Notes:** Assessment of the influence of petroleum exposure on osmoregulation and chloride regulation in the oyster. Oysters exposed to 1% oil-water mixture of either No. 2 fuel oil or South Louisiana crude oil for 96 hr, then moved to seawater with different salinities for up to 17 days; osmo- and chloride regulation measured periodically during the 17 da period.

**Andrade, M. L., E. F. Covelo, F. A. Vega, P. Marcet**, 2004. Effect of the *Prestige* oil spill on salt marsh soils on the coast of Galicia (northwest Spain). Journal of Environmental Quality **33**:2103-2110.
**Keywords:** chemical characteristics/ coast/ degradation/ fuel oil/ intertidal/ metals/ miscellaneous/ Oeleven/ oil/ oil spill/ salt marsh/ salt water/ shoreline/ soil/ Spain/ spill/ time/ weathered/ wetland
**Notes:** Samples of freshly spilled oil from the November 2002 spill of heavy fuel oil by the *Prestige* and shoreline samples of weathered oil residue (3 mos post- spill) were analyzed for physical and chemical characteristics. Simultaneous with the collection of weathered oil, samples of surface and subsurface soil were collected from the intertidal (polluted) and supratidal (unpolluted) area of four coastal wetlands. Measured physical and chemical characteristics of soil and their metal (Cr, Cu, Fe, Ni, Pb V) content.

**Andreasen, J. K., R. W. Spears**, 1983. Toxicity of Texan petroleum well brine to the sheepshead minnow (*Cyprinodon variegatus*), a common estuarine fish. Bulletin of Environmental Contamination and Toxicology **30**:277-283.
**Keywords:** brine water/ estuarine/ fish/ marine invertebrate/ oil field/ Othree/ petroleum/ salt water/ sheepshead minnow/ shrimp/ species/ Texas/ toxicity
**Notes:** Toxicity to several species of fish and shrimp of brine water from a Texas oilfield; experimental exposure with primary emphasis on the sheepshead minnow.

**Andres, B. A.**, 1997. The *Exxon Valdez* oil spill disrupted the breeding of black oystercatchers. Journal of Wildlife Management **61**:1322-1328.
**Keywords:** activity/ adult/ bird/ black oystercatcher/ effects/ evaluation/ Exxon Valdez/ feeding/ mussel/ oil/ oil spill/ oiled/ Oone/ rate/ reproduction/ salt water/ seasonal/ spill
**Notes:** Evaluation of the effects of the Exxon Valdez oil spill on black oystercatchers on an oiled island (Green Is.) and an unoiled island (Montague Is.). Data for 1989 and 1991 breeding seasons and partial information for 1990, 1992, and 1993. Measured nesting activity, reproductive success, deaths of bay mussels, and feeding rates of adults at the nesting sites.

**Andres, B. A.**, 1999. Effects of persistent shoreline oil on breeding success and chick growth in black oystercatchers. Auk **116**:640-650.
**Keywords:** bird/ black oystercatcher/ chicks/ composition/ consumption/ effects/ Exxon Valdez/ feces/ food/ foraging/ growth/ mussel/ nestling/ oil/ oiled/ Oone/ petroleum/ population/ Prince William Sound/ productivity/ reproduction/ salt water/ sediment/ shoreline/ weight
**Notes:** A post-spill (Exxon Valdez, 1989) assessment of the effects of persistent shoreline oil on the black oystercatcher. Heavily oiled and nonoiled areas of Prince William Sound were compared by collecting foraging information in 1991-93, breeding success and chick growth in 1992-93, oiled sediments in 1993, and fecal samples from nestlings in 1993. Quantified food consumption and delivery to chicks, reproductive productivity, weight gain of chicks, and composition of petroleum in sediments and feces.

**Anker-Nilssen, T., P. H. Jones, O. W. Rostad**, 1988. Age, sex and origins of auks (Alcidae) killed in the Skagerrak oiling incident of January 1981. Seabird **11**:28-46.
**Keywords:** age/ auks/ bird/ Denmark/ evaluation/ morphometry/ oil/ oil spill/ oiled/ Oone/ origin/ salt water/ sex/ spill/ wing

**Notes:** Evaluation of the body characteristics of auks killed in an oil spill north of Denmark. The author attempts to determine origins of corpses based on measurements.

**Anoliefo, G. O., D. E. Vwioko**, 1995. Effects of spent lubricating oil on the growth of *Capsicum annum* L. and *Lycopersicon esculentum*. Environmental Pollution **88**:361-364.
**Keywords:** effects/ freshwater plant/ germination/ growth/ leaves/ lubricating oil/ motor oil/ oil/ Oseven/ plant/ seed/ soil/ used motor oil
**Notes:** Seeds of tomato and hot pepper were planted in soil mixed with 1-5% used motor oil. Seed germination was measured after 15 da. Height of plant and leaf area were measured at 14, 28, 42, 56, 70, and 84 da after planting.

**Anonymous**, 1972. A unique petroleum hydrocarbon for control of mosquito larvae. Agrichemical Age **15**:4-5.
**Keywords:** bird/ FLIT-MLO/ fresh water/ freshwater invertebrate/ hydrocarbons/ larvae/ larvicide/ marine invertebrate/ mosquito/ Oone/ petroleum/ salt water
**Notes:** Discussion of FLIT-MLO for use as a mosquito larvicide.

**Ansari, Z. A., B. Ingole**, 2002. Effect of an oil spill from *M V Sea Transporter* on intertidal meiofauna at Goa, India. Marine Pollution Bulletin **44**:396-402.
**Keywords:** beach/ coast/ community/ concentration/ distance/ fuel oil/ India/ intertidal/ marine invertebrate/ meiofauna/ Ofour/ oil/ oil spill/ petroleum/ population/ recovery/ salt water/ sediment/ spill/ time
**Notes:** "Fuel oil" from a grounded cargo ship washed ashore on the central west coast of India. Intertidal sediments to a depth of 5 cm were collected at low-, mid-, and high- tide locations from three beach areas at varying distances from the spill site. Collections were made weekly for 5 weeks. Collections were also made at the beach nearest the spill at mid-tide on a monthly basis for 1 yr. Identified and quantified the meiofauna and determined the total petroleum hydrocarbon concentrations of the sediment samples.

**Antrim, L. D., R. M. Thom, W. W. Gardiner, V. I. Cullinan, D. K. Shreffler, R. W. Bienert**, 1995. Effects of petroleum products on bull kelp (*Nereocystis luetkeana*). Marine Biology **122**:23-31.
**Keywords:** activity/ aromatic hydrocarbons/ crude oil/ diesel/ diesel fuel/ effects/ experiment/ fuel oil/ hydrocarbons/ kelp/ marine plant/ oil/ Osix/ PAH/ petroleum/ petroleum products/ plant/ polar compounds/ respiration/ salt water/ saturated hydrocarbons/ weathered
**Notes:** Bull kelp plants were exposed in indoor experimental tanks to either weathered or unweathered diesel fuel, intermediated fuel oil (80% crude, 20 % fuel oil), or crude oil for 4 or 24 hrs. Measured visible damage to the stipe, bulb, or blade of the plant for 7 da after removal to clean water. Determined photosynthetic activity and respiration of experimental plants in a separate experiment. Analyzed petroleum products and crude oil for saturated hydrocarbons, polar PAHs, phenolics, and very polar compounds.

**Ara, K., K. Nojima, J. Hiromi**, 2002. Acute toxicity of Bunker A and C refined oils to the marine harpacticoid copepod *Tigriopus japonicus* Mori. Bulletin of Environmental Contamination and Toxicology **69**:104-110.
**Keywords:** acute/ Bunker A/ Bunker C/ copepod/ experiment/ fuel oil/ grass/ grass shrimp/ marine invertebrate/ ODfour/ oil/ oil spill/ refined oil/ salt water/ sex/ shrimp/ spill/ survival/ toxicity
**Notes:** Determination of the toxicity of the chemically-dispersed (D-1128) water-soluble fraction (WSF) of Bunker A and C fuel oils to a marine copepod (both sexes). Exposures were for 96 hr with or without medium renewal at 24 hr intervals. Results were compared to results of other experiments utilizing dispersed Bunker C WSF from an oil spill and undispersed Bunker C WSF to assess toxicity to mysids, grass shrimp, and brown shrimp.

**Ara, K., D. Aoike, J. Hiromi, N. Uchida**, 2004. Acute toxicity of Bunker C refined oil to the Japanese littleneck clam *Ruditapes philippinarum* (Bivalvia:Veneridae). Bulletin of Environmental Contamination and Toxicology **72**:632-638.
**Keywords:** acute/ Bunker C/ clam/ concentration/ dispersant/ invertebrate/ Japan/ marine invertebrate/ Ofour/ refined oil/ salt water/ survival/ time/ toxicity

**Notes:** Littleneck clams were collected from a petroleum-contaminated intertidal area of coastal Japan and used in an acute toxicity test. Clams were exposed for 96 hrs to varying concentrations of the water-soluble fraction (WSF) of either Bunker C oil or Bunker C plus a chemical dispersant. Determined the relation between exposure time and water concentration. Compared results to results of studies with other species of marine invertebrates .

**Armstrong, H. W., K. Fucik, J. W. Anderson, J. M. Neff**, 1979. Effects of oilfield brine effluent on sediments and benthic organisms in Trinity Bay, Texas. Marine Environmental Research **2**:55-69.
**Keywords:** benthic/ brine water/ concentration/ effects/ effluent/ marine invertebrate/ naphthalene/ numbers/ offshore/ Ofour/ oil/ oil field/ oil platform/ salt water/ sampling/ sediment/ species/ Texas/ transect
**Notes:** Effects of oilfield brine effluent from an offshore oil platform in Trinity Bay, Texas were determined with the use of three sampling transects from April, 1974 through December, 1975. Monthly samples of sediment were analyzed for total naphthalene concentration and numbers and species of benthic organisms.

**Armstrong, J. E., J. A. Calder**, 1978. Inhibition of light-induced pH increase and $O_2$ evolution of marine microalgae by water-soluble components of crude and refined oils. Applied Environmental Microbiology **35**:858-862.
**Keywords:** crude oil/ fuel oil/ Louisiana/ Louisiana crude oil/ marine plant/ microalgae/ No.2 fuel oil/ oil/ Osix/ oxygen/ pH/ photosynthesis/ refined oil/ salt water/ South Louisiana crude oil/ species
**Notes:** Several species (4) of marine microalgae were exposed to 10% water-soluble fractions of either No. 2 fuel oil, South Louisiana crude oil, or Jay crude oil. Measured light-induced pH increase over a 38-min period and photosynthetic oxygen production.

**Artz, R. R. E., K. T. Semple, K. Killham, J. I. Prosser, G. I. Paton**, 2002. The potential for anaerobic mineralisation of hydrocarbon constituents of oily drill cutings from the North Sea seabed. Journal of Environmental Monitoring **4**:553-557.
**Keywords:** anaerobic/ concentration/ cuttings/ degradation/ hydrocarbons/ microbes/ microcosm/ naphthalene/ nitrate/ North Sea/ Oten/ petroleum/ petroleum hydrocarbons/ phosphate/ reduction/ salt water/ sulfate/ time
**Notes:** Assessment of the potential for anaerobic degradation of petroleum hydrocarbons in drill cuttings from the floor of the North Sea. Cuttings were brought into the laboratory and mixed with one of three radio-labelled compounds (hexadecane, octacosane, naphthalene) and incubated for 11 mos. Sets of microcosms were either supplemented with N and P, sulfate reduction inhibited, methanogenesis inhibited, and made abiotic with formaldehyde. Measured $CO_2$ production, nitrate and phosphate concentration, and methane production.

**Atagana, H. I., R. J. Haynes, F. M. Wallis**, 2003. Optimization of soil physical and chemical conditions for the bioremediation of creosote-contaminated soil. Biodegradation **14**:297-307.
**Keywords:** bioremediation/ combination/ concentration/ condition/ creosote/ degradation/ experiment/ microbes/ microcosm/ nutrients/ Oten/ pH/ ratio/ soil
**Notes:** Soil contaminated with a high concentration of creosote was collected and the C:N:P ratio adjusted in several combinations to determine the best nutrient situation for microbial degradation of the creosote. Duration of the jar microcosm experiment was 6 wks. Authors made weekly measurements of microbial concentrations, pH, soil moisture, and selected components of creosote.

**Atema, J.**, 1977. The effects of oil on lobsters. Oceanus **20**:67-73.
**Keywords:** adult/ behavior/ concentration/ crude oil/ effects/ fuel oil/ kerosene/ La Rosa crude oil/ lobster/ marine invertebrate/ No.2 fuel oil/ Ofour/ oil/ salt water
**Notes:** Exposure of adult lobsters to kerosene, crude oil, and several concentrations of No. 2 fuel oil; measured behavioral responses.

**Atkinson, J.**, 1989. Bio-economics of oil-spill rescue - the dollars and sense. American Association of Zoological Parks and Aquariums annual conference proceedings **1989**:205-208.

**Keywords:** cost/ miscellaneous/ Oeleven/ oil spill/ oiled/ otter/ rehabilitation/ rescue/ seal/ whale
**Notes:** An examination of the cost of rehabilitation for oiled otters, seal pups, and killer whales.

**Atlas, R. M., R. Bartha**, 1973. Fate and effects of polluting petroleum in the marine environment. Residue Reviews **49**:49-85.
**Keywords:** biological effects/ composition/ effects/ environment/ fate/ marine environment/ Onine/ overview/ petroleum/ review/ salt water/ technical/ treatment
**Notes:** A thorough and very readable treatment of the nature, fate, and effects of petroleum in the marine environment. Although the biological effects sections are no longer 'state of knowledge', it remains a good source of basic information. One of the earliest (if not the earliest) works of its kind.

**Atlas, R. M., E. A. Schofield, F. A. Morell, R. E. Cameron**, 1976. Effects of petroleum pollutants on Arctic microbial populations. Environmental Pollution **10**:35-43.
**Keywords:** algae/ Arctic/ bacteria/ concentration/ crude oil/ effects/ estuarine/ fresh water/ freshwater plant/ fungi/ marine plant/ miscellaneous/ oil/ oil seep/ Oten/ petroleum/ population/ protozoa/ Prudhoe Bay/ Prudhoe Bay crude oil/ salt water/ species
**Notes:** Assessment of the effects of Prudhoe Bay crude oil on freshwater and estuarine bacteria, protozoa, algae, and fungi. Collected samples from Prudhoe Bay, two coastal ponds, and two oil seeps. Two concentrations of crude oil were added to water samples from the ponds and Prudhoe Bay. Species were identified and enumerated in controls and oil-exposed water samples.

**Atlas, R. M.** 1976. Fate and effects of oil pollutants in extremely cold marine environments. Dept. of Biology, University of Louisville, Louisville, Kentucky. Annual Report No. 4. Office of Naval Research, Contract No. N00014-76-C-0400, Task No. NR 205-013, AD-A033 477 . 36 pp.
**Keywords:** amphipod/ bioassay/ biodegradation/ community/ effects/ environment/ evaluation/ fate/ flow-through/ ice/ marine environment/ marine invertebrate/ microbes/ miscellaneous/ oil/ Oten/ petroleum/ population/ salt water/ spill
**Notes:** A report on four types of research performed under contract by the author. (1) Flow through chambers were used to assess changes in microbial populations exposed to petroleum. (2) Assessed the fate of oil trapped under sea ice. (3) Developed a bioassay system employing amphipods to assess the ecological consequences of enhanced oil biodegradation. (4) Evaluation of actual cold water petroleum spills to determine their effects on the microbial community.

**Atlas, R. M.**, 1978. Microorganisms and petroleum pollutants. BioScience **28**:387-391.
**Keywords:** biodegradation/ commentary/ hydrocarbons/ microbes/ oil/ oil spill/ Oten/ petroleum/ petroleum hydrocarbons/ remediation/ spill
**Notes:** General commentary and discussion of the ability of microorganisms to degrade petroleum hydrocarbons and the implications for industry and oil spill remediation.

**Atlas, R. M.**, 1991. Microbial hydrocarbon degradation -- bioremediation of oil spills. Journal of Chemical Technology and Biotechnology **52**:149-156.
**Keywords:** bioremediation/ degradation/ environment/ fresh water/ marine environment/ microbes/ oil/ oil spill/ Oten/ petroleum/ rate/ review/ salt water/ soil/ spill
**Notes:** A summarized review of the bioremediation of petroleum from oil spills. Sections on general microbial degradation, rates of petroleum degradation, bioremediation of contaminated soil and groundwater, and bioremediation of oil in the marine environment.

**Atlas, R. M.**, 1995. Petroleum biodegradation and oil spill bioremediation. Marine Pollution Bulletin **31**:178-182.
**Keywords:** biodegradation/ bioremediation/ degradation/ microbes/ oil/ oil spill/ Oten/ petroleum/ salt water/ spill
**Notes:** A lucid and uncomplicated assessment and description of natural and enhanced biodegradation of spilled petroleum. Sections on basic petroleum degradation, biodegradation after oil spills, and efforts to enhance biodegradation at spill sites.

**Atlas, R. M., C. E. Cerniglia**, 1995. Bioremediation of petroelum pollutants. BioScience **45**:332-338.
**Keywords:** bioremediation/ degradation/ microbes/ oil/ oil spill/ Oten/ petroleum/ remediation/ spill/ treatment
**Notes:** A detailed treatment of the process of microbial degradation of petroleum. The author compares bacterial and fungal actions and discusses examples of the role of microbial degradation at oil spill sites. Specifics of site remediation and regulatory oversight are also discussed.

**Atwood, D. K., R. L. Ferguson**, 1982. An example study of the weathering of spilled petroleum in a tropical marine environment: IXTOC-1. Bulletin of Marine Science **32**:1-13.
**Keywords:** crude oil/ environment/ Ixtoc/ marine environment/ microbes/ movement/ oil/ Onine/ petroleum/ salt water/ sampling/ technical/ water column/ weathered
**Notes:** A water sampling cruise in September 1979 followed the movement of crude oil from the IXTOC-1 well blowout in June 1979. Petroleum appearance in the water column was described, multiple water samples were collected and analyzed, and the state of weathering (microbial and physical-chemical) was determined.

**Atwood, D. K., F. J. Burton, J. E. Corredor, G. R. Harvey, A. J. Mata-Jimenez, A. Vasquez-Botello, B. A. Wade**, 1987. Results of the CARIPOL petroleum pollution monitoring project in the wider Caribbean. Marine Pollution Bulletin **18**:540-548.
**Keywords:** beach/ Caribbean/ dissolved/ hydrocarbons/ miscellaneous/ monitoring/ Oeleven/ petroleum/ petroleum hydrocarbons/ pollution/ region/ salt water/ tar ball
**Notes:** A petroleum pollution monitoring project focused on the Caribbean region was initiated in 1979. Three types of measurement include tar on beaches, floating tar, and total dissolved and dispersed petroleum hydrocarbons in surface water.

**Augenfeld, J. M., J. W. Anderson, D. L. Woodruff, J. L. Webster**, 1980. Effects of Prudhoe Bay crude oil-contaminated sediments on *Protothaca staminea* (Mollusca: Pelecypoda): hydrocarbon content, condition index, free amino acid level. Marine Environmental Research **4**:135-143.
**Keywords:** aliphatic hydrocarbons/ amino acids/ aromatic hydrocarbons/ bivalve/ clam/ concentration/ condition/ crude oil/ effects/ hydrocarbons/ index/ marine invertebrate/ Ofour/ oil/ Prudhoe Bay/ Prudhoe Bay crude oil/ salt water/ sediment/ species/ tissue
**Notes:** Two species of clams exposed to sediment containing 1237 ppm of Prudhoe Bay crude oil in a field situation for 38 or 54 da. Measured aliphatic and aromatic hydrocarbon content of tissue, free amino acid concentration, and a 'condition index'.

**Augenfeld, J. M.**, 1980. Effects of Prudhoe Bay crude oil contamination on sediment working rates of *Abarenicola pacifica*. Marine Environmental Research **3**:307-313.
**Keywords:** crude oil/ effects/ lugworms/ marine invertebrate/ Ofour/ oil/ Prudhoe Bay/ Prudhoe Bay crude oil/ rate/ salt water/ sediment
**Notes:** Exposure of lugworms to sediment containing 0, 250, 500, or 1000 ppm of Prudhoe Bay crude oil for 11 da; measured amount of sediment processed by worms.

**Austin, B., R. R. Colwell, J. D. Walker, J. Calomiris**, 1977. The application of numerical taxonomy to the study of petroleum-degrading bacteria isolated from the aquatic environment. Developments in Industrial Microbiology **60**:685-695.
**Keywords:** bacteria/ Chesapeake/ degradation/ development/ environment/ microbes/ motor oil/ oil/ Oten/ sediment/ taxonomy
**Notes:** Water and sediment from a polluted and two unpolluted sites in the Chesapeake Bay were the source of petroleum-degrading bacteria grown on a medium containing motor oil. Bacterial isolates were identified with a computerized numerical taxonomy program.

**Avci, A., M. Kacmaz, I Durak**, 2005. Peroxidation in muscle and liver tissues from fish in a contaminated river due to a petroleum refinery industry. Ecotoxicology and Environmental Safety **60** :101-105.
**Keywords:** antioxidant/ biochemical/ effluent/ fish/ fresh water/ liver/ metabolism/ muscle/ Othree/ oxidation/ petroleum/ physiology/ refinery/ river/ species/ tissue
**Notes:** One species of fish was collected above (n=21) and below (n=20) an outfall of petroleum refinery

effluent in Turkey. Muscle and liver tissue were analyzed for oxidant and antioxidant measures. Specifically, malondialdehyde, susceptibility to oxidation, antioxidant potential, superoxide dismutase, glutathione peroxidase, and catalase.

**Awad, H.**, 1988. Oil in Saudian Red Sea territorial waters. Marine Pollution Bulletin **19**:287-290.
**Keywords:** Arabian crude oil/ aromatic hydrocarbons/ depth/ hydrocarbons/ miscellaneous/ Oeleven/ oil/ petroleum/ Red Sea/ salt water
**Notes:** Surface water (1 m depth) was collected from four areas of the Red Sea and analyzed for total aromatic hydrocarbons.

**Axiak, V., J. J. George**, 1987. Bioenergetic responses of the marine bivalve *Venus verrucosa* on long-term exposure to petroleum hydrocarbons. Marine Environmental Research **23**:33-47.
**Keywords:** bivalve/ condition/ crude oil/ feeding/ food/ hydrocarbons/ Kuwait/ Kuwait crude oil/ long-term/ marine invertebrate/ metabolism/ Ofour/ oil/ petroleum/ petroleum hydrocarbons/ physiology/ rate/ salt water
**Notes:** Exposure of bivalve *Venus verrucosa* to the water-accomodated fractions of Kuwait crude oil for 145 da. Measured feeding rates, food absorption efficiency, several physiological functions, and body condition indicies.

**Axiax, V., L. J. Saliba**, 1981. Effects of surface and sunken crude oil on the behaviour of a sea urchin. Marine Pollution Bulletin **12**:14-19.
**Keywords:** behavior/ crude oil/ effects/ marine invertebrate/ Ofour/ oil/ salt water/ sea urchin/ urchin/ weathered
**Notes:** Exposure of a sea urchin to fresh or weathered surface or sunken crude oil, or water-soluble fractions of surface fresh crude oil (8, 16, 32 ppm) or sunken fresh crude oil (6, 11, 22 ppm); measured righting response.

**Baars, B.-J.**, 2002. The wreckage of the oil tanker 'Erika' -- human health risk assessment of beach cleaning, sunbathing and swimming. Toxicology Letters **128**:55-68.
**Keywords:** beach/ bird/ Bunker C/ cleaning/ coast/ composition/ effects/ France/ fuel oil/ hazard/ health/ ingestion/ inhalation/ mammal/ oil/ oiled/ Otwo/ risk/ risk assessment/ salt water/ skin/ tanker
**Notes:** The 1999 wreck of the tanker *Erika* (Bunker C) off the coast of France resulted in 500 km of oiled beach. A human health risk assessment was conducted to determine the hazard to persons engaged in beach cleaning or bird cleaning, and tourists. The fuel oil was analyzed and the composition related to known toxic effects of individual compounds. Evaluated dermal contact, inhalation, and ingestion as potential routes of exposure.

**Baca, B. J., C. D. Getter, and J. Lindstedt-Siva** 1985. Freshwater oil spill considerations: protection and cleanup. Pages 385-390 *in* Proceedings 1985 Oil Spill Conference, API Publication 4385. American Petroleum Institute, Washington, D.C.
**Keywords:** cleaning/ effects/ environment/ evaluation/ fresh water/ freshwater plant/ oil/ oil spill/ Oseven/ protection/ review/ spill/ vegetation
**Notes:** A review and evaluation of the effects of oil spills in freshwater environments. Separates spills into river spills and standing water spills. Provides examples from eight selected freshwater spills and provides recommendations for protection and cleanup.

**Baca, B. J., T. E. Lankford, and E. R. Gundlach** 1987. Recovery of Brittany coastal marshes in the eight years following the *Amoco Cadiz* incident. Pages 459-464 *in* Proceedings 1987 Oil Spill Conference, API Publication 4452. American Petroleum Institute, Washington, D.C.
**Keywords:** Amoco Cadiz/ coast/ community/ evaluation/ marine plant/ oil/ oil spill/ Osix/ recovery/ review/ salt water/ species/ spill/ transect/ vegetation/ wetland
**Notes:** Begins with a review of studies performed on the Brittany coastal marshes in the years 1978-83 after the 1978 *Amoco Cadiz* spill. The assessment continues with this report of a 1986 evaluation at five sites along the Brittany coast. Established transects, indentified vegetation, measured the occurrence of common species, measured vegetative cover, and described geomorphic features.

**Badaway, M. I., I. S. Al-Mujainy, M. D. Hernandez**, 1993. Petroleum-derived hydrocarbons in water, sediment and biota from the Mina al Fahal coastal waters. Marine Pollution Bulletin **26**:457-460.
**Keywords:** aliphatic hydrocarbons/ analysis/ aromatic hydrocarbons/ benthic/ depth/ hydrocarbons/ invertebrate/ marine invertebrate/ miscellaneous/ Oeleven/ PAH/ petroleum/ salt water/ sediment
**Notes:** On five occasions between March and November of 1990, water (1 m depth), sediments, and benthic invertebrates were collected for petroleum analysis. All samples were analyzed for total aromatic hydrocarbons, whereas sediments were also analyzed for aliphatic hydrocarbons and a suite of 13 PAHs.

**Badawy, M. I., R. A. Wahaab, H. F. Abou Waly**, 1995. Petroleum and chlorinated hydrocarbons in water from Lake Manzala and associated canals. Bulletin of Environmental Contamination and Toxicology **55**:258-263.
**Keywords:** aliphatic hydrocarbons/ analysis/ aromatic hydrocarbons/ concentration/ Egypt/ hydrocarbons/ miscellaneous/ Oeleven/ petroleum/ salt water/ survey/ total hydrocarbons
**Notes:** A survey of petroleum hydrocarbon and organochlorine concentrations in a shallow coastal lake and feeder canals near Port Said, Egypt. Twelve locations were sampled for subsurface water; analysis was for aliphatic hydrocarbons, selected aromatic hydrocarbons, total hydrocarbons, and selected organochlorine compounds.

**Baden, S. P.**, 1982. Impaired osmoregulation in the shrimp *Palaemon adspersus* exposed to crude oil extract. Marine Pollution Bulletin **13**:208-210.
**Keywords:** crude oil/ marine invertebrate/ North Sea/ North Sea crude oil/ Ofour/ oil/ osmoregulation/ salt water/ shrimp
**Notes:** Exposure of the shrimp *Palaemon adspersus* to 20, 70, 100, or 200 ppb of water-soluble fraction of North Sea crude oil for up to 34 da; measured osmoregulation.

**Baek, K.-H., H.-S. Kim, H.-M. Oh, B.-D. Yoon, J. Kim, I.-S. Lee**, 2004. Effects of crude oil, oil components, and bioremediation on plant growth. Journal of Environmental Science and Health **A39**:1-8.
**Keywords:** aliphatic hydrocarbons/ Arabian Light crude oil/ assay/ biomass/ bioremediation/ concentration/ corn/ crude oil/ effects/ freshwater plant/ growth/ light/ microbes/ naphthalene/ oil/ Oseven/ PAH/ petroleum/ phenanthrene/ plant/ roots/ seed/ soil/ toxicity
**Notes:** Soils treated with either Arabian light crude oil, hexadecane, eicosane, naphthalene, phenanthrene, or pyrene; or biodegraded for 50 da, were used in plant toxicity assays. Bean and corn seeds were germinated in the treated soil for 14 da, after which shoots and roots were measured, weighed, and biomass estimated. Total petroleum hydrocarbon concentration of bioremediated soil was determined by normalizing results to the squalene peak and comparing to the control.

**Bagg, J., J. D. Smith, W. A. Maher**, 1981. Distribution of polycyclic aromatic hydrocarbons in sediments from estuaries of south-eastern Australia. Austraian Journal of Marine and Freshwater Research **32**:65-73.
**Keywords:** aromatic hydrocarbons/ Australia/ benzo[a]pyrene/ coast/ distribution/ estuary/ hydrocarbons/ miscellaneous/ Oeleven/ PAH/ perlene/ salt water/ sediment
**Notes:** Sediment was collected from a polluted river estuary, part of an urbanized bay, and an estuary inlet in a rural area in southeast Australia. The samples were analyzed for benzo[a]pyrene and perylene. Results were compared to other sites along the coast of southeast Australia and in other parts of the world.

**Baillie, S. R., T. J. Stowe**, 1984. A comparison between the percentage of seabirds reported as oiled from ringing recoveries and from the beached bird survey. Seabird **7**:47-54.
**Keywords:** beached bird survey/ bird/ England/ oiled/ Oone/ rate/ recovery/ salt water/ survey
**Notes:** Comparison of oiling rates among birds from banding recovery and the beached bird survey in England.

**Bajt, O.**, 2001. The impact of a highway on hydrocarbon content in coastal sediments - a case study. Fresenius Environmental Bulletin **10**:59-62.
**Keywords:** aromatic hydrocarbons/ evaluation/ highway/ hydrocarbons/ miscellaneous/ Oeleven/ offshore/ pollution/ salt water/ sediment/ shoreline/ Slovenia/ transect

**Notes:** An evaluation of the hydrocarbon pollution associated with a coastal highway in Slovenia. Sediment samples were collected along the highway at 10 m offshore, two locations on a transect extending to 200 m offshore, three sites along an unpolluted shoreline 10 m offshore, and two samples well out into the ocean. In addition, a sample of highway runoff water was collected during a spring storm (runoff water and water at the end of the drain in the ocean). Water and sediments were analyzed for aromatic hydrocarbons.

**Bak, R. P. M., J. H. B. W. Elgershuizen**, 1976. Patterns of oil-sediment rejection in corals. Marine Biology **37** :105-113.
**Keywords:** behavior/ Caribbean/ coral/ marine invertebrate/ Ofour/ salt water/ sediment/ species
**Notes:** Assessment of the sediment rejection behavior of 19 species of Caribbean corals. Compared rejection of clean sediment particles with sediment-oil particles.

**Bak, R. P. M.**, 1987. Effects of chronic oil pollution on a Caribbean coral reef. Marine Pollution Bulletin **18**:534-539.
**Keywords:** Aruba/ Caribbean/ chronic/ coast/ coral/ coral reef/ effects/ marine invertebrate/ Ofour/ oil/ pollution/ refinery/ salt water/ species/ survey
**Notes:** Documentation of the effects of 60 yr of chronic oil pollution near a refinery in Aruba; conducted a survey of coral species along the coast near the refinery.

**Baker, J. H., R. Y. Morita**, 1983. A note on the effects of crude oil on microbial activities in a stream sediment. Environmental Pollution (Series A) **31**:149-157.
**Keywords:** activity/ carbon/ carbon dioxide/ concentration/ creek/ crude oil/ effects/ evaluation/ fresh water/ freshwater invertebrate/ glucose/ microbes/ mineralization/ nitrogen/ Ofive/ oil/ rate/ sediment/ stream
**Notes:** Evaluation of the effect of crude oil on microbial activity in freshwater stream sediment. Sediment from a creek was treated with either of two concentrations of Alaskan crude oil, placed in pots, and replaced in the creek sediment. Pots were removed after 4, 8, and 16 wks. Measured ethylene (nitrogen fixation), methane, and carbon dioxide production rates, phosphatase concentrations, and glucose mineralization.

**Baker, J. M.**, 1978. Marine ecology and oil pollution. Journal of the Water Pollution Control Federation **50**:442-449.
**Keywords:** behavior/ community/ effects/ general effect/ invertebrate/ marine invertebrate/ marine plant/ monitoring/ Oeight/ oil/ plant/ pollution/ population/ salt water
**Notes:** A description of the types of field and laboratory studies used by the Oil Pollution Research Unit of the Field Studies Council (Great Britain) to determine the effects of oil pollution on marine plants and invertebrates. Major discussion headings are: (1) Factors affecting extent of biological damage; (2) Monitoring oil pollution effects; and (3) Biological monitoring.

**Baker, J. M., L. M. Guzman, P. D. Bartlett, D. I. Little, and C. M. Wilson** 1993. Long-term fate and effects of untreated thick oil deposits on salt marshes. Pages 395-399 *in* Proceedings 1993 International Oil Spill Conference, API Publication 4580. American Petroleum Institute, Washington, D.C.
**Keywords:** Arabian crude oil/ Arabian Light crude oil/ Bunker C/ crude oil/ degradation/ effects/ England/ fate/ fuel oil/ light/ long-term/ marine plant/ Metula/ miscellaneous/ oil/ oil spill/ Osix/ recovery/ spill/ vegetation/ wetland
**Notes:** Long-term assessment of the recovery of vegetation in two salt marshes. A 1969 spill of heavy fuel oil in Milford Haven, England was evaluated 23 yrs later; several previous assessments were also made. The grounding of the *Metula* in the Strait of Magellan, Chile in 1974 discharged Light Arabian crude oil and Bunker C fuel oil. An assessment was made 17 yrs later; previous assessments were also made.

**Baker, J. R., A. M. Jones, T. P. Jones, H. C. Watson**, 1981. Otter *Lutra lutra* L. mortality and marine oil pollution. Biological Conservation **20**:311-321.
**Keywords:** analysis/ Bunker C/ chemical analysis/ fuel oil/ mammal/ necropsy/ oil/ Otwo/ pathology/ pollution/ salt water/ sea otter/ Shetland/ spill/ stomach

**Notes:** Report of deaths of sea otters following a spill of Bunker C fuel oil at Sullom Voe Terminal in Shetland; necropsy and pathology results and chemical analysis of stomach contents.

**Bakker, M. I., B. Casado, J. W. Koerselman, J. Tolls, C. Kolloffel**, 2000. Polycyclic aromatic hydrocarbons in soil and plant samples from the vicinity of an oil refinery. Science of the Total Environment **263**:91-100.
**Keywords:** aromatic hydrocarbons/ freshwater plant/ grass/ hydrocarbons/ leaves/ oil/ Oseven/ PAH/ plant/ refinery/ soil/ spatial scale/ species
**Notes:** Soil, leaves of great plantain, and mixed grass species were sampled from three sites downwind (50 m, 1.3 km, 3.5 km distant) and one site upwind (4.2 km distant) of an oil refinery in Belgium. Samples were analyzed for seven PAHs and compared to the results from other studies throughout the world.

**Balba, M. T., R. Al-Daher, N. Al-Awadhi, H. Chino, H. Tsuji**, 1998. Bioremediation of oil-contaminated desert soil: the Kuwaiti experience. Environment International **24**:163-173.
**Keywords:** abundance/ bioremediation/ crude oil/ degradation/ evaluation/ Kuwait/ methods/ microbes/ Oten/ petroleum/ remediation/ salinity/ soil/ static
**Notes:** Evaluation of three remediation methods for treating oil-contaminated soil in Kuwait. Tested landfarming, windrow composting, and static bioventing piles. Measured petroleum degredation, microbial abundance, and soil salinity.

**Balci, A.**, 1993. Dissolved and dispersed petroleum hydrocarbons in the eastern Aegean Sea. Marine Pollution Bulletin **26**:222-223.
**Keywords:** Aegean Sea/ aromatic hydrocarbons/ depth/ dissolved/ hydrocarbons/ miscellaneous/ Oeleven/ petroleum/ petroleum hydrocarbons/ salt water/ sampling
**Notes:** A small water sampling (1 m depth) project in the Aegean Sea. Samples were analyzed for total aromatic hydrocarbons.

**Ballard, W. B., M. A. Cronin, R. Rodrigues, R. O. Skoog, R. H. Pollard**, 2000. Arctic fox, *Alopex lagopus*, den densities in the Prudhoe Bay Oil Field, Alaska. Canadian Field-Naturalist **114**:453-456.
**Keywords:** activity/ Alaska/ Arctic/ Arctic fox/ Canada/ density/ development/ fresh water/ mammal/ oil/ oil field/ Otwo/ population/ Prudhoe Bay/ reproduction/ survey
**Notes:** An assessment of Arctic fox densities in the Prudhoe Bay Oil Field complex. Aerial and ground surveys were performed 1991-93 at the Prudhoe Bay site and in adjacent areas. Dens were classified as either natal, secondary, active non-natal, inactive, status unknown, or active artificial. Comparisons were made with earlier studies of Arctic fox denning activity at Prudhoe Bay and other areas within Alaska and Canada. No information exists on denning activity at Prudhoe Bay prior to oil field development. [Some of the totals in Table 1 cannot be explained by data in the table].

**Ballou, T. G., R. Dodge, S. Hess, and A. Knap** 1989. Tropical oil pollution investigations in coastal systems (tropics): the effects of untreated and chemically dispersed Prudhoe Bay crude oil on mangroves, seagrasses, and corals in Panama. Pages 229-256 *in* L. M. Flaherty, editor. Oil Dispersants: New Ecological Approaches. STP 1018. American Society for Testing and Materials, Philadelphia, PA.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ coral/ coral reef/ crude oil/ dispersant/ effects/ experiment/ general effect/ grass/ hydrocarbons/ intertidal/ mangrove/ marine invertebrate/ marine plant/ ODeight/ oil/ Panama/ petroleum/ petroleum hydrocarbons/ pollution/ Prudhoe Bay/ Prudhoe Bay crude oil/ release/ salt water/ seagrass/ sediment/ subtidal/ tissue
**Notes:** Results of a large-scale field experiment utilizing the release of crude oil onto coastal areas of Panama. Three study sites (reference, untreated crude oil, dispersed crude oil) were employed; intertidal areas of all sites contained mangroves, and subtidal areas contained sea grasses and coral reefs. Water, sediment, and biological tissue was collected before and after exposure ( 8 mos and 3 da prespill; 5 da, 4 mos, 7 mos, 12 mos, and 20 mos postspill) and analyzed for petroleum hydrocarbons. Biological characterists were also measured before and after oil release.

**Banks, P. D, K. M. Brown**, 2002. Hydrocarbon effects on fouling assemblages: the importance of taxonomic differences, seasonal, and tidal variation. Marine Environmental Research **53**:311-326.

**Keywords:** barnacle/ crude oil/ effects/ experiment/ intertidal/ larvae/ Louisiana/ Louisiana crude oil/ marine invertebrate/ Ofour/ oil/ oiled/ oyster/ salt water/ seasonal/ size/ solubility/ South Louisiana crude oil/ species/ subtidal/ time/ water column
**Notes:** Laboratory and field assessment of the effect of whole South Louisiana crude oil and the water soluble fraction of crude oil on fouling species (oyster, barnacle, bryozoan). Oyster larval settlement (72 hr), larvae in water column (72 hr), and spat number and size (21 da) were measured in a laboratory experiment with oiled tiles. Similarly oiled tiles were used in field experiments at two tidal locations (intertidal and subtidal) over two time periods (3 wks and 6 wks) to determine settlement of all three species.

**Banks, S.**, 2003. SeaWiFS satellite monitoring of oil spill impact on primary production in the Galapagos Marine Reserve. Marine Pollution Bulletin **47**:325-330.
**Keywords:** Bunker C/ chlorophyll/ diesel fuel/ distribution/ marine plant/ monitoring/ oil/ oil spill/ Osix/ salt water/ spill
**Notes:** The NASA SeaWiFS spectrophotometric sensor mounted on an orbiting satellite was used to monitor the effect of the *Jessica* oil spill on chlorophyll *a* distribution in the Galapagos Marine Reserve. Coverage from January 1998, 1999, 2000, 2001, and coverage for the period 1 wk before the spill (Jan. 16) through 6 wks post spill was compared to determine the likely effect.

**Banu, J. R., S. Esakkiraj, R. Nagendran, S. Logakanthi**, 2005. Biomanagement of petrochemical sludge using an exotic earthworm *Eudrilus eugineae*. Journal of Environmental Biology **26**:43-47.
**Keywords:** biodegradation/ carbon/ density/ earthworm/ freshwater invertebrate/ miscellaneous/ nitrogen/ Oeleven/ remediation/ reproduction/ survival
**Notes:** Petrochemical sludge was used in an assessment of the biodegradation potential of vermiculture. Earthworms were added to mixtures of bedding material and 0, 25, 50, 75% sludge. Duration was 60 da. Measured earthworm survival and reproduction, bacterial density every 15 da, and carbon and nitrogen utilization every week.

**Barakat, A. O., A. R. Mostafa, J. Rullkotter, A. R. Hegaz**, 1999. Application of a multimolecular marker approach to fingerprint petroleum pollution in the marine environment. Marine Pollution Bulletin **38**:535-544.
**Keywords:** alkane/ coast/ Egypt/ environment/ hopane/ marine environment/ Onine/ petroleum/ pollution/ salt water/ sources/ sterane/ tar ball/ technical/ terpane
**Notes:** Tar balls were collected from the Mediterrean coast of northern Egypt and analyzed for a variety of conserved steranes, terpanes, hopanes, and other cyclic alkanes in an effort to identify the source of the material.

**Barata, C. Calbet A. Saiz E. Ortiz L. Bayona J. M.**, 2005. Predicting single and mixture toxicity of petrogenic polycyclic aromatic hydrocarbons to the copepod *Oithona davisae*. Environmental Toxicology Chemistry **24**:2992-2999.
**Keywords:** aromatic/ aromatic hydrocarbon/ aromatic hydrocarbons/ combination/ concentration/ copepod/ experiment/ hydrocarbons/ marine invertebrate/ Ofour/ PAH/ salt water/ survival/ time/ toxicity/ transfer/ water
**Notes:** A marine copepod was used in a laboratory experiment to determine toxicity of 10 single petrogenic PAHs and a mixture of those PAHs. The PAHs were used in quantities approximating their $EC_{50s}$; the mixture of 10 PAHs was employed in three concentrations. Duration was 48 hrs followed by transfer to clean sea water for 1.5-3 hrs. Measured narcotic effect and survival. Measured the PAH concentrations in water at time 0 and 48 hrs.

**Barber, W. E., L. L. McDonald, W. P. Erickson, M. Vallarino**, 1995. Effect of the *Exxon Valdez* oil spill on intertidal fish: a field study. Transactions of the American Fisheries Society **124**:461-476.
**Keywords:** biomass/ crude oil/ Exxon Valdez/ fish/ fishery/ intertidal/ oil/ oil spill/ Othree/ Prince William Sound/ Prudhoe Bay crude oil/ salt water/ sampling/ society/ species diversity/ spill
**Notes:** Assessment of the effect of the Exxon Valdez oil spill on intertidal fish of Prince William Sound; sampling performed in 1990 and 1991.

**Barnett, J., D. Toews**, 1978. The effects of crude oil and the dispersant, Oilsperse 43, on respiration and coughing rates in Atlantic salmon (*Salmo salar*). Canadian Journal of Zoology **56**:307-310.
**Keywords:** Atlantic/ Atlantic salmon/ coughing/ crude oil/ dispersant/ effects/ emulsion/ fish/ fresh water/ ODthree/ oil/ rate/ respiration/ salmon/ Venezuelan crude oil/ weathered
**Notes:** Effects on post-smolt Atlantic salmon coughing rates and respiration of exposure to emulsions of unweathered and weathered Venezuelan crude oil and the dispersant Oilsperse 43.

**Barr-Nea, L., M. Wolman**, 1977. Tumors and amyloidosis in mice painted with crude oil found on bathing beaches. Bulletin of Environmental Contamination and Toxicology **18**:385-391.
**Keywords:** beach/ crude oil/ effects/ mammal/ mouse/ oil/ Otwo/ skin/ solvent/ solvent extract/ weathered
**Notes:** Effects on mice of skin application of solvent extracts of weathered crude oil; applied twice weekly for 12 months.

**Barrett, R. T.**, 1979. Small oil spill kills 10-20000 seabirds in north Norway. Marine Pollution Bulletin **10**:253-255.
**Keywords:** bird/ coast/ fuel oil/ guillemot/ Norway/ oil/ oil spill/ Oone/ salt water/ spill
**Notes:** Description of the seabirds killed in a small oil spill off the north coast of Norway.

**Barron, M. G., T. Podrabsky, S. Ogle, R. W. Ricker**, 1999. Are aromatic hydrocarbons the primary determinant of petroleum toxicity to aquatic organisms? Aquatic Toxicology **46**:253-268.
**Keywords:** alkane/ analysis/ aromatic hydrocarbons/ assay/ California/ coast/ concentration/ crude oil/ growth/ hydrocarbons/ invertebrate/ marine invertebrate/ Ofour/ oil/ petroleum/ salt water/ shrimp/ survival/ toxicity/ weathered
**Notes:** A determination of the relation between aromatic content of crude oil and toxicity to aquatic invertebrates. Used naturally-weathered crude oil from three locations off the coast of Southern California and a mysid shrimp. Water accomodated fractions of the weathered oil were added in varying concentrations to determine $LC_{50s}$ and $LC_{20s}$ for survival and growth. Tests lasted 6-7 da. Exposure media were analyzed for alkane and aromatic constituents.

**Barron, M. G., T. Podrabsky, R. S. Ogle, J. E. Dugan, R. W. Ricker**, 1999. Sensitivity of the mysid *Mysidopsis bahia* to a weathered oil. Bulletin of Environmental Contamination and Toxicology **62**:266-271.
**Keywords:** California/ dissolved/ growth/ hydrocarbons/ marine invertebrate/ Ofour/ oil/ oxygen/ petroleum/ petroleum hydrocarbons/ pH/ salinity/ salt water/ shrimp/ survival/ temperature/ weathered
**Notes:** Exposure of mysid shrimp to the water-accomodated fraction (WAF) of environmentally weathered oil from coastal California. Exposure levels were 1.25, 2.5, 5, 10, and 20 % WAF for 6 da. Measured temperature, pH, dissolved oxygen, salinity, death, survival to 6 da, and growth. Exposure solutions analyzed for total petroleum hydrocarbons.

**Barron, M. G., L. Ka'Aihue**, 2001. Potential for photoenhanced toxicity of spilled oil in Prince William Sound and Gulf of Alaska waters. Marine Pollution Bulletin **43**:86-92.
**Keywords:** Alaska/ aromatic hydrocarbons/ Exxon Valdez/ Gulf of Alaska/ injury/ miscellaneous/ Oeleven/ oil/ oil spill/ PAH/ photoenhanced/ phototoxicity/ Prince William Sound/ risk/ risk assessment/ salt water/ spill/ spill response/ technical/ toxicity
**Notes:** A technical discussion of the phenomenon of photoenhanced toxicity of PAHs with special reference to the potential for such enhanced toxicity during the *Exxon Valdez* oil spill. Also discusses the role of such enhanced toxicity in injury and risk assessment and in oil spill response.

**Barron, M. G., M. G. Carls, J. W. Short, S. D. Rice**, 2003. Photoenhanced toxicity of aqueous phase and chemically dispersed weathered Alaska North Slope crude oil to Pacific herring eggs and larvae. Environmental Toxicology and Chemistry **22**:650-660.
**Keywords:** Alaska/ chemical analysis/ concentration/ Corexit 9527/ crude oil/ dispersant/ eggs/ experiment/ fish/ herring/ larvae/ light/ North Slope/ North Slope crude oil/ ODthree/ oil/ Pacific/ Pacific herring/ PAH/ photoenhanced/ salt water/ sunlight/ survival/ toxicity/ ultraviolet/ weathered
**Notes:** Pacific herring eggs or larvae were exposed to water-accomodated fractions (WAF) of Alaska North Slope crude oil with or without the presence of Corexit 9527 dispersant. A total of six

concentrations of oil and three ultraviolet A (UVA) exposures were used. Several experiments with natural sunlight (control light, UVA only, sunlight only, UVA + sunlight) were performed. Crude oil, WAF, eggs, and larvae were analyzed for selected PAHs. Measured survival of eggs and larvae and incidence of yolk sac edema.

**Barron, M. G., M. G. Carls, J. W. Short, S. D. Rice, R. A. Heintz, M. Rau, R. Di Giulio**, 2005. Assessment of the phototoxicity of weathered Alaska North Slope crude oil to juvenile pink salmon. Chemosphere **60**:105-110.
**Keywords:** Alaska/ concentration/ crude oil/ experiment/ fish/ fresh water/ gill/ juvenile/ light/ lipid/ North Slope/ North Slope crude oil/ oil/ Othree/ PAH/ photoenhanced/ phototoxicity/ pink salmon/ salmon/ survival/ time/ toxicity/ ultraviolet/ water/ weathered
**Notes:** Evaluated phototoxicity of the water accomodated fraction (WAF) of North Slope crude oil to juvenile pink salmon. The experiment used juveniles from previously-exposed parents and non-exposed parents, five concentrations of the WAF, two time durations (22, 48 hrs), two levels of UV light intensity, and two durations of light exposure. Determined PAHs in exposure water and salmon (at 24 hrs). Measured survival, photoenhanced toxicity, and gill lipid peroxidation.

**Barsdate, R. J., M. C. Miller, V. Alexander, J. R. Vestal, and J. E. Hobbie** 1980. Oil spill effects. Pages 388-408 *in* John E. Hobbie, editor. Limnology of Tundra Ponds, Barrow, Alaska. US/IBP Synthesis Series Vol. 13. Dowden, Hutchinson & Ross, Stroudsburg, Pa.
**Keywords:** abundance/ Alaska/ algae/ benthic/ biomass/ composition/ crude oil/ density/ depth/ effects/ experiment/ fresh water/ freshwater invertebrate/ freshwater plant/ general effect/ macroinvertebrate/ nutrients/ Oeight/ oil/ oil spill/ oiled/ oxygen/ photosynthesis/ phytoplankton/ plant/ productivity/ Prudhoe Bay/ respiration/ sediment/ spill/ temperature/ tundra/ zooplankton
**Notes:** Description of a large-scale experiment conducted at Prudhoe Bay, Alaska. One tundra pond was treated with crude oil in 1970 and a second pond in 1975; several control ponds were used for comparison. Physical, chemical, and biological measures were taken prespill and postspill in 1970, and again in 1971, 1972, and 1975. Prespill and postspill samples were taken from the second oiled pond in 1975. Measured temperature, depth of thaw and water level, oxygen, water chemistry, several nutrients, bacterial abundance, sediment respiration, acetate turnover, biomass and photosynthesis of benthic algae, and algal productivity; determined taxonomic composition of phytoplankton, measured biomass of rooted plants, measured zooplankton presence, biomass, and production, and measured densities and determined taxonomic composition of benthic macroinvertebrates.

**Barszcz, C., P. P. Yevich, L. R. Brown, J. D. Yarbrough, C. D. Minchew**, 1978. Chronic effects of three crude oils on oysters suspended in estuarine ponds. Journal of Environmental Pathology and Toxicology **1**:879-896.
**Keywords:** aromatic hydrocarbons/ chronic/ concentration/ crude oil/ effects/ estuarine/ hydrocarbons/ marine invertebrate/ Nigerian crude oil/ Ofour/ oil/ oyster/ pathology/ salt water/ sediment/ survival/ tissue
**Notes:** Exposure of oysters in estuarine experimental ponds to 4 ppm of either Empire Mix, Saudi Arabian, or Nigerian crude oils. Oyster, sediment, and water samples taken for up to 9 mo. Measured aromatic hydrocarbon content of water, sediment, and oyster tissue, oyster survival, gross appearance of oysters, and a variety of histopathological comparisons.

**Barton, D. R., R. R. Wallace**, 1979. The effects of an experimental spillage of oil sands tailings sludge on benthic invertebrates. Environmental Pollution **18**:305-312.
**Keywords:** abundance/ Alberta/ benthic/ Canada/ community/ effects/ fresh water/ freshwater invertebrate/ invertebrate/ Ofive/ oil/ oil sands/ petroleum hydrocarbons/ release/ sampling/ sand/ substrate/ synthetic oil
**Notes:** A small amount of oil sands tailing sludge was dumped into a river in northern Alberta, Canada to simulate an accidental discharge of the tailings material. The sampling area was a 30 m stretch divided into upper, middle, and lower sampling sites. Samples of benthic substrate were taken before and 2 hrs, 1 da, 3 da, 7 da, 14 da, and 28 da after the tailings release. Benthic organisms were identified and enumerated. The tailings sludge was characterized according to physical and chemical measures.

**Basseres, A., B. Verschuere, G. Holtzinger, J.-P. Jacques, and B. Tramier** 1995. A new cleaning product for oiled birds and an integrated automated process. Pages 171-175 *in* 1995 International Oil Spill Conference, API 4620. American Petroleum Institute, Washington, D.C.
**Keywords:** bird/ cleaning/ duck/ evaluation/ feathers/ insulation/ mallard/ metabolism/ oil/ oil spill/ oiled/ Oone/ rat/ rate/ spill/ thermoregulation
**Notes:** Overall evaluation of a new chemical product for cleaning oiled birds. Duck feathers were used to demonstrate the superiority of the new product. Toxicological tests (dosing) were performed on laboratory rats. Metabolic rate and thermal insulation were measured on six mallard ducks. Also, a description and photos of an automated cleaning device for birds.

**Bate, G. C., S. D. Crafford**, 1985. Inhibition of phytoplankton photosynthesis by the WSF of used lubricating oil. Marine Pollution Bulletin **16**:401-404.
**Keywords:** activity/ algae/ composition/ crude oil/ fuel oil/ light/ lubricating oil/ marine plant/ motor oil/ oil/ Osix/ PAH/ photosynthesis/ phytoplankton/ Qatar/ salt water/ used motor oil
**Notes:** One diatom, two green flagellates, and two blue-green algae were exposed to the water-soluble fractions (WSF) of either light Qatar crude oil, used motor oil, or an outboard fuel-oil mixture. The incubated cultures were measured for photosynthetic activity ($O_2$ and $CO_2$). The WSF mixtures were analyzed for PAH composition.

**Batten, S. D., R. J. S. Allen, C. O. M. Wotton**, 1998. The effects of the Sea Empress oil spill on the plankton of the southern Irish Sea. Marine Pollution Bulletin **36**:764-774.
**Keywords:** abundance/ crude oil/ diversity/ effects/ marine invertebrate/ marine plant/ Ofour/ oil/ oil spill/ phytoplankton/ plankton/ salt water/ sampling/ species/ spill/ zooplankton
**Notes:** Effect of Sea Empress crude oil spill on the zooplankton and phytoplankton of the southern Irish Sea. Plankton sampling conducted since 1970 in the Irish Sea provided a background for comparison to the plankton species, abundance, and diversity during the year of the oil spill.

**Battershill, C. N., P. R. Bergquist**, 1982. Responses of an intertidal gastropod to field exposure of an oil and a dispersant. Marine Pollution Bulletin **13**:159-162.
**Keywords:** condition/ dispersant/ experiment/ gastropod/ gonads/ index/ intertidal/ marine invertebrate/ Maui condensate/ ODfour/ oil/ salt water/ shell/ survival/ tissue/ weathered/ weight
**Notes:** Exposure of a marine gastropod to fresh and weathered Maui condensate alone or combined with Shell SD LTX dispersant or to Shell SD LTX alone in a 3-wk field experiment. Measured survival, weight, gonad weight, gonad index, and general tissue condition.

**Batterton, J. C., K. Winters, C. Van Baalen**, 1978. Sensitivity of three microalgae to crude oils and fuel oils. Marine Environmental Research **1**:31-41.
**Keywords:** aromatic hydrocarbons/ concentration/ crude oil/ effects/ fuel oil/ growth/ marine plant/ microalgae/ oil/ Osix/ photosynthesis/ rate/ refinery/ salt water/ sources/ species/ survival/ toxicity
**Notes:** Determined the effects on three species of marine microalgae of four crude oils and No. 2 fuel oil from five refinery sources. Employed four concentrations of crude or fuel oil in the culture medium and measured culture growth rate per day, photosynthetic inhibition ($O_2$ production), and culture survival after 24 hrs. Determined the effect of heating on the toxicity of three fuel oils. Analyzed the aromatic fraction of three of the fuel oils and one crude oil, and the volatile aromatics removed from the fuel oils by heating.

**Baussant, T., S. Sanni, A. Skadsheim, G. Jonsson, J. F. Borseth, B. Gaudebert**, 2001. Bioaccumulation of polycyclic aromatic compounds: 2. Modeling bioaccumulation in marine organisms chronically exposed to dispersed oil. Environmental Toxicology and Chemistry **20**:1185-1195.
**Keywords:** Arabian Light crude oil/ aromatic hydrocarbons/ crude oil/ elimination/ fish/ juvenile/ kinetic/ light/ model/ mussel/ oil/ Othree/ PAH/ salt water/ turbot/ uptake
**Notes:** Juvenile turbot and blue mussels were exposed to artifically-weathered Arabian light crude oil dispersed in a flow-thru experimental system. Turbot were exposed for 21 da to 0.06, 0.12, 0.25, 0.5, 1, or 2 ppm crude oil, followed by a 9-da elimination period. Mussels were exposed for 8 da to 1 ppm crude oil, followed by a 10-da elimination period. Fish, mussels, crude oil, and water were analyzed for 27 PAHs. Data were used to develop a kinetic model of uptake and elimination of PAHs.

**Baussant, T., S. Sanni, G. Jonsson, A. Skadsheim, J. F. Borseth**, 2001. Bioaccumulation of polycyclic aromatic compounds: 1. Bioconcentration in two marine species and in semipermeable membrane devices during chronic exposure to dispersed crude oil. Environmental Toxicology and Chemistry **20**:1175-1184.
**Keywords:** accumulation/ analysis/ Arabian Light crude oil/ aromatic hydrocarbons/ chronic/ crude oil/ depuration/ dispersal/ elimination/ fish/ juvenile/ light/ mussel/ oil/ Othree/ PAH/ salt water/ species/ SPMD/ turbot
**Notes:** Juvenile turbot and blue mussels were exposed to artificially-weathered Arabian light crude oil dispersed in a flow-thru experimental system. Turbot were exposed for 21 da to 0.06, 0.12, 0.25, 0.5, 1, or 2 ppm crude oil, followed by a 9-da elimination period. Mussels were exposed for 8 da to 1 ppm crude oil, followed by a 10-da elimination period. Semi-permeable membrane devices (SPMD) were subjected to the same exposure and elimination cycles. Fish, mussels, SPMDs, crude oil, and water were analyzed for 27 PAHs. Data were compared at the end of the exposure period and at the end of the elimination period, subjected to a principal components analysis, and used to calculate lipid-based bioconcentration factors.

**Bayer, R. D.**, 1988. Changes in waterbird numbers before and after the 1983 oil spill at Yaquina Estuary, Oregon. Oregon Birds **14**:157-161.
**Keywords:** bird/ Bunker C/ diesel/ diesel fuel/ estuary/ numbers/ oil/ oil spill/ Oone/ salt water/ spill/ wintering
**Notes:** Changes in waterbird numbers as a result of a Bunker C and diesel fuel spill in Yaquina Estuary, Oregon.

**Beaver, D. L.**, 1982. Avian populations and hydrocarbon development at Baker Sanctuary. Jack-Pine Warbler **60**.
**Keywords:** bird/ development/ effects/ fresh water/ hydrocarbons/ oil field/ Oone/ population
**Notes:** Assessment of the effects of well drilling adjacent to a bird sanctuary.

**Beck, R, R. Shore, T. A. Scriven, and M. Lindquist**. 1981. Project Summary: Potential Environmental problems of enhanced oil and gas recovery techniques. U.S. Environmental Protection Agency, Cincinnati, Ohio. **EPA-600/S2-81-149**. 7 pp.
**Keywords:** miscellaneous/ natural gas/ Oeleven/ oil/ oil field/ recovery/ review
**Notes:** A critical review of published and unpublished information on nine precesses for enhanced oil and gas recovery.

**Beckett, K. J., R. J. Aulerich, L. K. Duffy, J. S. Patterson, S. J. Bursian**, 2002. Effects of dietary exposure to environmentally relevant concentrations of weathered Prudhoe Bay crude oil in ranch-raised mink (*Mustela vison*). Bulletin of Environmental Contamination and Toxicology **69**:593-600.
**Keywords:** blood/ concentration/ consumption/ crude oil/ diet/ dietary exposure/ effects/ food/ male/ mammal/ mink/ oil/ Otwo/ pathology/ Prudhoe Bay crude oil/ serum/ time/ tissue/ toxicity/ weathered/ weight
**Notes:** Male ranch mink were fed diets containing either 0, 100, or 1,000 ppm of weathered Prudhoe Bay crude oil for 4 mos. Food consumption was measured, body weights were checked bi-weekly, and animals were observed for clinical signs of toxicity. At study termination, blood was collected from all animals and selected tissues were collected from three mink per group. Measured blood characteristics (5) and serum characteristics (10) and performed a histopathological assessment of collected tissues.

**Beckmann, M., J. D. Hardege, E. Zeeck**, 1995. Effects of the volatile fraction of crude oil on spawning behaviour of nereids (annelida, polychaeta). Marine Environmental Research **40**:267-276.
**Keywords:** crude oil/ distillation fraction/ effects/ female/ male/ marine invertebrate/ North Sea/ North Sea crude oil/ Ofour/ oil/ polychaete/ reproduction/ salt water/ spawning/ species
**Notes:** Exposure of males and females from two polychaete species to EKO-FISK, North Sea crude oil or a distillation fraction of the crude oil; measured the reproductive behaviour.

**Beer, J. V.**, 1968. The attempted rehabilitation of oiled sea birds. Wildfowl **19**:120-124.
**Keywords:** bird/ methods/ oiled/ Oone/ rehabilitation/ salt water
**Notes:** Assessment of rehabilitation methods for birds in the late 60s.

**Beg, M. U., M. Al-Bahloul, P. G. Jacob, K. R. Beg, K. Al-Matrouk, K. Abdel-Elah**, 2001. Biomarker response in sheim (*Acanthopagrus latus*) exposed to polycyclic aromatic hydrocarbons. Bulletin of Environmental Contamination and Toxicology **67**:210-216.
**Keywords:** adult/ Arabian Gulf/ aromatic hydrocarbons/ biochemical/ biomarker/ concentration/ dosed/ fish/ food/ hydrocarbons/ Othree/ PAH/ salt water
**Notes:** Adult fish were dosed with food containing varying concentrations of BaP as a surrogate for PAHs. All fish were sacrificed 4 da after dosing and the amount of EROD induction was determined.

**Beg, M. U., T. Saeed, S. Al-Muzaini, K. R. Beg, M. Al-Bahloul**, 2003. Distribution of petroleum hydrocarbon in sediment from coastal area receiving industrial effluents in Kuwait. Ecotoxicology and Environmental Safety **54**:47-55.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ industrial effluent/ Kuwait/ miscellaneous/ Oeleven/ offshore/ PAH/ petroleum hydrocarbons/ salt water/ sediment/ total hydrocarbons
**Notes:** Twenty-one sites offshore from the Shuaiba industrial area of Kuwait were sampled for sediments. Petroleum hydrocarbons were extracted from the sediment and analyzed for aliphatic hydrocarbons, total petroleum hydrocarbons, and selected (16) polycyclic aromatic hydrocarbons. PAH results were compared to interim marine sediment quality guidelines (ISQG) and probable effect levels (PEL).

**Begg, G. S., J. B. Reid, M. L. Tasker, A. Webb**, 1997. Assessing the vulnerability of seabirds to oil pollution: sensitivity to spatial scale. Colonial Waterbirds **20**:339-352.
**Keywords:** bird/ effects/ Ireland/ oil/ Oone/ pollution/ population/ salt water/ spatial scale/ spill/ United Kingdom/ vulnerability
**Notes:** Addressess the vulnerability of seabirds to oil pollution from the aspect of spatial scale. Uses the technique of area vulnerability scores (AVS), as used in the United Kingdom and Ireland, to demonstrate the effects of changing the scale of the areas of concern.

**Bejarano, A. C., T. Chandler, L. He, T. L. Cary, J. L. Ferry**, 2006. Risk assessment of the National Institute of Standards and Technology petroleum crude oil standard water accommodated fraction: further application of a copepod-based, full life-cycle bioassay. Environmental Toxicology and Chemistry **25**:1953-1960.
**Keywords:** bioassay/ concentration/ copepod/ crude oil/ growth/ life cycle/ marine invertebrate/ model/ Ofour/ oil/ PAH/ petroleum/ population/ reproduction/ risk/ risk assessment/ salt water/ water
**Notes:** A NIST crude oil standard material was used in a full life-cycle bioassay (ASTM standard test) of a copepod. Copepods were exposed to several concentrations of the water-accommodated fraction (WAF) of the standard. Also, the effect of UV irradiation was determined and a stage-structured population growth model was created. The WAF was analyzed for 16 PAHs.

**Belisle, A. A., M. L. Gay, N. C. Coon**, 1981. Comparison of two extraction methods for the analysis of petroleum hydrocarbon residues in mallard duck eggs by GC and GC-MS. Chemosphere **10**:1197-1203.
**Keywords:** analysis/ concentration/ crude oil/ duck/ eggs/ female/ Louisiana/ Louisiana crude oil/ mallard/ methods/ oil/ Onine/ petroleum/ South Louisiana crude oil/ technical
**Notes:** A comparison of extraction methods for petroleum hydrocarbon analysis in mallard duck eggs. Eggs from female mallards fed a dietary concentration of 25,000 ppm South Louisiana crude oil were subjected to cleanup with or without saponification.

**Bello, O. O., J. A. Sonibare, S. R. A. Macaulay, A. O. Okelana, A. O. Durojaiye**, 2004. Incineration of hazardous wastes from the petroleum industry in Nigeria. International Journal of Environmental Pollution **22**:710-720.
**Keywords:** effluent/ hazardous waste/ incineration/ methods/ Nigeria/ Onine/ petroleum/ technical/ waste oil/ waste water
**Notes:** A discussion of the design considerations for a facility to incinerate a range of petroleum industry wastes. Other disposal methods and their limitations are briefly discussed.

**Ben-David, M., T. M. Williams, O. A. Ormseth**, 2000. Effects of oiling on exercise physiology and diving behavior of river otters: a captive study. Canadian Journal of Zoology **78**:1380-1390.
**Keywords:** behavior/ blood/ consumption/ crude oil/ diet/ effects/ evaluation/ feeding/ hemoglobin/ male/ mammal/ oil/ oiled/ Otwo/ oxygen/ physiology/ Prince William Sound/ Prudhoe Bay/ Prudhoe Bay crude oil/ river otter/ salt water
**Notes:** An evaluation of the effects of ingested Prudhoe Bay crude oil on the exercise physiology and behavior of river otters. Fifteen male river otters were captured from northwestern Prince William Sound and transferred to a holding facility for 2.5 mos of acclimation. Otters were divided into control (no oil), low-dose (50 ppm in diet), and high-dose (500 ppm in diet) groups; oil feeding lasted 100 da. Otters were then rehabilitated for 100 da, fitted with transmitters, and released. Blood samples were drawn before oil exposure, every 3 wks during exposure, and once after exposure. Measured hemoglobin, oxygen consumption, and diving behavior.

**Ben-David, M., L. K. Duffy, R. T. Bowyer**, 2001. Biomarker responses in river otters experimentally exposed to oil contamination. Journal of Wildlife Diseases **37**:489-508.
**Keywords:** biochemical/ biomarker/ blood/ crude oil/ fresh water/ mammal/ oil/ Otwo/ PAH/ physiology/ Prudhoe Bay/ Prudhoe Bay crude oil/ rehabilitation/ river otter/ salt water/ serum/ time/ toxicity/ weathered
**Notes:** Wild-caught river otters (15) were administered artificially-weathered Prudhoe Bay crude oil in amounts of 0, 5, or 50 ppm/day/kg body mass for a period of 100 da followed by a 100-da rehabilitation period. Two different batches of crude oil were used during the study. Blood was collected from the otters before oil exposure, at 3-wk intervals during exposure, and three times during the rehabilitation period. Each batch of crude oil was analyzed for 43 PAHs. Blood cellular characteristics were determined and blood serum was analyzed for a suite of biochemical characteristics.

**Ben-David, M., G. M. Blundell, J. E. Blake**, 2002. Post-release survival of river otters: effects of exposure to crude oil and captivity. Journal of Wildlife Management **66**:1208-1223.
**Keywords:** Alaska/ blood/ capture/ carcass/ concentration/ crude oil/ diet/ effects/ experiment/ hemoglobin/ male/ mammal/ monitoring/ necropsy/ oil/ Otwo/ Prince William Sound/ Prudhoe Bay crude oil/ rate/ recovery/ rehabilitation/ release/ river otter/ salt water/ skin/ survival/ time/ weathered
**Notes:** River otters were captured in Prince William Sound 1996-98. Of 111 otters captured, 55 were implanted with radio-transmitters and released at the site. Morphometric data, a premolar tooth, skin sample, and blood were collected from all animals. In 1998, 15 males were selected for an oil exposure experiment. After 2.5 mos in captivity, five otters were given either 0, 50, or 500 ppm weathered Prudhoe Bay crude oil in the diet. Oil exposure lasted 100 da followed by a recovery period of 4.5 mos. Blood and skin were collected every 3 wks. Prior to release near their capture site, radio-transmitters were implanted. Radio-marked otters were monitored for $\geq$ 422 da. Carcasses of dead animals were retrieved and necropsied. Paper presents survival rates for all otters, percent body fat and hemoglobin concentrations of the experimental otters, and results of the necropsies of deceased otters. Other results are presented in different publications.

**Bence, A. E., K. A. Kvenvolden, M. C. Kennicutt, II**, 1996. Organic geochemistry applied to environmental assessments of Prince William Sound, Alaska, after the *Exxon Valdez* oil spill -- a review. Organic Geochemistry **24**:7-42.
**Keywords:** Alaska/ crude oil/ degradation/ Exxon Valdez/ fingerprinting/ miscellaneous/ Oeleven/ oil/ oil spill/ petroleum/ Prince William Sound/ rate/ review/ salt water/ sediment/ sources/ spill/ time
**Notes:** A large review paper detailing various aspects of the organic geochemistry of Prince William Sound, Alaska and relating it to the Exxon Valdez oil spill of 1989. Sections on the 1989 Exxon Valdez oil spill, chemical fingerprinting of petroleum after the spill, rates of oil removal and degradation, and quantification of hydrocarbon sources in the sediments.

**Bender, M. E., E. A. Shearls, L. Murray, R. J. Huggett**, 1980. Ecological effects of experimental oil spills in eastern coastal plain estuaries. Environment International **3**:121-133.
**Keywords:** benthic/ bivalve/ Chesapeake/ concentration/ crude oil/ effects/ estuarine/ estuary/ feeding/ fish/ gastropod/ general effect/ habitat/ invertebrate/ Louisiana/ Louisiana crude oil/ marine invertebrate/ marine plant/ Oeight/ oil/ oil spill/ phytoplankton/ plant/ productivity/ salt water/ South Louisiana crude oil/ spill/ time/ water column/ weathered/ wetland

**Notes:** Five structurally identical enclosures in a natural estuarine marsh-creek habitat feeding into the York River, Chesapeake Bay were used in a study of the effects of an experimental oil spill. Fresh South Louisiana crude oil was applied to two enclosures, weathered crude oil to two others, and no oil to the fifth enclosure. Environmental effects were monitored for 36 mos. Measured water quality characteristics, primary productivity, phytoplankton concentration, wetland plants, benthic, epibenthic, and water column invertebrates, and fish.

**Benka-coker, M. O., J. A. Ekundayo**, 1995. Effects of an oil spill on soil physico-chemical properties of a spill site in the Niger Delta area of Nigeria. Environmental Monitoring and Assessment **36**:93-104.
**Keywords:** carbon/ chemical characteristics/ crude oil/ depth/ effects/ hydrocarbons/ metals/ miscellaneous/ Nigeria/ nutrients/ Oeleven/ oil/ oil spill/ organic/ organic carbon/ petroleum/ petroleum hydrocarbons/ pipeline/ pollution/ soil/ spill/ time
**Notes:** A pipeline rupture contaminated farmland and aquatic areas. In a post-spill (no time given) assessment, soil samples were collected up to 17 m depth from areas with heavy, moderate, and no pollution. Physical and chemical characteristics of the soil were determined, as well as organic carbon, total petroleum hydrocarbons, selected metals, and P and N nutrients.

**Benka-coker, M. O., J. A. Ekundayo**, 1997. Applicability of evaluating the ability of microbes isolated from an oil spill site to degrade oil. Environmental Monitoring and Assessment **45**:259-272.
**Keywords:** crude oil/ degradation/ hydrocarbons/ microbes/ Nigeria/ oil/ oil spill/ Oten/ salt water/ soil/ spill
**Notes:** Assessment of the hydrocarbon degredation potential of several taxa of microbes isolated from soil and water at an oil spill site in the Niger Delta of Nigeria.

**Bennett, A., T. S. Bianchi, J. C. Means, K. R. Carman**, 1999. The effects of polycyclic aromatic hydrocarbon contamination and grazing on the abundance and composition of microphytobenthos in salt marsh sediments (Pass Fourchon, LA) I. A microcosm experiment. Journal of Experimental Marine Biology and Ecology **242**:1-20.
**Keywords:** abundance/ aromatic hydrocarbons/ carbon/ chlorophyll/ composition/ concentration/ effects/ experiment/ grazing/ hydrocarbons/ Louisiana/ marine invertebrate/ marine plant/ microcosm/ nitrogen/ organic/ organic carbon/ Osix/ PAH/ periwinkle/ salt marsh/ salt water/ sampling/ sediment/ snail/ time/ weight
**Notes:** An assessment of the effects of sediment PAHs on the composition and abundance of microphytobenthos and related epibenthic grazing by the periwinkle in a south Louisiana salt marsh. A laboratory microcosm experiment employing high and low PAH contamination; no snails, low-exposure snails, high-exposure snails; and nine sampling times (days 0, 4, 12, 20, 28, 36, 44, 52, 60) was conducted. Sediments were sampled on days 0, 28, and 60. Sediments were analyzed for selected aromatic hydrocarbons, organic carbon, and nitrogen. Snails were analyzed for selected aromatic hydrocarbons and monitored for weight change. Surface sediment and snail digestive tracts were analyzed for chlorophyll-*a*, phaeophytin-*a*, phaeophorbide, fucoxanthin, and zeaxanthin concentrations. [Authors use the undefined terms "unexposed" and "exposed" snails in six of nine figures; they probably mean low-exposure and high-exposure].

**Benville, P. E., Jr., S. Korn**, 1977. The acute toxicity of six monocyclic aromatic crude oil components to striped bass (*Morone saxatilis*) and bay shrimp (*Crago franciscorum*). California Fish and Game **63**:204-209.
**Keywords:** acute/ aromatic hydrocarbons/ crude oil/ fish/ marine invertebrate/ monoaromatic/ oil/ Othree/ salt water/ shrimp/ striped bass/ toxicity
**Notes:** Determination of acute toxicities of six monocyclic aromatics to striped bass and bay shrimp.

**Berdugo, V., R. P. Harris, S. C. O'Hara**, 1977. The effect of petroleum hydrocarbons on reproduction of an estuarine planktonic copepod in laboratory cultures. Marine Pollution Bulletin **8**:138-143.
**Keywords:** acute/ aromatic hydrocarbons/ chronic/ copepod/ estuarine/ feeding/ heating oil/ hydrocarbons/ marine invertebrate/ Ofour/ oil/ petroleum/ petroleum hydrocarbons/ rate/ reproduction/ salt water/ survival
**Notes:** Exposure of an estuarine copepod to the water-soluble fraction (1 ppm) of an 'aromatic heating oil'

for 0.25 to 72 hrs in acute exposures and then to 10 or 50 ppb for 10 da in a longer-term exposure. Measured survival, feeding rate, reproduction, and life span.

**Berge, J. A.**, 1990. Macrofauna recolonization of subtidal sediments. Experimental studies on defaunated sediment contaminated with crude oil in two Norwegian fjords with unequal eutrophication status. I. Community responses. Marine Ecology Progress Series **66**:103-115.
**Keywords:** benthic/ biomass/ colonization/ community/ crude oil/ diversity/ eutrophication/ macrofauna/ marine invertebrate/ North Sea/ North Sea crude oil/ Ofour/ oil/ oiled/ salt water/ sediment/ species/ subtidal
**Notes:** Placed boxes of defaunated, oiled or unoiled, sediment on the seafloor of a eutrophicated and a non-eutrophicated fjord. North Sea crude oil was used to contaminate the sediment. Measure colonization response by benthic macrofauna (no. of species, individuals, eveness, diversity, biomass).

**Bergman, R. D., R. L. Howard, K. F. Abraham, M. W. Weller**, 1977. Water birds and their wetland resources in relation to oil development at Storkersen Point, Alaska. Volume 129. U.S. Fish & Wildlife Service, Washington, DC.
**Keywords:** Alaska/bird/development/fresh water/habitat/North Slope/oil/oil field/Oone/wetland
**Notes:** Assessment of breeding birds and their habitat needs prior to oil development on the North Slope of Alaska.

**Berman, M. S., D. R. Heinle**, 1980. Modification of the feeding behavior of marine copepods by sub-lethal concentrations of water-accomodated fuel oil. Marine Biology **56**:59-64.
**Keywords:** behavior/ concentration/ copepod/ feeding/ fuel oil/ marine invertebrate/ No.2 fuel oil/ Ofour/ oil/ salt water/ species/ sublethal
**Notes:** Exposed two species of marine copepods to low concentrations (70-250 ppb) of water-accomodated No. 2 fuel oil for 18 h. Measured feeding behavior.

**Bernabeu, A. M., M. Nuez de la Fuente, D. Rey, B. Rubio, F. Vilas, R. Medina, M. E. Gonzalez**, 2006. Beach morphodynamics forcements in oiled shorelines: Coupled physical and chemical processes during and after fuel burial. Marine Pollution Bulletin **52**:1156-1168.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ beach/ Bunker C/ fuel oil/ hydrocarbons/ intertidal/ miscellaneous/ model/ Oeleven/ oil/ oil spill/ oiled/ PAH/ salt water/ sediment/ shoreline/ spill/ time/ weathered
**Notes:** Two sections of beach affected by the Prestige oil spill were core sampled 14 mos after the spill (Bunker C fuel oil). A total of 20 cores were collected at low, mid, and high intertidal locations. Each core was sampled at 10-cm increments. Sediments were characterized, fuel oil presence was physically characterized, and sediments were analyzed for aliphatic hydrocarbons and PAH. Results were used to develop a conceptual model of the oil burial and weathering process at these sites.

**Bernard, D., J.-J. Jeremie, H. Pascaline**, 1995. First assessment of hydrocarbon pollution in a mangrove estuary. Marine Pollution Bulletin **30**:146-150.
**Keywords:** aliphatic hydrocarbons/ chemical characteristics/ estuary/ Guadeloupe/ hydrocarbons/ mangrove/ miscellaneous/ Oeleven/ pollution/ river/ salt water
**Notes:** Water samples were collected from a river and estuary area of Guadeloupe in two consecutive months. Samples were analyzed for aquatic chemical characteristics and aliphatic hydrocarbons.

**Bernard, D., H. Pascaline, J.-J. Jeremie**, 1996. Distribution and origin of hydrocarbons in sediments from lagoons with fringing mangrove communities. Marine Pollution Bulletin **32**:734-739.
**Keywords:** aromatic hydrocarbons/ Caribbean/ community/ concentration/ discharges/ distribution/ hydrocarbons/ mangrove/ miscellaneous/ Oeleven/ origin/ salt water/ saturated hydrocarbons/ sediment/ urban
**Notes:** Assessment of aromatic and non-aromatic hydrocarbons in the sediments of two lagoons on the Caribbean island of Guadeloupe; one lagoon receives river drainage from an agricultural area and the other receives discharges and runoff from industry, urban areas, and shipping.

**Berne, S., M. Marchand, L. D'Ozouville**, 1980. Pollution of sea water and marine sediments in coastal areas. Ambio **9**:287-293.
**Keywords:** Amoco Cadiz/ coast/ concentration/ crude oil/ evaluation/ France/ hydrocarbons/ miscellaneous/ movement/ Oeleven/ oil/ petroleum/ petroleum hydrocarbons/ pollution/ salt water/ sediment/ spill/ time
**Notes:** An early evaluation of the movement of crude oil from the Amoco Cadiz wreck to the coastline of Brittany. A total of 278 water samples and numerous sediment samples were collected during the first year after the spill. Samples were analyzed for total petroleum hydrocarbons.

**Berner, N. H., D. G. Ahearn**, 1977. Observations on the growth and survival of *Cladosporium resinae* in jet fuel. Developments in Industrial Microbiology **62**:705-710.
**Keywords:** aviation kerosine/ biocide/ degradation/ development/ fungi/ growth/ jet fuel/ microbes/ Oten/ survival
**Notes:** A study of the presence and suppression of a common fungi found in aviation fuel tanks. Samples of fuel were taken from jet aircraft and cultured in jet fuel with or without water added, and in the presence or absence of a boron-based biocide or a deicing compound.

**Berry, W. O., J. D. Brammer**, 1977. Toxicity of water-soluble gasoline fractions to fourth-instar larvae of the mosquito *Aedes aegypti* L. Environmental Pollution **13**:229-234.
**Keywords:** benzene/ bioassay/ evaluation/ fresh water/ freshwater invertebrate/ gasoline/ larvae/ lethal/ mosquito/ Ofive/ static/ survival/ toluene/ toxicity/ xylene
**Notes:** Evaluation of the toxicity of gasoline and its major water-soluble constituents (benzene, toluene, xylene) to fourth-instar mosquito larvae. Exposures were in a static 24-hr bioassay. Calculated the $LD_{50}$ and maximum non lethal dose (NLD).

**Berry, W. O., J. D. Brammer, D. E. Bee**, 1978. Uptake of water-soluble gasoline fractions and their effect on oxygen consumption in aquatic stages of the mosquito (*Aedes aegypti* (L.)). Environmental Pollution **15**:1-22.
**Keywords:** benzene/ bioassay/ concentration/ consumption/ experiment/ food/ fresh water/ freshwater invertebrate/ gasoline/ larvae/ mosquito/ Ofive/ oxygen/ pupae/ respiration/ static/ toluene/ uptake/ xylene
**Notes:** Multiple experiments evaluating the effect of water-soluble fractions of gasoline or of specific concentrations of benzene, xylene, or toluene on oxygen consumption in aquatic stages of the mosquito. Third and fourth instar and pupae stages of mosquito were exposed to varying concentrations of toxicant for 24 hr in a static bioassay, followed by measurement of oxygen consumption. Mosquito larvae were either provided with food or not fed and either exposed to toxicant or not exposed. Toluene uptake in food was also measured.

**Bhattacharyya, S., P. L. Klerks, J. A. Nyman**, 2003. Toxicity to freshwater organisms from oils and oil spill chemical treatments in laboratory microcosms. Environmental Pollution **122**:205-215.
**Keywords:** amphipod/ benthic/ bioassay/ Corexit 9500/ Corexit 9580/ crude oil/ diesel/ diesel fuel/ dispersant/ effects/ fish/ fresh water/ freshwater invertebrate/ invertebrate/ Louisiana/ Louisiana crude oil/ microcosm/ ODfive/ oil/ oil spill/ oligochaete/ petroleum/ soil/ South Louisiana crude oil/ spill/ toxicity/ water column/ weathered/ wetland
**Notes:** Soils from two freshwater wetlands in Louisiana were use to established microcosms used to test the effects of petroleum on invertebrates and fish. Soil microcosms were treated with either of several test substances: control, Corexit 9580, Corexit 9500, South Louisiana crude oil, crude oil plus Corexit 9580, crude oil plus Corexit 9500, diesel fuel, diesel plus Corexit 9580, and diesel plus Corexit 9500. The crude oil and diesel was 'weathered' before use. After 1, 7, 31, or 186 days, the soils were used in bioassays with fish (4 da), a water column invertebrate (2 da), and a benthic invertebrate (4 da). A second study compared the toxic response (4 da) of the primary benthic invertebrate (chironomid) to an amphipod and an oligochaete after day 7 of soil treatment.

**Bhosle, N. B., A. Row**, 1983. Effect of dispersants on the growth of indigenous bacterial population & biodegradation of crude oil. Indian Journal of Marine Science **12**:194-196.
**Keywords:** Arabian crude oil/ bacteria/ biodegradation/ combination/ crude oil/ dispersant/ growth/ marine invertebrate/ numbers/ ODfour/ oil/ population/ salt water/ Saudi Arabian crude oil

**Notes:** Seven oil dispersants, alone or in combination with Saudi Arabian crude oil, were evaluated for their effect on the growth of indigenous bacteria. Measured bacteria numbers and the loss of dispersant and oil from experimental flasks [interpretation of results with regard to biodegradation of crude oil are unclear].

**Bhupathiraju, V. K., P. Krauter, H.-Y. N. Holman, M. E. Conrad, P. F. Daley, A. S. Templeton, J. R. Hunt, M. Hernandez, L. Alvarez-Cohen** , 2002. Assessment of in-situ bioremediation at a refinery waste-contaminated site and an aviation gasoline contaminated site. Biodegradation **13**:79-90.
**Keywords:** aviation gasoline/ bacteria/ bioremediation/ degradation/ density/ hydrocarbons/ microbes/ microcosm/ Oten/ petroleum/ petroleum hydrocarbons/ refinery/ soil
**Notes:** Two sites on Almeda Island in San Francisco Bay were sampled with soil cores. One site was an old petroleum refinery (1879-1903), the other was an abandoned fuel storage area that leaked aviation gasoline during the 1960s and 1970s. Authors determined groundwater geochemical and soil gas characteristics, and density of total and active bacteria. Laboratory microcosms were employed to measure the ability of indiginous microbes to metabolize radio-labeled hydrocarbons.

**Bibby, C. J.**, 1981. An experiment on the recovery of dead birds from the North Sea. Ornis Scandinavica **12**:261-265.
**Keywords:** bird/ drift/ experiment/ North Sea/ Oone/ recovery/ salt water
**Notes:** Results of a dead bird recovery experiment in the North Sea.

**Bicego, M. C., R. R. Weber, R. G. Ito**, 1996. Aromatic hydrocarbons on surface waters of Admiralty Bay, King George Island, Antarctica. Marine Pollution Bulletin **32**:549-553.
**Keywords:** Antarctica/ aromatic hydrocarbons/ depth/ hydrocarbons/ miscellaneous/ Oeleven/ PAH/ salt water/ time
**Notes:** Water samples at 1 m depth were collected from 24 sites in Admiralty Bay, King George Island, Antarctica during the summers of 1989, 1990, 1992, and 1993. Measured total aromatic hydrocarbons in all samples and quantified 11 individual PAHs in one water sample.

**Bicego, M. C., E. Zanardi-Lamardo, S. Taniguchi, R. R. Weber**, 2002. Natural levels of dissolved/dispersed petroleum hydrocarbons in the South West Atlantic. Marine Pollution Bulletin **44**:1152-1169.
**Keywords:** Argentina/ aromatic hydrocarbons/ Atlantic/ Brazil/ coast/ depth/ hydrocarbons/ miscellaneous/ Oeleven/ petroleum/ petroleum hydrocarbons/ salt water
**Notes:** Water samples at 1 m depth were collected off the coast of Argentina in 1995-96 and 1996-97, and off the coast of Brazil in 1997. Samples were analyzed for aromatic hydrocarbons. Purpose was to establish baselines for southwest Atlantic waters.

**Bickham, J. W., J. A. Mazet, J. Blake, M. J. Smolen, Y. Lou, E. Ballachey**, 1998. Flow cytometric determination of genotoxic effects of exposure to petroleum in mink and sea otters. Ecotoxicology **7**:191-199.
**Keywords:** blood/ Bunker C/ crude oil/ diet/ DNA/ effects/ experiment/ female/ fresh water/ fuel oil/ genotoxic/ kidney/ liver/ mammal/ mink/ oil/ oil spill/ Otwo/ petroleum/ Prince William Sound/ Prudhoe Bay/ Prudhoe Bay crude oil/ salt water/ sea otter/ size/ spill/ spleen/ tissue/ weathered
**Notes:** Flow cytometric assessment of the effects of petroleum exposure in mink and sea otters. In one experiment, female mink were fed weathered Prudhoe Bay crude oil in the diet for 3 wks prior to mating, during pregnancy, and through weaning. Kits were exposed through lactation and by diet until 4 mo old. Kidney and liver tissue examined. In the second experiment, female mink were exposed either by diet or externally to crude oil or bunker C fuel oil. Spleen and kidney tissue examined. Also, blood was collected from sea otters from the eastern and western portions of Prince William Sound 1.5 yrs after the oil spill. Measured genome size (DNA) and coefficient of variation of the $G_1$ peak.

**Bidleman, T. F., A. A. Castleberry, W. T. Foreman, M. T. Zaranski, D. W. Wall**, 1990. Petroleum hydrocarbons in the surface water of two estuaries in the southeastern United States. Estuarine, Coastal and Shelf Science **30**:91-109.
**Keywords:** aromatic hydrocarbons/ estuary/ hydrocarbons/ miscellaneous/ Oeleven/ PAH/ petroleum/

petroleum hydrocarbons/ salt water/ total hydrocarbons
**Notes:** Water samples from 20-50 cm below the surface were collected from Winyah Bay, SC (94 samples) and Charleston Harbor, SC (37 samples). Analyzed for total aromatic hydrocarbons and total hydrocarbons in all samples, and 12 individual PAHs in four samples from Winyah Bay.

**Bidwell, J. R., D. S. Cherry, A. T. Merski**, 2003. Toxicity evaluation of a commercial bioremediation agent mixed with crude oil. Environmental Toxicology and Chemistry **22**:84-91.
**Keywords:** alkane/ aromatic hydrocarbons/ assay/ bacteria/ bioremediation/ concentration/ crude oil/ degradation/ evaluation/ fish/ growth/ microbes/ North Slope/ North Slope crude oil/ nutrients/ oil/ Othree/ petroleum/ salt water/ survival/ time/ toxicity/ weathered
**Notes:** Assessment of the toxicity of a commercial bioremediation agent to the inland silverside minnow. The water-soluble fraction of weathered North Slope crude oil was combined with multiple concentrations of the CBA or nutrients alone, and CBA alone in sea water in assays of 96 hr and 7 da. Also conducted a 42 da petroleum degradation study. Measured survival and growth of the minnows, concentrations of bacteria, and concentrations of alkane and aromatic analytes.

**Bieger, T., J. Hellou, T. A. Abrajano, Jr.**, 1996. Petroleum biomarkers as tracers of lubricating oil contamination. Marine Pollution Bulletin **32**:270-274.
**Keywords:** analysis/ biomarker/ fingerprinting/ hydrocarbons/ indicator/ lubricating oil/ Newfoundland/ oil/ Onine/ petroleum/ plankton/ saturated hydrocarbons/ sediment/ technical/ terpane/ urban
**Notes:** Samples of fresh and used automotive and outboard engine lubricating oil, auto muffler soot, urban roadsweepings, St. John's (Newfoundland) harbor sediment, rural harbor sediment, urban pond sediment, and Conception Bay plankton and sediment were collected for analysis of saturated hydrocarbons. Emphasis was on the analysis and use of tricyclic and pentacyclic terpanes as tracer compounds for identifying the source of petroleum contamination and as indicators of the degree of weathering that has occurred.

**Bigford, T. E.**, 1977. Effects of oil on behavioral responses to light, pressure and gravity in larvae of the rock crab *Cancer irroratus*. Marine Biology **43**:137-148.
**Keywords:** behavior/ concentration/ condition/ crab/ development/ effects/ fuel oil/ larvae/ light/ marine invertebrate/ No.2 fuel oil/ Ofour/ oil/ pressure/ salt water/ static/ water column
**Notes:** Larvae of the rock crab at six stages of development were exposed to three concentrations of the water-accomodated fraction of No. 2 fuel oil under static conditions. Also included various conditions of light, pressure, and gravity. Water column behaviors of the larvae were measured.

**Birkhead, T. R., C. Lloyd, P. Corkhill**, 1973. Oiled seabirds successfully cleaning their plumage. British Birds **66**:535-537.
**Keywords:** bird/ cleaning/ oiled/ Oone/ plumage/ reproduction/ salt water
**Notes:** Report of the successful cleaning of oiled plumage and subsequent successful breeding.

**Bitton, G., D. A. Chuckran, I. Chet, R. Mitchell**, 1979. Resistance of bacterial chemotaxis to blockage in petroleum waters. Marine Pollution Bulletin **10**:48-49.
**Keywords:** bacteria/ chemotaxis/ concentration/ fresh water/ kerosene/ microbes/ Oten/ petroleum/ salt water
**Notes:** Exposure of marine bacteria to various concentrations of kerosene in water. Comparison of chemotaxis of kerosene-degrading bacteria with that of bacteria not capable of decomposing kerosene. Used both sea water and fresh water.

**Blackman, R. A. A., F. L. Franklin, M. G. Norton, K. W. Wilson**, 1978. New procedures for the toxicity testing of oil slick dispersants in the United Kingdom. Marine Pollution Bulletin **9**:234-238.
**Keywords:** beach/ dispersant/ ODnine/ oil/ oil slick/ oil spill/ procedure/ salt water/ spill response/ technical/ toxicity/ United Kingdom
**Notes:** A description of two new (vintage 1978) toxicity tests (a sea test and a beach test) developed for toxicity testing of chemical dispersants. Tests were required before the product could be licensed for use in the United Kingdom.

**Blackman, R. A. A., R. J. Law**, 1980. The *Eleni V* oil spill: fate and effects of the oil over the first twelve months. Part I. Oil in waters and sediments. Marine Pollution Bulletin **11**:199-204.
**Keywords:** aliphatic hydrocarbons/ beach/ cleaning/ dispersant/ effects/ evaluation/ fate/ fuel oil/ hydrocarbons/ miscellaneous/ ODeleven/ offshore/ oil/ oil spill/ salt water/ sediment/ spill/ time
**Notes:** An evaluation of this spill of heavy fuel oil during the first year after the event. An area of aggressive beach cleaning and an area of no cleaning are contrasted. Sampled subsurface water (including during offshore dispersant application) and offshore sediments. Analyzed aliphatic hydrocarbons in samples and converted to fuel oil equivalents.

**Blackman, R. A. A., R. J. Law**, 1980. The *Eleni V* oil spill: fate and effects of the oil over the first twelve months. Marine Pollution Bulletin **11**:217-220.
**Keywords:** biological effects/ coast/ concentration/ depuration/ effects/ England/ fate/ fish/ fuel oil/ general effect/ hydrocarbons/ intertidal/ marine invertebrate/ marine plant/ mussel/ Oeight/ oil/ oil spill/ oiled/ population/ salt water/ saturated hydrocarbons/ shrimp/ spill/ survey/ time/ tissue/ winkle
**Notes:** A presentation of the results of several surveys and studies performed to assess the biological effects of the *Eleni V* oil spill (fuel oil?) off the coast of England. Commercial fish populations were monitored and flesh tainting was evaluated. Generalized description of the response to oiling of intertidal organisms; mussels, ragworms, and winkles were collected and analyzed for hydrocarbon concentrations ("fuel oil equivalents"). Mussels were collected six times between 163 and 363 da after the spill. Depuration of hydrocarbons by mussels was determined in laboratory tanks during a 139 da period . GC tracings are presented of saturated hydrocarbons from surface oil, and winkle and ragworm tissue. Brown shrimp were exposed for 6 wks to water containing water extracts of the spilled fuel oil.

**Blackman, R. A. A., R. J. Law**, 1981. The *Eleni V* oil spill: return to normal conditions. Marine Pollution Bulletin **12**:126-130.
**Keywords:** biological effects/ coast/ concentration/ condition/ effects/ England/ fuel oil/ general effect/ hydrocarbons/ marine invertebrate/ marine plant/ mussel/ Oeight/ oil/ oil spill/ salt water/ sampling/ saturated hydrocarbons/ sediment/ spill/ time/ tissue/ weathered/ winkle
**Notes:** A continuation of the post-spill assessment of biological effects of the *Eleni V* oil spill off the coast of England. A second year of sampling was performed similar to that described in Blackman and Law (1980). Hydrocarbon concentrations ("fuel oil equivalents") are shown for mussels, ragworms, winkles, and their ambient water during the 2-yr period. Hydrocarbon concentrations are also shown for subsurface sediments and subsurface water during the 2-yr period. Presents several GC tracings of saturated hydrocarbons in water, sediment, tissue, and weathered oil.

**Blackwell, B. F., T. W. Seamans, D. A. Helon, R. A. Dolbeer**, 2000. Early loss of herring gull clutches after egg-oiling. Wildlife Society Bulletin **28**:70-75.
**Keywords:** animal control/ bird/ colony/ corn/ corn oil/ eggs/ fresh water/ gull/ hatching/ herring/ herring gull/ incubation/ oil/ oiled/ Oone
**Notes:** Herring gull eggs in a colony in Sandusky Bay, Lake Erie were treated with corn oil either between days 7-15 or days 21-27 of incubation. Recorded clutches hatching, clutches incubated beyond hatching date, and clutches lost to abandonment or other causes prior to the hatching date.

**Blaise, C., F. Gagne, N. Chevre, M. Harwood, K. Lee, J. Lappalainen, B. Chial, G. Persoone, K. Doe**, 2004. Toxicity assessment of oil-contaminated freshwater sediments. Environmental Toxicology **19**:267-273.
**Keywords:** algae/ ammonia/ ammonium/ assay/ Biotox Flash/ Canada/ crude oil/ fresh water/ freshwater invertebrate/ freshwater plant/ general effect/ microbes/ Microtox/ nitrate/ nutrients/ Oeight/ oil/ oil spill/ phosphate/ remediation/ river/ sediment/ species/ spill/ time/ toxicity/ vegetation/ wetland
**Notes:** A freshwater wetland along the St. Lawrence (Canada) River was used in an oil spill remediation study. Crude oil was applied in June to wetland plots as oil only, oil plus ammonium nitrate and phosphate with vegetation cut back, oil plus ammonium nitrate and phosphate, oil plus sodium nitrate and phosphate, and no oil plus ammonium nitrate and phosphate. Nutrients were reapplied during July-October. Sediment samples were collected 11 times during the 65 wk study. Measured microbe toxicity with the Microtox and Biotox Flash assays, microalgal (one species) toxicity, and microinvertebrate (two species) toxicity.

**Blake, B. F.**, 1983. A comparative study of the diet of auks killed during an oil incident in the Skagerrak in January 1981. Journal of Zoology (London) **201**:12.
**Keywords:** auks/ bird/ Denmark/ diet/ oil/ oil spill/ oiled/ Oone/ salt water/ spill
**Notes:** Diets of seabirds killed in an oil spill in the Skagerrak, north of Denmark, and their relation to the amount of oiling.

**Blankenship, D. W., R. A. Larson**, 1978. Plant growth inhibition by the water extract of a crude oil. Water Air and Soil Pollution **10**:471-476.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ concentration/ crude oil/ effects/ fresh water/ freshwater plant/ germination/ growth/ harvest/ leaves/ Nigerian crude oil/ oil/ Oseven/ phenol/ photosynthesis/ plant/ respiration/ seed/ size/ toxicity/ weight
**Notes:** The water-soluble fraction of Nigerian crude oil was used to germinate radish seeds and water the resultant radish plant in an assessment of the effects on seed germination and plant growth. Measured seed germination, leaf size, taproot weight, harvest weight, onset of flowering, respiration, and photosynthesis. Also, measured the approximate concentrations of aliphatic, aromatic, and phenolic compounds in the water-soluble fraction.

**Blaylock, W. M. and J. P. Houghton** 1989. Infaunal recovery at Ediz Hook following the *Arco Anchorage* oil spill. Pages 421-426 *in* 1989 Oil Spill Conference (Prevention, Behavior, Control, Cleanup). American Petroleum Institute, Washington, D.C.
**Keywords:** behavior/ benthic/ crude oil/ infauna/ marine invertebrate/ Ofour/ oil/ oil spill/ recovery/ salt water/ sampling/ seasonal/ spill/ transect/ Washington
**Notes:** Assessment of the recovery of benthic infauna after a crude oil spill near Ediz Hook in Port Angeles, Washington. Five transects at four elevations, with respect to mean low tide, were sampled for benthic infauna during five sampling seasons over an 18 mo period.

**Blokpoel, H., R. M. G. Hamilton**, 1989. Effects of applying white mineral oil to chicken and gull eggs. Wildlife Society Bulletin **17**:435-441.
**Keywords:** bird/ chicken/ development/ effects/ eggs/ fresh water/ gull/ mineral oil/ oil/ Oone/ population/ population control
**Notes:** Development of an egg-oiling technique using mineral oil for controlling gull populations.

**Blot, W. J., L. A. Brinton, J. F. Fraument, Jr., B. J. Stone**, 1977. Cancer mortality in U.S. counties with petroleum industries. Science **198**:51-53.
**Keywords:** cancer/ humans/ miscellaneous/ Oeleven/ petroleum/ refinery/ survey
**Notes:** A survey of cancer incidence, in 22 cancer categories, in 39 counties classified as petroleum-industry counties and 117 counties not so classified. The two types of counties were matched as closely as possible with regard to demographic and economic categories.

**Blundo, R.**, 1978. The toxic effects of the water soluble fractions of No. 2 fuel oil and of three aromatic hydrocarbons on the behavior and survival of barnacle larvae. Contributions in Marine Science **21**:25-37.
**Keywords:** aromatic hydrocarbons/ barnacle/ behavior/ benzene/ concentration/ effects/ fuel oil/ hydrocarbons/ larvae/ marine invertebrate/ naphthalene/ No.2 fuel oil/ Ofour/ oil/ salt water/ solubility/ survival/ toluene/ water column/ weathered
**Notes:** Exposure of barnacle larvae to varying concentrations of the water-soluble fraction of No. 2 fuel oil, naphthalene, toluene, or benzene. Compared fresh stock solutions with slightly weathered solutions. Measured survival and water column behavior.

**Bobra, A. M., W. Y. Shiu, D. Mackay**, 1983. Acute toxicity of fresh and weathered crude oils to Daphnia magna. Chemosphere **12**:1137-1149.
**Keywords:** acute/ bioassay/ concentration/ crude oil/ daphnia/ fresh water/ freshwater invertebrate/ natural gas/ Ofive/ oil/ solubility/ static/ survival/ synthetic oil/ toxicity/ weathered
**Notes:** Comparison of the toxicity of water-soluble solutions of four crude oils, a natural gas condensate, and a synthetic oil mixture. Three of the crude oils and the natural gas condensate were also weathered before preparation of the solutions. Daphnia magna exposed in a static bioassay to varying concentrations of all substances. Measured survival and calculated aqueous solubilities of all test

substances and $LC_{50s}$. Authors also discuss the issue of substance 'toxicity' versus substance 'potency' and whether substance toxicity is equivalent to its solubility.

**Bobra, A. M., W. Y. Shiu, D. Mackay, R. H. Goodman**, 1989. Acute toxicity of dispersed fresh and weathered crude oil and dispersants to Daphnia Magna. Chemosphere **19**:1199-1222.
**Keywords:** acute/ assay/ bioassay/ composition/ crude oil/ daphnia/ dispersant/ dissolved/ fresh water/ freshwater invertebrate/ Norman Wells crude oil/ ODfive/ oil/ phenol/ solubility/ static/ survival/ temperature/ toxicity/ weathered
**Notes:** Assessment of the effect of a crude oil at three stages of weathering (fresh, 20% and 42% evaporated), five chemical dispersants, and a phenol reference. Crude oil tested as the maximum water soluble fraction at two temperatures, WSF from 40 ppm oil at two temperatures, and mechanically dispersed oil from 40 ppm oil at two temperatures. Dispersants tested at two temperatures. Oil-dispersant mixtures tested at two temperatures. All test containers rotated during the 48 hr assay period. Phenol tested in a static bioassay. Measured survival, analyzed the composition of the weathered crude oil, and estimated the relative contributions to lethality of dispersed oil, dissolved oil, and dispersant.

**Bocard, C., B. Durif-Varambon, C. Gatellier, Ph. Renault, P. Laboureur, and L. Person** 1977. New concept of oil dispersion in view of clean up by degradation. Pages 407-410 *in* 1977 Oil Spill Conference. American Petroleum Institute, Washington, DC.
**Keywords:** degradation/ detergent/ dispersant/ microbes/ ODnine/ oil/ oil spill/ petroleum/ spill/ technical
**Notes:** An early description of the desirability (from a degradation perspective) of the use of the new (vintage 1977) types of chemical dispersant formulations on petroleum spills. The author had to deal with the negative legacy of the disastrous efforts to disperse oil from the 1967 Torrey Canyon oil spill with commercial detergent formulations.

**Bocard, C., P. Renault, and J. Croquette** 1979. Cleaning products used in operations after the *Amoco Cadiz* disaster. Pages 163-167 *in* 1979 Oil Spill Conference, API 4308. American Petroleum Institute, Washington, DC.
**Keywords:** Amoco Cadiz/ Arabian Light crude oil/ cleaning/ coast/ crude oil/ evaluation/ methods/ miscellaneous/ ODeleven/ oil/ oil spill/ procedure/ spill
**Notes:** A report and evaluation of a variety of cleaning methods and cleaning chemicals used during the Amoco Cadiz oil spill. Covers products used at sea and products and procedures employed on the coast.

**Bode, H., R. Ernst, J. Arditti**, 1978. Biological effects of surfactants, III hydra as a highly sensitive assay animal. Environmental Pollution **17**:175-185.
**Keywords:** anionic/ assay/ biological effects/ concentration/ effects/ fresh water/ freshwater invertebrate/ hydra/ nonionic/ ODfive/ rate/ surfactant/ survival
**Notes:** Exposure of hydra to varying concentrations of homologous series of surfactants within three classes of surfactants (nonionic, amphoteric, anionic); measured budding rate and survival.

**Bodkin, J. L., B. E. Ballachey, T. A. Dean, A. K. Fukuyama, S. C. Jewett, L. McDonald, D. H. Monson, C. E. O'Clair, G. R. VanBlaricom**, 2002. Sea otter population status and the process of recovery from the 1989 'Exxon Valdez' oil spill. Marine Ecology Progress Series **241**:253.
**Keywords:** Alaska/ blood/ crude oil/ estimate/ evaluation/ Exxon Valdez/ mammal/ metabolism/ numbers/ oil/ oil spill/ oiled/ Otwo/ population/ Prince William Sound/ protein/ recovery/ region/ salt water/ sea otter/ shoreline/ spill/ survey/ time
**Notes:** An evaluation of sea otter population status and recovery in western Prince William Sound, Alaska. Aerial surveys (1993-2000) were used to estimate numbers of otters along shorelines that were oiled during the Exxon Valdez spill. A subarea within the oiled region was intensively studied 1995-2000 and compared with an unoiled shoreline area at the edge of the oiled region. Reproductive success was determined by small boat survey. Otters were also captured and tagged for population estimation. Blood samples were collected from caputured otters and analyzed for selected blood proteins.

**Boehm, P. D., J. G. Quinn**, 1977. The persistence of chronically accumulated hydrocarbons in the hard shell clam *Mercenaria mercenaria*. Marine Biology **44**:227-233.
**Keywords:** chronic/ clam/ concentration/ depuration/ hydrocarbons/ marine invertebrate/ Ofour/

persistence/ rate/ salt water/ shell
**Notes:** Assessment of the depuration rate for hard shell clams from the chronically polluted Providence River, RI; measured total hydrocarbon concentration at intervals during a 120 da depuration period.

**Boehm, P. D., J. E. Barak, D. L. Fiest, A. A. Elskus**, 1982. A chemical investigation of the transport and fate of petroleum hydrocarbons in littoral and benthic environments: the Tsesis oil spill. Marine Environmental Research **6**:157-188.
**Keywords:** aromatic hydrocarbons/ benthic/ bivalve/ environment/ fate/ fuel oil/ general effect/ hydrocarbons/ littoral/ marine invertebrate/ monitoring/ No.5 fuel oil/ Oeight/ oil/ oil spill/ petroleum/ petroleum hydrocarbons/ salt water/ saturated hydrocarbons/ sediment/ species/ spill/ time/ tissue/ transport/ Tsesis
**Notes:** The fate and transport of a spill of No. 5 fuel oil in the Baltic Sea was determined in a 1 year monitoring study. Surface sediments, sediment traps, and two bivalve species were collected from 3-9 locations. Saturated and aromatic hydrocarbons were analyzed in sediment and tissue. Numerous GC tracings are shown.

**Boehm, P. D., P. J. Mankiewicz, R. Hartung, J. M. Neff, D. S. Page, E. S. Gilfillan, E. O'Reilly, K. R. Parker**, 1996. Characterization of mussel beds with residual oil and the risk to foraging wildlife 4 years after the *Exxon Valdez* oil spill. Environmental Toxicology and Chemistry **15**:1289-1303.
**Keywords:** Alaska/ analysis/ aromatic hydrocarbons/ bird/ crude oil/ estimate/ Exxon Valdez/ foraging/ hazard/ mammal/ marine invertebrate/ mussel/ oil/ oil spill/ oiled/ Oone/ PAH/ Prince William Sound/ residual oil/ risk/ risk assessment/ salt water/ sea otter/ sediment/ spill
**Notes:** Risk assessment of mussels in Prince William Sound 4 years after the Exxon Valdez oil spill. Mussel beds in upper, middle, and lower tidal zones of 64 randomly selected sites in oiled and reference sites were sampled for PAH analysis. Mussel beds were also characterized to compare with similar information collected in 1990. Findings were compared with 1990 results to estimate the hazard to birds and sea otters from consuming oiled mussels.

**Boehm, P. D., G. S. Douglas, W. A. Burns, P. J. Mankiewicz, D. S. Page, A. E. Bence**, 1997. Application of petroleum hydrocarbon chemical fingerprinting and allocation techniques after the *Exxon Valdez* oil spill. Marine Pollution Bulletin **34**:599-613.
**Keywords:** development/ Exxon Valdez/ fingerprinting/ hydrocarbons/ interpretation/ methods/ mixing/ model/ oil/ oil spill/ Onine/ petroleum/ petroleum hydrocarbons/ review/ salt water/ spill/ technical
**Notes:** Review and assessment of the status of petroleum hydrocarbon fingerprinting methods. Authors present a historical summary, fingerprinting during the Exxon Valdez oil spill, advances in analytical techniques and data interpretation, development of a mixing model algorithm, development of a fingerprinting strategy for oil spills, and current research in fingerprinting of petroleum.

**Boehm, P. D., D. S. Page, E. S. Gilfillan, A. E. Bence, W. A. Burns, P. J. Mankiewicz**, 1998. Study of the fates and effects of the *Exxon Valdez* oil spill on benthic sediments in two bays in Prince William Sound, Alaska. 1. Study design, chemistry, and source fingerprinting. Environmental Science and Technology **32**:567-576.
**Keywords:** Alaska/ aromatic hydrocarbons/ benthic/ crude oil/ depth/ effects/ Exxon Valdez/ fate/ fingerprinting/ miscellaneous/ North Slope/ North Slope crude oil/ Oeleven/ oil/ oil seep/ oil spill/ PAH/ Prince William Sound/ pyrogenic/ salt water/ sediment/ spill/ subtidal
**Notes:** Comparison of the PAHs in subtidal sediments of two bays on Knight Island, Prince William Sound, Alaska; one bay affected by the Alaska oil spill and the other not affected. Sampled sediments at water depths ranging from 10 to 150 m and analyzed for Alaska North Slope PAHs, natural oil-seep PAHs, pyrogenic PAHs, and biogenic/diagenic PAHs.

**Boehm, P. D., D. S. Page, J. S. Brown, J. M. Neff, W. A. Burns**, 2004. Polycyclic aromatic hydrocarbon levels in mussels from Prince William Sound, Alaska, USA, document the return to baseline conditions. Environmental Toxicology and Chemistry **23**:2916-2929.
**Keywords:** Alaska/ analysis/ aromatic hydrocarbons/ condition/ Exxon Valdez/ marine invertebrate/ mussel/ Ofour/ oil spill/ oiled/ Prince William Sound/ remediation/ risk/ salt water/ spill/ time
**Notes:** Mussels from 73 unoiled and 218 oiled sites (Exxon Valdez spill, 1989) in western Prince William

Sound were collected 1998-02. Samples were analyzed for 2-6 ring aromatic hydrocarbons and the results used to estimate risk to wildlife.

**Boer, B.**, 1993. Anomalous pneumatophores and adventitious roots of *Avicennia marina* (Forssk.) Vierh. mangroves two years after the 1991 Gulf War oil spill in Saudi Arabia. Marine Pollution Bulletin **27**:207-211.
**Keywords:** Gulf oil spill/ mangrove/ marina/ marine plant/ oil/ oil spill/ Osix/ roots/ salt water/ sampling/ Saudi Arabia/ soil/ soil profile/ spill/ transect/ war
**Notes:** In Saudi Arabia, an area of mangroves affected by the Gulf War oil spill was compared with mangroves in an unaffected area 2 yrs after the war. The incidence of pneumatophores and adventitious roots was quantified and cross-section drawings of both were made. Soil profiles were taken at each sampling quadrat within the five transects established at the affected and unaffected locations.

**Boersma, P. D.**, 1986. Ingestion of petroleum by seabirds can serve as a monitor of water quality. Science **231**:373-376.
**Keywords:** alkane/ bird/ ingestion/ long-term/ monitoring/ oil/ Oone/ petroleum/ pollution/ Prudhoe Bay crude oil/ salt water/ storm-petrel
**Notes:** Promotion of the use of storm-petrels as monitors of low-level long-term oil pollution on the open seas.

**Boersma, P. D.**, 1987. Penguins oiled in Argentina. Science **236**:135.
**Keywords:** Argentina/ bird/ coast/ oiled/ Oone/ penguin/ salt water
**Notes:** Report of serious oiling of penguins on the coast of Argentina.

**Boersma, P. D., E. M. Davies, W. V. Reid**, 1988. Weathered crude oil effects on chicks of fork-tailed storm-petrels (*Oceanodroma furcata*). Archives of Environmental Contamination and Toxicology **17**:527-531.
**Keywords:** bird/ chicks/ crude oil/ development/ dosed/ effects/ growth/ oil/ Oone/ Prudhoe Bay/ Prudhoe Bay crude oil/ salt water/ storm-petrel/ weathered
**Notes:** Young fork-tailed storm-petrels dosed with weathered Prudhoe Bay crude oil were evaluated for effects on growth and development.

**Bonin, P., E. R. Ranaivoson, N. Raymond, A. Chalamet, J. C. Bertrand**, 1994. Evidence for denitrification in marine sediment highly contaminated by petroleum products. Marine Pollution Bulletin **28**:89-95.
**Keywords:** aliphatic hydrocarbons/ assay/ bacteria/ coast/ concentration/ France/ microbes/ nitrification/ Oten/ petroleum/ petroleum products/ refinery/ salt water/ saturated hydrocarbons/ sediment
**Notes:** Sediment was collected near a refinery outlet on the Mediterrean coast of France and partitioned into layers (0-2, 2-4, 4-6, 6-10 cm). Overlying water and sediment were chemically and physically characterized. Denitrification capability of several strains of bacteria were determined in laboratory assays. The saturated hydrocarbon concentration of two of the sediment layers was determined.

**Bonsdorff, E.**, 1981. The *Antonio Gramsci* oil spill. Impact on the littoral and benthic ecosystems. Marine Pollution Bulletin **12**:301-305.
**Keywords:** abundance/ benthic/ bivalve/ community/ crude oil/ distribution/ ecosystem/ effects/ general effect/ intertidal/ littoral/ marine invertebrate/ Oeight/ oil/ oil spill/ salt water/ size/ spill/ subtidal/ time
**Notes:** A 1979 spill of crude oil in the Baltic Sea was assessed for 2 mos for its effects on the littoral community and for 3 yrs for its effects on benthic communities. An undeclared number of sites were sampled from the lower and upper intertidal area and from the subtidal area. Fauna were identified and enumerated, community indicies calculated, and size frequency distributions determined for one bivalve.

**Bonsdorff, E., T. Bakke, A. Pedersen**, 1990. Colonization of amphipods and polychaetes to sediments experimentally exposed to oil hydrocarbons. Marine Pollution Bulletin **21**:355-358.
**Keywords:** amphipod/ colonization/ crude oil/ density/ effects/ Ekofisk crude oil/ experiment/ hydrocarbons/ invertebrate/ marine invertebrate/ Ofour/ oil/ polychaete/ salt water/ sediment/ treatment

**Notes:** Effects of water-soluble fractions of Ekofisk crude oil in sediments on colonization by amphipods and polychaetes; two oil treatments during a 6-mo field experiment. Measured density of invertebrates.

**Born, A. F., E. Espinoza, J. C. Murillo, F. Nicolaides, G. J. Edgar**, 2003. Effects of the *Jessica* oil spill on artisanal fisheries in the Galapagos. Marine Pollution Bulletin **47**:319-324.
**Keywords:** Bunker C/ diesel fuel/ economy/ fish/ fishery/ miscellaneous/ Oeleven/ oil/ oil spill/ salt water/ spill
**Notes:** An assessment of the effect of the *Jessica* oil spill in the Galapagos Islands on the fishing industry of the islands. Authors evaluated catch and effort, distributrion of fishing sites, prices, and exports.

**Borowsky, B., P. Aitken-Ander, J. T. Tanacredi**, 1993. The effects of low doses of waste crankcase oil on *Melita nitida* Smith (Crustacea: Amphipoda). Journal of Experimental Marine Biology and Ecology **166**:39-46.
**Keywords:** adult/ amphipod/ crankcase oil/ effects/ female/ juvenile/ marine invertebrate/ Ofour/ oil/ reproduction/ salt water/ sediment/ survival
**Notes:** Exposure of adult amphipods to 1, 10, or 100 ppm waste crankcase oil mixed in sediment. Measured survival of adults and juveniles and reproduction of adult females.

**Botello, A. V., J. A. Goni, S. A. Castro**, 1983. Levels of organic pollution in coastal lagoons of Tabasco State, Mexico; I: Petroleum hydrocarbons. Bulletin of Environmental Contamination and Toxicology **31**:271-277.
**Keywords:** aromatic hydrocarbons/ coast/ hydrocarbons/ marine invertebrate/ Mexico/ miscellaneous/ Oeleven/ organic/ oyster/ petroleum/ petroleum hydrocarbons/ pollution/ salt water/ saturated hydrocarbons/ sediment/ tissue/ total hydrocarbons
**Notes:** Samples of sediment and oysters were collected at 27 sites along the coast of Tabasco State, Mexico during October 1979 and January, March, and May 1980. Sediments and oyster tissue were analyzed for saturated and aromatic hydrocarbons, and total hydrocarbons.

**Botello, A. V., C. Gonzalez, G. Diaz**, 1991. Pollution by petroleum hydrocarbons in sediments from continental shelf of Tabasco State, Mexico. Bulletin of Environmental Contamination and Toxicology **47**:565-571.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ carbon/ Caribbean/ hydrocarbons/ Mexico/ miscellaneous/ Oeleven/ offshore/ organic/ organic carbon/ PAH/ petroleum/ petroleum hydrocarbons/ pollution/ salt water/ sediment
**Notes:** Surface sediment from 15 nearshore and offshore sites on the Caribbean side of Mexico was collected and analyzed for petroleum hydrocarbons. Measured total organic carbon, aliphatic hydrocarbons, and aromatic hydrocarbons. Also measured 16 individual PAHs.

**Botello, A. V., S. F. Villanueva, G. G. Diaz, E. Escobar-Briones**, 1998. Polycyclic aromatic hydrocarbons in sediments from Salina Cruz Harbor and coastal areas, Oaxaca, Mexico. Marine Pollution Bulletin **36**:554-558.
**Keywords:** aromatic hydrocarbons/ carbon/ coast/ concentration/ harbour/ hydrocarbons/ Mexico/ miscellaneous/ Oeleven/ organic/ organic carbon/ PAH/ salt water/ sediment
**Notes:** Determination of concentrations of total PAHs and organic carbon in sediments of Salina Cruz Harbour and nearby coast areas.

**Bott, T. L., K. Rogenmuser, P. Thorne**, 1978. Effects of No. 2 fuel oil, Nigerian crude oil, and used crankcase oil on benthic algal communities. Journal of Environmental Science and Health **A13**:751-779.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ benthic/ chlorophyll/ community/ concentration/ crankcase oil/ crude oil/ effects/ experiment/ fresh water/ freshwater plant/ fuel oil/ hydrocarbons/ microcosm/ Nigerian crude oil/ No.2 fuel oil/ nutrients/ oil/ oil spill/ Oseven/ Pennsylvania/ productivity/ respiration/ sediment/ spill
**Notes:** Algal mats and underlying sediment from Oldmans Creek in Pennsylvania, USA were used to create laboratory microcosms placed in outdoor greenhouses. A series of experiments were preformed in summer, fall, and winter by using Nigerian crude oil, No. 2 fuel oil, and used crankcase oil in simulated oil spill scenarios. Aliphatic and aromatic hydrocarbons were monitored in the water and algal mats. Water

was also monitored for alkalinity and major nutrients. Measured net community primary productivity, community respiration, community gross productivity, and chlorophyll *a* concentrations.

**Bott, T. L., K. Rogenmuser**, 1978. Effects of No. 2 fuel oil, Nigerian crude oil, and used crankcase oil on attached algal communities: acute and chronic toxicity of water-soluble constituents. Applied Environmental Microbiology **36**:673-682.
**Keywords:** acute/ algae/ aliphatic hydrocarbons/ chlorophyll/ chronic/ community/ composition/ concentration/ condition/ crankcase oil/ crude oil/ effects/ experiment/ fresh water/ freshwater plant/ fuel oil/ hydrocarbons/ light/ microcosm/ Nigerian crude oil/ No.2 fuel oil/ nutrients/ oil/ Oseven/ Pennsylvania/ toxicity/ uptake
**Notes:** Water from Oldmans Creek, Pennsylvania, USA was used to establish cultures of attached algae in laboratory microcosms; community composition was determined prior to a series of 5-wk-long experiments performed in the summer and in the fall. Water-soluble extracts were prepared in light and darkness from No. 2 fuel oil, Nigerian crude oil, and used crankcase oil; concentrations of aliphatic hydrocarbons and several nutrients were measured in the microcosm water. Measured community composition; phycocyanin, chlorophyll *a,* and chlorophyll *c* concentrations; and $^{14}C$ uptake (light and dark conditions).

**Boucher, G.**, 1980. Impact of *Amoco Cadiz* oil spill on intertidal and sublittoral meiofauna. Marine Pollution Bulletin **11**:95-101.
**Keywords:** Amoco Cadiz/ copepod/ crude oil/ density/ diversity/ intertidal/ marine invertebrate/ meiofauna/ nematode/ numbers/ Ofour/ oil/ oil spill/ oiled/ salt water/ sand/ species/ spill/ sublittoral/ substrate
**Notes:** Assessment of the intertidal and sublittoral nematodes and copepods in sand substrate heavily oiled by the Amoco Cadiz oil spill. Measured densities, number of species, and diversity indicies over a 7-mo period following the spill.

**Boucher, G.**, 1985. Long term monitoring of meiofauna densities after the *Amoco Cadiz* oil spill. Marine Pollution Bulletin **16**:328-333.
**Keywords:** Amoco Cadiz/ copepod/ crude oil/ density/ estuarine/ invertebrate/ long-term/ marine invertebrate/ meiofauna/ monitoring/ nematode/ Ofour/ oil/ oil spill/ pollution/ salt water/ spill/ sublittoral
**Notes:** Assessement of the long-term effect of pollution from the Amoco Cadiz oil spill on copepods and nematodes in a sublittoral and an estuarine site. Measured densities of invertebrates monthly during a 1-year prespill period and for 4 years after the spill.

**Boukir, A., E. Aries, M. Guiliano, L. Asia, P. Doumenq, G. Mille**, 2001. Subfractionation, characterization and photooxidation of crude oil resins. Chemosphere **43**:279-286.
**Keywords:** chemical analysis/ chemical characteristics/ crude oil/ development/ Kuwait/ Kuwait crude oil/ light/ oil/ Onine/ photooxidation/ resin/ technical
**Notes:** Development of analytical techniques for the fractionation and characterization of resins (maltenes) in blended Arabian light, blended Arabian medium, Kuwait, Handil, and Zarzaitine crude oils. Measured the chemical changes induced by exposure to light for up to 2 mos.

**Bouloubassi, I., J. Fillaux, A. Saliot**, 2001. Hydrocarbons in surface sediments from the Changjiang (Yangtze River) Estuary, East China Sea. Marine Pollution Bulletin **42**:1335-1346.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ China/ concentration/ estuary/ hydrocarbons/ miscellaneous/ Oeleven/ pollution/ salt water/ sediment
**Notes:** Samples of surface sediment from the Changjiang River estuary and the adjacent South China Sea were collected from 11 sites. Sediments were analyzed for aliphatic hydrocarbons and a suite of 18 aromatic hydrocarbons. Results were interpreted with regard to their origin and their concentration relative to other areas of the world.

**Bourne, W. R. P.** 1968. Oil pollution and bird populations. Pages 99-121 *in* J. D. Carthy, D. R. Arthur, editors. The Biological effects of oil pollution on littoral communities: proceedings of a symposium held at the Orielton Field Centre, Pembroke, Wales, on 17th, 18th and 19th February 1968. Field Studies. Field Studies Council, London.

**Keywords:** biological effects/ bird/ community/ effects/ history/ littoral/ oil/ Oone/ pollution/ population/ region/ salt water/ Wales
**Notes:** A historical and contemporary assessment of the effects of oil pollution on bird populations.

**Bourne, W. R. P., L. Johnston**, 1971. The threat of oil pollution to north Scottish seabird colonies. Marine Pollution Bulletin **2**:117-119.
**Keywords:** bird/ colony/ oil/ oil spill/ Oone/ pollution/ salt water/ Scotland/ spill
**Notes:** Report and assessment of an oil spill in the north Scottish islands.

**Bourne, W. R. P., C. J. Bibby**, 1975. Temperature and the seasonal and geographical occurrence of oiled birds on west European beaches. Marine Pollution Bulletin **6**:77-80.
**Keywords:** beach/ bird/ Europe/ oiled/ Oone/ salt water/ seasonal/ temperature
**Notes:** Comparison of occurrence of oiled birds with the season; west European beaches.

**Bourne, W. R. P.**, 1978. *Amoco Cadiz* seems likely to exterminate the French auks. Marine Pollution Bulletin **9**:145.
**Keywords:** Amoco Cadiz/ auks/ bird/ France/ oil/ oil spill/ Oone/ population/ salt water/ spill
**Notes:** Comment on the likelyhood of extermination of French auks because of the Amoco Cadiz oil spill.

**Bourne, W. R. P.**, 1979. The *Christos Bitas* affair. Marine Pollution Bulletin **10**:122-123.
**Keywords:** bird/ coast/ crude oil/ effects/ England/ mammal/ oil/ Oone/ salt water/ seal/ spill/ Wales
**Notes:** Effects of the Christos Bitas spill of crude oil on birds and seals off the coast of Wales.

**Bowman, R. E. and R. W. Langton** 1978. Fish predation on oil-contaminated prey from the region of the *Argo Merchant* oil spill. Pages 137-141 *in* In the Wake of the Argo Merchant. University of Rhode Island.
**Keywords:** Argo Merchant/ Bunker C/ fish/ food chain/ fuel oil/ marine invertebrate/ movement/ oil/ oil spill/ Othree/ predation/ region/ salt water/ species/ spill/ squid/ transfer
**Notes:** An assessment of the movement of spilled Bunker C fuel oil (Argo Merchant) from prey species to predator species; field collections of fish and squid.

**Bowman, R. S.**, 1978. Dounreay oil spill: major implications of a minor incident. Marine Pollution Bulletin **9**:269-273.
**Keywords:** bird/ effects/ fuel oil/ general effect/ marine invertebrate/ marine plant/ Oeight/ oil/ oil spill/ salt water/ Scotland/ shoreline/ spill/ time
**Notes:** The author compares the preliminary assessment of the effects of a 1977 spill of fuel oil on the shoreline of northern Scotland with a subsequent reassessment of the effects. The pitfalls of superficial judgements and the lack of baseline information are highlighted.

**Bowman, T. D., P. F. Schempf, J. A. Bernatowicz**, 1995. Bald eagle survival and population dynamics in Alaska after the *Exxon Valdez* oil spill. Journal of Wildlife Management **59**:317-324.
**Keywords:** Alaska/ bald eagle/ bird/ eagle/ Exxon Valdez/ oil/ oil spill/ Oone/ population/ Prince William Sound/ recovery/ salt water/ spill/ survival
**Notes:** Survival and population recovery for bald eagles in the Prince William Sound area following the Exxon Valdez oil spill.

**Bowman, T. D., P. F. Schempf, J. I. Hodges**, 1997. Bald eagle population in Prince William Sound after the *Exxon Valdez* oil spill. Journal of Wildlife Management **61** :962-967.
**Keywords:** bald eagle/ bird/ crude oil/ eagle/ Exxon Valdez/ oil/ oil spill/ Oone/ population/ Prince William Sound/ salt water/ spill/ survey
**Notes:** Survey of the bald eagle population of Prince William Sound in an effort to determine the effect of the Exxon Valdez oil spill; census conducted in 1982 (partial), 1989-91, and 1995.

**Bowyer, R. T., J. W. Testa, J. B. Faro, C. C. Schwartz, J. B. Browning**, 1994. Changes in diets of river otters in Prince William Sound, Alaska: effects of the *Exxon Valdez* oil spill. Canadian Journal of Zoology **72**:970-976.

**Keywords:** Alaska/ crude oil/ diet/ effects/ Exxon Valdez/ feces/ mammal/ oil/ oil spill/ Otwo/ Prince William Sound/ Prudhoe Bay crude oil/ river otter/ salt water/ spill
**Notes:** Effects of the Exxon Valdez oil spill on diet of river otters in Prince William Sound.

**Bowyer, R. T., J. W. Testa, J. B. Faro**, 1995. Habitat selection and home ranges of river otters in a marine environment: effects of the Exxon Valdez oil spill. Journal of Mammalogy **76**:1-11.
**Keywords:** Alaska/ crude oil/ effects/ environment/ Exxon Valdez/ habitat/ mammal/ marine environment/ oil/ oil spill/ Otwo/ Prince William Sound/ Prudhoe Bay crude oil/ river otter/ salt water/ sea otter/ spill
**Notes:** Effects of Exxon Valdez oil spill on habitat selection and use by sea otters in Prince William Sound.

**Bowyer, R. T., G. M. Blundell, M. Ben-David, S. C. Jewett, T. A. Dean, L. K. Duffy**, 2004. Effects of the *Exxon Valdez* oil spill on river otters: injury and recovery of a sentinel species. Wildlife Monographs **No. 153**:1-53.
**Keywords:** Alaska/ assay/ biomarker/ capture/ diet/ Exxon Valdez/ fresh water/ injury/ mammal/ oil/ oil spill/ Otwo/ population/ Prince William Sound/ recovery/ river otter/ salt water/ species/ spill/ survival/ time
**Notes:** A detailed accounting of the effects of the Exxon Valdez oil spill of 1989 on river otterns in Prince William Sound, Alaska. Authors research involved an early set of studies (1989-92) and a later set (1996-99). The Methods contains sections on live capture of otters, surgical procedures, morphometrics, field biosampling, biomarker assays, diet analyses, prey availability, radiotelemetry, age structure, estimating population size, survival, and synthesis.

**Braddock, J. F., J. E. Lindstrom, E. J. Brown**, 1995. Distribution of hydrocarbon-degrading microorganisms in sediments from Prince William Sound, Alaska, following the *Exxon Valdez* oil spill. Marine Pollution Bulletin **30**:125-132.
**Keywords:** Alaska/ crude oil/ density/ depth/ distribution/ Exxon Valdez/ intertidal/ microbes/ miscellaneous/ oil/ oil spill/ Oten/ Prince William Sound/ salt water/ sampling/ sediment/ spill/ subtidal
**Notes:** Measurement of density of hydrocarbon-degrading microorganisms in intertidal and subtidal (depths varying from 3 to 100 m) sediments of Prince William Sound. Six sampling cruises conducted from summer of 1989 to summer of 1991. Densities and temporal changes in densities compared to distribution of oil from the Exxon Valdez spill.

**Braddock, J. F., M. L. Ruth, P. H. Catterall, J. L. Walworth, K. A. McCarthy**, 1997. Enhancement and inhibition of microbial activity in hydrocarbon-contaminated Arctic soils: implications for nutrient-amended bioremediation. Environmental Science and Technology **31**:2078-2084.
**Keywords:** activity/ Arctic/ bioremediation/ evaluation/ jet fuel/ mesocosm/ microbes/ microcosm/ nutrients/ Oten/ soil
**Notes:** Evaluation of nutrient supplementation (N, P) on the bioremediation of an Alaskan site contaminated with jet fuel; three levels of supplementation, laboratory microcosms, on-site mesocosms.

**Bradshaw, C. J. A., S. Boutin, D. M. Hebert**, 1997. Effects of petroleum exploration on woodland caribou in northeastern Alberta. Journal of Wildlife Management **61**:1127-1133.
**Keywords:** activity/ Alberta/ behavior/ Canada/ caribou/ development/ effects/ evaluation/ habitat/ mammal/ movement/ oil/ oil field/ Otwo/ petroleum/ time
**Notes:** Evaluation of the effects of simulated petroleum exploration activities on the movement and behavior of caribou during the winter. Caribou in Alberta exposed to noises adjusted for volume and duration to simulated specific stages in the exploration for oil. Measured time devoted to movement and the use of habitat patches.

**Bradshaw, C. J. A., S. Boutin, D. M. Hebert**, 1998. Energetic implications of disturbance caused by petroleum exploration to woodland caribou. Canadian Journal of Zoology **76**:1319-1324.
**Keywords:** Alberta/ caribou/ cost/ development/ energetics/ estimate/ female/ mammal/ Otwo/ petroleum/ rate/ region/ weight
**Notes:** Estimation of the energetic costs to female woodland caribou of disturbance caused by petroleum exploration during the winter in northeast Alberta. Derived estimates of encounter rates and subsequent

energy expenditure for nine separate regions. Energy expenditure estimates were then converted to loss of body mass.

**Bragg, J. R., R. C. Prince, E. J. Harner, R. M. Atlas**, 1994. Effectiveness of bioremediation for the *Exxon Valdez* oil spill. Nature **368**:413-418.
**Keywords:** Alaska/ bioremediation/ crude oil/ effectiveness/ evaluation/ Exxon Valdez/ microbes/ oil/ oil spill/ Oten/ petroleum/ procedure/ salt water/ spill
**Notes:** Authors present an evaluation procedure for determining the effectiveness of petroleum bioremediation. The Exxon Valdez oil spill bioremediation efforts are discussed in detail.

**Brandt, C. A., J. M. Becker, A. Porta**, 2002. Distribution of polycyclic aromatic hydrocarbons in soils and terrestrial biota after a spill of crude oil in Trecate, Italy. Environmental Toxicology and Chemistry **21**:1638-1643.
**Keywords:** accumulation/ amphibian/ aromatic hydrocarbons/ crude oil/ distribution/ effects/ evaluation/ fresh water/ freshwater invertebrate/ freshwater plant/ frog/ general effect/ hydrocarbons/ Oeight/ oil/ plant/ soil/ species/ spill/ time
**Notes:** Evaluation of the effects of an oil well blowout in northern Italy in February 1994. Plants (six species), terrestrial insects, wood mice, and frogs were collected each July during 1994-97. Soil samples were collected quarterly from more than 50 locations throughout the affected area and outside the area. Analyzed samples for total aromatic hydrocarbons and a suite of individual aromatic hydrocarbons. Calculated biota-soil accumulation factors for the aromatic hydrocarbons.

**Brannon, E. L., K. C. M. Collins, L. L. Moulton, K. R. Parker**, 2001. Resolving allegations of oil damage to incubating pink salmon eggs in Prince William Sound. Canadian Journal of Fisheries and Aquatic Sciences **58**:1070-1076.
**Keywords:** crude oil/ effects/ eggs/ Exxon Valdez/ fish/ oil/ oil spill/ Othree/ pink salmon/ Prince William Sound/ salmon/ salt water/ sampling/ spill/ survival/ time
**Notes:** Authors re-evaluate previously published information on the effects on pink salmon eggs of crude oil from the *Exxon Valdez* oil spill. Adjustments are made for 'shock mortality' during the times that egg sampling occurred and data for the years 1989-97 are reanalyzed.

**Brannon, E. L., K. M. Collins, J. S. Brown, J. M. Neff, K. R. Parker, W. A. Stubblefield**, 2006. Toxicity of weathered *Exxon Valdez* crude oil to pink salmon embryos. Environmental Toxicology Chemistry **25**:962-972.
**Keywords:** alevin/ concentration/ crude oil/ effects/ eggs/ embryo/ experiment/ Exxon Valdez/ fertilization/ fish/ fresh water/ gravel/ monitoring/ oil/ Othree/ PAH/ pink salmon/ reproduction/ salmon/ survival/ time/ tissue/ toxicity/ water/ weathered
**Notes:** Evaluated the effects of naturally-weathered and artificially-weathered Exxon Valdez crude oil on pink salmon embryos. Eggs were exposed to gravel loadings of either 0, 200, 750, 1,500, or 2,250 ppm crude oil. After a 4-da stabilization period for the test apparatus, fertilized eggs were introduced for an exposure period of 79 da. Measured survival and PAH concentrations in gravel, water, and tissue (eggs or alevins) at days 0, 11, 23, 40, and 83. Eggs undergoing fertilization were exposed to either 0, 750, 1,500, or 2,250 ppm crude oil in gravel in a separate experiment lasting for 8 hrs of exposure followed by monitoring through the alevin swim-up stage.

**Brannon, E. L., A. W. Maki, L. L. Moulton, K. R. Parker**, 2006. Results from a sixteen year study on the effects of oiling from the *Exxxon Valdez* on adult pink salmon returns. Marine Pollution Bulletin **52**:892-899.
**Keywords:** adult/ Alaska/ effects/ fish/ intertidal/ oiled/ oiling/ Othree/ pink salmon/ population/ Prince William Sound/ reproduction/ salmon/ salt water/ stream/ time
**Notes:** Adult returning pink salmon were monitored during 1989-2004 (except 1993) in southwestern Prince William Sound. The study was initiated with 40 streams (oiled and non-oiled) in 1989 and continued with a subset of five oiled and five non-oiled for the rest of the study. Both intertidal and upstream portions of the streams were surveyed.

**Bratbak, G., M. Heldal, G. Knutsen, T. Lien, S. Norland**, 1982. Correlation of dispersant effectiveness and toxicity of oil dispersants towards the alga *Chlamydomonas reinhardti*. Marine Pollution Bulletin **13**:351-353.
**Keywords:** algae/ crude oil/ dispersant/ effectiveness/ Ekofisk crude oil/ fresh water/ freshwater plant/ growth/ miscellaneous/ ODseven/ oil/ petroleum/ toxicity
**Notes:** A freshwater algae was used to test the toxicity of 16 concentrated and 10 solvent-based petroleum dispersants. Also tested the effectiveness of the dispersants in algal growth medium and artificial sea water. Compared effectiveness with algal toxicity.

**Brauner, C. J., C. L. Ballantyne, M. M. Vijayan, A. L. Val**, 1999. Crude oil exposure affects air-breathing frequency, blood phosphate levels and ion regulation in an air-breathing teleost fish, *Hoplosternum littorale*. Comparative Biochemistry and Physiology **123C**:127-134.
**Keywords:** blood/ concentration/ crude oil/ dosed/ effects/ experiment/ fish/ fresh water/ ion regulation/ oil/ Othree/ parameters/ phosphate/ plasma/ regulation/ Urucu crude oil
**Notes:** Determination of the effects on an air-breathing fish of exposure to a crude oil. Fish were sequentially exposed to 12.5, 25, 37.5, and 50% water-soluble fraction (WSF) of Urucu crude oil in one experiment. In a second experiment, fish were dosed with crude oil in amounts of 0.3, 1.0, or 3.0 ml/kg body mass for one assessment and in the amount of 3.0 ml/kg in a second assessment. Measured air breathing frequency and blood parameters in fish exposed to WSF. Measured $K^+$ and $NA^+$ fluxes in blood plasma at 24, 48, and 72 hrs post dosing, $K^+$ over a 24-hr period post dosing, and blood phosphate concentrations over a 24-hr period post dosing.

**Bregnard, T. P. A., P. Hohener, A. Haner, J. Zeyer**, 1996. Degradation of weathered diesel fuel by microorganisms from a contaminated aquifer in aerobic and anaerobic microcosms. Environmental Toxicology and Chemistry **15**:299-307.
**Keywords:** aerobic/ anaerobic/ carbon/ combination/ condition/ consumption/ degradation/ diesel/ diesel fuel/ experiment/ fresh water/ hydrocarbons/ incubation/ microbes/ microcosm/ nitrate/ nutrients/ Oten/ oxygen/ pH/ remediation/ saturated hydrocarbons/ soil/ temperature/ time/ weathered
**Notes:** A subsurface leak of diesel fuel in Switzerland was bioremediated with oxygen and nutrient supplementation for 3.5 yrs. To check on the success of the effort, samples of aquifer soil from below the water table was sampled and used in 14 laboratory microcosm experiments. Experiments involved aerobic and anaerobic conditions and a variety of combinations of nutrients, temperature, and pH. Incubation periods lasted for up to 500+ da. Measured oxygen and nitrate consumption, inorganic carbon production; and saturated hydrocarbons in fresh and weathered diesel fuel.

**Bregnard, T. P. A., P. Hohener, J. Zeyer**, 1998. Bioavailability and biodegradation of weathered diesel fuel in aquifer material under denitrifying conditions. Environmental Toxicology and Chemistry **17**:1222-1229.
**Keywords:** biodegradation/ condition/ diesel/ diesel fuel/ fresh water/ microbes/ Oten/ surfactant/ weathered
**Notes:** Experimental efforts to enhance biodegredation of weathered diesel fuel in an aquifer by indigenous microorganisms under denitrifying conditions. Tested agitation of aquifer, addition of a biosurfactant and a synthetic surfactant, and addition of solvent-extracted weathered diesel fuel.

**Briggs, K. T., S. H. Yoshida, M. E. Gershwin**, 1996. The influence of petrochemicals and stress on the immune system of seabirds. Regulatory Toxicology and Pharmacology **23**:145-155.
**Keywords:** bird/ effects/ immune response/ Oone/ pathology/ petroleum/ rehabilitation/ review/ salt water/ sources/ stress
**Notes:** A general review of the immune system of vertebrates and implications for petroleum exposure by birds. Sections cover immune system function, sources of petroleum, and effects of petroleum on birds (general pathology, immunopathology, stress responses, and consequences of bird rehabilitation efforts). Recommends assessment of immune status before returning rehabilitated birds to the wild.

**Briggs, K. T., M. E. Gershwin, D. W. Anderson**, 1997. Consequences of petrochemical ingestion and stress on the immune system of seabirds. ICES Journal of Marine Science **54**:718-725.
**Keywords:** bird/ capture/ cleaning/ commentary/ effects/ immune response/ ingestion/ oil/ Oone/

petroleum/ rehabilitation/ review/ salt water/ stress
**Notes:** Review and commentary of the effects on the immune system of birds of petroleum ingestion and related stresses associated with oil exposure, environmental disturbance by people, capture, and cleaning. Recommendations for seabird rehabilitation proceedures and needed research.

**Brils, J. M., S. L. Huwer, B. J. Kater, P. G. Schout, J. Harmsen, G. A. L. Delvigne, M. C. Th. Scholten**, 2002. Oil effect in freshly spiked marine sediment on *Vibro fischeri*, *Corophium volutator*, and *Echinocardium cordatum*. Environmental Toxicology and Chemistry **21**:2242-2251.
**Keywords:** alkane/ bacteria/ concentration/ criteria/ development/ experiment/ heart/ Netherlands/ oil/ Onine/ salt water/ sediment/ shrimp/ survival/ technical/ urchin/ weathered
**Notes:** Development of sediment quality criteria for oil-contaminated sediments in The Netherlands. Used a marine gasoil (low boiling alkanes) and a high viscosity hydraulic oil (high boiling alkanes). Established concentration series for each and exposed a luminescent bacteria, the mud shrimp, and the heart urchin for 10 min, 10 da, and 14 da, respectively. Measured survival and calculated $EC_x$ values. Also conducted an experiment with gasoil weathered for 15 and 28 wks.

**Brodersen, C. C., S. D. Rice, J. W. Short, T. A. Mecklenburg, and J. F. Karinen** 1977. Sensitivity of larval and adult Alaskan shrimp and crabs to acute exposures of the water-soluble fraction of Cook Inlet crude oil. Pages 575-578 *in* Proceedings, 1977 Oil Spill Conference. American Petroleum Institute, Washington, DC.
**Keywords:** acute/ adult/ Alaska/ behavior/ concentration/ Cook Inlet crude oil/ crab/ crude oil/ juvenile/ larvae/ marine invertebrate/ Ofour/ oil/ oil spill/ salt water/ shrimp/ species/ spill/ static/ survival
**Notes:** Exposure of larval and adult shrimp of several species and juvenile king crabs (Alaska) to varying concentrations of the water-soluble fraction of Cook Inlet crude oil. Used a 96 hr static test to calculate LC50s.

**Brody, A. J., K. Ralls, D. B. Siniff**, 1996. Potential impact of oil spills on California sea otters: implications of the *Exxon Valdez* spill in Alaska. Marine Mammal Science **12**:38-53.
**Keywords:** Alaska/ California/ distance/ estimate/ Exxon Valdez/ mammal/ model/ oil/ oil spill/ Otwo/ risk/ salt water/ sea otter/ spill/ time
**Notes:** Estimate of the risk to California sea otters calculated with models of distance from spill site and time since spill; Exxon Valdez spill information on sea otters used as reference data for the models.

**Brody, S. D., S. Bernhardt, B. Whitaker**, 2006. Identifying potential conflict associated with oil and gas exploration in Texas state coastal waters: a multicriteria spatial analysis. Environmental Management **38**:597-617.
**Keywords:** analysis/ commercial fishing/ development/ evaluation/ GIS/ habitat/ miscellaneous/ Oeleven/ offshore/ oil/ oil field/ salt water/ Texas/ water
**Notes:** A GIS-based evaluation of the potential conflicts associated with offshore oil and gas exploration for the state of Texas. Authors used 1385 leased drilling tracts and employed eight spatially-expressed values; (1) biodiversity/critical habitat, (2) recreation and tourism, (3) aesthetics, (4) commercial fishing and bioproductivity, (5) marine transportation, (6) coastal development, (7) historic/cultural, and (8) research and education.

**Brooks, J. M., D. A. Wiesenburg, R. A. Burke, Jr., M. C. Kennicutt**, 1981. Gaseous and volatile hydrocarbon inputs from a subsurface oil spill in the Gulf of Mexico. Environmental Science and Technology **15**:951-959.
**Keywords:** alkane/ aromatic hydrocarbons/ concentration/ depth/ distance/ Gulf of Mexico/ hydrocarbons/ Ixtoc/ Mexico/ oil/ oil spill/ Onine/ salt water/ sampling/ spill/ technical/ water column/ weight
**Notes:** A determination of the low molecular weight (C1-C4) and volatile liquid (C5-C14) hydrocarbons in the water column at varying distances from the IXTOC I well blowout. A total of 17 sampling stations were used to collect water from depths of 1-40 m. Water was analyzed for the low-molecular-weight alkanes and aromatics.

**Brown, H. M., R. H. Goodman** 1989. Dispersants in the freshwater environment. Pages 31-40 *in* L. M. Flaherty, editor. Oil Dispersants: New Ecological Approaches. Special Technical Publication. American Society for Testing and Materials, Philadelphia.
**Keywords:** acute/ algae/ crude oil/ daphnia/ dispersant/ effectiveness/ effects/ environment/ fish/ fresh water/ freshwater invertebrate/ freshwater plant/ general effect/ invertebrate/ microbes/ Norman Wells crude oil/ ODeight/ oil/ plant/ rainbow trout/ sublethal/ technical/ toxicity
**Notes:** A description of the results of 4 years of research on the toxicity of nine oil dispersants in the freshwater environment. Studies used Norman Wells crude oil and attempted to simulate a coldwater environment. Determined dispersant effectiveness; acute toxicity to rainbow trout, algae, and daphnia; and sublethal effects for microbes, several plants, *Daphnia* and *Gammarus*, and larval rainbow trout.

**Brown, J. L., J. Syslo, L. Yi-Hua, S. Getty, R. Vemuri, R. Nadeau**, 1998. On-site treatment of contaminated soils: an approach to bioremediation of weathered petroleum compounds. Journal of Soil Contamination **7**:773-800.
**Keywords:** bioremediation/ combination/ compost/ degradation/ hydrocarbons/ microbes/ nitrogen/ organic/ Oten/ petroleum/ petroleum hydrocarbons/ refinery/ soil/ treatment/ weathered
**Notes:** A bench-scale investigation of the options for bioremediation of a large quantity of petroleum-contaminated soil from an old refinery site. Compared degradation over a 110 da period for soil mixed with combinations of high- or low-nitrogen compost and organic or nonorganic bulking agents. Measured petroleum hydrocarbons at beginning and at 2-wk intervals.

**Brown, R. A., H. L. Huffman, Jr.**, 1976. Hydrocarbons in open ocean waters. Science **191**:847-849.
**Keywords:** Africa/ aliphatic hydrocarbons/ aromatic hydrocarbons/ Caribbean/ coast/ depth/ Europe/ evaluation/ hydrocarbons/ miscellaneous/ North America/ Oeleven/ salt water/ sulfur/ survey
**Notes:** A survey and evaluation of water samples collected at 1m and 10 m depths in the open ocean off the coasts of Africa, western Europe, northeast South America, eastern North America, the Caribbean, and the east coast of Greenland. Results are presented as classes of aliphatic hydrocarbons, and 1-4 ring groupings and sulfur heterocycles of aromatic hydrocarbons.

**Brown, R. C., R. H. Pierce, S. A. Rice**, 1985. Hydrocarbon contamination in sediments from urban stormwater runoff. Marine Pollution Bulletin **16**:236-240.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ Florida/ fresh water/ hydrocarbons/ miscellaneous/ motor oil/ Oeleven/ oil/ particulate/ petroleum/ petroleum hydrocarbons/ river/ sediment/ stormwater/ urban/ used motor oil
**Notes:** An assessment of urban stormwater runoff in Tampa, Florida. Sediment (12 sites)and water (8 sites; near surface and near bottom) were collected from the lower Hillsborough River, Hillsborough Reservoir, and Hillsborough Bay, and stormwater was collected from one outlet. Measured petroleum hydrocarbons (aliphatic and aromatic) in sediments and suspended particulate matter (water) and compared to used motor oil.

**Brown, R. P., A. Cristini, K. R. Cooper**, 1992. Histopathological alterations in *Mya arenaria* following a #2 Fuel Oil spill in the Arthur Kill, Elizabeth, New Jersey. Marine Environmental Research **34**:65-68.
**Keywords:** clam/ effects/ fuel oil/ lesions/ marine invertebrate/ New Jersey/ No.2 fuel oil/ Ofour/ oil/ oil spill/ pathology/ salt water/ spill/ tissue
**Notes:** Documentation of the effects of a large No. 2 fuel oil spill on the soft tissue of the clam *Mya arenaria*. Clams were sampled 1 wk after the spill and at monthly intervals for 1 yr; soft tissue examined for tissue lesions.

**Bucas, G., A. Saliot**, 2002. Sea transport of animal and vegetable oils and its environmental consequences. Marine Pollution Bulletin **44**:1388-1396.
**Keywords:** animal oil/ effects/ English Channel/ fate/ fresh water/ miscellaneous/ Oeleven/ oil/ review/ salt water/ spill/ tanker/ transport/ vegetable oil
**Notes:** A review of spills of animal and vegetable oils in salt and fresh water and their environmental effects. A case study is presented of the 1997 spill into the English Channel of 900 tons of palm nut oil from the tanker *Allegra*.

**Buck, W. F. A., J. Harrison** 1967. Some prolonged effects of oil pollution on the Medway Estuary. Pages 32-33 *in* Yearbook. Wildfowler's Association of Great Britain and Ireland,
**Keywords:** bird/ crude oil/ effects/ estuary/ habitat/ Ireland/ oil/ Oone/ pollution/ population/ salt water/ spill
**Notes:** An account of the immediate effect (death) and prolonged effects (decreased bird use) of the spill of crude oil into the Medway Estuary.

**Bue, B. G., S. Sharr, S. D. Moffitt, and A. K. Craig** 1996. Effects of the *Exxon Valdez* oil spill on pink salmon embryos and preemergent fry. Pages 619-627 *in* S. D. Rice, R. B. Spies, D. A. Wolfe, B. A Wright, editors. Proceedings of the Exxon Valdez Oil Spill Symposium: held at Anchorage, Alaska, USA, 2-5 February 1993. American Fisheries Society Symposium. Bethesda, Maryland.
**Keywords:** crude oil/ effects/ embryo/ Exxon Valdez/ fish/ fishery/ fresh water/ fry/ oil/ oil spill/ Othree/ pink salmon/ salmon/ society/ spill/ stream/ survival/ Alaska
**Notes:** Evaluated the effects of the Exxon Valdez oil spill on survival of pink salmon embryos and preemergent fry in streams during the fall of 1989-92. Most of the work performed on 10 oil-contaminated and 15 reference streams. Measured survival of embryos and survival of embryo to preemergent fry.

**Bue, B. G., S. Sharr, J. E. Seeb**, 1998. Evidence of damage to pink salmon populations inhabiting Prince William Sound, Alaska, two generations after the *Exxon Valdez* oil spill. Transactions of the American Fisheries Society **127**:35-43.
**Keywords:** Alaska/ condition/ eggs/ embryo/ Exxon Valdez/ fish/ fresh water/ oil/ oil spill/ Othree/ pink salmon/ population/ Prince William Sound/ salmon/ sperm/ spill/ stream/ survival
**Notes:** Extension of the Bue et.al. (1996) study. Survival of embryos measured in 10 oil-contaminated and 15 reference streams in 1993-95. Collected eggs and sperm from mature salmon in oil-contaminated and reference streams and performed intrastream crosses under laboratory conditions.

**Bugbee, S. L., C. M. Walter** 1973. The response of macroinvertebrates to gasoline pollution in a mountain stream. Pages 725-731 *in* Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13-15, 1973, Washington, D.C. American Petroleum Institute, Washington, DC.
**Keywords:** aviation gasoline/ community/ fish/ fresh water/ freshwater invertebrate/ gasoline/ invertebrate/ macroinvertebrate/ Ofive/ oil/ oil spill/ pollution/ spill/ stream/ Washington
**Notes:** Report of a spill of aviation gasoline into a stream in South Dakota; losses of fish and aquatic vertebrates were documented.

**Burger, A. E.** 1992. The effects of oil pollution on seabirds off the west coast of Vancouver Island. Pages 120-128 *in* K. Vermeer, R. W. Butler, K. H. Morgan, editors. The ecology, status, and conservation of marine and shoreline birds on the west coast of Vancouver Island. Occasional Paper. Canadian Wildlife Service,
**Keywords:** bird/ coast/ effects/ history/ oil/ oil spill/ Oone/ pollution/ population/ salt water/ spill/ Vancouver Island/ conservation/ shoreline
**Notes:** A general assessment of the historical and potential effects of oil spills on seabirds of the west coast of Vancouver Island.

**Burger, A. E.**, 1993. Mortality of seabirds assessed from beached-bird surveys in southern British Columbia. Canadian Field-Naturalist **107**:164-176.
**Keywords:** beached bird survey/ bird/ British Columbia/ Oone/ salt water/ spill/ survey
**Notes:** Report on 5 years of beached-bird surveys in British Columbia.

**Burger, A. E., D. M. Fry** 1993. Effects of oil pollution on seabirds in the northeast Pacific. Pages 254-263 *in* K. Vermeer, K. T. Briggs, K. H. Morgan, D. Siegel-Causey, editors. The Status, ecology and conservation of marine birds of the North Pacific. Special Publication. Canadian Wildlife Service, Ottawa, Canada.
**Keywords:** bird/ effects/ methods/ oil/ Oone/ Pacific/ pollution/ rehabilitation/ salt water/ spill/ conservation/ marine birds
**Notes:** General assessment of the effects of oil pollution on seabirds in the northeast Pacific, especially during the period 1974-89.

**Burger, A. E.**, 1993. Estimating the mortality of seabirds following oil spills: effects of spill volume. Marine Pollution Bulletin **26**:140-143.
**Keywords:** bird/ effects/ oil/ oil spill/ Oone/ salt water/ spill/ spill size
**Notes:** Assessment of the relation between spill volume and mortality of seabirds.

**Burger, J., J. Brzorad, M. Gochfeld**, 1991. Immediate effects of an oil spill on behavior of fiddler crabs (*Uca pugnax*). Archives of Environmental Contamination and Toxicology **20**:404-409.
**Keywords:** behavior/ crab/ effects/ fuel oil/ marine invertebrate/ movement/ No.2 fuel oil/ Ofour/ oil/ oil spill/ oiled/ salt water/ spill
**Notes:** Assessment of the effects of a spill of No. 2 fuel oil on the behavior of fiddler crabs. Crabs collected from oiled areas on three dates within 35 da of the spill and compared to two groups of controls. Measured righting response, movement, and defensive behavior.

**Burger, J., J. Brzorad, M. Gochfeld**, 1992. Effects of an oil spill on emergence and mortality in fiddler crabs *Uca pugnax*. Environmental Monitoring and Assessment **22**:107-115.
**Keywords:** crab/ creek/ effects/ emergence/ fuel oil/ marine invertebrate/ No.2 fuel oil/ Ofour/ oil/ oil spill/ salt marsh/ salt water/ spill/ survival
**Notes:** Assessment of the effects of a No. 2 fuel oil spill on emergence and subsequent survival of fiddler crabs *Uca pugnax*. Thirty salt marsh creeks located adjacent, near, and distant from the spill were surveyed over a 2 mo period.

**Burger, J., M. Gochfeld**, 1992. Effects of washing fiddler crabs (*Uca pugnax*) following an oil spill. Environmental Pollution **77**:15-22.
**Keywords:** behavior/ crab/ effects/ fuel oil/ marine invertebrate/ movement/ No.2 fuel oil/ Ofour/ oil/ oil spill/ salt water/ spill/ washing
**Notes:** Assessment of the effects of a No. 2 fuel oil spill on the behavior of fiddler crabs *Uca pugnax*. Washed and unwashed fiddler crabs were compared with regard to righting behavior, movement, and aggressive behavior; evaluated temporal aspect by also measuring behavior 2 and 4 da after washing.

**Burger, J.** 1994. From the past to the future: conclusions from the Arthur Kill. Pages 283-289 *in* J. Burger, editor. Before and After an Oil Spill: the Arthur Kill. Rutgers University Press, New Brunswick.
**Keywords:** biological effects/ bird/ commentary/ crustacean/ effects/ fish/ general effect/ marine invertebrate/ marine plant/ Oeight/ oil/ oil spill/ overview/ risk/ salt water/ spill/ turtle
**Notes:** An overview and commentary on the consequences of the Arthur Kill, NJ oil spill of 1990; biological effects, risk and risk management, and lessons for the future.

**Burger, J., N. Tsipoura**, 1998. Experimental oiling of sanderlings (*Calidris alba*): behavior and weight changes. Environmental Toxicology and Chemistry **17**:1154-1158.
**Keywords:** behavior/ bird/ crude oil/ feathers/ oil/ oiled/ Oone/ plumage/ salt water/ shorebird/ size/ weight
**Notes:** Applied crude oil to the belly feathers of sanderlings to simulate 20% plumage oiling. Measured weight change, change in size of oil patch, and change in behavior during a 35 da post-oiling period.

**Burk, C. J.**, 1977. A four year analysis of vegetation following an oil spill in a freshwater marsh. Journal of Applied Ecology **14**:515-522.
**Keywords:** analysis/ diversity/ fresh water/ freshwater plant/ fuel oil/ index/ No.2 fuel oil/ oil/ oil spill/ Oseven/ plant/ species/ spill/ time/ transect/ vegetation/ wetland
**Notes:** A wetland on the Mill River, Massachusetts, USA was affected by a No. 2 fuel oil spill. The wetland was studied the year before and 3 yrs after the spill. Plant quadrats were placed on line transects in three vegetation zones (high, mid-, and low marsh). Plants were identified and percentage cover estimated for each species. Calculated species richness, mean species per quadrat, a diversity index, and total plant cover.

**Burns, K. A. and J. M. Teal**. 1971. Hydrocarbon incorporation into the salt marsh ecosystem from the West Falmouth oil spill. Woods Hole Oceanographic Institute, Woods Hole, MA. **Technical Report 71-69**. 24 pp.

**Keywords:** algae/ bird/ degradation/ ecosystem/ fish/ Florida/ fuel oil/ hydrocarbons/ marine invertebrate/ marine plant/ Massachusetts/ mussel/ No.2 fuel oil/ oil/ oil spill/ Oone/ salt marsh/ salt water/ sediment/ spill/ technical
**Notes:** Analyses of sediments and organisms collected one year later from the site of the barge "Florida" spill of No. 2 fuel oil near West Falmouth, MA.

**Burns, K. A., J. M. Teal**, 1973. Hydrocarbons in the pelagic *Sargassum* community. Deep-Sea Research **20**:207-211.
**Keywords:** Atlantic/ community/ crab/ fish/ hydrocarbons/ marine invertebrate/ marine plant/ miscellaneous/ Oeleven/ petroleum/ petroleum hydrocarbons/ salt water/ saturated hydrocarbons
**Notes:** Samples of *Sargassum* weed and associated fauna were analyzed for saturated hydrocarbons to determine the loading of petroleum hydrocarbons in this area of the Atlantic Ocean.

**Burns, K. A.**, 1976. Hydrocarbon metabolism in the intertidal fiddler crab *Uca pugnax*. Marine Biology **36**:5-11.
**Keywords:** concentration/ crab/ hydrocarbons/ intertidal/ marine invertebrate/ metabolism/ Ofour/ petroleum hydrocarbons/ salt water
**Notes:** Comparison of hydrocarbon metabolism and hydrocarbon content between fiddler crabs from an uncontaminated and a previously contaminanted marsh; in vivo and in vitro measurements of metabolism.

**Burns, K. A., J. M. Teal**, 1979. The West Falmouth oil spill: hydrocarbons in the salt marsh ecosystem. Estuarine and Coastal Marine Science **8**:349-360.
**Keywords:** algae/ bird/ crustacean/ degradation/ ecosystem/ fish/ fuel oil/ hydrocarbons/ marine invertebrate/ marine plant/ No.2 fuel oil/ oil/ oil spill/ Oone/ salt marsh/ salt water/ sediment/ spill/ uptake
**Notes:** Analyses of sediments and organisms from the West Falmouth No. 2 fuel oil spill collected from 1 to 7 years after the spill.

**Burns, K. A., J. L. Smith**, 1982. Hydrocarbons in Victorian coastal ecosystems (Australia): chronic petroleum inputs to Western Port and Port Phillip Bays. Archives of Environmental Contamination and Toxicology **11**:129-140.
**Keywords:** aromatic hydrocarbons/ Australia/ chronic/ ecosystem/ hydrocarbons/ marine invertebrate/ miscellaneous/ mussel/ Oeleven/ petroleum/ salt water/ saturated hydrocarbons/ sediment/ survey/ tissue/ transplant
**Notes:** A survey of the hydrocarbons in Western Port and Port Phillip Bays of Australia. Core samples (39) of sediment and mussel samples (69) were collected from Port Philip Bay. 'Clean' mussels were collected from a remote site and transplanted to 14 locations in Western Port. Hydrocarbons in sediment and mussel tissue were analyzed to determine their source and quantitated (saturated and aromatic fractions) to determine relative hydrocarbon inputs at both sites.

**Burns, K. A., A. H. Knap**, 1989. The Bahia las Minas oil spill. Hydrocarbon uptake by reef building corals. Marine Pollution Bulletin **20**:391-398.
**Keywords:** Caribbean/ coral/ crude oil/ marine invertebrate/ Ofour/ oil/ oil spill/ Panama/ petroleum/ salt water/ sediment/ spill/ storage/ uptake
**Notes:** Assessment of the presence of crude oil 5 mos after the rupture of a storage tank near the Caribbean entrance of the Panama Canal (Bahia las Minas spill). Measured petroleum in corals, sediments, and seawater.

**Burns, K. A., S. D. Garrity, S. C. Levings**, 1993. How many years until mangrove ecosystems recover from catastrophic oil spills? Marine Pollution Bulletin **26**:239-248.
**Keywords:** bivalve/ Caribbean/ ecosystem/ epifauna/ mangrove/ marine invertebrate/ marine plant/ oil/ oil spill/ Osix/ Panama/ region/ review/ roots/ salt water/ sediment/ spill/ time
**Notes:** A review of the information generated by studies of the Bahias las Minas oil spill in coastal Panama in 1986. Presents 5 yrs of data from this spill (sediments, mangroves, epibiota on mangrove roots) and reviews information presented in other reports of spills in the Caribbean region.

**Burns, K. A., M. G. Ehrhardt, B. L. Howes, C. D. Taylor**, 1993. Subtidal benthic community respiration and production near the heavily oiled Gulf Coast of Saudi Arabia. Marine Pollution Bulletin **27**:199-205.
**Keywords:** benthic/ coast/ community/ effects/ Gulf oil spill/ hydrocarbons/ light/ marine invertebrate/ Ofour/ oil/ oiled/ respiration/ salt water/ Saudi Arabia/ sediment/ subtidal/ war
**Notes:** Assessment of the effects of oil from the Gulf War on subtidal benthic respiration and production. Used benthic respirometers to measure DO flux in light and dark chambers. Also measured hydrocarbon content of sediments.

**Burns, K. A.**, 1993. Analytical methods used in oil spill studies. Marine Pollution Bulletin **26**:68-72.
**Keywords:** biological effects/ chemical analysis/ effects/ Exxon Valdez/ fate/ methods/ oil/ oil spill/ Onine/ petroleum/ spill/ technical
**Notes:** A discussion of the use of multiple analytical techniques for determining chemical fate and biological effects of petroleum in oil spill studies. Offered as a counter to the criticized EPA "legally defensible methods" that were used for the Exxon Valdez oil spill.

**Burns, K. A., S. D. Garrity, D. Jorissen, J. MacPherson, M. Stoelting, J. Tierney, L. Yelle-Simmons**, 1994. The Galeta oil spill. II. Unexpected persistence of oil trapped in mangrove sediments. Estuarine and Coastal and Shelf Science **38**:349-364.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ crude oil/ depth/ hydrocarbons/ mangrove/ marine plant/ miscellaneous/ oil/ oil spill/ oiled/ Osix/ PAH/ Panama/ persistence/ roots/ salt water/ sediment/ spill
**Notes:** An assessment of the presence of crude oil from the Galeta, Panama oil spill in mangrove sediments. Sediment cores were collected 6 mos, 3.5 yrs, 4.5 yrs, and 5 yrs post-spill from oiled and unoiled sites. Sediments were analyzed at various depths for aliphatic and polycyclic aromatic hydrocarbons. The number of dead mangrove roots in sediment cores were also counted.

**Burns, K. A., L. Yelle-Simmons**, 1994. The Galeta oil spill. IV. Relationship between sediment and organism hydrocarbon loads. Estuarine and Coastal and Shelf Science **38**:397-412.
**Keywords:** Caribbean/ crude oil/ hydrocarbons/ marine invertebrate/ mussel/ Ofour/ oil/ oil spill/ oyster/ Panama/ petroleum/ petroleum hydrocarbons/ salt water/ saturated hydrocarbons/ sediment/ spill/ unsaturated hydrocarbons
**Notes:** Assessment of the presence of saturated and unsaturated petroleum hydrocarbons from the 1986 Bahia las Minas oil spill near the Caribbean entrance of the Panama Canal. Measure petroleum in sediment, false mussels, and oysters over a 5-yr period.

**Burns, K. A., S. Codi, N. C. Duke**, 2000. Gladstone, Australia field studies: weathering and degradation of hydrocarbons in oiled mangrove and salt marsh sediments with and without the application of an experimental bioremediation protocol. Marine Pollution Bulletin **41**:392-402.
**Keywords:** alkane/ Australia/ bioremediation/ Bunker C/ crude oil/ degradation/ fuel oil/ hydrocarbons/ mangrove/ microbes/ oil/ oiled/ Oten/ rate/ salt marsh/ salt water/ sediment/ time/ total hydrocarbons/ treatment/ vegetation
**Notes:** Assessment of the degradation rate for crude oil or Bunker C fuel oil in salt marsh or mangrove forest sediments. Treatments were salt marsh with Bunker C fuel oil or bioremediated Bunker C fuel oil, crude oil or bioremediated crude oil, and cut (vegetation removed) and uncut control; and mangroves with the same treatment array. Sediments were collected at day 2 and then at 1, 2, 5 or 6, and 12 or 13 mos post-spill for mangroves; and day 2, then 1, 3, and 9 mos post-spill for salt marshes. Sediments were analyzed for total hydrocarbons and individual alkanes.

**Burridge, T. R., M.-A. Shir**, 1995. The comparative effects of oil dispersants and oil/dispersant conjugates on germination of the marine macroalga *Phyllospora comosa* (Fucales: Phaeophyta). Marine Pollution Bulletin **31**:446-452.
**Keywords:** Australia/ bioassay/ combination/ concentration/ Corexit 7664/ Corexit 8667/ Corexit 9500/ Corexit 9527/ crude oil/ diesel/ diesel fuel/ dispersant/ effects/ evaluation/ germination/ macrophyte/ marine plant/ ODsix/ oil/ salt water/ static/ zygote
**Notes:** An evaluation of the effect of four chemical dispersants (Corexit 7664, 8667, 9500, and 9527), crude oil, diesel fuel, and combinations of dispersants and crude oil or diesel fuel on germination of

zygotes from an Australian marine macrophyte. Used a static bioassay and a range of concentrations to generate NOEC, LOEC, and 48-hr $EC_{50}$ values. [The crude oil is given different names in the text and figure headings].

**Busdosh, M.**, 1981. Long-term effects of the water soluble fraction of Prudhoe Bay crude oil on survival, movement and food search success of the Arctic amphipod *Boeckosimus (= Onisimus) affinis*. Marine Environmental Research **5**:167-180.
**Keywords:** amphipod/ Arctic/ behavior/ concentration/ crude oil/ effects/ food/ long-term/ marine invertebrate/ movement/ Ofour/ oil/ Prudhoe Bay/ Prudhoe Bay crude oil/ salt water/ solubility/ survival
**Notes:** Exposure of an Arctic amphipod to varying concentrations of the water-soluble fraction of Prudhoe Bay crude oil. Exposed for either 16 wks at constant concentration, one-time exposure for 3 da, or one-time exposure for 10 da. Measured survival and behavior.

**Bushdosh, M., R. M. Atlas**, 1977. Toxicity of oil slicks to Arctic amphipods. Arctic **30**:85-92.
**Keywords:** aliphatic hydrocarbons/ amphipod/ Arctic/ aromatic hydrocarbons/ crude oil/ diesel/ diesel fuel/ marine invertebrate/ Ofour/ oil/ oil slick/ Prudhoe Bay/ Prudhoe Bay crude oil/ rate/ respiration/ salt water/ species/ survival/ toxicity
**Notes:** Exposure of two species of Arctic amphipods to diesel fuel or one of three components (aliphatic, aromatic, or asphaltic) of Prudhoe Bay crude oil for 25 da. Laboratory exposure and outdoor exposure in brackish water ponds. Half of the amphipod trays in laboratory exposure were shielded from the surface oil by a screen. Measured survival and respiration rates.

**Butler, J. N., P. G. Wells, S. Johnson, J. J. Manock**, 1998. Beach tar on Bermuda: recent observations and implications for global monitoring. Marine Pollution Bulletin **36**:458-463.
**Keywords:** beach/ distribution/ intertidal/ methods/ miscellaneous/ monitoring/ Oeleven/ salt water/ sampling/ survey/ tar ball/ transect
**Notes:** Intertidal beach tar sampled on a Bermuda beach with a transect sampling method. Described distribution, appearance, and quantity of tar lumps and related the results to previous beach tar surveys performed on Bermuda beaches.

**Butler, R. G., P. Lukasiewicz**, 1979. A field study of the effect of crude oil on herring gull (*Larus argentatus*) chick growth. Auk **96**:809-812.
**Keywords:** bird/ chicks/ crude oil/ development/ dosed/ growth/ gull/ herring/ herring gull/ Louisiana/ Louisiana crude oil/ Maine/ oil/ Oone/ salt water/ South Louisiana crude oil
**Notes:** Growth of herring gull chicks dosed with South Louisiana crude oil.

**Butler, R. G., W. Trivelpiece, D. Miller, P. Bishop, C. D'Amico, M. D'Amico, G. Lambert, D. Peakall**, 1979. Further studies of the effects of petroleum hydrocarbons on marine birds. Bulletin of the Mount Desert Island Biological Laboratory **19**:33-35.
**Keywords:** aromatic hydrocarbons/ bird/ chicks/ dispersant/ dosed/ effects/ growth/ gull/ herring/ herring gull/ hydrocarbons/ Louisiana/ marine birds/ ODone/ organ/ petroleum/ petroleum hydrocarbons/ Prudhoe Bay/ salt water/ storm-petrel/ weathered/ weight
**Notes:** Herring gull and Leach's storm-petrel chicks dosed with Prudhoe Bay crude, weathered South Louisiana crude, an aromatic fraction of PBC, dispersant, or an oil/dispersant mixture. Chick growth and organ weights monitored.

**Butler, R. G., W. Trivelpiece, D. S. Miller**, 1982. The effects of oil, dispersant, and emulsions on the survival and behavior of an estuarine teleost and an intertidal amphipod. Environmental Research **27**:266-276.
**Keywords:** amphipod/ behavior/ dispersant/ effects/ emulsion/ estuarine/ fish/ fuel oil/ intertidal/ marine invertebrate/ No.2 fuel oil/ ODthree/ oil/ salt water/ survival
**Notes:** Experimental assessment of the effects of No. 2 fuel oil, AP chemical dispersant, or an emulsion of the two on the survival and behavior of a killifish and an amphipod.

**Butler, R. G., D. B. Peakall, F. A. Leighton, J. Borthwick, R. S. Harmon**, 1986. Effects of crude oil exposure on standard metabolic rate of Leach's storm-petrel. Condor **88**:248-249.

**Keywords:** bird/ crude oil/ effects/ experiment/ ingestion/ metabolism/ oil/ Oone/ plumage/ Prudhoe Bay/ Prudhoe Bay crude oil/ rate/ salt water/ storm-petrel
**Notes:** Effects of ingested Prudhoe Bay crude oil and oil applied to plumage on the metabolic rate of Leach's storm-petrel; two experiments.

**Butler, R. G., A. Harfenist, F. A. Leighton, D. B. Peakall**, 1988. Impact of sublethal oil and emulsion exposure on the reproductive success of Leach's storm-petrels: short and long-term effects. Journal of Applied Ecology **25**:125-143.
**Keywords:** bird/ Corexit 9527/ crude oil/ effects/ emulsion/ long-term/ oil/ Oone/ Prudhoe Bay/ Prudhoe Bay crude oil/ reproduction/ salt water/ storm-petrel/ sublethal
**Notes:** The short- and long-term reproductive effects on Leach's storm-petrels of exposure to Prudhoe Bay Crude oil or dispersed (Corexit 9527) crude oil during a 3-year field study.

**Byrne, C.**, 1989. Effects of the water-soluble fractions of No. 2 fuel oil on the cytokinesis of the quahog clam *(Mercenaria mercenaria)*. Bulletin of Environmental Contamination and Toxicology **42**:81-86.
**Keywords:** clam/ development/ effects/ eggs/ embryo/ fuel oil/ marine invertebrate/ No.2 fuel oil/ Ofour/ oil/ salt water
**Notes:** Exposure of eggs of the quahog clam to water-soluble fraction of No. 2 fuel oil. Measured development at early stages of embryo formation.

**Cabioch, L., J.-C. Dauvin, F. Gentil**, 1978. Preliminary observations on pollution of the sea bed and disturbance of sub-littoral communities in northern Brittany by oil from the *AMOCO CADIZ*. Marine Pollution Bulletin **9**:303-307.
**Keywords:** Amoco Cadiz/ amphipod/ coast/ community/ crude oil/ density/ effects/ France/ general effect/ marine invertebrate/ movement/ Oeight/ oil/ pollution/ salt water/ sampling/ species/ sublittoral/ subtidal/ time
**Notes:** An early assessment of the movement and effects of crude oil spilled by the *Amoco Cadiz* off the coast of Brittany, France. Authors provide a qualitative description of the movement of the oil into the subtidal coastal areas and present some data on the density and number of amphipod species at one sampling station.

**Cabioch, L.**, 1980. Pollution of subtidal sediments and disturbance of benthic animal communities. Ambio **9**:294-296.
**Keywords:** Amoco Cadiz/ benthic/ coast/ community/ crude oil/ effects/ France/ invertebrate/ marine invertebrate/ Ofour/ oil/ oil spill/ oiled/ pollution/ recovery/ salt water/ sediment/ spill/ subtidal
**Notes:** Description of the effects on and subsequent recovery of subtidal benthic invertebrates in heavily oiled portions of the coast of France near the site of the Amoco Cadiz oil spill. Covers the first year after the spill.

**Cadbury, C. J.**, 1978. The beach bird survey and other seabird surveillance. Ibis **120**:119-120.
**Keywords:** beach/ beached bird survey/ bird/ England/ oil/ oil spill/ Oone/ salt water/ spill/ survey
**Notes:** The British beach bird survey and it's relation to oil spill assessment.

**Cairns, D. K., R. D. Elliot**, 1987. Oil spill impact assessment for seabirds: the role of refugia and growth centres. Biological Conservation **40**:1-9.
**Keywords:** bird/ colony/ growth/ marine birds/ Newfoundland/ oil/ oil spill/ Oone/ population/ recovery/ salt water/ sources/ spill
**Notes:** Assessment of the role of refugia to serve as population sources in cases of oil spill impacts on marine bird colonies.

**Cajaraville, M. P., J. A. Marigomez, E. Angulo**, 1991. Automated measurement of lysosomal structure alterations in oocytes of mussels exposed to petroleum hydrocarbons. Archives of Environmental Contamination and Toxicology **21**:395-400.
**Keywords:** crude oil/ effects/ gonads/ hydrocarbons/ lubricating oil/ marine invertebrate/ mussel/ Ofour/ oil/ pathology/ petroleum/ petroleum hydrocarbons/ physiology/ salt water/ species/ structure
**Notes:** Exposure of one species of mussel to the water-accomodated fraction of two crude oils (Ural and

Maya) or a commercial lubricant oil for 21 da. Measured effects on the lysosomal system of mature oocytes; physiology and histopathology.

**Cajaraville, M. P., J. A. Marigomez, G. Diez, E. Angulo**, 1992. Comparative effects of the water accommodated fraction of three oils on mussels -- 2. Quantitative alterations in the structure of the digestive tubules. Comparative Biochemistry and Physiology **102C**:113-123.
**Keywords:** crude oil/ digestive gland/ effects/ lubricating oil/ marine invertebrate/ mussel/ Ofour/ oil/ salt water/ structure
**Notes:** Exposure of mussels for 91 da to the water accommodated fraction of Ural and Maya crude oils and a lubricant oil. Measured several aspects of digestive gland structure.

**Cajaraville, M. P., J. A. Marigomez, E. Angulo**, 1992. Comparative effects of the water accommodated fraction of three oils on mussels -- 1. Survival, growth and gonad development. Comparative Biochemistry and Physiology **102C**:103-112.
**Keywords:** abnormalities/ crude oil/ development/ effects/ gonads/ growth/ lubricating oil/ marine invertebrate/ mussel/ Ofour/ oil/ pathology/ salt water/ shell/ spawning/ species/ survival/ tissue
**Notes:** Exposed one species of mussel to the water-accomodated fraction of two crude oils (Maya and Ural) or a commerical lubricating oil for 91 da. Measured survival, flesh and shell growth, shell abnormalities, spawning, and histopathological changes in gonad tissue.

**Cajaraville, M. P., A. Orbea, I. Marigomez, I. Cancio**, 1997. Peroxisome proliferation in the digestive epithelium of mussels exposed to the water accommodated fraction of three oils. Comparative Biochemistry and Physiology **117C**:233-242.
**Keywords:** biochemical/ biomarker/ bivalve/ concentration/ crude oil/ marine invertebrate/ mussel/ Ofour/ oil/ petroleum/ physiology/ salt water/ time
**Notes:** Assessment of the induction of peroxisomes in the digestive epithelium of mussels as a result of exposure to three concentrations of water accommmodated fraction of two crude oils for 21, 49, and 91 da. Purpose was to determine if peroxisome proliferation could be used as a diagnostic biomarker for petroleum exposure.

**Cajaraville, M. P., L. Garmendia, A. Orbea, R. Werding, A. Gomez-Mendikute, U. Izagirre, M. Soto, I. Marigomez**, 2006. Signs of recovery of mussels health two years after the Prestige oil spill. Marine Environmental Research **62**:S337-S341.
**Keywords:** Bunker C/ cell/ coast/ composition/ condition/ development/ digestive gland/ fuel oil/ health/ index/ marine invertebrate/ mussel/ Ofour/ oil/ oil spill/ recovery/ salt water/ Spain/ spill/ time
**Notes:** Following the Prestige Bunker C fuel oil spill (2002), mussels were sampled at 22 locations along the coast of Galicia and the Bay of Biscay (Spain) during 2003 (three times) and 2004 (four times). The digestive gland was evaluated for peroxisome proliferation, changes in digestive alveoli, lysosomal membrane stability, and cell type composition. Also classified the mussels according to a flesh condition index and gamete development stage.

**Calder, J. A., J. H. Lader**, 1976. Effect of dissolved aromatic hydrocarbons on the growth of marine bacteria in batch culture. Applied Environmental Microbiology **32**:95-101.
**Keywords:** aromatic hydrocarbons/ bacteria/ cell/ density/ dissolved/ growth/ hydrocarbons/ microbes/ Oten/ rate/ salt water/ saturated hydrocarbons/ species
**Notes:** Exposure of two species of marine bacteria to saturated water solutions of seven aromatic hydrocarbons for up to 30 hrs. Measured growth rate and maximum cell density of bacteria in cell cultures.

**Caldwell, C. A.**, 1997. Aromatic hydrocarbon pathology in fish following a large spill into the Nemadji River, Wisconsin, USA. Bulletin of Environmental Contamination and Toxicology **58**:574-581.
**Keywords:** aromatic hydrocarbons/ fish/ fresh water/ hydrocarbons/ Othree/ pathology/ spill/ stream/ tissue
**Notes:** Tissue damage to fish following a spill of aromatic hydrocarbons into a Wisconsin river.

**Caldwell, P. J., A. E. Snart**, 1974. A photographic index for aging mallard embryos. Journal of Wildlife Management **38**:298-301.
**Keywords:** bird/ development/ embryo/ growth/ index/ mallard/ Oone/ photograph
**Notes:** A series of photographs of mallard embryos showing the growth and development of the embryo in the egg.

**Calfee, R. D., E. E. Little, L. Cleveland, M. G. Barron**, 1999. Photoenhanced toxicity of a weathered oil on *Ceriodaphnia dubia* reproduction. Environmental Science and Pollution Research **6**:207-212.
**Keywords:** adult/ concentration/ crude oil/ fresh water/ freshwater invertebrate/ light/ Ofive/ oil/ photoenhanced/ reproduction/ species/ static/ survival/ toxicity/ weathered/ zooplankton
**Notes:** Assessment of the toxicity of a weathered crude oil, in the presence of simulated solar radiation, to reproduction in a zooplankton species. Six concentrations of the water-accomodated fraction of the crude oil were combined with three levels of UV and visible light in 7-da static renewal laboratory tests. Measured survival and offspring per adult on a daily basis.

**Callaham, M. A., Jr., A. J. Stewart, C. Alarcon, S. J. McMillen**, 2002. Effects of earthworm (*Eisenia fetida*) and wheat (*Triticum aestivum*) straw additions on selected properties of petroleum-contaminated soils. Environmental Toxicology and Chemistry **21**:1658-1663.
**Keywords:** combination/ degradation/ earthworm/ effects/ freshwater invertebrate/ freshwater plant/ growth/ hydrocarbons/ Ofive/ oil/ petroleum/ petroleum hydrocarbons/ plant/ remediation/ respiration/ soil/ survival/ time/ wheat
**Notes:** An assessment of the role of earthworms in reclamation of petroleum-contaminated soil. Used landfarm and reference soils and a 1:1 combination of the two. Tested soils alone, earthworms added, straw added, or both added. Tests ran for 45 or 150 da. Measured plant (wheat) growth, soil respiration, earthworm survival, oil and grease, and total petroleum hydrocarbons.

**Callen, D. F., R. A. Larson**, 1978. Toxic and genetic effects of fuel oil photoproducts and three hydroperoxides in *Saccharomyces cerevisiae*. Journal of Toxicology and Environmental Health **4**:913-917.
**Keywords:** cell/ effects/ fuel oil/ genetic/ irradiance/ microbes/ No.2 fuel oil/ oil/ Oten/ photoenhanced/ stress/ survival/ toxicity/ yeast
**Notes:** No. 2 fuel oil was irradiated for 0, 12, 24,48, or 96 hrs and used, in various dilutions, to stress a strain of yeast. Measured survival of yeast cells and the incidence of genetic modification.

**Cameotra, S. S., J.-M. Bollag**, 2003. Biosurfactant-enhanced bioremediation of polycyclic aromatic hydrocarbons. Critical Reviews in Environmental Science and Technology **30**:111-126.
**Keywords:** aromatic hydrocarbons/ bioremediation/ evaluation/ hydrocarbons/ microbes/ ODten/ PAH/ petroleum/ petroleum hydrocarbons/ review/ soil
**Notes:** A review and evaluation of the use of biosurfactants for enhancing bioremediation of petroleum hydrocarbons. Presents a listing of major types of biosurfactants, discusses biosurfactants in soil bioremediation, and biosurfactants in PAH bioremediation.

**Cameron, J. A., R. L. Smith**, 1980. Ultrastructural effects of crude oil on early life stages of Pacific herring. Transactions of the American Fisheries Society **109**:224-228.
**Keywords:** abnormalities/ crude oil/ effects/ eggs/ fish/ fishery/ herring/ larvae/ oil/ Othree/ Pacific/ Pacific herring/ pathology/ Prudhoe Bay/ Prudhoe Bay crude oil/ salt water/ society
**Notes:** Effects on eggs of the Pacific herring experimentally exposed to Prudhoe Bay crude oil; gross abnormalities and electron microscopy of newly hatched larve.

**Campbell, D. A.**, 1981. Enhanced oil-recovery and its environmental and economic implications in the United States. Environmental Conservation **8**:5-18.
**Keywords:** effects/ enhanced recovery/ oil field/ Onine/ petroleum/ recovery/ review/ technical
**Notes:** A review of enhanced petroleum recovery. Sections on enhanced oil-recovery processes (four categories), environmental implications, and economic implications.

**Campbell, L. H., K. T. Standring, C. J. Cadbury**, 1978. Firth of Forth oil pollution incident, February 1978. Marine Pollution Bulletin **9**:335-339.
**Keywords:** bird/ effects/ England/ fuel oil/ oil/ Oone/ pollution/ salt water/ spill/ waterfowl/ wintering
**Notes:** Description of effects on wintering waterfowl of a small spill of medium/heavy fuel oil.

**Camphuysen, C. J.**, 1998. Beached bird surveys indicate decline in chronic oil pollution in the North Sea. Marine Pollution Bulletin **36**:519-526.
**Keywords:** analysis/ beached bird survey/ bird/ chronic/ coast/ decline/ index/ Netherlands/ North Sea/ oil/ oiled/ Oone/ pollution/ rate/ salt water/ survey/ vulnerability
**Notes:** Analysis of 21 yrs of beached bird surveys along the coast of the Netherlands. Use of oil vulnerability indicies, oiling rates, and counts of corpses.

**Camphuysen, C. J., M. Heubeck**, 2001. Marine oil pollution and beached bird surveys: the development of a sensitive monitoring instrument. Environmental Pollution **112**:443-461.
**Keywords:** analysis/ beached bird survey/ bird/ development/ history/ monitoring/ oil/ Oone/ petroleum/ pollution/ review/ salt water/ survey/ treatment
**Notes:** A scholarly and thorough treatment of the issue of beached bird surveys. The authors review the history of oil pollution and beached bird surveys (BBS), purposes and problems of BBS, and recommendations for the design and analysis of BBS.

**Camus, L., M. B. Jones, J. F. Borseth, F. Regoli, M. H. Depledge**, 2002. Heart rate, respiration and total oxyradical scavenging capacity of the Arctic spider crab, *Hyas araneus*, following exposure to polycyclic aromatic compounds via sediment and injection. Aquatic Toxicology **61**:1-13.
**Keywords:** Arctic/ aromatic hydrocarbons/ bioassay/ biochemical/ concentration/ crab/ crude oil/ crustacean/ effects/ experiment/ heart/ heart rate/ injection/ marine invertebrate/ North Sea/ North Sea crude oil/ Ofour/ oil/ oiled/ PAH/ petroleum/ rate/ respiration/ salt water/ sediment
**Notes:** Arctic spider crabs were used in an experiment to determine the effects of exposure to petroleum-contaminated sediment or injected petroleum. Used North Sea crude oil. Oil injection was 5 ul on days 0, 1, 3, and 6; experiment duration was 15 da. Measured heart rate, respiration, and total oxyradical scavenging capacity. Also, measured the concentration of 26 PAHs in the oiled sediment after 2 wks of exposure.

**Camus, L., S. R. Birkely, M. B. Jones, J. F. Borseth, B. E. Grosvik, B. Gulliksen, O. J. Lonne, F. Regoli, M. H. Depledge**, 2003. Biomarker responses and PAH uptake in *Mya truncata* following exposure to oil-contaminated sediment in an Arctic fjord (Svalbard). Science of the Total Environment **308**:221-234.
**Keywords:** Arctic/ biochemical/ biomarker/ bivalve/ clam/ crude oil/ marine invertebrate/ mussel/ North Sea/ North Sea crude oil/ offshore/ Ofour/ PAH/ respiration/ salt water/ sediment/ Svalbard/ tissue/ uptake
**Notes:** Mussels and sediment were collected from offshore Svalbard and used in a laboratory assessment of the effects of North Sea crude oil on selected biochemical responses. Sediment was mixed with crude oil (about 1 % oil) and two boxes of sediment, (one treatment and one control with mussels) were placed on the nearshore seabed for 14 days. Mussels were retrieved and returned to the lab. Measured total oxyradical scavenging capacity, stability of haemocyte membranes, and respiration. Also, measured total PAHs in sediment and clam tissue.

**Canaday, C., J. Rivadeneyra**, 2001. Initial effects of a petroleum operation on Amazonian birds: terrestrial insectivores retreat. Biodiversity Conservation **10**:567-595.
**Keywords:** Amazon/ analysis/ bird/ distance/ distribution/ effects/ multivariate/ Oone/ petroleum/ petroleum development/ species/ survey
**Notes:** An assessment of the effects of petroleum exploration on the species distribution of Amazonian forest birds. Employed 32 standardized surveys at 21 locations of varying distance from roads (0, 0.5, 1.5, 4.5 km). Identified bird species, grouped them according to guild, and performed multivariate analysis.

**Canevari, G. P.** 1975. A review of the utility of self-mixing dispersants in recent years. Pages 337-342 *in* 1975 Oil Spill Conference. American Petroleum Institute, Washington, D.C.
**Keywords:** dispersant/ mixing/ ODnine/ oil/ oil spill/ petroleum/ review/ spill/ technical

**Notes:** An early review of the usefulness of 'self mixing' chemical dispersants in dispersing spilled petroleum. A good description of the physical chemistry aspects of these dispersants.

**Canevari, G. P., G. P. Lindblom**, 1976. Some dissenting remarks on 'Deleterious effects of Corexit 9527 on fertilization and development'. Marine Pollution Bulletin **7**:127-128.
**Keywords:** Corexit 9527/ development/ dispersant/ effects/ eggs/ fertilization/ marine invertebrate/ ODfour/ salt water/ sea urchin/ urchin
**Notes:** Some rebuttal statements concerning a report of the effects of Corexit 9527 on sea urchin eggs by Lonning and Hagstrom (1976).

**Canevari, G. P.** 1977. Some recent observations regarding the unique characteristics and effectiveness of self-mix chemical dispersants. Pages 387-390 *in* 1977 Oil Spill Conference. American Petroleum Institute, Washington, D.C.
**Keywords:** commentary/ dispersant/ effectiveness/ mixing/ ODnine/ oil/ oil spill/ spill/ technical
**Notes:** An early commentary on the results of experimentation with 'self mixing' chemical dispersants; primarily a discussion of the physical chemistry aspects.

**Canevari, G. P.** 1979. The restoration of oiled shorelines by the proper use of chemical dispersants. Pages 443-446 *in* 1979 Oil Spill Conference, API 4308. American Petroleum Institute, Washington, DC.
**Keywords:** dispersant/ effects/ ODnine/ oil/ oil spill/ oiled/ restoration/ salt water/ shoreline/ spill/ technical
**Notes:** An early discussion of the advantages of chemical dispersants to clean oiled shorelines. Author presents a case study and discusses the effects of several other oil spills on coastal fauna. Recommendations for research are made.

**Cantelmo, A., L. Mantel, R. Lazell, F. Hospod, E. Flynn, S. Goldberg, and M. Katz** 1982. The effects of benzene and dimethylnaphthalene on physiological processes in juveniles of the blue crab, *Callinectes sapidus*. Pages 349-389 *in* W. B. Vernberg, A. Calabrese, F. P. Thurberg, F. J. Vernberg, editors. Physiological mechanisms of marine pollutant toxicity. Academic Press, New York.
**Keywords:** activity/ benzene/ biochemical/ blue crab/ consumption/ crab/ dimethylnapthalene/ dissolved/ effects/ growth/ juvenile/ marine invertebrate/ molt/ Ofour/ oxygen/ physiology/ salt water/ time/ tissue/ toxicity/ weight
**Notes:** Exposure of juvenile blue crabs to either 1 ppm dissolved benzene or 0.01 ppm dissolved dimethylnaphthalene until they died or molted. Measured time to molt, limb regeneration, weight and width at molt, oxygen consumption of whole animals and tissues, constituents of hemolymph, and ATPase activity.

**Capuzzo, J. M., B. A. Lancaster** 1982. Physiological effects of petroleum hydrocarbons in larval lobsters (*Homarus americanus*): hydrocarbon accumulation and interference with lipid metabolism. Pages 477-501 *in* W. B. Vernberg, A. Calabrese, F. P. Thurberg, F. J. Vernberg, editors. Physiological mechanisms of marine pollutant toxicity. Academic Press, Inc., New York.
**Keywords:** accumulation/ ammonia/ ammonium/ Corexit 9527/ crude oil/ diet/ dispersant/ effects/ hydrocarbons/ lipid/ lobster/ Louisiana/ Louisiana crude oil/ marine invertebrate/ metabolism/ molt/ nauplii/ ODfour/ oil/ petroleum/ petroleum hydrocarbons/ rate/ ratio/ respiration/ salt water/ South Louisiana crude oil/ survival/ tissue/ toxicity
**Notes:** Larval American lobsters were exposed for 96 hr to the water-soluble fractions of South Louisiana crude oil (250 ppb), crude oil-dispersant (Corexit 9527; 250 ppb:25 ppb), or a diet of Artemia sp. nauplii that were hatched in 250 ppb crude oil. Measured hydrocarbon content of water and tissues of larval lobsters, survival, moulting rates, ammonia excretion rates, and O:N ratios.

**Carls, E. G., D. B. Fenn, S. A. Chaffey**, 1995. Soil contamination by oil and gas drilling and production operations in Padre Island National Seashore, Texas, U.S.A. Journal of Environmental Management **45**:273-286.
**Keywords:** aliphatic hydrocarbons/ drilling fluids/ hydrocarbons/ metals/ miscellaneous/ Oeleven/ oil/ oil field/ pH/ salinity/ salt water/ soil/ Texas
**Notes:** Soil samples were collected from the vicinity of 18 active or inactive oil wells on South Padre

Island National Seashore, Texas. In each case, a companion reference sample was collected from a nearby area. Measured selected metals (drilling fluids), Na, salinity, pH, and aliphatic hydrocarbons.

**Carls, M. G., S. D. Rice**, 1989. Abnormal development and growth reductions of pollock *Theragra chalcogramma* embryos exposed to water-soluble fractions of oil. Fishery Bulletin **88**:29-37.
**Keywords:** Cook Inlet crude oil/ crude oil/ development/ effects/ embryo/ fish/ growth/ oil/ Othree/ pollock/ reduction/ salt water/ survival
**Notes:** Effects of water-soluble fractions of Cook Inlet crude oil on embryos of pollock; survival, growth, and development.

**Carls, M. G., G. D. Marty, T. R. Meyers, R. E. Thomas, S. D. Rice**, 1998. Expression of viral hemorrhagic septicemia virus in prespawning Pacific herring (*Clupea pallasi*) exposed to weathered crude oil. Canadian Journal of Fisheries and Aquatic Sciences **55**:2300-2309.
**Keywords:** adult/ bioassay/ concentration/ crude oil/ fish/ flow-through/ gravel/ herring/ immune response/ monooxygenase/ oil/ oiled/ Othree/ Pacific/ Pacific herring/ PAH/ pathology/ salt water/ survival/ virus/ weathered
**Notes:** Adult Pacific herring were exposed to gravel oiled with varying concentrations of "weathered' crude oil (control, trace, low, mid, high) (initial aqueous concentrations ranged from 0.03 to 58.3 ppb). Exposure lasted for 16-18 da in a laboratory flow-through bioassay. Measured total and specific PAH concentrations, herring survival, prevalence of viral hemorrhagic septicemia virus, MFO response, and micro- and macroscopic pathological responses.

**Carls, M. G., S. D. Rice, J. E. Hose**, 1999. Sensitivity of fish embryos to weathered crude oil: part I. Low-level exposure during incubation causes malformations, genetic damage, and mortality in larval Pacific herring (*Clupea pallasi*). Environmental Toxicology and Chemistry **18**:481-493.
**Keywords:** abnormalities/ aromatic hydrocarbons/ concentration/ crude oil/ eggs/ embryo/ fish/ genetic/ hatching/ herring/ incubation/ larvae/ malformation/ North Slope/ North Slope crude oil/ oil/ Othree/ Pacific/ Pacific herring/ PAH/ salt water/ swimming/ weathered
**Notes:** Eggs of the Pacific herring were exposed for up to 16 d to four concentrations of weathered Alaskan North Slope crude oil. Two types of weathered oil used. Measured selective and total PAH concentrations in water, hatching success, hatching timing, swimming ability of larvae, and larval abnormalities.

**Carls, M. G., J. E. Hose, R. E. Thomas, S. D. Rice**, 2000. Exposure of Pacific herring to weathered crude oil: assessing effects on ova. Environmental Toxicology and Chemistry **19**:1649-1659.
**Keywords:** abnormalities/ composition/ concentration/ crude oil/ effects/ eggs/ embryo/ female/ fertility/ fertilization/ fin/ fish/ genetic/ herring/ incubation/ larvae/ muscle/ oil/ Othree/ ova/ Pacific/ Pacific herring/ PAH/ Prudhoe Bay/ Prudhoe Bay crude oil/ salt water/ survival/ swimming/ time/ weathered
**Notes:** Pre-spawning Pacific herring were exposed to aqueous total PAH concentrations (initial; 0.03, 3.2, 10, 27, and 58 ppb) of artificially-weathered Prudhoe Bay crude oil for either 8 or 16 da. Eggs were artificially spawned and sampled at 0, 0.5, 1, 2, 4, 8, 16, and 24 da after fertilization. Measured total PAHs and composition of PAHs in exposure water, ova, fertilized eggs, and muscle of female parent. Also measured egg fertility, incubation time, embryo survival, larval survival, swimming ability of larvae, morphological abnormalities, larval characteristics, and genetic aberrations in pectoral fins.

**Carls, M. G., M. M. Babcock, P. M. Harris, G. V. Irvine, J. A. Cusick, S. D. Rice**, 2001. Persistence of oiling in mussel beds after the *Exxon Valdez* oil spill. Marine Environmental Research **51**:167-190.
**Keywords:** Alaska/ concentration/ crude oil/ estimate/ Exxon Valdez/ Gulf of Alaska/ marine invertebrate/ miscellaneous/ mussel/ Ofour/ oil/ oil spill/ oiled/ PAH/ persistence/ petroleum/ petroleum hydrocarbons/ phenanthrene/ Prince William Sound/ Prudhoe Bay crude oil/ salt water/ sediment/ spill/ time
**Notes:** A total of 98 different sites in Prince William Sound, Alaska and the Gulf of Alaska were sampled for mussels and sediment during 1992-95; the number sampled varied from year to year as sites were added or deleted from the collection process. Mussels and sediment were analyzed for 39 PAHs and an estimate of total petroleum was based on the amount of phenanthrene present. Data were used to estimate time to reach background concentrations and to make regional comparisons.

**Carls, M. G., G. D. Marty, J. E. Hose**, 2002. Synthesis of the toxicological impacts of the *Exxon Valdez* oil spill on Pacific herring (*Clupea pallasi*) in Prince William Sound, Alaska, U.S.A. Canadian Journal of Fisheries and Aquatic Sciences **59**:153-172.
**Keywords:** Alaska/ crude oil/ effects/ Exxon Valdez/ fish/ herring/ methods/ North Slope crude oil/ oil/ oil spill/ Othree/ Pacific/ Pacific herring/ petroleum/ population/ Prince William Sound/ review/ salt water/ spill/ time
**Notes:** A review and synthesis of the literature on the effects of the Exxon Valdez oil spill on Pacific herring in Prince William Sound, Alaska. Much of the discussion is devoted to the different methods and conclusions put forth by NRDA scientists and petroleum industry scientists. A thorough assessment with much detail.

**Carls, M. G., P. M. Harris, S. D. Rice**, 2004. Restoration of oiled mussel beds in Prince William Sound, Alaska. Marine Environmental Research **57**:359-376.
**Keywords:** Alaska/ aromatic/ aromatic hydrocarbons/ bivalve/ chemical analysis/ concentration/ experiment/ Exxon Valdez/ marine invertebrate/ mussel/ Ofour/ oil/ oil spill/ oiled/ PAH/ Prince William Sound/ restoration/ salt water/ sediment/ spill/ time/ tissue
**Notes:** Description of an experiment in restoration of mussel beds oiled by the Exxon Valdez oil spill. Nine oiled mussel beds were restored and compared to three oiled mussel beds that were not restored. In restored beds, mussels were removed and rinsed off, sediments were replaced with clean sediment from a nearby site, and the mussels were replaced. Sediment and mussel tissue were monitored before and during a 5-yr restoration period. Measured total hydrocarbon concentrations (aromatics) and total PAH concentrations in sediment and mussel tissue.

**Carls, M. G.**, 2006. Nonparametric identification of petrogenic and pyrogenic hydrocarbons in aquatic ecosystems. Environmental Science and Technology **40**:4233-4239.
**Keywords:** Alaska/ analysis/ crude oil/ ecosystem/ fish/ hydrocarbons/ methods/ model/ mussel/ oiled/ Onine/ PAH/ petroleum/ petroleum products/ pollution/ Prince William Sound/ pyrogenic/ ratio/ salt water/ sediment/ technical/ water/ weathered
**Notes:** A discussion and presentation of alternative methods of employing analytical results to distinguish between oiled and nonoiled or pyrogenic and petrogenic hydrocarbon (PAH) pollution. Tested three nonparametric models on the PAH content of water, sediment, fish, and mussels from Prince William Sound, Alaska. Also tested water and sediment containing a variety of other petroleum products and tested multiple PAH-containing substances.

**Carlson, R. I., J. A. Wilson, R. L. Lochmiller, D. M. Janz, J. L. Schroder, N. T. Basta**, 2003. Ecotoxicological risks associated with land treatment of petrochemical wastes. II. Effect on hepatic phase I and phase II detoxification enzymes in cotton rats. Journal of Toxicology and Environmental Health, Part A **66**:327-343.
**Keywords:** capture/ cotton rat/ enzyme/ liver/ mammal/ Otwo/ petroleum waste/ rat/ remediation/ risk/ seasonal/ sex
**Notes:** Cotton rats were collected from four petrochemcal landfarms and matched reference sites during the summer, fall, and winter of 1999-20. Livers were removed and analyzed for five detoxification enzymes. Comparisons were made between sexes and between liver removal on day of capture versus 48 hrs later.

**Carman, K. R., J. W. Fleeger, S. M. Pomarico**, 2000. Does historical exposure to hydrocarbon contamination alter the response of benthic communities to diesel contamination? Marine Environmental Research **49**:255-278.
**Keywords:** abundance/ activity/ benthic/ community/ composition/ concentration/ diesel/ grazing/ history/ Louisiana/ marine invertebrate/ marine plant/ microalgae/ microcosm/ Mississippi/ Ofour/ PAH/ petroleum/ petroleum hydrocarbons/ salt water/ sediment
**Notes:** Sediment was collected from a coastal marsh in Louisiana with a history of petroleum extraction and transportation and a coastal marsh in Mississippi with no history of petroleum-related activities. The biotic and abiotic characteristics of the sediment were determined. A total of 64 cylindrical PVC microcosms of sediment were collected from both sites and treated with diesel contaminated sediment (high, medium, low, and control) for either 0 (within 2 hr of dosing), 3, 10, or 21 da. Measured total PAH

concentrations in sediment, microalgal abundance and activity, meiofaunal grazing on microalgae, and meiofaunal community composition.

**Carmen, E. P., T. L. Crossman, E. G. Gatliff**, 1998. Phytoremediation of No. 2 fuel oil-contaminated soil. Journal of Soil Contamination **7**:455-466.
**Keywords:** fresh water/ freshwater plant/ fuel oil/ growth/ hydrocarbons/ No.2 fuel oil/ oil/ Oseven/ petroleum hydrocarbons/ plant/ remediation/ soil
**Notes:** Description of a phytoremediation effort at an industrial site containing 'hot spots' of soil heavily contaminated with No. 2 fuel oil. Soil was biovented for 24 wks and tested for suitability for plant growth. Willow trees were planted to bioremediate the remaining fuel oil hydrocarbons in the subsurface water.

**Carr, R. S., O. Linden**, 1984. Bioenergetic responses of *Gammarus salinus* and *Mytilus edulis* to oil and oil dispersants in a model ecosystem. Marine Ecology Progress Series **19**:285-291.
**Keywords:** ammonia/ ammonium/ amphipod/ biochemical/ crude oil/ dispersant/ ecosystem/ Ekofisk crude oil/ marine invertebrate/ model/ mussel/ ODfour/ oil/ ratio/ reproduction/ respiration/ salt water
**Notes:** Exposure of a mussel and an amphipod to a mixture of oil (Ekofisk crude oil) and water or oil+dispersant (Corexit 9550) and water for 12 da. Measured oil in water; O:N ratio, respiration, and ammonia excretion for amphipods; and byassal thread production and percent spawned for mussels.

**Carr, R. S., M. E. Barrows, N. G. Reichenbach, G. M. DeGraeve, T. L. Pollock, J. A. Fava, A. H. Glickman**, 1990. Investigation of preference-avoidance responses to an oil refinery effluent with striped bass and steelhead trout. Environmental Toxicology and Chemistry **9**:1513-1521.
**Keywords:** avoidance/ behavior/ effluent/ fish/ juvenile/ oil/ Othree/ refinery/ salt water/ steelhead trout/ striped bass
**Notes:** Assessment of the behavioral response of juvenile striped bass and steelhead trout exposed to refinery effluent discharged into San Francisco Bay.

**Carro, N., J. Cobas, J. Maneiro**, 2006. Distribution of aliphatic compounds in bivalve mollusks from Galicia after the Prestige oil spill: spatial and temporal trends. Environmental Research **100**:339-348.
**Keywords:** aliphatic hydrocarbons/ bivalve/ coast/ crude oil/ distribution/ fuel oil/ hydrocarbons/ marine invertebrate/ mussel/ Ofour/ oil/ oil spill/ salt water/ Spain/ spill/ trend
**Notes:** Raft-cultured mussels and wild cockles from numerous sites along the coast of Spain were collected 12/02-2/03 and analyzed for aliphatic hydrocarbons following the *Prestige* heavy fuel oil (the authors erroneously call it crude oil) spill of 11/02. Results were evaluated to determine the likely source of the hydrocarbons.

**Cavanaugh, K. P.** 1982. The effects of South Louisiana and Kuwait crude oils on reproduction. Pages 371-377 *in* C. G. Scanes, M. A. Ottinger, A. D. Kenny, J. Balthazart, J. Cronshaw, I. C. Jones, editors. Aspects of Avian Endocrinology: Practical and Theoretical Implications. Graduate Studies, Texas Tech University. Texas Tech Press, Lubbock, Texas.
**Keywords:** bird/ concentration/ crude oil/ duck/ effects/ egg shell/ eggs/ fresh water/ hormone/ Kuwait/ Kuwait crude oil/ Louisiana/ mallard/ oil/ Oone/ reproduction/ South Louisiana crude oil/ Texas
**Notes:** Discussion of the results of multiple studies of the reproductive effects of ingested South Louisiana and Kuwait crude oils on mallard ducks; egg production, eggshell thickness, hormone concentrations.

**Cavanaugh, K. P., W. N. Holmes**, 1982. Effects of ingested petroleum on plasma levels of ovarian steroid hormones in photostimulated mallard ducks. Archives of Environmental Contamination and Toxicology **11**:503-508.
**Keywords:** bird/ crude oil/ duck/ effects/ fresh water/ hormone/ Louisiana/ Louisiana crude oil/ mallard/ oil/ Oone/ petroleum/ plasma/ reproduction/ South Louisiana crude oil/ steroid
**Notes:** Effects of ingested South Louisiana crude oil on reproduction in mallards.

**Cavanaugh, K. P., A. R. Goldsmith, W. N. Holmes, B. K. Follett**, 1983. Effects of ingested petroleum on the plasma prolactin levels during incubation and on the breeding success of paired mallard ducks. Archives of Environmental Contamination and Toxicology **12**:335-341.

**Keywords:** bird/ crude oil/ duck/ effects/ fresh water/ incubation/ Louisiana/ Louisiana crude oil/ mallard/ oil/ Oone/ petroleum/ plasma/ prolactin/ reproduction/ South Louisiana crude oil
**Notes:** Effects of ingested South Louisiana crude oil on mallard reproduction.

**Cavanaugh, K. P., W. N. Holmes**, 1987. Effects of ingested petroleum on the development of ovarian endocrine function in photostimulated mallard ducks (*Anas platyrhynchos*). Archives of Environmental Contamination and Toxicology **16**:247-253.
**Keywords:** bird/ crude oil/ development/ duck/ effects/ endocrine/ fresh water/ Louisiana/ Louisiana crude oil/ mallard/ oil/ Oone/ petroleum/ reproduction/ South Louisiana crude oil
**Notes:** Effects of ingested South Louisiana crude oil on mallard reproduction.

**Celander, M., C. Naf, D. Broman, L. Forlin**, 1994. Temporal aspects of induction of hepatic cytochrome P450 1A and conjugating enzymes in the viviparous blenny (*Zoarces viviparus*) treated with petroleum hydrocarbons. Aquatic Toxicology **29**:183-196.
**Keywords:** blenny/ crude oil/ effects/ enzyme/ fish/ gas oil/ hydrocarbons/ injection/ metabolism/ North Sea/ North Sea crude oil/ oil/ Othree/ petroleum/ petroleum hydrocarbons/ salt water
**Notes:** Effects on hepatic cytochrome P450 1A and other enzymes of the viviparous blenny following injection with the heavy gas oil fraction distilled from North Sea crude oil.

**Celander, M., D. Broman, L. Forlin, C. Naf**, 1995. Effects of petroleum hydrocarbons on the hepatic cytochrome P450 1A1 system in rainbow trout. Marine Environmental Research **39**:61-65.
**Keywords:** crude oil/ effects/ fish/ fresh water/ gas oil/ hydrocarbons/ injection/ juvenile/ kerosene/ light/ metabolism/ North Sea/ North Sea crude oil/ oil/ Othree/ petroleum/ petroleum hydrocarbons/ rainbow trout
**Notes:** Effects on the hepatic cytochrome P450 1A1 system of juvenile rainbow trout injected with kerosene, light gas oil, or heavy gas oil distilled from North Sea crude oil.

**Chabreck, R. H.**, 1973. Bird usage of marsh ponds subjected to oil spills. Proceedings of the Louisiana Academy of Sciences **26**:101-110.
**Keywords:** bird/ concentration/ crude oil/ effects/ fish/ fresh water/ freshwater invertebrate/ freshwater plant/ invertebrate/ Louisiana/ oil/ oil spill/ Oone/ petroleum/ plant/ recovery/ sediment/ spill
**Notes:** Effects of a crude oil spill in three freshwater ponds in Louisiana over a 2-year period. Data on bird usage, plants, invertebrates, fish, and oil in sediments and water. The petroleum concentrations are suspect because they are so high.

**Chaerun, S. K., K. Tazaki, R. Asada, K. Kogure**, 2004. Bioremediation of coastal areas 5 years after the *Nakhodka* oil spill in the Sea of Japan: isolation and characterization of hydrocarbon-degrading bacteria. Environment International **30**:911-922.
**Keywords:** alkane/ aromatic/ aromatic hydrocarbons/ bacteria/ beach/ bioremediation/ composition/ experiment/ growth/ Japan/ microbes/ oil/ oil spill/ Oten/ physical characteristics/ remediation/ salt water/ sand/ spill/ tanker/ time/ water
**Notes:** Sampled 'heavy oil', seawater, and sand from the Nakhodka spill site in 1997, from a seashore site in 1999, and from two seashore sites in 2001. Authors describe a series of experiments and analyses that provide the elemental composition and physical characteristics of beach sands, tanker oil, and sea water during 5 yrs of post-spill remediation. Isolated and identified bacteria from samples and determined their ability to use selected alkanes, aromatics, and the heavy oil itself. Also determined the growth potential of bacterial strains in an enriched liquid growth medium.

**Chaillan, F., C. H. Chaineau, V. Point, A. Saliot, J. Oudot**, 2006. Factors inhibiting bioremediation of soil contaminated with weathered oils and drill cuttings. Environmental Pollution **144**:255-265.
**Keywords:** accumulation/ analysis/ bioremediation/ concentration/ crude oil/ cuttings/ degradation/ experiment/ fertilizer/ incubation/ microbes/ oil/ Oten/ petroleum/ soil/ time/ treatment/ weathered
**Notes:** An outdoor (Indonesia) and a laboratory bioremediation study of bioremediation of oily drill cuttings and soil contaminated with weathered crude oils. Outdoor bioremediation consisted of soil containing weathered crude oils only, weathered crude oil soil plus drill cuttings, and control soil; fertilizer was added to the contaminated soils. Duration of treatment was 12 mos; hydrocarbon analysis was

performed before treatment and at 3 mo intervals. Microbial concentrations were determined at 0.5, 3, 6, 9, and 12 mos. Laboratory incubation experiments were for 90 da and evaluated the effect of varying amounts of N and the accumulation of metabolic byproducts on the amount of petroleum degradation.

**Chaineau, C.-H., J. L. Morel, J. Oudot**, 1995. Microbial degradation in soil microcosms of fuel oil hydrocarbons from drilling cuttings. Environmental Science and Technology **29**:1615-1621.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ bacteria/ biodegradation/ concentration/ cuttings/ degradation/ drilling mud/ fuel oil/ fungi/ hydrocarbons/ microbes/ microcosm/ oil/ oil field/ Oten/ petroleum/ petroleum hydrocarbons/ rate/ soil/ time
**Notes:** Soil from an agricultural area populated by oil wells was used in a laboratory assessment of biodegradation rates of the petroleum hydrocarbons in drill cuttings from the local oil wells. Soils were untreated, sterilized, or treated with drill cuttings; all were fertilized. Experimental groups were analyzed for aliphatic and aromatic hydrocarbons on days 0, 8, 16, 30, 60, 90, 150, 210, and 270. Similarly, concentrations of total heterotrophic and hydrocarbon-utilizing bacteria were determined. Hydrocarbon-degrading bacteria and fungi were isolated and identified.

**Chaineau, C. H., J. L. Morel, J. Oudot**, 1997. Phytotoxicity and plant uptake of fuel oil hydrocarbons. Journal of Environmental Quality **26**:1478-1483.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ effects/ freshwater plant/ fuel oil/ germination/ growth/ hydrocarbons/ lettuce/ oil/ Oseven/ plant/ seed/ soil/ uptake/ weight/ wheat
**Notes:** The effects of a normal fuel oil and a fuel oil with lowered aromatic content were tested for phytotoxicity when incorporated into soil at 0.3 to 1.2 % by weight. Plants tested were sunflower, maize, wheat, barley, bean, lettuce, and clover. Measured effects on seed germination, plant growth, and plant uptake.

**Chaineau, C. H., C. Yepremian, J. F. Vidalie, J. Ducreux, D. Ballerini**, 2003. Bioremediation of a crude oil-polluted soil: biodegradation, leaching and toxicity assessments. Water, Air, and Soil Pollution **144**:419-440.
**Keywords:** biodegradation/ bioremediation/ concentration/ crude oil/ density/ evaluation/ growth/ hydrocarbons/ leachate/ methods/ microbes/ Microtox/ nutrients/ oil/ organic carbon/ Oten/ photosynthesis/ plant/ sampling/ seed/ seedling/ soil/ time/ total hydrocarbons/ toxicity
**Notes:** An evaluation of methods to enhance the bioremediation of crude oil polluted soil. Crude oil was added to soil without additives, nutrients only, nutrients + straw, nutrients + straw + fresh rye grass, nutrients + straw and covered with a greenhouse, and nutrients + straw between black plastic sheets. Samples were collected on days 0, 90, 180, 270, 330, and 480. Analyzed soil for concentrations of total hydrocarbons and several fractions. Also measured the solvent-extractable organic matter and dissolved organic carbon in drainage and leachate fluids. Microbe densities were determined at each sampling time. Soil toxicity was measured with seed inhibition for five plants and growth inhibition for four plants. Performed worm toxicity tests, Microtox (inhibition of luminescence), and Hill reaction (inhibition of photosynthesis).

**Chambers, J. E., J. R. Heitz, F. M. McCorkle, J. D. Yarbrough**, 1978. The effects of crude oil on enzymes in the brown shrimp *(Penaeus* sp). Comparative Biochemistry and Physiology **61C**:29-32.
**Keywords:** Arabian crude oil/ crude oil/ effects/ enzyme/ hepatopancreas/ marine invertebrate/ Ofour/ oil/ salt water/ Saudi Arabian crude oil/ shrimp
**Notes:** Exposure of brown shrimp to 10 ppm emulsified Saudi Arabian crude oil for 24 hr. Measured changes in 12 enzymes from the stomach-hepatopancreas.

**Chambers, J. E., J. R. Heitz, F. M. McCorkle, J. D. Yarbrough**, 1979. Enzyme activities following chronic exposure to crude oil in a simulated ecosystem. Environmental Research **20**:133-139.
**Keywords:** activity/ chronic/ concentration/ crude oil/ ecosystem/ Empire Mix crude oil/ enzyme/ hepatopancreas/ marine invertebrate/ Ofour/ oil/ oil spill/ oyster/ petroleum/ salt water/ shrimp/ simulation/ spill
**Notes:** Exposure of oysters and shrimp in a simulated ecosystem to chronic petroleum contamination. Empire Mix crude oil was added to produce an initial concentration of 0.2 ppm. Whole oyster

homogenates and hepatopancreas homogenates from shrimp were analyzed for enzyme activities at 6, 4, and 0.5 mos before oil exposure and 0.5, 1, 2, 4, and 6 mos after the simulated oil spill.

**Chambers, J. E.**, 1979. Induction of microsomal mixed-function oxidase system components in striped mullet by short-term exposure to crude oil. Toxicology Letters **4**:227-230.
**Keywords:** Arabian crude oil/ crude oil/ Empire Mix crude oil/ fish/ juvenile/ metabolism/ microsome/ mixed-function oxidase/ mullet/ oil/ Othree/ salt water/ short-term/ striped mullet
**Notes:** Effect on the hepatic microsomal mixed-function oxidase system of juvenile striped mullet following water exposure to Empire Mix crude oil or Arabian crude oil.

**Chambers, J. E., J. R. Heitz, F. M. McCorkle, J. D. Yarbrough**, 1979. Enzyme activities following chronic exposure to crude oil in a simulated ecosystem. II. Striped mullet. Environmental Research **20**:140-147.
**Keywords:** activity/ brain/ chronic/ crude oil/ ecosystem/ effects/ Empire Mix crude oil/ enzyme/ estuarine/ fish/ gill/ liver/ mullet/ muscle/ oil/ Othree/ salt water/ striped mullet/ tissue
**Notes:** Effects on a set of enzymes from brain, gill, liver, and muscle tissue of striped mullet following exposure for 10 months to Empire Mix crude oil in a simulated estuarine ecosystem.

**Chan, K., S. Y. Chiu**, 1985. The effects of diesel oil and oil dispersants on growth, photosynthesis, and respiration of *Chlorella salina*. Archives of Environmental Contamination and Toxicology **14**:325-331.
**Keywords:** algae/ chlorophyll/ combination/ diesel/ diesel fuel/ dispersant/ effects/ estuarine/ growth/ light/ marine plant/ ODsix/ oil/ photosynthesis/ respiration/ salt water/ shell
**Notes:** An estuarine algae was cultured in the presence of either light diesel fuel, chemical dispersants (BP1100X, BP1100WD, Shell Oil Herder), or combinations of diesel fuel and dispersants. Exposures were 0.05%, 0.5%, or 0.5% v/v. Measured culture growth, chlorophyl *a* content, photosynthesis ($O_2$ production), and respiration ($O_2$).

**Chandrasekar, S., G. A. Sorial, J. W. Weaver**, 2006. Dispersant effectiveness on oil spills -- impact of salinity. ICES Journal of Marine Science **63**:1430.
**Keywords:** analysis/ crude oil/ dispersant/ effectiveness/ fuel oil/ Louisiana/ mixing/ No.2 fuel oil/ ODnine/ oil/ oil spill/ Prudhoe Bay/ Prudhoe Bay crude oil/ salinity/ salt water/ South Louisiana crude oil/ spill/ technical/ temperature
**Notes:** A laboratory assessment of chemical dispersant effectiveness involving three oils (South Louisiana crude, Prudhoe Bay crude, No. 2 fuel oil), three salinities, and three levels of weathering. Also considered temperature and mixing energy in the analysis.

**Chang, Z. Z., R. W. Weaver**, 1997. Nitrification and utilization of ammonium and nitrate during oil bioremediation at different soil water potentials. Journal of Soil Contamination **6**:149-160.
**Keywords:** ammonia/ ammonium/ Arabian crude oil/ bioremediation/ clay/ concentration/ crude oil/ fresh water/ microbes/ nitrate/ nitrification/ oil/ Oten/ soil
**Notes:** Nitrification and utilization of ammonium and nitrate during a 40-day bioremediation study with Arabian crude oil and a clay loam soil; varying crude oil concentrations and soil water potentials.

**Chasse, C.**, 1978. The ecological impact on and near shores by the *AMOCO CADIZ* oil spill. Marine Pollution Bulletin **9**:298-301.
**Keywords:** algae/ Amoco Cadiz/ bivalve/ coast/ crude oil/ crustacean/ echinoderm/ effects/ fish/ France/ gastropod/ general effect/ invertebrate/ macroalgae/ marine invertebrate/ marine plant/ microalgae/ movement/ Oeight/ oil/ oil spill/ polychaete/ salt water/ spill/ survey/ time
**Notes:** An overall assessment of the effects of the *AMOCO CADIZ* crude oil spill on coastal fish, invertebrates, and algae during the first 3-4 mos after the spill. Movement of the oil was tracked and surveys performed at a large number of locations on the coast of Brittany, France. Included in the surveys were fish, crustaceans, gastropods, bivalves, polychaetes, echinoderms, macroalgae, and microalgae.

**Chaudhury, S., M. Martin, J. F. Payne, A. Rahimtula**, 1987. Alterations in platelet aggregation and microsomal benzo-a-pyrene hydroxylase activities after exposure of rats to a Prudhoe Bay crude oil.

Journal of Biochemical Toxicology **2**:93-104.
**Keywords:** activity/ crude oil/ effects/ mammal/ microsome/ oil/ Otwo/ physiology/ platelet/ Prudhoe Bay/ Prudhoe Bay crude oil/ rat
**Notes:** Effects on rat platelet aggregation and microsomal benzo-a-pyrene hydroxylase activity after dosing rats with Prudhoe Bay crude oil.

**Chaudhury, S., S. Macko, A. D. Rahimtula**, 1987. Inhibition of rat platelet aggregation by a Prudhoe Bay crude oil and its aliphatic, aromatic, and heterocyclic fractions. Toxicology and Applied Pharmacology **90**:347-356.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ crude oil/ effects/ mammal/ nonhydrocarbon/ oil/ Otwo/ physiology/ platelet/ Prudhoe Bay/ Prudhoe Bay crude oil/ rat
**Notes:** Effects on rat platelet aggregation after dosing rats with Prudhoe Bay crude oil; also incubated platelets with DMSO, a DMSO extract of the crude oil, aliphatic fraction, aromatic fraction, or nonhydrocarbon fraction.

**Chaudhury, S., S. Khan, A. D. Rahimtula**, 1988. Comparison of the inhibitory effects of some compounds present in crude oils on rat platelet aggregation: role of intra- and extra-cellular calcium. Toxicology **51**:35-46.
**Keywords:** crude oil/ effects/ hydrocarbons/ mammal/ nonhydrocarbon/ oil/ Otwo/ physiology/ platelet/ rat
**Notes:** Effects on rat platelet aggregation of several hydrocarbon and nonhydrocarbon compounds found in crude oil.

**Chet, I., R. Mitchell**, 1976. Petroleum hydrocarbons inhibit decomposition of organic matter in seawater. Nature **261**:308-309.
**Keywords:** bacteria/ decomposition/ effects/ hydrocarbons/ kerosene/ microbes/ motility/ organic/ Oten/ petroleum/ petroleum hydrocarbons/ rate/ salt water
**Notes:** Effects on motility and chemotactic response of motile bacteria of exposure to 3 mg/ml (parts per thousand) kerosene. Measured rate of decomposition of organic matter in seawater.

**Cheung, M. T., T. Y. Cheng, S. W. Leung, C. C. Lo, L. M. Mak**, 1979. Oil pollution along coastal areas of Hong Kong. Marine Pollution Bulletin **10**:228-231.
**Keywords:** depth/ hydrocarbons/ miscellaneous/ Oeleven/ oil/ pollution/ salt water/ saturated hydrocarbons/ time/ total hydrocarbons/ unsaturated hydrocarbons
**Notes:** Nearshore water samples were collected at two depths (1 ft and 5-10 ft) at three sites along coastal Hong Kong over an 8 mo period. Samples were analyzed for saturated and unsaturated hydrocarbons.

**Chianelli, R. R., T. Aczel, R. E. Bare, G. N. George, M. W. Genowitz, M. J. Gossman, C. E. Haith, F. J. Kaiser, R. R. Lessard, R. Liotta, R. L. Mastracchio, V. Minak-Bernero, R. C. Prince, W. K. Robbins, E. I. Stiefel, J. B. Wilkinson, S. M. Hinton, J. R. Bragg, S. J. McMillen, and R. M. Atlas** 1991. Bioremediation technology development and application to the Alaskan spill. Pages 549-558 *in* 1991 International Oil Spill Conference, API Publication 4529. American Petroleum Institute, Washington, D.C.
**Keywords:** Alaska/ beach/ bioremediation/ crude oil/ degradation/ development/ microbes/ oil/ oil spill/ Oten/ Prince William Sound/ Prudhoe Bay crude oil/ salt water/ spill
**Notes:** Summary of a large block of work on nutrient enhancement of microbial degradation performed by Exxon scientists in coordination with EPA. Descriptions cover preliminary laboratory trials, field trials, and large-scale applications to more than 70 miles of beaches in Prince William Sound during 1989-90.

**Cho, B-H., H. Chino, H. Tsuji, T. Kunito, K. Nagaoka, S. Otsuka, K. Yamashita, S. Matsumoto, H. Oyaizu**, 1998. Laboratory-scale bioremediation of oil-contaminated soil of Kuwait with soil amendment materials. Chemosphere **35**:1599-1611.
**Keywords:** bioremediation/ degradation/ hydrocarbons/ Kuwait/ methods/ microbes/ nutrients/ oiled/ Oten/ petroleum/ petroleum hydrocarbons/ soil/ spill/ surfactant/ toxicity
**Notes:** Experimentation with degradation methods for the oil-contaminated soils of Kuwait. Four kinds of materials and eight kinds of surfactants were added to oiled soils, in addition to the nutrient materials,

hyponex and bark manure. Measured amount of petroleum degradation and toxicity of the degraded hydrocarbons in the soil (Ames test).

**Chouksey, M. K., A. N. Kadam, M. D. Zingde**, 2004. Petroleum hydrocarbon residues in the marine environment of Bassein-Mumbai. Marine Pollution Bulletin **49**:637-647.
**Keywords:** aromatic/ aromatic hydrocarbon/ aromatic hydrocarbons/ coast/ crude oil/ environment/ fish/ hydrocarbons/ India/ marine environment/ miscellaneous/ Oeleven/ petroleum/ pollution/ salt water/ sediment/ species/ water
**Notes:** Samples of surface sediment (28), surface water (30), near-bottom water (19), and fish (five species in three areas) were collected from a coastal industrial and shipping area on the west coast of India. These samples were compared with samples of surface sediment (8), surface water (6), and near-bottom water (1) from a reference area to the south. Samples were analyzed for total aromatic hydrocarbons and compared with results from studies in selected parts of the world. Used a residue of Saudi Arabian Mix as a petroleum standard.

**Choules, G. L., W. C. Russell, D. A. Gauthier**, 1978. Duck mortality from detergent-polluted water. Journal of Wildlife Management **42**:410-414.
**Keywords:** bird/ cleaning/ detergent/ duck/ experiment/ fresh water/ mallard/ oiled/ Oone/ waterfowl
**Notes:** Investigation of the recurring deaths of waterfowl on an industrial waste basin at the Rocky Mountain Arsenal, Denver. Experiments were performed with mallards being exposed externally and internally to water containing detergents. Results related to the cleaning of oiled birds.

**Christens, E., H. Blokpoel**, 1991. Operational spraying of white mineral oil to prevent hatching of gull eggs. Wildlife Society Bulletin **19**:423-430.
**Keywords:** bird/ Canada/ eggs/ embryo/ fresh water/ gull/ hatching/ herring/ herring gull/ mineral oil/ oil/ Oone/ population control/ ring-billed gull/ spray
**Notes:** Operational use of mineral oil spray to kill embryos of herring and ring-billed gulls.

**Christens, E., H. Blokpoel, G. Rason, S. W. D. Jarvie**, 1995. Spraying white mineral oil on Canada goose eggs to prevent hatching. Wildlife Society Bulletin **23**:228-230.
**Keywords:** bird/ Canada/ Canada geese/ eggs/ fresh water/ hatching/ mineral oil/ oil/ Oone/ population control
**Notes:** Operational spraying of Canada goose eggs to prevent hatching.

**Christensen, J. H., A. B. Hansen, G. Tomasi, J. Mortensen, O. Andersen**, 2004. Integrated methodology for forensic oil spill identification. Environmental Science and Technology **38**:2912-2918.
**Keywords:** analysis/ fingerprinting/ miscellaneous/ Oeleven/ oil/ oil spill/ petroleum/ spill/ statistics
**Notes:** Description of an integrated methodology to be used in identifying the source of an oil sample. The first section describes the procedure which is heavily reliant on statistical tests and ratios. The second part is a case study demonstrating the utility of the methods.

**Christiansen, M. E., F. C. Stormer**, 1978. Effects of the water-soluble fraction of Ekofisk crude oil on zoeal larvae of the crab *Hyas araneus*. Ambio **7**:23-25.
**Keywords:** crab/ crude oil/ effects/ Ekofisk crude oil/ larvae/ marine invertebrate/ molt/ Ofour/ oil/ salt water/ survival
**Notes:** Exposure of larvae of a brachyuran crab to 0.3, 1.5, and 3.0 ppm of the water-soluble fraction of Ekofisk crude oil for 75 da. Measured survival and molt response.

**Chukwu, L. O., S. C. U. Nwachukwu**, 2005. Impact of refined petroleum spills on water quality, macro-invertebrate and microbial communities of a tropical aquatic environment. Journal of Environmental Biology **26**:449-458.
**Keywords:** abundance/ bacteria/ benthic/ community/ environment/ freshwater invertebrate/ invertebrate/ macroinvertebrate/ microbes/ Nigeria/ Oten/ petroleum/ pipeline/ soil/ spill/ stream/ water/ yeast
**Notes:** Four months after a pipeline rupture in Nigeria contaminated a large surrounding area, samples of water, soil, and benthic stream invertebrates were collected at five impacted sites on three first-order streams and three unaffected sites on streams above the spill. Invertebrates were counted and identified,

water was physically and chemically characterised; and bacteria, molds, and yeasts were identified and their abundance estimated.

**Chung, K.-H., J.-H. Lee, K. S. Ro**, 2000. Composting of kerosene-contaminated soil: fate of kerosene. Journal of Environmental Science and Health **A35**:1183-1194.
**Keywords:** activity/ compost/ concentration/ degradation/ effectiveness/ fate/ hydrocarbons/ kerosene/ microbes/ movement/ Oten/ remediation/ soil/ temperature
**Notes:** A bench-scale compost reactor system was used to determine the effect of kerosene concentration on composting effectiveness. Soil was contaminated with 0, 1, 5, or 20 % (w/w) kerosene. Samples were taken from the reactors at 0, 6, 14, and 22 da of composting and analyzed for kerosene. Microbial activity was determined by measuring $CO_2$ generation and the soil temperature was monitored. Radio-labelled hexadecane was used to quantify the movement of hydrocarbons withing the 1 % concentration reactor (monitored for 64 da).

**Clark, R. B.**, 1978. Oiled seabird rescue and conservation. Journal of the Fisheries Research Board of Canada **35**:675-678.
**Keywords:** bird/ conservation/ oiled/ Oone/ population/ rehabilitation/ rescue/ salt water
**Notes:** Discussion of the usefulness of oiled bird rehabilitation as practiced in the late 70s.

**Clark, R. B., G. Dunnet, J. M. Addy**, 1984. Seabirds and North Sea oil. Marine Pollution Bulletin **15**:272-274.
**Keywords:** bird/ North Sea/ oil/ Oone/ salt water
**Notes:** Results of a seminar on seabirds and the North Sea oil industry; problems and research recommendations.

**Clark, R. B.**, 1984. Impact of oil pollution on seabirds. Environmental Pollution (Series A) **33**:1-22.
**Keywords:** Atlantic/ auks/ bird/ colony/ decline/ history/ oil/ oil spill/ Oone/ pollution/ population/ salt water/ spill
**Notes:** Discusses impact of oil pollution on seabirds of the Atlantic. Declines in southern auk colonies and increases in auk colonies of the northeast Atlantic are thought to be independent of oil spills. Concludes that oil spills are not generally damaging to seabird populations.

**Clark, R. B.**, 1987. Summary and conclusions: environmental effects of North Sea oil and gas developments. Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences **316**:669-677.
**Keywords:** activity/ bird/ community/ development/ effects/ environment/ fish/ general effect/ marine invertebrate/ marine plant/ natural gas/ North Sea/ Oeight/ oil/ petroleum/ region
**Notes:** A very good and clear summary of a scientific meeting held in 1986 to discuss the effects on the North Sea of oil and gas development. All aspects of the environment, including human activities, are incorporated.

**Clark, R. C., Jr.**, 1976. Impact of the transportation of petroleum on the waters of the northeastern Pacific Ocean. Marine Fisheries Review **38**:20-26.
**Keywords:** Alaska/ coast/ crude oil/ effects/ fate/ fishery/ general effect/ miscellaneous/ Oeleven/ oil/ Pacific/ petroleum/ pipeline/ pollution/ Prudhoe Bay crude oil/ refinery/ salt water/ sources/ tanker
**Notes:** An assessment of the potential impacts of the impending completion of the trans-Alaska pipeline and the subsequent shipment of crude oil by tanker to refineries on the west coast of the United States. Author has sections on transportation and production of petroleum related to the west coast, charactertistics of Prudhoe Bay crude oil, superports and supertankers, oil pollution sources, projected pollution impact from increased tanker traffic, chemical, physical, and biological fate of oil, effects on fisheries, and general effects on marine resources.

**Clark, W. S., E. Gorney**, 1987. Oil contaminantion of raptors migrating along the Red Sea. Environmental Pollution **46**:307-313.
**Keywords:** bird/ oil/ Oone/ raptor/ Red Sea/ salt water/ spill
**Notes:** Report of oil on migrating raptors going through Israel.

**Clarke, P. J., T. J. Ward**, 1994. The response of southern hemisphere saltmarsh plants and gastropods to experimental contamination by petroleum hydrocarbons. Journal of Experimental Marine Biology and Ecology **175**:43-57.
**Keywords:** Australia/ crude oil/ diesel/ diesel fuel/ dispersant/ gastropod/ general effect/ hydrocarbons/ marine invertebrate/ marine plant/ ODeight/ oil/ petroleum/ petroleum hydrocarbons/ plant/ salt marsh/ salt water/ species/ treatment/ vegetation/ weathered
**Notes:** Saltmarsh enclosures on coastal Australia were exposed to either no oil, weathered Bass Strait crude oil, weathered diesel fuel, Corexit NSC 6850, or weathered crude oil plus dispersant. Saltmarsh vegetation was photographed before treatment and 1 and 8 mos after treatment; plant tillers were counted until 17 mos after treatment. Counts of four gastropod species were made before and 10 da after treatment, and at about 30 da intervals for 1 yr.

**Claxton, L. D., V. S. Houk, R. Williams, F. Kremer**, 1991. Effect of bioremediation on the mutagenicity of oil spilled in Prince William Sound, Alaska. Chemosphere **23**:643-650.
**Keywords:** Alaska/ assay/ beach/ bioassay/ bioremediation/ crude oil/ fertilizer/ microbes/ oil/ oiled/ organic/ Oten/ Prince William Sound/ Prudhoe Bay crude oil/ sand/ time
**Notes:** A mutagenicity bioassay of beach sand from a demonstration project of enhanced bioremediation on Knight Island, Prince William Sound, Alaska. An oiled beach received either of two types of fertilizer and were compared to a reference site on the same beach. Samples (three) of beach sand were collected approximately 2 mos apart during the summer of 1989 and used in a laboratory assay with spiral Salmonella. Also measured total extractable organic mass.

**Clayton, J. R., Jr., G. H. Farmer, J. R. Payne, G. D. McNabb, Jr., P. C. Harkins, J. S. Evans, N. P. Rottunda, C. R. Phillips, and M. I. Evans** 1989. Effects of chemical dispersant agents on the behavior and retention of spilled crude oil in a simulated streambed channel. Pages 4-24 *in* M. Flaherty, editor. Oil Dispersants: New Ecological Approaches. ASTM Special Technical Publication 1018. American Society for Testing and Materials, Philadelphia, PA.
**Keywords:** aliphatic hydrocarbons/ behavior/ crude oil/ dispersant/ effects/ fresh water/ hydrocarbons/ miscellaneous/ ODeleven/ oil/ Prudhoe Bay/ Prudhoe Bay crude oil/ sediment/ stream/ technical/ time
**Notes:** An artificial streambed consisting of six parallel and interconnected runs was constructed for use in an assessment of chemically dispersed crude oil in a fresh water stream scenario. Three trials were performed; fresh Prudhoe Bay crude oil only, crude oil and OFC D-609 dispersant, and crude oil with Corexit 9550. Eleven sites in the runs were physically characterized and sampled at times 0, 0.5, 2, 4, 8, 24, 72, 120, 168, and 190-220 hrs. Samples were analyzed for aliphatic hydrocarbons.

**Clement, L. E., M. S. Stekoll, D. G. Shaw**, 1980. Accumulation, fractionation and release of oil by the intertidal clam *Macoma balthica*. Marine Biology **57**:41-50.
**Keywords:** accumulation/ clam/ crude oil/ depuration/ intertidal/ marine invertebrate/ Ofour/ oil/ petroleum hydrocarbons/ Prudhoe Bay/ Prudhoe Bay crude oil/ release/ salt water/ tissue
**Notes:** Exposure of the clam *Macoma balthica* to oil and seawater dispersions of 0.03, 0.3, or 3.0 ppm Prudhoe Bay crude oil for 180 da followed by a 60 da depuration period. Measured accumulation and depuration of various fractions of the crude oil in clam tissue.

**Clifton, H. E., K. A. Kvenvolden, J. B. Rapp**, 1984. Spilled oil and infaunal activity -- modification of burrowing behavior and redistribution of oil. Marine Environmental Research **11**:111-136.
**Keywords:** activity/ aliphatic hydrocarbons/ behavior/ burrowing/ coast/ composition/ crude oil/ effects/ experiment/ hydrocarbons/ infauna/ marine invertebrate/ North Slope/ North Slope crude oil/ Ofour/ oil/ persistence/ petroleum/ salt water/ sand/ tidal flat/ Washington
**Notes:** Assessment of the effects of North Slope crude oil on the infaunal activity in a tidal flat on the coast of Washington. Crude oil spilled over the surface of the flat in one experiment; a layer of oil-saturated sand 1 cm thick buried 5 cm beneath the surface in another experiment. Measured burrowing activity and petroleum persistence for up to 2 yrs. Petroleum composition monitored by analyzing for aliphatic hydrocarbons.

**Cobb, J. L. S.**, 1976. Seabird mortality. Bird Study **23**:299-300.
**Keywords:** bird/ commentary/ England/ fishery/ nets/ oil/ oil spill/ Oone/ salt water/ spill

**Notes:** Commentary on the magnitude of seabird deaths due to fishermen of the nineteenth century. Comparisons made with the contemporary loss of birds due to oil spills.

**Coffey, J. C., C. H. Ward, J. M. King**, 1977. Effects of petroleum hydrocarbons on growth of fresh-water algae. Developments in Industrial Microbiology **18**:661-672.
**Keywords:** algae/ aromatic hydrocarbons/ cell/ concentration/ crude oil/ effects/ fresh water/ freshwater plant/ fuel oil/ growth/ hydrocarbons/ Kuwait/ Kuwait crude oil/ Louisiana/ Louisiana crude oil/ naphthalene/ No.2 fuel oil/ oil/ Oseven/ petroleum/ petroleum hydrocarbons/ South Louisiana crude oil/ species
**Notes:** Three species of green algae and two species of blue-green algae were used in flask and test tube cultures to assess the effects of water-soluble fractions (WSF) of Kuwait crude oil, South Louisiana crude oil, No. 2 fuel oil (fresh (24 hrs)and aged WSF ( 72 hrs)); and naphthalene in water solution. Four concentrations of each were used. Analyzed the culture water for aromatic hydrocarbons. Measured culture growth in terms of cell yield.

**Coffin, R. B., L. A. Cifuentes, P. H. Pritchard**, 1997. Assimilation of oil-derived carbon and remedial nitrogen applications by intertidal food chains on a contaminated beach in Prince William Sound, Alaska. Marine Environmental Research **44**:27-39.
**Keywords:** Alaska/ algae/ assimilation/ bacteria/ beach/ bivalve/ carbon/ degradation/ experiment/ fertilizer/ food/ food chain/ intertidal/ isotope/ marine plant/ microbes/ microcosm/ nitrogen/ oil/ oiled/ Oten/ Prince William Sound/ ratio/ salt water/ substrate
**Notes:** Stable $^{13}C$ and $^{15}N$ ratios were used to evaluate oil degradation and the use of fertilizer supplements by bacteria on oiled beaches in the rocky intertidal zone of an island in Prince William Sound and in microcosm experiments. Isotope rations were measured in bacterial substrate, algae, and bivalve grazers of algae and bacteria.

**Cohen, A., M. M. Gagnon, D. Nugegoda**, 2003. Biliary PAH metabolite elimination in Australian Bass, *Macquaria novemaculeata* following exposure to Bass Strait crude oil and chemically dispersed crude oil. Bulletin of Environmental Contamination and Toxicology **70**:394-400.
**Keywords:** Australia/ bile/ crude oil/ depuration/ dispersant/ fish/ gall bladder/ hydrocarbons/ juvenile/ metabolite/ ODthree/ oil/ PAH/ petroleum/ petroleum hydrocarbons/ salt water/ time
**Notes:** Juvenile Australian bass were exposed to the water-accomodate fraction (WAF) of Bass Strait crude oil or chemically dispersed WAF. Exposure time was 4 da followed by 12 da of depuration. Fish were sampled on days 0, 4, and 16 and the gall bladders were removed and analyzed for naphthalene-type and benzo(a)pyrene-type metabolites. The WAF was analyzed for total petroleum hydrocarbons.

**Cohen, A., M. M. Gagnon, D. Nugegoda**, 2005. Alterations of metabolic enzymes in Australian bass, *Macquaria novemaculeata*, after exposure to petroleum hydrocarbons. Bulletin of Environmental Contamination and Toxicology **49**:200-205.
**Keywords:** activity/ Australia/ burning/ concentration/ Corexit 9527/ crude oil/ dispersant/ effects/ enzyme/ fish/ food/ gill/ hydrocarbons/ liver/ metabolism/ muscle/ ODthree/ oil/ petroleum/ petroleum hydrocarbons/ salt water/ time/ water
**Notes:** Australian bass were used in a semi-static laboratory test of the effects of the water-accomodated fraction of Bass Strait crude oil, chemically-dispersed (Corexit 9527) crude oil, and burned crude oil. Employed two concentrations of WAF and exposure via water or food for a period of 16 da. Measured cytochrome C oxidase and lactate dehydrogenase activities in gills, liver, and white muscle, and total petroleum hydrocarbons in exposure water.

**Cohen, A., M. M. Gagnon, D. Nugegoda**, 2006. Oil spill remediation techniques can have different impacts on mixed function oxygenase enzyme activities in fish. Bulletin of Environmental Contamination and Toxicology **76**:855-862.
**Keywords:** activity/ biochemical/ crude oil/ depuration/ dispersant/ enzyme/ fish/ juvenile/ liver/ microsomal/ ODthree/ oil/ oil spill/ remediation/ salt water/ spill
**Notes:** Juvenile Australian sea bass were exposed to the water-accomodated fraction of Bass Strait crude oil for 4 da followed by a 12 da depuration period. Exposures groups were WAF, WAF of

chemically-dispersed crude oil, and WAF from burned surface oil. Fish were sampled at days 0, 4, and 16 and the livers removed for measurement of hepatic microsomal EROD activity.

**Cohen, A. M., D. Nugegoda**, 2000. Toxicity of three oil spill remediation techniques to the Australian bass *Macquaria novemaculeata*. Ecotoxicology and Environmental Safety **47**:178-185.
**Keywords:** behavior/ burning/ crude oil/ dispersant/ effects/ experiment/ fish/ hydrocarbons/ ODthree/ oil/ oil spill/ petroleum/ petroleum hydrocarbons/ remediation/ salt water/ spill/ survival/ toxicity
**Notes:** Assessment of the effects of a reference toxicant (4-chlorophenol), crude oil water accomodated fraction (WAF), dispersed oil WAF, and burned oil WAF on the Australian bass. Experiment was performed in aerated tanks for determination of 96-hr $LC_{50}$; water was changed every 24 hrs. Measured water characteristics, total petroleum hydrocarbons, survival, behavior, and morphology (fish color change).

**Cohen, A. M., D. Nugegoda, M. M. Gagnon**, 2001. The effect of different oil spill remediation techniques on petroleum hydrocarbon elimination in Australian bass (*Macquaria novemaculeata*). Archives of Environmental Contamination and Toxicology **40** :264-270.
**Keywords:** amphipod/ bile/ concentration/ consumption/ Corexit 9527/ crude oil/ dispersant/ effects/ elimination/ evaluation/ experiment/ fish/ flow-through/ hydrocarbons/ metabolite/ methods/ oil/ oil spill/ Othree/ PAH/ petroleum/ petroleum hydrocarbons/ remediation/ salt water/ shrimp/ spill/ uptake
**Notes:** Australian bass were used in an evaluation of the effects of spill remediation methods on bioavailability and elimination of petroleum hydrocarbons. Bass were exposed to water-accommodated fractions of Bass Strait crude oil, chemically-dispersed (Corexit 9527) crude oil, or burned crude oil in flow-through and semi-static experiments. Duration of exposure was 16 da and two types of stock solutions were used. Fish were exposed to either 0.5% or 2% stock solution in the water or by consumption of amphipods and brine shrimp exposed to the same dilutions of stock solution. Measured total petroleum hydrocarbon concentrations, PAH concentrations, two types of metabolites in fish bile, and characteristics of the exposure water.

**Cohen, M. J.**, 1995. Technological disasters and natural resource damage assessment: an evaluation of the *Exxon Valdez* oil spill. Land Economics **71**:65-82.
**Keywords:** Alaska/ analysis/ cost/ crab/ damage assessment/ economy/ evaluation/ Exxon Valdez/ fishery/ miscellaneous/ natural resource/ Oeleven/ oil/ oil spill/ spill
**Notes:** An economic analysis of the cost of the *Exxon Valdez* oil spill to the fisheries industry of southcentral Alaska; includes finfish and crabs.

**Cohen, Y., A. Nissenbaum, R. Eisler**, 1977. Effects of Iranian crude oil on the Red Sea octocoral *Heteroxenia fuscescens*. Environmental Pollution **12**:173-186.
**Keywords:** aliphatic hydrocarbons/ behavior/ concentration/ coral/ crude oil/ effects/ flow-through/ hydrocarbons/ Iranian crude oil/ marine invertebrate/ Ofour/ oil/ Red Sea/ salt water/ static/ survival/ toxicity
**Notes:** Experimental exposure of a Red Sea coral to Iranian crude oil in static and flow-through toxicity tests. Static tests used concentrations of 1, 3, 10, or 30 ml/liter for 96 hr exposure. Flow-through tests used 10 ml/liter for 168 hr followed by a post-treatment period of 168 hr. Measured survival, behavior, and aliphatic hydrocarbon content of the coral.

**Colavecchia, M. V., S. M. Backus, P. V. Hodson, J. L. Parrott**, 2004. Toxicity of oil sands to early life stages of fathead minnows (*Pimephales promelas*). Environmental Toxicology and Chemistry **23**:1709-1718.
**Keywords:** abnormalities/ bioassay/ embryo/ fathead minnow/ fish/ fresh water/ larvae/ oil/ oil sands/ Othree/ PAH/ sand/ sediment/ survival/ time/ toxicity/ weight
**Notes:** Sediments from a wastewater pond at an oil sands production facility, three oil sands sites, and two reference sites were used in a bioassay involving fathead minnows. Fertilized embryos were placed in containers of sediment and water that were renewed daily; exposure time was 12 da. Measured survival of embryos and larvae, abnormalities, and weights of larvae. Analyzed sediments for alkylated and non-alkylated PAHs.

**Coles, S. L., K. A. Al-Riyami**, 1996. Beach tar concentrations on the Muscat coastline, Gulf of Oman, Indian Ocean, 1993-1995. Marine Pollution Bulletin **32**:609-614.
**Keywords:** beach/ concentration/ Gulf of Oman/ Indian Ocean/ miscellaneous/ Oeleven/ salt water/ survey/ tar ball/ time/ transect
**Notes:** Tar balls were counted 20 times during the period 2/93 to 2/95 at nine sites along the beach near Muscat, Sultanate of Oman. At each site, three transects were established and all tar balls were collected. Results were compared to previous surveys in this area and surveys in other middle east countries.

**Collier, T. K., M. M. Krahn, D. C. Malins**, 1980. The disposition of naphthalene and its metabolites in the brain of rainbow trout (*Salmo gairdneri*). Environmental Research **23**:35-41.
**Keywords:** blood/ brain/ fish/ fresh water/ injection/ liver/ metabolism/ metabolite/ naphthalene/ Othree/ rainbow trout
**Notes:** Disposition of naphthalene and its metabolites in the brain, liver, and blood of rainbow trout following exposure by oral administration or injection.

**Collier, T. K., M. M. Krahn, C. A. Krone, L. L. Johnson, M. S. Myers, S.-L. Chan, and U. Varanasi** 1993. Oil exposure and effects in subtidal fish following the *Exxon Valdez* oil spill. Pages 301-305 *in* 1993 International Oil Spill Conference, API Publication 4580. American Petroleum Institute, Washington, D.C.
**Keywords:** activity/ Alaska/ analysis/ aromatic hydrocarbons/ biochemical/ condition/ effects/ enzyme/ Exxon Valdez/ fish/ hormone/ liver/ oil/ oil spill/ Othree/ ovary/ pathology/ salt water/ species/ spill/ subtidal/ survey/ time/ tissue
**Notes:** A summarized description of a large fish impact survey conducted during 1989-91 after the Exxon Valdez oil spill. Six fish species were collected at 41 sites. Fish were analyzed for biliary fluorescent aromatic compounds and P4501A liver enzyme activity. Tissues were examined microscopically and reproductive characteristics (ovary condition, hormones) were determined.

**Collins, C. M., C. H. Racine, M. E. Walsh**, 1994. The physical, chemical, and biological effects of crude oil spills after 15 years on a black spruce forest, interior Alaska. Arctic **47**:164-175.
**Keywords:** Alaska/ alkane/ aromatic hydrocarbons/ biological effects/ condition/ crude oil/ degradation/ depth/ effects/ freshwater plant/ movement/ oil/ oil spill/ Oseven/ soil/ spill/ spruce/ time/ vegetation/ weathered
**Notes:** Two experimental crude oil spills (one summer, one winter) in permafrost black spruce forest of interior Alaska were evaluated 15 years after the oil was discharged. Measured physical movement of the oil, effects of the oil on thaw depth, and the condition of the vegetation. Soil samples were analyzed for alkane and aromatic fractions.

**Colombo, J. C., A. Barreda, C. Bilos, N. Cappelletti, S. Demichelis, P. Lombardi, M. C. Migoya, C. Skorupka, G. Suarez**, 2005. Oil spill in the Rio de la Plata estuary, Argentina: 1. Biogeochemical assessment of waters, sediments, soils and biota. Environmental Pollution **134**:277-289.
**Keywords:** aliphatic hydrocarbons/ Argentina/ aromatic/ aromatic hydrocarbon/ aromatic hydrocarbons/ baseline/ bivalves/ estuary/ general effect/ hydrocarbons/ intertidal/ macrophyte/ marine invertebrate/ marine plant/ Oeight/ offshore/ oil/ oil spill/ salt water/ sampling/ sediment/ shoreline/ soil/ spill/ time/ water
**Notes:** A 1999 oil spill in the Rio de la Plata was evaluated 6 mos after the spill with a network of 14 shoreline and 12 offshore sampling stations. Collected surface water, intertidal soils and sediments, macrophytes, and bivalves. Analyzed samples for aliphatic and aromatic hydrocarbons and compared results to baseline data.

**Colombo, J. C., A. Barreda, C. Bilos, N. Cappelletti, M. C. Migoya, C. Skorupka**, 2005. Oil spill in the Rio de la Plata estuary, Argentina: 2-hydrocarbon disappearance rates in sediments and soils. Environmental Pollution **134**:267-276.
**Keywords:** aliphatic hydrocarbons/ Argentina/ aromatic/ aromatic hydrocarbon/ aromatic hydrocarbons/ condition/ degradation/ estuary/ evaluation/ hydrocarbons/ intertidal/ microbes/ oil/ oil spill/ Oten/ rate/ salt water/ sediment/ soil/ spill/ time
**Notes:** An evaluation of hydrocarbon degradation after a 1999 oil spill in the Rio de la Plata. Intertidal

soils and surface sediments were sampled 6, 13, and 42 mos after the spill and analyzed for aliphatic and aromatic hydrocarbons. Compared results to prespill conditions.

**Colwell, R. R., J. D. Walker**, 1977. Ecological aspects of microbial degradation of petroleum in the marine environment. Critical Reviews in Microbiology **5**:423-445.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ condition/ degradation/ environment/ hydrocarbons/ marine environment/ microbes/ nonhydrocarbon/ Oten/ petroleum/ rate/ review/ salt water
**Notes:** Review of the process of microbial degredation of petroleum in the marine environment. Discusses degradation of various classes of hydrocarbons and non-hydrocarbons and environmental conditions that affect rates of degradation.

**Conklin, P. J., D. Drysdale, D. G. Doughtie, K. R. Rao**, 1983. Comparative toxicity of drilling muds: role of chromium and petroleum hydrocarbons. Marine Environmental Research **10**:105-125.
**Keywords:** assay/ bioassay/ drilling mud/ fish/ fuel oil/ grass/ grass shrimp/ hydrocarbons/ marine invertebrate/ No.2 fuel oil/ Ofour/ oil/ petroleum/ petroleum hydrocarbons/ salt water/ sheepshead minnow/ shrimp/ toxicity
**Notes:** A toxicity assessment of used drilling mud (28 samples) from Mobile Bay, Alabama. The mud was analyzed for Cr and total No.2 fuel oil hydrocarbons. The mud was diluted for use with bioassays with grass shrimp and sheepshead minnows. Supplemental assays were performed with Cr and fuel oil in seawater to compare toxicity of each substance on grass shrimp. Calculated 96-hr $LC_{50s}$ for mud, Cr, and fuel oil.

**Conklin, P. J., K. R. Rao**, 1984. Comparative toxicity of offshore and oil-added drilling muds to larvae of the grass shrimp *Palaemonetes intermedius*. Archives of Environmental Contamination and Toxicology **13**:685-690.
**Keywords:** diesel/ diesel fuel/ drilling mud/ grass/ grass shrimp/ larvae/ marine invertebrate/ mineral oil/ offshore/ Ofour/ oil/ salt water/ shrimp/ survival/ toxicity
**Notes:** Exposure of larvae of the grass shrimp to 11 offshore drilling muds, diesel oil, mineral oil, and eight diesel- and mineral oil-spiked drilling muds. Exposed for 96 hr and calculated 96 hr $LC_{50s}$.

**Connell, D. W., K. Cox, R. L. McLauchlan**, 1975. Occurrence of kerosene-like hydrocarbons in the bream, *Mylio australis* Gunther. Australian Journal of Freshwater Research **26**:419-422.
**Keywords:** Australia/ bream/ fish/ fresh water/ hydrocarbons/ kerosene/ Othree/ taint
**Notes:** Report of a kerosene-like taint in bream collected in Australia; discussion of possible causes of the taint.

**Connell, D. W.**, 1982. An approximate petroleum hydrocarbon budget for the Hudson Raritan Estuary -- New York. Marine Pollution Bulletin **13**:89-93.
**Keywords:** estuary/ fate/ miscellaneous/ New Jersey/ New York/ Oeleven/ petroleum/ petroleum hydrocarbons/ salt water/ sources/ water column
**Notes:** The author develops a petroleum hydrocarbon budget for the Hudson Raritan Estuary. Sources are identified and losses from the water column are discussed.

**Connors, P. G., S. Gelman**, 1980. Red phalarope responses to thin oil films in foraging experiments. Pacific Seabird Group Annual Meeting **1980**:17.
**Keywords:** behavior/ bird/ detection/ experiment/ foraging/ oil/ oil slick/ Oone/ phalarope/ salt water/ spill
**Notes:** Behavioural experiment with oil slick detection by red phalaropes.

**Cook, C. B., A. H. Knap**, 1983. Effects of crude oil and chemical dispersant on photosynthesis in the brain coral *Diploria strigosa*. Marine Biology **78**:21-27.
**Keywords:** activity/ algae/ Arabian Light crude oil/ brain/ combination/ coral/ Corexit 9527/ crude oil/ dispersant/ effects/ labelled/ light/ marine invertebrate/ marine plant/ ODsix/ oil/ photosynthesis/ salt water/ storage/ time/ tissue/ uptake
**Notes:** Exposure of a brain coral to either Arabian Light crude oil mixed in water (19 ppm), Corexit 9527 dispersant (1 ppm), or a combination of crude oil and dispersant. Exposure time was 8 hr followed by a

post-exposure period of 48 hr. Tracked photosynthetic activity by means of $^{14}C$ uptake; measured total fixed C in coral tissue and in several specific fractions of the tissue.

**Cook, S. V., A. Chu, R. H. Goodman**, 2002. Leachability and toxicity of hydrocarbons, metals and salt contamination from flare pit soil. Water, Air, and Soil Pollution **133**:297-314.
**Keywords:** anion/ assay/ bioassay/ combination/ earthworm/ fresh water/ freshwater invertebrate/ freshwater plant/ germination/ growth/ hydrocarbons/ inorganic/ leachate/ lettuce/ metals/ Microtox/ millet/ miscellaneous/ oil/ organic/ Oseven/ refinery/ roots/ seed/ soil/ toxicity
**Notes:** Soil from a 30-yr old refinery flare pit was compared to that of a nearby uncontaminated site. Soils and leachates from the soils were analyzed for organic and inorganic components. Bioassays included Microtox, 96-hr algal growth inhibition, 14-da earthworm toxicity, and seed germination and root elongation (lettuce and millet). Whole soil and leachate assays were performed. Also, anions and metals in the leachate were tested separately and in combination, and the hydrocarbon fraction (oil and grease) was tested with and without soil.

**Coon, N. C., P. H. Albers, R. C. Szaro**, 1979. No. 2 fuel oil decreases embryonic survival of great black-backed gulls. Bulletin of Environmental Contamination and Toxicology **21**:152-156.
**Keywords:** age/ bird/ coast/ effects/ eggs/ embryo/ fuel oil/ great black-backed gull/ gull/ Maine/ No.2 fuel oil/ oil/ oiled/ Oone/ salt water/ survival/ time
**Notes:** Field study of the effects of No. 2 fuel oil applications to the eggs of great black-backed gulls on an island off the coast of Maine. Fuel oil applied in amounts of either 5 or 20 *u*l. All eggs opened 8 da later. Measured survival and estimated age of embryo at time of egg oiling.

**Coon, N. C., M. P. Dieter**, 1981. Responses of adult mallard ducks to ingested South Louisiana crude oil. Environmental Research **24**:309-314.
**Keywords:** adult/ bird/ blood/ crude oil/ diet/ duck/ effects/ fresh water/ ingestion/ Louisiana/ Louisiana crude oil/ mallard/ oil/ Oone/ organ/ paraffin/ pathology/ physiology/ reproduction/ South Louisiana crude oil/ survival/ tissue/ weight
**Notes:** Assessment of the effects on mallards of ingested crude oil. Adult mallard ducks were fed diets containing 0.25% or 2.5% South Louisiana crude oil, or 1% paraffin mixture for 26 wk. Measured survival, body and organ weights, reproduction, blood chemistry, and tissue pathology.

**Cooper, K. R., A. Cristini** 1994. The effects of oil spills on bivalve mollusks and blue crabs. Pages 142-159 *in* J. Burger, editor. Before and After an Oil Spill: The Arthur Kill. Rutgers Univ. Press, New Brunswick.
**Keywords:** bivalve/ blue crab/ clam/ crab/ effects/ fuel oil/ lesions/ marine invertebrate/ New Jersey/ No.2 fuel oil/ Ofour/ oil/ oil spill/ pathology/ salt water/ species/ spill
**Notes:** Discussion of the effects of the 1990 Exxon spill of No. 2 fuel oil in the Arthur Kill of northeast New Jersey. Only presents data for lesions in one species of clam; crab data presented in other chapters. Much discussion of the literature.

**Corbin, C. J.**, 1993. Petroleum contamination of the coastal environment of St. Lucia. Marine Pollution Bulletin **26**:579-580.
**Keywords:** analysis/ aromatic hydrocarbons/ environment/ miscellaneous/ Oeleven/ offshore/ petroleum/ salt water
**Notes:** Water samples were collected from three bays and five offshore sites and analyzed for aromatic hydrocarbon content.

**Cormack, D. and J. A. Nichols** 1977. The concentrations of oil in sea water resulting from natural and chemically induced dispersion of oil slicks. Pages 381-385 *in* 1977 Oil Spill Conference. American Petroleum Institute, Washington, D.C.
**Keywords:** aromatic hydrocarbons/ concentration/ crude oil/ depth/ dispersant/ Kuwait/ Kuwait crude oil/ ODnine/ oil/ oil slick/ oil spill/ salt water/ spill/ technical
**Notes:** Description of an early sea trial using Ekofisk and Kuwait crude oils and 'new generation' chemical dispersants. Presents data on the physical chemistry of oil spill slicks and the aromatic hydrocarbon concentrations at varying depths beneath the surface oil.

**Cormack, D.**, 1984. Seabirds and oil. Marine Pollution Bulletin **15**:345-347.
**Keywords:** bird/ critique/ England/ index/ numbers/ oil/ oil spill/ Oone/ population/ salt water/ spill
**Notes:** Critique of the assumption that beached bird numbers provide a valid index of the loss of seabirds to oil spills.

**Corner, E. D. S., R. P. Harris, C. C. Kilvington, S. C. M. O'Hara**, 1976. Petroleum compounds in the marine food web: short-term experiments on the fate of naphthalene in *Calanus*. Journal of the Marine Biological Association of the United Kingdom **56**:121-133.
**Keywords:** copepod/ depuration/ experiment/ fate/ food/ labelled/ marine invertebrate/ metabolism/ naphthalene/ Ofour/ petroleum/ rate/ salt water/ short-term/ uptake
**Notes:** Exposure of the copepod *Calanaus* to $^{14}$C-labelled naphthalene in water for 24 hr followed by a depuration period of up to 10 da. Measured uptake from water or food containing $^{14}$C-labelled naphthalene, rate of dupuration, and amount of metabolism of the naphthalene by the copepod.

**Corredor, J. E., J. M. Morell, C. E. Del Castillo**, 1990. Persistence of spilled crude oil in a tropical intertidal environment. Marine Pollution Bulletin **21**:385-388.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ coast/ crude oil/ degradation/ depth/ environment/ hydrocarbons/ intertidal/ miscellaneous/ Oeleven/ oil/ oil spill/ PAH/ persistence/ petroleum/ petroleum hydrocarbons/ salt water/ sediment/ spill/ time/ total hydrocarbons
**Notes:** Sediment cores from an intertidal mud flat fringed by mangroves on the Puerto Rican coast were analyzed for petroleum hydrocarbons. Measured resolved and unresolved aliphatic hydrocarbons, PAHs, and total hydrocarbons at four depths within the cores. Two layers of high petroleum hydrocarbon content appeared to correspond to oil spills that occurred 17 and 28 yrs previously.

**Costa, D. P., G. L. Kooyman**, 1982. Oxygen consumption, thermoregulation, and the effect of fur oiling and washing on the sea otter, *Enhydra lutris*. Canadian Journal of Zoology **60**:2761-2767.
**Keywords:** consumption/ crude oil/ detergent/ fur/ insulation/ mammal/ metabolism/ oil/ oiled/ Otwo/ oxygen/ Prudhoe Bay/ Prudhoe Bay crude oil/ salt water/ sea otter/ thermoregulation/ washing
**Notes:** Effect on the insulating quality of sea otter fur after oiling with Prudhoe Bay crude oil or after oiling and washing with detergent.

**Cotou, E., I. Castritis-Catharios, M. Moraitou-Apostolopoulou**, 2001. Surfactant-based oil dispersant toxicity to developing nauplii of *Artemia*: effects on ATPase enzymatic system. Chemosphere **42**:959-964.
**Keywords:** activity/ assay/ concentration/ crustacean/ dispersant/ effects/ enzyme/ experiment/ lethal/ marine invertebrate/ nauplii/ ODfour/ oil/ protein/ salt water/ sublethal/ toxicity
**Notes:** A laboratory assay was used to determine the effect of an oil dispersant (Finasol OSR-5) on the ATPase enzyme activities of a brine crustacean (*Artemia*). Exposure of newly-hatched nauplii to serial concentrations of the dipersant established the lethal threshold. Incidence of death was measured after 6 and 24 hrs of exposure. Nauplii were then exposed to either of two sublethal concentrations in another experiment wherein six measures of ATPase activity were collected and total protein content was determined at 6 and 24 hrs of exposure. [The headings for Tables 1&2 imply that the results presented in the tables are from exposure to lethal and sub-lethal concentrations; only results for sub-lethal concentrations are presented].

**Couillard, C. M., F. A. Leighton**, 1989. Comparative pathology of Prudhoe Bay crude oil and inert shell sealants in chicken embryos. Fundamental and Applied Toxicology **13**:165-173.
**Keywords:** abnormalities/ bird/ chicken/ crude oil/ effects/ embryo/ fresh water/ oil/ oiled/ Oone/ pathology/ Prudhoe Bay/ Prudhoe Bay crude oil/ shell/ toxicity
**Notes:** Pathological investigation of the effects of oiling (Prudhoe Bay crude oil) versus inert shell sealants. Observed abnormalities confirmed the unique toxicity of crude oil compared to the effects of restricted air flow.

**Couillard, C. M., F. A. Leighton**, 1990. Sequential study of the pathology of Prudhoe Bay crude oil in chicken embryos. Ecotoxicology and Environmental Safety **19**:17-23.
**Keywords:** bird/ chicken/ crude oil/ embryo/ fresh water/ oil/ Oone/ pathology/ Prudhoe Bay/ Prudhoe Bay crude oil/ shell

**Notes:** Sequential pathology of chicken embryos exposed to external (shell) applications of Prudhoe Bay crude oil.

**Couillard, C. M., F. A. Leighton**, 1990. The toxicopathology of Prudhoe Bay crude oil in chicken embryos. Fundamental and Applied Toxicology **14**:30-39.
**Keywords:** bird/ chicken/ crude oil/ embryo/ fresh water/ oil/ Oone/ pathology/ Prudhoe Bay/ Prudhoe Bay crude oil/ shell
**Notes:** Description of the pathology of chicken embryos exposed to externally applied (shell) Prudhoe Bay crude oil.

**Couillard, C. M., F. A. Leighton**, 1991. Bioassays for the toxicity of petroleum oils in chicken embryos. Environmental Toxicology and Chemistry **10**:533-538.
**Keywords:** bioassay/ bird/ chicken/ crude oil/ eggs/ embryo/ fresh water/ oil/ Oone/ pathology/ petroleum/ petroleum oil/ refined oil/ toxicity
**Notes:** Toxic comparison of six crude and refined oils using chicken eggs.

**Couillard, C. M., F. A. Leighton**, 1991. Critical period of sensitivity to petroleum toxicity in the chicken embryo. Environmental Toxicology and Chemistry **10**:249-253.
**Keywords:** bird/ chicken/ crude oil/ embryo/ fresh water/ incubation/ oil/ Oone/ pathology/ petroleum/ Prudhoe Bay crude oil/ shell/ South Louisiana crude oil/ toxicity
**Notes:** Identification of a large decrease in embryo sensitivity to shell crude oil application between days 8 and 9 of incubation.

**Couillard, C. M.**, 2002. A microscale test to measure petroleum oil toxicity to mummichog embryos. Environmental Toxicology **17**:195-202.
**Keywords:** abnormalities/ Alaska/ bioassay/ crude oil/ effects/ eggs/ embryo/ fish/ incubation/ length/ light/ malformation/ mineral oil/ mummichog/ North Slope/ North Slope crude oil/ oil/ Othree/ petroleum/ rate/ salt water/ sand/ survival/ toxicity/ weathered
**Notes:** Description of a bioassay for incubating mummichog eggs directly on wet sand. Technique used to compare effects of sand contaminated with two different crude oils (Alaska North Slope, Mesa light) mixed with mineral oil, mineral oil alone, or water alone. The incubation period was 11 da. Crude oil was weathered 24-48 hrs and serial dilutions ranging from 0 to 100 % were used. Measured survival, malformation rates, cardiovascular abnormalities, and body length.

**Couillard, C. M., K. Lee, B. Legare, T. L. King**, 2005. Effect of dispersant on the composition of the water-accommodated fraction of crude oil and its toxicity to larval marine fish. Environmental Toxicology and Chemistry **24**:1496-1504.
**Keywords:** activity/ aromatic hydrocarbons/ assay/ composition/ concentration/ Corexit 9527/ crude oil/ dispersant/ experiment/ fish/ hydrocarbons/ larvae/ length/ metabolism/ mummichog/ ODthree/ oil/ salt water/ survival/ toxicity/ weathered
**Notes:** The water-accomodated fraction (WAF) of weathered Mesa crude oil and chemically-dispersed (Corexit 9527) weathered crude oil were used in a toxicity assay lasting 96 hr. Mummichog larvae were the test fish. In one experiment, three concentrations of WAF were compared to one concentration of dispersed WAF. In another experiment, four concentrations of dispersed WAF were used. Assay water was analyzed for aromatic hydrocarbons at 24-hr intervals. Survival, body length, and EROD activity of mummichog larvae were measured at the end of 96 hr.

**Coulon, F., E. Pelletier, R. St.Louis, L. Gourhant, D. Delille**, 2004. Degradation of petroleum hydrocarbons in two sub-Antarctic soils: influence of an oleophilic fertilizer. Environmental Toxicology and Chemistry **23**:1893-1901.
**Keywords:** analysis/ Arabian Light crude oil/ aromatic hydrocarbons/ bacteria/ chemical analysis/ crude oil/ degradation/ diesel/ diesel fuel/ experiment/ fertilizer/ hydrocarbons/ microbes/ Microtox/ oil/ Oten/ PAH/ petroleum/ petroleum hydrocarbons/ soil/ time/ toxicity
**Notes:** Two types of sub-Antarctic soils were placed in outdoor containers and contaminated, in duplicate, with either Arabian light crude oil or diesel fuel. An oleophilic fertilizer (Inipol EAP-22) was added to one of each set of two contaminated containers. Duration of the experiment was 660 da.

Primary sampling was done on days 7, 42, 90, 210, and 330; sampling on day 660 was for chemical analysis only. Measured hydrocarbon-degrading bacteria, total petroleum hydrocarbons, total saturates, total PAHs, and individual saturate and aromatic hydrocarbons. The Microtox solid phase test was used to determine toxicity of the soil.

**Coulon, F., E. Pelletier, L. Gourhant, D. Delille**, 2005. Effects of nutrient and temperature on degradation of petroleum hydrocarbons in contaminated sub-Antarctic soil. Chemosphere **58**:1439-1448.
**Keywords:** abundance/ aerobic/ aliphatic hydrocarbons/ alkane/ Arabian Light crude oil/ aromatic hydrocarbons/ assay/ bacteria/ condition/ crude oil/ degradation/ diesel/ effects/ fertilizer/ hydrocarbons/ light/ microbes/ Microtox/ oil/ Oten/ PAH/ petroleum/ petroleum hydrocarbons/ soil/ temperature/ time
**Notes:** Soil from a sub-Antarctic island were mixed with either Arabian light crude oil or diesel oil and with or without fertilizer (Inipol EAP 22) under three temperature regimes (4, 10, 20$^{o}$C). Soils were incubated in the dark under aerobic conditions for 6 mos. Abundance of hydrocarbon-degrading bacteria was determine eight times and hydrocarbons were analyzed and a Microtox assay was performed on days 0, 42, 90, and 180. Measured alkanes and PAHs as totals and groups of compounds.

**Cowell, E. B.**, 1969. The effects of oil pollution on salt-marsh communities in Pembrokeshire and Cornwall. Journal of Applied Ecology **6**:133-142.
**Keywords:** coast/ combination/ community/ condition/ crude oil/ effects/ Kuwait/ Kuwait crude oil/ marine plant/ oil/ Osix/ plant/ pollution/ salt marsh/ salt water/ shoreline/ Spartina/ species/ spill/ transect/ vegetation
**Notes:** Assessment of the effects of oil spillages in Milford Haven and off the coast of Cornwall (*Torrey Canyon*) in 1967. Both spills involved Kuwait crude oil. In Milford Haven, the spilled oil reached some shorelines in less than 30 min, whereas in Cornwall the oil remained at sea for 8 da before coming ashore. Before-spill information on vegetation was available for some, but not all, sites. A combination of permanent quadrats and transects with temporary quadrats were used to collect data. Counted tillers of *Spartina* and frequency of occurance of species, and made qualitative observations on plant condition.

**Cowles, T. J.**, 1983. Effects of exposure to sublethal concentrations of crude oil on the copepod *Centropages hamatus* II. Activity patterns. Marine Biology **78**:53-57.
**Keywords:** activity/ bioassay/ concentration/ copepod/ crude oil/ effects/ flow-through/ Louisiana/ Louisiana crude oil/ marine invertebrate/ Ofour/ oil/ salt water/ South Louisiana crude oil/ sublethal/ swimming
**Notes:** Exposure of a marine copepod to 80 ppb South Louisiana crude oil in a flow-through bioassay system for 64 hr. Measured activity patterns after 48-64 hr of exposure.

**Cram, S., C. A. Ponce de Leon, P. Fernandez, I. Sommer, H. Rivas, L. M. Morales**, 2006. Assesment of trace elements and organic pollutants from a marine oil complex into the coral reef system of Cayo Arcas, Mexico. Environmental Monitoring and Assessment **121**:127-149.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ coral/ coral reef/ crude oil/ diesel/ diesel fuel/ ecosystem/ hydrocarbons/ metals/ Mexico/ miscellaneous/ Oeleven/ offshore/ oil/ organic/ PAH/ salt water/ sediment/ transect/ water
**Notes:** Sediment (71) and water (25) samples were collected in the vicinity of the Cayo Arcas coral reef ecosystem (offshore Mexico) to determine if the crude oil pumping stations and marine terminal were causing environmental contamination. Samples were collected along transects extending away from the pumping stations and terminal. Sediments were physically characterized and analyzed for aliphatic hydrocarbons, PAH, and metals. Water samples, crude oil, and diesel fuel were chemically characterized and similarly analyzed for hydrocarbons and metals.

**Cranford, P. J., D. C. Gordon**, 1991. Chronic sublethal impact of mineral oil-based drilling mud cuttings on adult sea scallops. Marine Pollution Bulletin **22**:339-344.
**Keywords:** adult/ biochemical/ chronic/ composition/ cuttings/ digestive gland/ drilling mud/ gonads/ growth/ hydrocarbons/ marine invertebrate/ muscle/ Ofour/ oil-based/ salt water/ scallop/ shell/ size/ sublethal/ survival/ tissue
**Notes:** Exposed adult sea scallops to mineral oil-based drilling muds from two wells for 59 da. Analyzed hydrocarbon content of drilling mud, determined survival of scallops, measured shell and tissue growth,

and relative size and biochemical composition of the adductor muscle, digestive gland, gonad, and total soft tissue.

**Cranford, P. J., D. C. Gordon, Jr., K. Lee, S. L. Armsworthy, G.-H. Tremblay**, 1999. Chronic toxicity and physical disturbance effects of water-and oil-based drilling fluids and some major constituents on adult sea scallops (*Placopecten magellanicus*). Marine Environmental Research **48**:225-256.
**Keywords:** adult/ aliphatic hydrocarbons/ aromatic hydrocarbons/ bioassay/ chronic/ concentration/ drilling fluids/ drilling mud/ effects/ flow-through/ growth/ marine invertebrate/ Ofour/ oil-based/ particulate/ salt water/ scallop/ tissue/ toxicity/ water-based
**Notes:** Adult sea scallops were exposed to used oil-based drilling mud, water-based drilling mud and barite in a flow-through bioassay. Results were compared to previous work on bentonite. Exposure concentrations were several for each test substance and the test duration varied from 10 to 72 da. Measured suspended particulate matter and particulate organic matter in the water, aliphatic and aromatic concentrations in water and scallop tissue, several growth measures for the scallops, and performed scope for growth calculations.

**Crapp, G. B.** 1971. The ecological effects of stranded oil. Pages 181-186 *in* E. B. Cowell, editor. The ecological effects of oil pollution on littoral communities. Applied Science Publishers, London.
**Keywords:** bivalve/ community/ crude oil/ effects/ Kuwait/ Kuwait crude oil/ littoral/ marine invertebrate/ mixing/ Ofour/ oil/ pollution/ ratio/ recovery/ salt water/ species/ survival/ time/ weathered
**Notes:** Exposure of seven species of littoral bivalves to immersion for 6 hrs in Kuwait crude oil or weathered Kuwait crude oil. Exposure of one species to immersion for 6 hrs in Kuwait crude oil or five refined products. Exposure of two species to immersion for 6 hrs to Kuwait crude oil after mixing with water (1:4 ratio) for up to 24 hrs. Measured survival and "recovery" times.

**Cravedi, J. P., J. Tulliez**, 1981. Distribution and elimination routes of a naphthenic hydrocarbon (dodecylcyclohexane) in rainbow trout (*Salmo gairdneri*). Bulletin of Environmental Contamination and Toxicology **26**:337-344.
**Keywords:** cycloalkane/ distribution/ elimination/ fish/ fresh water/ ingestion/ metabolism/ Othree/ rainbow trout
**Notes:** Metabolism, distribution, and elimination of a cycloalkane following ingestion by rainbow trout.

**Crawford, R. B., M. G. Muto**, 1977. Effects of water soluble fractions from crude oils on development of sand dollar embryos. Bulletin of the Mount Desert Island Biological Laboratory **17**:112-115.
**Keywords:** Bunker C/ crude oil/ development/ effects/ embryo/ fertilization/ fuel oil/ Kuwait/ Kuwait crude oil/ Louisiana/ Louisiana crude oil/ marine invertebrate/ Ofour/ oil/ recovery/ salt water/ sand/ solubility/ South Louisiana crude oil
**Notes:** Exposure of sand dollar embryos prior to fertilization or 9 min to 20 hrs after fertilization to 1, 10, 50, or 100% water soluble fraction of either Kuwait crude oil, South Louisiana crude oil, or Bunker C fuel oil. Also tested recovery of post-fertilization embryos after 1 hr of exposure.

**Crider, J. Y., J. Wilhm, H. J. Harmon**, 1982. Effects of naphthalene on the hemoglobin concentration and oxygen uptake of *Daphnia magna*. Bulletin of Environmental Contamination and Toxicology **28**:52-57.
**Keywords:** behavior/ bioassay/ concentration/ daphnia/ effects/ fresh water/ freshwater invertebrate/ hemoglobin/ naphthalene/ Ofive/ oxygen/ static/ survival/ uptake
**Notes:** Daphnia exposed to several concentrations of naphthalene in static bioassays. Tests ran for 48 hrs with observations at 24 and 48 hrs. Measured survival, behavior, hemoglobin concentration, oxygen uptake, and calculated $LC_{50s}$.

**Cripps, G. C.**, 1992. Natural and anthropogenic hydrocarbons in the Antarctic marine environment. Marine Pollution Bulletin **25**:266-273.
**Keywords:** aliphatic hydrocarbons/ Antarctic/ Antarctica/ aromatic hydrocarbons/ benthic/ bird/ environment/ evaluation/ fish/ hydrocarbons/ invertebrate/ marine environment/ marine invertebrate/ miscellaneous/ Oeleven/ particulate/ pollution/ review/ salt water/ sediment/ sources/ zooplankton
**Notes:** A review and evaluation of information on hydrocarbons in the ocean around Antarctica. Sections on hydrocarbons in seawater, sedimenting particulates, sediment, benthic invertebrates, microplankton

and sea-ice microbiota, zooplankton, fish, and birds. Discusses sources of hydrocarbons, including pollution incidents.

**Cripps, G. C., J. Shears**, 1997. The fate in the marine environmental of a minor diesel fuel spill from an Antarctic research station. Environmental Monitoring and Assessment **46**:221-232.
**Keywords:** alkane/ Antarctic/ aromatic hydrocarbons/ concentration/ diesel/ diesel fuel/ effects/ fate/ intertidal/ limpet/ marine invertebrate/ Ofour/ salt water/ spill/ tissue/ toxicity
**Notes:** Report of the effects of a small spill of diesel fuel at an Antarctic research station; death of intertidal limpets, water and limpet tissue concentrations of aromatics and alkanes for up to 40 da post-spill.

**Croce, B., R. M. Stagg**, 1997. Exposure of Atlantic salmon parr (*Salmo salar*) to a combination of resin acids and a water soluble fraction of diesel fuel oil: a model to investigate the chemical causes of pigmented salmon syndrome. Environmental Toxicology and Chemistry **16**:1921-1929.
**Keywords:** Atlantic/ Atlantic salmon/ biochemistry/ blood/ combination/ concentration/ diesel/ diesel fuel/ effects/ fish/ fresh water/ fuel oil/ model/ oil/ Othree/ pigment/ resin/ salmon/ solubility
**Notes:** Effects on Atlantic salmon parr of exposure (9 da) to the water-soluble fraction of diesel fuel and resin acids, separate and in combination; concentrations, blood characteristics, biochemistry.

**Crocker, A. D., J. Cronshaw, W. N. Holmes**, 1974. The effect of a crude oil on intestinal absorption in ducklings (*Anas platyrhynchos*). Environmental Pollution **7**:165-177.
**Keywords:** bird/ crude oil/ duck/ duckling/ fresh water/ intestinal absorption/ mallard/ oil/ Oone/ physiology/ salt water/ Santa Barbara crude oil
**Notes:** Oral dosing of mallard ducklings with single doses of Santa Barbara crude oil inhibited the normal increase in intestinal absorption of water and Na+ when ducks move from fresh water to salt water.

**Crocker, A. D., J. Cronshaw, W. N. Holmes**, 1975. The effect of several crude oils and some petroleum distillation fractions on intestinal absorption in ducklings (*Anas platyrhynchos*). Environmental Physiology and Biochemistry **5**:92-106.
**Keywords:** bird/ crude oil/ distillation fraction/ duckling/ effects/ intestinal absorption/ mallard/ oil/ Oone/ petroleum/ physiology/ salt water/ weathered
**Notes:** Single oral doses of eight crude oils and several distillate fractions and weathered samples of two of the crude oils were compared for their effects on mallard duckling ability to adjust to salt water (inhibited water and Na+ absorption).

**Cronin, M. A., J. W. Bickham**, 1998. A population genetic analysis of the potential for a crude oil spill to induce heritable mutations and impact natural populations. Ecotoxicology **7**:259-278.
**Keywords:** analysis/ crude oil/ eggs/ evaluation/ fish/ genetic/ lethal/ miscellaneous/ monitoring/ mutation/ Oeleven/ oil/ oil spill/ oiled/ pink salmon/ population/ Prince William Sound/ Prudhoe Bay/ Prudhoe Bay crude oil/ salmon/ salt water/ spill/ stream
**Notes:** Evaluation of the potential for genetic damage from Prudhoe Bay crude oil to pink salmon populations in Prince William Sound. Constucts a theoretical analysis of the likelyhood of lethal mutations. The theoretical scenarios are compared to results of egg monitoring from 10 oiled and 15 unoiled streams in southwestern Prince William Sound.

**Cronin, M. A., W. B. Ballard, J. D. Bryan, B. J. Pierson, J. D. McKendrick**, 1998. Northern Alaska oil fields and caribou: a commentary. Biological Conservation **83**:195-208.
**Keywords:** activity/ Alaska/ Canada/ caribou/ commentary/ fresh water/ humans/ mammal/ oil/ oil field/ Otwo/ population/ time
**Notes:** A population assessment of the four caribou herds of northern Alaska with regard to their relation of oil drilling activity. The time period covered is 1970-96. Authors discuss impacts on individuals and and impacts on herds. Also reviewed are population changes in several herds from Canada and Alaska during 1920-95, and the possible role of humans in causing some of these changes.

**Cronin, M. A., J. K. Wickliffe, Y. Dunina, R. J. Baker**, 2002. K-*ras* oncogene DNA sequences in pink salmon in streams impacted by the *Exxon Valdez* oil spill: no evidence of oil-induced heritable mutations.

Ecotoxicology **11**:233-241.
**Keywords:** Alaska/ crude oil/ DNA/ embryo/ Exxon Valdez/ fish/ genetic/ mutation/ oil/ oil seep/ oil spill/ Othree/ pink salmon/ Prince William Sound/ salmon/ salt water/ spill/ stream/ time
**Notes:** Wild Alaskan salmon were collected to determine the presence of heritable mutations in the K-*ras* gene of pink salmon. Salmon were collected in 1997 and 1999 from five previously-oiled and five unoiled streams in Prince William Sound, and two streams with and one stream without natural oil seeps in the Alaskan Peninsula. Results were compared to results of previous laboratory exposures of pink salmon embryos to Alaskan crude oil.

**Cronin, M. A., A. W. Maki**, 2004. Assessment of the genetic toxicological impacts of the *Exxon Valdez* oil spill on pink salmon (*Oncorhynchus gorbuscha*) may be confounded by the influence of hatchery fish. Ecotoxicology **13**:495-501.
**Keywords:** critique/ effects/ embryo/ Exxon Valdez/ fish/ genetic/ mutation/ oil/ oil spill/ Othree/ pink salmon/ salmon/ salt water/ spill/ stream/ time/ toxicity
**Notes:** A critique of the proposal that the Exxon Valdez oil spill induced heritable mutations that increase embryo mortality in pink salmon. Authors use a statistical approach to emphasize the potential influence of straying hatchery fish on determinations of inter-generational effects in any given stream. The matter of reduced fitness of hatchery fish versus wild fish is also discussed.

**Cronshaw, J.** 1982. Introduction: pollutants and endocrine systems. Pages 351-357 *in* C. G. Scanes, M. A. Ottinger, A. D. Kenny, J. Balthazart, J. Cronshaw, I. C. Jones, editors. Aspects of Avian Endocrinology: Practical and Theoretical Implications. Graduate Studies, Texas Tech University. Texas Tech Press, Lubbock, Texas.
**Keywords:** adrenal/ bird/ effects/ endocrine/ fresh water/ gonads/ hormone/ mallard/ Oone/ petroleum/ salt water/ stress/ Texas
**Notes:** General introductory discussion of the effects of ingested petroleum on hormone production by gonads and adrenal glands in birds.

**Cross, W. E., C. M. Martin, D. H. Thomson**, 1987. Effects of experimental releases of oil and dispersed oil on Arctic nearshore macrobenthos. II. Epibenthos. Arctic **40**:201-210.
**Keywords:** abundance/ Arctic/ Canada/ Corexit 9527/ crude oil/ crustacean/ density/ depth/ dispersant/ echinoderm/ effects/ marine invertebrate/ ODfour/ oil/ population/ release/ salt water/ sampling/ species/ structure/ weathered
**Notes:** Release of undispersed or chemically dispersed (Corexit 9527) Lagomedio crude oil (weathered) in two shallow bays on northern Baffin Island, Canada. Measured effects on epibenthos for two sampling periods before and four sampling periods after oil release during the years 1980-83. Sampled at 3 and 7 m depths. Measured species presence, density, and population structure of crustaceans, and abundance of echinoderms.

**Cross, W. E., R. T. Wilce, M. F. Fabijan**, 1987. Effects of experimental releases of oil and dispersed oil on Arctic nearshore macrobenthos. III. Macroalgae. Arctic **40**:211-219.
**Keywords:** algae/ Arctic/ biomass/ Canada/ condition/ Corexit 9527/ crude oil/ depth/ dispersal/ dispersant/ effects/ macroalgae/ marine plant/ ODsix/ oil/ release/ salt water/ sampling/ species/ time/ transect
**Notes:** Artificially-weathered crude oil (undispersed) was released on the surface of one shallow bay and subsurface (chemically dispersed; Corexit 9527) in another shallow bay on Baffin Island, Canada. Macroalgae were sampled at both sites, an adjacent bay that received contamination from the subsurface release, and a reference bay. Oil releases occurred in August 1981 and macroalgae were sampled in September 1980 and August 1981 (prespill), and September 1981-82 and August 1982-83 (postspill). Sampling transects were parallel to the shore at 3 and 7 m depth. Algae were identified, number of species counted, and biomass determined for the most common groups and in total. Also, observations were made of the reproductive condition of the algae.

**Cross, W. E., D. H. Thomson**, 1987. Effects of experimental releases of oil and dispersed oil on Arctic nearshore macrobenthos. I. Infauna. Arctic **40**:184-200.
**Keywords:** Arctic/ bivalve/ Canada/ community/ Corexit 9527/ crude oil/ depth/ dispersant/ distribution/

effects/ infauna/ marine invertebrate/ ODfour/ oil/ population/ release/ salt water/ sampling/ species/ structure/ weathered/ weight
**Notes:** Release of undispersed or chemically dispersed (Corexit 9527) Lagomedio crude oil (weathered) in two shallow bays on northern Baffin Island, Canada. Measured effects on infauna for two sampling periods before and four sampling periods after oil release during the years 1980-83. Sampled at 3 and 7 m depths. Measured distribution of species, community structure, population structure, and weight-length relations of bivalves.

**Crothers, J. H.**, 1983. Field experiments on the effects of crude oil and dispersant on the common animals and plants of rocky sea shores. Marine Environmental Research **8**:215-239.
**Keywords:** coast/ crude oil/ dispersant/ effects/ England/ experiment/ Forties Field crude oil/ general effect/ intertidal/ invertebrate/ marine invertebrate/ marine plant/ ODeight/ oil/ photograph/ plant/ salt water/ time/ treatment
**Notes:** Two nearly identical sets of field experiments (July and January) were performed at two sites on the coast of England. Experimental plots (0.1 $m^2$) were established near the upper end of the intertidal zone and designated as either control, crude oil (Forties) only, dispersant (BP 1100WD) only, or crude oil plus dispersant. Photographs were taken at monthly intervals for 15 mos in the July experiment and for 9 mos in the January experiment. The first two photographs were taken before treatment. Intertidal plants and attached invertebrates were identified and counted.

**Crowe, A. U., B. Han, A. R. Kermode, L. I. Bendell-Young, A. L. Plant**, 2001. Effects of oil sands effluent on cattail and clover: photosynthesis and the level of stress proteins. Environmental Pollution **113**:311-322.
**Keywords:** Alberta/ Canada/ effects/ effluent/ fresh water/ freshwater plant/ oil/ oil sands/ Oseven/ photosynthesis/ protein/ sand/ stress/ vegetation
**Notes:** The effects of oil sands effluents on cattail and clover were evaluated at four sites (three contaminated and one reference) near Ft. McMurray, Alberta, Canada. Samples of clover and cattail were collected at all sites and used in a laboratory assessment of photosynthesis ($CO_2$ production). Samples of vegetation were also collected and analyzed for the presence of stress proteins.

**Crowe, T. P., E. L. Smith, P. Donkin, D. L. Barnaby, S. J. Rowland**, 2004. Measurements of sublethal effects on individual organisms indicate community-level impacts of pollution. Journal of Applied Ecology **41**:123.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ bivalve/ coast/ community/ England/ evaluation/ growth/ marine invertebrate/ miscellaneous/ mussel/ Oeleven/ petroleum/ petroleum hydrocarbons/ pollution/ salt water/ sublethal/ tissue
**Notes:** A field evaluation of the concept of 'scope for growth' (SFG) with regard to mussels as a component of macrofaunal communities at six coastal sites on the west coast of England. Mussels were collected and analyzed for the UCM component of the aliphatic and aromatic fractions of petroleum hydrocarbons in the tissue. Comparisons were made with the SFG ratings.

**Croxall, J. P.** 1975. The effect of oil on nature conservation, especially birds. Pages 93-103 *in* H. A. Cole, editor. Petroleum and the Continental Shelf of North-West Europe. Applied Science Publ.,Inc.,
**Keywords:** bird/ conservation/ Europe/ history/ oil/ oil spill/ Oone/ petroleum/ population/ rehabilitation/ risk/ salt water/ spill
**Notes:** Assessment of the significance of oil spills to seabirds.

**Crump-Wiesner, H. J. and A. L. Jennings** 1975. Properties and effects of nonpetroleum oils. Pages 29-32 *in* 1975 Conference on Prevention and Control of Oil Pollution. American Petroleum Institute, Washington, DC.
**Keywords:** animal oil/ effects/ history/ miscellaneous/ nonpetroleum oil/ Oeleven/ oil/ petroleum/ pollution/ vegetable oil
**Notes:** An early presentation of the properties and effects of non-petroleum oils. Sections on physical and chemical properties, environmental effects, case histories, and distinctions between oil and other hazardous substances.

**Crunkilton, R. L., R. M. Duchrow**, 1990. Impact of a massive crude oil spill on the invertebrate fauna of a Missouri Ozark stream. Environmental Pollution **63**:13-31.
**Keywords:** benthic/ conductance/ creek/ crude oil/ dissolved/ diversity/ effects/ feeding/ feeding groups/ fresh water/ freshwater invertebrate/ index/ invertebrate/ Missouri/ Ofive/ oil/ oil spill/ oxygen/ pH/ pipeline/ pollution/ species/ spill/ stream/ stream discharge/ temperature/ time
**Notes:** Report of the effects on stream invertebrates of a pipeline rupture that spilled crude oil into Asher Creek, Missouri in August 1979. Benthic invertebrates were sampled 11 times between September 1979 and February 1981at four sites, one above and three below the point of rupture. Benthic invertebrates were sampled from riffle areas and identified. Also measured dissolved oxygen, pH, conductance, temperature, and stream discharge. Calculated a diversity index and compared, among sites, the presence of species sensitive to oil pollution and the presence of functional feeding groups.

**Cubit, J. D., C. D. Getter, J. B. C. Jackson, S. D. Garrity, H. M. Caffey, R. C. Thompson, E. Weil, and M. J. Marshall** 1987. An oil spill affecting coral reefs and mangroves on the Caribbean coast of Panama. Pages 401-406 *in* 1987 Oil Spill Conference, API 4452. American Petroleum Institute, Washington, DC.
**Keywords:** abundance/ algae/ Caribbean/ coast/ community/ condition/ coral/ coral reef/ crude oil/ density/ general effect/ habitat/ mangrove/ marine invertebrate/ marine plant/ movement/ Oeight/ oil/ oil spill/ oiled/ Panama/ population/ refinery/ roots/ salt water/ sea urchin/ spill/ storage/ subtidal/ survey/ time/ urchin
**Notes:** A report of surveys being conducted on coral reef and mangrove habitats on the Caribbean coast of Panama following a 1986 spill of crude oil from refinery storage tanks. Presents information on the movement of the oil, sessile organisms on mangrove prop roots before and 3 mos post spill, mangrove condition in oiled areas 2-3 and 5 mos post spill, presence and abundance of corals and associated algae on reef flats 2 and 5 mos post spill, condition of subtidal reefs before and after the spill, and densities of sea urchins on a monthly basis before and up to 5 mos after the spill.

**Culik, B. M., R. P. Wilson, A. T. Woakes, F. W. Sanudo**, 1991. Oil pollution of Antarctic penguins: effects on energy metabolism and physiology. Marine Pollution Bulletin **22**:388-391.
**Keywords:** Antarctic/ bird/ effects/ metabolism/ oil/ oiled/ Oone/ penguin/ physiology/ pollution/ salt water/ spill
**Notes:** Physiological effects of oiling on penguins tested in indoor and outdoor facilities; special emphasis on metabolism.

**Curl, H., Jr., K. O'Donnell**, 1977. Chemical and physical properties of refined petroleum products. Volume ERL MESA-17. National Oceanic and Atmospheric Administration, Boulder, CO.
**Keywords:** chemical characteristics/fuel oil/oil/Onine/petroleum/petroleum products/physical characteristics/refined oil/technical
**Notes:** Basic description of the physical and chemical characteristics of major classes of refined oil products.

**Curtis, F., J. Lammey**, 1998. Intrinsic remediation of a diesel fuel plume in Goose Bay, Labrador, Canada. Environmental Pollution **103**:203-210.
**Keywords:** biodegradation/ BTEX/ Canada/ diesel/ diesel fuel/ fresh water/ fuel oil/ ground water/ hydrocarbons/ Labrador/ microbes/ oil/ Oten/ plume/ remediation/ soil/ TPH
**Notes:** A case study of the natural remediation of sub-surface fuel oil at Goose Bay, Labrador. A total of 102 groundwater and three surface water samples were collected to determine the extent of natural biodegradation of the hydrocarbons. Measured BTEX, TPH, TEH, numerous soil chemistry characteristics, and general characteristics of the subsurface diesel fuel and water.

**Cushman, R. M., J. C. Goyert**, 1984. Effects of a synthetic crude oil on pond benthic insects. Environmental Pollution (Series A) **33**:163-186.
**Keywords:** abundance/ benthic/ biomass/ coal/ community/ concentration/ crude oil/ diversity/ effects/ fresh water/ freshwater invertebrate/ freshwater plant/ invertebrate/ macroinvertebrate/ Ofive/ oil/ plant/ population/ time/ toxicity/ treatment/ water
**Notes:** Eight outdoor experimental ponds were established in December and monitored for benthic invertebrates through the following October on a bimonthly basis. Synthetic (coal) crude oil, at three

different concentrations, was added to the treatment ponds in July. Measured macroinvertebrate abundance, number of taxa, biomass, and diversity; and emergent plant establishment. Pond water was analyzed for selected chemicals known to occur in the synthetic crude oil and compared to available information on toxicity.

**Custer, T. W., P. H. Albers**, 1980. Response of captive, breeding mallards to oiled water. Journal of Wildlife Management **44**:915-918.
**Keywords:** behavior/ bird/ crude oil/ duck/ fresh water/ mallard/ oil/ oil slick/ oiled/ Oone/ Prudhoe Bay/ Prudhoe Bay crude oil/ time/ treatment
**Notes:** Behavioral response of mallard ducks to Prudhoe Bay crude oil slicks on water basins. Water basins were oiled with either 5 or 100 *u*l of oil and monitored with time-lapse cameras for 24 hr before and after water treatment. Measured time of first entry and amount of time spent on the water.

**Da Silva, E. M., M. C. Peso-Aguiar, M. de F. T. Navarro, C. de B. e A. Chastinet**, 1997. Impact of petroleum pollution on aquatic coastal ecosystems in Brazil. Environmental Toxicology and Chemistry **16**:112-118.
**Keywords:** bird/ bivalve/ Brazil/ coast/ community/ ecosystem/ effects/ effluent/ fish/ general effect/ hydrocarbons/ invertebrate/ marine invertebrate/ marine plant/ Oeight/ petroleum/ petroleum hydrocarbons/ plant/ pollution/ population/ refinery/ review/ rocky shore/ salt water/ sediment
**Notes:** A review of the presence and environmental consequences of petroleum pollution along the coast of Brazil. Information is presented on petroleum hydrocarbons in sediment, fish, and bivalves; effects of petroleum on mangroves; effects of petroleum on sessile organisms of rocky shores; effects of petroleum on birds; and effects of refinery effluents on aquatic plants and invertebrates.

**Daan, R., M. Mulder, A. Van Leeuwen**, 1994. Differential sensitivity of macrozoobenthic species to discharges of oil-contaminated drill cuttings in the North Sea. Netherlands Journal of Sea Research **33**:113-127.
**Keywords:** abundance/ bivalve/ coast/ crustacean/ cuttings/ discharges/ drilling mud/ echinoderm/ effects/ marine invertebrate/ mollusc/ Netherlands/ North Sea/ Ofour/ oil-based/ polychaete/ salt water/ species/ survey/ transect/ water-based
**Notes:** Assessment of the effects of discharged drill cuttings on macrobenthos in the North Sea off the coast of the Netherlands. Fifteen transect surveys extending from <40 m to 5000 m from the drilling platform were conducted between 1985 and 1992. Eleven of the surveys dealt with oil-based drilling muds and four dealt with water-based drilling muds. Measured abundance of polychaetes, molluscs, crustaceans, and echinoderms.

**Daan, R., M. Mulder**, 1996. On the short-term and long-term impact of drilling activities in the Dutch sector of the North Sea. ICES Journal of Marine Science **53**:1036-1044.
**Keywords:** activity/ benthic/ crude oil/ discharges/ drilling mud/ effects/ long-term/ macrofauna/ marine invertebrate/ North Sea/ offshore/ Ofour/ oil-based/ salt water/ short-term/ water-based
**Notes:** Effects of oil-based and water-based drilling muds on benthic fauna at offshore drilling platforms in the North Sea.

**Dahlmann, G., D. Timm, Chr. Averbeck, C. Camphuysen, H. Skov, J. Durinck**, 1994. Oiled seabirds -- comparative investigations on oiled seabirds and oiled beaches in the Netherlands, Denmark and Germany (1990-93). Marine Pollution Bulletin **28**:305-310.
**Keywords:** beach/ bird/ coast/ Denmark/ feathers/ Germany/ Netherlands/ oil/ oiled/ Oone/ petroleum products/ pollution/ salt water
**Notes:** Results of a 3-year assessment of oil pollution chemicals found on the beaches and on bird feathers from the coasts of Netherlands, Denmark, and Germany.

**Dalla Venezia, L., V. U. Fossato**, 1977. Characteristics of suspensions of Kuwait oil and Corexit 7664 and their short- and long-term effects on *Tisbe bulbisetosa* (Copepoda: Harpacticoida). Marine Biology **42**:233-237.
**Keywords:** concentration/ copepod/ Corexit 7664/ crude oil/ dispersant/ effects/ experiment/ female/ hydrocarbons/ Kuwait/ Kuwait crude oil/ long-term/ marine invertebrate/ ODfour/ oil/ reproduction/ salt

water/ static/ survival
**Notes:** Description of a method of preparing seawater suspensions of Kuwait crude oil and Corexit 7664. The suspension was employed in static exposure experiments with a copepod. Female copepods were exposed for 20 da to a range of concentrations of the oil and Corexit suspension. Ovigerous female copepods were also exposed to a single concentration of the test suspension for 30 or 50 da. Measured survival, reproduction, and hydrocarbon concentrations in water.

**Daly, E. J., J. Hoddinott, M. R. T. Dale**, 1988. The effects of oil spill chemicals on carbon translocation rates in *Phaseolus vulgaris* L. Environmental Pollution **52** :151-163.
**Keywords:** carbon/ effects/ fresh water/ freshwater plant/ labelled/ leaves/ ODseven/ oil/ oil spill/ photosynthesis/ rate/ seedling/ spill
**Notes:** Seedlings of *Phaseolus vulgaris* were raised in a steady-state $^{14}CO_2$ labelling system. Primary leaves were sprayed with Corexit 9600 or 7664 24 or 48 hrs before isotopic equilibrium was reached, or after equilibrium was reached. Measured photosynthesis and rates of translocation of labelled carbon.

**Daniels, C. B., J. C. Means**, 1989. Assessment of the genotoxicity of produced water discharges associated with oil and gas production using a fish embryo and larval test. Marine Environmental Research **28**:303-307.
**Keywords:** chromosome/ discharges/ embryo/ fish/ genotoxic/ Louisiana/ oil/ oil field/ Othree/ produced water/ salt water/ sheepshead minnow/ waste water
**Notes:** Assessment of the genotoxicity of produced water from coastal oilfields in Louisiana; use of sheepshead minnow embryos to determine the incidence of chromosomal aberrations.

**Daniels, C. B., C. B. Henry, and J. C. Means** 1990. Coastal oil drilling produced waters: chemical characterization and assessment of genotoxicity using chromosomal aberrations in *Cyprinodon variegatus*. Pages 356-371 *in* W. G. Landis, W. H. van der Schalie, editors. Aquatic Toxicology and Risk Assessment: Thirteenth Volume, ASTM STP 1096. American Society for Testing and Materials, Philadelphia.
**Keywords:** chromosome/ fish/ genotoxic/ Louisiana/ oil/ oil field/ Othree/ petroleum/ produced water/ risk/ risk assessment/ salt water/ sediment/ sheepshead minnow/ waste water
**Notes:** Characterization of petroleum compounds in produced waters of coastal oilfields in Louisiana and an assessment of the genotoxicity of the water using embryonic sheepshead minnows.

**Danovaro, R., M. Fabiano, M. Vincx**, 1995. Meiofauna response to the *Agip Abruzzo* oil spill in subtidal sediments of the Ligurian Sea. Marine Pollution Bulletin **30**:133-145.
**Keywords:** benthic/ chemical characteristics/ crude oil/ density/ hydrocarbons/ marine invertebrate/ meiofauna/ monitoring/ Ofour/ oil/ oil spill/ petroleum hydrocarbons/ physical characteristics/ salt water/ sediment/ spill/ subtidal/ total hydrocarbons
**Notes:** A benthic monitoring study was interrupted by a large oil spill that drifted into the study area in the Ligurian Sea (Italy). Sediment samples were collected for one year (4 mo before and 8 mo after the spill). Measured physical and chemical characteristics of the sediment, total hydrocarbons, and meiofauna densities.

**Dauvin, J-C.**, 1998. The fine sand *Abra alba* community of the Bay of Morlaix twenty years after the Amoco Cadiz oil spill. Marine Pollution Bulletin **36**:669-676.
**Keywords:** abundance/ Amoco Cadiz/ biomass/ community/ crude oil/ dominance/ effects/ environment/ fish/ France/ long-term/ macroinvertebrate/ marine invertebrate/ Ofour/ oil/ oil spill/ salt water/ sand/ species/ spill
**Notes:** A long-term (1977-96) assessment of the effects of the Amoco Cadiz oil spill on the macrobenthic and fish communities of the fine sand bottom environment of the Bay of Morlaix, France. Measured species and trophic abundance and dominance, and biomass.

**Dauvin, J.-C., F. Gentil**, 1990. Conditions of the peracarid populations of subtidal communities in northern Brittany ten years after the *Amoco Cadiz* oil spill. Marine Pollution Bulletin **21**:123-130.
**Keywords:** Amoco Cadiz/ amphipod/ community/ condition/ density/ isopod/ marine invertebrate/ Ofour/ oil/ oil spill/ population/ recovery/ salt water/ sediment/ spill/ subtidal/ survey

**Notes:** An assessment of the recovery of peracarid (ampipods, isopods, mysids, etc.) populations in the sediments of coastal Brittany 10 years after the Amoco Cadiz oil spill. A total of 19 sites in three locations were sampled and compared to the results of surveys at the same sites before the spill and during the 3 yr after the spill. Identified and determined the density of all peracarids.

**Dauvin, J.-C.**, 2000. The muddy fine sand *Abra alba* -- *Melinna palmata* community of the Bay of Morlaix twenty years after the *Amoco Cadiz* oil spill. Marine Pollution Bulletin **40**:528-536.
**Keywords:** abundance/ Amoco Cadiz/ benthic/ biomass/ community/ crude oil/ dominance/ effects/ France/ invertebrate/ long-term/ marine invertebrate/ Ofour/ oil/ oil spill/ population/ salt water/ sand/ sediment/ spill/ time
**Notes:** A long-term assessment of the effects of the *Amoco Cadiz* oil spill on the benthic invertebrate community of the Bay of Morlaix, France. Bottom samples were collected 4-6 times per year from 1977 to 1982 and five times per year from 1983 to 1996 (20 yrs). Individuals were identified and categorized according to functional groups. Abundance, biomass, and dominance were compared over the 20 yr period.

**Dauvin, J. C., J. L. Gomez Gesteira, M. Salvande Fraga**, 2003. Taxonomy sufficiency: an overview of its use in the monitoring of sublittoral benthic communities after oil spills. Marine Pollution Bulletin **46**:552-555.
**Keywords:** benthic/ commentary/ community/ effects/ marine invertebrate/ monitoring/ oil/ oil spill/ Onine/ overview/ salt water/ spill/ sublittoral/ taxonomy/ technical
**Notes:** A commentary on the use of and need for taxonomic identification of benthic communities in studies of the effects of oil spills. Addresses the question "How much taxonomic detail is enough?".

**Davenport, J.**, 1982. Oil and planktonic ecosystems. Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences **297**:369-384.
**Keywords:** community/ ecosystem/ experiment/ fresh water/ freshwater invertebrate/ freshwater plant/ marine invertebrate/ marine plant/ Ofour/ oil/ phytoplankton/ plankton/ pollution/ population/ review/ salt water/ spill/ survey/ zooplankton
**Notes:** A review of the effect of oil pollution on plankton. Discusses evidence from laboratory experiments, enclosed ecosystem experiments, and field studies.

**Davies, J. M., I. E. Baird, L. C. Massie, S. J. Hay, A. P. Ward**, 1980. Some effects of oil-derived hydrocarbons on a pelagic food web from observations in an enclosed ecosystem and a consideration of their implications for monitoring. Rapports et Proces-Verbaux des Reunions Conseil International pour l'Exploration de la Mer **179**:201-211.
**Keywords:** chemical characteristics/ chlorophyll/ community/ concentration/ crude oil/ density/ depth/ ecosystem/ effects/ experiment/ food/ hydrocarbons/ marine invertebrate/ marine plant/ microbes/ monitoring/ North Sea/ North Sea crude oil/ Ofour/ oil/ particulate/ phytoplankton/ population/ salt water/ time/ zooplankton
**Notes:** Assessment of the effects of the water-soluble fraction of North Sea crude oil on zooplankton and phytoplankton in an enclosed ecosystem. Oil concentration was 100 ppb, experiment duration was 3 mo., and samples were taken from up to six depths at frequencies of one to six times per week. Measured physical and chemical characteristics of the water, chlorophyll *a*, $^{14}C$ fixation, particulate C & N, phytoplankton and zooplankton density, and hydrocarbon concentrations.

**Davies, J. M., R. Hardy, A. D. McIntyre**, 1981. Environmental effects of North Sea oil operations. Marine Pollution Bulletin **12**:412-416.
**Keywords:** aromatic hydrocarbons/ assay/ effects/ fish/ general effect/ hydrocarbons/ marine invertebrate/ marine plant/ microbes/ North Sea/ Oeight/ oil/ oil field/ overview/ petroleum/ phytoplankton/ salt water/ sampling/ sediment/ short-term/ water column/ zooplankton
**Notes:** An overview of the environmental consequences of oil operations in the North Sea based primarily on research generated during 1977-80. Studies included short-term laboratory assays, large water-column field enclosures maintained for 100 da, and collections of sediment samples. Information on fish egg sensitivity to petroleum, AHH of commercially-caught fish; and responses of microorganisms,

phytoplankton, zooplankton, and primary carnivores to water-soluble fractions of petroleum are presented. Analyzed sediments from sampling sites in established oil fields for aromatic hydrocarbons.

**Davies, J. M., J. M. Addy, R. A. Blackman, J. R. Blanchard, J. E. Ferbrache, D. C. Moore, H. J. Somerville, A. Whitehead, T. Wilkinson**, 1984. Environmental effects of the use of oil-based drilling muds in the North Sea. Marine Pollution Bulletin **15**:363-370.
**Keywords:** abundance/ community/ concentration/ distance/ diversity/ drilling mud/ effects/ marine invertebrate/ miscellaneous/ North Sea/ Oeleven/ oil/ oil-based/ petroleum hydrocarbons/ population/ review/ salt water/ sediment/ species
**Notes:** A report from a joint industry-government working group convened to evaluate the environmenal effects of oil-based drilling muds. Presents literature review, comments on existing field studies, data on hydrocarbon and metal concentrations around drilling platforms, relations between number of species, abundance, and diversity and concentration of oil in sediment and distance from platform.

**Davis, H. K., C. F. Moffat, N. J. Shepherd**, 2002. Experimental tainting of marine fish by three chemically dispersed petroleum products, with comparisons to the *Braer* oil spill. Spill Science Technology Bulletin **7**:257-278.
**Keywords:** bivalve/ concentration/ crude oil/ depuration/ diesel/ dispersant/ experiment/ fish/ fresh water/ fuel oil/ marine invertebrate/ mussel/ ODthree/ oil/ oil spill/ PAH/ petroleum/ petroleum products/ salmon/ salt water/ shellfish/ spill/ taint/ time/ tissue
**Notes:** A three part experiment to examine petroleum tainting in finfish and shellfish. Separate experiments were conducted with salmon, trout and mussels exposed to varying concentrations of Forties crude oil, diesel, and medium fuel oil in an effort to determine (1) tainting thresholds, (2) dose response in tainting intensity, and (3) depuration time. Trout were also exposed to a dispersant (NS25). Water and tissue were analyzed in detail for *n*-alkanes and PAHs.

**Davis, J. E., S. S. Anderson**, 1976. Effects of oil pollution on breeding grey seals. Marine Pollution Bulletin **7**:115-118.
**Keywords:** coast/ effects/ grey seal/ mammal/ oil/ oiled/ Otwo/ pollution/ reproduction/ salt water/ seal/ spill/ survival/ United Kingdom/ Wales/ washing
**Notes:** Observations on the oiling of breeding grey seals on the coast of Wales and the consequences for survival; also, attempts at washing oiled seals.

**Davis, P. H., R. B. Spies**, 1980. Infaunal benthos of a natural petroleum seep: study of community structure. Marine Biology **59**:31-41.
**Keywords:** California/ community/ composition/ density/ distribution/ diversity/ marine invertebrate/ Ofour/ oil/ oil seep/ petroleum/ salt water/ species/ structure
**Notes:** Comparison of the infaunal benthos at a natural oil seep location and a comparison site near Santa Barbara, California during the period 1975-78. Measured organism density, number of species, diversity indicies, and size-class distribution of two species.

**Davis, P. H., T. W. Schultz, R. B. Spies**, 1981. Toxicity of Santa Barbara seep oil to starfish embryos: Part 2 -- the growth bioassay. Marine Environmental Research **5**:287-294.
**Keywords:** abnormalities/ bioassay/ crude oil/ development/ embryo/ experiment/ growth/ length/ marine invertebrate/ Ofour/ oil/ salt water/ Santa Barbara crude oil/ starfish/ static/ toxicity
**Notes:** Starfish embryos exposed to 100% water-soluble fraction (WSF) of Santa Barbara crude oil in a 48-hr static bioassay. Three experiments conducted; determine effect of length of exposure, determine most sensitive stage of development, and determine effect of ageing the WSF mixture. Measured length and incidence of abnormal development of embryos.

**Davis, R. W., T. M. Williams, J. A. Thomas, R. A. Kastelein, L. H. Cornell**, 1988. The effects of oil contamination and cleaning on sea otters (*Enhydra lutris*). II. Metabolism, thermoregulation, and behavior. Canadian Journal of Zoology **66**:2782-2790.
**Keywords:** behavior/ cleaning/ development/ effects/ fur/ mammal/ metabolism/ methods/ oil/ oiled/ Otwo/ salt water/ sea otter/ thermoregulation

**Notes:** Development of methods for cleaning oiled sea otters; also observations on thermoregulation, metabolism, and behavior.

**Davis, R. W.**, 1990. Advances in rehabilitating oiled sea otters: the Valdez experience. Wildlife Journal **13**:30-41.
**Keywords:** Alaska/ crude oil/ Exxon Valdez/ mammal/ oil/ oil spill/ oiled/ Otwo/ procedure/ Prudhoe Bay crude oil/ rehabilitation/ salt water/ sea otter/ spill
**Notes:** Description of the procedures and facilities used to rehabilitate oiled sea otters from the Exxon Valdez oil spill in Alaska.

**Davison, W., C. E. Franklin, J. C. McKenzie, M. C. R. Dougan**, 1992. The effects of acute exposure to the water soluble fraction of diesel fuel oil on survival and metabolic rate of an Antarctic fish (*Pagothenia borchgrevinki*). Comparative Biochemistry and Physiology **102C**:185-188.
**Keywords:** acute/ Antarctic/ blood/ diesel/ diesel fuel/ effects/ fish/ fuel oil/ metabolism/ oil/ Othree/ physiology/ rate/ salt water/ solubility/ survival
**Notes:** Effects on an Antarctic fish of acute exposure to the water soluble fraction of diesel fuel; physiology, metabolism, and blood chemistry.

**Davison, W., C. E. Franklin, J. C. McKenzie, P. W. Carey** , 1993. The effects of chronic exposure to the water soluble fraction of fuel oil on an Antarctic fish *Pagothenia borchgrevinki*. Comparative Biochemistry and Physiology **104C**:67-70.
**Keywords:** Antarctic/ chronic/ diesel/ diesel fuel/ effects/ fish/ fuel oil/ oil/ Othree/ physiology/ salt water/ solubility
**Notes:** Physiological effects in an Antarctic fish following experimental exposure to water soluble fractions of diesel fuel for 7 days.

**Day, R. H., S. M. Murphy, J. A. Wiens, G. D. Hayward, E. J. Harner, B. E. Lawhead**, 1997. Effects of the *Exxon Valdez* oil spill on habitat use by birds along the Kenai Peninsula, Alaska. Condor **99**:728-742.
**Keywords:** abundance/ Alaska/ bird/ coast/ density/ effects/ Exxon Valdez/ habitat/ Kenai Peninsula/ oil/ oil spill/ oiled/ Oone/ Prudhoe Bay crude oil/ salt water/ species/ spill
**Notes:** Assessment of the effects of the Exxon Valdez oil spill on habitat use by 34 species of birds along the coast of the Kenai Peninsula, Alaska. Study began in late summer 1989 and ended in late summer 1991. Measured bird density, degree of oiling, habitat measures, and degree of disturbance from cleanup.

**Day, R. H., S. M. Murphy, J. A. Wiens, G. D. Hayward, E. J. Harner, L. N. Smith**, 1997. Effects of the *Exxon Valdez* oil spill on habitat use by birds in Prince William Sound, Alaska. Ecological Applications **7**:593-613.
**Keywords:** Alaska/ bird/ crude oil/ effects/ Exxon Valdez/ habitat/ marine birds/ oil/ oil spill/ Oone/ Prince William Sound/ recovery/ salt water/ spill
**Notes:** Effects of oil spill on habitat use by birds.

**de Jong, E.**, 1980. The effect of a crude oil spill on cereals. Environmental Pollution (Series A) **22**:187-196.
**Keywords:** biomass/ Canada/ crude oil/ depth/ fresh water/ freshwater plant/ grain/ growth/ harvest/ nutrients/ oil/ oil spill/ Oseven/ pipeline/ plant/ recovery/ seasonal/ soil/ spill/ time
**Notes:** A ruptured sub-surface pipeline discharged crude oil beneath the frost line in farm land north of Moose Jaw, Saskatchewan, Canada. After partial recovery of the oil, the land was planted with cereal crops (1 yr fallow) for 5 consecutive yrs. Measured total above ground plant mass, grain yield, major nutrients at three depths at harvest time, total oil content of soil; and the percent of oil, water and air at three depths within soil core samples taken after the fifth growing season.

**de la Cruz, A. A.**, 1982. Effects of oil on phytoplankton metabolism in natural and experimental estuarine ponds. Marine Environmental Research **7**:257-263.
**Keywords:** concentration/ crude oil/ effects/ Empire Mix crude oil/ estuarine/ evaluation/ light/ marine plant/ metabolism/ oil/ oiled/ Osix/ oxygen/ photosynthesis/ phytoplankton/ productivity/ salt water

**Notes:** An assessment of the effect of crude oil on the primary productivity of estuarine phytoplankton in a natural tidal pond and in experimental estuarine ponds. The tidal pond received Empire Mix crude oil and was evaluated by a light and dark bottle method for oxygen concentration (converted to C production). Evaluations were made before oiling and 16 and 60 da after oiling. Experimental ponds received either Nigerian, Arabian, or Empire Mix crude oils and productivity was determined with a $^{14}C$ method. Evaluations were made 5 da and 2 da before oiling and 5, 34, and 55 da after oiling.

**de Oteyza, T. G., J. O. Grimalt**, 2006. GC and GC-MS characterization of crude oil transformation in sediments and microbial mat samples after the 1991 oil spill in the Saudi Arabian Gulf coast. Environmental Pollution **139**:523-531.
**Keywords:** aliphatic hydrocarbons/ Arabian Gulf/ aromatic/ aromatic hydrocarbon/ aromatic hydrocarbons/ biodegradation/ coast/ composition/ crude oil/ GC-MS/ hydrocarbons/ miscellaneous/ Oeleven/ oil/ oil spill/ salt water/ sediment/ spill/ time/ war
**Notes:** Surface sediments, subsurface sediments, and microbial mats were collected in 1995 and 1998 at four sites along the Saudi Arabian coast. Samples were analyzed for aliphatic and aromatic hydrocarbons and compared to the composition of crude oil from the 1991 Gulf War spill.

**De Vogelaere, A. P., M. S. Foster**, 1994. Damage and recovery in intertidal *Fucus gardneri* assemblages following the 'Exxon Valdez' oil spill. Marine Ecology Progress Series **106**:263-271.
**Keywords:** Alaska/ barnacle/ experiment/ Exxon Valdez/ herring/ intertidal/ limpet/ marine invertebrate/ marine plant/ numbers/ oil/ oil spill/ Osix/ periwinkle/ Prince William Sound/ recovery/ recruitment/ salt water/ species/ spill/ survival/ time/ vegetation
**Notes:** An assessment of the recovery of *Fucus gardneri* and associated fauna in Herring Bay, Prince William Sound, Alaska 18 mos thru 29 mos after the Exxon Valdez spill. Sites were classified at 18 mos as either unoiled or uncleaned, less intensely cleaned, or intensely cleaned. Status of vegetation was determined at 18, 25, 27, and 29 mos post-spill. Measured percent cover of *Fucus*, number of *Fucus* recruits, percent cover of tar, percent cover of barnacles, number of species of periwinkles and limpets, and number of species of fauna. An experiment was conducted to determine the influence of tree canopy cover on *Fucus* survival and recruitment on all three types of sites.

**Dean, T. A., M. S. Stekoll, S. C. Jewett, R. O. Smith, J. E. Hose**, 1998. Eelgrass (*Zostera marina* L.) in Prince William Sound, Alaska: effects of the *Exxon Valdez* oil spill. Marine Pollution Bulletin **36**:201-210.
**Keywords:** Alaska/ eelgrass/ effects/ Exxon Valdez/ growth/ hydrocarbons/ marina/ marine plant/ oil/ oil spill/ oiled/ Osix/ petroleum/ petroleum hydrocarbons/ Prince William Sound/ reproduction/ salt water/ sediment/ spill/ time
**Notes:** Assessment of the effects of the Exxon Valdez oil spill on eelgrass in Prince William Sound, Alaska. Measured six characteristics of eelgrass in 1990 and two characteristics in 1991, 1993, and 1995. Compared oiled sites with reference sites. Also tracked petroleum hydrocarbons in sediments during the same time period.

**Dean, T. A., J. L. Bodkin, A. K. Fukuyama, S. C. Jewett, D. H. Monson, C. E. O'Clair, G. R. VanBlaricom**, 2002. Food limitation and the recovery of sea otters following the 'Exxon Valdez' oil spill. Marine Ecology Progress Series **241**:255-270.
**Keywords:** activity/ Alaska/ clam/ consumption/ crab/ crude oil/ estimate/ Exxon Valdez/ feeding/ food/ length/ mammal/ mussel/ oil/ oil spill/ Otwo/ population/ Prince William Sound/ rate/ ratio/ recovery/ salt water/ sea otter/ shoreline/ spill/ time/ weight
**Notes:** An assessment of food limitation as a possible cause of the retarded recovery of the sea otter population of northern Knight Island, Prince William Sound. Mussels, clams, and crabs were collected during 1996-98 at a large number of sites on the shoreline of northern Knight Island and western Montague Island (unoiled). Observations were made on feeding activity to estimate prey consumption rates. Captured animals were weighed and measured to determine age-adjusted body mass and mass to length ratios.

**Debrot, A. O., J. E. Bradshaw, A. B. Tiel**, 1995. Tar contamination on beaches in Curacao, Netherlands Antilles. Marine Pollution Bulletin **30**:689-693.
**Keywords:** beach/ Curacao/ miscellaneous/ Netherlands/ Oeleven/ pollution/ refinery/ salt water/ tar ball/

time
**Notes:** Tar pollution was monitored at 10 sites along the beaches of Curacao during a 14 mo period spanning 1991-1993.

**Decker, C. J., J. W. Fleeger**, 1984. The effect of crude oil on the colonization of meiofauna into salt marsh sediments. Hydrobiologia **118**:49-58.
**Keywords:** aromatic hydrocarbons/ colonization/ concentration/ crude oil/ density/ diversity/ Louisiana/ Louisiana crude oil/ marine invertebrate/ meiofauna/ Ofour/ oil/ salt marsh/ salt water/ sediment/ South Louisiana crude oil/ species/ species diversity
**Notes:** Assessment of the effect of South Louisiana crude oil on the colonization of meiofauna into sediments of a Louisiana salt marsh. Employed 45 experimental trays of sediment mixed with three concentrations of crude oil; trays were placed in the marsh to receive natural colonization over a 60 da period. Measured aromatic hydrocarbon concentration, meiofauna density, and species diversity.

**DeGange, A. R., A. M. Doroff, D. H. Monson**, 1994. Experimental recovery of sea otter carcasses at Kodiak Island, Alaska, following the Exxon Valdez oil spill. Marine Mammal Science **10**:492-496.
**Keywords:** Alaska/ carcass/ crude oil/ experiment/ Exxon Valdez/ mammal/ oil/ oil spill/ Otwo/ Prudhoe Bay crude oil/ recovery/ salt water/ sea otter/ spill
**Notes:** Results of a sea otter carcass recovery experiment several months after the Exxon Valdez oil spill.

**DeGraeve, G. M., R. G. Elder, D. C. Woods, H. L. Bergman** , 1982. Effects of naphthalene and benzene on fathead minnows and rainbow trout. Archives of Environmental Contamination and Toxicology **11**:487-490.
**Keywords:** acute/ adult/ benzene/ effects/ eggs/ fathead minnow/ fish/ fresh water/ fry/ growth/ juvenile/ naphthalene/ Othree/ rainbow trout/ survival/ toxicity
**Notes:** Effects of naphthalene and benzene on juvenile rainbow trout, fathead minnows, and fathead minnow eggs and fry; acute toxicity for the trout and adult fathead minnows and growth and survival for the fry and eggs.

**Dehrmann, A.**, 1994. Penguins affected by oil spill in South African waters. Penquin Conservation **7**:8-12.
**Keywords:** bird/ effects/ fuel oil/ oil/ oil spill/ Oone/ penguin/ rehabilitation/ salt water/ South Africa/ spill
**Notes:** Report of the effects on penguins of a large spill of heavy fuel oil from the "Apollo Sea".

**Dehrmann, A.**, 1994. South African oil spill: clean-up continues, thousands of penguins released after treatment. Penquin Conservation **7**:10-11.
**Keywords:** bird/ fuel oil/ oil/ oil spill/ oiled/ Oone/ penguin/ population/ rehabilitation/ salt water/ South Africa/ spill/ treatment
**Notes:** Follow-up report on the consequences of the "Apollo Sea" oil spill.

**Deis, D. R., N. G. Tavel, P. Masciangioli, C. Villoria, M. A. Jones, G. F. Ortega, and G. R. Lee** 1997. Orimulsion: research and testing and open water containment and recovery trials. Pages 459-467 *in* 1997 International Oil Spill Conference. Improving Environmental Protection. Progress, Challenges, Responsibilities. API Publication. American Petroleum Institute, Washington, DC.
**Keywords:** beach/ behavior/ community/ effects/ mangrove/ marine invertebrate/ oil/ oil spill/ Onine/ Orimulsion/ protection/ recovery/ review/ salt water/ sand/ seagrass/ spill/ technical
**Notes:** Chemical and physical properties of orimulsion and its behavior in water. A review of the effects of orimulsion on seagrass, mangroves, biofouling communities, and sand beach communities. Also, containment and recovery testing and response strategies for orimulsion spills.

**Deka, S., A. Devi, H. P. Barthakur, L. C. Kagti**, 1997. Studies on the impact of crude oil pollution on the physico-chemical properties, nature of micro-organisms and growth of rice plants in soil. Journal of Environmental Biology **18**:167-171.
**Keywords:** crude oil/ experiment/ freshwater plant/ growth/ microbes/ oil/ Oseven/ plant/ pollution/ soil

**Notes:** Growth of rice plants in a pot culture experiment wherein the soil was amended with varying amounts of crude oil; soil properties and micro-organisms were also evaluated.

**Del'Arco, J. P., F. P. de Franca**, 2001. Influence of oil contamination levels on hydrocarbon biodegradation in sandy sediment. Environmental Pollution **112**:515-519.
**Keywords:** aliphatic hydrocarbons/ Arabian crude oil/ Arabian Light crude oil/ biodegradation/ concentration/ crude oil/ degradation/ experiment/ fresh water/ hydrocarbons/ light/ microbes/ oil/ Oten/ petroleum/ sediment
**Notes:** An assessment of the effect of petroleum concentration on the amount of biodegradation in sandy sediment. An experiment was performed with sandy sediment treated with three concentrations of light Arabian crude oil and incubated for 28 da. Each degradation 'reactor' was innoculated with a microbial culture obtained from a landfarming operation. Measured the degradation in terms of aliphatic hydrocarbons and the 'oil and grease' component.

**Delaune, R. D., W. H. Patrick, Jr., R. J. Buresh**, 1979. Effect of crude oil on a Louisiana *Spartina alterniflora* salt marsh. Environmental Pollution **20**:21-31.
**Keywords:** alkane/ aromatic hydrocarbons/ biomass/ crude oil/ density/ effects/ experiment/ growth/ Louisiana/ Louisiana crude oil/ marine plant/ nitrate/ nitrogen/ oil/ Osix/ phosphorus/ plant/ population/ reduction/ salt marsh/ salt water/ sediment/ Spartina/ vegetation/ wetland
**Notes:** An assessment of the effects of Louisiana crude oil on a *Spartina* salt marsh in Louisiana. Three experiments were performed. In a field experiment, four quantities of crude oil were added to wetland sediment enclosures in May. Plant biomass was harvested in September, weighed, and analyzed for P and N. Regenerated shoots were measured in the following April and vegetation harvested again in September; stem density also was measured in September. Sediment cores were analyzed for alkanes, aromatics, and NSO compounds. In a greenhouse study, potted plants were exposed to one of seven quantities of oil. The plants were harvested after 75 da and weighed. Two wks later, the number of new tillers was counted; biomass of the second growth was determined 60 da after the first cutting. The effect of crude oil on sediment processes was determined in a 28-da experiment by exposed sediment in flasks to one of five amounts of crude oil and measuring production of manganous manganese, ferrous iron, and sulphide; nitrogen mineralisation; nitrate reduction; and methane production.

**Delaune, R. D., C. J. Smith, W. H. Patrick, Jr., J. W. Fleeger, M. D. Tolley**, 1984. Effect of oil on salt marsh biota: methods for restoration. Environmental Pollution (Series A) **36**:207-227.
**Keywords:** aromatic hydrocarbons/ biomass/ carbon/ carbon fixation/ crude oil/ dispersant/ general effect/ growth/ infauna/ Louisiana/ Louisiana crude oil/ macrofauna/ marine invertebrate/ marine plant/ meiofauna/ methods/ Oeight/ oil/ photosynthesis/ restoration/ salt marsh/ salt water/ seasonal/ sediment/ snail/ South Louisiana crude oil/ time/ treatment/ vegetation
**Notes:** Experimental application of South Louisiana crude oil (2 $l/m^2$) to 6 $m^2$ plots of coastal salt marsh in Louisiana. Treatments were no oil, oil, oil plus mechanical water flush, oil plus dispersant plus water flush, dispersant, dispersant plus oil, and oil followed by vegetation removal. Aromatic hydrocarbon content of sediment was measured 2 da post treatment. Photosynthetic carbon fixation determined on days 7, 20, and 37 after treatment. Standing crop biomass determined after the end of the first and second growing season. Marsh infauna (macrofauna) were sampled on days 10, 30, 60, and 144 post treatment; meiofauna were sampled on days 2, 5, 10, 20, 30, 60, 95, and 144. Snails were sampled on days 2, 5, 20, 60, and 95 post treatment.

**Delaune, R. D., C. W. Lindau, B. C. Banker, I. Devai**, 2000. Degradation of petroleum hydrocarbons in sediment receiving produced water discharge. Journal of Environmental Science and Health **A35**:1-14.
**Keywords:** alkane/ concentration/ condition/ crude oil/ degradation/ effects/ evaluation/ fertilizer/ hydrocarbons/ Louisiana/ Louisiana crude oil/ microbes/ oil/ Oten/ PAH/ petroleum/ petroleum hydrocarbons/ produced water/ rate/ salt water/ sediment/ South Louisiana crude oil
**Notes:** An evaluation of the petroleum degradation potential of sediments collected from a produced water discharge site in an oil and gas field in Louisiana. The initial concentrations of PAHs and alkanes were determined. Degradation rates were determined for residual hydrocarbons under oxidized and reduced conditions; this was repeated for alkanes (South Louisiana crude oil added to sediment). Determined effects of high and low fertilizer additions on oxidized and reduced degradation of alkanes.

**Delille, D., A. Basseres, A. Dessommes**, 1997. Seasonal variation of bacteria in sea ice contaminated by diesel fuel and dispersed crude oil. Microbial Ecology **33**:97-105.
**Keywords:** abundance/ Antarctic/ bacteria/ cell/ community/ crude oil/ diesel/ diesel fuel/ effects/ fertilizer/ ice/ microbes/ oil/ Oten/ petroleum/ petroleum hydrocarbons/ population/ salt water/ seasonal
**Notes:** Effects of petroleum contamination of Antarctic sea ice. Sea ice exposed to either crude oil, crude oil plus fertilizer, diesel fuel, or diesel fuel plus fertilizer. Measured seasonal (Apr.-Nov.) pattern of total bacterial abundance, mean cell volume, and abundance of three categories of bacteria in sea ice and underlying sea water.

**Delille, D., A. Basseres, A. Dessommes, C. Rosiers**, 1998. Influence of daylight on potential biodegradation of diesel and crude oil in Antarctic seawater. Marine Environmental Research **45**:249-258.
**Keywords:** abundance/ Antarctic/ Arabian Light crude oil/ biodegradation/ cell/ community/ crude oil/ diesel/ effects/ light/ mesocosm/ microbes/ oil/ Oten/ salt water/ treatment
**Notes:** Assessed the effects of crude oil and diesel oil addition to Antarctic sea water on the bacterial community in covered and non-covered mesocosms during 1991-93. Bacterial changes were monitored for 2 or 5 wks. Treatments were open and covered controls, diesel oil, and Arabian Light crude oil. Measured bacterial abundance and mean cell volumes.

**Delille, D., B. Delille**, 2000. Field observations on the variability of crude oil impact on indigenous hydrocarbon-degrading bacteria from sub-Antarctic intertidal sediments. Marine Environmental Research **49**:403-417.
**Keywords:** abundance/ Antarctica/ Arabian Light crude oil/ bacteria/ beach/ biodegradation/ crude oil/ experiment/ index/ intertidal/ light/ long-term/ methods/ microbes/ oil/ Oten/ petroleum/ salt water/ sand/ sediment/ short-term/ time
**Notes:** Determination of the hydrocarbon-degrading capabilities of indigenous bacteria on nine beaches on the Kerguelen Archipelago, Antarctica. PVC enclosures were treated with Arabian light crude oil for a short-term (5 da) experiment and a long-term (90 da) experiment. Enclosures were sampled periodically during the study (the Methods fail to mention this). Figures show 100 da of elapsed time despite the fact that the long-term experiment only went 90 da. Sand outside the enclosure was a natural control for each site. Measured bacterial abundance, total remaining petroleum, and calculated three biodegradation indexes.

**Derenbach, J. B., M. V. Gereck**, 1980. Interference of petroleum hydrocarbons with the sex pheromone reaction of *Fuscus vesiculosus* (L.). Journal of Experimental Marine Biology and Ecology **44**:61-65.
**Keywords:** algae/ alkane/ aromatic hydrocarbons/ chemotaxis/ concentration/ crude oil/ diesel/ diesel fuel/ hydrocarbons/ Iranian crude oil/ marine plant/ oil/ Osix/ petroleum/ petroleum hydrocarbons/ pheromone/ salt water/ sex
**Notes:** Assessment of the chemotaxic response of brown algae spermatozoids to diesel fuel, Iranian crude oil, and several alkane and aromatic components. Measured the concentration required to elicite a chemotaxic response.

**Dewling, R. T. and C. C. D. A. E. Silva** 1979. Impact of dispersant use during the *Brazilian Marina* incident. Pages 269-276 *in* 1979 Oil Spill Conference, API Publication 4308. American Petroleum Institute, Washington, DC.
**Keywords:** beach/ Brazil/ coast/ crude oil/ crustacean/ dispersant/ evaluation/ fuel oil/ growth/ Kuwait/ Kuwait crude oil/ marina/ miscellaneous/ No.2 fuel oil/ ODeleven/ oil/ oil spill/ phytoplankton/ salt water/ sand/ species/ spill/ survival/ toxicity
**Notes:** Evaluation of the use of a chemical dispersant on a crude oil spill off the coast of Brazil. Kuwait crude oil was treated with a Brazilian dispersant (BRAS-X-Plus). After use on the spill, toxicity tests of dispersant alone and dispersant plus No. 2 fuel oil were performed with phytoplankton growth inhibition and survival of a species of crustacean. Chemically analyzed the dispersant, measured oil penetration into beach sand at six sites encompassing dispersant-treated and non-dispersant-treated beaches, and compared toxicity of BRAS-X to that of other chemical dispersants.

**Dewling, R. T., L. T. McCarthy**, 1980. Chemical treatment of oil spills. Environment International **3**:155-162.

**Keywords:** burning/ chemical agent/ dispersant/ evaluation/ miscellaneous/ ODeleven/ oil/ oil spill/ petroleum/ salt water/ spill/ treatment
**Notes:** An early evaluation of the range of chemical agents available for treating petroleum spills. Sections on dispersants, film-forming agents, surface active chemicals, surface collecting agents, gelling agents, sinking agents, and burning agents.

**Dey, A. C., J. W. Kiceniuk, U. P. Williams, R. A. Khan, J. F. Payne**, 1983. Long term exposure of marine fish to crude petroleum -- I. Studies on liver lipids and fatty acids in cod (*Gadus morhua*) and winter flounder (*Pseudopleuronectes americanus*). Comparative Biochemistry and Physiology **75C**:93-101.
**Keywords:** biochemistry/ cod/ crude oil/ effects/ fatty acids/ fish/ flounder/ growth/ lipid/ liver/ long-term/ oil/ Othree/ petroleum/ physiology/ salt water/ tissue/ Venezuelan crude oil/ winter flounder
**Notes:** Effects on cod and winter flounder of exposure to Venezuelan crude oil for 24 weeks; growth, physiology, tissue biochemistry.

**deZwart, D., W. Slooff**, 1987. Toxicity of mixtures of heavy metals and petrochemicals to *Xenopus laevis*. Bulletin of Environmental Contamination and Toxicology **38**:345-351.
**Keywords:** amphibian/ clawed frog/ combination/ fresh water/ larvae/ metals/ OthreeA/ petroleum hydrocarbons/ toxicity
**Notes:** Assessment of the toxicity to larvae of clawed toads of combinations of metals and petroleum-derived compounds.

**Diamond, J. M.**, 1982. How eggs breathe while avoiding desiccation and drowning. Nature **295**:10-11.
**Keywords:** bird/ egg shell/ eggs/ Oone/ physiology
**Notes:** Discourse on mechanisms and adaptations of eggs for control of gas diffusion and dessication.

**Dibner, P. C.** 1978. Response of a salt marsh to oil spill and cleanup. U.S. Environmental Protection Agency, Cincinnati, Ohio. **EPA-600/7-78-109**. 10 pp.
**Keywords:** fuel oil/ marine plant/ miscellaneous/ No.6 fuel oil/ Oeleven/ oil/ oil spill/ oiled/ restoration/ salt marsh/ spill/ vegetation/ wetland
**Notes:** Description of a spill of No. 6 fuel oil on the Hackensack River, NJ and the subsequent cleanup of the oil from affected wetlands. After removal of all accessible oil, vegetation along the bank of the river was removed by cutting and hauling away. Author assesses the consequences of this method of response to oiled marsh vegetation.

**Dicks, B.** 1977. Changes in the vegetation of an oiled Southampton Water salt marsh. Pages 208-240 *in* J. Cairns, Jr., K. L. Dickson, E. E. Herricks, editors. Recovery and Restoration of Damaged Ecosystems. University of Virginia, Charlottesville.
**Keywords:** community/ discharges/ ecosystem/ effects/ effluent/ England/ experiment/ history/ long-term/ marine plant/ oiled/ Osix/ petroleum/ photograph/ pollution/ population/ recovery/ refinery/ restoration/ salt marsh/ salt water/ Spartina/ vegetation
**Notes:** A long-term assessment of the effects of refinery discharges on the vegetation of a salt marsh on Southhampton Water, England. The study covers the period 1950-74; refinery effluents began in 1951 and caused progressive damage to the vegetation until 1970 when effluent quality improved enough for recovery to begin. Vegetation is dominated by *Spartina anglica*. Author conducted several experiments, discusses the history of vegetation change as shown by maps and photographs of the area, and provides extensive descriptions of the petroleum pollution and related changes in vegetation. Also, a description of the efforts to re-establish viable stands of vegetation.

**Dierschke, V.**, 1994. The influence of oil-polluted plumage on survival and body mass of purple sandpipers *Calidris maritima* at Helgoland. (Text in German, English abstract). Vogelwelt **115**:253-255.
**Keywords:** bird/ effects/ Germany/ oiled/ Oone/ plumage/ salt water/ sandpiper/ survival/ weight
**Notes:** Discussion of the effects of plumage oiling on the body weight and survival of purple sandpipers.

**Dieter, M. P.** 1976. The effects of petroleum hydrocarbons on aquatic birds. Pages 438-446 *in* Sources, Effects, and Sinks of Hydrocarbons in the Aquatic Environment. American Institute of Biological Sci.,

Arlington, VA.
**Keywords:** bird/ effects/ environment/ hydrocarbons/ oil/ Oone/ overview/ petroleum/ petroleum hydrocarbons/ sources/ spill
**Notes:** Overview of the effects of oil on aquatic birds and a discussion of oil research at the Patuxent Wildlife Research Center.

**Diez, S., J. Sabate, M. Vinas, J. M. Bayona, A. M. Solanas, J. Albaiges**, 2005. The *Prestige* oil spill. I. Biodegradation of a heavy fuel oil under simulated conditions. Environmental Toxicology **24**:2203-2217.
**Keywords:** aliphatic hydrocarbons/ analysis/ aromatic/ aromatic hydrocarbons/ biodegradation/ biomarker/ chemical analysis/ coast/ combination/ condition/ degradation/ experiment/ fuel oil/ incubation/ inorganic/ microbes/ nutrients/ oil/ oil spill/ Oten/ petroleum/ Spain/ spill/ time/ water
**Notes:** A heavy Russian fuel oil spilled from the *Prestige* oil spill off the coast of Spain was used in biodegradation experiments. The experiment employed either unweathered or artificially-weathered fuel oil, either of two microbe mixtures, a broth or artificial sea water medium, and either of three nutrient supplements (iron octoate, inorganic nutrients, S200 commercial product) or no nutrients. This resulted in 14 combinations. Incubation batches were sampled at 30 and 40 da. A thorough chemical analysis was performed on aliphatic and aromatic compounds and specific molecular markers used to track degradation of petroleum.

**Dillon, T. M., J. M. Neff, J. S. Warner**, 1978. Toxicity and sublethal effects of No. 2 fuel oil on the supralittoral isopod *Lygia exotica*. Bulletin of Environmental Contamination and Toxicology **20**:320-327.
**Keywords:** adult/ aromatic hydrocarbons/ bioassay/ concentration/ effects/ fuel oil/ hydrocarbons/ isopod/ lethal/ marine invertebrate/ No.2 fuel oil/ Ofour/ oil/ petroleum/ petroleum hydrocarbons/ rate/ respiration/ salt water/ spill/ static/ sublethal/ toxicity/ whole body
**Notes:** Assessed the effects of water-soluble fractions (WSF) and oil-in-water dispersions (OWD) of No. 2 fuel oil on a marine isopod. Adult isopods were exposed to OWD of 1-1000 ppm or WSF of 5-100% of the stock solution for 96 hr in a static bioassay. Measured death, respiration rates, actual exposure concentrations, and whole body concentrations of petroleum hydrocarbons for isopods collected from a spill site.

**Dimov, N., A. Pavlova**, 2000. Traceability from weathered oil spills in the marine environment to the original contamination source. A case study. Journal of Environmental Monitoring **2**:266-270.
**Keywords:** analysis/ crude oil/ development/ environment/ fingerprinting/ Iranian crude oil/ marine environment/ oil/ oil spill/ Onine/ petroleum/ Russian crude oil/ salt water/ spill/ technical/ weathered
**Notes:** Development and use of a discrimination algorithm for tracing weathered petroleum to it's most likely source. The algorithm uses analytical steps that progressively increase in complexity. Authors use artificially-weathered Russian and Iranian crude oils to demonstrate the viablility of the proceedure.

**DiToro, D. M., J. A. McGrath, W. A. Stubblefield**, 2007. Predicting the toxicity of neat and weathered crude oil: toxic potential and the toxicity of saturated mixtures. EnvironmentalToxicology and Chemistry **26**:24-36.
**Keywords:** aqueous/ crude oil/ hydrocarbons/ oil/ Onine/ petroleum hydrocarbons/ solubility/ technical/ toxicity/ weathered
**Notes:** A discussion and elaboration of the issue of toxicity of fresh and weathered crude oil in an aquatic medium. Focus is on solubility as the key to toxicity and the use of toxic units to standardize the determination of toxic potential for a mixture of hydrocarbons.

**Dixon, T. J., T. R. Dixon**, 1976. *Olympic Alliance* oil spillage. Marine Pollution Bulletin **7**:86-90.
**Keywords:** bird/ crude oil/ effects/ England/ oil/ oil spill/ Oone/ population/ salt water/ spill
**Notes:** Description of the Olympic Alliance oil spill and the effects on seabirds.

**Dobroski, C. J., Jr., C. E. Epifanio**, 1980. Accumulation of benzo[*a*]pyrene in a larval bivalve via trophic transfer. Canadian Journal of Fisheries and Aquatic Sciences **37**:2318-2322.
**Keywords:** accumulation/ algae/ benzo[a]pyrene/ bivalve/ depuration/ feeding/ labelled/ larvae/ marine invertebrate/ marine plant/ Ofour/ rate/ salt water/ transfer/ trophic transfer/ uptake
**Notes:** Determination of the uptake and depuration of labelled benzo[*a*]pyrene by a diatom and the

subsequent uptake by feeding bivalve larvae. Measured accumulation rate and depuration rate for diatoms and accumulation rate for bivalve larvae; also calulated accumulation efficiencies.

**Donahue, W. H., R. T. Wang, M. Welch, J. A. Colin Nicol**, 1977. Effects of water-soluble components of petroleum oils and aromatic hydrocarbons on barnacle larvae. Environmental Pollution **13**:187-202.
**Keywords:** acute/ aromatic hydrocarbons/ barnacle/ bioassay/ Bunker C/ crankcase oil/ crude oil/ development/ effects/ embryo/ fuel oil/ hatching/ hydrocarbons/ larvae/ marine invertebrate/ No.2 fuel oil/ Ofour/ oil/ petroleum/ phototaxis/ salt water/ static
**Notes:** Assessment of the effects on larvae of two barnacles of four crude oils, Bunker C, No. 2 fuel oil, used and unused crankcase oil, and 18 aromatic hydrocarbons. Used a 1-hr static bioassay employing 10-100% water-soluble fractions (WSF) of each test substance to test for acute effects. No. 2 fuel oil WSF evaluated for effects on embryo development and hatching. Unweathered and partially-weathered No. 2 fuel oil, and two aromatics evaluated for effects on larval phototaxis.

**Donkin, P., E. L. Smith, S. J. Rowland**, 2003. Toxic effects of unresolved complex mixtures of aromatic hydrocarbons accumulated by mussels, *Mytilus edulis*, from contaminated field sites. Environmental Science and Technology **37**:4825-4830.
**Keywords:** aromatic hydrocarbons/ bivalve/ chemical analysis/ coast/ depuration/ England/ experiment/ feeding/ hydrocarbons/ juvenile/ marine invertebrate/ mussel/ Ofour/ rate/ salt water/ time/ transplant/ unresolved complex mixture
**Notes:** Mussels were collected from three clean and three polluted sites on the southwest coast of England. Mussels from one clean site were transplanted to two polluted sites in January for a transplant experiment. Mussels from three sites were collected in February and April, feeding rates measured, depurated for 24 hr in clean water, and feeding rates measured again. Samples of mussels collected from other sites were steam distillated and the distillate placed in water containing juvenile mussels. The feeding rate of the juveniles was then measured. Analyzed the depuration water and the distillate material for aromatic hydrocarbons.

**Dorn, P. B., T. E. Vipond, J. P. Salanitro, H. L. Wisniewski**, 1998. Assessment of the acute toxicity of crude oils in soils using earthworms, microtox, and plants. Chemosphere **37**:845-860.
**Keywords:** acute/ bacteria/ concentration/ corn/ crude oil/ earthworm/ effects/ fresh water/ freshwater invertebrate/ freshwater plant/ germination/ growth/ lettuce/ light/ Microtox/ oat/ Ofive/ oil/ oil spill/ plant/ seed/ soil/ spill/ survival/ toxicity/ weight/ wheat
**Notes:** Assessment of the effects of an oil spill on soil quality. Exposed earthworms (14 da toxicity test), Microtox bacteria, and plant seeds of lettuce, corn, wheat, rye, and wild oat (14 da germination and growth) to soil treated with varying concentrations of light, medium, and heavy crude oils. Used two types of soil. Measured survival, germination, and plant weight. Calculated LC50, EC50, NOEC, and IC25 values.

**Dorn, P. B., J. P. Salanitro**, 2000. Temporal ecological assessment of oil contaminated soils before and after bioremediation. Chemosphere **40**:419-426.
**Keywords:** assay/ bioremediation/ combination/ corn/ crude oil/ earthworm/ freshwater invertebrate/ freshwater plant/ germination/ growth/ incubation/ light/ microbes/ Microtox/ mixing/ nutrients/ oat/ oil/ Oten/ plant/ ratio/ seed/ seedling/ soil/ survival/ time/ toxicity/ weathered/ wheat
**Notes:** Determination of toxicity of different soil and oil combinations before and after the bioremediation sequence begins. Three crude oils (light, medium, heavy) were mixed with two different artificial soils in a 1:19 ratio and weathered for 2-3 da; N and P nutrients were then added as incubation began. Earthworms were used to test soil toxicity at 0, 0.5, 1, 3, 5, 8, and 10 months after soil mixing. Microtox tests were performed on the same time schedule as the earthworm assays. Corn, wheat, and wild oat seeds were planted in soils bioremediated for 8-10 mos. Measured survival of earthworms, luminescence decrease in Microtox, % germination of seeds, and growth of seedlings 21 da after germination.

**Douabul, A. A. Z., N. A. Al-Shiwafi**, 1998. Dissolved/dispersed hydrocarbons in the Arabian region. Marine Pollution Bulletin **36**:844-850.
**Keywords:** Arabian Gulf/ aromatic hydrocarbons/ Gulf of Aden/ hydrocarbons/ miscellaneous/ Oeleven/ petroleum hydrocarbons/ Red Sea/ region/ salt water/ saturated hydrocarbons

**Notes:** Water samples collected from 110 stations in the Arabian Gulf, Arabian Sea, Guld of Aden, and southern Red Sea during Nov.-Dec. 1996. Water analyzed for total saturated and aromatic hydrocarbons.

**Douabul, A. A. Z., H. T. Al-Saad, S. A. Darmoian**, 1984. Distribution of petroleum residues in surficial sediments from Shatt al-Arab River and the north-west region of Arabian Gulf. Marine Pollution Bulletin **15**:198-200.
**Keywords:** Arabian Gulf/ aromatic hydrocarbons/ crude oil/ distribution/ hydrocarbons/ Iraq/ Kuwait/ Kuwait crude oil/ miscellaneous/ Oeleven/ oil/ petroleum/ region/ river/ salt water/ sediment
**Notes:** Surface sediments in the Shatt al-Arab River and extreme northwest portion of the Arabian Gulf were collected from 30 sites plus a reference location. Sediments were analyzed for aromatic hydrocarbons and the results standardized to Kuwait crude oil equivalents. Results were compared to sites in other parts of the world.

**Douglas, G. S., A. E. Bence, R. C. Prince, S. J. McMillen, E. L. Butler**, 1996. Environmental stability of selected petroleum hydrocarbon source and weathering ratios. Environmental Science and Technology **30**:2332-2339.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ degradation/ Exxon Valdez/ hopane/ hydrocarbons/ oil/ oil spill/ Onine/ PAH/ petroleum/ petroleum hydrocarbons/ ratio/ sediment/ soil/ spill/ technical/ time/ weathered
**Notes:** Sediment and soil from the Exxon Valdez oil spill were analyzed for petroleum hydrocarbons (2-6 ring PAHs, C7-C36 aliphatics, pristane, phytane, hopane). Ratios of persisent aromatics and hopane are shown to have utility in characterizing the weathering process and identifying the source of the petroleum. These 'markers' were also applied to other oil spills.

**Doval, M. D., A. Morono, Y. Pazos, A. Lopez, M. Madrinan, J. M. Cabanas, J. Maneiro**, 2006. Monitoring dissolved aromatic hydrocarbon in Rias Baixas embayments (NW Spain) after Prestige oil spills: relationship with hydrography. Estuarine and Coastal Shelf Science **67**:205-218.
**Keywords:** aromatic/ aromatic hydrocarbon/ aromatic hydrocarbons/ concentration/ condition/ dissolved/ fuel oil/ hydrocarbons/ miscellaneous/ monitoring/ Oeleven/ oil/ oil spill/ oxygen/ river/ salinity/ salt water/ Spain/ spill/ temperature/ time/ water/ water column
**Notes:** Dissolved and dissolved + dispersed aromatic hydrocarbons in the water column were monitored during the year after the November *Prestige* spill of heavy fuel oil. Four rivers in northwest Spain were sampled on a weekly basis. Also monitored wind conditions, water temperature and salinity, and dissolved oxygen concentration.

**Dow, R. L.**, 1978. Size-selective mortalities of clams in an oil spill site. Marine Pollution Bulletin **9**:45-48.
**Keywords:** bivalve/ clam/ coast/ effects/ fuel oil/ growth/ jet fuel/ Maine/ marine invertebrate/ No.2 fuel oil/ Ofour/ oil/ oil spill/ salt water/ sediment/ species/ spill/ survival
**Notes:** Determination of the effects on a clam species of a 1971 spill of No. 2 fuel oil and JP5 jet fuel along the coast of Maine. In 1976, collected live and dead clams from pits dug into the sediment. Measured annual growth of clams.

**Downing, K., M. Reed**, 1996. Object-oriented migration modelling for biological impact assessment. Ecological Modelling **93**:203-219.
**Keywords:** behavior/ biological effects/ effects/ mammal/ migration/ model/ oil/ oil spill/ Otwo/ polar bear/ ringed seal/ salt water/ seal/ spill
**Notes:** Use of an animal migration model for assessing the potential biological effects of oil spills. Hypothetical spills in the Barents Sea were linked to migration behaviors of ringed seal and polar bear.

**Downing, N., C. Roberts**, 1993. Has the Gulf War affected coral reefs of the northwestern Gulf? Marine Pollution Bulletin **27**:149-156.
**Keywords:** age/ community/ coral/ coral reef/ density/ diversity/ fish/ Kuwait/ marine invertebrate/ offshore/ Ofour/ population/ salt water/ sampling/ Saudi Arabia/ sea urchin/ structure/ survey/ survival/ urchin/ war
**Notes:** Survey of nearshore and offshore coral reefs in Kuwait and Saudi Arabia performed in late 1992

as a followup to a survey performed in July 1991. Measured survival of coral reefs, diversity of associated fish communities, age structure of several fish populations, and density of sea urchins. Compared results with 1991 sampling and several years of prewar information.

**Downs, C. A., R. H. Richmond, W. J. Mendiola, L. Rougee, G. K. Ostrander**, 2006. Cellular physiological effects of the MV *Kyowa Violet* fuel-oil spill on the hard coral *Porites lobata*. EnvironmentalToxicology and Chemistry **25**:3171-3180.
**Keywords:** assay/ biochemical/ coast/ condition/ coral/ effects/ fuel oil/ marine invertebrate/ metabolism/ Ofour/ oil/ porphyrin/ protein/ salt water/ spill
**Notes:** Coral was collected from a spill (180 fuel oil) impacted site and two reference sites off the coast of the island of Yap in Micronesia. Samples were processed and analyzed by enzyme-linked immunosorbent assay (ELISA). Biochemical measures (22) were representative of protein metabolic conditions, oxidative damage and response, porphyrin metabolism, and xenobiotic response. The purpose of the assessment was to establish a diagnostic link between the spill and observed cellular responses.

**Driskell, W. B, J. L. Ruesink, D. C. Lees, J. P. Houghton, S. C. Lindstrom**, 2001. Long-term signal of disturbance *Fucus gardneri* after the *Exxon Valdez* oil spill. Ecological Applications **11**:815-827.
**Keywords:** abundance/ algae/ Exxon Valdez/ intertidal/ invertebrate/ length/ limpet/ long-term/ marine invertebrate/ marine plant/ oil/ oil spill/ oiled/ Osix/ salt water/ snail/ spill/ time
**Notes:** A long-term assessment (1989-1996) of the intertidal brown algae *Fucus gardneri* at two unoiled sites, three oiled and unwashed sites, and three sites that were oiled and washed with high-pressure hot water. Ten quadrats were established at each of the sites. Measured percent cover and length of the algae, and abundance of littorine snails and limpets.

**Duffy, D. C.**, 1977. Incidence of oil contamination on breeding common terns. Bird-Banding **48**:370-371.
**Keywords:** bird/ gull/ New York/ oil/ oiled/ Oone/ plumage/ salt water/ tern
**Notes:** Report of the incidence of oiled birds in common terns of Great Gull Island, NY during the years 1973-76.

**Duffy, L. K., R. T. Bowyer, J. W. Testa, J. B. Faro**, 1993. Differences in blood haptoglobin and length--mass relationships in river otters (*Lutra canadensis*) from oiled and nonoiled areas of Prince William Sound, Alaska. Journal of Wildlife Diseases **29**:353-359.
**Keywords:** Alaska/ blood/ crude oil/ mammal/ oiled/ Otwo/ physiology/ Prince William Sound/ Prudhoe Bay crude oil/ river otter/ salt water/ weight
**Notes:** Comparison of blood chemistry and body weight of river otters from oiled and nonoiled areas of Prince William Sound, Alaska.

**Duffy, L. K., R. T. Bowyer, J. W. Testa, J. B. Faro**, 1994. Chronic effects of the *Exxon Valdez* oil spill on blood and enzyme chemistry of river otters. Environmental Toxicology and Chemistry **13**:643-647.
**Keywords:** Alaska/ blood/ chronic/ crude oil/ effects/ enzyme/ Exxon Valdez/ mammal/ oil/ oil spill/ oiled/ Otwo/ physiology/ Prince William Sound/ Prudhoe Bay crude oil/ river otter/ salt water/ spill
**Notes:** Comparison of blood characteristics of river otters from oiled and nonoiled areas of Prince William Sound, Alaska in 1991.

**Duffy, L. K., R. T. Bowyer, J. W. Testa, J. B. Faro**, 1994. Evidence for recovery of body mass and haptoglobin values of river otters following the Exxon Valdez oil spill. Journal of Wildlife Diseases **30**:421-425.
**Keywords:** Alaska/ blood/ crude oil/ Exxon Valdez/ mammal/ oil/ oil spill/ oiled/ Otwo/ physiology/ Prince William Sound/ Prudhoe Bay crude oil/ recovery/ river otter/ salt water/ spill/ weight
**Notes:** Measurement of blood chemistry and body weight of river otters from oiled and nonoiled areas of Prince William Sound, Alaska during 1990-92.

**Duke, N. C., Z. S. Pinzon M., M. C. Prada T.**, 1997. Large-scale damage to mangrove forests following two large oil spills in Panama. Biotropica **29**:2-14.
**Keywords:** Bunker C/ Caribbean/ coast/ crude oil/ diesel/ diesel fuel/ effects/ estimate/ mangrove/ marine

plant/ oil/ oil spill/ Osix/ Panama/ salt water/ spill/ structure/ sublethal/ tanker
**Notes:** Discussion of the damage to mangrove forests caused by two oil spills in or near Bahia Las Minas on the Caribbean coast of Panama. A 1968 tanker spill of diesel fuel and Bunker C and a 1986 land tank rupture involving crude oil. Estimates of deforestation in 1968 and deforestation plus sublethal effects on mangroves in 1986.

**Duke, N. C., K. A. Burns, R. P. J. Swannell, O. Dalhaus, R. J. Rupp**, 2000. Dispersant use and a bioremediation strategy as alternate means of reducing impacts of large oil spills on mangroves: the Gladstone Field Trials. Marine Pollution Bulletin **41**:403-412.
**Keywords:** Australia/ biomass/ bioremediation/ Bunker C/ consumption/ Corexit 9527/ crab/ crude oil/ crustacean/ dispersant/ effects/ feeding/ fuel oil/ growth/ leaves/ litter/ mangrove/ marine invertebrate/ marine plant/ ODsix/ oil/ oil spill/ salt water/ spill/ survival/ time
**Notes:** Assessment of the effects of dispersed and undispersed crude oil, and bioremediation on mangroves in coastal Australia. The first trial consisted of crude oil only, crude oil plus Corexit 9527 dispersant, exposed and unexposed enclosures, and ambient control. The second trial consisted of crude oil only, crude oil with bioremediation, Bunker C fuel oil only, Bunker C fuel oil with bioremediation, exposed and unexposed enclosures, and ambient control. Measured mangrove survival, litter fall, leafy shoot growth, feeding by catepillars, dead crustaceans on forest floor, leaf consumption and burial by crabs, and presence and biomass of Sipunculan worms living below ground. Responses were measured within 6 mos and 1-2 yrs post-exposure.

**Duke, N. C., A. J. Watkinson**, 2002. Chlorophyll-deficient propagules of *Avicennia marina* and apparent longer term deterioration of mangrove fitness in oil-polluted sediments. Marine Pollution Bulletin **44**:1269-1276.
**Keywords:** aromatic hydrocarbons/ Australia/ coast/ concentration/ hydrocarbons/ mangrove/ marine plant/ mutation/ Osix/ salt water/ saturated hydrocarbons/ sediment
**Notes:** Three sites along the east coast of Australia were surveyed for the presence of chlorophyll-deficient mangrove (*A. marina*) propagules and their parent trees. Sediment samples were analyzed for saturated and aromatic hydrocarbons. Hydrocarbon concentrations were compared to the incidence of the albino mutation.

**DuMont, P. G.**, 1977. Oiled birds seen at Ocean City, Maryland. Maryland Birdlife **33**:12-13.
**Keywords:** bird/ Maryland/ oiled/ Oone/ plumage/ salt water/ species
**Notes:** Report of sightings of oiled plumage on several species of seabirds near Ocean City, MD.

**Dunnet, G. M.**, 1982. Oil pollution and seabird populations. Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences **297**:413-427.
**Keywords:** bird/ Europe/ history/ oil/ oil spill/ Oone/ pollution/ population/ salt water/ spill
**Notes:** Good discussion of the relation between oil spills and seabird populations of western Europe.

**Dunnet, G. M.**, 1987. Seabirds and North Sea oil. Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences **316**:513-524.
**Keywords:** bird/ North Sea/ oil/ Oone/ population/ salt water
**Notes:** Discussion of the relation between North Sea oil exploitation and seabird populations.

**Durako, M. J., W. J. Kenworthy, S. M. R. Fatemy, H. Valavi, G. W. Thayer**, 1993. Assessment of the toxicity of Kuwait crude oil on the photosynthesis and respiration of seagrasses of the northern Gulf. Marine Pollution Bulletin **27**:223-227.
**Keywords:** assay/ crude oil/ irradiance/ Kuwait/ Kuwait crude oil/ leaves/ marine plant/ oil/ Osix/ oxygen/ photosynthesis/ rate/ respiration/ salt water/ seagrass/ species/ tissue/ toxicity
**Notes:** Segments of three species of seagrasses were collected from the Gulf of Arabia and used in a laboratory assay of the relation between irradiance and photosynthetic rate ($O_2$). Seagrass leaf tissue was exposed to the water-soluble-fraction of a 1% solution of Kuwait crude oil and water for 12 hrs, followed by the assessment of irradiance response.

**Durell, G., T. Roe Utvik, S. Johnsen, T. Frost, J. Neff**, 2006. Oil well produced water discharges to the North Sea. Part I: Comparison of deployed mussels (*Mytilus edulis*), semi-permeable membrane devices, and the DREAM model predictions to estimate the dispersion of polycyclic aromatic hydrocarbons. Marine Environmental Research **62**:194-223.
**Keywords:** aromatic/ aromatic hydrocarbon/ aromatic hydrocarbons/ bivalve/ concentration/ discharges/ estimate/ hydrocarbons/ marine invertebrate/ methods/ miscellaneous/ model/ mussel/ North Sea/ Norway/ Oeleven/ offshore/ oil/ oil field/ PAH/ prediction/ produced water/ salt water/ sampling/ SPMD/ tissue/ water
**Notes:** A comparison of three methods (DREAM model, deployed mussels, semi-permeable membrane devices (SPMD)) of estimating the concentrations of PAH from oil and gas field produced-water discharges. Twenty-five sampling stations were located in two oil and gas fields offshore from Norway in the North Sea; samples were collected <1 km, 10 km, and >50 km from the discharge. Analyzed produced water, sea water, mussel tissue, and SPMD devices for >50 PAH.

**Dutrieux, E., F. Martin, A. Debry**, 1990. Growth and mortality of *Sonneratia caseolaris* planted on an experimentally oil-polluted soil. Marine Pollution Bulletin **21**:62-68.
**Keywords:** beach/ dispersant/ effects/ experiment/ fertilizer/ growth/ hydrocarbons/ mangrove/ marine plant/ nitrate/ oil/ oiled/ Osix/ petroleum/ petroleum hydrocarbons/ plant/ redox potential/ salt water/ sediment/ soil/ survival/ treatment/ washing
**Notes:** Two field experiments performed to determine the effects of 'oil' on mangrove plants. The first experiment involved five beach parcels; oil only, oil plus water washing, oil plus nitrate fertilizer, oil plus chemical dispersant on same day, and oil plus chemical dispersant 15 da after oiling. Mangroves were planted 20 da after oiling and were counted and measured 9 mos, 13 mos, and 2 yrs later. In the second experiment, beach parcels were exposed to either of two oil treatments, some sub-parcels excavated 20 cm 15 da after oiling, planted at 20 da after oiling, and the plants were counted periodically for a year. Sediment samples were periodically analyzed for total petroleum hydrocarbons. Also determined redox profiles of some beach parcels.

**Dutta, T. K., S. Harayama**, 2000. Fate of crude oil by the combination of photooxidation and biodegradation. Environmental Science and Technology **34**:1500-1505.
**Keywords:** Arabian Light crude oil/ aromatic hydrocarbons/ biodegradation/ combination/ crude oil/ effects/ experiment/ fate/ light/ microbes/ nutrients/ oil/ Oten/ petroleum hydrocarbons/ photooxidation/ salt water/ saturated hydrocarbons/ sunlight
**Notes:** Artificially-weathered Arabian light crude oil was biodegraded in seawater with N & P nutrients added. Artificial sunlight was used to produce photooxidation effects. Experiments were performed to determine the consequences of biodegradation, photooxidation, and biodegradation plus photooxidation.

**Dyrynda, E. A., R. J. Law, P. E. J. Dyrynda, C. A. Kelly, R. K. Pipe, N. A. Ratcliffe**, 2000. Changes in immune parameters of natural mussel *Mytilus edulis* populations following a major oil spill ('Sea Empress', Wales, UK). Marine Ecology Progress Series **206**:155-170.
**Keywords:** aromatic hydrocarbons/ coast/ crude oil/ effects/ England/ hydrocarbons/ marine invertebrate/ mussel/ Ofour/ oil/ oil spill/ PAH/ parameters/ population/ salt water/ spill/ time/ tissue/ total hydrocarbons/ Wales
**Notes:** Assessment of the effects of the 1996 Sea Empress oil spill (crude oil) on mussels. Mussels were collected from three affected sites and one control site on the southwest coast of England. Mussels were collected 11 times over a 2-yr period. Measured total hydrocarbons and 18 PAHs in mussel tissue, and seven immune characteristics.

**Easley, J. R., J. M. Holland, L. C. Gipson, M. J. Whitaker**, 1982. Renal toxicity of middle distillates of shale oil and petroleum in mice. Toxicology and Applied Pharmacology **65**:84-91.
**Keywords:** crude oil/ diesel/ diesel fuel/ mammal/ mouse/ oil/ Otwo/ pathology/ petroleum/ shale oil/ survival/ time/ tissue/ toxicity
**Notes:** The middle distillates (JP5, JP8, diesel fuel marine) of petroleum and shale crude oils were applied to the backs of young laboratory mice three times weekly for 60 wks. Measured survival and tissue pathology. Compared results between the two types of crude oils.

**Eastin, W. C. and D. J. Hoffman** 1979. Biological effects of petroleum on aquatic birds. Pages 562-582 *in* Conference on Assessment of Ecological Impacts of Oil Spills. American Institute of Biological Sciences, Arlington, VA.
**Keywords:** biological effects/ bird/ effects/ eggs/ embryo/ ingestion/ metals/ oil/ oil spill/ Oone/ petroleum/ physiology/ spill
**Notes:** Discussion of the effects of oil on aquatic birds using results of studies performed at the Patuxent Wildlife Research Center.

**Eastin, W. C., Jr.** 1979. Methods used at Patuxent Wildlife Research Center to study the effects of oil on birds. Pages 60-65 *in* C. H. Brown, editor. 1979 U.S. Fish and Wildlife Service Pollution Response Workshop. U.S. Fish and Wildlife Service, Washington, DC.
**Keywords:** bird/ effects/ fish/ methods/ oil/ Oone/ pollution

**Eastin, W. C., Jr., H. C. Murry**, 1981. Effects of crude oil ingestion on avian intestinal function. Canadian Journal of Physiology and Pharmacology **59**:1063-1068.
**Keywords:** bird/ crude oil/ duckling/ effects/ fresh water/ ingestion/ intestinal absorption/ mallard/ oil/ Oone/ physiology/ Prudhoe Bay/ Prudhoe Bay crude oil
**Notes:** Effects of dietary ingestion of Prudhoe Bay crude oil on intestinal function of mallard ducklings.

**Eastin, W. C., Jr., B. A. Rattner**, 1982. Effects of dispersant and crude oil ingestion on mallard ducklings (*Anas platyrhynchos*). Bulletin of Environmental Contamination and Toxicology **29**:273-278.
**Keywords:** bird/ blood/ Corexit 9527/ crude oil/ diet/ dispersant/ duckling/ effects/ fresh water/ ingestion/ mallard/ ODone/ oil/ physiology/ Prudhoe Bay/ Prudhoe Bay crude oil/ weight
**Notes:** Mallard ducklings were fed a diet containing Prudhoe Bay crude oil or Corexit 9527 for 9 weeks; weight and blood chemistries were measured.

**Eastin, W. C., Jr., D. J. Hoffman, C. T. O'Leary**, 1983. Lead accumulation and depression of d-aminolevulinic acid dehydratase (ALAD) in young birds fed automotive waste oil. Archives of Environmental Contamination and Toxicology **12**:31-35.
**Keywords:** accumulation/ bird/ chicks/ crankcase oil/ dietary exposure/ duckling/ effects/ fresh water/ mallard/ oil/ Oone/ pheasant/ physiology/ waste oil
**Notes:** Dietary exposure of mallard ducklings and pheasant chicks to waste crankcase oil; physiological effects.

**Eberhardt, L. L., R. A. Garrott**, 1997. Response to critique by Garshelis and Estes of *Exxon Valdez* sea otter mortality estimate. Marine Mammal Science **13**:351-354.
**Keywords:** critique/ estimate/ Exxon Valdez/ mammal/ oil/ oil spill/ Otwo/ population/ Prince William Sound/ salt water/ sea otter/ spill/ survival
**Notes:** Response of authors to a critique of their paper on estimation of sea otter mortality in Prince William Sound following the Exxon Valdez oil spill.

**Edgar, G. J., L. Kerrison, S. A. Shepherd, V. M. Toral-Granda**, 2003. Impacts of the *Jessica* oil spill on intertidal and shallow subtidal plants and animals. Marine Pollution Bulletin **47**:276-283.
**Keywords:** Bunker C/ community/ depth/ diesel/ diesel fuel/ fish/ general effect/ intertidal/ invertebrate/ marine invertebrate/ marine plant/ Oeight/ oil/ oil spill/ plant/ salt water/ species/ spill/ subtidal/ tanker/ transect
**Notes:** Bunker C and diesel fuel from the tanker *Jessica* came ashore on several of the Galapagos Islands. Intertidal and subtidal plants and animals on two affected islands and one unaffected island were surveyed just before the spill and 30 da after the spill. Transect line samples included percentage cover of plants and sponges, identity and quantity of mobile invertebrates, and number of fish species seen along depth (0.5,1,2 m) contours at the end of each transect line.

**Edgar, G. J., P. A. Marshall, P. Mooney**, 2003. The effect of the *Jessica* grounding on Galapagos reef fish communities adjacent to the wreck site. Marine Pollution Bulletin **47**:296-302.
**Keywords:** Bunker C/ community/ density/ depth/ diesel fuel/ fish/ oil spill/ Othree/ salt water/ species/ survey/ transect

**Notes:** Fish survey transects were conducted around the wreck of the *Jessica* in the Galapagos Islands. Twelve transects of 100 m (30 degrees apart) were run outward from the wreck by divers who recorded all species observed. Numbers of species and their densities were compared, at three water depths, to surveys at other locations in the islands.

**Eganhouse, R. P., T. F. Dorsey, C. S. Phinney, A. M. Westcott**, 1996. Processes affecting the fate of monoaromatic hydrocarbons in an aquifer contaminated by crude oil. Environmental Science and Technology **30**:3304-3312.
**Keywords:** crude oil/ fate/ ground water/ hydrocarbons/ miscellaneous/ monoaromatic/ Oeleven/ oil
**Notes:** Monoaromatic fate in an aquifer contaminanted by crude oil.

**Eghtesadi, P., G. Riazi, M. Taghikhani, S. O. Ranaei Siadat**, 2002. Distribution and sources of polycyclic aromatic hydrocarbons in the northern Persian Gulf as indicated by kinetic and thermodynamic criteria. Bulletin of Environmental Contamination and Toxicology **69**:704-711.
**Keywords:** aromatic hydrocarbons/ coast/ concentration/ distribution/ Gulf oil spill/ hydrocarbons/ Iran/ miscellaneous/ Oeleven/ PAH/ petroleum/ salt water/ sediment/ sources
**Notes:** Concentrations of selected PAHs (15) in surface sediments of the northern Persian Gulf were determined at four islands near the coast of Iran. Eleven sediment samples were collected in 1998 and analyzed for PAHs. Results were compared to sediment PAH concentrations in other parts of the Gulf and other places in the world. Figure 2 is missing a right side Y axis label and hard to understand.

**Ehrhardt, M. G., K. A. Burns**, 1993. Hydrocarbons and related photo-oxidation products in Saudi Arabian Gulf coastal waters and hydrocarbons in underlying sediments and bioindicator bivalves. Marine Pollution Bulletin **27**:187-197.
**Keywords:** Arabian Gulf/ aromatic hydrocarbons/ bivalve/ coast/ hydrocarbons/ marine invertebrate/ miscellaneous/ Oeleven/ photooxidation/ salt water/ saturated hydrocarbons/ Saudi Arabia/ sediment/ survey/ war
**Notes:** A survey of the coastal waters of Saudi Arabia 1 yr after the Gulf War. Sampled water, sediment, and bivalves at 3-13 sites along the coast. Analyzed material for the presence of aromatic hydrocarbons and their photo-oxidation products. Limited data on saturated hydrocarbons.

**Eisler, R.**, 1973. Latent effects of Iranian crude oil and a chemical oil dispersant on Red Sea molluscs. Israel Journal of Zoology **22**:97-105.
**Keywords:** bioassay/ crude oil/ dispersant/ effects/ eggs/ gastropod/ Iranian crude oil/ marine invertebrate/ mollusc/ mussel/ ODfour/ oil/ predation/ rate/ Red Sea/ salt water/ static
**Notes:** Assessment of the effect of Iranian crude oil or a chemical oil dispersant on the predation rate of a gastropod drill. Mussels and gastropod drills were exposed in a static bioassay to 10 ml/liter of crude oil or 0.003 ml/liter of dispersant for 168 h. Measured predation rates by drills and the number of egg cases deposited by drill during a 28 da period after the initial exposure period.

**Eisler, R.**, 1975. Acute toxicities of crude oils and oil-dispersant mixtures to Red Sea fishes and invertebrates. Israel Journal of Zoology **24**:16-27.
**Keywords:** acute/ adult/ bioassay/ concentration/ coral/ crab/ crude oil/ dispersant/ fish/ gastropod/ invertebrate/ juvenile/ marine invertebrate/ mollusc/ mussel/ ODfour/ oil/ Red Sea/ salt water/ sea urchin/ shrimp/ Sinai crude oil/ static/ toxicity/ urchin
**Notes:** Assessment of the toxicities of a Persian Gulf crude oil, a Sinai crude oil, a chemical oil dispersant and crude oil-dispersant mixtures to adults or juveniles of 10 marine organisms (coral, two gastropods, mussel, chiton, sea urchin, hermit crab, shrimp, and two fish) with a static bioassay. Exposed organisms to varying concentrations over a 168 hr period. Calculated $LC_{0,50,100}$ at 24, 96, and 168 hr for each type of exposure.

**Eisler, R., G. W. Kissil**, 1975. Toxicities of crude oils and oil-dispersant mixtures to juvenile rabbitfish, *Siganus rivulatus*. Transactions of the American Fisheries Society **104**:571-578.
**Keywords:** blood/ concentration/ crude oil/ degradation/ depth/ dispersant/ fish/ flow-through/ index/ Iranian crude oil/ juvenile/ ODthree/ oil/ rabbitfish/ salinity/ salt water/ Sinai crude oil/ sources/ static/ survival/ toxicity

**Notes:** Assessment of Iranian crude oil, Sinai crude oil, a chemical dispersant (ST-5), and mixtures of dispersant and crude oils to juvenile rabbitfish. Employed a static test (3-liter jar) and a flow-through tank test (1,500 liters). Static tests had six concentrations for 168 hrs, four levels of salinity, and application of test substances 0-168 hrs before organism exposure. Different boiling fractions of the crude oils were also tested for the source of toxicity. Measured survival, hematocrit, and somatoliver index. $LC_{0, 50, 100}$ calculated at 24, 48, 96, and 168 hrs. In tank tests, measured survival at two depths and compared results to those of the static tests.

**Eisler, R.** 1975. Toxic, sublethal, and latent effects of petroleum on Red Sea macrofauna. Pages 535-540 *in* 1975 Conference on Prevention and Control of Oil Pollution. American Petroleum Institute, Washington DC.
**Keywords:** blood/ coelenterate/ crude oil/ crustacean/ depth/ dispersant/ echinoderm/ effects/ eggs/ fish/ flow-through/ index/ Iranian crude oil/ macrofauna/ marine invertebrate/ mollusc/ mussel/ ODfour/ oil/ petroleum/ pollution/ predation/ rabbitfish/ rate/ Red Sea/ salt water/ Sinai crude oil/ species/ static/ sublethal/ substrate/ survival
**Notes:** Assessment of the effects of Sinai crude oil, Iranian crude oil, chemical oil dispersant, and mixtures of dispersant and crude oils to 15 species of coelenterates, molluscs, crustaceans, echinoderms, and teleosts. Employed static tests (3 liters) and large flow-through tanks (1,500 liters). In static tests, $LC_{0, 50, 100}$ was calculated for 168 hrs exposure (details reported in another publ.). In tank tests, organisms were tested at two depths and subjected to dispersant at 0.001-0.100 ml/liter, crude oils at 3.00-10.00 ml/liter, and mixtures at 0.110 ml/liter. Measured survival, blood hematocrit and a somatoliver index of rabbitfish, substrate fastening ability of mussels, tentacular pulsation rate of octocorals, predation of drills on mussels, and egg case deposition of drills.

**Ekker, M., S.-H. Lorentsen, N. Rov**, 1992. Chronic oil-fouling of grey seal pups at the Froan breeding ground, Norway. Marine Pollution Bulletin **24**:92-93.
**Keywords:** chronic/ grey seal/ mammal/ Norway/ oiled/ Otwo/ reproduction/ salt water/ seal
**Notes:** Incidence of oiling among grey seal pups at the Froan breeding ground in Norway during 1985-89.

**Ekundayo, E. O., C. O. Obuekwe**, 1997. Effects of an oil spill on soil physico-chemical properties of a spill site in a typic paleudult of midwestern Nigeria. Environmental Monitoring and Assessment **45**:209-221.
**Keywords:** analysis/ chemical analysis/ crude oil/ effects/ fresh water/ miscellaneous/ Nigeria/ Oeleven/ oil/ oil field/ oil spill/ soil/ spill
**Notes:** Chemical analysis of soil samples from an inland oil field in Nigeria.

**Ekundayo, E. O., O. Obuekwe**, 2000. Effects of an oil spill on soil physico-chemical properties of a spill site in a typic udipsamment of the Niger Delta Basin of Nigeria. Environmental Monitoring and Assessment **60**:235-249.
**Keywords:** cations/ concentration/ crude oil/ effects/ ions/ miscellaneous/ Nigeria/ Oeleven/ oil/ oil spill/ petroleum/ petroleum hydrocarbons/ pipeline/ soil/ soil profile/ spill
**Notes:** Assessment of the soil penetration and chemical effects of a pipeline rupture in Nigeria. A variety of soil samples (borings, core samples, soil profile pits) were collected in the heavy impact, medium impact, and reference zone around the rupture. Soil samples were physically and chemically characterized, including selected cations and ions, and the total petroleum hydrocarbon content was determined.

**Ekundayo, E. O., T. O. Emede, D. I. Osayande**, 2001. Effects of crude oil spillage on growth and yield of maize (*Zea mays* L.) in soils of midwestern Nigeria. Plant Foods for Human Nutrition **56**:313-324.
**Keywords:** analysis/ cations/ concentration/ corn/ crude oil/ experiment/ freshwater plant/ germination/ grain/ growth/ leaves/ length/ metals/ Nigeria/ oil/ organic carbon/ Oseven/ plant/ pollution/ rate/ roots/ soil/ time
**Notes:** Soil was mixed with crude oil in a pot experiment to determine the effect of contaminated soil (5% oil) on corn germination and growth. Measured germination rate, plant height, leaf area, stem girth, ear length, average length and number of primary roots, time to maturity, grain yield, physiochemical soil

characteristics, trace element concentrations in soil; and an analysis of leaves for N, P, organic carbon, exchangeable cations, and other metals.

**Ekundayo, J. A., M. O. Benka-coker**, 1994. Effects of exposure of aquatic snails to sublethal concentrations of waste drilling fluid. Environmental Monitoring and Assessment **30**:291-297.
**Keywords:** activity/ bioassay/ concentration/ drilling fluids/ effects/ fresh water/ freshwater invertebrate/ Nigeria/ Ofive/ oil/ oil field/ physical characteristics/ snail/ species/ static/ sublethal/ survival/ toxicity/ waste water
**Notes:** Determination of the toxicity to two species of snails of discharged waste water from oil field drilling activity in Nigeria. Snails exposed by static bioassay to one of five concentrations (10, 25, 50, 75, 100%) of the waste water for 96 hrs. Chemical and physical characteristics of the waste water were determined and snail survival was measured at 24 hr, 48 hrs, and 96 hrs. Behavioral observations also were reported.

**El-Dib, M. A., H. F. Abou-Waly, A. M. H. El-Naby**, 1997. Impact of fuel oil on the freshwater alga *Selenastrum capricornutum*. Bulletin of Environmental Contamination and Toxicology **59**:438-444.
**Keywords:** algae/ carbohydrate/ chlorophyll/ concentration/ effects/ fresh water/ freshwater plant/ fuel oil/ growth/ No.2 fuel oil/ oil/ Oseven/ protein/ survival
**Notes:** Effects on a freshwater alga of exposure to four concentrations of a water extract of No. 2 fuel oil for 10 da. Measured survival, chlorophyll (a), growth, and carbohydrate and protein content.

**El-Sikaily, A., A. Khaled, A. El Nemr, T. O. Said, A. M. A. Abd-Alla**, 2003. Polycyclic aromatic hydrocarbons and aliphatics in the coral reef skeleton of the Egyptian Red Sea coast. Bulletin of Environmental Contamination and Toxicology **71**:1252-1259.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ coast/ coral/ coral reef/ hydrocarbons/ marine invertebrate/ Ofour/ PAH/ pollution/ Red Sea
**Notes:** The coral reefs of the Egyptian Red Sea were sampled at 20 sites and analyzed for aliphatic and polycyclic aromatic hydrocarbons (PAH). A total of 16 PAHs and three aliphatic hydrocarbons were individually quantitated; summations of each group are also presented.

**El Dib, M. A., H. F. Abou-Waly, A. H. El-Naby**, 2001. Fuel oil effect on the population growth, species diversity and chlorophyll (a) content of freshwater microalgae. International Journal of Environmental Health **11**:189-197.
**Keywords:** algae/ assay/ carbohydrate/ chlorophyll/ concentration/ diversity/ Egypt/ fresh water/ freshwater plant/ fuel oil/ glucose/ growth/ microalgae/ oil/ Oseven/ population/ protein/ species/ species diversity/ static
**Notes:** Algal populations in Nile river (Egypt) water were subjected to the aqueous extract of No. 2 fuel oil for 10 days in a static laboratory assay. Concentrations of extract were 0.03, 0.07, 0.12, 0.25, and 0.5 g/l. On days 1, 3, 5, 7, and 10, investigators measured algal concentrations and chlorophyll *a* content; and determined the carbohydrate, glucose, and protein content of the algae.

**El Nemr, A., A. El-Sikaily, A. Khaled, T. O. Said, A. M. A. Abd-Alla**, 2004. Determination of hydrocarbons in mussels from the Egyptian Red Sea coast. Environmental Monitoring and Assessment **96**:251-261.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ bivalve/ coast/ hydrocarbons/ length/ marine invertebrate/ miscellaneous/ mussel/ Oeleven/ PAH/ petroleum/ petroleum hydrocarbons/ Red Sea/ salt water/ sources/ tissue
**Notes:** Mussels were collected in 2000 at 11 sites along a 450 km length of Egyptian Red Sea coast. Mussel tissue was analyzed for 16 PAHs, $C_{12\text{-}C40}$ aliphatics, pristane, and the aliphatic UCM. Authors discuss possible sources of the petroleum hydrocarbons.

**El Samra, M. I., H. I. Emara, F. Shunbo**, 1986. Dissolved petroleum hydrocarbon in the northwestern Arabian Gulf. Marine Pollution Bulletin **17**:65-68.
**Keywords:** Arabian Gulf/ aromatic hydrocarbons/ crude oil/ dissolved/ hydrocarbons/ Kuwait/ Kuwait crude oil/ miscellaneous/ Oeleven/ oil/ petroleum/ salt water/ survey/ total hydrocarbons
**Notes:** Surface water (1 m) was collected at 19 locations in the northwestern Arabian Gulf during 1984

and analyzed for aromatic hydrocarbons. Kuwait crude oil was used as a reference standard for estimating total hydrocarbons present. Results were compared to several other studies in the middle east and elsewhere.

**El Samra, M. I., K. Z. El Deeb**, 1988. Horizontal and vertical distribution of oil pollution in the Arabian Gulf and the Gulf of Oman. Marine Pollution Bulletin **19**:14-18.
**Keywords:** analysis/ Arabian Gulf/ aromatic hydrocarbons/ crude oil/ distribution/ Gulf of Oman/ hydrocarbons/ Kuwait/ Kuwait crude oil/ miscellaneous/ Oeleven/ oil/ pollution/ salt water/ survey
**Notes:** Surface (1 m) water was sampled at 45 locations in the Gulf of Oman and the Arabian Gulf during 1985 and 1986. Twelve locations also were sampled at 5 m, 10 m, and sea bottom. Analysis was for aromatic hydrocarbons and Kuwait crude oil was used as the reference standard.

**Eldridge, M. B., T. Echeverria, J. A. Whipple**, 1977. Energetics of Pacific herring (*Clupea harengus pallasi*) embryos and larvae exposed to low concentrations of benzene, a monoaromatic component of crude oil. Transactions of the American Fisheries Society **106**:452-461.
**Keywords:** benzene/ concentration/ crude oil/ effects/ embryo/ energetics/ fish/ herring/ larvae/ metabolism/ monoaromatic/ oil/ Othree/ Pacific/ Pacific herring/ salt water
**Notes:** Effects of experimental exposure to benzene on embryos and larvae of Pacific herring.

**Elgershuizen, J. H. B. W., H. A. M. DeKruijf**, 1976. Toxicity of crude oils and a dispersant to the stony coral *Madracis mirabilis*. Marine Pollution Bulletin **7**:22-25.
**Keywords:** bioassay/ concentration/ coral/ crude oil/ dispersant/ marine invertebrate/ ODfour/ oil/ petroleum/ salt water/ shell/ static/ toxicity
**Notes:** Exposure of coral to four crude oils and a petroleum dispersant (Shell LTX) in a 24 hr static bioassay. Exposures were either water-soluble fraction, oil-seawater mixture, dispersant-seawater mixture, or oil-dispersant-seawater mixture in concentrations of 10-10,000 ppm. Measured degree of polyp retraction and calculated dose responses.

**Ellenton, J. A., D. J. Hallett**, 1981. Mutagenicity and chemical analysis of aliphatic and aromatic fractions of Prudhoe Bay crude oil and fuel oil No. 2. Journal of Toxicology and Environmental Health **8**:959-972.
**Keywords:** aliphatic hydrocarbons/ analysis/ aromatic hydrocarbons/ assay/ cell/ chemical analysis/ chromosome/ crude oil/ fuel oil/ genotoxic/ No.2 fuel oil/ oil/ Onine/ ovary/ Prudhoe Bay/ Prudhoe Bay crude oil/ technical/ toxicity
**Notes:** Prudhoe Bay crude oil and fuel oil No. 2 were fractionated into aliphatic, one- to three-ring aromatic, and four- to five-ring aromatic groups and used in toxicity and mutagenicity assays. Fractions were chemically characterized and compared with *Salmonella typhimurium* (toxicity and mutagenicity) and Chinese hamster ovary cells (chromosome aberrations, sister chromatid exchanges).

**Ellenton, J. A.**, 1982. Teratogenic activity of aliphatic and aromatic fractions of Prudhoe Bay crude and fuel oil No. 2 in the chicken embryo. Toxicology and Applied Pharmacology **63**:209-215.
**Keywords:** activity/ aliphatic hydrocarbons/ aromatic hydrocarbons/ bird/ chicken/ crude oil/ development/ effects/ eggs/ embryo/ fuel oil/ oil/ Oone/ Prudhoe Bay/ Prudhoe Bay crude oil
**Notes:** Aliphatic and aromatic (3) fractions of No. 2 fuel oil and Prudhoe Bay crude oil were applied to chicken eggs; developmental effects on embryos were measured.

**Elliott, M., A. H. Griffiths**, 1987. Contamination and effects of hydrocarbons on the Forth ecosystem, Scotland. Proceedings of the Royal Society of Edinburgh **93B**:327-342.
**Keywords:** ecosystem/ effects/ general effect/ hydrocarbons/ Oeight/ petroleum/ petroleum hydrocarbons/ salt water/ Scotland/ sediment/ sources
**Notes:** An assessment of the contamination of the Forth (Scotland) by hydrocarbons from the petrochemical industry and other anthropogenic sources. Authors present information from a variety of sources and discuss petroleum inputs, water and sediments, biota, ecological effects, toxicological studies, future work, and conclusions.

**Engel, S. E., T. E. Roudybush, J. C. Dobbs, and C. R. Grau** 1977. Depressed food intake and reduced reproduction in Japanese quail following a single dose of Prudhoe Bay crude oil. Pages 27-36 *in* D.

Mahlum, M. Sikov, P. Hackett, F. Andrew, editors. Developmental Toxicology of Energy-Related Pollutants. Hanford Biology Symposium. U.S. Energy Research and Development Administration, Washington, DC,
**Keywords:** bird/ crude oil/ dosed/ eggs/ food/ fresh water/ Japanese quail/ oil/ Oone/ Prudhoe Bay/ Prudhoe Bay crude oil/ quail/ reproduction
**Notes:** Japanese quail were dosed with Prudhoe Bay crude oil and food intake and egg production measured.

**Engelhardt, F. R., J. R. Geraci, T. G. Smith**, 1977. Uptake and clearance of petroleum hydrocarbons in the ringed seal, *Phoca hispida*. Journal of the Fisheries Research Board of Canada **34**:1143-1147.
**Keywords:** clearance/ concentration/ crude oil/ hydrocarbons/ ingestion/ mammal/ Norman Wells crude oil/ oil/ Otwo/ petroleum/ petroleum hydrocarbons/ ringed seal/ salt water/ seal/ skin/ uptake
**Notes:** Exposure of ringed seals to Norman Wells crude oil either by immersion or ingestion; uptake, concentration, and clearance.

**Engelhardt, F. R.**, 1983. Petroleum effects on marine mammals. Aquatic Toxicology **4**:199-217.
**Keywords:** behavior/ effects/ fur/ mammal/ metabolism/ oil/ Otwo/ pathology/ petroleum/ physiology/ review/ salt water/ skin/ survival/ thermoregulation/ uptake
**Notes:** A review of the effects of oil on marine mammals; adherence, uptake, metabolism, survival, behavior, thermoregulation, physiology, pathology.

**Engelhardt, F. R.**, 1994. Limitations and innovations in the control of environmental impacts from petroleum industry activities in the Arctic. Marine Pollution Bulletin **29**:334-341.
**Keywords:** activity/ Arctic/ biological effects/ discharges/ effects/ habitat/ hazard/ miscellaneous/ Oeleven/ oil/ oil field/ oil spill/ petroleum/ review/ spill/ spill response
**Notes:** A review of the environmental hazards associated with petroleum extraction activities in the Arctic. Sections on noise and seismic activities, habitat disturbance, waste discharges, oil spill incidence, oil spill response, and biological effects of spilled oil.

**Englehardt, F. R., M. P. Wong, M. E. Duey**, 1981. Hydromineral balance and gill morphology in rainbow trout (*Salmo gairdneri*), acclimated to fresh and sea water, as affected by petroleum exposure. Aquatic Toxicology **1**:175-186.
**Keywords:** blood/ crude oil/ effects/ emulsion/ fish/ fresh water/ gill/ injection/ oil/ Othree/ paraffin/ particulate/ pathology/ petroleum/ physiology/ rainbow trout/ salt water/ weathered
**Notes:** Effects of Norman Wells and Venezuelen crude oils and a paraffin compound, as particulate emulsions of weathered oil, water-soluble fraction only, or intraperitoneal injection, on immature rainbow trout; exposure was for 7 days. Some fish were acclimated to fresh water, some to salt water. Assessment performed on blood chemistry and gill morphology.

**Englehardt, F. R.**, 1982. Hydrocarbon metabolism and cortisol balance in oil-exposed ringed seals, *Phoca hispida*. Comparative Biochemistry and Physiology **72C**:133-136.
**Keywords:** crude oil/ effects/ hydrocarbons/ ingestion/ mammal/ metabolism/ Norman Wells crude oil/ oil/ Otwo/ physiology/ ringed seal/ salt water/ seal/ steroid/ stress
**Notes:** Effects of ingestion of Norman Wells crude oil on hydrocarbon metabolism and steroid balance in ringed seals.

**Eppley, Z. A., M. A. Rubega**, 1989. Indirect effects of an oil spill. Nature **340**:513.
**Keywords:** Antarctic/ bird/ diesel/ diesel fuel/ effects/ jet fuel/ oil/ oil spill/ Oone/ population/ reproduction/ salt water/ spill
**Notes:** Discussion of the indirect effects on seabirds of a spill of diesel and jet fuel; avian effects ranged from very negative to slightly positive.

**Eppley, Z. A., M. A. Rubega**, 1990. Indirect effects of an oil spill: reproductive failure in a population of South Polar skuas following the 'Bahia Paraiso' oil spill in Antarctica. Marine Ecology Progress Series **67**:1-6.
**Keywords:** Antarctic/ Antarctica/ bird/ colony/ diesel/ diesel fuel/ effects/ jet fuel/ oil/ oil spill/ Oone/

population/ reproduction/ salt water/ skuas/ spill
**Notes:** Discussion of the indirect effects of a spill of diesel fuel and jet fuel on the reproduction of a local colony of South Polar skuas.

**Eppley, Z. A.**, 1992. Assessing indirect effects of oil in the presence of natural variation: the problem of reproductive failure in South Polar Skuas during the *Bahia Paraiso* oil spill. Marine Pollution Bulletin **25**:9-12.
**Keywords:** bird/ diesel/ diesel fuel/ effects/ oil/ oil spill/ Oone/ population/ reproduction/ salt water/ skuas/ South Pole/ spill/ time
**Notes:** Assessment of the causes of reproductive failure of a local population of South Polar Skuas; failure occurred at the time of a spill of diesel fuel.

**Epstein, N., R. P. M. Bak, B. Rinkevich**, 2000. Toxicity of third generation dispersants and dispersed Egyptian crude oil on Red Sea coral larvae. Marine Pollution Bulletin **40**:497-503.
**Keywords:** bioassay/ concentration/ coral/ crude oil/ dispersant/ Egyptian crude oil/ larvae/ marine invertebrate/ ODfour/ oil/ pathology/ Red Sea/ salt water/ short-term/ species/ static/ survival/ toxicity
**Notes:** Larvae of two species of Red Sea coral were exposed to water-soluble fractions (WSF), water-accomodate fractions (WAF), chemically dispersed Egyptian crude oil, or dispersants in sea water in short-term (2-96 hr static bioassays). Four concentrations of WSF, three concentrations of WAF, four concentrations of dispersants, and three concentrations of dispersed crude oil were employed. Five 'third generation' chemical dispersants were used. Measured survival and conducted histopathological examinations of larvae.

**Erasmus, T., R. M. Randall, B. M. Randall**, 1981. Oil pollution, insulation and body temperatures in the jackass penguin *Spheniscus demersus*. Comparative Biochemistry and Physiology **69A**:169-171.
**Keywords:** bird/ cleaning/ hypothermia/ insulation/ molt/ oil/ oiled/ Oone/ penguin/ plumage/ pollution/ salt water/ temperature
**Notes:** Effect on deep body temperature of jackass penguins of oiling, oiling plus cleaning, or natural moult; temperature measured during exposure to water and air.

**Eriyamremu, G. E., S. O. Asagba, I. A. Akpoborie, S. I. Ojeaburu**, 2005. Evaluation of lead and cadmium levels in some commonly consumed vegetables in the Niger-Delta oil area of Nigeria. Bulletin of Environmental Contamination and Toxicology **75**:278-283.
**Keywords:** combination/ crude oil/ evaluation/ fresh water/ freshwater plant/ lead/ leaves/ metals/ Nigeria/ Nigerian crude oil/ oil/ Oseven/ vegetable
**Notes:** Four leafy vegetables grown in the Niger Delta were collected form the vicinity of three industrial towns and one non-industrial town. The leaves were analyzed for lead and cadmium. Nigerian crude oil is high in lead and other metals. Oil extraction and refining and heavy industrial complexes all occur in the delta, hence the cause of metal contamination is a combination of factors.

**Ernst, V. V., J. M. Neff**, 1977. The effects of the water-soluble fractions of No. 2 fuel oil on the early development of the estuarine fish, *Fundulus grandis* Baird and Girard. Environmental Pollution **14**:25-35.
**Keywords:** concentration/ development/ effects/ embryo/ estuarine/ evaluation/ fish/ fuel oil/ growth/ No.2 fuel oil/ oil/ Othree/ pathology/ salt water/ survival/ tissue
**Notes:** Effects on embryos of an estuarine fish following exposure to varying concentrations of the water-soluble fraction of No. 2 fuel oil; survival, growth, and pathological evaluation of selected tissues.

**Erwin, R. M., G. J. Smith, R. B. Clapp**, 1986. Winter distribution and oiling of common terns in Trinidad: a further look. Journal of Field Ornithology **57**:300-308.
**Keywords:** bird/ distribution/ oiled/ Oone/ plumage/ salt water/ tern/ Trinidad/ wintering
**Notes:** Report of the incidence of plumage oiling in wintering common terns in Trinidad.

**Esler, D., J. A. Schmutz, R. L. Jarvis, D. M. Mulcahy**, 2000. Winter survival of adult female harlequin ducks in relation to history of contamination by the *Exxon Valdez* oil spill. Journal of Wildlife Management **64**:839-847.
**Keywords:** adult/ Alaska/ bird/ duck/ evaluation/ Exxon Valdez/ female/ harlequin duck/ history/ molt/ oil/

oil spill/ oiled/ Oone/ population/ Prince William Sound/ Prudhoe Bay crude oil/ salt water/ spill/ survival/ wintering
**Notes:** Evaluation of the survival of wintering female harlequin ducks in Prince William Sound, Alaska during the winters of 1995-96, 1996-97, and 1997-98. Females were captured during the wing molt in August and September, received an implanted transmitter, and were monitored weekly by aircraft through the end of the following March. Survival probabilities were calculated for oiled and unoiled areas.

**Esler, D., T. D. Bowman, K. A. Trust, B. E. Ballachey, T. A. Dean, S. C. Jewett, C. E. O'Clair**, 2002. Harlequin duck population recovery following the 'Exxon Valdez' oil spill: progress, process and constraints. Marine Ecology Progress Series **241**:271-286.
**Keywords:** adult/ bird/ composition/ duck/ Exxon Valdez/ female/ food/ growth/ harlequin duck/ oil/ oil spill/ Oone/ overview/ population/ rate/ recovery/ review/ salt water/ spill/ survey/ survival/ time
**Notes:** An overview assessment of the population recovery for the harlequin duck following the Exxon Valdez oil spill. The author reviews past research and presents sections on population status surveys, adult female survival during winter, variation in body mass and composition, intrinsic limitations on population growth rates, continued exposure to oil, food limitation, and conclusions and recomendations.

**Esmoil, B. J., S. H. Anderson**, 1995. Wildlife mortality associated with oil pits in Wyoming. Prairie Naturalist **27**:81-88.
**Keywords:** bird/ carcass/ crude oil/ fresh water/ oil/ oil field/ Oone/ survey/ waste water
**Notes:** A survey of oil field waste pits in Wyoming, mostly in the Bighorn Basin, during two consective years. Pits were physically characterized, examined for animal carcasses, and the presence of animal deterrent practices was noted.

**Estes, J. A.**, 1991. Catastrophes and conservation: lessons from sea otters and the *Exxon Valdez*. Science **254**:1596.
**Keywords:** commentary/ cost/ crude oil/ effects/ Exxon Valdez/ mammal/ oil/ oil spill/ Otwo/ population/ Prudhoe Bay crude oil/ rehabilitation/ salt water/ sea otter/ spill
**Notes:** Commentary on the lessons learned from the Exxon Valdez oil spill with respect to sea otters; losses, population effects, rehabilitation.

**Esteves, J. L., M. G. Commendatore**, 1993. Total aromatic hydrocarbons in water and sediment in a coastal zone of Patagonia, Argentina. Marine Pollution Bulletin **26**:341-342.
**Keywords:** Argentina/ aromatic hydrocarbons/ coast/ crude oil/ hydrocarbons/ intertidal/ miscellaneous/ Oeleven/ oil/ salt water/ sediment/ survey
**Notes:** Intertidal sediment and surface water were collected at 27 sites along the Patagonian coast of Argentina in 1989. Samples were analyzed for aromatic hydrocarbons and compared to reference standards of a local crude oil and chrysene.

**Esteves, J. L., M. G. Commendatore, M. L. Nievas, V. Massara Paletto, O. Amin**, 2006. Hydrogen pollution in coastal sediments of Tierra del Fuego Islands, Patagonia Argentina. Marine Pollution Bulletin **52**:572-597.
**Keywords:** aliphatic hydrocarbons/ Argentina/ carbon/ hydrocarbons/ indicator/ miscellaneous/ Oeleven/ organic/ organic carbon/ pollution/ ratio/ salt water/ sediment
**Notes:** Surface sediments from the high tide line of Tierra del Fuego and Isla de los Estados were sampled at 44 locations and analyzed for organic material, total organic carbon, and aliphatic hydrocarbons. A number of ratios were used as indicators of the source of the hydrocarbons.

**Evans, C. W.** 1985. The effects and implications of oil pollution in mangrove forests. Pages 367-371 *in* Proceedings 1985 Oil Spill Conference, API Publication 4385. American Petroleum Institute, Washington, D.C.
**Keywords:** effects/ mangrove/ marine plant/ mitigation/ oil/ oil spill/ Osix/ petroleum/ pollution/ protection/ review/ salt water/ spill/ vegetation
**Notes:** A review of the effects of petroleum on mangroves. The author was concerned about the lack of guidance on protection and mitigation measures for mangrove forests during oil spills. Presents recommendations for spill cleanup within mangrove vegetation.

**Evans, G. W., M. Lyes, A. P. M. Lockwood**, 1977. Some effects of oil dispersants on the feeding behaviour of the brown shrimp, *Crangon crangon*. Marine Behaviour and Physiology **4**:171-181.
**Keywords:** behavior/ bioassay/ concentration/ dispersant/ effects/ feeding/ marine invertebrate/ ODfour/ oil/ salt water/ shrimp/ static
**Notes:** Assessment of the effects of three oil dispersants (BP1100X, Slickgone LT2, Tween 80) on the feeding behavior of brown shrimp. Concentrations of dispersant ranged between 1 and 1000 ppm, depending on the dispersant. Shrimp were exposed for 24 hr in a static bioassay.

**Evans, M. I., P. Symens, C. W. T. Pilcher**, 1993. Short-term damage to coastal bird populations in Saudi Arabia and Kuwait following the 1991 Gulf War marine pollution. Marine Pollution Bulletin **27**:157-161.
**Keywords:** bird/ crude oil/ effects/ Gulf oil spill/ Kuwait/ oil/ oil spill/ Oone/ pollution/ population/ salt water/ Saudi Arabia/ short-term/ spill/ war
**Notes:** A preliminary assessment of the short-term effects of the Gulf oil spill on seabird populations.

**Fabregas, J., C. Herrero, M. Veiga**, 1984. Effect of oil and dispersant on growth and chlorophyll *a* content of the marine microalga *Tetraselmis suecica*. Applied Environmental Microbiology **47**:445-447.
**Keywords:** algae/ chlorophyll/ combination/ concentration/ crude oil/ dispersant/ growth/ incubation/ marine plant/ microalgae/ nonionic/ ODsix/ oil/ salt water/ weathered
**Notes:** A marine microagala was exposed to weathered crude oil, the water-soluble-fraction (WSF) of weathered crude oil, a non-ionic dispersant, or a combination of weathered crude oil and dispersant. The alga was exposed to 11 concentrations of crude oil, 10 concentrations of WSF, 12 concentrations of dispersant, and 11 concentrations of crude oil and dispersant. The incubation period was 11 da. Measured growth of culture and chlorophyll *a* concentration.

**Fabricius, E.**, 1959. What makes plumage waterproof? Annual Report of The Wildfowl Trust **10, 1957-1958**:105-113.
**Keywords:** bird/ experiment/ Oone/ plumage/ waterfowl
**Notes:** The definitive explanation of how bird plumage repels water; includes experiments testing various alternative explanations.

**Falk-Petersen, I.-B., E. Kjorsvik**, 1987. Acute toxicity tests of the effects of oils and dispersants on marine fish embryos and larvae -- a review. Sarsia **72**:411-413.
**Keywords:** acute/ cell/ chromosome/ crude oil/ dispersant/ effects/ embryo/ fish/ hydrocarbons/ larvae/ Norway/ ODthree/ oil/ physiology/ review/ salt water/ survival/ toxicity
**Notes:** A review of approximately 10 years of work on the toxicity of oils and dispersants to marine fish embryos and larvae; University of Tromso, Norway. Includes survival, physiological, cellular, and chromosomal effects.

**Fang, C. S.**, 1990. Petroleum drilling and production operations in the Gulf of Mexico. Estuaries **13**:89-97.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ composition/ cuttings/ drilling fluids/ Gulf of Mexico/ hydrocarbons/ Mexico/ oil/ oil field/ Onine/ petroleum/ produced water/ salt water/ sediment/ technical
**Notes:** An assessment of oil and gas operations in the Gulf of Mexico. Author describes the magnitude of oil and gas production, the operational steps in extraction, chemical additives used in drilling operation, volume and composition of produced water, volume and composition of drilling fluids and cuttings, and a listing of selected aromatic and aliphatic hydrocarbons in sediments beneath drilling platforms.

**Farke, H., K. Wonneberger, W. Gunkel, G. Dahlmann**, 1985. Effects of oil and a dispersant on intertidal organisms in field experiments with a mesocosm, the Bremerhaven caisson. Marine Environmental Research **15**:97-114.
**Keywords:** abundance/ activity/ algae/ Arabian Light crude oil/ benthic/ bivalve/ community/ crude oil/ dispersant/ effects/ experiment/ fate/ feeding/ flow-through/ general effect/ hydrocarbons/ intertidal/ light/ marine invertebrate/ marine plant/ mesocosm/ microbes/ ODeight/ oil/ salt water/ sediment/ time/ total hydrocarbons/ treatment
**Notes:** An assessment of the fate and effects of crude oil and dispersant in the intertidal zone through the use of a flow-through caisson device that formed a mesocosm. Period of treatment lasted for six

successive tides and consisted of either no crude oil, mechanically-mixed Arabian light crude oil, or crude oil plus dispersant. Water and sediment from inside the caisson were analyzed for total hydrocarbons before treatment, after six tides, and 4 wks after treatment. Gross photosynthetic activity of benthic algae was measured during treatment and for up to 38 da post treatment. Abundance of microbes was determined for 3 da post treatment. Feeding activity of two bivalves was determined during the exposure and for 12 da post treatment. Feeding of the lugworm was determined for oil, oil plus dispersant, and dispersant treatment during the exposure period of six tides.

**Farke, H., D. Blome, N. Theobald, and K. Wonneberger** 1985. Field experiments with dispersed oil and a dispersant in an intertidal ecosystem: fate and biological effects. Pages 515-520 *in* 1985 Oil Spill Conference, API 4385. American Petroleum Institute, Washington, DC.
**Keywords:** activity/ algae/ Arabian Light crude oil/ aromatic hydrocarbons/ benthic/ biological effects/ community/ crude oil/ dispersant/ ecosystem/ effects/ experiment/ fate/ feeding/ flow-through/ general effect/ Germany/ hydrocarbons/ intertidal/ light/ macrofauna/ marine invertebrate/ marine plant/ mesocosm/ mussel/ nematode/ ODeight/ oil/ oil spill/ population/ rate/ salt water/ sand/ saturated hydrocarbons/ sediment/ spill/ time/ treatment
**Notes:** A field experiment using flow-through mesocosm containers placed in the intertidal area of a sand flat in the Wadden Sea (Germany). Over a period of 12 successive tides, the incoming water was treated with either dispersant (finasol OSR 5), chemically dispersed Arabian Light crude oil, or ultrasonically dispersed crude oil. Sediment and water were sampled within the mesocosm containers during the treatment phase and sediment continued to be sampled up to 40 da after treatment; analyzed for aromatic and saturated hydrocarbons. Benthic algal activity was measured by determining photosynthetic rate during treatment and up to 16 da after treatment. Nematodes were identified and quantified during treatment and for 90 da after treatment. Macrofauna of sediments were identified and quantified during treatment and for more than 1 yr after treatment. Also measured feeding activity of a cockle and a mussel, and the cast production of a lugworm.

**Farran, A., J. Grimalt, J. Albaiges, A. V. Botello, S. A. Macko**, 1987. Assessment of petroleum pollution in a Mexican river by molecular markers and carbon isotope ratios. Marine Pollution Bulletin **18**:284-289.
**Keywords:** analysis/ aromatic hydrocarbons/ carbon/ fingerprinting/ fresh water/ hopane/ hydrocarbons/ isoprenoid/ isotope/ Mexico/ miscellaneous/ Oeleven/ petroleum/ petroleum hydrocarbons/ physical characteristics/ pollution/ ratio/ river/ salt water/ sediment/ sterane
**Notes:** Surface sediments were collected from 11 sites on the lower Coatzacoalcos River, Mexico and analyzed for petroleum hydrocarbons. Physical characteristics of the sediment were determined. Petroleum analysis consisted of a detailed assessment of n-alkanes, isoprenoids, steranes, and hopanes; and total aromatic hydrocarbons (fluoresence) referenced to a chrysene standard.

**Farrington, J. W.** 1973. Analytical techniques for the determination of petroleum contamination in marine organisms. Pages 157-179 *in* Inputs, Fates, and Effects of Petroleum in the Marine Environment. Ocean Affairs Board, National Academy of Sciences, Washington, D.C.
**Keywords:** analysis/ composition/ effects/ environment/ fate/ marine environment/ methods/ Onine/ petroleum/ technical
**Notes:** A good description of the composition of petroleum and the methods (circa 1970s) used to analyze it.

**Farrington, J. W., A. C. Davis, N. M. Frew, K. S. Rabin**, 1982. No. 2 fuel oil compounds in *Mytilus edulis*. Retention and release after an oil spill. Marine Biology **66**:15-26.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ bivalve/ Cape Cod/ clam/ cod/ depuration/ fuel oil/ hydrocarbons/ marine invertebrate/ No.2 fuel oil/ Ofour/ oil/ oil spill/ release/ salt water/ spill/ time/ uptake
**Notes:** Assessment of uptake and depuration by a clam of No. 2 fuel oil from a spill in the Cape Cod Canal, MA. Clams sampled six times during an 86 da period following the spill. Measured aliphatic and aromatic hydrocarbons by GC/MS and calculated half lives of selected compounds.

**Farrington, J. W.**, 1985. Oil pollution: a decade of research and monitoring. Oceanus **28**:3-12.
**Keywords:** biological effects/ effects/ fate/ general effect/ monitoring/ Oeight/ oil/ pollution/ salt water/ sources/ treatment
**Notes:** A summarized treatment of a 1985 NRC report on oil in the sea. The author presents information on sources and characteristics, fate, pollution status today (1985 vs 1975), biological effects of oil, conclusions, and personal comments. A nice synopsis in lieu of reading the 600 page NRC report.

**Farwell, A. J., V. Nero, M. Croft, S. Rhodes, D. G. Dixon**, 2006. Phototoxicity of oil sands-derived polycyclic aromatic compounds to Japanese medaka (*Oryzias latipes*) embryos. EnvironmentalToxicology and Chemistry **25**:3266-3274.
**Keywords:** aromatic/ aromatic hydrocarbons/ concentration/ eggs/ embryo/ fish/ fresh water/ hatching/ heart/ length/ light/ oil/ oil sands/ Othree/ phototoxicity/ sand/ survival/ ultraviolet
**Notes:** Japanese medaka fertilized eggs were exposed to an extract from an oil sands tailings pond. Exposure was either of six concentrations of extracts not exposed to UV light, exposed to UV light for 24 or 96 hr, exposed to UV light for 16 hr, or fresh extract exposed insitu to 16, 4, or 1 hr UV light. Duration extended through hatching. Measured survival, hatch length, cranial-skeletal deformities, yolk sac-pericardial edema, and heart deformities.

**Fauchald, P., K. E. Erikstad, G. H. Systad**, 2002. Seabirds and marine oil incidents: is it possible to predict the spatial distribution of pelagic seabirds? Journal of Applied Ecology **39**:349-360.
**Keywords:** bird/ distribution/ oil/ Oone/ salinity/ salt water/ spatial scale/ species/ spill/ temperature
**Notes:** An assessment of the spatial distribution of pelagic seabirds in the Barents Sea. Nine years of information on birds (species and number) and four oceanographic variables collected from regular winter cruises were analyzed to determine spatial (small and large scale) and temporal patterns.

**Faulkner, B. C., R. L. Lochmiller**, 2000. Increased abundance of terrestrial isopod populations in terrestrial ecosystems contaminated with petrochemical wastes. Archives of Environmental Contamination and Toxicology **39**:86-90.
**Keywords:** abundance/ community/ composition/ density/ ecosystem/ freshwater invertebrate/ invertebrate/ isopod/ Ofive/ Oklahoma/ population/ refinery/ time
**Notes:** Assessment of macroarthropod populations at three old refinery sites in Oklahoma and two reference sites. Sampled macroarthropod assemblages three times from late summer to early fall and identified to Family or Class. Determined densities of macroarthropods and similarities of community composition.

**Faulkner, B. C., R. L. Lochmiller**, 2000. Ecotoxicity revealed in parasite communities of *Signodon hispidus* in terrestrial environments contaminated with petrochemicals. Environmental Pollution **110**:135-145.
**Keywords:** abundance/ community/ cotton rat/ diversity/ environment/ freshwater invertebrate/ mammal/ Ofive/ parasite/ population/ rat/ refinery/ species
**Notes:** Evaluated the presence of intestinal parasites in cotton rats from three sites on an old refinery site and two reference sites. Cotton rats were captured on four occasions between September 1993 and October 1995. Parasites were removed from the intestinal tract and identified. Determined abundance, intensity, and prevalence of parasites in their hosts; and calculated species richness and community diversity.

**Fayad, N. M., R. L. Edora, A. H. El-Mubarak, A. B. Polancos, Jr.**, 1992. Effectiveness of a bioremediation product in degrading the oil spilled in the 1991 Arabian Gulf War. Bulletin of Environmental Contamination and Toxicology **49**:787-796.
**Keywords:** aliphatic hydrocarbons/ Arabian Gulf/ aromatic hydrocarbons/ bacteria/ biodegradation/ bioremediation/ concentration/ effectiveness/ evaluation/ experiment/ hydrocarbons/ microbes/ mousse/ nutrients/ oil/ Oten/ petroleum/ salt water/ time/ war
**Notes:** An evaluation of an unnamed commercial bacteria product designed to enhance biodegradation of petroleum. Petroleum mousse was field collected and used in laboratory aquaria in concentrations of 5, 10, and 20 g/L. For each concentration, mousse only, mousse and nutrients, and mousse plus

nutrients and bacteria additive were tested. Experiment duration was 120 hr and the water was analyzed three times for aliphatic and aromatic hydrocarbons.

**Fayad, N. M., E. Overton**, 1995. A unique biodegradation pattern of the oil spilled during the 1991 Gulf War. Marine Pollution Bulletin **30**:239-246.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ bacteria/ biodegradation/ concentration/ degradation/ evaluation/ experiment/ hydrocarbons/ microbes/ mousse/ nutrients/ oil/ Oten/ PAH/ petroleum/ salt water/ time/ war
**Notes:** An evaluation of the effect of nutrients on hydrocarbon biodegradation. Petroleum mousse was field collected and used in laboratory aquaria in concentrations of 5, 10, and 20 g/L. For each concentration, mousse only, mousse and nutrients, and mousse plus nutrients and bacteria additive were tested. Experiment duration was 144 hr and the water was analyzed three times for aliphatic and aromatic hydrocarbons. This report focuses on the PAH degradation in aquaria with oil only and oil plus nutrients.

**Fayad, N. M., A. H. El-Mubarak, R. L. Edora**, 1996. Fate of oil hydrocarbons in fish and shrimp after major oil spills in the Arabian Gulf. Bulletin of Environmental Contamination and Toxicology **56**:475-482.
**Keywords:** aliphatic hydrocarbons/ Arabian Gulf/ aromatic hydrocarbons/ crude oil/ fate/ fish/ hydrocarbons/ marine invertebrate/ oil/ oil spill/ Othree/ salt water/ shrimp/ species/ spill/ uptake/ war
**Notes:** Uptake of hydrocarbons by five species of fish and one species of shrimp after the Iran-Iraq War (1983) and the Gulf War (1991); measures of aliphatic and aromatic hydrocarbons.

**Feder, H. M., A. S. Naidu, A. J. Paul**, 1990. Trace element and biotic changes following a simulated oil spill on a mudflat in Port Valdez, Alaska. Marine Pollution Bulletin **21**:131-137.
**Keywords:** abundance/ Alaska/ copepod/ crude oil/ effects/ hydrocarbons/ marine invertebrate/ metals/ Ofour/ oil/ oil spill/ petroleum hydrocarbons/ Prudhoe Bay/ Prudhoe Bay crude oil/ salt water/ sediment/ species/ spill/ tidal flat/ time/ total hydrocarbons
**Notes:** Prudhoe Bay crude oil was applied to tidal flat sediments in Port Valdez, Alaska to assess effects on marine copepods and trace element changes in the sediment. Oil was added at 500, 1,000, or 2,000 ppm during low tide at five times during the period Jun.-Aug. and sampled at the next low tide. Measured total hydrocarbons, trace metals, and abundance of three copepod species.

**Feder, H. M., A. Blanchard**, 1998. The deep benthos of Prince William Sound, Alaska, 16 months after the *Exxon Valdez* oil spill. Marine Pollution Bulletin **36**:118-130.
**Keywords:** abundance/ Alaska/ benthic/ crude oil/ depth/ diversity/ Exxon Valdez/ invertebrate/ marine invertebrate/ Ofour/ oil/ oil spill/ Prince William Sound/ salt water/ sediment/ spill
**Notes:** Sediment samples were collected, 16 mo after the Exxon Valdez oil spill, from depths of 40 and 100 m in areas affected by the spill and in reference areas. Physical sediment characteristics and benthic invertebrate abundance and diversity were measured.

**Federle, T. W., J. R. Vestal, G. R. Hater, M. C. Miller**, 1979. Effects of Prudhoe Bay crude oil on primary production and zooplankton in Arctic tundra thaw ponds. Marine Pollution Bulletin **2** :3-18.
**Keywords:** Arctic/ biomass/ composition/ crude oil/ effects/ experiment/ fresh water/ freshwater invertebrate/ freshwater plant/ grazing/ Ofive/ oil/ oiled/ phytoplankton/ Prudhoe Bay/ Prudhoe Bay crude oil/ spill/ tundra/ zooplankton
**Notes:** Assessment of the effects of Prudhoe Bay crude oil on phytoplankton and zooplankton of tundra thaw ponds. Pond water was combined with various doses of oil to determine experimental effects on primary production. Effects of uncontrolled spills were determined on one pond oiled 1 yr previously and one pond oiled 6 yrs previously with four weekly samples during June-July. Experimental containers placed within one pond were used to measure the effect of oil on zooplankton grazing of phytoplankton. Test groups were zooplankton with and without oil, oil without zooplankton, and no zooplankton or oil. Measured primary production, phytoplankton composition, and phytoplankton biomass.

**Ferguson, S. H., P. D. Franzmann, I. Snape, A. T. Revill, M. G. Trefry, L. R. Zappia**, 2003. Effects of temperature on mineralisation of petroleum. Chemosphere **52**:975-987.
**Keywords:** analysis/ Antarctic/ Antarctica/ degradation/ effects/ evaluation/ fresh water/ microbes/

microcosm/ mineralization/ Oten/ petroleum/ rate/ soil/ spill/ temperature
**Notes:** An evaluation of the mineralization potential of soil microbes at a terrestrial fuel (Special Antarctic Blend) spill site in Antarctica. Subsurface soil samples were used in a laboratory microcosm study run at either -2, 0, 4, 10, 15, 20, 28, 37, or 42 C for 6 or 7 wks. $^{14}$C-octadecane was added to the soil samples and $CO_2$ traps were used to determine amount of mineralization. Also measured soil temperature at the site of the spills, analyzed the soil samples for hydrocarbon content, and modelled the degradation rates.

**Ferguson, S. H., P. D. Franzmann, A. T. Revill, I. Snape, J. L. Rayner**, 2003. The effects of nitrogen and water on mineralisation of hydrocarbons in diesel-contaminated terrestrial Antarctic soils. Cold Regions Science and Technology **37**:197-212.
**Keywords:** aliphatic hydrocarbons/ Antarctic/ Antarctica/ combination/ concentration/ degradation/ experiment/ hydrocarbons/ incubation/ microbes/ microcosm/ nitrogen/ Oten/ petroleum/ soil
**Notes:** Soil from a petroleum contaminated site in Antarctica was transported to a laboratory for microcosm assessments of the effects on hydrocarbon degradation of water and N addition. Samples of soil stored under refrigeration (2 yrs old) from the same site were also used. Aliphatic hydrocarbon concentrations were measured before and after a 95 da incubation period. At the start of the experiment, $^{14}$C-octadecane and squalane were added to the microcosm soils. Varying combinations of water and N were added to the soils during incubation.

**Fernandes, M. B., M.-A. Sicre, A. Boireau, J. Tronczynski**, 1997. Aquatic hydrocarbon distributions in the Seine estuary: biogenic polyaromatics and n-alkanes. Estuaries **20**:281-290.
**Keywords:** alkane/ aromatic hydrocarbons/ biogenic/ distribution/ estuary/ France/ fresh water/ hydrocarbons/ miscellaneous/ Oeleven/ salt water/ Seine River/ survey
**Notes:** Survey of the biogenic n-alkane and polyaromatic hydrocarbons in surface waters of the lower Seine and Seine estuary.

**Fernandez, N., A. Cesar, M. J. Salamanca, T. A. DelValls** , 2006. Toxicological characterisation of the aqueous soluble phase of the *Prestige* fuel-oil using the sea-urchin embryo bioassay. Ecotoxicology **15**:593-599.
**Keywords:** aqueous/ assay/ bioassay/ Bunker C/ development/ embryo/ fuel oil/ marine invertebrate/ Ofour/ oil/ PAH/ salt water/ sea urchin/ soluble/ toxicity/ urchin
**Notes:** Sea urchin embryos were used in a toxicity assay of eluted (rotation and stirring) water-soluble compounds from the Bunker C cargo of the Prestige shipwreck. Seven dilutions of the eluted phase were used in a 48 hr laboratory assay of embryo development. Parent fuel oil and the elutriates were analyzed for a set of 16 PAH.

**Fernley, P. W., M. N. Moore, D. M. Lowe, P. Donkin, S. Evans**, 2000. Impact of the *Sea Empress* oil spill on lysosomal stability in mussel blood cells. Marine Environmental Research **50**:451-455.
**Keywords:** assay/ bivalve/ blood/ cell/ coast/ concentration/ crude oil/ England/ marine invertebrate/ mussel/ Ofour/ oil/ oil spill/ PAH/ salt water/ spill/ tissue
**Notes:** Mussels were collected from multiple sites near and remote from the site of the 1996 *Sea Empress* oil spill off the southwest coast of England. Mussel samples were collected 132 da after the spill and subjected to the neutral red retention assay for lysosomes in blood cells. Whole mussel tissue was analyzed for total PAH concentration and compared to the results of the lysosome assay.

**Feuston, M. H., C. R. Mackerer, C. A. Schreiner, C. E. Hamilton**, 1997. Systemic toxicity of dermally applied crude oils in rats. Journal of Toxicology and Environmental Health **51**:387-399.
**Keywords:** biochemical/ biochemistry/ blood/ crude oil/ mammal/ oil/ organ/ Otwo/ pathology/ rat/ toxicity/ weight
**Notes:** Comparative assessment of systemic toxicity of two dermally applied crude oils; laboratory rats, body weight, organ weights, blood characteristics, biochemistry, pathology.

**Feuston, M. H., C. E. Hamilton, C. A. Schreiner, C. R. Mackerer**, 1997. Developmental toxicity of dermally applied crude oils in rats. Journal of Toxicology and Environmental Health **52**:79-93.
**Keywords:** abnormalities/ crude oil/ development/ effects/ female/ growth/ litter/ mammal/ oil/ Otwo/ rat/ size/ skin/ survival/ toxicity/ weight

**Notes:** Assessment of the effects of dermal application of varying amounts of two different crude oils to the backs of pregnant rats. Oils were applied on gestation days 0-19; prenatal females were killed on GD 20, postnatal females and offspring were killed 3-4 wks postpartum. Endpoints included survival of both females, fetuses, and young; litter size, parturition date, developmental abnormalities, weight, and growth of young.

**Fevolden, S. E., S. P. Garner**, 1986. Population genetics of *Mytilus edulis* (L.) from Oslofjorden, Norway, in oil-polluted and non oil-polluted water. Sarsia **71**:247-257.
**Keywords:** bivalve/ clam/ concentration/ diesel/ diesel fuel/ effects/ enzyme/ genetic/ genotoxic/ marine invertebrate/ Norway/ Ofour/ oil/ population/ salt water/ species
**Notes:** Assessment of the effects of oil exposure on population genetics of a species of clam in Norway. Experimental basins with two concentrations of diesel fuel were used to expose clams from late 1982 to late 1984. Electrophoresis used to measure allelic frequencies at gene loci on 17 enzymes; results compared with control basins and a fjord control.

**Field, R., M. R. North, J. Wells**, 1993. Nesting activity of yellow-billed loons on the Colville River delta, Alaska, after the *Exxon Valdez* oil spill. Wilson Bulletin **105**:325-332.
**Keywords:** activity/ Alaska/ bird/ Exxon Valdez/ fresh water/ loon/ oil/ oil spill/ Oone/ Prudhoe Bay crude oil/ reproduction/ spill
**Notes:** Assessment of nesting activity of yellow-billed loons in northern Alaska following the Exxon Valdez oil spill.

**Fileman, T. W., R. J. Law**, 1988. Hydrocarbon concentrations in sediments and water from the English Channel. Marine Pollution Bulletin **19**:390-393.
**Keywords:** aromatic hydrocarbons/ coast/ concentration/ crude oil/ English Channel/ estimate/ hydrocarbons/ miscellaneous/ Oeleven/ oil/ petroleum/ petroleum hydrocarbons/ salt water/ sediment/ survey
**Notes:**
Subsurface (1 m) water and surface sediment were collected from 200+ sites along the southern coast of Great Britian during 1982-84. Samples were analyzed for aromatic hydrocarbons with Ekofish crude oil as a reference standard to estimate total petroleum hydrocarbons.

**Fingas, M. F.** 1989. Field measurement of effectiveness: historical review and examination of analytical methods. Pages 157-178 *in* L. M. Flaherty, editor. Oil Dispersants: New Ecological Approaches. ASTM Special Technical Publication 1018. American Society for Testing and Materials, Philadelphia.
**Keywords:** dispersant/ effectiveness/ evaluation/ experiment/ mass balance/ methods/ miscellaneous/ ODeleven/ offshore/ oil/ overview/ review/ salt water/ technical
**Notes:** Author reviews 106 offshore experiments dealing with the effectiveness of chemical dispersants. Presents sections on overview of past field trials, analytical field methods, observations of unique phenomena, determination of mass balance, and conclusions.

**Fingas, M. F., V. M. Dufort, K. A. Hughes, M. A. Bobra, and L. V. Duggan** 1989. Laboratory studies on oil spill dispersants. Pages 207-219 *in* L. M. Flaherty, editor. Oil Dispersants: New Ecological Approaches. STP 1018. American Society for Testing and Materials, Philadelphia.
**Keywords:** combination/ crude oil/ dispersant/ effectiveness/ ODnine/ oil/ oil spill/ refined oil/ spill/ technical/ weathered
**Notes:** Report of the assessment of four laboratory apparatus used to determine the effectiveness of chemical dispersants. A large number of crude and refined oils, at varying stages of weathering, and three dispersants were used in 121 combinations. All oils were not used with all apparatus.

**Fingas, M. F., R. Stoodley, N. Stone, R. Hollins, and I. Bier** 1991. Testing the effectiveness of spill-treating agents: laboratory test development and initial results. Pages 411-414 *in* 1991 International Oil Spill Conference, API Publication 4529. American Petroleum Institute, Washington, D.C.
**Keywords:** commentary/ development/ dispersant/ effectiveness/ emulsion/ ODnine/ oil/ oil spill/ spill/ spill response/ technical/ treatment
**Notes:** A commentary and discussion of laboratory effectiveness studies for four categories of spill

treatment agents (gelling agents or solidifiers, emulsion breakers, surface-washing agents, dispersants). Authors present the results of their tests using the 'swirling flask' method.

**Fiori, S. M., S. M. Zalba**, 2003. Potential impacts of petroleum exploration and exploitation on biodiversity in a Patagonian Nature Reserve, Argentina. Biodiversity Conservation **12**:1261-1270.
**Keywords:** activity/ Argentina/ diversity/ economy/ habitat/ miscellaneous/ Oeleven/ petroleum/ petroleum development
**Notes:** A description of the environmental damage caused by petroleum seismic exploration lines and petroleum extraction activities in a nature reserve in the Patagonian steppe lands. Authors discuss habitat fragmentation and the consequences of facilitated access along the bulldozed lines.

**Fischel, M., W. Grip, and I. A. Mendelssohn** 1989. Study to determine the recovery of a Louisiana marsh from an oil spill. Pages 383-387 *in* Proceedings 1989 Oil Spill Conference, API Publication 4479. American Petroleum Institute, Washington, D.C.
**Keywords:** crude oil/ estuarine/ evaluation/ index/ Louisiana/ marine plant/ oil/ oil spill/ Osix/ pipeline/ recovery/ salt water/ species/ spill/ survey/ time/ vegetation/ wetland
**Notes:** An assessment of the recovery of a Louisiana, USA estuarine wetland following a pipeline rupture spilling crude oil. Aerial photography (18 mos post-spill) and a vegetation survey (17 mos post-spill) were used to determine the status of vegetation and compare findings to an assessment performed 3 mos post-spill. The aerial evaluation employed six catagories and the vegetation survey measured total percent vegetative cover, percent live vegetation cover by species, percent dead vegetative cover, and degree of oil impact to the vegetation (index).

**Fischer, D. W., D. von Winterfeldt**, 1978. Setting standards for chronic oil discharges in the North Sea. Journal of Environmental Management **7**:177-199.
**Keywords:** chronic/ discharges/ miscellaneous/ North Sea/ Norway/ Oeleven/ offshore/ oil/ oil field/ oil platform/ petroleum/ petroleum waste/ salt water/ United Kingdom
**Notes:** A comparison of the process used in Norway and the United Kingdom (pre-1978) to set standards for chronic petroleum waste discharges at offshore oil platforms.

**Fisher, W. S., S. S. Foss**, 1993. A simple test for toxicity of Number 2 fuel oil and oil dispersants to embryos of grass shrimp, *Palaemonetes pugio*. Marine Pollution Bulletin **26**:385-391.
**Keywords:** bioassay/ concentration/ Corexit 7664/ Corexit 9527/ development/ dispersant/ effects/ embryo/ fuel oil/ grass/ grass shrimp/ marine invertebrate/ No.2 fuel oil/ ODfour/ oil/ salinity/ salt water/ shrimp/ survival/ temperature/ toxicity
**Notes:** Development of a toxicity bioassay employing embryos of the grass shrimp. Shrimp embryos were exposed to four concentrations of either the water-soluble fraction of No. 2 fuel oil, Corexit 9527, Corexit 7664, or fuel oil plus Corexit 9527 or 7664 for up to 16 da. Measured survival and the effects on toxicity of salinity and water temperature.

**Fitzgerald, D. E.** 1977. Utilization of dispersants in offshore areas. Pages 395-398 *in* 1977 Oil Spill Conference. American Petroleum Institute, Washington, D.C.
**Keywords:** cost/ dispersant/ effectiveness/ effects/ fate/ ODnine/ offshore/ oil/ oil spill/ spill/ technical
**Notes:** A short discussion of the use of chemical dispersants with sections on rational for their use, fate and effects of dispersed oil, reports of dispersant use on spills, effectiveness of dispersants, dispersant spraying equipment, and cost effectiveness.

**Flaherty, L. M., W. B. Katz, and S. Kaufmann** 1989. Dispersant use guidelines for freshwater and other inland environments. Pages 25-30 *in* L. M. Flaherty, editor. Oil Dispersants: New Ecological Approaches. ASTM Special Technical Publication 1018. American Society for Testing and Materials, Philadelphia.
**Keywords:** dispersant/ environment/ fresh water/ guidelines/ miscellaneous/ ODeleven/ oil/ oil spill/ petroleum/ spill/ technical
**Notes:** A description of work underway by an ASTM subcommittee to develop guidelines for the use of chemical dispersants in inland environments. The guidelines have since been completed but the paper

contains a couple of good tables of data on the incidence and classification of inland oil spills during the years 1977-1984.

**Fleeger, J. W., G. T. Chandler**, 1983. Meiofauna responses to an experimental oil spill in a Louisiana salt marsh. Marine Ecology Progress Series **11**:257-264.
**Keywords:** community/ concentration/ crude oil/ density/ effects/ Louisiana/ Louisiana crude oil/ marine invertebrate/ meiofauna/ Ofour/ oil/ oil spill/ salt marsh/ salt water/ sediment/ South Louisiana crude oil/ spill/ structure
**Notes:** Effects of an oil spill on meifauna of a Louisiana salt marsh were determined through use of experimental plots sprayed with South Louisiana crude oil. Plots were sampled before spraying and on days 2, 5, 10, 20, 30, 60, 95, and 144 after spraying. Measured densities of meiofauna and hydrocarbon concentrations in sediment, and calculated measures of community structure.

**Fleming, W. J., L. Sileo, J. C. Franson**, 1982. Toxicity of Prudhoe Bay crude oil to sandhill cranes. Journal of Wildlife Management **46**:474-478.
**Keywords:** bird/ blood/ crane/ crude oil/ dosed/ effects/ fresh water/ necropsy/ oil/ Oone/ pathology/ physiology/ Prudhoe Bay/ Prudhoe Bay crude oil/ toxicity
**Notes:** Sandhill cranes were dosed with Prudhoe Bay crude oil for 25 days and effects assessed by clinical signs, necropsy, blood chemistries, and histological examination.

**Fletcher, G. L., J. W. Kiceniuk, U. P. Williams**, 1981. Effects of oiled sediments on mortality, feeding and growth of winter flounder *Pseudopleuronectes americanus*. Marine Ecology Progress Series **4**:91-96.
**Keywords:** crude oil/ effects/ experiment/ feeding/ fish/ flounder/ growth/ oil/ oiled/ Othree/ salt water/ sediment/ survival/ Venezuelan crude oil/ winter flounder
**Notes:** Effects on winter flounder of exposure to sediments containing Venezuelen crude oil in three experiments of 4-5 months duration during winter and summer; measures of survival, feeding, and growth.

**Fletcher, G. L., M. J. King, J. W. Kicieniuk, R. F. Addison**, 1982. Liver hypertrophy in winter flounder following exposure to experimentally oiled sediments. Comparative Biochemistry and Physiology **73C**:457-462.
**Keywords:** crude oil/ effects/ fish/ flounder/ liver/ oil/ oiled/ Othree/ pathology/ physiology/ salt water/ sediment/ Venezuelan crude oil/ winter flounder
**Notes:** Effects on the liver of winter flounder exposed to sediments oiled with Venezuelan crude oil for 4-5 months during summer and winter.

**Flickinger, E. L.**, 1981. Wildlife mortality at petroleum pits in Texas. Journal of Wildlife Management **45**:560-564.
**Keywords:** bird/ fresh water/ oil/ oil field/ Oone/ petroleum/ petroleum waste/ refinery/ Texas
**Notes:** Report of the extent of bird deaths in oil refinery sludge pits and oil-field spillage pits in Texas.

**Flickinger, E. L., C. M. Bunck**, 1987. Number of oil-killed birds and fate of bird carcasses at crude oil pits in Texas. Southwestern Naturalist **32**:377-381.
**Keywords:** bird/ carcass/ crude oil/ estimate/ evaluation/ fate/ fresh water/ methods/ numbers/ oil/ Oone/ Texas/ waste oil
**Notes:** Evaluation of proper methods for determining the numbers of birds perishing in waste oil pits.

**Flint, P. L., A. C. Fowler**, 1998. A drift experiment to assess the influence of wind on recovery of oiled seabirds on St. Paul Island, Alaska. Marine Pollution Bulletin **36**:165-166.
**Keywords:** Alaska/ bird/ Bunker C/ carcass/ drift/ experiment/ offshore/ oil/ oiled/ Oone/ recovery/ salt water/ spill
**Notes:** An experiment to assess the influence of offshore winds on carcass recovery of oiled seabirds. Experiment followed an offshore spill of Bunker C oil near St. Paul Island, Alaska. Wooden blocks were used to simulate dead seabirds.

**Flint, P. L., A. C. Fowler, R. F. Rockwell**, 1999. Modeling bird mortality associated with the M/V Citrus oil spill off St. Paul Island, Alaska. Ecological Modelling **117**:261-267.
**Keywords:** Alaska/ beach/ bird/ carcass/ detection/ eiders/ estimate/ model/ oil/ oil spill/ Oone/ persistence/ rate/ salt water/ species/ spill
**Notes:** Developed a model to estimate bird deaths associated with the M/V Citrus oil spill off St. Paul Island. Used beach searches to determine detection probabilities and persistence rates for bird carcasses. Created a model for king eiders and applied the results to all species because data were lacking for models specific to other species.

**Floc'h, J.-Y., M. Diouris**, 1980. Initial effects of Amoco Cadiz oil on intertidal algae. Ambio **9**:284-286.
**Keywords:** algae/ Amoco Cadiz/ community/ crude oil/ effects/ intertidal/ macroalgae/ marine plant/ oil/ Osix/ photograph/ recovery/ salt water/ survival
**Notes:** A verbal and photographic description of the initial impact on intertidal macroalgae of crude oil from the *Amoco Cadiz*.

**Fogelqvist, E., S. Lagerkvist, P. Lindroth**, 1982. Petroleum hydrocarbons in the Arctic Ocean surface water. Marine Pollution Bulletin **13**:211-213.
**Keywords:** Arctic/ aromatic hydrocarbons/ crude oil/ depth/ hydrocarbons/ ice/ Kuwait/ Kuwait crude oil/ miscellaneous/ Oeleven/ oil/ petroleum/ petroleum hydrocarbons/ salt water/ Svalbard
**Notes:** Water samples were collected from varying depths (1-20 m) below the ice at eight stations north of Svalbard and Franz Josef Land. The water was analyzed for aromatic hydrocarbons and related to a standard of Kuwait crude oil.

**Foget, C. R., R. W. Castle, S. Naughton, J. D. Sartor, M. Miller, P. Dibner, D. E. Glowe, F. Weber, B. J. Yager, and P. E. Cassidy**. 1984. Surface treatment agents for protection of shorelines from oil spills. U.S. Environmental Protection Agency, Washington, D.C. **EPA-600/S2-84-085**. 4 pp.
**Keywords:** dispersant/ evaluation/ methods/ ODnine/ oil/ oil spill/ protection/ review/ salt water/ shoreline/ spill/ technical/ treatment
**Notes:** A project summary of an evaluation of shoreline protection methods. Consists of a literature review, laboratory tests, preliminary field tests, and full-scale field tests. Evaluated 10 surface treatment agents, including three chemical oil dispersants and an oil herding agent.

**Folmar, L. C., D. R. Craddock, J. W. Blackwell, G. Joyce, H. O. Hodgins**, 1981. Effects of petroleum exposure on predatory behavior of coho salmon (*Oncorhynchus kisutch*). Bulletin of Environmental Contamination and Toxicology **27**:458-462.
**Keywords:** adult/ behavior/ brain/ concentration/ Cook Inlet crude oil/ crude oil/ effects/ feeding/ fish/ hydrocarbons/ liver/ oil/ Othree/ petroleum/ predation/ salmon/ salt water
**Notes:** Effects of exposure to the water-soluble fraction of Cook Inlet crude oil on predatory behavior of adult coho salmon; measures of feeding behavior and hydrocarbon concentrations in brain and liver.

**Folmar, L. C., W. W. Dickhoff, W. S. Zaugg, H. O. Hodgins**, 1982. The effects of aroclor 1254 and No. 2 fuel oil on smoltification and sea-water adaptation of coho salmon (*Oncorhynchus kisutch*). Aquatic Toxicology **2**:291-299.
**Keywords:** biochemical/ biochemistry/ combination/ effects/ fish/ fresh water/ fuel oil/ No.2 fuel oil/ oil/ Othree/ PCB/ salmon/ salt water/ survival/ tissue
**Notes:** Effects of Aroclor 1254 and No. 2 fuel oil, singly and in combination, on the smoltification and sea-water adaptation of yearling coho salmon; survival and tissue biochemistry.

**Folmar, L. C., H. O. Hodgins**, 1982. Effects of Arocolor 1254 and No. 2 fuel oil, singly and in combination, on predator-prey interactions in coho salmon (*Oncorhynchus kisutch*). Bulletin of Environmental Contamination and Toxicology **29**:24-28.
**Keywords:** aromatic hydrocarbons/ behavior/ combination/ concentration/ effects/ fish/ fuel oil/ hydrocarbons/ interactions/ No.2 fuel oil/ oil/ Othree/ PCB/ predation/ salmon/ salt water
**Notes:** Effects of exposure to No. 2 fuel oil and Aroclor 1254, singly or in combination, on coho salmon predation behavior; measures of predation behavior and concentrations of PCBs and selected aromatic hydrocarbons.

**Fong, W. C.**, 1976. Uptake and retention of Kuwait crude oil and its effects on oxygen uptake by the soft-shell clam, *Mya arenaria*. Journal of the Fisheries Research Board of Canada **33**:2774-2780.
**Keywords:** bivalve/ clam/ crude oil/ distribution/ effects/ hydrocarbons/ Kuwait/ Kuwait crude oil/ marine invertebrate/ Ofour/ oil/ oxygen/ petroleum/ petroleum hydrocarbons/ respiration/ salt water/ tissue/ uptake
**Notes:** Exposure of soft-shell clams to water-accomodated Kuwait crude oil for 10-30 da. Measured uptake of oil particles, distribution of petroleum hydrocarbons in various tissues of the clam, and effect of exposure on respiration.

**Ford, R. G., J. A. Wiens, D. Heinemann, G. L. Hunt**, 1982. Modelling the sensitivity of colonially breeding marine birds to oil spills: guillemot and kittiwake populations on the Pribilof Islands, Bering Sea. Journal of Applied Ecology **19**:1-31.
**Keywords:** Bering Sea/ bird/ guillemot/ kittiwake/ marine birds/ model/ oil/ oil spill/ Oone/ population/ salt water/ simulation/ spill
**Notes:** Simulation modeling exercise of the population response of long-lived marine birds to environmental disturbances, such as oil spills. Special emphasis on guillemots and kittiwakes.

**Forde, S. E.**, 2002. Modelling the effects of an oil spill on open populations of intertidal invertebrates. Journal of Applied Ecology **39**:595-604.
**Keywords:** barnacle/ development/ effects/ estimate/ intertidal/ invertebrate/ marine invertebrate/ model/ Ofour/ oil/ oil spill/ population/ recruitment/ salt water/ size/ spill/ structure
**Notes:** Development of a population model describing the changes to a source and focal population of a sessile intertidal invertebrate (barnacle) affected by an oil spill. The model evaluated several size structures of the source population, the severity of the spill impact on the source population, and the intensity of recruitment by the focal population.

**Fossato, V. U., W. J. Canzonier**, 1976. Hydrocarbon uptake and loss by the mussel *Mytilus edulis*. Marine Biology **36**:243-250.
**Keywords:** bivalve/ depuration/ diesel/ diesel fuel/ marine invertebrate/ mussel/ Ofour/ petroleum hydrocarbons/ salt water/ uptake
**Notes:** Assessment of the uptake and depuration of suspended diesel fuel by blue mussels in a continuous-flow experimental system. Mussels exposed to 200-400 ppb diesel fuel for up to 41 da and depurated for up to 32 da.

**Fowler, A. C., P. L. Flint**, 1997. Persistence rates and detection probabilities of oiled king eider carcasses on St. Paul Island, Alaska. Marine Pollution Bulletin **34**:522-526.
**Keywords:** Alaska/ beach/ bird/ carcass/ detection/ eiders/ oiled/ Oone/ persistence/ rate/ rocky shore/ salt water/ sand/ sandy beach/ sex
**Notes:** A study of king eider carcass persistence and detection probabilities on four sand or rocky beaches on St. Paul Island, Alaska. Searches carried out over a 6-da period; results evaluated according to beach type and sex of carcass.

**Fowler, G. S., J. C. Wingfield, P. D. Boersma**, 1995. Hormonal and reproductive effects of low levels of petroleum fouling in Magellanic penguins (*Spheniscus magellanicus*). Auk **112**:382-389.
**Keywords:** Argentina/ bird/ crude oil/ dispersant/ effects/ hormone/ ODone/ oil/ penguin/ petroleum/ reproduction/ salt water/ spill/ washing
**Notes:** Effects of exposure to crude oil and dispersant washing on hormonal production and subsequent reproduction in Magellanic penguins of coastal Argentina.

**Fowler, S. W., J. W. Readman, B. Oregioni, J.-P. Villeneuve, K. McKay**, 1993. Petroleum hydrocarbons and trace metals in nearshore Gulf sediments and biota before and after the 1991 war. Marine Pollution Bulletin **27**:171-182.
**Keywords:** aromatic hydrocarbons/ Bahrain/ bivalve/ concentration/ fish/ hydrocarbons/ Kuwait/ marine invertebrate/ metals/ miscellaneous/ Oeleven/ petroleum/ petroleum hydrocarbons/ salt water/ saturated hydrocarbons/ Saudi Arabia/ sediment/ survey/ time/ war
**Notes:** A survey of petroleum contamination along coastal Kuwait, Saudi Arabia Bahrain, UAE, and

Oman performed from June to October 1991. Collected nearshore sediments, bivalves, and fish; analyzed them for saturated and aromatic hydrocarbons, and metals. Hydrocarbon concentrations and metals in bivalves and sediments for 1991 were compared to those collected before the war.

**Franco, P. J., J. M. Giddings, S. E. Herbes, L. A. Hook, J. D. Newbold, W. K. Roy, G. R. Southworth, A. J. Stewart**, 1984. Effects of chronic exposure to coal-derived oil on freshwater ecosystems: I. Microcosms. EnvironmentalToxicology and Chemistry **3**:447-463.
**Keywords:** bacteria/ benthic/ chlorophyll/ chronic/ coal/ community/ concentration/ crude oil/ ecosystem/ effects/ fresh water/ freshwater/ freshwater invertebrate/ general effect/ invertebrate/ microcosm/ Oeight/ oil/ phenol/ population/ recovery/ respiration/ time/ water/ water column/ zooplankton
**Notes:** Sixteen established indoor microcosms were used in an assessment of the effects of a middle distillate of synthetic (coal) crude oil on microcosm organisms. Seven concentrations of distillate were added daily or weekly (weekly total of 0.028-7 ml) to the treated microcosms for 8 wks followed by a 5-wk recovery period. Monitored water characteristics and chemistry, primary production and nighttime respiration, phenol concentrations, chlorophyll *a* concentrations, zooplankton, and water column bacteria. Benthic invertebrates were observed but not sampled or measured quantitatively.

**Frankenberger, W. T., Jr., J. B. Johanson**, 1982. Influence of crude oil and refined petroleum products on soil dehydrogenase activity. Journal of Environmental Quality **11**:602-607.
**Keywords:** activity/ crude oil/ degradation/ diesel/ diesel fuel/ gasoline/ incubation/ kerosene/ microbes/ motor oil/ oil/ Oten/ petroleum/ petroleum products/ soil
**Notes:** Three soil types and three levels of petroleum loading were used to assess the effect of crude oil, leaded gasoline, kerosene, diesel fuel, and motor oil on soil dehydrogenase activity. Measurements were made on days 0, 3, 7, 14, and 30 of incubation.

**French-McCay, D. P.**, 2002. Development and application of an oil toxicity and exposure model, Oiltoxex. Environmental Toxicology and Chemistry **21**:2080-2094.
**Keywords:** aromatic hydrocarbons/ concentration/ development/ environment/ hydrocarbons/ model/ monoaromatic/ narcosis/ oil/ Onine/ PAH/ technical/ temperature/ time/ toxicity
**Notes:** Development of a toxicity model for aromatic hydrocarbons in an aquatic environment. The cause of death is proposed to be narcosis due to the presence of monoaromatics and two-four ring PAHs. The model incorporates known (or QSAR) toxicity of compounds, time of exposure, temperature, additive toxicity, and exposure concentrations. Author made extensive use of the experimental and field literature to verify the model output.

**French-McCay, D. P.**, 2004. Oil spill impact modeling development and validation. Environmental Toxicology and Chemistry **23**:2441-2456.
**Keywords:** biological effects/ development/ evaluation/ Exxon Valdez/ fate/ marine environment/ model/ oil/ oil spill/ Onine/ review/ simulation/ spill/ technical
**Notes:** A detailed description of a large oil spill modeling product of Applied Science Associates called The Spill Impact Model Application Package (SIMAP). It was derived from the physical fates and biological effects submodels in the NRDA Model for Coastal and Marine Environments. The author reviews the formation of all components of the current version of the model and evaluates the strengths and weaknesses of the package. The Exxon Valdez oil spill is presented as a case study.

**Fricke, A. H., H. F-K. O. Hennig, M. J. Orren**, 1981. Relationship between oil pollution and psammolittoral meiofauna density of two South African beaches. Marine Environmental Research **5**:59-77.
**Keywords:** aromatic hydrocarbons/ beach/ concentration/ crude oil/ density/ fuel oil/ hydrocarbons/ invertebrate/ marine invertebrate/ meiofauna/ Ofour/ oil/ pollution/ salt water/ sediment/ time
**Notes:** Assessment of the effect of crude oil and fuel oil from a ship collision on meiofauna of two South African beaches. Two affected beaches (one cleaned, one undisturbed) were sampled by taking sediment cores four times between March 1978 and March 1979. Measured meiofauna density and concentrations of aromatic hydrocarbons in sediment.

**Frink, L. and G. Gauvry** 1995. Response to oiled wildlife in Tampa Bay. Pages 635-639 *in* 1995 International Oil Spill Conference, API Publication 4620. American Petroleum Institute, Washington, D.C.
**Keywords:** bird/ miscellaneous/ Oeleven/ oil/ oil spill/ oiled/ petroleum/ rehabilitation/ salt water/ spill/ turtle
**Notes:** A three-ship collision in Tampa Bay produced a petroleum spill that affected local wildlife. A total of 370 oiled animals (birds, a sea turtle, and a tortoise) were treated at a wildlife rehabilitation facility. Authors discuss details of the rehabilitation effort.

**Fritcher, D. L., J. A. K. Mazet, M. H. Ziccardi, I. A. Gardner**, 2002. Evaluation of two direct immunoassays for rapid detection of petroleum products on marine birds. Marine Pollution Bulletin **44**:388-395.
**Keywords:** assay/ bird/ common murre/ detection/ evaluation/ feathers/ fuel oil/ methods/ oil/ oiled/ Oone/ PAH/ petroleum/ petroleum products/ spill
**Notes:** An evaluation of two methods for the detection of PAHs on bird feathers. The assays RaPID$^{R}$ and EnviroGard$^{TM}$ were used in a comparative assessment of the petroleum on feathers from 30 oiled and 30 unoiled common murres from a spill of intermediate grade fuel oil (IFO 180). A recommendation is made based on the results.

**Frithsen, J. B., R. Elmgren, D. T. Rudnick**, 1985. Responses of benthic meiofauna to long-term, low-level additions of No. 2 fuel oil. Marine Ecology Progress Series **23**:1-14.
**Keywords:** abundance/ benthic/ community/ concentration/ effects/ experiment/ flow-through/ fuel oil/ invertebrate/ long-term/ marine invertebrate/ meiofauna/ mesocosm/ No.2 fuel oil/ Ofour/ oil/ petroleum/ population/ recruitment/ salt water/ sediment/ structure
**Notes:** Assessment of the effects of No. 2 fuel oil on benthic meiofauna in a flow-through experimental mesocosm system. One experiment had an average concentration of 190 ppb for 168 da followed by a 64 da period of no oil additions. A second experiment had an average concentration of 90 ppb followed by a 386 da period of no oil additions. Measured meiofauna abundance, community structure, recruitment, and petroleum concentrations in sediment.

**Fritts, T. H. and M. A. McGehee**. 1981. Effects of petroleum on the development and survival of marine turtle embryos. U.S. Fish and Wildlife Service, Washington, DC. **FWS/OBS-81/37**. 47 pp.
**Keywords:** beach/ concentration/ development/ effects/ eggs/ embryo/ experiment/ incubation/ marine turtle/ oiled/ OthreeR/ petroleum/ reptile/ sand/ survival/ turtle
**Notes:** Field and laboratory experiments were employed to assess the effects of oiled sand on the embryo development of marine turtles. Nine field-collected clutches of Kemp's ridley turtle were divided and incubated in three types of containers using naturally-oiled beach sand and clean sand. Laboratory tests employed five clutches of loggerhead turtle eggs; three concentrations of oiled sand and oiling at initiation of incubation, the half-way point, and the 3/4 point were tested. Hatchlings were measured and weighed; eggs that failed to hatch were opened and examined.

**Frost, K. J., L. F. Lowry, J. M. Ver Hoef**, 1999. Monitoring the trend of harbor seals in Prince William Sound, Alaska, after the *Exxon Valdez* oil spill. Marine Mammal Science **15**:494-506.
**Keywords:** Alaska/ estimate/ Exxon Valdez/ harbor seals/ mammal/ monitoring/ oil/ oil spill/ oiled/ Otwo/ population/ Prince William Sound/ Prudhoe Bay crude oil/ salt water/ sampling/ seal/ spill/ survey/ time/ trend
**Notes:** Assessment of the population of harbor seals in eastern and central Prince William Sound, Alaska. Aerial surveys were performed from 1990 through 1997 along a trend-count route that included seven oiled and 18 unoiled sites. Determined environmental factors that most affected the counts and calculated a trend estimate for the population during the sampling period.

**Fry, D. M., L. J. Lowenstine**, 1985. Pathology of common murres and Cassin's auklets exposed to oil. Archives of Environmental Contamination and Toxicology **14**:725-737.
**Keywords:** bird/ Bunker C/ Cassin's auklet/ common murre/ crude oil/ oil/ Oone/ pathology/ salt water/ Santa Barbara crude oil
**Notes:** Pathological assessment of common murres and Cassin's auklets exposed to Bunker C and Santa Barbara crude oil.

**Fry, D. M., J. Swenson, L. A. Addiego, C. R. Grau, A. Kang**, 1986. Reduced reproduction of wedge-tailed shearwaters exposed to weathered Santa Barbara crude oil. Archives of Environmental Contamination and Toxicology **15**:453-463.
**Keywords:** behavior/ bird/ chicks/ crude oil/ dosed/ effects/ eggs/ long-term/ oil/ Oone/ reproduction/ salt water/ Santa Barbara crude oil/ survival/ weathered
**Notes:** Breeding wedge-tailed shearwaters dosed with Santa Barbara crude oil were evaluated for effects on reproduction; egg production, behavior, survival of chicks, return of breeders in second year.

**Fry, D. M., L. A. Addiego**, 1987. Hemolytic anemia complicates the cleaning of oiled seabirds. Wildlife Journal **10**:3-8.
**Keywords:** anemia/ bird/ cleaning/ crude oil/ oiled/ Oone/ petroleum products/ rehabilitation/ salt water/ spill
**Notes:** Discussion of hemolytic anemia in oiled birds and how to deal with it in oiled bird rehabilitation.

**Fry, D. M.** 1991. Point-source and non-point-source problems affecting seabird populations. Pages 547-562 *in* D. R. McCullough, R. H. Barrett, editors. Wildlife 2001: Populations. Elsevier Science Publishers, LTD, Oxford, England.
**Keywords:** bird/ chronic/ discharges/ oil/ oil spill/ Oone/ population/ species/ spill
**Notes:** Presentation and discussion of the numerous point- and non-point-source threats to seabird populations throughout the world; includes short sections on oil spills and chronic oil discharges.

**Fukuyama, A. K., G. Shigenaka, R. Z. Hoff**, 2000. Effects of residual *Exxon Valdez* oil on intertidal *Protothaca staminea*: mortality, growth, and bioaccumulation of hydrocarbons in transplanted clams. Marine Pollution Bulletin **40**:1042-1050.
**Keywords:** accumulation/ Alaska/ aromatic hydrocarbons/ clam/ depuration/ effects/ experiment/ Exxon Valdez/ growth/ hydrocarbons/ intertidal/ marine invertebrate/ monitoring/ Ofour/ oil/ oiled/ Prince William Sound/ salt water/ sediment/ spill/ survival/ time/ tissue/ transplant
**Notes:** Clams from an oiled and an unoiled site in Prince William Sound were collected, tagged, and used in a transplant experiment; oiled clams went to an unoiled area and unoiled clams went to the oiled area. Clams were recovered 1 and 2 years later. Other clams and sediment were also collected for hydrocarbon monitoring. Thirty-five aromatic hydrocarbons or their isomers were quantified in sediment and clam tissue. Measured mortality and growth of clams, and accumulation or depuration of aromatics in clam tissue.

**Fuller, C., J. Bonner, C. Page, A. Ernest, T. McDonald, S. McDonald**, 2004. Comparative toxicity of oil, dispersant, and oil plus dispersant to several marine species. Environmental Toxicology and Chemistry **23**:2941-2949.
**Keywords:** assay/ concentration/ Corexit 9500/ crude oil/ dispersant/ experiment/ fish/ general effect/ microbes/ Microtox/ ODeight/ oil/ salt water/ shrimp/ species/ spill response/ survival/ toxicity/ weathered
**Notes:** A series of laboratory experiments was performed to determine the effects of a chemical dispersant and a crude oil on representative near-shore species. Test species were two common species of fish, a common species of shrimp, and microbes in the Microtox assay. Arabian medium crude oil (weathered and unweathered) and Corexit 9500 were used to produce varying concentrations of no oil or dispersant, crude oil only, dispersant only, and crude oil plus dispersant. Used results to calculate a continuous NOEC and LC50, a declining NOEC and LC50, and a 15-min EC50.

**Furness, R. W.**, 1989. Declining seabird populations. Journal of Zoology (London) **219**:177-180.
**Keywords:** bird/ decline/ England/ growth/ Ireland/ Oone/ population/ salt water/ survey
**Notes:** After decades of general seabird population increase around Britain and Ireland, the first indications of tapering off of growth and a few population declines were observed during a 1985-88 survey.

**Furness, R. W., C. J. Camphuysen**, 1997. Seabirds as monitors of the marine environment. ICES Journal of Marine Science **54**:726-737.
**Keywords:** analysis/ beached bird survey/ bird/ condition/ environment/ estimate/ evaluation/ fingerprinting/ marine environment/ monitoring/ oil/ Oone/ petroleum/ pollution/ salt water/ survey

**Notes:** Evaluation of the use of seabirds as monitors of conditions in the marine environment. Section on the use of seabirds in beached bird surveys to estimate changes in the amount of oil pollution and to provide samples of petroleum for fingerprinting analysis.

**Gabche, C. E., J. Folack, G. C. Yongbi**, 1998. Tar ball levels on some beaches in Cameroon. Marine Pollution Bulletin **36**:535-539.
**Keywords:** beach/ Cameroon/ coast/ density/ miscellaneous/ Oeleven/ salt water/ tar ball
**Notes:** Measured tar ball density on one industrial, one tourist, and one reference beach along the coast of Cameroon. Collections made once a month for 12 consecutive mos.

**Gagnon, M. M., D. A. Holdway**, 1999. Metabolic enzyme activities in fish gills as biomarkers of exposure to petroleum hydrocarbons. Ecotoxicology and Environmental Safety B **44**:92-99.
**Keywords:** activity/ Atlantic/ Atlantic salmon/ biomarker/ Corexit 9527/ crude oil/ depuration/ dispersant/ effects/ enzyme/ fish/ flow-through/ gill/ hydrocarbons/ juvenile/ metabolism/ ODthree/ oil/ petroleum/ petroleum hydrocarbons/ salmon/ salt water/ tissue
**Notes:** Assessment of the effects on juvenile Atlantic salmon of either the water accomodated fraction (WAF) of crude oil or chemically dispersed crude oil. The chemical dispersant was Corexit 9527 and exposures were conducted in flow-through tanks. Exposure was to 250 ppm for 2 da, then 125 ppm for 2 da, followed by 8 da of depuration. Measured three metabolic enzymes in gill tissue.

**Gagnon, M. M., D. A. Holdway**, 2000. EROD induction and biliary metabolite excretion following exposure to the water accommodated fraction of crude oil and to chemically dispersed crude oil. Archives of Environmental Contamination and Toxicology **38**:70-77.
**Keywords:** activity/ Atlantic/ Atlantic salmon/ bile/ bioassay/ Corexit 9527/ crude oil/ depuration/ dispersant/ female/ fish/ flow-through/ hydrocarbons/ juvenile/ metabolite/ monooxygenase/ ODthree/ oil/ petroleum/ petroleum hydrocarbons/ salmon/ salt water
**Notes:** Juvenile female Atlantic salmon were exposed to the water-accommodated fraction (WAF) of Bass Strait crude oil or crude oil dispersed with Corexit 9527 for 6 da in a flow-through bioassay. The exposure period was followed by a 29 da depuration period. Crude oil only exposure was 1 % of the WAF and dispersed oil exposure was equivalent to 0.132 ppm dispersant and 0.89 ppm total petroleum hydrocarbons. Fish were sampled every second day from day 0 through 14, and then day 21 and day 35; measured metabolites in the bile and hepatic EROD activity.

**Gales, N. J., D. J. St.Aubin** 1995. The effects of oil contamination and rehabilitation on other fur-bearing marine mammals. Pages 197-212 *in* T. M. Williams, R. W. Davis, editors. Emergency Care and Rehabilitation of Oiled Sea Otters: A Guide for Oil Spills Involving Fur-Bearing Marine Mammals. University of Alaska Press, Fairbanks.
**Keywords:** analysis/ blood/ capture/ cleaning/ crude oil/ effects/ Exxon Valdez/ mammal/ monitoring/ North Slope crude oil/ oil/ oil spill/ oiled/ Otwo/ pathology/ petroleum/ physiology/ polar bear/ procedure/ rehabilitation/ review/ river otter/ salt water/ sea otter/ seal/ spill/ treatment
**Notes:** A reference chapter for assessing the effects of petroleum spills on pinnipeds and polar bears. The authors perform a review of the literature (including a review of literature on river otters) and supplement it with experiences at the Exxon Valdez spill in 1989. Chapter subheadings are (1) a brief historical perspective, (2) categories of oil impact, (3) assessment of impact and strategy planning, (4) capture and restraint, (5) clinical examination and treatment, (6) cleaning procedures, (7) blood analysis and pathology, and (8) post-release monitoring and summary.

**Gallego, A., L. H. Cargill, M. R. Heath, S. J. Hay, T. Knutsen**, 1995. An assessment of the immediate effect of the *Braer* oil-spill on the growth of herring larvae using otolith microstructure analysis. Marine Pollution Bulletin **30**:536-542.
**Keywords:** analysis/ crude oil/ fish/ growth/ herring/ larvae/ oil spill/ Othree/ salt water/ Shetland/ spill
**Notes:** Assessment of the growth of herring larvae following the *Braer* spill near the Shetland Islands; otolith microstructure analysis.

**Galvao, S. A. O., A. L. N. Mota, D. N. Silva, J. E. F. Moraes, C. A. O. Nascimento, O. Chiavone-Filho**, 2006. Application of the photo-Fenton process to the treatment of wastewaters contaminated with diesel.

Science of the Total Environment **367**:42-49.
**Keywords:** diesel/ diesel fuel/ Onine/ oxidation/ remediation/ technical/ treatment/ waste water
**Notes:** Description of the photo-Fenton oxidation process for the treatment of wastewater contaminated by diesel fuel. This method was compared to UV-photolysis alone and the thermal Fenton reaction with or without UV radiation.

**Gandini, P., P. D. Boersma, E. Frere, M. Gandini, T. Holik, V. Lichtschein**, 1994. Magellanic penguins (*Spheniscus magellanicus*) affected by chronic petroleum pollution along coast of Chubut, Argentina. Auk **111**:20-27.
**Keywords:** Argentina/ beach/ bird/ carcass/ chronic/ coast/ oiled/ Oone/ penguin/ petroleum/ pollution/ salt water/ survey
**Notes:** Several carcass counts along beaches of Argentina. Incidence of oiling noted.

**Ganning, B., D. Broman, C. Lindblad**, 1983. Uptake of petroleum hydrocarbons by the blue mussel (*Mytilus edulis* L.) after experimental oiling and high pressure, hot water shore cleaning. Marine Environmental Research **10**:245-254.
**Keywords:** analysis/ aromatic hydrocarbons/ cleaning/ concentration/ crude oil/ dissolved/ distance/ hydrocarbons/ light/ marine invertebrate/ mussel/ Ofour/ oil/ oiled/ petroleum/ petroleum hydrocarbons/ pressure/ Russian crude oil/ salt water/ saturated hydrocarbons/ shoreline/ tissue/ uptake/ weathered
**Notes:** Effect of shoreline cleaning on the uptake of petroleum by blue mussels in shallow near-shore water. Russian crude oil (weathered for 3 wks) was sprayed on the shoreline, half was permitted to clean naturally, and the other half was cleaned with high-pressure hot-water cleaning equipment. Mussels were placed in suspended bags at distances of 3 and 8 m from shore . Mussels were sampled for hydrocarbon analysis at 3 and 14 da after cleaning. Tissue analyzed for saturated hydrocarbons and light aromatics. A supplemental study measured the uptake from a known concentration of 'dissolved' crude oil.

**Garcia-Borboroglu, P., P. D. Boersma, V. Ruoppolo, L. Reyes, G. A. Rebstock, K. Griot, S. R. Heredia, A. C. Adornes, R. P. da Silva**, 2006. Chronic oil pollution harms Magellanic penguins in the southwest Atlantic. Marine Pollution Bulletin **52**:193-198.
**Keywords:** Argentina/ Atlantic/ bird/ Brazil/ chronic/ condition/ numbers/ oil/ oiled/ Oone/ penguin/ pollution/ population/ reproduction/ salt water/ survey/ time
**Notes:** Twenty-five wildlife groups in Brazil and Argentina were surveyed about their efforts to survey or rehabilitate oiled seabirds along 6,800 km of coastline; four of the groups kept detailed records of numbers and condition of oiled birds. The focus was on penguins, specifically Magellanic penguins. Authors compared the numbers of oiled penguins from 1970 to 2002 to oil exportation by Argentina and speculated on the effect of increased chronic oil pollution on penguin reproduction.

**Gariazzo, C., A. Pelliccioni, P. DiFilippo, F. Sallusti, A. Cecinato**, 2005. Monitoring and analysis of volatile organic compounds around an oil refinery. Water Air and Soil Pollution **167**:17-38.
**Keywords:** air/ aliphatic hydrocarbons/ analysis/ benzene/ condition/ emissions/ hydrocarbons/ miscellaneous/ monitoring/ Oeleven/ oil/ organic/ petroleum/ pollution/ refinery/ toluene/ xylene
**Notes:** Volatile organic emissions generated by a petroleum refinery, a large landfill, a municipal incinerator, local quarries, and local vehicle traffic were measured for 1 week at two locations in the Valle Galeria area of Italy. Benzene, toluene, and xylene mean values were compared to other locations in Italy and throughout the world. Analyzed air samples for a large suite of aliphatic hydrocarbons during day and night and factored in the existing weather conditions.

**Garrett, R. M., I. J. Pickering, C. E. Haith, R. C. Prince**, 1998. Photooxidation of crude oils. Environmental Science and Technology **32**:3719-3723.
**Keywords:** biodegradation/ composition/ crude oil/ effects/ Forties Field crude oil/ miscellaneous/ North Slope/ Oeleven/ oil/ photooxidation/ weathered
**Notes:** Assessment of the effects of photooxidation on three weathered crude oils (North Slope, Forties, Gullfaks). Oil films and slicks were irradiated by a UV source for 48 hrs. Measured composition of crude before and after irradiation and compared results with reported results of biodegradation.

**Garrity, S. D., S. C. Levings**, 1990. Effects of an oil spill on the gastropods of a tropical intertidal reef flat. Marine Environmental Research **30**:119-153.
**Keywords:** abundance/ crude oil/ density/ effects/ gastropod/ habitat/ intertidal/ marine invertebrate/ monitoring/ Ofour/ oil/ oil spill/ population/ recruitment/ salt water/ size/ snail/ species/ spill/ weight
**Notes:** Assessment of the effect of a spill of medium weight crude oil on gastropods of a reef flat. Gastropod populations were monitored in six habitats within the reef flat; pre-spill monitoring occurred 1982-83 and post spill monitoring occurred for 3 years after the 1986 spill. Measured abundance of live and dead snails, number of species, temporal changes in snail size frequencies, and episodes of recruitment.

**Garrity, S. D., S. C. Levings**, 1993. Effects of an oil spill on some organisms living on mangrove (*Rhizophora mangle* L.) roots in low wave-energy habitats in Caribbean Panama. Marine Environmental Research **35**:251-271.
**Keywords:** barnacle/ Caribbean/ community/ crude oil/ effects/ estuary/ habitat/ mangrove/ marine invertebrate/ marine plant/ mussel/ Ofour/ oil/ oil spill/ oyster/ Panama/ population/ refinery/ roots/ salt water/ species/ spill/ stream/ time
**Notes:** A large refinery spill of crude oil into the coastal waters of Panama affected large areas of mangrove-fringed estuary. The epibiota (oysters, mussels, barnacles; five species) of mangrove prop roots in channels, lagoons, and streams were surveyed three times prior to the spill and 3, 7, 10, and 13 mos after the spill. Measured the percent cover of dead and live organisms on each root.

**Garrity, S. D., S. C. Levings, K. A. Burns**, 1994. The Galeta oil spill. I. Long-term effects on the physical structure of the mangrove fringe. Estuarine and Coastal and Shelf Science **38**:327-348.
**Keywords:** coast/ condition/ crude oil/ density/ effects/ long-term/ mangrove/ marine plant/ oil/ oil spill/ oiled/ Osix/ Panama/ roots/ salt water/ size/ spill/ structure/ time/ vegetation
**Notes:** Assessment of the effect on the physical structure of the coastal mangrove fringe of crude oil from the Galeta oil spill in Panama. Mangroves were classified as open coast, channel, or river/stream, and as oiled or unoiled. Assessment performed during the 5 yrs after the spill (1987-1991). Measured or described amount of oiling on roots, description and sequence of oiling effects, amount of fringe loss and change in prop root density, size and physical condition of prop roots, partial defoliation of trees, and calculation of overall damage.

**Garrott, R. A., L. L. Eberhardt, D. M. Burn**, 1993. Mortality of sea otters in Prince William sound following the *Exxon Valdez* oil spill. Marine Mammal Science **9**:343-359.
**Keywords:** crude oil/ estimate/ Exxon Valdez/ mammal/ numbers/ oil/ oil spill/ Otwo/ Prince William Sound/ Prudhoe Bay crude oil/ salt water/ sea otter/ spill
**Notes:** Estimation of the numbers of sea otters killed by the Exxon Valdez oil spill.

**Garshelis, D. L.**, 1997. Sea otter mortality estimated from carcasses collected after the *Exxon Valdez* oil spill. Conservation Biology **11**:905-916.
**Keywords:** beach/ carcass/ crude oil/ estimate/ Exxon Valdez/ mammal/ numbers/ oil/ oil spill/ Otwo/ salt water/ sea otter/ search effort/ spill
**Notes:** Estimate of numbers of sea otters killed during the Exxon Valdez oil spill. Author included information on proportion of dying otters that hauled out onto beaches, carcasses recovered at sea, and differences in search effort in different areas of the spill.

**Garshelis, D. L., J. A. Estes**, 1997. Sea otter mortality from the *Exxon Valdez* oil spill: evaluation of an estimate from boat-based surveys. Marine Mammal Science **13**:341-351.
**Keywords:** critique/ crude oil/ estimate/ evaluation/ Exxon Valdez/ mammal/ methods/ oil/ oil spill/ Otwo/ salt water/ sea otter/ spill/ survey
**Notes:** A critique of the estimate of sea otter deaths related to the Exxon Valdez oil spill made by Garrott et.al. (1993). Authors criticize the use of inadequate boat-based survey data and make several suggestions for other methods to be used after a major oil spill.

**Garshelis, D. L., C. B. Johnson**, 2001. Sea otter population dynamics and the *Exxon Valdez* oil spill: disentangling the confounding effects. Journal of Applied Ecology **38**:19-35.

**Keywords:** abundance/ activity/ Alaska/ effects/ Exxon Valdez/ foraging/ mammal/ oil/ oil spill/ Otwo/ population/ Prince William Sound/ salt water/ sea otter/ spill/ survey
**Notes:** A reassessment of results from 1990-96 surveys of sea otter abundance, pup production, activities, and foraging performed in Prince William Sound, Alaska after the Exxon Valdez oil spill of 1989. Reanalyzed results from another study that proposed conclusions contrary to those of the authors and compared both sets of results with data collected in the late 1970s and early 1980s.

**Gashev, S. N.**, 1992. Effect of oil spills on the fauna and ecology of small mammals from the Central Ob' region. Soviet Journal of Ecology **23**:99-106.
**Keywords:** abundance/ activity/ crude oil/ diversity/ effects/ fresh water/ freshwater plant/ mammal/ oil/ oil field/ oil spill/ organ/ Otwo/ region/ soil/ species/ spill/ USSR
**Notes:** Effects on small mammals of contamination from oil production activities in the Central Ob' region of the USSR. Small mammal diversity and abundance, organ indicies, and reproductive activity were measured.

**Gassmann, G. and W. Gunkel** 1983. Long-term investigations on chemical and microbial changes of a slightly oil polluted beach. Pages 479-483 *in* 1983 Oil Spill Conference, API 4356. American Petroleum Institute, Washington, DC.
**Keywords:** aliphatic hydrocarbons/ Arabian Light crude oil/ bacteria/ beach/ biodegradation/ concentration/ crude oil/ degradation/ hydrocarbons/ light/ long-term/ microbes/ oil/ oil spill/ Oten/ salt water/ sand/ spill/ time/ transect
**Notes:** A spill of Arabian light crude oil affected a portion of beach that was sandy in the upper reaches and mud in the lower reach. Authors sampled sand and mud along a transect at three locations in the sand and two locations in the mud a total of six times during a 7-yr period after the spill. Identified and quantified the aliphatic hydrocarbons and quantified the concentration of oil-degrading bacteria.

**Gaur, J. P., H. D. Kumar**, 1981. Growth response of four micro-algae to three crude oils and a furnace oil. Environmental Pollution (Series A) **25**:77-85.
**Keywords:** concentration/ crude oil/ fresh water/ freshwater plant/ fuel oil/ growth/ microalgae/ No.2 fuel oil/ oil/ Oseven/ petroleum/ rate
**Notes:** Four microalgae were grown in laboratory culture and exposed to four concentrations of one of three crude oils or No. 2 fuel oil. Measured algal growth daily and determined the maximum specific growth rate and the total growth 12 da after innoculation of the growth medium with petroleum.

**Gaur, J. P., A. K. Singh**, 1990. Growth, photosynthesis and nitrogen fixation of *Anabaena doliolum* exposed to Assam crude extract. Bulletin of Environmental Contamination and Toxicology **44**:494-500.
**Keywords:** activity/ bacteria/ biomass/ concentration/ crude oil/ fresh water/ growth/ labelled/ microbes/ nitrogen/ oil/ Oten/ photosynthesis/ rate/ size/ uptake
**Notes:** A cyanobacteria was exposed for 15 da in laboratory flask culture to five concentrations of the water-soluble fraction of a crude oil. Measured photosynthesis by uptake of $^{14}CO_2$, nitrogenase activity, and heterocyst differentiation. Determined the specific growth rate and final size (biomass) of the culture on the 15th day.

**Gearing, P. J., J. N. Gearing, R. J. Pruell, T. L. Wade, J. G. Quinn**, 1980. Partitioning of No. 2 fuel oil in controlled estuarine ecosystems, sediments and suspended particulate matter. Environmental Science and Technology **14**:1129-1136.
**Keywords:** aromatic hydrocarbons/ biodegradation/ ecosystem/ estuarine/ experiment/ fate/ fuel oil/ mesocosm/ microbes/ movement/ No.2 fuel oil/ oil/ Oten/ particulate/ petroleum/ salt water/ saturated hydrocarbons/ sediment/ time/ treatment
**Notes:** A petroleum fate experiment wherein fiberglass mesocosm tanks were used to determine the movement of No. 2 fuel oil into water, suspended particulate matter, and sediments. Fuel oil and seawater dispersions were added twice weekly to the tanks for 4 mos. Water and sediments were sampled periodically during a 500-da period, including the treatment time. Suspended particulate matter was sampled during the period of oil treatment. All samples were analyzed for saturated and aromatic hydrocarbon fractions; several GC tracings presented.

**Gearing, P. J., J. N. Gearing**, 1982. Behavior of No. 2 fuel oil in the water column of controlled ecosystems. Marine Environmental Research **6**:115-132.
**Keywords:** aromatic hydrocarbons/ behavior/ colonization/ degradation/ ecosystem/ experiment/ fate/ fuel oil/ hydrocarbons/ light/ microbes/ No.2 fuel oil/ oil/ Oten/ petroleum/ salt water/ saturated hydrocarbons/ time/ total hydrocarbons/ water column
**Notes:** A set of four experiments on petroleum degradation in sea water were conducted in large indoor water tanks over a 2.5 yr period. Oil and water dispersions (149-299 ppb) were followed in a cold water and warm water scenario, a high light scenario, and a colonization scenario. Experiments lasted from 134 to 552 hours. Analyzed the water column 7-9 times during the study for selected saturated and aromatic (only one) hydrocarbons and the total hydrocarbons in the saturated and aromatic fractions.

**Gearing, P. J., J. N. Gearing**, 1982. Transport of No.2 fuel oil between water column surface microlayer and atmosphere. Marine Environmental Research **6**:133-143.
**Keywords:** alkane/ aromatic hydrocarbons/ degradation/ experiment/ fate/ fuel oil/ microbes/ monitoring/ No.2 fuel oil/ oil/ Oten/ salt water/ saturated hydrocarbons/ time/ transport/ water column
**Notes:** A secondary collection of data from a set of indoor water tank experiments involving oil and water dispersions of No. 2 fuel oil and degradation over time periods of 150-300 hr. Sampled the surface microlayer, the atmosphere above the water surface, and the tank wall (a separate experiment) at various times during the parent studies. Analyzed samples for total saturates, total aromatics, and selected alkanes. Compared results to the monitoring data for water column degradation.

**Geiger, J. G., A. L. Buikema, Jr.**, 1981. Oxygen consumption and filtering rate of *Daphnia pulex* after exposure to water-soluble fractions of naphthalene, phenanthrene, No. 2 fuel oil, and coal-tar creosote. Bulletin of Environmental Contamination and Toxicology **27**:783-789.
**Keywords:** algae/ analysis/ assay/ consumption/ creosote/ daphnia/ effects/ fresh water/ freshwater invertebrate/ freshwater plant/ fuel oil/ naphthalene/ No.2 fuel oil/ Ofive/ oil/ oxygen/ phenanthrene/ rate/ static/ survival
**Notes:** Evaluated effects of the water-soluble fraction of naphthalene, phenanthrene, No. 2 fuel oil, and creosote on daphnia. Used 24- and 48-hr static assays. Measured survival, oxygen consumption, and rate of filtering algae. Calculated $LD_{20, 30, 50}$. Performed standard water chemistry analysis.

**Geiger, J. G., A. L. Buikema, Jr.**, 1982. Hydrocarbons depress growth and reproduction of *Daphnia pulex* (Cladocera). Canadian Journal of Fisheries and Aquatic Sciences **39**:830-836.
**Keywords:** acute/ bioassay/ chronic/ concentration/ creosote/ daphnia/ effects/ fresh water/ freshwater invertebrate/ fuel oil/ growth/ hydrocarbons/ No.2 fuel oil/ Ofive/ oil/ phenanthrene/ reproduction/ static/ survival
**Notes:** Assessment of the effects on daphnia of various concentrations of the water-soluble fractions of napthalene, phenanthrene, No. 2 fuel oil, and creosote. Used a static bioassay for 48 hr to do acute tests and static tests with water renewal for the chronic tests. Exposed daphnia in chronic tests to concentrations equivalent to either $LC_{20}$ or $LC_{30}$ until they died. Measured survival, growth, several reproductive characteristics, and calculated $LC_{50s}$.

**Geiszler, P. C., B. J. Grantham, G. J. Blomquist**, 1977. Fate of labeled n-alkanes in the blue crab and stripped mullet. Bulletin of Environmental Contamination and Toxicology **17**:463-467.
**Keywords:** alkane/ blue crab/ crab/ depuration/ fate/ fish/ marine invertebrate/ metabolism/ mullet/ Othree/ salt water/ striped mullet/ uptake
**Notes:** Uptake and fate of two n-alkanes by the blue crab and striped mullet.

**Gentes, M.-L., C. Waldner, Z. Papp, J. E. G. Smits**, 2006. Effects of oil sands tailings compounds and harsh weather on mortality rates, growth and detoxification efforts in nestling tree swallows (*Tachycineta bicolor*). Environmental Pollution **142**:24-33.
**Keywords:** activity/ bird/ condition/ effects/ fresh water/ growth/ length/ nest/ nestling/ oil/ oil field/ oil sands/ Oone/ PAH/ rate/ sampling/ sand/ time/ waste water/ weight/ wetland/ wing
**Notes:** A total of 92 tree swallow nest boxes located around three oil sands process-water wetlands and a reference wetland were monitored during the breeding seasons of 2003 and 2004. Recorded weather

conditions, reproductive success, and nestling weight and wing length on days 6 and 12 in 2003 and 2004. In 2004, EROD activity was measured in a sampling of nestlings.

**George-Ares, A., J. R. Clark, G. R. Biddinger, M. L. Hinman**, 1999. Comparison of test methods and early toxicity characterization for five dispersants. Ecotoxicology and Environmental Safety **42**:138-142.
**Keywords:** acute/ concentration/ Corexit 9527/ dispersant/ marine invertebrate/ methods/ Microtox/ ODfour/ salt water/ survival/ toxicity
**Notes:** The acute toxicities of Corexit 9527 and four experimental dispersant formulations were determined with the 96-hr mysid test, the Mysid IQ Toxicity Test, and Microtox. Survival was measured at 3, 6, 9, 12, 24, 48, 72, and 96 hr at nominal concentrations of 6.25 and 12.5 mg/liter in the 96-hr test. Nominal concentrations were 6.25 to 100 mg/liter for the IQ Test and 12.5 to 100 mg/liter for Microtox. LC50s were calculated and toxicities ranked.

**George-Ares, A., J. R. Clark**, 2000. Aquatic toxicity of two Corexit$^{R}$ dispersants. Chemosphere **40**:897-906.
**Keywords:** Corexit 9500/ Corexit 9527/ dispersant/ fish/ general effect/ invertebrate/ marine invertebrate/ marine plant/ Oeight/ plant/ review/ toxicity
**Notes:** A review of the aquatic toxicity of the chemical dispersants Corexit 9527 and 9500. Reviews reports of toxicity to plants, invertebrates, and fish.

**George, S. E., G. M. Nelson, M. J. Kohan, S. H. Warren, B. T. Eischen, L. R. Brooks**, 2001. Oral treatment of Fischer 344 rats with weathered crude oil and a dispersant influences intestinal metabolism and microbiota. Journal of Toxicology and Environmental Health, Part A **63**:297-316.
**Keywords:** biochemical/ Corexit 9527/ crude oil/ dispersant/ dosed/ intestine/ mammal/ metabolism/ microbes/ mutation/ Nigerian crude oil/ ODtwo/ oil/ rat/ survival/ tissue/ treatment/ weathered/ weight
**Notes:** Laboratory rats were dosed (0.1% of body weight) daily with either peanut oil (control), a 1:20 dilution of artificially-weathered Nigerian crude oil, a 1:50 dilution of Corexit 9527 dispersant, or crude oil plus dispersant. Dosing continued for 5 weeks. Measured survival, body weight, weight of the small and large intestines, weight of the cecum, B-glucuronidase, nitroreductase, and azoreductase; identified and enumerated cecal microflora; and determined the mutagenicity of all chemical treatments.

**George, S. G., J. Wright, J. Conroy**, 1995. Temporal studies of the impact of the Braer oilspill on inshore feral fish from Shetland, Scotland. Archives of Environmental Contamination and Toxicology **29**:530-534.
**Keywords:** activity/ aromatic hydrocarbons/ concentration/ crude oil/ fish/ hydrocarbons/ metabolism/ oil/ oil spill/ Othree/ petroleum/ petroleum hydrocarbons/ salt water/ Scotland/ Shetland/ species/ spill
**Notes:** Temporal assessment of exposure of several species of fish to petroleum hydrocarbons from the Braer oil spill near the Shetland Islands; mixed-function oxygenase activity for 7 months following the spill.

**Georgiades, E. T., D. A. Holdway, S. E. Brennan, J. S. Butty, A. Temara**, 2003. The impact of oil-derived products on the behaviour and biochemistry of the eleven-armed asteroid *Coscinasterias muricata* (Echinodermata). Marine Environmental Research **55**:257-276.
**Keywords:** activity/ aliphatic hydrocarbons/ analysis/ aromatic hydrocarbons/ biochemistry/ Corexit 9500/ crude oil/ effects/ foraging/ hydrocarbons/ marine invertebrate/ ODfour/ oil/ PAH/ petroleum/ physiology/ salt water
**Notes:** Australian 11-armed asteroids were used in a behavioral and physiological assessment of the effects of petroleum. Asteroids were either fed or starved for 45 da and then exposed for 4 da to either the water-accomodated fraction (WAF) of Bass Strait crude oil, crude oil dispersed with Corexit 9500, or burned WAF. The fed asteriods were dissected after 4 da and the pyloric caeca were analyzed for alkaline phosphatase activty and total cytochrome P450 activity. The starved asteroids were presented with a prey location challenge at 0, 2, 7, and 14 da after exposure ended. Experimental petroleum mixtures were analyzed for aliphatic hydrocarbons and nine PAHs.

**Geraci, J. R., T. G. Smith**, 1976. Direct and indirect effects of oil on ringed seals (*Phoca hispida*) of the Beaufort Sea. Journal of the Fisheries Research Board of Canada **33**:1976-1984.
**Keywords:** acute/ Canada/ crude oil/ effects/ ingestion/ mammal/ Norman Wells crude oil/ oil/ Otwo/

physiology/ population/ ringed seal/ salt water/ seal/ skin/ species
**Notes:** Two species of seals were exposed, by immersion or ingestion, to Norman Wells crude oil to simulate acute exposure to spilled oil. Work was done in anticipation of oil exploration in the Beaufort Sea.

**Geraci, J. R., D. J. St.Aubin**, 1980. Offshore petroleum resource development and marine mammals: a review and research recommendations. Marine Fisheries Review **42**:1-12.
**Keywords:** behavior/ development/ effects/ evaluation/ mammal/ mitigation/ offshore/ oil/ oil field/ Otwo/ pathology/ petroleum/ physiology/ review/ salt water
**Notes:** A discussion and evaluation of the effects of all aspects of offshore oil development on marine mammals. Contains recommendations for mitigation actions and identifies topics for research.

**Gerges, M. A.**, 1993. On the impacts of the 1991 Gulf War on the environment of the region: general observations. Marine Pollution Bulletin **27**:305-314.
**Keywords:** coral/ coral reef/ effects/ environment/ fish/ fishery/ general effect/ Gulf oil spill/ habitat/ health/ humans/ intertidal/ Iraq/ Kuwait/ marine plant/ miscellaneous/ Oeleven/ oil/ plume/ pollution/ region/ Saudi Arabia/ seagrass/ sediment/ shoreline/ smoke/ survey/ war
**Notes:** A summary of the results of a 90-da United Nations investigation of the environmental consequences of the 1991 Gulf War. Sections on initial surveys; oil pollution effects on water, sediment, shorelines, coral reefs, seagrass and intertidal habitats, and fisheries; atmospheric pollution, global climate change, local weather, smoke plume chemistry, human health considerations, and a country-specific (Iraq, Kuwait, Saudi Arabia) assessment of war damage.

**Getter, C. D.** 1982. Oil spills and mangroves: a review of the literature, field, and lab studies. Pages 303-318 *in* P. J. Rand, editor. Land and Water Issues Related to Energy Development. Ann Arbor Science Publishing Company, Ann Arbor.
**Keywords:** development/ index/ mangrove/ marine plant/ oil/ oil spill/ Osix/ review/ salt water/ spill/ stress
**Notes:** A review of the literature on oil spills and mangroves, and information from some lab and field studies by the author. Information is used to develop an 'index of mangrove stress'.

**Getter, C. D., T. G. Ballou, C. B. Koons**, 1985. Effects of dispersed oil on mangroves. Synthesis of a seven-year study. Marine Pollution Bulletin **16**:318-324.
**Keywords:** adult/ aliphatic hydrocarbons/ Arabian crude oil/ Arabian Light crude oil/ aromatic hydrocarbons/ Bunker C/ concentration/ Corexit 9527/ crude oil/ dispersant/ effects/ environment/ fuel oil/ hydrocarbons/ leaves/ light/ mangrove/ marine plant/ No.2 fuel oil/ No.6 fuel oil/ ODsix/ oil/ petroleum/ plant/ reproduction/ respiration/ salt water/ sediment/ seedling/ survival/ time/ tissue/ transpiration/ uptake
**Notes:** Reference is made to information from other studies performed during a 7-yr period of research on the effects of petroleum and chemical dispersants on tropical coastal environments. Research covered in this article deals with a laboratory and a field study of the effects of dispersants on mangroves. The laboratory study involved red and black mangrove seedlings; and Bunker C fuel oil, No. 2 fuel oil, or light Arabian crude oil with or without Corexit 9527 dispersant. Plants were exposed for 20 wks to five concentrations of petroleum with or without dispersant. Measured survival, uptake of aliphatic and aromatic hydrocarbons, foliage production, leaf shape, transpiration, respiration, and comparative responses of seedling stocks from unoiled and previously-oiled sites. In the field study, two areas of red mangrove were treated with either undispersed or chemically-dispersed oil. After 121 da, survival and sprouting success for mangrove propagules was measured. The aliphatic and aromatic hydrocarbon content of seedling leaf tissue, adult leaf tissue, and peat sediments was determined at several times during the 11 month field trial.

**Ghaly, A. E., J. B. Pyke**, 2001. In-vessel bioremediation of oil-contaminated peat. Energy Sources **23**:305-325.
**Keywords:** bioremediation/ chemical characteristics/ concentration/ development/ microbes/ motor oil/ oil/ oiled/ Oten/ petroleum/ remediation/ spill response/ temperature
**Notes:** Development of a method of petroleum cleanup and remediation involving oil-absorbent peat. The peat was added to oiled water (motor oil) to absorb the oil and the oiled peat was then transferred to a stainless steel bio-remediation reactor. Chicken manure was added as a nutrient supplement.

Determined the chemical characteristics of the motor oil, peat, and oil-peat mixture. Monitored the reactor vessel every 2 da for 15 da for temperature, moisture, and oil concentration.

**Giam, C.-S., H. S. Chan, G. S. Neff**, 1976. Distribution of *n*-parrafins in selected marine benthic organisms. Bulletin of Environmental Contamination and Toxicology **16**:37-43.
**Keywords:** benthic/ distribution/ fish/ marine invertebrate/ offshore/ Othree/ paraffin/ petroleum hydrocarbons/ salt water/ shrimp/ species/ squid/ Texas
**Notes:** Baseline study of paraffin content of shrimp, squid, and several species of marine fish from offshore Texas.

**Gibson, M. J.**, 1990. Results of the eagle capture, health assessment, and short-term rehabilitation program following the Valdez oil spill. Wildlife Journal **13**:49-57.
**Keywords:** Alaska/ bald eagle/ bird/ capture/ crude oil/ eagle/ Exxon Valdez/ health/ oil/ oil spill/ Oone/ Prudhoe Bay crude oil/ rehabilitation/ salt water/ short-term/ spill
**Notes:** Capture, health assessment, and rehabilitation of bald eagles after the Exxon Valdez oil spill.

**Giddings, J. M., B. R. Parkhurst, C. W. Gehrs, R. E. Millemann**, 1980. Toxicity of a coal liquefaction product to aquatic organisms. Environmental Pollution (Series A) **24**:263-275.
**Keywords:** algae/ assay/ Bunker C/ coal/ concentration/ crustacean/ daphnia/ fresh water/ freshwater/ freshwater invertebrate/ fuel oil/ No.2 fuel oil/ Ofive/ oil/ photosynthesis/ species/ synthetic oil/ toxicity
**Notes:** The water-soluble fractions of Bunker C fuel oil, No. 2 fuel oil, and a synthetic (coal) oil were used in assays of toxicity to two species of freshwater algae and a freshwater crustacean (daphnia). Algal toxicity was measured as photosynthesis inhibition to WSF concentrations of 0.1, 1, 10, and 100% during a 4-hr exposure. Daphnia toxicity was measured as 48-hr $EC_{50}$.

**Giddings, J. M., J. N. Washington**, 1981. Coal-liquification products, shale oil, and petroleum. Acute toxicity to freshwater algae. Environmental Science and Technology **15**:106-108.
**Keywords:** acute/ algae/ coal liquification/ coal oil/ concentration/ fresh water/ freshwater plant/ labelled/ oil/ Oseven/ petroleum/ petroleum products/ photosynthesis/ shale oil/ short-term/ toxicity/ uptake
**Notes:** A green and a blue-green algae were used in a short-term laboratory culture to assess the effect on photosynthesis of four concentrations of 11 coal-liquification products, five shale-oil products, and six petroleum products. Photosynthesis was measured by $^{14}C$ uptake.

**Giddings, J. M., P. J. Franco, R. M. Cushman, L. A. Hook, G. R. Southworth, A. J. Stewart**, 1984. Effects of chronic exposure to coal-derived oil on freshwater ecosystems: II. Experimental ponds. EnvironmentalToxicology and Chemistry **3**:465-488.
**Keywords:** bacteria/ chronic/ coal/ concentration/ crude oil/ ecosystem/ effects/ fish/ fresh water/ freshwater/ freshwater invertebrate/ general effect/ growth/ microbes/ Oeight/ oil/ periphyton/ phenol/ plant/ rate/ synthetic oil/ time/ water/ water column/ zooplankton
**Notes:** Ten outdoor experimental ponds were used to assess the effects of a middle distillate of synthetic (coal) crude oil on freshwater ecosystems. After establishment, the treated ponds received daily oil input at rates of 1, 2, 4, 8, or 16 $ml/m^3$ water for 8 wks; ponds were monitored and sampled for another 52 wks. Measure pond morphology, water characteristics and chemistry, phenol concentrations, periphyton, water column bacteria, aquatic plant growth, zooplankton (counted and identified), insects, and fish.

**Giere, O.**, 1980. The impact of crude oil and oil dispersants on the marine oligochaete *Marionina subterranea*. Cahiers De Biologie Marine **21**:51-60.
**Keywords:** Arabian Light crude oil/ combination/ concentration/ crude oil/ dispersant/ effects/ light/ marine invertebrate/ ODfour/ oil/ oligochaete/ salt water/ species/ static/ survival/ temperature
**Notes:** Assessement of the effects of Arabian Light crude oil and several chemical dispersants on a species of marine oligochaete. Tested a component of "old-type" dispersants at concentrations of 1-10 ppm and at two temperatures for 14 da in static tests; followed by addition of oil and only one temperature. Three "modern" dispersants alone, in combination, or combined with crude oil at concentrations of 50-1000 ppm and one temperature for 14 da. Measured survival of oligochaetes.

**Giese, M., S. D. Goldsworthy, R. Gales, N. Brothers, J. Hamill**, 2000. Effects of the *Iron Baron* oil spill on little penguins (*Eudyptula minor*), III. Breeding success of rehabilitated oiled birds. Wildlife Research **27**:583-591.
**Keywords:** Australia/ bird/ chicks/ effects/ evaluation/ oil/ oil spill/ oiled/ Oone/ penguin/ rehabilitation/ reproduction/ salt water/ sampling/ seasonal/ spill/ weight
**Notes:** An evaluation of the breeding success of previously-oiled and rehabilitated little penguins from the *Iron Baron* oil spill near Tasmania, Australia. All birds handled at the oil spill were banded. A total of 199 and 256 burrows were monitored during the two years; burrows were visited every 2 wks throughout the breeding season. Measured timing and duration of breeding, breeding success within and between sampling sites, breeding success of rehabilitated oiled penguins compared to non-oiled penguins, and pre-fledging weight of chicks.

**Giger, W., M. Reinhard, C. Schaffner, W. Stumm**, 1974. Petroleum-derived and indigenous hydrocarbons in recent sediments of Lake Zug, Switzerland. Environmental Science and Technology **8**:454-455.
**Keywords:** aliphatic hydrocarbons/ fresh water/ hydrocarbons/ miscellaneous/ Oeleven/ pollution/ sediment/ survey/ total hydrocarbons
**Notes:** Nearshore surface sediments were collected from six sites along Lake Zug in Switzerland and analyzed for total hydrocarbons and several individual aliphatic hydrocarbons. A comparison is made of sites near populated areas and sites near unpopulated areas, with emphasis on attempting to determine the source of the hydrocarbons.

**Gilbert, F., L. Rivet, J-C. Bertrand**, 1994. The in vitro influence of the burrowing polychaete Nereis diversicolor on the fate of petroleum hydrocarbons in marine sediments. Chemosphere **29**:1-12.
**Keywords:** Arabian Light crude oil/ burrowing/ concentration/ crude oil/ depth/ fate/ flow-through/ hydrocarbons/ light/ marine invertebrate/ mixing/ Ofour/ oil/ oligochaete/ petroleum/ petroleum hydrocarbons/ polychaete/ salt water/ saturated hydrocarbons/ sediment/ species
**Notes:** Determination of the effect of a species of marine polychaete on the fate of Arabian Light crude oil. Polychaetes added to sediment with or without crude oil for 45 da in a flow-through system. Measured mixing of sediments by oligochaetes and concentrations of saturated hydrocarbons at varying depths within the sediment containers. Discusses the influence of oligochaetes in the disposition of oil in sediments.

**Gilbert, F., G. Desrosiers, S. Hulth, G. Stora**, 2001. Comparison between the *Nereis diversicolor* and *Nereis virens* marine worms in the transformation of ingested hydrocarbons. Journal of the Marine Biological Association of the United Kingdom **81**:886.
**Keywords:** algae/ aliphatic hydrocarbons/ alkane/ evaluation/ experiment/ faeces/ hydrocarbons/ marine invertebrate/ metabolism/ Ofour/ polychaete/ salt water/ tissue
**Notes:** An evaluation and comparison of alkane metabolism in two closely related marine polychaetes. Polychaetes were fed aglae anaesthetized with an alkane mixture for up to 12 da. Faeces were collected during the first 24 hrs and gut tissue was collected at the end of the experiment. Analyzed control algae, faeces, and gut tissue for a suite of alkanes.

**Gilfillan, E. S., D. S. Page, S. A. Hanson, J. C. Foster, J. Hotham, D. Vallas, E. Pendergast, S. Hebert, S. D. Pratt, and R. Gerber** 1885. Tidal area dispersant experiment, Searsport Maine: and overview. Pages 553-559 *in* 1985 Oil Spill Conference, API 4385. American Petroleum Institute, Washington, DC.
**Keywords:** aliphatic hydrocarbons/ bivalve/ community/ concentration/ density/ dispersant/ experiment/ general effect/ growth/ hydrocarbons/ invertebrate/ Maine/ marine invertebrate/ metabolism/ ODeight/ oil/ oil spill/ overview/ population/ salt water/ species/ spill/ tissue
**Notes:** An overview of a dispersant experiment in Maine that is documented by five previously published reports (cited in reference section). Presents figures depicting GC tracings of aliphatic hydrocarbon fractions, concentrations of hydrocarbons in tissues of bivalves from before and after the spill, population density of several invertebrate species, and 'scope for growth' and metabolism data for bivalves.

**Gilfillan, E. S., D. Mayo, S. Hanson, D. Donovan, L. C. Jiang**, 1976. Reduction in carbon flux in *Mya arenaria* caused by a spill of No. 6 fuel oil. Marine Biology **37** :115-123.
**Keywords:** assimilation/ bivalve/ carbon/ chlorophyll/ clam/ concentration/ effects/ estimate/ fuel oil/ Maine/ marine invertebrate/ No.6 fuel oil/ Ofour/ oil/ oil spill/ petroleum/ petroleum hydrocarbons/ rate/ reduction/ respiration/ salinity/ salt water/ sediment/ shell/ spill/ temperature/ tissue
**Notes:** Assessment of the effects of a No. 6 fuel oil spill in Casco Bay, Maine on carbon flow in soft shell clams. Sampled clams at a contaminated and an uncontaminated site on a monthly basis from Nov. 1972 to Nov. 1973. Clams transported to a laboratory where rates of respiration, assimilation , and filtration were determined. Monthly estimates of carbons flow were calculated. Also measured annual cycle of seawater temperature, salinity, chlorophyll *a*, and petroleum concentrations in clam tissue and sediment.

**Gilfillan, E. S., S. A. Hanson, D. Vallas, R. Gerber, D. S. Page, J. Foster, J. Hotham, and S. D. Pratt** 1983. Effect of spills of dispersed and non-dispersed oil on intertidal infaunal community structure. Pages 457-463 *in* 1983 Oil Spill Conference, API 4356. American Petroleum Institute, Washington, DC.
**Keywords:** benthic/ community/ crude oil/ dispersant/ experiment/ infauna/ intertidal/ marine invertebrate/ ODfour/ oil/ oil spill/ population/ salt water/ sampling/ spill/ structure/ time/ treatment
**Notes:** A field experiment involving three large intertidal sampling plots in a Long Cove, Searsport, ME. The plots contained both upper and lower intertidal sampling sites and were exposed to either no oil, crude oil, or chemically-dispersed (dispersant unidentified) crude oil. Benthic infauna were sampled before treatment and six times during the following year. Infauna were identified and enumerated.

**Gilfillan, E. S., N. P. Maher, C. M. Krejsa, M. E. Lanphear, C. D. Ball, J. B. Meltzer, D. S. Page**, 1995. Use of remote sensing to document changes in marsh vegetation following the *Amoco Cadiz* oil spill (Brittany, France, 1978). Marine Pollution Bulletin **30**:780-787.
**Keywords:** Amoco Cadiz/ France/ marine plant/ oil/ oil spill/ oiled/ Osix/ photograph/ salt water/ sediment/ spill/ vegetation
**Notes:** Two areas of coastal marsh were heavily oiled by the *Amoco Cadiz* oil spill in 1978. One was subjected to sediment removal by heavy equipment and the other was never cleaned. Aerial photographs from before and after the spill (1971 and 1990 for the cleaned and 1971 and 1987 for the uncleaned) were compared to quantify changes in amount of vegetative cover and type of vegetation (low, mid, or high marsh).

**Gilfillan, E. S., E. J. Harner, J. E. O'Reilly, D. S. Page, W. A. Burns**, 1999. A comparison of shoreline assessment study designs used for the *Exxon Valdez* oil spill. Marine Pollution Bulletin **38**:380-388.
**Keywords:** analysis/ effects/ evaluation/ Exxon Valdez/ marine invertebrate/ marine plant/ methods/ oil/ oil spill/ Onine/ Prince William Sound/ shoreline/ spill/ statistics/ technical
**Notes:** An evaluation of the study designs of three study programs that assessed the effects of the *Exxon Valdez* oil spill on shoreline biota in Prince William Sound for 1990. Evaluated objectives, design characteristics, analysis methods, and statistical power.

**Gill, D. A.** 1994. Environmental disaster and fishery co-management in a natural resource community: impacts of the *Exxon Valdez* oil spill. Pages 207-235 *in* C. L. Dyer, J. R. McGoodwin, editors. Folk Management in the World's Fisheries. University Press of Colorado, Boulder.
**Keywords:** commercial fishing/ community/ crude oil/ economy/ Exxon Valdez/ fish/ fishery/ humans/ natural resource/ oil/ oil spill/ Othree/ salt water/ society/ spill/ structure
**Notes:** Assessment of the disruption of commercial fishing caused by the Exxon Valdez oil spill; consequences to fishermen and their social and economic structures.

**Gill, S. D.** 1977. Dispersant field trials in Canadian waters. Pages 391-394 *in* 1977 Oil Spill Conference. American Petroleum Institute, Washington, D.C.
**Keywords:** Canada/ condition/ dispersant/ effectiveness/ ODnine/ oil/ oil spill/ salt water/ spill/ technical/ temperature
**Notes:** Dispersant field trials were held in Canada during the summer of 1975 and the winter of 1976. Five chemical dispersants were tested under a variety of weather conditions and apparatus configurations involving the Warren Springs apparatus.

**Gilroy, D. J.**, 2000. Derivation of shellfish harvest reopening criteria following the New Carissa oil spill in Coos Bay, Oregon. Journal of Toxicology and Environmental Health, Part A **60**:317-329.
**Keywords:** clam/ coast/ concentration/ criteria/ diesel/ diesel fuel/ fuel oil/ harvest/ light/ marine invertebrate/ miscellaneous/ mussel/ Oeleven/ oil/ oil spill/ oyster/ PAH/ shellfish/ spill
**Notes:** Derivation of risk-based criteria for reopening shellfish harvesting after a large spill of light diesel fuel and heavy fuel oil on the coast of Oregon. Sampled oysters, clams, and mussels; analyzed them for PAH concentrations; and used the results in the assessment process.

**Gin, K. Y. H., M. K. Huda, W. K. Lim, P Tkalich**, 2001. An oil spill-food chain interaction model for coastal waters. Marine Pollution Bulletin **42**:590-597.
**Keywords:** dispersant/ fate/ fish/ food/ food chain/ marine invertebrate/ marine plant/ miscellaneous/ model/ ODeleven/ oil/ oil spill/ phytoplankton/ plankton/ sediment/ simulation/ Singapore/ spill/ transport/ water column/ zooplankton
**Notes:** Authors combine an oil spill fate and transport model and a food chain model and apply it to a recent oil spill in the Singapore Strait. The combined model was validated with a 2-dimensional simulation, the addition of an oil dispersant to the 2-dimensional simulation, and with a 3-dimensional hydrodynamic model of the Singapore Strait.

**Glegg, G. A., S. J. Rowland**, 1996. The *Braer* oil spill -- hydrocarbon concentrations in intertidal organisms. Marine Pollution Bulletin **32**:486-492.
**Keywords:** aromatic hydrocarbons/ bivalve/ concentration/ hydrocarbons/ intertidal/ marine invertebrate/ Ofour/ oil/ oil spill/ salt water/ Shetland/ species/ spill/ tissue
**Notes:** Determination of the concentrations of selected aromatic hydrocarbons in two bivalve species collected at five locations near the site of the *Braer* oil spill in Shetland, British Isles. Bivalves sampled at 1 wk, 3 mo, 6 mo, and 15 mo post spill. Tissue analyzed for 4-6 selected mono, di, and triaromatics.

**Glegg, G. A., L. Hickman, S. J. Rowland**, 1999. Contamination of limpets (*Patella vulgata*) following the *Sea Empress* oil spill. Marine Pollution Bulletin **38**:119-125.
**Keywords:** aromatic hydrocarbons/ coast/ crude oil/ England/ evaluation/ fuel oil/ hydrocarbons/ limpet/ marine invertebrate/ naphthalene/ Ofour/ oil/ oil spill/ phenanthrene/ salt water/ Shetland/ spill/ tanker/ time
**Notes:** Limpets were sampled 2 wk, 4 mos, and 7 mos after the grounding of the *Sea Empress* oil tanker near Milford Haven, England in February 1996. Limpets were collected at four sites and analyzed for naphthalenes and phenanthrenes. Results were compared to the results from a similar evaluation performed after the *Braer* oil spill off the coast of Shetland in 1993. An effort was made to identify the source of the hydrocarbons.

**Gochfeld, M.**, 1979. Prevalence of oiled plumage of terns and skimmers on western Long Island, New York: baseline data prior to petroleum exploration. Environmental Pollution **20**:123-129.
**Keywords:** bird/ colony/ New York/ oiled/ Oone/ petroleum/ plumage/ salt water/ skimmer/ tern
**Notes:** Incidence of plumage oiling for common terns and black skimmers in colonies on western Long Island.

**Goethe, F.**, 1968. The effects of oil pollution on populations of marine and coastal birds. Helgolander Wissenschaftliche Meeresuntersuchungen **17**:370-374.
**Keywords:** bird/ crude oil/ effects/ Europe/ oil/ oil spill/ Oone/ pollution/ population/ refined oil/ salt water/ spill
**Notes:** General comments and several specific descriptions of oil spills in western Europe.

**Gogot, B. K., N. N. Dutta, P. Goswami, T. R. Krishna Mohan**, 2003. A case study of bioremediation of petroleum-hydrocarbon contaminated soil at a crude oil spill site. Advances in Environmental Research **7**:767-782.
**Keywords:** aromatic hydrocarbons/ bioremediation/ crude oil/ degradation/ development/ India/ microbes/ oil/ oil field/ oil spill/ Oten/ petroleum/ procedure/ resin/ soil/ spill/ surfactant
**Notes:** Development of procedures for the bioremediation of contaminated oil field soils in India. Five samples of soil were analyzed for saturates, aromatics, resins, and asphaltines; soil chemical properties;

and microbial content. Cultures of selected bacterial groups were tested for their petroleum degradation potential. Trials involved enhancement of desorption (biosurfactant, synthetic surfactant) and degradation (bacterial consortia, nutrient addition, aeration) enhancement. Cultures were run for 60 da in the lab and > 300 da in field trials.

**Goksoyr, A., T. S. Solberg, B. Serigstad**, 1991. Immunochemical detection of cytochrome P450IA1 induction in cod larvae and juveniles exposed to a water soluble fraction of North Sea crude oil. Marine Pollution Bulletin **22**:122-127.
**Keywords:** cod/ concentration/ crude oil/ detection/ eggs/ fish/ juvenile/ larvae/ metabolism/ mixed-function oxidase/ North Sea/ North Sea crude oil/ oil/ Othree/ salt water/ solubility
**Notes:** Mixed-function oxidase response of cod eggs, larvae, and juveniles to variable concentrations of the water-soluble fraction of North Sea crude oil; exposure for 1 to 6 weeks.

**Gold-Bouchot, G., R. Sima-Alvarez, O. Zapata-Perez, J. Guemez-Ricalde**, 1995. Histopathological effects of petroleum hydrocarbons and heavy metals on the American oyster (*Crassostrea virginica*) from Tabasco, Mexico. Marine Pollution Bulletin **31**:4-12.
**Keywords:** condition/ effects/ Gulf of Mexico/ hydrocarbons/ index/ length/ lesions/ marine invertebrate/ metals/ Mexico/ Ofour/ oyster/ particulate/ pathology/ petroleum/ petroleum hydrocarbons/ salinity/ salt water/ shell/ tissue/ weight
**Notes:** Effort to relate histopathologic tissue lesions of oysters to contaminants and salinity at three coastal lagoons in the Mexican state of Tabasco (Gulf of Mexico). Collected oysters during Jun., Sept., and Nov. of 1992 and May of 1993. Measured soft tissue weight, shell length, and a condition index of oysters, as well as salinity at the collection site. Four classes of tissue examined for histologic lesions. Analyzed tissue for petroleum hydrocarbons, six metals, and particulate matter.

**Goldsworthy, S. D., R. P. Gales, M. Giese, N. Brothers**, 2000. Effects of the *Iron Baron* oil spill on little penguins (*Eudyptula minor*). I. Estimates of mortality. Wildlife Research **27**:559-571.
**Keywords:** activity/ bird/ coast/ colony/ effects/ estimate/ evaluation/ oil/ oil spill/ oiled/ Oone/ penguin/ population/ procedure/ reproduction/ salt water/ spill/ survey/ survival/ time/ transect
**Notes:** One part of a three part assessment of the effects of the *Iron Baron* oil spill on penguins in coastal Tasmania. The evaluation was performed on Ninth Island off the Tasmanian coast. Investigators employed transects, funnel traps, and a mark-recapture procedure to estimate the incidence of oiling and colony activities. The colony was survey in 1986 and then three times (1995-96) after the July 1995 spill.

**Golet, G. H., P. E. Seiser, A. D. McGuire, D. D. Roby, J. B. Fischer, K. J. Kuletz, D. B. Irons, T. A. Dean, S. C. Jewett, S. H. Newman**, 2002. Long-term direct and indirect effects of the 'Exxon Valdez' oil spill on pigeon guillemots in Prince William Sound, Alaska. Marine Ecology Progress Series **241**:287-304.
**Keywords:** adult/ Alaska/ analysis/ biochemical/ biochemistry/ bird/ blood/ chicks/ condition/ Exxon Valdez/ growth/ guillemot/ liver/ long-term/ oil/ oil spill/ oiled/ Oone/ population/ Prince William Sound/ salt water/ spill/ time
**Notes:** A major study of the residual effects of the Exxon Valdez oil spill on pigeon guillemots. An oiled study site in central Prince William Sound (PWS) was compared to an unoiled site in southwest PWS. The oiled site was studied for 5 yrs prior to the spill (1978-81, 1984) and for 8 yrs after the spill (1989-90, 1994-99). The unoiled site was studied for 6 yrs after the spill (1993-98). Investigators censused populations, collected livers from chicks for cytochrome P450 induction, collected blood from adults for biochemical analysis; and determined body condition of adults, prey availability, chick growth, and reproductive success.

**Gomez Gesteira, J. L., J.-C. Dauvin**, 2000. Amphipods are good bioindicators of the impact of oil spills on soft-bottom macrobenthic communities. Marine Pollution Bulletin **40**:1017-1027.
**Keywords:** abundance/ Aegean Sea/ Amoco Cadiz/ amphipod/ benthic/ community/ crude oil/ France/ habitat/ marine invertebrate/ mollusc/ Ofour/ oil/ oil spill/ polychaete/ population/ ratio/ salt water/ Spain/ spill/ time
**Notes:** A comparison of the macrobenthos in soft-bottom coastal habitats affected by the *Amoco Cadiz* crude oil spill in France (1978) and the *Aegean Sea* crude oil spill in Spain (1992). In France, benthic samples were collected four to six times per year (8/77 to 3/82) at one site and monthly (4/78 to 3/82) at a

second site. In Spain, samples were collected at five sites; monthly from 12/92 to 11/93, three times in 1994, eight times in 1995, and four times in 1996. Macrobenthos were identified and evaluated as total abundance, crustacea abundance, polychaete abundance, mollusc abundance, and polychaete/amphipod ratio.

**Gomez Gesteira, J. L., J. C. Dauvin, M. Salvande Fraga**, 2003. Taxonomic level for assessing oil spill effects on soft-bottom sublittoral benthic communities. Marine Pollution Bulletin **46**:562-572.
**Keywords:** Amoco Cadiz/ benthic/ community/ crude oil/ diversity/ effects/ France/ marine invertebrate/ multivariate/ oil/ oil spill/ Onine/ salt water/ Spain/ species/ spill/ sublittoral/ taxonomy/ technical
**Notes:** Authors sampled sublittoral benthic communities for 4 yrs after the *Aegean Sea* (Galicia, Spain) and *Amoco Cadiz* (Brittany, France) crude oil spills. Organisms were classified according to species, genus, and family; diversity indicies were calculated, and multivariate analyses were performed.

**Gonzalez, C., A. V. Botello, G. Diaz**, 1992. Presence of aliphatic hydrocarbons in sediments and organisms from Campeche Bank, Mexico. Marine Pollution Bulletin **24**:267-270.
**Keywords:** aliphatic hydrocarbons/ coast/ fish/ hydrocarbons/ marine invertebrate/ Mexico/ miscellaneous/ Oeleven/ offshore/ salt water/ sediment/ shrimp
**Notes:** Twenty-two samples of sediment and two samples each of fish and shrimp were collected from the offshore waters of the Campeche Bank and analyzed for aliphatic hydrocarbons. Several GC tracings are also shown.

**Gooday, G. W.**, 1980. *Convoluta roscoffensis* and the *Amoco Cadiz* oil spill. Marine Pollution Bulletin **11**:101-103.
**Keywords:** abundance/ Amoco Cadiz/ beach/ biomass/ colony/ crude oil/ density/ intertidal/ marine invertebrate/ Ofour/ oil/ oil spill/ population/ protein/ salt water/ species/ spill/ time
**Notes:** The populations of an intertidal flatworm at a beach affected by the Amoco Cadiz oil spill of 1978 were evaluated by comparing prespill (1976) data with postspill data (mid-1978). Measured abundance of colonies and species density within colonies at nine sites; one site was also characterized by measuring protein content, protein biomass, time of air exposure, and nearest spring tide.

**Gordon, J. C.**, 1929. No title (letter). Bird Notes and News **13**:175.
**Keywords:** bird/ oil/ oil spill/ Oone/ salt water/ Scotland/ spill
**Notes:** Report of bird deaths from an oil spill in Scotland.

**Gorman, M. L., C. E. Simms**, 1978. Lack of effect of ingested Forties Field crude oil on avian growth. Marine Pollution Bulletin **9**:273-276.
**Keywords:** bird/ chicks/ crude oil/ duckling/ Forties Field crude oil/ fresh water/ growth/ gull/ herring/ herring gull/ oil/ Oone
**Notes:** Report of no effect on growth of chicks, ducklings, and herring gull chicks as a result of dosing with Forties Field crude oil.

**Gorsline, J., W. N. Holmes**, 1981. Effects of petroleum on adrenocortical activity and on hepatic nathpthalene-metabolizing activity in mallard ducks. Archives of Environmental Contamination and Toxicology **10**:765-777.
**Keywords:** activity/ bird/ crude oil/ diet/ duck/ effects/ fresh water/ ingestion/ Louisiana/ Louisiana crude oil/ mallard/ oil/ Oone/ petroleum/ physiology/ South Louisiana crude oil
**Notes:** Physiological effects of ingestion of South Louisiana crude oil in diet for periods up to 500 days.

**Gorsline, J., W. N. Holmes, J. Cronshaw**, 1981. The effects of ingested petroleum on the naphthalene-metabolizing properties of liver tissue in seawater-adapted mallard ducks (*anas platyrhynchos*). Environmental Research **24**:377-390.
**Keywords:** bird/ crude oil/ diet/ duck/ effects/ Kuwait/ Kuwait crude oil/ liver/ Louisiana/ mallard/ oil/ Oone/ petroleum/ Prudhoe Bay/ Prudhoe Bay crude oil/ salt water/ Santa Barbara crude oil/ South Louisiana crude oil/ tissue
**Notes:** Effects on liver of mallards receiving diets containing South Louisiana, Kuwait, Prudhoe Bay, or two types of Santa Barbara crude oil for 50 days.

**Gorsline, J., W. N. Holmes**, 1982. Adrenocortical function and hepatic naphthalene metabolism in mallard ducks (*Anas platyrhynchos*) consuming petroleum distillates. Environmental Research **28**:139-146.
**Keywords:** bird/ crude oil/ diet/ duck/ effects/ fresh water/ Louisiana/ Louisiana crude oil/ mallard/ metabolism/ naphthalene/ oil/ Oone/ petroleum/ physiology/ South Louisiana crude oil
**Notes:** Physiological effects of four distillate fractions of South Louisiana crude oil in the diet on mallard ducks.

**Gorsline, J., W. N. Holmes**, 1982. Variations with age in the adrenocortical responses of mallard ducks (*Anas platyrhynchos*) consuming petroleum-contaminated food. Bulletin of Environmental Contamination and Toxicology **29**:146-152.
**Keywords:** age/ bird/ crude oil/ diet/ duck/ effects/ food/ fresh water/ Louisiana/ Louisiana crude oil/ mallard/ oil/ Oone/ physiology/ South Louisiana crude oil
**Notes:** Physiological effects on mallards of different ages (all less than 1 year) of South Louisiana crude oil in the diet; adrenocortical response.

**Gorsline, J., W. N. Holmes**, 1982. Suppression of adrenocortical activity in mallard ducks exposed to petroleum-contaminated food. Archives of Environmental Contamination and Toxicology **11**:497-502.
**Keywords:** activity/ bird/ crude oil/ diet/ duck/ effects/ food/ fresh water/ Louisiana/ Louisiana crude oil/ mallard/ oil/ Oone/ physiology/ South Louisiana crude oil
**Notes:** Physiological effects on mallard ducks of South Louisiana crude oil in the diet; suppression of adrenocortical activity.

**Gorsline, J., W. N. Holmes**, 1982. Ingestion of petroleum by breeding mallard ducks: some effects on neonatal progeny. Archives of Environmental Contamination and Toxicology **11**:147-153.
**Keywords:** bird/ crude oil/ diet/ duck/ duckling/ effects/ female/ fresh water/ ingestion/ Louisiana/ mallard/ oil/ Oone/ petroleum/ physiology/ Prudhoe Bay/ Prudhoe Bay crude oil/ South Louisiana crude oil
**Notes:** Physiological effects on breeding female mallards of South Louisiana and Prudhoe Bay crude oils in the diet; induction of similar physiological effects in ducklings.

**Gorsline, J.** 1982. The effects of South Louisiana crude oil on adrenocortical function. Pages 359-364 *in* C. G. Scanes, M. A. Ottinger, A. D. Kenny, J. Balthazart, J. Cronshaw, I. C. Jones, editors. Aspects of Avian Endocrinology: Practical and Theoretical Implications. Graduate Studies, Texas Tech University. Texas Tech Press, Lubbock, Texas.
**Keywords:** activity/ adrenal/ biochemistry/ bird/ crude oil/ duck/ effects/ fresh water/ Louisiana/ Louisiana crude oil/ mallard/ mixed-function oxidase/ oil/ Oone/ physiology/ South Louisiana crude oil/ steroid/ Texas
**Notes:** Discussion of the effect of ingested South Louisiana crude oil on adrenocortical function and mixed function oxidase activity in mallard ducks.

**Gough, M. A., S. J. Rowland**, 1990. Characterization of unresolved complex mixtures of hydrocarbons in petroleum. Nature **344**:648-650.
**Keywords:** alkane/ analysis/ biodegradation/ hydrocarbons/ methods/ oil/ Onine/ petroleum/ refined oil/ sand/ saturated hydrocarbons/ technical/ unresolved complex mixture
**Notes:** A chemical assessment of the unresolved complex mixture (UCM) of saturated hydrocarbons. Eight oils, including crudes, refined oils, spilled oil, and oil sand were subject to GC-MS analytical methods. Investigators synthesized linear and branched alkanes and subjected them to biodegradation. Also assessed the molecular consequences of oxidation of UCM components.

**Graham, R. J., T. C. Dorris**, 1968. Long-term toxicity bioassay of oil refinery effluents. Water Research **2**:643-663.
**Keywords:** bioassay/ effluent/ fathead minnow/ fish/ flow-through/ fresh water/ long-term/ oil/ Othree/ refinery/ survival/ toxicity
**Notes:** Toxicity assessment (survival) of four oil refinery effluents, using fathead minnows, flow-through bioassays, and exposure periods of 4 days and 32 days.

**Gramentz, D.**, 1988. Involvement of loggerhead turtle with the plastic, metal, and hydrocarbon pollution in the central Mediterranean. Marine Pollution Bulletin **19**:11-13.
**Keywords:** litter/ Mediterranean/ metals/ oil/ OthreeR/ plastic/ pollution/ reptile/ salt water/ spill/ turtle
**Notes:** Examination of 99 loggerhead turtles caught by fishermen near the island of Malta for evidence of exposure to oil and plastic and metal litter.

**Granby, K., N. H. Spliid**, 1995. Hydrocarbons and organochlorines in common mussels from the Kattegat and the Belts and their relation to condition indices. Marine Pollution Bulletin **30**:74-82.
**Keywords:** aromatic hydrocarbons/ condition/ Denmark/ hydrocarbons/ index/ length/ lipid/ marine invertebrate/ mussel/ North Sea/ Ofour/ organochlorines/ petroleum/ petroleum hydrocarbons/ salt water/ saturated hydrocarbons/ shell/ tissue/ weight
**Notes:** Common mussels were sampled at 26 sites in the waters east of Denmark (Baltic & North Sea interface) and analyzed for petroleum hydrocarbons and organochlorine compounds. Measured shell length, dry weight of tissue, lipid content, saturated hydrocarbons, aromatic hydrocarbons, chlorinated hydrocarbons, and calculated a condition index.

**Grant, A., A. D. Briggs**, 2002. Toxicity of sediments from around a North Sea oil platform: are metals or hydrocarbons responsible for ecological impacts? Marine Environmental Research **53**:116.
**Keywords:** amphipod/ concentration/ cuttings/ depth/ distance/ evaluation/ hydrocarbons/ marine invertebrate/ metals/ Microtox/ North Sea/ Ofour/ oil/ oil platform/ polychaete/ rate/ salt water/ sampling/ sediment/ survival/ toxicity/ transect
**Notes:** An evaluation of the cause of toxicity produced by drill cuttings around a North Sea oil platform. Sediments were sampled from two parallel transects at various distances from the platform and brought into the laboratory. Microtox toxicity (15 min) was determined at up to five sediment depths per sampling station. An amphipod and a polychaete were used to test for toxicity (10 da) of a number of dilutions of the surface (0-5 cm) sediment. Measured $EC_{50}$ for the Microtox, survival for the amphipod and polychaete, casting rate for the polychaete, metal concentrations, and total hydrocarbon concentrations.

**Grassle, J. F., R. Elmgren, J. P. Grassle**, 1981. Response of benthic communities in MERL experimental ecosystems to low level, chronic additions of No. 2 fuel oil. Marine Environmental Research **4**:279-297.
**Keywords:** benthic/ chronic/ community/ concentration/ density/ ecosystem/ effects/ fuel oil/ hydrocarbons/ macrofauna/ meiofauna/ No.2 fuel oil/ oil/ petroleum/ petroleum hydrocarbons/ recovery/ sediment/ species
**Notes:** Effects on sediment macrofauna and meiofauna of chronic exposure to No. 2 fuel oil was determined through the use of experimental marine ecosystems. Oil-water dispersions were added periodically to the water over a 25 wk period followed by an 8 wk recovery period. Measured density of macrofauna and meiofauna species and concentration of petroleum hydrocarbons in water and sediment.

**Grau, C. R., T. Roudybush, J. Dobbs, J. Wathen**, 1977. Altered yolk structure and reduced hatchability of eggs from birds fed single doses of petroleum oils. Science **195**:779-781.
**Keywords:** bird/ Bunker C/ Canada/ Canada geese/ chicken/ crude oil/ effects/ egg yolk/ eggs/ fresh water/ fuel oil/ hatchability/ Japanese quail/ Kuwait/ Kuwait crude oil/ Louisiana/ oil/ Oone/ petroleum/ petroleum oil/ quail/ South Louisiana crude oil/ structure
**Notes:** Report of the effects on yolk deposition in Japanese quail, Canada geese, and chickens of single oral doses of South Louisiana and Kuwait crude oils, Bunker C fuel oil, or No. 2 fuel oil.

**Gray, J. S., K. R. Clarke, R. M. Warwick, G. Hobbs**, 1990. Detection of initial effects of pollution on marine benthos: an example from the Ekofisk and Eldfisk oilfields, North Sea. Marine Ecology Progress Series **66**:285-299.
**Keywords:** benthic/ detection/ effects/ marine invertebrate/ multivariate/ North Sea/ Ofour/ oil/ oil field/ oil platform/ pollution/ salt water/ sampling/ species/ transect
**Notes:** Effects of contamination from oil drilling platforms in two oilfields in the North Sea on marine benthic organisms. Established sampling transects radiating away from the oil platforms. Used multivariate techniques to detect changes caused by contamination. Applied technique to species and higher taxonomic groups.

**Gregg, J. C., J. W. Fleeger, K. R. Carman**, 1997. Effects of suspended, diesel-contaminated sediment on feeding rate in the darter goby, *Gobionellus boleosoma* (Teleostei: Gobiidae). Marine Pollution Bulletin **34**:269-275.
**Keywords:** diesel/ diesel fuel/ effects/ estuarine/ feeding/ fish/ Othree/ rate/ salt water/ sediment
**Notes:** Effects of sediments contaminated with diesel fuel on feeding by a small bottom-feeding estuarine fish.

**Gregory, D. G., W. C. Edwards**, 1991. Investigating oiled birds from oil field waste pits. Veterinary and Human Toxicology **33**:497-498.
**Keywords:** bird/ fresh water/ oil/ oil field/ oiled/ Oklahoma/ Oone/ waste oil
**Notes:** Report of the the laboratory work supporting an investigation of deaths of birds in oil field waste pits in Oklahoma.

**Griffin, L. F., J. A. Calder**, 1977. Toxic effect of water-soluble fractions of crude, refined, and weathered oils on the growth of a marine bacterium. Applied Environmental Microbiology **33**:1092-1096.
**Keywords:** aromatic hydrocarbons/ bacteria/ Bunker C/ concentration/ crude oil/ evaluation/ Florida J crude oil/ growth/ hydrocarbons/ Kuwait crude oil/ No.2 fuel oil/ oil/ refined oil/ South Louisiana crude oil/ weathered
**Notes:** Evaluation of the toxic effect of water-soluble fractions of three crude and two refined oils to a marine bacterium in batch culture. One crude and one refined oil were 'weathered' and also tested on the bacterium. Measured bacterium growth and the concentration of selected aromatic hydrocarbons in the water-soluble fractions.

**Griffiths, R. P., T. M. McNamara, B. A. Caldwell, R. Y. Morita**, 1981. A field study on the acute effects of the dispersant Corexit 9527 on glucose uptake by marine microorganisms. Marine Environmental Research **5**:83-91.
**Keywords:** acute/ concentration/ Corexit 9527/ crude oil/ dispersant/ effects/ glucose/ marine invertebrate/ ODfour/ oil/ Prudhoe Bay/ Prudhoe Bay crude oil/ respiration/ salt water/ sediment/ uptake
**Notes:** Assessment of the effects of Corexit 9527 alone or combined with Prudhoe Bay crude oil on glucose uptake or respiration by marine microorganisms in water and sediment. A total of 149 water and 95 sediment samples were collected and tested. Concentration of Corexit 9527 ranged from 0 to 100 ppm.

**Griffiths, R. P., B. A. Caldwell, W. A. Broich, R. Y. Morita**, 1982. The long-term effects of crude oil on microbial processes in subarctic marine sediments. Estuarine and Coastal and Shelf Science **15**:183-198.
**Keywords:** Cook Inlet crude oil/ crude oil/ effects/ experiment/ long-term/ microbes/ nitrogen/ oil/ Oten/ redox potential/ salt water/ sediment/ time/ weathered
**Notes:** Assessment of the effects of Cook Inlet crude oil on microbes in sediment. Sediment collected from Kachemak Bay proper, mixed with 50 ppt crude oil, and used in several experiments. Some samples were returned to their site of collection and monitored for up to 18 mo. Other sediment was used to 'overlay' clean sediment and similarly returned to the collection site. Aquaria in a flowing seawater system were used for several experiments involving fresh and weathered crude oil for varying periods of time. Measured nitrogen fixation, denitrification, redox potential, $CO_2$ production, and methane production.

**Griffiths, R. P., B. A. Caldwell, W. A. Broich, R. Y. Morita**, 1982. Long-term effects of crude oil on microbial processes in subarctic marine sediments. Studies on sediments amended with organic nutrients. Marine Pollution Bulletin **13**:273-278.
**Keywords:** Alaska/ Cook Inlet crude oil/ crude oil/ effects/ long-term/ microbes/ nutrients/ oil/ organic/ Oten/ salt water/ sediment
**Notes:** Effects of Cook Inlet crude oil on microbes in sediments amended with organic nutrients. Sediments collected from several sites in Kachemak Bay proper, amended with starch, cellulose, chitin, or seaweed and mixed with 50 ppt crude oil. Sediments returned to collection site and retrieved 6 or 8 mo later. Measured 11 or 13 microbial processes.

**Groff, J. M., J. E. Blake, B. Rideout, R. Basaraba, and D. Wilson** 1990. Necropsy observations in Alaskan sea otters (*Enhydra lutis*) from Prince William Sound affected by the Exxon Valdez oil spill.

Pages 31-32 *in* Annual Meeting of the International Association of Aquatic Animal Medicine, 21.
**Keywords:** Alaska/ crude oil/ Exxon Valdez/ fur/ mammal/ necropsy/ oil/ oil spill/ oiled/ Otwo/ pathology/ physiology/ Prince William Sound/ Prudhoe Bay crude oil/ rehabilitation/ salt water/ sea otter/ spill
**Notes:** Report of the necropsy results for 78 Alaskan sea otters killed by the Exxon Valdez spill or dying in rehabilitation centers.

**Gross, A. O.** 1951. The herring gull - cormorant control project. Pages 532-536 *in* Sven Horstadius, editor. Proceedings of the Xth International Ornithological Congress, Uppsala, June 1950. Almqvist & Wiksell, Uppsala, Sweden.
**Keywords:** bird/ cormorant/ eggs/ England/ gull/ herring/ herring gull/ New England/ oiled/ Oone/ population/ population control/ salt water
**Notes:** Description of a population control project for herring gulls and cormorants in New England; use of a water-oil-formalin mixture sprayed on the eggs.

**Grossi, V., D. Massias, G. Stora, J.-C. Bertrand**, 2002. Burial, exportation and degradation of acyclic petroleum hydrocarbons following a simulated oil spill in bioturbated Mediterranean coastal sediments. Chemosphere **48**:947-954.
**Keywords:** Arabian Light crude oil/ benthic/ concentration/ crude oil/ degradation/ depth/ France/ hydrocarbons/ incubation/ infauna/ marine invertebrate/ Mediterranean/ microbes/ movement/ oil/ oil spill/ Oten/ petroleum/ petroleum hydrocarbons/ salt water/ sampling/ saturated hydrocarbons/ sediment/ spill/ time
**Notes:** Sediment cores at the bottom of the Gulf of Fos (France) were used to determine the influence of benthic infauna on the movement of petroleum into the sediment. One group of cores was contaminated with a petroleum 'cake' (sediment plus Arabian light crude oil), a second set was similarly contaminated but with fluorescent particles added as tracers, and a third set with sediment-only cake. In situ incubation lasted for 12 mos with sequential sampling of cores at 2, 6, and 12 mos. Presence of fluorescent particles and concentration of saturated hydrocarbons at depth were measured.

**Gruger, E. H., Jr., M. M. Wekell, T. Numoto, D. R. Craddock**, 1977. Induction of hepatic aryl hydrocarbon hydroxylase in salmon exposed to petroleum dissolved in seawater and to petroleum and polychlorinated biphenyls, separate and together, in food. Bulletin of Environmental Contamination and Toxicology **17**:512-520.
**Keywords:** crude oil/ dissolved/ effects/ fish/ food/ hydrocarbons/ metabolism/ oil/ Othree/ PCB/ petroleum/ Prudhoe Bay/ Prudhoe Bay crude oil/ salmon/ salt water
**Notes:** Effects on induction of aryl hydrocarbon hydroxylase in coho salmon by exposure to Prudhoe Bay crude oil (dispersed or dissolved in water or incorporated in food); food incorporation was with or without PCBs.

**Grujic, S., B. Jovancicevic, P. Polic, H. Wehner**, 2003. Biomarkers of oil-type pollutants in surface soil. Fresenius Environmental Bulletin **12**:359-363.
**Keywords:** aromatic hydrocarbons/ biomarker/ cycloalkane/ depth/ hydrocarbons/ microbes/ Onine/ petroleum/ soil/ sterane/ technical/ triterpane
**Notes:** Samples of soil at two depths were collected next to a bomb crater filled with unknown petroleum product and from a site 100 m distant. Samples were analyzed for *n*-alkanes, aromatic hydrocarbons, and sterane and triterpane cycloalkanes.

**Gruttner, H., K. Jensen**, 1983. Effects of chronic oil pollution from refinery effluent on sediment microflora in a Danish coastal area. Marine Pollution Bulletin **14**:456-459.
**Keywords:** abundance/ alkane/ assay/ bacteria/ chronic/ concentration/ Denmark/ discharges/ effects/ effluent/ fungi/ incubation/ microbes/ oil/ Oten/ petroleum/ pollution/ refinery/ salt water/ sediment/ transect/ waste water/ yeast
**Notes:** A refinery in Denmark annually discharges considerable waste water into a coastal inlet. Samples of surface sediment were collected from along a 12 km transect extending from the refinery discharge toward the sea. Alkanes in the sediment were quantified and the concentrations of heterotrophic bacteria, filamentous fungi, and yeasts were determined after laboratory incubation assays lasting from 1 wk to 2 mos. Microbe abundance was compared to the quantity of alkanes in the sediment.

**Gudin, C., W. J. Syratt**, 1975. Biological aspects of land rehabilitation following hydrocarbon contamination. Environmental Pollution **8**:107-112.
**Keywords:** aromatic hydrocarbons/ Europe/ farming/ fertilizer/ France/ freshwater plant/ land farming/ microbes/ Oten/ petroleum/ petroleum products/ petroleum waste/ plant/ rehabilitation/ soil/ survey/ vegetation
**Notes:** A set of studies that evaluates land farming of petroleum products and petroleum wastes. Studies included: (1) application of a paraffinic or aromatic residue to soil with or without N fertilizer and with or without plant cover, (2) four soil types at different locations received different types of petroleum products or wastes - one site was with or without N fertilizer, (3) a vegetation survey of 15 polluted (natural and anthropogenic) sites in Europe.

**Guerin, M. R., C.-h. Ho, T. K. Rao, B. R. Clark, J. L. Epler**, 1980. Polycyclic aromatic primary amines as determinant chemical mutagens in petroleum substitutes. Environmental Research **23**:42-53.
**Keywords:** aromatic hydrocarbons/ assay/ coal/ coal oil/ crude oil/ miscellaneous/ mutation/ Oeleven/ oil/ petroleum/ shale oil/ synthetic oil/ toxicity
**Notes:** A bacterial mutation assay with four types of crude oils, two types of shale oil, and five types of coal oil. Particular emphasis on the polycyclic aromatic primary amines.

**Guidetti, P., M. Modena, G. La Mesa, M. Vacchi**, 2000. Composition, abundance and stratification of macrobenthos in the marine area impacted by tar aggregates derived from the *Haven* oil spill (Ligurian Sea, Italy). Marine Pollution Bulletin **40**:1161-1166.
**Keywords:** abundance/ benthic/ community/ composition/ crude oil/ depth/ effects/ Iranian crude oil/ marine invertebrate/ Ofour/ oil/ oil spill/ oiled/ salt water/ sediment/ spill/ tanker/ taxonomy
**Notes:** An assessment of the effects of tar aggregates from heavy Iranian crude oil spilled by the tanker *Haven* on macrobenthos. Three oiled sites were compared to three unoiled sites. Sediment samples were divided into three depth layers. Qualitatively classified presence of tar aggregates and identified and counted benthic organisms according to depth layer.

**Guillen, G. J., D. Palafox**, 1985. The effects of weathered crude oil from the M/T Alvenus spill on eggs and yolk-sac larvae of red drum (*Sciaenops ocellatus*). Gulf Research Report **8**:15-20.
**Keywords:** abnormalities/ concentration/ crude oil/ development/ effects/ eggs/ fish/ larvae/ oil/ Othree/ salt water/ spill/ survival/ Venezuelan crude oil/ weathered
**Notes:** Effects on red drum eggs and larvae of exposure to weathered Venezuelan crude oil from the M/T Alvenus spill. Experimental exposure for approximately 4 days to varying concentrations of the weathered oil followed by assessment of survival, development, and abnormalities.

**Guiney, P. D., J. L. Sykora, G. Keleti**, 1987. Qualitative and quantitative analyses of petroleum hydrocarbon concentrations in a trout stream contaminated by an aviation kerosene spill. Environmental Toxicology and Chemistry **6**:105-114.
**Keywords:** aviation kerosine/ concentration/ fate/ fish/ fresh water/ kerosene/ Othree/ Pennsylvania/ petroleum/ petroleum hydrocarbons/ sediment/ species/ spill/ stream
**Notes:** Fate of aviation kerosene following a spill into a Pennsylvania stream; sediments sampled for 21 months, fish sampled for 7 months.

**Gundersen, D. T., S. W. Kristanto, L. R. Curtis, S. N. Al-Yakoob, M. M. Metwally, D. Al-Ajmi**, 1996. Subacute toxicity of the water-soluble fractions of Kuwait crude oil and partially combusted crude oil on *Menidia beryllina* and *Palaemonetes pugio*. Archives of Environmental Contamination and Toxicology **31**:1-8.
**Keywords:** crude oil/ fish/ growth/ Gulf oil spill/ Kuwait/ Kuwait crude oil/ marine invertebrate/ oil/ Othree/ salt water/ shrimp/ species/ subacute/ toxicity/ war
**Notes:** Comparative toxicity to a fish and a shrimp species of the water-soluble fraction of Kuwait crude oil and partially combusted crude oil; prompted by the extensive oil fires during the Gulf War (1991). Tests were run for 16 days and growth was measured.

**Gundlach, E. R., D. D. Domeracki, L. C. Thebeau**, 1982. Persistence of METULA oil in the Strait of Magellan six and one-half years after the incident. Oil & Petrochemical Pollution **1**:37-48.

**Keywords:** Arabian Light crude oil/ beach/ Bunker C/ crude oil/ degradation/ fuel oil/ gravel/ light/ Metula/ miscellaneous/ No.6 fuel oil/ Oeleven/ oil/ oil spill/ persistence/ pollution/ salt water/ sand/ shoreline/ spill/ tidal flat/ time/ weathered
**Notes:** An re-evaluation of shoreline pollution 6.5 yrs after the *Metula* oil spill (Arabian light crude oil and Bunker C fuel oil) in Patagonia and Tierra del Fuego. Sections on mixed sand and gravel beaches (exposed and sheltered), tidal flats (exposed and sheltered), and marshes.

**Gundlach, E. R., P. D. Boehm, M. Marchand, R. M. Atlas, D. M. Ward, D. A. Wolfe**, 1983. The fate of *Amoco Cadiz* oil. Science **221**:122-129.
**Keywords:** Amoco Cadiz/ aromatic hydrocarbons/ coast/ community/ concentration/ crude oil/ depth/ effects/ fate/ fish/ France/ general effect/ hydrocarbons/ invertebrate/ marine invertebrate/ miscellaneous/ Oeight/ oil/ oil slick/ persistence/ petroleum/ petroleum hydrocarbons/ population/ region/ review/ salt water/ saturated hydrocarbons/ sediment/ subtidal/ time
**Notes:** A review and assessment of the fate of the crude oil spilled from the *Amoco Cadiz* off the coast of Brittany, France. Presents GC tracings of saturated and aromatic hydrocarbons, hydrocarbon concentrations in sediment, temporal spread of the oil slick, sediment depth profile of saturated and aromatic hydrocarbons, and a table with the chronicological persistence of the oil in water, onshore, and in the subtidal regions. Also discusses the presence of petroleum hydrocarbons in fish and invertebrates and the observed effects on populations and communities.

**Gundlach, E. R.** 1987. Oil-holding capacities and removal coefficients for different shoreline types to computer simulate spills in coastal waters. Pages 451-457 *in* Proceedings 1987 Oil Spill Conference, API Publication 4452. American Petroleum Institute, Washington, D.C.
**Keywords:** beach/ estimate/ gravel/ oil/ oil spill/ Onine/ petroleum/ rate/ rocky shore/ salt water/ sand/ shoreline/ spill/ technical/ tidal flat/ wetland
**Notes:** An assessment of the petroleum retention characteristics and removal rates for rock, sand, and gravel beaches; tidal flats; and coastal wetlands. Author uses data from several major oil spills as the basis for estimates.

**Gunkel, W.** 1968. Bacteriological investigations of oil-polluted sediments from the Cornish coast following the *Torrey Canyon* disaster. Pages 151-158 *in* J. D. Carthy, D. R. Arthur, editors. The Biological effects of oil pollution on littoral communities: proceedings of a symposium held at the Orielton Field Centre, Pembroke, Wales, on 17th, 18th and 19th February 1968. Field Studies. Field Studies Council, London.
**Keywords:** abundance/ bacteria/ biological effects/ coast/ community/ effects/ littoral/ microbes/ oil/ oil spill/ Oten/ pollution/ salt water/ sediment/ spill/ survey/ Wales
**Notes:** Survey of microbe presence in sediments of the Cornish coast after the Torrey Canyon oil spill. Twenty-three samples collected from seven locations. Measured the quantity of oil-decomposing and total bacteria. A preliminary study resulting in only general conclusions about the response of sediment bacteria to the presence of oil and oil emulsifiers.

**Gunkel, W., G. Gassmann**, 1980. Oil, oil dispersants and related substances in the marine environment. Helgolander Meeresuntersuchungen **33**:164-181.
**Keywords:** analysis/ biological effects/ bird/ chemical analysis/ coral/ crude oil/ dispersant/ effects/ environment/ fate/ general effect/ long-term/ mammal/ marine environment/ marine invertebrate/ marine plant/ ODeight/ oil/ petroleum/ review/ salt water/ transport
**Notes:** A review of the presence and consequences of petroleum in the marine environment. Sections on production and transport of crude oil, oil input to the marine environment, fate of oil, oil dispersants, problems in chemical analysis, biological effects, field studies of long-term effects, carcinogenic substances, and conclusions.

**Gunster, D. G., N. L. Bonnevie, C. A. Gillis, J. J. Wenning**, 1993. Assessment of chemical loadings to Newark Bay, New Jersey from petroleum and hazardous chemical accidents occurring from 1986 to 1991. Ecotoxicology and Environmental Safety **25**:202-213.
**Keywords:** evaluation/ hazardous waste/ miscellaneous/ New Jersey/ Oeleven/ petroleum/ spill
**Notes:** A description and evaluation of hazardous materials spills in Newark Bay and its tributaries during 1986-91. Spill events broken down by volume and product.

**Gunster, D. G., C. A. Gillis, N. L. Bonnevie, T. B. Abel, R. J. Wenning**, 1993. Petroleum and hazardous chemical spills in Newark Bay, New Jersey, USA from 1982 to 1991. Environmental Pollution **82**:245-253.
**Keywords:** evaluation/ hazardous waste/ miscellaneous/ New Jersey/ Oeleven/ petroleum/ spill
**Notes:** A description and evaluation of petroleum and chemical spills in Neward Bay and it's major tributaries during the period 1982 to 1991. Spills are categorized according to location, volume, and type of material.

**Gurney, K. E., T. D. Williams, J. E. Smits, M. Wayland, S. Trudeau, L. I. Bendell-Young**, 2005. Impact of oil-sands based wetlands on the growth of mallard (*Anas platyrhynchos*) ducklings. Environmental Toxicology and Chemistry **24**:457-463.
**Keywords:** activity/ bile/ bird/ blood/ duckling/ foraging/ fresh water/ growth/ liver/ mallard/ metabolite/ oil sands/ Oone/ PAH/ plasma/ sand/ survival/ wetland
**Notes:** Ducklings (3 da old) were placed in pens (with shelters and feed) that extended into the water of two oil sands wetlands and a reference wetland. Multiple measures of growth were taken periodically during the next 33 days. Blood samples were collected at 13 and 33 days of age, and analyzed for plasma triglyceride and plasma glycerol. Survival was recorded and all ducklings were killed and necropsied at the end of the study. A sub-sample of the ducklings was immediately sampled for bile and a piece of liver. The bile was analyzed for PAH metabolites and the liver analyzed for EROD activity.

**Guzman, H. M., I. Holst**, 1993. Effects of chronic oil-sediment pollution on the reproduction of the Caribbean reef coral *Siderastrea siderea*. Marine Pollution Bulletin **26**:276-282.
**Keywords:** Caribbean/ chronic/ colony/ condition/ coral/ coral reef/ crude oil/ effects/ injury/ marine invertebrate/ Ofour/ oil/ oil spill/ oiled/ pollution/ reproduction/ salt water/ size/ spill
**Notes:** Assessment of the effect of a 1986 Panamanian crude oil spill on reproduction in a reef coral. The assessment was performed at four coral reefs, two oiled and two unoiled, between 39 and 54 mo post spill. Measured colony injury and size, and six characteristics of reproductive condition.

**Guzman, H. M., K. A. Burns, J. B. C. Jackson**, 1994. Injury, regeneration and growth of Caribbean reef corals after a major oil spill in Panama. Marine Ecology Progress Series **105**:231-241.
**Keywords:** behavior/ Caribbean/ coast/ coral/ coral reef/ crude oil/ effects/ growth/ hydrocarbons/ injury/ intertidal/ long-term/ marine invertebrate/ Ofour/ oil/ oil spill/ Panama/ petroleum/ petroleum hydrocarbons/ residual oil/ salt water/ seagrass/ sediment/ spill
**Notes:** Assessment of the long-term effects on reef corals of a large spill of crude oil on the Panamanian coast. The 1986 oil spill adversely affected intertidal mangroves, seagrass beds and reef flats. Authors conducted a 5-yr study of coral injury, regeneration, growth, behavior of residual oil, and petroleum hydrocarbons in sediment.

**Gyllenberg, G., G. Lundqvist**, 1976. Some effects of emulsifiers and oil on two copepod species. Acta Zoologica Fennica **148**:1-24.
**Keywords:** activity/ behavior/ combination/ concentration/ consumption/ copepod/ crude oil/ effects/ flow-through/ length/ lipid/ marine invertebrate/ ODfour/ oil/ oxygen/ petroleum/ respiration/ salt water/ species/ static/ survival
**Notes:** Assessment of the effects of two petroleum emulsifiers on two copepod species. Copepods were exposed in static and flow-through tests for up to 48 hr to emulsifiers alone or one emulsifier in combination with crude oil. Emulsifier concentrations varied from 10 to 10,000 ppm. Measured copepod behavior, survival, lipid content, oxygen consumption, and length of activity period.

**Hadley, D.**, 1977. Intra-and interspecific variability in tolerance of Southern California *Littorina planaxis* and *Littorina scutulata* to petroleum. Environmental Research **13**:186-208.
**Keywords:** bioassay/ California/ crude oil/ effects/ gasoline/ gastropod/ kerosene/ Kuwait/ Kuwait crude oil/ Louisiana/ Louisiana crude oil/ marine invertebrate/ Ofour/ oil/ petroleum/ rate/ recovery/ salt water/ Santa Barbara crude oil/ species/ static/ survival/ tolerance/ washing
**Notes:** Effects of gasoline, kerosene, Santa Barbara crude oil, Kuwait crude oil and Louisiana crude oil on two species of marine gastropods (Littorina sp.). Gastropods had direct contact with oil followed by 6

hr in a static bioassay, washing, and then 7 da in a clean water static bioassay. Measured survival and attachment rates during the exposure and recovery periods.

**Hagstrom, B. E., S. Lonning**, 1977. The effects of Esso Corexit 9527 on the fertilizing capacity of spermatozoa. Marine Pollution Bulletin **8**:136-138.
**Keywords:** Corexit 9527/ dispersant/ effects/ eggs/ fertilization/ marine invertebrate/ ODfour/ salt water/ sea urchin/ spermatozoa/ urchin
**Notes:** Assessment of the effect of Corexit 9527 on sea urchin spermatozoa. Exposed spermatozoa to 0.0003 to 1.5 ppm Corexit 9527 for 2 to 40 hr. Measured the ability of the exposed spermatozoa to fertilize sea urchin eggs.

**Haim, A., B. Nicolaisen, N. A. Oritsland**, 1984. Crude oil -- its impact on the rat's heat balance. Comparative Biochemistry and Physiology **78A**:259-261.
**Keywords:** consumption/ crude oil/ effects/ fur/ ingestion/ mammal/ metabolism/ oil/ oiled/ Otwo/ oxygen/ physiology/ rat/ temperature
**Notes:** Effects on oxygen consumption (heat production) and body temperature of laboratory rats caused by either ingestion or fur oiling with crude oil.

**Haines, J. R., R. M. Atlas**, 1982. *In situ* microbial degradation of Prudhoe Bay crude oil in Beaufort Sea sediments. Marine Environmental Research **7**:91-102.
**Keywords:** Alaska/ aliphatic hydrocarbons/ aromatic hydrocarbons/ bacteria/ Beaufort Sea/ biodegradation/ concentration/ crude oil/ degradation/ evaluation/ microbes/ oil/ Oten/ population/ Prudhoe Bay/ Prudhoe Bay crude oil/ rate/ salt water/ sediment/ time
**Notes:** An evaluation of the degradation rates of crude oil in Beaufort Sea sediments. Sediments were mixed with 5% Prudhoe Bay crude oil and placed in trays on the sea bottom. Trays were sampled at 0, 0.5, 24, 48, 72 hrs; 7, 14, 21, 28 da; 3, 4, 8 mo; 1, 1.5, 2 yr. Sediments were analyzed for total aliphatics, total aromatics, and selected aliphatic and aromatics. Populations of bacteria were quantified at total bacteria and hydrocarbon-utilizing bacteria. Also determined the nutrient concentration with the sediment.

**Hall, A. J., J. Watkins, L. Hiby**, 1996. The impact of the 1993 *Braer* oil spill on grey seals in Shetland. Science of the Total Environment **186**:119-125.
**Keywords:** coast/ crude oil/ grey seal/ mammal/ North Sea/ North Sea crude oil/ oil/ oil spill/ Otwo/ physiology/ respiration/ salt water/ seal/ Shetland/ spill/ tanker
**Notes:** A report of respiratory distress in grey seals following the grounding of the tanker Braer (North Sea crude oil) off the coast Shetland, 1993.

**Hall, L. W. Jr, A. L. Buikema, Jr., J. Cairns, Jr.**, 1978. The effects of a simulated refinery effluent on the grass shrimp, *Palaemonetes pugio*. Archives of Environmental Contamination and Toxicology **7**:23-35.
**Keywords:** age/ bioassay/ concentration/ effects/ effluent/ fish/ grass/ grass shrimp/ light/ marine invertebrate/ Ofour/ origin/ refinery/ salinity/ salt water/ sex/ shrimp/ size/ species/ survival/ temperature/ toxicity
**Notes:** Determination of the effect on four species (two genera) of grass shrimp and the pinfish of exposure to a simulated refinery effluent. Used four concentrations of effluent, five water temperatures, four light intensities, four photoperiods, and four salinities; survival was assessed at 4, 8, 24, 48, and 96 hrs. The investigators also determined the effects on survival of size, sex, and geographic origin of the shrimp. Bioassays were also performed to determine the relative toxicity of each of the six components of the simulated refinery effluent.

**Hall, R. J., A. A. Belisle, L. Sileo**, 1983. Residues of petroleum hydrocarbons in tissues of sea turtles exposed to the Ixtoc I oil spill. Journal of Wildlife Diseases **19**:106-109.
**Keywords:** coast/ crude oil/ hydrocarbons/ Ixtoc/ kidney/ liver/ Mexico/ naphthalene/ necropsy/ oil/ oil spill/ OthreeR/ pathology/ petroleum/ petroleum hydrocarbons/ reptile/ salt water/ saturated hydrocarbons/ spill/ Texas/ tissue/ turtle
**Notes:** Necropsy performed on three sea turtles (two green and one ridley) found dead after the Ixtoc I oil

reached the Texas coast. Necropsy results and analyses of saturated hydrocarbons plus naphthalene in liver and kidney of turtles.

**Hall, R. J. and N. C. Coon**. 1988. Interpreting residues of petroleum hydrocarbons in wildlife tissues. U.S. Fish and Wildlife Service, Washington, D.C. Biological Report **88(15)**. 7 pp.
**Keywords:** concentration/ hydrocarbons/ interpretation/ Onine/ petroleum/ petroleum hydrocarbons/ sampling/ technical/ tissue
**Notes:** A brief guidance publication that explains how to evaluate reports of petroleum concentrations in animal tissue. Sections on background, sampling and handling of samples, reports and interpretation, when to analyze for hydrocarbons, and how to interpret the magnitude of the concentrations.

**Hamad, A., E. Al-Zubaidy, M. E. Fayed**, 2005. Used lubricating oil recycling using hydrocarbon solvents. Journal of Environmental Management **74**:153-159.
**Keywords:** asphaltene/ carbon/ cleaning/ lubricating oil/ metals/ methods/ oil/ Onine/ petroleum/ procedure/ recycling/ solvent/ technical
**Notes:** A description of two new procedures for cleaning used lubricating oil so it can be recycled. Evaluated liquefied petroleum gas condensate and stabilized condensate as solvents for the removal of metals, asphaltenes, ash, and carbon residue. Compared the results to two other published methods.

**Hamdoun, A. M., F. J. Griffin, G. N. Cherr**, 2002. Tolerance to biodegraded crude oil in marine invertebrate embryos and larvae is associated with expression of a multixenobiotic resistance transporter. Aquatic Toxicology **61**:127-140.
**Keywords:** assay/ crude oil/ degradation/ development/ dye/ eggs/ embryo/ hatching/ larvae/ marine invertebrate/ Ofour/ salt water/ Santa Barbara crude oil/ sea urchin/ sediment/ survival/ transport
**Notes:** A sea urchin and a sediment worm were used in a laboratory assessment of the effects of microbially-degraded water-soluble fraction of Santa Barbara crude oil and the nondegraded equivalent. The WSF was analyzed for selected compounds. Fertilized eggs of both species were exposed to 0-3 ppm of degraded or nondegraded hydrocarbons through the period of embryonic development. Used a dye transport assay to determine whether the biodegraded WSF was acting as a competitive inhibitor of the MXR transporter. Measured survival and development of embryos. In a further study, embryos were also exposed to 0-2.2 ppm biodegraded WSF after hatching.

**Hamoutene, D., J. F. Payne, A. Rahimtula, K. Lee**, 2002. Use of the Comet assay to assess DNA damage in hemocytes and digestive gland cells of mussels and clams exposed to water contaminated with petroleum hydrocarbons. Marine Environmental Research **54**:471-474.
**Keywords:** Arabian crude oil/ assay/ bivalve/ clam/ crude oil/ digestive gland/ DNA/ genetic/ hemocytes/ hydrocarbons/ marine invertebrate/ mussel/ Ofour/ oil/ petroleum/ petroleum hydrocarbons/ salt water/ species
**Notes:** Oil-in-water dispersions and water-soluble fractions of Arabian crude oil were used in assays of the effects of the oil on two species of bivalves. Following experimental exposure for 6-12 da in aerated sea water tanks, hemocytes and digestive gland cells were evaluated with the Comet assay to measure DNA migration.

**Hamoutene, D., J. F. Payne, A. Rahimtula, K. Lee**, 2004. Effect of water soluble fractions of diesel and an oil spill dispersant (Corexit 9527) on immune responses in mussels. Bulletin of Environmental Contamination and Toxicology **72**:1260-1267.
**Keywords:** aromatic hydrocarbons/ assay/ coast/ concentration/ Corexit 9527/ corn oil/ diesel/ dispersant/ immune response/ marine invertebrate/ mussel/ Newfoundland/ ODfour/ oil/ oil spill/ salt water
**Notes:** Mussels collected from the coast of Newfoundland were used in laboratory assays to determine the effects of water-soluble fractions (WSF) of diesel, Corexit 9527, diesel + Corexit 9527, and corn oil on immune response. Exposure was to five concentrations of the WSF for 4 days. A second phagocytosis assay was performed over a 2-da exposure period. Measured effect on actin cytoskeleton integrity, hemocyte cellular response, and aromatic hydrocarbon content of the WSF.

**Hampson, G. R., E. T. Moul**, 1977. Salt marsh grasses and #2 fuel oil. Oceanus **20**:25-30.
**Keywords:** Cape Cod/ cod/ community/ effects/ fuel oil/ grass/ marine plant/ Massachusetts/ No.2 fuel oil/

oil/ Osix/ petroleum/ plant/ recovery/ salt marsh/ salt water/ spill/ vegetation/ wetland
**Notes:** A study of the effects of a spill of No. 2 fuel oil near the Cape Cod Canal, Massachussetts. A series of vegetation quadrats were established 9 mos after the spill in an affected coastal wetland and in a reference wetland. Vegetation was identified and described during the next 22 mos. Authors make reference to other studies of the effects of petroleum on salt water plants.

**Hangovan, K., M. Vivekanandan**, 1992. Effect of oil pollution on soil respiration and growth of *Vigna mungo* (L.) Hepper. Science of the Total Environment **116**:187-194.
**Keywords:** amino acids/ assay/ chlorophyll/ DNA/ effects/ emergence/ fresh water/ freshwater plant/ germination/ growth/ land farming/ lipid/ oil/ Oseven/ phenol/ plant/ pollution/ protein/ respiration/ RNA/ seed/ seedling/ soil/ solubility/ treatment/ waste water
**Notes:** Effect of repeated treatment of soil with treated oily waste water (land farming) on blackgram (*Vigna mungo*). Soil cores were taken and assessed for $CO_2$ production (respiration). Soil from the top 25 cm was used in a pot assay of seed effects; determined percentage of germination and seedling emergence, and the number of nodules per plant. Plants (30 da old) were analyzed for chlorophyll content, carotenoids, total phenols, total soluble sugars, total soluble proteins, total lipids, free amino acids, RNA, DNA, and leghaemoglobin content.

**Hansen, D. J.** 1981. The relative sensitivity of seabird populations in Alaska to oil pollution. U.S. Dept. of the Interior, Bureau of Land Management, Alaska Outer Continental Shelf Office, Anchorage, AK. **Technical Paper No. 3**. 30 pp.
**Keywords:** Alaska/ bird/ development/ offshore/ oil/ oil spill/ Oone/ pollution/ population/ salt water/ species/ spill/ vulnerability
**Notes:** An assessment of the vulnerability of species and populations of Alaskan seabirds to potential oil spills caused by offshore oil and gas development.

**Hansen, D. J.** 1985. The potential effects of oil spills and other chemical pollutants on marine mammals occurring in Alaskan waters. U.S. Dept. of the Interior, Minerals Management Service, Anchorage, AK. OCS Report **MMS 85-0031**. 21 pp.
**Keywords:** Alaska/ behavior/ effects/ foraging/ mammal/ oil/ oil spill/ Otwo/ pathology/ physiology/ reproduction/ salt water/ species/ spill
**Notes:** Summary of the potential effects of oil and other chemicals on marine mammals in Alaskan waters.

**Hansen, W. G., G. Bitton, J. L. Fox, P. L. Brezonik**, 1977. Hydrocarbon status in Florida real estate canals. Marine Pollution Bulletin **8**:57-62.
**Keywords:** abundance/ aerobic/ bacteria/ development/ Florida/ hydrocarbons/ marine invertebrate/ Ofour/ petroleum/ salt water/ saturated hydrocarbons/ sediment
**Notes:** Assessment of the presence of petroleum contamination in Florida real estate canals. Sediment samples collected at four coastal developments. Sediments analyzed for saturated hydrocarbons, aerobic bacteria, aerobic hydrocarbon-degrading aerobic bacteria, sulphate-reducing bacteria, and sulphate-reducing hydrocarbon degrading bacteria.

**Hanson, H. S.**, 1954. Criteria of age of incubated mallard, wood duck, and bob-white quail eggs. Auk **71**:267-272.
**Keywords:** age/ bird/ criteria/ development/ duck/ eggs/ embryo/ mallard/ Oone/ quail/ wood duck
**Notes:** Descriptions of embryo development for mallard, wood duck, and bob-white quail; characteristics to assist with age determination.

**Harfenist, A., A. P. Gilman, K. L. Maus**, 1990. The effects of exposure of incubating adult and young herring gulls to a simulated No. 2 fuel oil slick. Archives of Environmental Contamination and Toxicology **19**:902-906.
**Keywords:** adult/ bird/ chicks/ effects/ fresh water/ fuel oil/ gull/ herring/ herring gull/ incubation/ No.2 fuel oil/ oil/ oil slick/ Oone/ survival
**Notes:** Results of the exposure of nesting adult herring gulls (early and late-stage incubation) and chicks to simulated No 2 fuel oil slicks.

**Harrel, R. C.**, 1985. Effects of a crude oil spill on water quality and macrobenthos of a southeast Texas stream. Hydrobiologia **124**:223-228.
**Keywords:** benthic/ chemical characteristics/ crude oil/ effects/ fresh water/ freshwater invertebrate/ macroinvertebrate/ Ofive/ oil/ oil spill/ pipeline/ spill/ stream/ Texas/ time
**Notes:** Assessment of the effects on stream macrobenthos of a 160 gal. pipeline spill of crude oil in a Texas stream; spill occurred 12/81. Characteristics of stream water were measured monthly from 8/79 - 7/80 in a 'reference' stream and seven times between 12/81 and 2/84 in the affected stream. Benthic macroinvertebrates were measured 'seasonally' from 8/79 - 7/80 in the reference stream and six times between 12/81- 2/84 in the affected stream.

**Harris, B. C., J. S. Bonner, R. L. Autenrieth**, 1999. Nutrient dynamics in marsh sediments contaminated by an oil spill following a flood. Environmental Technology **20**:795-810.
**Keywords:** ammonia/ ammonium/ crude oil/ depth/ fuel oil/ gasoline/ microbes/ monitoring/ nutrients/ oil/ oil spill/ Oten/ petroleum/ pipeline/ salt water/ sediment/ spill/ wetland
**Notes:** Assessment of nutrient dynamics in a riverine wetland affected by simultaneous pipeline ruptures involving fuel oil, gasoline, and crude oil. Twenty-one permanent plots were established and sampled monthly for 323 da followed by a period of 'extended' monitoring lasting 146 da. Sediment was sampled at 0-5 cm and 5-10 cm depths and analyzed for ammonium, available P, total Kjeldahl N, total Kjeldahl P, and total petroleum analytes.

**Hartley, J. P. and J. Ferbrache** 1983. Biological monitoring of the Forties oilfield (North Sea). Pages 407-414 *in* 1983 Oil Spill Conference, API 4356. American Petroleum Institute, Washington, DC.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ benthic/ community/ concentration/ hydrocarbons/ marine invertebrate/ miscellaneous/ monitoring/ North Sea/ Oeleven/ oil/ oil spill/ organic/ population/ sampling/ sediment/ spill
**Notes:** The third (1981) in a series of monitoring efforts at the Forties Field of the North Sea. Seafloor sediments were sampled at 25 locations. Sediments were physically characterized and analyzed for total organic content and concentrations of aliphatic and aromatic hydrocarbons. Benthic fauna were identified and counted. Results were compared to previous sampling episodes in 1975 and 1978.

**Hartung, R.**, 1963. Ingestion of oil by waterfowl. Papers of the Michigan Academy of Science, Arts, and Letters **48**:49-55.
**Keywords:** bird/ duck/ fresh water/ ingestion/ mallard/ Michigan/ necropsy/ oil/ oiled/ Oone/ plumage/ viscosity/ waterfowl
**Notes:** Application of low and high viscosity oils (unidentified) to plumage of mallard ducks. Resulted in first quantified demonstration of the ingestion of oil by oiled birds. Also, information on the amount of oil on dead oiled birds from the Detroit River and some necropsy information from dead oiled ducks.

**Hartung, R.**, 1965. Some effects of oiling on reproduction of ducks. Journal of Wildlife Management **29**:872-874.
**Keywords:** bird/ duck/ effects/ eggs/ fresh water/ ingestion/ lubricating oil/ mallard/ mineral oil/ oil/ oiled/ Oone/ reproduction
**Notes:** Results on egg laying of dosing three mallards with unidentified lubricating oil and results of applying varying amounts of mineral oil on incubated eggs.

**Hartung, R., G. S. Hunt**, 1966. Toxicity of some oils to waterfowl. Journal of Wildlife Management **30**:564-570.
**Keywords:** bird/ black duck/ cutting oil/ diesel/ dosed/ duck/ effects/ fresh water/ fuel oil/ mallard/ motor oil/ necropsy/ oil/ oil spill/ Oone/ pathology/ spill/ toxicity/ waterfowl
**Notes:** Mallard and black ducks dosed with No. 1 fuel oil, diesel oil, motor oil, or cutting oil were assessed for pathological effects. Results were compared to the necropsy findings from a group of wild ducks killed by oil spills on the Detroit River.

**Hartung, R.**, 1967. Energy metabolism in oil-covered ducks. Journal of Wildlife Management **31**:798-804.
**Keywords:** activity/ bird/ black duck/ diesel/ diesel fuel/ duck/ effects/ fresh water/ mallard/ metabolism/

mineral oil/ oil/ oiled/ Oone
**Notes:** Effects of oiling with mineral oil or diesel oil on the metabolic activity of mallards and black ducks.

**Hartung, R., G. W. Klingler**, 1970. Concentration of DDT by sedimented polluting oils. Environmental Science and Technology **4**:407-410.
**Keywords:** concentration/ DDT/ Detroit River/ fresh water/ mineral oil/ miscellaneous/ Oeleven/ oil/ organic/ organochlorines/ petroleum/ river/ sediment/ soil/ stream
**Notes:** An artificial stream with synthetic soil and mineral oil was used to mimic the environmental interaction between petroleum-contaminated sediments and DDT. Sediment samples from the Detroit River were analyzed for total extractable organic material (mostly petroleum) and correlated with sediment DDT concentrations.

**Hartwick, E. B., R. S. S. Wu, D. B. Parker**, 1982. Effects of a crude oil and an oil dispersant (Corexit 9527) on populations of the littleneck clam (*Protothaca staminea*). Marine Environmental Research **6**:291-306.
**Keywords:** activity/ behavior/ clam/ Corexit 9527/ crude oil/ dispersant/ effects/ marine invertebrate/ ODfour/ oil/ population/ salt water/ survival/ weathered
**Notes:** Assessment of the effects of Corexit 9527 and a crude oil on the littleneck clam. Laboratory exposure consisted of either 100 ppm oil, 1000 ppm oil, 10 ppm Corexit, 100 ppm Corexit, 100 ppm oil plus 10 ppm Corexit, or 1000 ppm oil plus 100 ppm Corexit. Field exposure consisted of either 1000 ppm oil or 1000 ppp oil plus 100 ppm Corexit. Test solutions were taken daily from an outdoor weathering tank for 5 consecutive da. Measured survival, siphoning activities, larval settlement, and behavior.

**Harty, B., A. McLachlan**, 1982. Effects of water-soluble fractions of crude oil and dispersants on nitrate generation by sandy beach microfauna. Marine Pollution Bulletin **13**:287-291.
**Keywords:** ammonia/ ammonium/ Arabian Light crude oil/ beach/ concentration/ crude oil/ dispersant/ effects/ light/ marine invertebrate/ microbes/ nitrate/ nitrogen/ ODfour/ oil/ salt water/ sand/ sandy beach/ South Africa
**Notes:** Assessment of the effects of Arabian Light crude oil and dispersants on nitrate generation by microfauna of sandy beaches. Samples of sand exposed for 20 or 40 hr to four water-soluble fraction concentrations, four dispersant concentrations, or five concentrations of dispersant plus WSF. Measured total nitrogen, ammonia, nitrite, and nitrate.

**Harvey, S., J. G. Phillips, and P. J. Sharp** 1982. Reproductive performance and endocrine responses to ingested North Sea oil. Pages 379-395 *in* C. G. Scanes, M. A. Ottinger, A. D. Kenny, J. Balthazart, J. Cronshaw, I. C. Jones, editors. Aspects of Avian Endocrinology: Practical and Theoretical Implications. Graduate Studies, Texas Tech University. Texas Tech Press, Lubbock, Texas.
**Keywords:** biochemistry/ bird/ crude oil/ diet/ duck/ effects/ endocrine/ fresh water/ hormone/ North Sea/ North Sea crude oil/ oil/ Oone/ reproduction/ Texas/ weight
**Notes:** Effects on Khaki Campbell ducks of ingested (diet) North Sea crude oil; reproduction, hormone production, biochemistry. An extensive discussion of the literature pertaining to ingested oil and birds.

**Hawkes, J. W., E. H. Gruger, Jr., O. P. Olson**, 1980. Effects of petroleum hydrocarbons and chlorinated biphenyls on the morphology of the intestine of chinook salmon (*Oncorhynchus tshawytscha*). Environmental Research **23**:149-161.
**Keywords:** aromatic hydrocarbons/ chlorinated biphenyls/ diet/ effects/ evaluation/ fish/ hydrocarbons/ ingestion/ intestine/ Othree/ pathology/ petroleum/ petroleum hydrocarbons/ salmon/ salt water
**Notes:** Effects on intestinal mucosa of chinook salmon from ingestion of diets containing mixtures of chlorinated biphenyls, mixtures of aromatic hydrocarbons, or both mixtures; study lasted 49 days followed by histological evaluation.

**Hawkes, J. W., C. M. Stehr**, 1982. Cytopathology of the brain and retina of embryonic surf smelt (*Hypomesus pretiosus*) exposed to crude oil. Environmental Research **27**:164-178.
**Keywords:** brain/ concentration/ Cook Inlet crude oil/ crude oil/ development/ embryo/ fish/ hatching/ oil/ Othree/ pathology/ retina/ salt water
**Notes:** Exposure of surf smelt embryos at 6 days of development to two concentrations of the seawater-

accomodated fraction of Cook Inlet crude oil for 21 and 27 days; hatching success and pathology of brain and retina.

**Hayes, M. O., J. Michel, and D. C. Noe** 1991. Factors controlling initial deposition and long-term fate of spilled oil on gravel beaches. Pages 453-460 *in* 1991 International Oil Spill Conference, API Publication 4529. American Petroleum Institute, Washington, D.C.
**Keywords:** Amoco Cadiz/ beach/ Exxon Valdez/ fate/ gravel/ long-term/ Metula/ miscellaneous/ Oeleven/ oil/ oil spill/ overview/ petroleum/ salt water/ spill/ time/ weathered
**Notes:** An overview and discussion of the behavior of spilled petroleum on gravel beaches. Authors focus on their experiences at the *Metula* (1974), *Amoco Cadiz* (1978), and *Exxon Valdez* (1989) oil spills.

**Hayes, M. O., J. Michel, T. M. Montello, D. V. Aurand, A. M. Al-Mansi, A. H. Al-Moamen, T. C. Sauer, G. W. Thayer**, 1993. Distribution and weathering of shoreline oil one year after the Gulf War oil spill. Marine Pollution Bulletin **27**:135-142.
**Keywords:** beach/ coast/ degradation/ distribution/ evaluation/ Gulf oil spill/ habitat/ intertidal/ miscellaneous/ Oeleven/ oil/ oil spill/ salt water/ Saudi Arabia/ shoreline/ spill/ transect/ war/ weathered
**Notes:** An evaluation of intertidal habitats along the coast of Saudi Arabia 1 yr after the Gulf War oil spill. Transects (36) were established at two locations. Sections on exposed outer beaches, surface penetration mechanisms, sheltered bayheads, and lower intertidal zones.

**Hayes, M. O., J. Michel, T. M. Montello, D. V. Aurand, T. C. Sauer, A. Al-Mansi, and A. H. Al-Momen** 1995. Distribution and weathering of oil from the Iraq-Kuwait conflict oil spill within intertidal habitats -- two years later. Pages 443-451 *in* 1995 International Oil Spill Conference, API Publication 4620. American Petroleum Institute, Washington, D.C.
**Keywords:** analysis/ aromatic hydrocarbons/ chemical analysis/ degradation/ distribution/ Gulf oil spill/ habitat/ hydrocarbons/ intertidal/ miscellaneous/ Oeleven/ oil/ oil spill/ salt water/ spill/ time/ transect/ weathered
**Notes:** Eight types of intertidal habitat in two Saudi Arabian bays were surveyed in 1992 and 1993. Established 36 transects in 1992 and resurveyed 21 in 1993. A total of 80 sites were resampled for chemical analysis in 1993; analyzed for a set of 36 aromatic hydrocarbons. This report deals with the 1993 results and relates them to the previously reported results of the 1992 work.

**Hayes, M. O., J. Michel**, 1999. Factors determining the long-term persistence of *Exxon Valdez* oil in gravel beaches. Marine Pollution Bulletin **38**:92-101.
**Keywords:** Alaska/ beach/ Exxon Valdez/ gravel/ long-term/ miscellaneous/ Oeleven/ oil/ oiled/ organic/ PAH/ persistence/ Prince William Sound/ Prudhoe Bay crude oil/ residual oil/ salt water/ sediment/ survey
**Notes:** Assessment of the oiling of 6 intermittently exposed, coarse-grained gravel beaches in Prince William Sound, Alaska. Beaches surveyed from 1989 through summer of 1997. Beaches classified into two subclasses, those with well-established surface armor, flat slope, and thick layer of underlying sediment and (2) those with partial armor covering, steep slope, and thin layer of underlying sediment. Analyzed underlying sediment for total extractable organics and PAHs.

**Hedtke, S. F., F. A. Puglisi**, 1980. Effects of waste oil on the survival and reproduction of the American flagfish, *Jordanella floridae*. Canadian Journal of Fisheries and Aquatic Sciences **37**:757-764.
**Keywords:** flagfish/ crankcase oil/ effects/ fish/ fresh water/ growth/ larvae/ life cycle/ oil/ Othree/ reproduction/ survival/ toxicity/ waste oil
**Notes:** Effects of waste crankcase oil on the survival and reproduction of the American flagfish; 4-day toxicity test, 30 day survival of 1-day old larvae, and a life cycle test. Measured survival and growth.

**Hedtke, S. F., F. A. Puglisi**, 1982. Short-term toxicity of five oils to four freshwater species. Archives of Environmental Contamination and Toxicology **11**:425-430.
**Keywords:** amphibian/ crankcase oil/ crude oil/ emulsion/ fish/ flow-through/ fresh water/ frog/ fuel oil/ oil/ OthreeA/ salamander/ short-term/ species/ static/ survival/ toxicity
**Notes:** Toxicity tests on two species of fish, one species of frog, and one species of salamander with waste crankcase oil, No. 1 fuel oil, No. 2 fuel oil, and two crude oils. Tests run for 8 days with oils as floating layers, emulsions, and water-soluble fractions in static and flow-through tests.

**Hegazy, A. K.**, 1997. Plant succession and its optimization on tar-polluted coasts in the Arabian Gulf region. Environmental Conservation **24**:149-158.
**Keywords:** accumulation/ Arabian Gulf/ beach/ cleaning/ coast/ colonization/ diversity/ experiment/ fresh water/ freshwater plant/ Oseven/ plant/ Qatar/ region/ restoration/ seed/ soil/ species/ species diversity/ tar cover/ wetland
**Notes:** Assessment of the floral colonization of tar piles created in coastal wetlands of Qatar. The tar comes from periodic cleaning of tar accumulation on beaches. Measured soil moisture of tar piles, identified colonizing species, calculated species diversity, identified seeds in soil samples from tar piles and surrounding landscapes, planted seeds in a greenhouse pot experiment involving soil with varying amounts of tar. Presents a management and restoration framework for optimizing natural recolonization of the tar piles.

**Heintz, R. A., J. W. Short, S. D. Rice**, 1999. Sensitivity of fish embryos to weathered crude oil: part II. Increased mortality of pink salmon (*Oncorhynchus gorbuscha*) embryos incubating downstream from weathered *Exxon Valdez* crude oil. Environmental Toxicology and Chemistry **18**:494-503.
**Keywords:** aromatic hydrocarbons/ concentration/ crude oil/ eggs/ embryo/ experiment/ Exxon Valdez/ fish/ fresh water/ gravel/ hatching/ incubation/ North Slope/ North Slope crude oil/ oil/ Othree/ PAH/ pink salmon/ salmon/ salt water/ sediment/ survival/ tissue/ weathered
**Notes:** Eggs of the pink salmon, throughout incubation and hatching, were exposed to Alaskan North Slope crude oil. Separate experiments employed direct contact of eggs with sediment contaminated by unweathered crude oil, eggs separated from the sediment by a barrier, and direct contact with sediment contaminated by weathered crude oil. Measured survival of embryos and PAH concentrations in gravel, water, and in fish tissue.

**Heitkamp, M. A., B. T. Johnson**, 1984. Impact of an oil field effluent on microbial activities in a Wyoming river. Canadian Journal of Microbiology **30**:786-792.
**Keywords:** activity/ amino acids/ biodegradation/ carbon/ carbon dioxide/ chemical analysis/ conductivity/ discharges/ effluent/ fresh water/ freshwater invertebrate/ glucose/ microbes/ mineralization/ nitrogen/ nutrients/ Ofive/ oil/ oil field/ organic/ organic carbon/ pH/ phosphorus/ population/ sediment/ stream/ transfer/ waste water
**Notes:** Assessment of the sediment microbial activity of a stream in Wyoming that received oil field wastewater. Samples of water and sediment were taken above, at, and three points below the wastewater discharge. Measured conductivity, pH, total nitrogen, total phosphorus, and total oil residue in the water. Measured total organic carbon, electron transfer system, carbon dioxide production, total oil residue, glucose, amino acids, and hexanoic acid in the sediment. Also determined hexadecane mineralization in sediments with and without nutrient enrichment and xenobiotic biodegradation potential of the sediment microbes.

**Heldal, M., S. Norland, T. Lien, G. Knutsen**, 1978. Acute toxicity of several oil dispersants towards the green algae Chlamydomonas and Dunaliella. Chemosphere **3**:247-255.
**Keywords:** acute/ algae/ assay/ crude oil/ dispersant/ fresh water/ freshwater plant/ marine plant/ oil/ Osix/ salt water/ toxicity
**Notes:** A freshwater and a marine algae were used to determine the toxicity of a number of chemical oil dispersants. A plate test and a tube test were used. Algae were exposed to 28 dispersants in 24-48 hr toxicity assays. Exposure was to dispersant alone, water extracts of crude oil plus dispersant, and mixtures of whole crude oil and dispersants.

**Hellou, J., C. Upshall, D. Taylor, P. O'Keefe, V. O'Malley, T. Abrajano**, 1994. Unsaturated hydrocarbons in muscle and hepatopancreas of two crab species, *Chionoecetes opilio* and *Hyas coarctatus*. Marine Pollution Bulletin **28**:482-488.
**Keywords:** aromatic hydrocarbons/ Canada/ concentration/ crab/ hepatopancreas/ hydrocarbons/ marine invertebrate/ muscle/ Newfoundland/ Ofour/ PAH/ salt water/ sediment/ species/ unsaturated hydrocarbons
**Notes:** Determination of background concentrations of PAH in snow and spider crabs from nearshore Newfoundland. Concentrations of selected PAHs compared to the PAH content of sediments collected from Conception Bay. Measured PAHs in hepatopancreas and muscle.

**Hellou, J., J. F. Payne, C. Upshall, L. L. Fancey, C. Hamilton**, 1994. Bioaccumulation of aromatic hydrocarbons from sediments: a dose-response study with flounder (*Pseudopleuronectes americanus*). Archives of Environmental Contamination and Toxicology **27**:477-485.
**Keywords:** aromatic hydrocarbons/ concentration/ crude oil/ fish/ flounder/ Hibernia crude oil/ hydrocarbons/ liver/ muscle/ oil/ Othree/ salt water/ sediment
**Notes:** Exposure of flounder to sediments containing varying concentrations of Hibernia crude oil for 4 months. Bioaccumulation of selected aromatic hydrocarbons was measured in the liver and muscle.

**Hellou, J., W. G. Warren**, 1997. Polycyclic aromatic compounds and saturated hydrocarbons in tissues of flatfish: insight on environmental exposure. Marine Environmental Research **43**:11-25.
**Keywords:** American plaice/ analysis/ aromatic hydrocarbons/ Atlantic/ fish/ flounder/ gonads/ hydrocarbons/ liver/ muscle/ Newfoundland/ Othree/ plaice/ salt water/ saturated hydrocarbons/ tissue/ yellowtail flounder
**Notes:** Analysis of American plaice and yellowtail flounder for aromatic and saturated hydrocarbons in liver, muscle, and gonads. Fish collected from the northwest Atlantic near Newfoundland.

**Hellou, J., W. Warren, C. Andrews, G. Mercer, J. F. Payne, D. Howse**, 1997. Long-term fate of crankcase oil in rainbow trout: a time- and dose-response study. Environmental Toxicology and Chemistry **16**:1295-1303.
**Keywords:** aromatic hydrocarbons/ biochemical/ crankcase oil/ dietary exposure/ fate/ fish/ fresh water/ long-term/ oil/ Othree/ rainbow trout/ time/ uptake/ waste oil
**Notes:** Dietary exposure of rainbow trout to crankcase oil. Measured uptake and biochemical responses.

**Henderson, S. B., S. J. W. Grigson, P. Johnson, B. D. Roddie**, 1999. Potential impact of production chemicals on the toxicity of produced water discharges from North Sea oil platforms. Marine Pollution Bulletin **38**:1141-1151.
**Keywords:** assay/ crude oil/ discharges/ evaluation/ Microtox/ miscellaneous/ North Sea/ Oeleven/ oil/ oil platform/ produced water/ production chemicals/ salt water/ toxicity
**Notes:** Evaluation of the influence of 11 oilfield production chemicals on the toxicity of produced water discharge. Used Microtox assay to determine toxicity of chemicals as water-accomodated fractions or as solutions, and in the aqueous phase of a crude oil and water mixture.

**Hennig, H. F. K. O., A. H. Fricke**, 1980. Recovery potential and chronic oil pollution on the South African coast. Marine Pollution Bulletin **11**:301-302.
**Keywords:** beach/ Bunker C/ chronic/ coast/ degradation/ fuel oil/ hydrocarbons/ miscellaneous/ No.6 fuel oil/ Oeleven/ oil/ pollution/ recovery/ salt water/ sediment/ spill/ tanker/ time/ total hydrocarbons
**Notes:** Following the *Venepet/Venoil* tanker (Bunker C fuel oil) collision in December 1977, sediment samples were collected at five times (3/78, 4/78, 7/78, 3/79, 12/79) after the spill. Total sediment hydrocarbons were extracted. Authors made general biological observations and comment on recovery timetables and the issue of chronic oil pollution of beaches.

**Henson, J. M., S. S. Hayasaka**, 1982. Effects of the water-soluble fraction of microbiologically or physically altered crude petroleum on the heterotrophic activity of marine bacteria. Marine Environmental Research **6**:205-214.
**Keywords:** activity/ bacteria/ crude oil/ effects/ emulsion/ Florida/ glutamate/ microbes/ oil/ Oten/ petroleum/ salt water/ uptake/ weathered
**Notes:** Assessment of the comparative effects on marine bacteria of Florida crude oil emulsified or degraded by marine microorganisms; compared to fresh crude oil and artificially weathered crude oil. Water-soluble fractions of oil emulsified or degraded for 3 or 8 da, or weathered for 42 da were used. Measured glutamate (labeled with $^{14}C$) uptake by bacteria.

**Heras, H., R. G. Ackman, E. J. Macpherson**, 1992. Tainting of Atlantic salmon (*Salmo salar*) by petroleum hydrocarbons during a short-term exposure. Marine Pollution Bulletin **24**:310-315.
**Keywords:** aromatic hydrocarbons/ Atlantic/ Atlantic salmon/ concentration/ crude oil/ fish/ hydrocarbons/ liver/ muscle/ North Sea/ North Sea crude oil/ oil/ Othree/ petroleum/ petroleum hydrocarbons/ salmon/

salt water/ short-term/ taint
**Notes:** Exposure of young Atlantic salmon for 6 hours to the water-soluble fraction of Flotta North Sea crude oil; fish were killed and assessed for taint. Bioaccumulation of aromatic hydrocarbons in liver and muscle presented.

**Herbert, R., S. A. Poulet**, 1980. Effect of modification of particle size of emulsions of Venezuelan crude oil on feeding, survival and growth of marine zooplankton. Marine Environmental Research **4**:121-134.
**Keywords:** Canada/ concentration/ copepod/ crude oil/ distribution/ emulsion/ estuary/ feeding/ growth/ ingestion/ marine invertebrate/ Ofour/ oil/ particle size/ particulate/ salt water/ size/ species/ survival/ Venezuelan crude oil/ zooplankton
**Notes:** Effect of oil particle size on ingestion by marine zooplankton (two copepods, one euphausiid). Venezuelan crude oil and zooplankton collected from the St. Lawrence estuary. Measured particle size distribution occurring naturally and in artificially created emulsions, feeding response of two species to particle size, and growth and survival of one species exposed to a fixed concentration of oil.

**Herbes, S. E., L. R. Schwall**, 1978. Microbial transformation of polycyclic aromatic hydrocarbons in pristine and petroleum-contaminated sediments. Applied Environmental Microbiology **35**:306-316.
**Keywords:** anthracene/ aromatic hydrocarbons/ concentration/ degradation/ fresh water/ freshwater invertebrate/ hydrocarbons/ incubation/ kinetic/ microbes/ naphthalene/ Ofive/ PAH/ parameters/ sediment/ stream
**Notes:** Assessment of the ability of sediment microbes from an oil-contaminated stream and an uncontaminated stream to transform $^{14}C$-labeled naphthalene, anthracene, benz(a)anthracene, and benz(a)pyrene. Laboratory incubations lasted for up to 27 da. Determined the concentrations of PAHs in the sediments of both streams and calculated kinetic parameters for the four test PAHs.

**Herman, D. C., W. E. Inniss, C. I. Mayfield**, 1990. Impact of volatile aromatic hydrocarbons, alone and in combination, on growth of the freshwater alga. Aquatic Toxicology **18**:87-100.
**Keywords:** algae/ aromatic hydrocarbons/ assay/ benzene/ BTEX/ cell/ chlorophyll/ combination/ concentration/ effects/ ethylbenzene/ fresh water/ freshwater plant/ growth/ hydrocarbons/ interactions/ Oseven/ species/ toluene/ weight/ xylene
**Notes:** An assessment of the effects of BTEX (benzene, toluene, ethyl-benzene, xylene) on growth of a species of algae. Assays were performed in sealed hypo-vials over an 8-da period. BTEX concentrations were monitored to measure loss of hydrocarbons during a trial assay. Algal growth was measured as cell number, chlorophyll content, dry weight, and absorbance. Paired combinations of the BTEX compounds and a three-compound assay were used to evaluate interactions among the four aromatics.

**Hermida Ameijeiras, A., J. Simal Gandara, J. Lopez Hernandez, J. Simal Lozano**, 1994. Aliphatic hydrocarbon levels in farmed and free-living mussels from Galicia (N.W. Spain). Marine Pollution Bulletin **28**:178-181.
**Keywords:** aliphatic hydrocarbons/ analysis/ concentration/ farming/ fishery/ hydrocarbons/ marine invertebrate/ mussel/ Ofour/ salt water/ Spain/ uptake
**Notes:** Collection of free-living and farmed mussels from coastal northwest Spain (Galicia) for aliphatic hydrocarbon analysis; assessment of potential contamination due to shipping, fishing, and coastal industrialization.

**Hershner, C., J. Lake**, 1980. Effects of chronic oil pollution on a salt-marsh grass community. Marine Biology **56**:163-173.
**Keywords:** adult/ chronic/ community/ concentration/ effects/ fuel oil/ grass/ health/ hydrocarbons/ marine plant/ No.2 fuel oil/ oil/ oiled/ Osix/ physical characteristics/ plant/ pollution/ population/ productivity/ rate/ roots/ salt marsh/ salt water/ saturated hydrocarbons/ sediment/ Spartina/ species/ treatment/ vegetation/ wetland
**Notes:** Two coastal wetlands (treatment and reference) were used to determine the effects on a wetland plant community of repeated oiling by No. 2 fuel oil. Oiling was performed twice a month from 11/73 thru 8/74. Vegetation was surveyed at the start of the study and again during 4/74, 7/74, and 10/74. Vegetation quadrats were established to monitor changes in physical characteristics and health of vegetation. Measured physical changes in areal cover of grass species, net production, decay rates,

physical characteristics of adult plants and shoots, and concentrations of saturated hydrocarbons in sediments and roots and rhizomes of *Spartina alterniflora*.

**Hester, M. W., I. A. Mendelssohn**, 2000. Long-term recovery of a Louisiana brackish marsh plant community from oil-spill impact: vegetation response and mitigating effects of marsh surface elevation. Marine Environmental Research **49**:233-254.
**Keywords:** community/ crude oil/ effects/ experiment/ long-term/ Louisiana/ Louisiana crude oil/ marine plant/ oil/ oil spill/ Osix/ photosynthesis/ pipeline/ plant/ recovery/ salt water/ sampling/ transect/ vegetation/ wetland
**Notes:** An oil pipeline break in 1985 affected 20 ha of brackish wetland in Louisiana. A total of 15 transects with 68 sampling plots were established in the affected wetland, adjacent wetland, and control areas; and sampled in 1985 and 1989. Measured percent vegetative cover in 1985 and 1989 and photosynthetic response of vegetation in 1990. A transplantation experiment was employed to determine the cause of revegetation failure in the oil-affected area; vegetation was harvested 15 mos later. Remote sensing data from 1985 was compared with data from 1990.

**Heubeck, M., K. C. J. Camphuysen, R. Bao, D. Humple, A. S. Rey, B. Cadiou, S. Brager, T. Thomas**, 2003. Assessing the impact of major oil spills on seabird populations. Marine Pollution Bulletin **46**:900-902.
**Keywords:** bird/ drift/ experiment/ oil/ oil spill/ Oone/ population/ salt water/ search effort/ shoreline/ spill/ survey
**Notes:** A short commentary proposing how to organize the assessment of the effect of oil spills on seabird populations. Four components are proposed; (1) a shoreline search effort, (2) a facility to house a corpse examination (taxonomic, physiological) effort, (3) rapid dissemination of results of steps 1&2 through a website, and (4) surveys of seabirds at sea and drift experiments conducted as soon as possible during the spill event.

**Ho, C. L., H. Karim**, 1978. Impact of adsorbed petroleum hydrocarbons on marine organisms. Marine Pollution Bulletin **9**:156-162.
**Keywords:** alkane/ clay/ crude oil/ depuration/ experiment/ hydrocarbons/ larvae/ marine invertebrate/ minerals/ Ofour/ oil/ oil spill/ oyster/ petroleum/ petroleum hydrocarbons/ salt water/ sediment/ spill/ uptake
**Notes:** Assessment of the effect on oysters of petroleum adsorbed to sediments. Conducted experiments on adsorption potential of non-clay minerals, clay minerals, and two sediment mixtures. Measured uptake of alkanes from oily sediments after 1, 2, 4, and 6 wk. Measured alkane uptake from oil spill sites 2 wk and 5 mo after the spill. Compared 2 and 6 wk exposure followed by 2 wk depuration. Evaluated effect on larval settlement of crude oil coating on artificial surface.

**Ho, K., L. Patton, J. S. Latimer, R. J. Pruell, M. Pelletier, R. McKinney, S. Jayaraman**, 1999. The chemistry and toxicity of sediment affected by oil from the *North Cape* spilled into Rhode Island Sound. Marine Pollution Bulletin **38**:314-323.
**Keywords:** amphipod/ aromatic hydrocarbons/ bioassay/ bivalve/ concentration/ degradation/ embryo/ fuel oil/ hydrocarbons/ larvae/ marine invertebrate/ No.2 fuel oil/ Ofour/ oil/ petroleum/ petroleum hydrocarbons/ Rhode Island/ salt water/ sediment/ spill/ toxicity
**Notes:** Determination of the concentration and toxicity of petroleum hydrocarbons in sediments of a semi-enclosed harbor area of Rhode Island Sound following a barge spill of No. 2 fuel oil. Water samples were taken on days 2, 2.5, 3, and 13 post spill and tested for toxicity with a bivalve embryo and larvae bioassay. Sediments were sampled on days 2, 6, 13, 33, 62, 132, 189, and 270 post spill, analyzed for aromatic hydrocarbons, and tested for toxicity with an amphipod bioassay. The pattern of natural degradation is shown.

**Hodson, R. E., F. Azam, R. F. Lee**, 1977. Effects of four oils on marine bacterial populations: controlled ecosystem pollution experiment. Bulletin of Marine Science **27**:119-126.
**Keywords:** bacteria/ Bunker C/ concentration/ crude oil/ ecosystem/ effects/ experiment/ fuel oil/ glucose/ Kuwait/ Kuwait crude oil/ Louisiana/ Louisiana crude oil/ microbes/ mineralization/ No.2 fuel oil/ numbers/ oil/ Oten/ pollution/ population/ salt water/ uptake

**Notes:** Assessment of the effect on marine bacteria of water extracts of Louisiana crude oil, Kuwait crude oil, No. 2 fuel oil, and Bunker C fuel oil. Field-collected microbes exposed to a range of concentrations of each oil extract for 30 da in "controlled ecosystem enclosures". Measured the uptake and mineralization of $^{14}$C-labelled D-glucose and counted numbers of bacteria.

**Hoff, R. Z., G. Shigenaka, and C. B. Henry, Jr.** 1993. Salt marsh recovery from a crude oil spill: vegetation, oil weathering, and response. Pages 307-311 *in* 1993 International Oil Spill Conference, API Publication 4580. American Petroleum Institute, Washington, D.C.
**Keywords:** analysis/ biomass/ chemical analysis/ crude oil/ degradation/ marine plant/ oil/ oil spill/ oiled/ Osix/ plant/ Prudhoe Bay crude oil/ ratio/ recovery/ salt marsh/ salt water/ sediment/ spill/ time/ transect/ vegetation/ Washington
**Notes:** A coastal salt marsh in Fidalgo Bay, Washington was oiled with Prudhoe Bay crude oil as the result of a 1991 pumping accident. Authors established four transects through the coastal salt marsh; unoiled control, oiled with heavy foot traffic, oiled with surface vacuuming, and oiled with low pressure washing and vacuuming. Photo quadrats were used to measure vegetation monthly and sediment was sampled monthly for 16 mos after the spill. Below ground plant biomass was measured with a core sample in 1991 and 1992. Similarly, sediment cores were taken for chemical analysis (pristane and phytane ratios).

**Hoff, R. Z.**, 1993. Bioremediation: an overview of its development and use for oil spill cleanup. Marine Pollution Bulletin **26**:476-481.
**Keywords:** bioremediation/ cleaning/ development/ evaluation/ history/ microbes/ oil/ oil spill/ Oten/ overview/ review/ salt water/ spill
**Notes:** A review of bioremediation, particularly for marine oil spills. Sections on recent history (pre-1989, 1989-91, 1992 to present), lessons learned, standardization of protocols and evaluation, and conclusions.

**Hoffman, D. J.**, 1978. Embryotoxic effects of crude oil in mallard ducks and chicks. Toxicology and Applied Pharmacology **46**:183-190.
**Keywords:** aliphatic hydrocarbons/ bird/ chicken/ chicks/ crude oil/ development/ duck/ effects/ embryo/ growth/ Louisiana/ Louisiana crude oil/ mallard/ oil/ Oone/ paraffin/ shell/ South Louisiana crude oil
**Notes:** Effects on mallard and chicken embryo growth and development from shell application of a paraffin mixture or several amounts of South Louisiana crude oil.

**Hoffman, D. J.**, 1979. Embryotoxic and teratogenic effects of petroleum hydrocarbons in mallards (*Anas platyrhynchos*). Journal of Toxicology and Environmental Health **5**:835-844.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ bird/ crude oil/ development/ effects/ eggs/ embryo/ growth/ hydrocarbons/ mallard/ oil/ Oone/ petroleum/ petroleum hydrocarbons
**Notes:** Applications of an aliphatic hydrocarbon mixure or several aromatic fractions found in crude oils were made to mallard eggs at 72 hr of development. Embryonic growth and development were evaluated in an effort to identify the most toxic components of crude oils.

**Hoffman, D. J., J. M. Moore**, 1979. Teratogenic effects of external egg applications of methyl mercury in the mallard, *Anas platyrhynchos*. Teratology **20**:453-461.
**Keywords:** aliphatic hydrocarbons/ bird/ development/ effects/ eggs/ embryo/ hydrocarbons/ mallard/ mercury/ methyl mercury/ Oone/ shell
**Notes:** Effects on mallard embryos of shell application of methyl mercury in an aliphatic hydrocarbon vehicle on day 3 of development.

**Hoffman, D. J.**, 1979. Embryotoxic and teratogenic effects of crude oil on mallard embryos on day one of development. Bulletin of Environmental Contamination and Toxicology **22**:632-637.
**Keywords:** aliphatic hydrocarbons/ bird/ crude oil/ development/ effects/ egg shell/ eggs/ embryo/ growth/ hydrocarbon mixture/ hydrocarbons/ incubation/ Louisiana/ Louisiana crude oil/ mallard/ oil/ Oone/ shell/ South Louisiana crude oil
**Notes:** Growth and developmental effects on mallard embryos of applications to the egg shell of an aliphatic hydrocarbon mixture and several quantities of South Louisiana crude oil on day one of incubation.

**Hoffman, D. J.**, 1979. Embryotoxic effects of crude oil containing nickel and vanadium in mallards. Bulletin of Environmental Contamination and Toxicology **23**:203-206.
**Keywords:** bird/ crude oil/ development/ effects/ embryo/ growth/ Louisiana/ Louisiana crude oil/ mallard/ nickel/ oil/ Oone/ shell/ South Louisiana crude oil/ vanadium
**Notes:** Effects on mallard embryo development of shell application of South Louisiana crude oil with and without augmentation with vanadium and nickel.

**Hoffman, D. J., M. L. Gay**, 1981. Embryotoxic effects of benzo[*a*]pyrene, chrysene, and 7,12-dimethylbenz[*a*]anthracene in petroleum hydrocarbon mixtures in mallard ducks. Journal of Toxicology and Environmental Health **7**:775-787.
**Keywords:** aromatic hydrocarbons/ benzo[a]pyrene/ bird/ development/ duck/ effects/ embryo/ hydrocarbon mixture/ hydrocarbons/ mallard/ Oone/ petroleum/ shell
**Notes:** Effects on mallard embryos of shell application of three aromatic hydrocarbons added to a synthetic petroleum mixture at 3 days of development.

**Hoffman, D. J., W. C. Eastin, Jr.**, 1981. Effects of industrial effluents, heavy metals, and organic solvents on mallard embryo development. Toxicology Letters **9**:35-40.
**Keywords:** bird/ development/ effects/ effluent/ embryo/ incubation/ industrial effluent/ mallard/ metals/ Oone/ organic/ petroleum/ shell/ solvent
**Notes:** Effects on mallard embryos of shell application of seven industrial effluents and seven heavy metal, organic solvent, and petroleum solutions on days 3 and 8 of incubation.

**Hoffman, D. J., W. C. Eastin, Jr., M. L. Gay**, 1982. Embryotoxic and biochemical effects of waste crankcase oil on birds' eggs. Toxicology and Applied Pharmacology **63**:230-241.
**Keywords:** biochemical/ bird/ crankcase oil/ development/ effects/ eggs/ embryo/ mallard/ oil/ Oone/ quail/ shell
**Notes:** Effects on mallard and quail embryos of shell applications of waste crankcase oil at 2 days of development.

**Hoffman, D. J., P. H. Albers**, 1984. Evaluation of potential embryotoxicity and teratogenicity of 42 herbicides, insecticides, and petroleum contaminants to mallard eggs. Archives of Environmental Contamination and Toxicology **13**:15-27.
**Keywords:** bird/ development/ eggs/ evaluation/ experiment/ fresh water/ incubation/ malformation/ mallard/ Oone/ pesticide/ petroleum/ survival
**Notes:** Presentation of the results of experiments on the embryotoxicity and teratogenicity of 29 pesticide and 13 petroleum substances. Fertile mallard eggs were exposed to tested substances early in incubation. Eggs were candled every other day and survivors were evaluated for survival and development on day 18 of incubation.

**Hoffman, D. J.**, 1990. Embryotoxicity and teratogenicity of environmental contaminants to bird eggs. Reviews of Environmental Contamination and Toxicology **115**:39-89.
**Keywords:** biochemical/ bird/ development/ effects/ eggs/ embryo/ Oone/ physiology/ review/ shell
**Notes:** Review of the effects on developing bird embryos of shell applications of a variety of environmental contaminants. Covers developmental and biochemical effects, residues in eggs, and field studies.

**Hoffman, D. J., P. H. Albers, M. J. Melancon, A. K. Miles**, 2004. Effects of the mosquito larvicide GB-1111 on bird eggs. Environmental Pollution **127**:353-358.
**Keywords:** biochemical/ bird/ bobwhite/ effects/ eggs/ embryo/ evaluation/ larvicide/ liver/ malformation/ mallard/ mosquito/ Oone/ rate/ time/ toxicity
**Notes:** An evaluation of the effect of a mosquito larvicide (GB-1111) on fertile bobwhite and mallard eggs. Artificially-incubated eggs received applications of either 0, 1/3, 1, 3, or 10 times the maximum rate of field application. Skeletal measurements were made on hatchlings and embryos that failed to hatch and malformations were noted. Hatchlings were weighed and their livers weighed and analyzed for a suite of biochemical measures.

**Hoffman, E. J., J. S. Latimer, G. L. Mills, J. G. Quinn**, 1982. Petroleum hydrocarbons in urban runoff from a commercial land use area. Journal of the Water Pollution Control Federation **54**:1517-1525.
**Keywords:** concentration/ fresh water/ hydrocarbons/ miscellaneous/ Oeleven/ petroleum/ petroleum hydrocarbons/ rate/ Rhode Island/ total hydrocarbons/ urban
**Notes:** Stormwater runoff from a large shopping center in Rhode Island was sampled during six storm events in 1979 and 1980. Samples were collected every 30 min except during periodic flow surges (flushes), when samples were collected every 10 min. Measured total hydrocarbons, suspended solids, flow rate, and rain intensity.

**Hoi-Chaw, L. and F. Meow-Chan** 1985. Field and laboratory studies on the toxicities of oils to mangroves. Pages 539-546 *in* Proceedings 1985 Oil Spill Conference, API Publication4385. American Petroleum Institute, Washington, D.C.
**Keywords:** age/ aliphatic hydrocarbons/ Arabian Light crude oil/ Bunker C/ Corexit 9527/ crude oil/ effects/ experiment/ fuel oil/ growth/ hydrocarbons/ leaves/ light/ Malaysia/ mangrove/ marine invertebrate/ marine plant/ ODsix/ oil/ oil spill/ oiled/ petroleum/ salt water/ shrimp/ spill/ survival/ toxicity/ uptake
**Notes:** Report of a group of related studies performed in Malaysia to test the effects of undispersed and dispersed petroleum on mangroves. Employed laboratory and field experiments; Arabian light crude oil, Bunker C fuel oil, and Malaysian crude oil; Corexit 9527: and two genera of mangroves. Measured survival of mangrove saplings, effect of extent of oiling on sapling survival, effect of age of saplings on survival, amount of uptake of aliphatic hydrocarbons by leaves of saplings, and the growth of shrimp in experimental tanks 4 mos after an experiment 'spill'.

**Holcomb, J, J White**, 1990. Rehabilitating oiled seabirds during the Exxon/Valdez oil spill. Wildlife Journal **13**:26-29.
**Keywords:** bird/ crude oil/ Exxon Valdez/ medical/ oil/ oil spill/ oiled/ Oone/ procedure/ rehabilitation/ release/ salt water/ spill
**Notes:** An early report of the oiled bird rehabilitation efforts during the Exxon Valdez oil spill. Sections on transportation, caging, procedures, medical data collection, research, bird release, and conclusions.

**Holcomb, J.**, 1989. Alaskan oil spill bird rescue efforts. Wildlife Journal **12**:3-13.
**Keywords:** bird/ Exxon Valdez/ mammal/ oil/ oil spill/ Oone/ Prudhoe Bay crude oil/ rehabilitation/ rescue/ salt water/ spill
**Notes:** Early report of the efforts to establish the animal rehabilitation facilities for the Alaskan oil spill (Exxon Valdez).

**Holdway, D. A.**, 2002. The acute and chronic effects of wastes associated with offshore oil and gas production on temperate and tropical marine ecological processes. Marine Pollution Bulletin **44**:185-203.
**Keywords:** acute/ biological effects/ chronic/ crude oil/ drilling fluids/ effects/ environment/ general effect/ metals/ Oeight/ offshore/ oil/ produced water/ production chemicals/ review/ salt water/ time
**Notes:** A review of the acute and chronic biological effects in temperate and tropical environments of wastes from offshore oil and gas production. Sections on produced formation water, drilling fluids and chemicals, crude oil, and metals. Also discusses potential, but unresolved, biological effects and presents a list of questions that remain unanswered.

**Hollaway, S. L., G. M. Faw, R. K. Sizemore**, 1980. The bacterial community composition of an active oil field in the northwestern Gulf of Mexico. Marine Pollution Bulletin **11**:153-156.
**Keywords:** abundance/ bacteria/ biomass/ community/ composition/ depth/ Gulf of Mexico/ Mexico/ miscellaneous/ offshore/ oil/ oil field/ Oten/ salt water/ sulfur
**Notes:** Comparison of community composition of bacteria in an active offshore oil field with that of a control site. Samples were collected during summer, fall, and winter at three locations (7.6 m, 1.6 km, and 3.2 km downcurrent) and at three depths (surface, 10 m, and 20 m). Measured bacterial abundance and biomass, classified major taxa, and measured percent of oil degrading and sulfur oxidizing bacteria.

**Hollister, T. A., G. S. Ward, P. R. Parrish**, 1980. Acute toxicity of a #6 fuel oil to marine organisms. Bulletin of Environmental Contamination and Toxicology **24**:656-661.

**Keywords:** acute/ algae/ Argo Merchant/ combination/ copepod/ fish/ fuel oil/ general effect/ marine invertebrate/ marine plant/ No.6 fuel oil/ Oeight/ oil/ oil spill/ salt water/ spill/ toxicity
**Notes:** An assessment of the toxicity of several pollutants present at the Argo Merchant fuel oil spill. An algae, a copepod, and a fish were exposed to No. 6 fuel oil, a wicking agent, lighter fluid, fuel oil plus wicking agent, fuel oil plus wicking agent plus lighter fluid, burned residue of the former combination, and a reference toxicant. Calculated $EC_{50s}$ and $LC_{50s}$ for all substances.

**Holmes, W. N., J. Cronshaw, J. Gorsline**, 1978. Some effects of ingested petroleum on seawater-adapted ducks (*Anas platyrhynchos*). Environmental Research **17**:177-190.
**Keywords:** bird/ crude oil/ diet/ duck/ effects/ fresh water/ fuel oil/ Kuwait/ Kuwait crude oil/ Louisiana/ mallard/ No.2 fuel oil/ oil/ Oone/ petroleum/ salt water/ South Louisiana crude oil/ stress/ survival
**Notes:** Effects on survival of cold-stressed mallards fed diets containing South Louisiana or Kuwait crude oil, or No. 2 fuel oil.

**Holmes, W. N., K. P. Cavanaugh, J. Cronshaw**, 1978. The effects of ingested petroleum on oviposition and some aspects of reproduction in experimental colonies of mallard ducks (*Anas platyrhynchos*). Journal of Reproduction and Fertility **54**:335-347.
**Keywords:** bird/ colony/ crude oil/ diet/ duck/ effects/ female/ fresh water/ Kuwait/ Kuwait crude oil/ Louisiana/ mallard/ oil/ Oone/ petroleum/ reproduction/ South Louisiana crude oil
**Notes:** Effects on reproductive function of female mallards fed South Louisiana or Kuwait crude oil in the diet for 100 days.

**Holmes, W. N., J. Gorsline, J. Cronshaw**, 1979. Effects of mild cold stress on the survival of seawater-adapted mallard ducks (*Anas platyrhynchos*) maintained on food contaminated with petroleum. Environmental Research **20**:425-444.
**Keywords:** bird/ crude oil/ diet/ duck/ effects/ food/ fresh water/ fuel oil/ Kuwait/ Kuwait crude oil/ Louisiana/ mallard/ No.2 fuel oil/ oil/ Oone/ petroleum/ Prudhoe Bay/ Prudhoe Bay crude oil/ salt water/ Santa Barbara crude oil/ South Louisiana crude oil/ stress/ survival
**Notes:** Effects on adrenocortical stimulation and survival of seawater-adapted and cold-stressed mallards fed South Louisiana, Kuwait, Prudhoe Bay, or Santa Barbara crude oil, or No. 2 fuel oil in the diet for a 100-day experimental period.

**Holmes, W. N.** 1982. Some common pollutants and their effects on steroid hormone-regulated mechanisms. Pages 365-370 *in* C. G. Scanes, M. A. Ottinger, A. D. Kenny, J. Balthazart, J. Cronshaw, I. C. Jones, editors. Aspects of Avian Endocrinology: Practical and Theoretical Implications. Graduate Studies, Texas Tech University. Texas Tech Press, Lubbock, Texas.
**Keywords:** biochemistry/ bird/ concentration/ effects/ gonads/ hormone/ hydrocarbons/ Oone/ petroleum/ petroleum hydrocarbons/ physiology/ steroid/ Texas
**Notes:** Discussion of potential for petroleum hydrocarbons to reduce production and circulating concentrations of gonadal steroid hormones.

**Holmes, W. N., K. P. Cavanaugh**, 1990. Some evidence for an effect of ingested petroleum on the fertility of the mallard drake (*Anas platyrhynchos*). Archives of Environmental Contamination and Toxicology **19**:898-901.
**Keywords:** bird/ crude oil/ diet/ effects/ female/ fertility/ fresh water/ Louisiana/ Louisiana crude oil/ male/ mallard/ oil/ Oone/ petroleum/ reproduction/ South Louisiana crude oil
**Notes:** Effects on gonadal function of male and female mallards fed South Louisiana crude oil in the diet for 100 days.

**Hoover-Miller, A., K. R. Parker, J. J. Burns**, 2001. A reassessment of the impact of the *Exxon Valdez* oil spill on harbor seals (*Phoca vitulina Richardsi*) in Prince William sound, Alaska. Marine Mammal Science **17**:111-135.
**Keywords:** Alaska/ crude oil/ effects/ Exxon Valdez/ harbor seals/ mammal/ North Slope crude oil/ oil/ oil spill/ oiled/ Otwo/ population/ Prince William Sound/ salt water/ seal/ spill/ trend
**Notes:** A re-evaluation and criticism of previous conclusions (Frost et al., 1994) about the effect of the *Exxon Valdez* oil spill on harbor seals in the oiled areas of central and western Prince William Sound.

The authors address the assumptions that (1) seals have a 100% fidelity to a specific haul-out site, (2) they were not displaced by the spill and associated disturbances, and (3) population trends (in the absence of oil spill effects) varied similarly throughout the Sound.

**Horowitz, A., R. M. Atlas**, 1977. Response of microorganisms to an accidental gasoline spillage in an Arctic freshwater ecosystem. Applied Environmental Microbiology **33**:1252-1258.
**Keywords:** Arctic/ biodegradation/ community/ composition/ degradation/ ecosystem/ effects/ fertilizer/ fresh water/ freshwater invertebrate/ gasoline/ hydrocarbons/ microbes/ Ofive/ petroleum hydrocarbons/ population/ respiration/ sediment/ spill
**Notes:** Assessment of the response of sediment microbes from an Arctic lake to a spill of leaded gasoline. Collected sediment samples weekly for 6 consecutive weeks beginning 11 da after the spill and incubated the microbes in laboratory culture; used $^{14}C$. Measured microbial population change, community composition change, respiration, effect of fertilizer on degradation of gasoline, hydrocarbon biodegradation potential, and chemical composition of gasoline in sediment.

**Horsfall, M., Jr., F. E. Ogban, A. I. Spiff**, 1994. Petroleum hydrocarbon pollution: the distribution in sediment and water of the New Calabar River, Port Harcourt, Nigeria. Science of the Total Environment **141**:217-221.
**Keywords:** condition/ distribution/ fresh water/ methods/ miscellaneous/ Nigeria/ Oeleven/ petroleum/ pollution/ river/ sampling/ seasonal/ sediment/ survey
**Notes:** Water and sediment were collected from six zones along a 250 km stretch of the New Calabar River in Nigeria over a 12 mo period during 1990-91. Samples were analyzed for total hydrocarbon content. Results were related to the environmental conditions near the sampling sites. Methods and results descriptions have some gaps.

**Hose, J. E., J. B. Hannah, D. DiJulio, M. L. Landolt, B. S. Miller, W. T. Iwaoka, S. P. Felton**, 1982. Effects of benzo(a)pyrene on early development of flatfish. Archives of Environmental Contamination and Toxicology **11**:167-171.
**Keywords:** abnormalities/ concentration/ development/ effects/ fish/ larvae/ Othree/ pathology/ salt water/ sole/ species/ survival
**Notes:** Larvae of three species of flatfish (sole) were exposed to varying concentrations of benzo(a)pyrene for 7 to 10 days; survival, abnormalities, and pathology.

**Hosmer, A. W., C. E. Stanton, and J. L. Beane** 1997. Intent to spill: environmental effects of oil spills caused by war, terrorism, vandalism, and theft. Pages 157-163 *in* Proceedings 1997 International Oil Spill Conference, 4651. American Petroleum Institute, Washington, D.C.
**Keywords:** effects/ environment/ miscellaneous/ Oeleven/ oil/ oil spill/ spill/ terrorism/ theft/ vandalism/ war
**Notes:** A discussion of intentional oil spills and their effects on the environment. Divided into the categories of war, terrorism, vandalism, and theft.

**Hou, F. S. L., M. W. Milke, D. W. M. Leung, D. J. MacPherson**, 2001. Variations in phytoremediation performance with diesel-contaminated soil. Environmental Technology **22**:215-222.
**Keywords:** diesel/ diesel fuel/ evaluation/ fresh water/ freshwater plant/ germination/ grass/ growth/ hydrocarbons/ miscellaneous/ No.2 fuel oil/ Oseven/ petroleum/ petroleum hydrocarbons/ plant/ roots/ seed/ soil/ weight
**Notes:** An evaluation of the performance of rye grass as a phytoremediation plant. Columns of soil containing 6,400 ppm dry weight of total petroleum hydrocarbons (diesel fuel) were seeded with rye grass. The columns were monitored for 102 da. The soil was analyzed for total petroleum hydrocarbons on four occasions during the study. Measured seed germination, root growth, $CO_2$ in soil, and root and shoot weight.

**Houghton, J. P., R. H. Gilmour, D. C. Lees, W. B. Driskell, S. C. Lindstrom, and A. Mearns** 1997. Prince William Sound intertidal biota seven years later: has it recovered? Pages 679-686 *in* Proceedings 1997 International Oil Spill Conference, 4651. American Petroleum Institute, Washington, D.C.
**Keywords:** Alaska/ barnacle/ bioremediation/ evaluation/ intertidal/ limpet/ marine invertebrate/ marine

plant/ Ofour/ oil/ oil spill/ oiled/ Prince William Sound/ Prudhoe Bay crude oil/ recovery/ rockweed/ salt water/ snail/ spill/ time
**Notes:** Evaluation of the recovery of intertidal flora and fauna in western Prince William Sound, Alaska. Intertidal areas in three categories (unoiled; oiled but untreated or moderately treated with water flushes or bioremediation only; treated with high-pressure, hot-water wash) were sampled in three life zones (upper, middle, lower intertidal) from 1989 through 1996. Primary emphasis on rockweed, snails, limpets, drills, and barnacles.

**Howard, P., W. Meylan, D. Aronson, W. Stiteler, J. Tunkel, M. Comber, T. F. Parkerton**, 2005. A new biodegradation prediction model specific to petroleum hydrocarbons. Environmental Toxicology and Chemistry **24**:1847-1860.
**Keywords:** biodegradation/ degradation/ development/ hydrocarbons/ model/ Onine/ petroleum/ petroleum hydrocarbons/ prediction/ sources/ technical
**Notes:** A biodegradation model was developed for petroleum hydrocarbons. The model development process employed a set of 175 compounds divided into a training set and a validation set. Degradation relations were taken from literature sources. Produced a description of the chronological order of degradation for crude and refined petroleum.

**Howard, S. and D. I. Little** 1987. Effect of infaunal burrow structure on oil penetration into sediments. Pages 427-431 *in* 1987 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), API Publication 4452. American Petroleum Institute, Washington, D.C.
**Keywords:** abundance/ beach/ behavior/ England/ infauna/ lugworms/ marine invertebrate/ mousse/ Ofour/ oil/ oil spill/ oiled/ salt water/ sediment/ spill/ structure
**Notes:** Assessment of the influence of infaunal burrow structures on penetration of oil into sediment. Beach plots in Milford Haven (England) were covered with oil mousse and compared to oiled sterile plots and controls. Measured lugworm casts, abundance of individuals in various taxonomic groups, and oil penetration into sediment.

**Howari, F. M.**, 2004. Investigation of hydrocarbon pollution in the vicinity of United Arab Emirates coasts using visible and near infrared remote sensing data. Journal of Coastal Research **20** :1089-1095.
**Keywords:** Arabian Gulf/ coast/ detection/ methods/ oil/ oil spill/ Onine/ pollution/ remote sensing/ salt water/ spill/ technical/ United Arab Emirates
**Notes:** Description of the use of Landsat ETM+ images for detection of oil spills on the ocean surface. Methods were tested in the Arabian Gulf off the coast of the United Arab Emirates.

**Hsiao, S. I. C.**, 1978. Effects of crude oils on the growth of Arctic marine phytoplankton. Environmental Pollution **17**:93-107.
**Keywords:** algae/ Arctic/ assay/ concentration/ crude oil/ effects/ growth/ marine plant/ oil/ Osix/ phytoplankton/ rate/ salt water/ species/ static/ survival/ temperature/ time
**Notes:** An assessment of the effects of three crude oils on four species of Arctic marine phytoplankton. Algae were exposed to five concentrations of crude oil and three ambient temperatures in static assays lasting 10 da. Cultures were sampled every 2 da. Measured survival, growth rate, and generation time.

**Hsiao, S. I. C., D. W. Kittle, M. G. Foy**, 1978. Effects of crude oils and the oil dispersant Corexit on primary production of Arctic marine phytoplankton and seaweed. Environmental Pollution **15**:209-221.
**Keywords:** algae/ Arctic/ Canada/ carbon-14/ concentration/ crude oil/ dispersant/ effects/ macroalgae/ marine plant/ ODsix/ oil/ phytoplankton/ productivity/ salt water/ species/ uptake
**Notes:** An assessment of the effects of chemically-dispersed and undispersed crude oil on primary production of Arctic marine phytoplankton and two species of macroalgae. Phytoplankton were exposed to three concentrations of either of four crude oils, Corexit dispersant alone, or crude oils plus dispersant in BOD bottles placed *in situ* at various sites in the Beaufort Sea and Eskimo Lakes area of Canada. Macroalgae were exposed to crude oils only. Carbon-14 uptake was used to determine productivity in phytoplankton and macroalgae. Physical, chemical, and biological characteristics of the seawater were measured at each *in situ* experimental site.

**Hudak, P. F., D. J. Wachal**, 2001. Oil production, agriculture, and groundwater quality in the southeastern Gulf Coast Aquifer, Texas. Environmental Monitoring and Assessment **72**:249-264.
**Keywords:** barium/ brine water/ bromide/ chloride/ coast/ concentration/ dissolved/ fresh water/ ground water/ iodine/ miscellaneous/ nitrate/ Oeleven/ oil/ sulfate/ Texas/ waste water
**Notes:** An assessment of the influence of oil production and agriculture on ground water quality in counties along the Gulf coast of Texas. A GIS system was used to map data on oil or gas wells (19,234), water wells (256), and land uses. Concentrations of chloride, bromide, sulfate, barium, iodine, and nitrate, as well as total dissolved solids, were compared to the proximity of oil and gas wells and the adjacent land use.

**Huesemann, M. H.**, 1995. Predictive model for estimating the extent of petroleum hydrocarbon biodegradation in contaminated soils. Environmental Science and Technology **29**:7-18.
**Keywords:** analysis/ aromatic hydrocarbons/ bacteria/ biodegradation/ bioremediation/ crude oil/ diesel/ drilling mud/ farming/ fertilizer/ fuel oil/ hydrocarbons/ land farming/ methods/ microbes/ model/ motor oil/ No.2 fuel oil/ oil/ Oten/ petroleum/ saturated hydrocarbons/ soil/ technical/ total hydrocarbons/ treatment/ weathered
**Notes:** A set of seven bioremediationexperiments were conducted with three crude oils, diesel-based drilling mud, weathered crude oil, weathered motor oil, and weathered No. 2 fuel oil (diesel). Fertilizer or a bacteria supplement was added and each batch was subjected to either land farming or slurry treatment. Duration of the treatment ranged from 34 to 52 wks. Soil samples were analyzed for saturated, aromatic, and total hydrocarbons by a variety of methods. Results are very well presented for a number of interpretive purposes.

**Huesemann, M. H.** 1997. Land treating petroleum hydrocarbon-contaminated soils. Pages 237-261 *in* P. N. Cheremisinoff, editor. Ecological Issues and Environmental Impact Assessment. Gulf Publishers, Houston, TX.
**Keywords:** biodegradation/ degradation/ hydrocarbons/ microbes/ nutrients/ Oten/ petroleum/ remediation/ soil
**Notes:** Description of the steps involved in the remediation of soils contaminated by petroleum; all actions are designed to understand the biodegradation potential and to maximize microbial degradation of petroleum compounds.

**Huesemann, M. H., T. S. Hausmann, T. J. Fortman**, 2003. Assessment of bioavailability limitations during slurry biodegradation of petroleum hydrocarbons in aged soils. Environmental Toxicology and Chemistry **22**:2853-2860.
**Keywords:** alkane/ biodegradation/ concentration/ degradation/ hydrocarbons/ microbes/ Oten/ PAH/ petroleum/ petroleum hydrocarbons/ rate/ release/ soil/ time
**Notes:** Six soils with different physical properties and aged either artificially or naturally were used to determine the role of bioavailability on degradation rates. A synthetic mixture of eight alkanes and four PAHs were added to three laboratory soil samples and aged for 51 mos; a fourth soil was aged for 21 mos. Field soils were > 5 yrs and > 10 yrs old. Samples of aged soils were bioremediated in slurry reactors for182-354 da. Measured biodegration and abiotic release rates of the 12 hydrocarbons, and concentrations of hydrocarbon degraders.

**Huggett, R. J., J. J. Stegeman, D. S. Page, K. R. Parker, B. Woodin, J. S. Brown**, 2003. Biomarkers in fish from Prince William Sound and the Gulf of Alaska: 1999-2000. Environmental Science and Technology **37**:4043-4051.
**Keywords:** Alaska/ analysis/ aromatic hydrocarbons/ bile/ biochemical/ biomarker/ fish/ gill/ Gulf of Alaska/ heart/ liver/ oiled/ Othree/ Prince William Sound/ salt water/ spill/ tissue
**Notes:** Fish from the spill path (oiled area), spill path (unoiled area), non-spill path, and Gulf of Alaska were sampled for a suite of biochemical and histological measures. Investigators collected bile and liver for analysis of fluorescent aromatic contaminants and liver cytochrome P450 (EROD) induction; and liver, heart, and gill tissue for immunohistochemical determinations.

**Huggett, R. J., J. M. Neff, J. J. Stegeman, B. Woodin, K. R. Parker, J. S. Brown**, 2006. Biomarkers of PAH exposure in an intertidal fish species from Prince William Sound, Alaska: 2004-2005. Environmental

Science and Technology **40**:6513-6517.
**Keywords:** activity/ Alaska/ aromatic/ aromatic hydrocarbons/ bile/ biomarker/ fish/ intertidal/ liver/ oiled/ Othree/ PAH/ Prince William Sound/ salt water/ species/ time
**Notes:** A comparison of biomarkers of exposure to PAH for an intertidal fish in Prince William Sound, Alaska. Fish were collected in 2004 at 10 previously oiled (1989) and two unoiled sites, and two sites with previous human activity. In 2005, four previously oiled and three unoiled sites were sampled. Livers of fish from 2004 were analyzed for EROD activity. Livers of fish from 2005 were analyzed for EROD and bile fluorescent aromatic compounds.

**Hughes, J. B.**, 1999. Cytological -- cytogenetic analyses of winter flounder embryos collected from the benthos at the barge *North Cape* oil spill. Marine Pollution Bulletin **38**:30-35.
**Keywords:** abnormalities/ chromosome/ decline/ diesel/ effects/ embryo/ fish/ flounder/ heating oil/ No.2 fuel oil/ oil/ oil spill/ Othree/ pathology/ population/ Rhode Island/ salt water/ spill/ winter flounder
**Notes:** Effects of a spill of diesel and home heating oil in coastal Rhode Island from the barge *North Cape.* Embryos of winter flounder were collected from 22 sites near the spill. Embryos were assessed for morphological and chromosomal abnormalities; estimated the probable decline in the number of embryos surviving to the larval stage.

**Hughes, M. R., C. Kasserra, B. R. Thomas**, 1990. Effect of externally applied bunker fuel on body mass and temperature, plasma concentration, and water flux of glaucous-winged gulls, *Larus glaucescens*. Canadian Journal of Zoology **68**:716-721.
**Keywords:** bird/ blood/ Bunker C/ concentration/ fresh water/ fuel oil/ glaucous-winged gull/ gull/ oil/ oiled/ Oone/ physiology/ plasma/ plumage/ temperature/ weight
**Notes:** Effect on body mass, temperature, and blood chemistry of young glaucous-winged gulls subjected to plumage oiling with Bunker C fuel oil for 4-5 days.

**Hull, C. L., M. A. Hindell, R. P. Gales, R. A. Meggs, D. I. Moyle, N. P. Brothers**, 1998. The efficacy of translocating little penguins *Eudyptula minor* during an oil spill. Biological Conservation **86**:393-400.
**Keywords:** bird/ Bunker C/ coast/ fuel oil/ movement/ oil/ oil spill/ oiled/ Oone/ penguin/ population/ rate/ rehabilitation/ salt water/ spill
**Notes:** The grounding of the *Iron Baron* off the north coast of Tasmania produced a Bunker C fuel oil spill that oiled many little penguins. Over 2000 penguins were brought into captivity. Thirty-one penguins were tagged with radio transmitters and released on the far side of Tasmania. Movement and return rate information was used to guide subsequent relocations of rehabilitated penguins.

**Humphrey, B., P. D. Boehm, M. C. Hamilton, R. J. Norstrom**, 1987. The fate of chemically dispersed and untreated crude oil in Arctic benthic biota. Arctic **40**:149-161.
**Keywords:** aliphatic hydrocarbons/ Arctic/ aromatic hydrocarbons/ beach/ benthic/ bivalve/ Canada/ crude oil/ depth/ dispersal/ dispersant/ fate/ marine invertebrate/ ODfour/ oil/ oil spill/ release/ salt water/ sampling/ sea urchin/ species/ spill/ tissue/ uptake/ urchin
**Notes:** Assessment of the uptake by benthic biota of chemically dispersed and untreated crude oil from two experimental oil spills at Cape Hatt, N.W.T., Canada. One experimental spill was chemically dispersed, the other was released on the surface and allowed to strand on the beach. Four species of bivalve and one sea urchin were sampled from four bays at two sampling depths before the oil release, immediately after the release, 2-3 wk after releases, 1 yr after release, and 2 yr after release. Measured the aliphatic and aromatic hydrocarbon content of whole tissue.

**Hunt, G. S.** 1961. Waterfowl losses on the lower Detroit River due to oil pollution. Pages 10-26 *in* Proceedings, Fourth Conference on Great Lakes Research: Ann Arbor, Michigan, April 17-18, 1961. Great Lakes Research Division publication. Institute of Science and Technology, University of Michigan, Ann Arbor, MI.
**Keywords:** bird/ effects/ experiment/ fresh water/ history/ oil/ Oone/ pollution/ review/ spill/ survival/ waterfowl/ Great Lakes/ Michigan
**Notes:** An account of losses of waterfowl due to oil pollution on the Detroit River, a literature review, eleven small experiments on the effects of oil on waterfowl, and management recommendations. A good historical reference to oil pollution in the 30s, 40s, and 50s.

**Hunt, W. M., Jr. and J. G. Parks** 1997. Regulatory approaches to oils under the federal Water Pollution Control Act and the Oil Pollution Act of 1990. Pages 51-58 *in* 1997 International Oil Spill Conference. Improving Environmental Protection. Progress, Challenges, Responsibilities. American Petroleum Institute, Washington, DC.
**Keywords:** coast/ effects/ history/ miscellaneous/ nonpetroleum oil/ Oeleven/ oil/ oil spill/ petroleum/ pollution/ protection/ regulation/ review/ spill/ vegetable oil
**Notes:** A review of the effects, definitions, and legislative history of petroleum and nonpetroleum oils as environmental contaminants. Discussion of the significance of nonpetroleum oils for the Coast Guard, EPA, and Dept. of Transportation.

**Hunter, J. V., T. Sabatino, R. Gomperts, M. J. MacKenzie** , 1979. Contribution of urban runoff to hydrocarbon pollution. Journal of the Water Pollution Control Federation **51**:2129-2139.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ depth/ fresh water/ hydrocarbons/ miscellaneous/ Oeleven/ particulate/ pollution/ solubility/ sources/ urban
**Notes:** A storm sewer in northern Philadelphia was sampled during five storm events in 1974-75. Measured the duration of the discharge, discharge volume, and calculated the watershed 'depth' of the runoff. The water was analyzed for soluble and particulate aliphatic and aromatic hydrocarbons. Calculated hydrocarbon loadings for the watershed and attempted to identify the sources of the hydrocarbons.

**Huntley, S. L., N. L. Bonnevie, R. J. Wenning**, 1995. Polycyclic aromatic hydrocarbon and petroleum hydrocarbon contamination in sediment from the Newark Bay estuary, New Jersey. Archives of Environmental Contamination and Toxicology **28**:93-107.
**Keywords:** aromatic hydrocarbons/ diesel/ diesel fuel/ estuary/ hydrocarbons/ miscellaneous/ New Jersey/ No.2 fuel oil/ Oeleven/ PAH/ petroleum/ petroleum hydrocarbons/ sediment/ survey
**Notes:** A total of 213 sediment samples from 58 sediment cores were collected from the Newark Bay estuary area during 1991-93. Sediments were analyzed for individual PAHs (19) and total extractable petroleum hydrocarbons calibrated with diesel fuel. Results are broken down into regional assessments.

**Hurst, R. J., N. A. Oritsland**, 1982. Polar bear thermoregulation: effect of oil on the insulative properties of fur. Journal of Thermal Biology **7**:201-208.
**Keywords:** crude oil/ fur/ insulation/ mammal/ motor oil/ oil/ Otwo/ polar bear/ salt water/ thermoregulation
**Notes:** Effect of motor oil and two crude oils on the insulative properties of polar bear fur; fur from three bears, several types of air exposure, winter and summer.

**Hurst, R. J., P. D. Watts, N. A. Oritsland**, 1991. Metabolic compensation in oil-exposed polar bears. Journal of Thermal Biology **16**:53-56.
**Keywords:** crude oil/ effects/ fur/ insulation/ mammal/ oil/ oiled/ Otwo/ physiology/ polar bear/ respiration/ salt water/ thermoregulation
**Notes:** Effects of experimental oiling on thermoregulation of polar bears; three bears, crude oil, respiration chamber, body transmitters.

**Hussein, H. S., N. Terry**, 2002. Phytomonitoring the unique colonization of oil-contaminated saline environment by *Limoniastrum monopetalum* (L.) Boiss in Egypt. Environment International **28**:127-135.
**Keywords:** amino acids/ coast/ Egypt/ environment/ fatty acids/ marine plant/ minerals/ Osix/ petroleum/ plant/ pollution/ salt water/ species/ vegetation
**Notes:** Investigation of a petroleum polluted coastal (Egypt) saline depression and the vegetation growing in it. The area was divided into four sections and 15 plants of the one remaining species were collected from each section, pooled , and analyzed for proline, betaine, free amino acids, fatty acid esters, and mineral elements. There were four replicate analyses. The same was done at a control location. Results were compared in an effort to describe physiological changes in the remaining species.

**Hyland, J., D. Hardin, M. Steinhauer, D. Coats, R. Green, J. Neff**, 1994. Environmental impact of offshore oil development on the Outer Continental Shelf and slope off Point Arguello, California. Marine Environmental Research **37**:195-229.

**Keywords:** abundance/ benthic/ California/ concentration/ development/ drilling fluids/ drilling mud/ effects/ epifauna/ hydrocarbons/ marine invertebrate/ metals/ offshore/ Ofour/ oil/ petroleum/ petroleum hydrocarbons/ salt water/ sediment
**Notes:** Assessment of several effects of drilling platforms on the ocean floor off Southern California. Hard- and soft-bottom sites were sampled over a 4-yr period. Drilling sites were sampled before, during, and after initiation of drilling. Measured depositional flux, depositional pattern, concentrations of metals and petroleum hydrocarbons in sediments, and abundance of epifauna.

**Hyland, J., D. Laur, J. Jones, J. Shrake, D. Cadian, L. Harris**, 1994. Effects of an oil spill on the soft-bottom macrofauna of Arthur Harbour, Antarctica compared with long-term natural change. Antarctic Science **6**:37-44.
**Keywords:** Antarctic/ Antarctica/ aromatic hydrocarbons/ benthic/ community/ diesel/ diesel fuel/ effects/ evaluation/ harbour/ hydrocarbons/ long-term/ macrofauna/ marine invertebrate/ numbers/ Ofour/ oil/ oil spill/ PAH/ population/ salt water/ sediment/ species/ spill/ total hydrocarbons/ unresolved complex mixture
**Notes:** Evaluation of the effects on benthic macrofauna of a spill of diesel fuel in Arthur Harbor, Antarctica. Sampled four sites (two historical controls, one spill site, one spill control) 2 mo after the spill. Measured numbers of individuals, species, and families of macrofauna, sediment characteristics, total hydrocarbons, unresolved complex mixture, and PAHs.

**Hyland, J. L., E. D. Schneider** 1979. Petroleum hydrocarbons and their effects on marine organisms, populations, communities, and ecosystems. Pages 463-506 *in* Sources, Effects & Sinks of Hydrocarbons in the Aquatic Environment. The American Institute of Biological Sciences, Washington, DC.
**Keywords:** bird/ community/ ecosystem/ effects/ environment/ fish/ general effect/ hydrocarbons/ mammal/ marine environment/ marine invertebrate/ marine plant/ Oeight/ petroleum/ petroleum hydrocarbons/ population/ review/ salt water/ sources
**Notes:** A 1976 review and summarization of our knowledge of the effects of petroleum hydrocarbons in the marine environment. Over 100 references and five tables of information. A good record of knowledge accumulated by the mid 1970s.

**Hyotylainen, T., A. Oikari**, 2004. Bioaccumulation of PAHs from creosote-contaminated sediment in a laboratory-exposed freshwater oligochaete, *Lumbriculus variegatus*. Chemosphere **57**:159-164.
**Keywords:** chemical analysis/ creosote/ Finland/ freshwater/ freshwater invertebrate/ nitrogen/ Ofive/ oligochaete/ PAH/ sediment/ uptake/ water
**Notes:** A sediment-dwelling oligochaete was used to determine the uptake of creosote PAHs from contaminated lake sediments. Sediments were from a remediated lake site and were kept stored for 5 yrs under nitrogen. Oligochaetes were exposed for 28 da to either the creosote sediment or a synthethic reference sediment of identical characteristics. The sediment, overlying water, and oligochaetes were analyzed at the beginning and end of the study for six PAHs.

**Ibrahim, M. B. M., H. A. Gamila**, 2004. Algal bioassay for evaluating the role of algae in bioremediation of crude oil: II. Freshwater phytoplankton. Bulletin of Environmental Contamination and Toxicology **73**:971-978.
**Keywords:** algae/ bacteria/ bioassay/ biomass/ bioremediation/ chlorophyll/ community/ composition/ crude oil/ experiment/ fresh water/ freshwater/ freshwater plant/ fungi/ light/ methods/ oil/ Oseven/ PAH/ phytoplankton/ river/ water
**Notes:** Cultures of Nile River agal communities were used in a laboratory assessment of the ability of phytoplankton to degrade Egyptian light crude oil in water. Experiment duration was 42 da. Chlorophyll *a* was used as a surrogate for algal biomass increase and community composition was determined at the beginning and end of the study. Measured 8 n-alkanes and 15 PAHs at 7, 21, and 42 da. Data presentation is hard to follow because some details are missing from the Methods. Also, the authors do not consider the role of bacteria and fungi that likely accompanied their collections of algae from the Nile River.

**Ignatiades, L., N. Mimicos**, 1977. Ecological responses of phytoplankton on chronic oil pollution. Environmental Pollution **13**:109-118.
**Keywords:** chronic/ coast/ community/ depth/ diversity/ Greece/ hydrocarbons/ index/ marine plant/ oil/ Osix/ petroleum/ petroleum hydrocarbons/ phytoplankton/ pollution/ salt water/ sampling/ species/ species diversity/ time
**Notes:** A comparison, over a 1-yr period, of the phytoplankton communities of a polluted bay and an unpolluted reference site off the coast of Greece. Details of the reference site were reported in another publication. This report describes the results of sampling (1, 5, 10, and 20 m) at one location in Elefsis Bay (polluted). Water at the site was characterized at 1 and 20 m; and phytoplankton were identified at all depths 12 times during the year. 'Petroleum hydrocarbons' were measured at 1 m and 20 m depths. An index of species diversity for phytoplankton was calculated at each depth and the results compared to those of the reference location.

**Ijah, U. J. J., S. P. Antai**, 2003. Removal of Nigerian light crude oil in soil over a 12-month period. International Biodeterioration & Biodegradation **51**:93-99.
**Keywords:** crude oil/ degradation/ incubation/ microbes/ Nigerian crude oil/ oil/ Oten/ soil/ time
**Notes:** Soil was treated with either 10, 20, 30, or 40 % v/w of Nigerian crude oil and incubated for 12 months. Monthly samples were taken for identification and quantification of microbes. Crude oil was measured in the soil at 0, 3, 6, 9, and 12 mos. Five bacterial isolates were assessed for their ability to degrade crude oil over a 16-da period of incubation.

**Ikarashi, Y., M. Kaniwa, T. Tsuchiya**, 2005. Monitoring of polycyclic aromatic hydrocarbons and water-extractable phenols in creosotes and creosote-treated woods made and procurable in Japan. Chemosphere **60**:1279-1287.
**Keywords:** aromatic/ aromatic hydrocarbon/ aromatic hydrocarbons/ creosote/ effectiveness/ hazard/ hydrocarbons/ Japan/ miscellaneous/ monitoring/ Oeleven/ PAH/ phenol/ procedure
**Notes:** Measured and described the PAH content of nine creosote wood preservatives, three non-creosote wood preservatives, creosote foundation pilings, creosote wood from railway sleeper cars, and creosote wood stakes. Compared the effectiveness of four extraction procedures and measured 16 PAHs.

**Ilarionov, S. A., A. V. Nazarov, I. G. Kalachnikova**, 2003. The role of micromycetes in the phytotoxicity of crude oil-polluted soils. Russian Journal of Ecology **34**:303-308.
**Keywords:** biomass/ concentration/ crude oil/ freshwater plant/ germination/ growth/ microbes/ Oten/ roots/ seed/ seedling/ soil/ survival
**Notes:** Meadow clover seedlings were grown in either (1) oil-polluted soil (30% crude oil), unsterile conditions, (2) oil-polluted soil, sterile conditions, (3) clean soil, unsterile conditions, (4) clean soil, sterile conditions, (5) oil-polluted soil plus bacterial addition, and (6) oil-polluted soil plus fungal addition. Measured survival and air-dry biomass of surviving plants. Used meadow clover and smooth brome seeds in a germination study involving five concentrations of petroleum in the soil. The effectiveness of three antifungal agents on fungal presence on and near roots was the objective of another initiative. A complex and somewhat confusing description of a mutifaceted investigation with interesting results.

**Irons, D. B., S. J. Kendall, W. P. Erickson, L. L. McDonald, B. K. Lance**, 2000. Nine years after the *Exxon Valdez* oil spill: effects on marine bird populations in Prince William Sound, Alaska. Condor **102**:723-737.
**Keywords:** Alaska/ bird/ density/ effects/ Exxon Valdez/ foraging/ marine birds/ oil/ oil spill/ Oone/ population/ Prince William Sound/ Prudhoe Bay crude oil/ salt water/ spatial scale/ spill/ survey/ transect
**Notes:** Densities of marine birds in Prince William Sound, Alaska were determined in 1984-85, 1989-91, 1993, 1996, and 1998. The pre-spill surveys consisted of 772 transects but the post-spill surveys consisted of a subset of 187 transects in 1989 and 212 transects in 1990-91, 1993, 1996, and 1998. A subset of those transects (108 in 1989, 123 in other post-spill years) was used in the population analyses. Methodology was consistent over all years. Pre-spill and post-spill results were evaluated according to foraging method and three spatial scales.

**Irvine, G. V., D. H. Mann, J. W. Short**, 1999. Multi-year persistence of oil mousse on high energy beaches distant from the *Exxon Valdez* spill origin. Marine Pollution Bulletin **38**:572-584.
**Keywords:** beach/ condition/ Exxon Valdez/ gravel/ miscellaneous/ mousse/ North Slope crude oil/ Oeleven/ oil/ oiled/ origin/ PAH/ persistence/ salt water/ spill/ time/ weathered
**Notes:** Five study sites were established in 1992 on boulder and gravel beaches along the Alaskan Penninsula; areas of heaviest oiling were identified and studied in 1992 and 1994. Stranded oil (mousse) was sampled and analyzed in 1989, 1992, and 1994. The geomorphology and oiling conditions were described for each site and the remnant oil was analyzed for a suite of 40 PAHs.

**Irvine, G. V., D. H. Mann, J. W. Short**, 2006. Persistence of 10-year old *Exxon Valdez* oil on Gulf of Alaska beaches: The importance of boulder-armoring. Marine Pollution Bulletin **52**:1011-1022.
**Keywords:** Alaska/ beach/ boulder/ crude oil/ Exxon Valdez/ Gulf of Alaska/ miscellaneous/ movement/ Oeleven/ oil/ oil spill/ PAH/ persistence/ salt water/ sampling/ sediment/ shoreline/ spill/ weathered
**Notes:** Six shoreline locations along the Kenai and Alaska Peninsula, characterized by boulder-armoring, were sampled in 1999 for the presence of crude oil from the Exxon Valdez oil spill. Sediments were analyzed for a set of PAH and the results compared to an identical sampling performed in 1994. Results of both were compared to results of similar samples collected from a subset of the sites in 1992 and 1989. Movement of boulders was also measured.

**Isikhuemhen, O. S., G. O. Anoliefo, O. I. Oghale**, 2003. Bioremediation of crude oil polluted soil by the white rot fungus, *Pleurotus tuberregium* (Fr.) Sing. Environmental Science and Pollution Research **10**:108-112.
**Keywords:** bioremediation/ crude oil/ evaluation/ germination/ height/ length/ oil/ plant/ root/ seed/ soil/ weight
**Notes:** An evaluation of a white rot fungus as a bioremediation tool for petroleum-contaminated soils. Soil was mixed with sawdust innoculated with the fungus and either 1, 3, 5, 10, or 15% crude oil (by weight) was added. Bean seeds were planted in the soil at 0, 7, or 14 da after the soil mixture was prepared. Measured seed germination, and then plant height and root length at 7-da intervals up to 21 da post-germination.

**Iturbe, R., R. M. Flores, L. G. Torres**, 2003. Soil and water contamination levels in an out-of-service oil distribution and storage station in Michoacan, Mexico. Water, Air, and Soil Pollution **146**:261-281.
**Keywords:** BTEX/ concentration/ crude oil/ diesel/ distribution/ gasoline/ health/ Mexico/ miscellaneous/ Oeleven/ oil/ PAH/ petroleum/ remediation/ risk/ risk assessment/ soil/ storage/ TPH
**Notes:** A detailed description of the soil contamination beneath an inactive petroleum product storage and distribution center in Mexico. Site characteristics were described, soil analyzed for TPH, PAHs, BTEX, gasoline, diesel, MTBE, VOCs, Pb, Cr, Fe, and Zn. Several crude oils and products were also analyzed for Cu and Ni. Remediation concentrations were established based on human health risk assessments.

**Jackson, J. B. C., J. D. Cubit, B. D. Keller, V. Batista, K. Burns, H. M. Caffey, R. L. Caldwell, S. D. Garrity, C. D. Getter, C. Gonzalez, H. M. Guzman, K. W. Kaufmann, A. H. Knap, S. C. Levings, M. J. Marshall, R. Steger, R. C. Thompson, E. Weil**, 1989. Ecological effects of a major oil spill on Panamanian coastal marine communities. Science **243**:37-44.
**Keywords:** algae/ community/ coral/ crude oil/ effects/ general effect/ infauna/ intertidal/ invertebrate/ marine invertebrate/ marine plant/ Oeight/ oil/ oil spill/ Panama/ population/ salt water/ seagrass/ spill/ subtidal/ time
**Notes:** A summarized report on the environmental effects of the 1986 Bahia Las Minas crude oil spill in coastal Panama at the 1.5 yr post-spill stage. Effects on intertidal mangroves, seagrasses, algae, and associated invertebrates; and subtidal reef corals and infauna of seagrass beds are described. This is an extremely well-studied tropical oil spill.

**Jackson, L., T. Bidleman, W. Vernberg**, 1981. Influence of reproductive activity on toxicity of petroleum hydrocarbons to ghost crabs. Marine Pollution Bulletin **12**:63-65.
**Keywords:** activity/ aromatic hydrocarbons/ bioassay/ concentration/ crab/ crude oil/ eye/ flow-through/ gill/ gonads/ heart/ hepatopancreas/ hydrocarbons/ Kuwait/ Kuwait crude oil/ marine invertebrate/ muscle/

Ofour/ oil/ petroleum/ petroleum hydrocarbons/ salt water/ survival/ toxicity
**Notes:** Assessment of the effect of crude oil on ghost crabs during reproductive and nonreproductive periods. Field-captured crabs were exposed to the water-soluble fraction of Kuwait crude oil in a flow-through bioassay for 96 hr. Crabs were captured in July, August, September, and October. Measured survival and concentration of aromatic hydrocarbons in exposure water, heart, muscle, gonad, eye, hepatopancreas, and gill.

**Jackson, S.**, 1993. The effects of oil pollution on seabirds. Penquin Conservation **6**:4-9.
**Keywords:** bird/ effects/ oil/ Oone/ physiology/ pollution/ population/ salt water/ spill
**Notes:** A general account of the effects of oil on seabirds.

**Jackson, W. A., J. H. Pardue**, 1999. Potential for enhancement of biodegradation of crude oil in Louisiana salt marshes using nutrient amendments. Water, Air, and Soil Pollution **109**:343-355.
**Keywords:** alkane/ aromatic hydrocarbons/ biodegradation/ crude oil/ degradation/ effects/ evaluation/ experiment/ hydrocarbons/ Louisiana/ Louisiana crude oil/ mesocosm/ microbes/ nitrogen/ nutrients/ oil/ Oten/ phosphorus/ rate/ salt marsh/ salt water/ soil/ South Louisiana crude oil/ vegetation
**Notes:** Evaluation of the effects of nutrient enhancement on biodegradation of South Louisiana crude oil. One experiment performed in aquatic mesocosms (N and P used) and a second performed with intact cores of marsh soil and vegetation (N only). Loading rates and the best form of N were determined. Measured the degradation of selected alkane and aromatic hydrocarbons.

**Jacobs, R. P. W. M.**, 1980. Effects of the 'Amoco Cadiz' oil spill on the seagrass community at Roscoff with special reference to the benthic infauna. Marine Ecology Progress Series **2**:207-212.
**Keywords:** Amoco Cadiz/ benthic/ coast/ community/ crude oil/ density/ diversity/ eelgrass/ effects/ evaluation/ France/ infauna/ invertebrate/ marine invertebrate/ marine plant/ numbers/ Ofour/ oil/ oil spill/ salt water/ seagrass/ species/ spill
**Notes:** Evaluation of the effects of the Amoco Cadiz crude oil spill (March 1978) on the benthic invertebrates of an eelgrass bed off the coast of France. Upper and lower portions of the eelgrass bed were separately evaluated on a monthly basis during the period October 1977 to April 1979. Measured density of benthic individuals, species numbers and diversity.

**Jacobsson, A., E. Newman**, 1991. Fish recruitment around a petrochemical centre in the North Sea. Marine Pollution Bulletin **22**:269-272.
**Keywords:** abundance/ fish/ North Sea/ Othree/ population/ recruitment/ refinery/ reproduction/ salt water/ size/ species/ Sweden
**Notes:** Assessment of recruitment of two marine fish species near a petrochemical complex on coastal Sweden; abundance, size, and reproductive success measured.

**Jahn, A. E. and G. A. Robilliard** 1997. Natural recovery: a practical natural resource restoration option following oil spills. Pages 665-668 *in* Proceedings 1997 International Oil Spill Conference, API 4651. American Petroleum Institute, Washington, D.C.
**Keywords:** miscellaneous/ natural resource/ Oeleven/ oil/ oil spill/ recovery/ restoration/ spill
**Notes:** A discussion of 'natural recovery' as a restoration option following oil spills. Authors define 'natural recovery', discuss the natural role of disturbance, recovery following disturbance, and natural recovery following oil spills.

**Jahns, H. O., J. R. Bragg, L. C. Dash, and E. H. Owens** 1991. Natural cleaning of shorelines following the *Exxon Valdez* spill. Pages 167-176 *in* 1991 International Oil Spill Conference, API Publication 4529. American Petroleum Institute, Washington, D.C.
**Keywords:** Alaska/ analysis/ cleaning/ Exxon Valdez/ hydrocarbons/ microbes/ monitoring/ oil/ oil spill/ Oten/ petroleum/ petroleum hydrocarbons/ Prince William Sound/ salt water/ sediment/ shoreline/ spill/ time/ weathered
**Notes:** A description and discussion of natural shoreline cleaning at 16 monitoring sites in Prince William Sound, Alaska. The sites were monitored during the winter (Sept - Mar) of 1989-90. Analyzed surface and subsurface sediments for total petroleum hydrocarbons and compared among high, moderate, and low energy sites.

**Jayko, K., M. Reed, A. Bowles**, 1990. Simulation of interactions between migrating whales and potential oil spills. Environmental Pollution **63**:97-127.
**Keywords:** Alaska/ development/ interactions/ mammal/ model/ oil/ oil spill/ Otwo/ salt water/ simulation/ species/ spill/ whale
**Notes:** Development of a simulation model for migrating bowhead and gray whales in the presence of oil spills in Alaskan waters.

**JBF Scientific Corporation**. 1984. Response of crude oil slicks to dispersant treatment at sea. U.S. Environmental Protection Agency, Washington, D.C. **EPA-600/S2-84-067**. 4 pp.
**Keywords:** concentration/ crude oil/ depth/ dispersant/ ODnine/ oil/ oil slick/ oil spill/ petroleum/ salt water/ spill/ technical/ treatment/ water column
**Notes:** A Project Summary describing the results of four experimental oil spills in 1978 and four more in 1979. Employed two crude oils (Murban and LaRosa) and an unidentified chemical dispersant. Sampled the concentration of petroleum in the water column beneath oil slicks at depths of 0-9 m over several hours.

**Jensen, K.**, 1981. Levels of hydrocarbons in mussels, *Mytilus edulis*, and surface sediments from Danish coastal areas. Bulletin of Environmental Contamination and Toxicology **26**:202-206.
**Keywords:** concentration/ Denmark/ hydrocarbons/ marine invertebrate/ mussel/ Ofour/ petroleum/ petroleum hydrocarbons/ salt water/ sediment/ tissue/ total hydrocarbons
**Notes:** Determination of the concentrations of petroleum hydrocarbons in blue mussels and sediments of coastal Denmark. Samples collected from 12 locations between January and May 1980. Measured total hydrocarbons in mussel tissue and sediments.

**Jenssen, B. M., M. Ekker, C. Bech**, 1985. Thermoregulation in a naturally oil-contaminated black-billed murre *Uria aalge*. Bulletin of Environmental Contamination and Toxicology **35**:9-14.
**Keywords:** bird/ oiled/ Oone/ physiology/ plumage/ salt water/ temperature/ thermoregulation
**Notes:** Thermoregulation in a single naturally-oiled black-billed murre.

**Jenssen, B. M., M. Ekker**, 1988. A method for evaluating the cleaning of oiled seabirds. Wildlife Society Bulletin **16**:213-215.
**Keywords:** bird/ cleaning/ methods/ oiled/ Oone/ physiology/ plumage/ rehabilitation/ temperature
**Notes:** Description of a method to assess the success of cleaning of oiled birds; based on measured body temperature and heat production.

**Jenssen, B. M.**, 1989. Effects of ingested crude and dispersed crude oil on thermoregulation in ducks (*Anas platyrhynchos*). Environmental Research **48**:49-56.
**Keywords:** bird/ crude oil/ dispersant/ duck/ effects/ fresh water/ ingestion/ mallard/ ODone/ oil/ temperature/ thermoregulation
**Notes:** Effects on thermoregulation in mallard ducks of doses of crude oil and chemically-dispersed crude oil.

**Jenssen, B. M., M. Ekker**, 1989. Rehabilitation of oiled birds: a physiological evaluation of four cleaning agents. Marine Pollution Bulletin **20**:509-512.
**Keywords:** bird/ cleaning/ evaluation/ oiled/ Oone/ physiology/ plumage/ rehabilitation
**Notes:** An assessment of the ability of four cleaning agents to clean plumage and restore the natural insulative properties; use of a metabolic chamber.

**Jenssen, B. M., M. Staurnes**, 1989. Effects of oil on eggshell conductance. Comparative Biochemistry and Physiology **93C**:221-223.
**Keywords:** bird/ chicken/ conductance/ crude oil/ effects/ egg shell/ eggs/ oil/ Oone/ shell
**Notes:** Effects on water vapor conductance of chicken egg shells receiving varied applications of crude oil.

**Jenssen, B. M., M. Ekker** 1990. Effects of plumage oiling on thermoregulation in common eiders residing in air and in water. Pages 281-287 *in* Svein. Myrberget, editor. Transactions of the XIXth IUGB

Congress the International Union of Game Biologists, September 1989, Trondheim, Norway. NINA Norwegian Institute for Nature Research, Trondheim, Norway.
**Keywords:** bird/ common eider/ crude oil/ effects/ eiders/ oiled/ Oone/ physiology/ plumage/ temperature/ thermoregulation/ Norway
**Notes:** Comparison of the heat loss of oiled common eiders on water versus on land.

**Jenssen, B. M., M. Ekker, K. Zahlsen**, 1990. Effects of ingested crude oil on thryroid hormones and on the mixed function oxidase system in ducks. Comparative Biochemistry and Physiology **95C**:213-216.
**Keywords:** bird/ crude oil/ duck/ effects/ hormone/ mallard/ oil/ Oone/ physiology
**Notes:** Effects on thyroid hormones and the mixed function oxidase system of mallards as a result of dosing with crude oil.

**Jenssen, B. M., M. Ekker**, 1991. Effects of plumage contamination with crude oil dispersant mixtures on thermoregulation in common eiders and mallards. Archives of Environmental Contamination and Toxicology **20**:398-403.
**Keywords:** bird/ common eider/ crude oil/ dispersant/ effects/ eiders/ mallard/ ODone/ oil/ physiology/ plumage/ temperature/ thermoregulation
**Notes:** A comparison of the effects on thermoregulation of mallards and common eiders of undispersed and chemically dispersed crude oil.

**Jenssen, B. M., M. Ekker**, 1991. Dose dependent effects of plumage-oiling on thermoregulation of common eiders *Somateria mollissima* residing in water. Polar Research **10**:580-584.
**Keywords:** bird/ common eider/ crude oil/ effects/ eiders/ oiled/ Oone/ physiology/ plumage/ temperature/ thermoregulation/ time
**Notes:** Assessment of the time- and dose-dependent aspect of the effect of plumage oiling on thermoregulation in common eiders.

**Jenssen, B. M.**, 1994. Review article: effects of oil pollution, chemically treated oil, and cleaning on the thermal balance of birds. Environmental Pollution **86**:207-215.
**Keywords:** bird/ cleaning/ dispersant/ effects/ ODone/ oil/ oiled/ physiology/ plumage/ pollution/ rehabilitation/ review/ temperature/ thermoregulation
**Notes:** A review of the effects on thermoregulation in birds of ingested oil and plumage oiling from dispersed and undispersed oil.

**Jenssen, B. M.**, 1996. An overview of exposure to, and effects of, petroleum oil and organochlorine pollution in Grey seals *(Halichoerus grypus)*. Science of the Total Environment **186**:109-118.
**Keywords:** effects/ grey seal/ mammal/ oil/ organochlorines/ Otwo/ overview/ petroleum/ pollution/ population/ review/ salt water/ seal/ sublethal/ survival
**Notes:** Review of the exposure to, and effects of, petroleum and organochorines in grey seals throughout the world. Discussion of effects on individuals and consequences for populations.

**Jewett, S. C., T. A. Dean, R. O. Smith, A. Blanchard**, 1999. "Exxon Valdez' oil spill: impacts and recovery in the soft-bottom benthic community in and adjacent to eelgrass beds. Marine Ecology Progress Series **185**:59-83.
**Keywords:** abundance/ Alaska/ benthic/ biomass/ community/ depth/ diversity/ eelgrass/ effects/ epifauna/ evaluation/ Exxon Valdez/ hydrocarbons/ infauna/ invertebrate/ marine invertebrate/ Ofour/ oil/ oil spill/ oiled/ petroleum/ petroleum hydrocarbons/ population/ Prince William Sound/ recovery/ salt water/ sampling/ sediment/ species/ spill
**Notes:** Evaluation of the effects of the *Exxon Valdez* oil spill on the benthic community in and near eelgrass beds in western Prince William Sound, Alaska. Matched oiled and reference sites were sampled in 1990 (4 pairs), 1991 (5 pairs), 1993 (3 pairs), and 1995 (4 pairs). Only presents data for the 3 pairs sampled in every year. Sampling of sediments and eelgrass occurred at two depths; eelgrass beds (< 3 m) and at 6-20 m. Sediments were characterized and analyzed for petroleum hydrocarbons. Benthic invertebrates were identified to genus or species. Calculated species abundance, richness, diversity, and biomass for infauna and epifauna.

**Jewett, S. C., T. A. Dean, B. R. Woodin, M. K. Hoberg, J. J. Stegeman**, 2002. Exposure to hydrocarbons 10 years after the *Exxon Valdez* oil spill: evidence from cytochrome P4501A expression and biliary FACs in nearshore demersal fishes. Marine Environmental Research **54**:21-48.
**Keywords:** aromatic hydrocarbons/ bile/ Exxon Valdez/ fish/ hydrocarbons/ liver/ mussel/ oil/ oil spill/ oiled/ Othree/ petroleum/ petroleum hydrocarbons/ Prince William Sound/ review/ salt water/ sediment/ species/ spill/ time
**Notes:** Begins with a review of fish exposure studies performed in Prince William Sound during 1989-92. Two species of fish (masked greenling, crescent gunnel) were collected from 17 sites during 1996, 1998, and 1999. The sites were classified as moderately to heavily oiled, unoiled within the spill zone, and unoiled outside the spill zone. Liver and bile were collected from the fish and sediment was collected from mussel beds located at the collection sites. Measured CYP1A and EROD in the liver, fluorescent aromatic hydrocarbons in the bile, and total petroleum hydrocarbons in the sediment.

**Jimenez, N., M. Vinas, J. Sabate, S. Diez, J. M. Bayona, A. M. Solanas, J. Albaiges**, 2006. The *Prestige* oil spill. 2. Enhanced biodegradation of a heavy fuel oil under field conditions by the use of an oleophilic fertilizer. Environmental Science and Technology **40**:2578-2585.
**Keywords:** aliphatic hydrocarbons/ beach/ biodegradation/ bioremediation/ condition/ cycloalkane/ degradation/ experiment/ fertilizer/ fuel oil/ hopane/ microbes/ oil/ oil spill/ Oten/ PAH/ residual oil/ salt water/ spill/ time
**Notes:** A beach contaminated with heavy fuel oil from the Prestige oil spill was the site of a biodegradation experiment employing an oleophilic fertilizer. One plot was sprayed with S200 fertilizer and the other remained as a control. Each plot was divided into nine sectors and residual oil sampled from rock surfaces at 0, 30, 60, and 220 days. Samples were analyzed for n-alkanes, cycloalkanes, hopanes, cholestanes, and a suite of PAHs to document the pattern of degradation over time.

**Joensen, A. H.**, 1972. Oil pollution and seabirds in Denmark 1935-1968. Danish Review of Game Biology **6**:1-24.
**Keywords:** bird/ Denmark/ history/ oil/ oil spill/ oiled/ Oone/ pollution/ population/ salt water/ spill
**Notes:** Historical account of oil spills and seabirds for Denmark during the period 1935-1968.

**Johansson, S., U. Larsson, P. Boehm**, 1980. The *Tsesis* oil spill. Marine Pollution Bulletin **11**:284-293.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ bacteria/ concentration/ effects/ fate/ fuel oil/ general effect/ hydrocarbons/ marine invertebrate/ microbes/ Oeight/ oil/ oil spill/ phytoplankton/ rate/ salt water/ sediment/ spill/ tanker/ time/ Tsesis/ zooplankton
**Notes:** A general assessment of the fate and effects consequences of the 10/77 grounding of the tanker *Tsesis* in the Baltic Sea. The tanker was carrying No. 5 fuel oil. Samples were collected three times at 4 locations in and near the spilled oil during the month following the spill, and compared with ongoing collections at two remote locations. Collected depth-integrated phytoplankton, bacteria at 2 m, zooplankton by vertical net hauls, and employed sediment traps to collect sinking fuel oil. Measured primary production, bacteria concentration in water, daily rates of sediment deposition, amount of fuel oil deposited daily, and the resolved and unresolved aliphatic and aromatic hydrocarbons in the deposited sediments.

**Johns, D. M., J. A. Pechenik**, 1980. Influence of the water-accomodated fraction of No. 2 fuel oil on energetics of *Cancer irroratus* larvae. Marine Biology **55**:247-254.
**Keywords:** crab/ development/ effects/ energetics/ food/ fuel oil/ growth/ ingestion/ larvae/ marine invertebrate/ No.2 fuel oil/ Ofour/ oil/ rate/ respiration/ salt water/ survival/ weight
**Notes:** Assessment of the effects of No. 2 fuel oil on larval development of the rock crab. Newly-hatched larvae were exposed to 0.1 ppm water-accomodated fraction of No. 2 fuel oil for the period of larval development (five stages) until the megalopa stage. Measured survival, food ingestion, dry weight at each developmental stage, respiration rate, and growth efficiency.

**Johnson, B. T., J. D. Petty, J. N. Huckins, K. Lee, J. Gauthier**, 2004. Hazard assessment of a simulated oil spill on intertidal areas of the St. Lawrence River with SPMD-TOX. Environmental Toxicology **19**:329-335.
**Keywords:** ammonia/ ammonium/ assay/ Canada/ catfish/ crude oil/ freshwater plant/ hazard/ intertidal/

liver/ microbes/ Microtox/ miscellaneous/ Mutatox/ nitrate/ Oeleven/ oil/ oil spill/ PAH/ phosphate/ plant/ river/ spill/ SPMD/ treatment/ water column/ wetland
**Notes:** Semipermeable membrane devices (SPMD) were used to monitor the water column after an experimental crude oil spill in a wetland along the St. Lawrence River (Canada). Spill treatments included crude oil only, oil plus ammonium nitrate and phosphate and cut plants, oil plus ammonium nitrate and phosphate, oil plus ammonium nitrate, and ammonium nitrate and phosphate only. SPMD residues were extracted and used in Microtox and Mutatox assessments, and an assay of EROD induction in catfish liver. The presence of PAH in the residues was confirmed by fluorescence.

**Johnson, S. W., M. G. Carls, R. P. Stone, C. C. Brodersen, S. D. Rice**, 1997. Reproductive success of Pacific herring, *Clupea pallasi*, in Prince William Sound, Alaska, six years after the *Exxon Valdez* oil spill. Fishery Bulletin **95**:748-761.
**Keywords:** abnormalities/ Alaska/ crude oil/ Exxon Valdez/ fish/ hatching/ herring/ larvae/ oil/ oil spill/ Othree/ Pacific/ Pacific herring/ Prince William Sound/ region/ salt water/ spill/ swimming
**Notes:** Assessment of reproductive performance of Pacific herring in Prince William Sound six years after the Exxon Valdez oil spill. Evaluated according to region (affected area vs unaffected area) and specific years. Measured percent hatching, percent viable larvae, percent effective swimmers, and percent larvae with spinal defects.

**Jones, D. A., J. Plaza, I. Watt, M. Al Sanei**, 1998. Long-term (1991-1995) monitoring of the intertidal biota of Saudi Arabia after the 1991 Gulf War oil spill. Marine Pollution Bulletin **36**:472-489.
**Keywords:** abundance/ Arabian Gulf/ intertidal/ invertebrate/ long-term/ marine invertebrate/ marine plant/ monitoring/ Ofour/ oil/ oil spill/ plant/ recruitment/ rocky shore/ salt water/ sand/ Saudi Arabia/ seasonal/ species/ spill/ transect/ war
**Notes:** Monitoring of the intertidal invertebrate and plant occurrance and abundance along permanent transect lines on the western shore of the Arabian Gulf from 1991 to 1995. Classified shore line as sand shores, rocky shores, or saltmarsh-mud shores, and also evaluated recruitment and seasonal changes in biota.

**Jones, M. A. and J. H. Greenfield** 1991. In-situ comparison of bioremediation methods for a number 6 residual fuel oil spill in Lee County, Florida. Pages 533-540 *in* 1991 International Oil Spill Conference, API Publication 4529. American Petroleum Institute, Washington, D.C.
**Keywords:** bacteria/ bioremediation/ Bunker C/ combination/ degradation/ Florida/ fresh water/ fuel oil/ methods/ microbes/ nutrients/ oil/ oil spill/ Oten/ remediation/ simulation/ spill/ time
**Notes:** A spill of No. 6 residual fuel oil (Bunker C) was used to evaluated the feasibility of enhanced bioremediation methods. Laboratory slurry tests and site simulation tests employed various combinations of nutrient and bacteria additions. Results were used to establish a field remediation program for the spill site. A follow-up small plot study was conducted on an untreated portion of the spill site during the following year. An economic comparison was made of the various remediation options.

**Jones, P. H., J.-Y. Monnat, C. J. Cadbury, T. J. Stowe**, 1978. Birds oiled during the *AMOCO CADIZ* incident -- an interim report. Marine Pollution Bulletin **9**:307-310.
**Keywords:** Amoco Cadiz/ bird/ coast/ crude oil/ France/ oil/ oil spill/ oiled/ Oone/ population/ salt water/ spill
**Notes:** An early report of seabird deaths from the Amoco Cadiz oil spill off the coast of France.

**Jonker, M. T. O., J. M. Brils, A. J. C. Sinke, A. J. Murk, A. A. Koelmans**, 2006. Weathering and toxicity of marine sediments contaminated with oils and polycyclic aromatic hydrocarbons. Environmental Toxicology and Chemistry **25**:1345-1353.
**Keywords:** aliphatic hydrocarbons/ aromatic/ aromatic hydrocarbon/ aromatic hydrocarbons/ assay/ bacteria/ crude oil/ hydrocarbons/ light/ lubricating oil/ microbes/ miscellaneous/ Oeleven/ oil/ oxygen/ PAH/ pore water/ salt water/ sediment/ toxicity/ water/ weathered/ weight
**Notes:** A complex study of the toxicity of weathered oils and PAHs in sediment. Used a suite of 11 PAHs, Distillate Marine grade A, Arabian Crude Light, and a waste lubricating oil isolated from bilge water. Collected sediments were mixed with 0-100,000 ppm dry weight of either of the three oils. In addition, all sediment containers were spiked with the same quantity of a mixture of the selected 11

PAHs. Approximately 2/3 of the test sediments were weathered for 27 mos with sediment oxygen demand measured after 3, 7, 9, 14, 19, and 26 mos. Pore water was tested for toxicity with a luminescent bacteria and the DR-CALUX assay. Measured PAHs in pore water and aliphatic hydrocarbons in sediment.

**Jonsson, G., R. K. Bechmann, S. D. Bamber, T. Baussant**, 2004. Bioconcentration, biotransformation, and elimination of polycyclic aromatic hydrocarbons in sheepshead minnows (*Cyprinodon variegatus*) exposed to contaminated seawater. Environmental Toxicology and Chemistry **23**:1538-1548.
**Keywords:** aromatic hydrocarbons/ bile/ biotransformation/ combination/ concentration/ depuration/ elimination/ fish/ hydrocarbons/ metabolite/ Othree/ PAH/ salt water/ sheepshead minnow/ tissue/ uptake
**Notes:** Sheepshead minnows were exposed to a high and a low concentration of a combination of eight 2-4 ring aromatic hydrocarbons for 36 da, followed by an 8-da depuration period. Water, fish tissue, and fish bile were sampled periodically during the exposure and depuration periods. Measured the concentrations of the parent PAHs and their metabolites.

**Jovancicevic, B., L. Tasic, H. Wehner, D. Markovic, P. Polic**, 1998. *n*-alkane distribution as a tool in the identification of organic type pollution in river sediments. Fresenius Environmental Bulletin **7**:320-326.
**Keywords:** alkane/ distribution/ fresh water/ miscellaneous/ Oeleven/ organic/ petroleum hydrocarbons/ pollution/ sediment
**Notes:** Authors attempt to contrast sediments from a sewage-polluted river with sediments from an unpolluted river through the use of *n*-alkane distributions. Purpose is to identify the source of the organic pollution.

**Joyce, P.**, 1998. Floating tar in the western North Atlantic and Caribbean Sea, 1982-1996. Marine Pollution Bulletin **36**:167-171.
**Keywords:** Atlantic/ Caribbean/ density/ hydrocarbons/ miscellaneous/ Oeleven/ salt water/ tar ball
**Notes:** Assessment of the density of floating tar balls in the western North Atlantic and Caribbean Sea during the years 1982-96.

**Juvonen, R., E. Martikainen, E. Schultz, A. Joutti, J. Ahtiainen, M. Lehtokari**, 2000. A battery of toxicity tests as indicators of decontamination in composting oily waste. Ecotoxicology and Environmental Safety **47**:156-166.
**Keywords:** assay/ benzene/ cell/ chemical characteristics/ compost/ concentration/ enzyme/ genotoxic/ growth/ indicator/ invertebrate/ metals/ microbes/ Oten/ PAH/ plant/ refinery/ reproduction/ soil/ species/ survival/ toluene/ toxicity
**Notes:** Oily waste from an old refinery landfill was composted with sewage sludge and coniferous bark. Samples of the compost were collected on days 0, 32, 60, 74, and 123; analyzed for physical and chemical characteristics, and concentrations of benzene, toluene, PAHs, and a suite of metals. Toxicity was assessed with cell organelles (RET assay), three species of microbes, two species of plants, and three species of soil invertebrates. Measured enzyme inhibition, luminescence, growth inhibition, survival, reproduction, and genotoxicity.

**Kalke, R. D., T. A. Duke, R. W. Flint**, 1982. Weathered IXTOC I oil effects on estuarine benthos. Estuarine and Coastal and Shelf Science **15**:75-84.
**Keywords:** benthic/ biomass/ condition/ crude oil/ density/ diversity/ effects/ estuarine/ evaluation/ flow-through/ index/ Ixtoc/ Ixtoc I crude oil/ larvae/ marine invertebrate/ Ofour/ oil/ salt water/ sediment/ weathered
**Notes:** An evaluation of the effects of weathered IXTOC I crude oil on benthic organisms in estuarine sediment. Test containers were placed both in a laboratory flow-through system and on the sea floor. All containers remained in place for 8 wks to permit settlement by planktonic larvae. In the laboratory, both sets of containers were exposed to weathered crude oil and kept under flow-through conditions for another 4 wks. Identified benthic organisms and determined density and biomass; and calculated diversity index.

**Kammerer, M., O. Mastain, S. Le Drean-Quenech'du, H. Pouliquen, M. Larhantec**, 2004. Liver and kidney concentrations of vanadium in oiled seabirds after the Erika wreck. Science of the Total

Environment **333**:295-301.
**Keywords:** bird/ carcass/ chemical analysis/ coast/ common eider/ common murre/ concentration/ crude oil/ France/ kidney/ liver/ marine birds/ oil/ oiled/ Oone/ salt water/ species/ spill/ vanadium
**Notes:** Three species of marine birds, common murre, black scoter, and common eider, were sampled from carcasses brought into animal care centers along the west coast of France after the 1999 Erika spill of crude oil. Liver and kidney were removed from 150 oiled carcasses and seven unoiled common murres and razorbills from the north coast of France. Analyzed all 150 livers and 60 kidneys from the oiled birds and the livers and kidneys from the seven 'control' birds for vanadium. Difficult reading due to language translation problems.

**Kaplan, I., S.-T. Lu, R-P. Lee, G. Warrick**, 1996. Polycyclic hydrocarbon biomarkers confirm selective incorporation of petroleum in soil and kangaroo rat liver samples near an oil well blowout site in the western San Joaquin Valley, California. Environmental Toxicology and Chemistry **15**:696-707.
**Keywords:** alkane/ aromatic hydrocarbons/ biomarker/ California/ crude oil/ degradation/ fresh water/ hydrocarbons/ liver/ mammal/ metabolism/ oil/ Onine/ petroleum/ rat/ soil/ sterane/ technical/ terpane
**Notes:** Description of the use of sterane and terpane compounds as chemical biomarkers indicative of crude oil contamination in soil and kangaroo rat livers. Useful because they are more resistent to metabolism and degradation than alkane and aromatic hydrocarbons.

**Kashner, J., J. V. Hunter**, 1983. Influence of land utilization on hydrocarbon runoff pollution. Journal of Environmental Science and Health **A18**:135-144.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ fresh water/ hydrocarbons/ miscellaneous/ New Jersey/ Oeleven/ pollution/ sediment/ stream/ survey/ total hydrocarbons
**Notes:** Sediments were collected from two small streams in central New Jersey that were characterized according to the different land uses within their watersheds. A total of six samples were collected from the smaller stream and 14 from the slightly larger stream. Sediments were analyzed for total solids, total hydrocarbons, total volatiles, aliphatic hydrocarbons, and aromatic hydrocarbons. Results were related to land use.

**Kasymov, A. G., E. E. Velikhanov**, 1992. The joint effect of oil and drilling agents on some invertebrate species of the Caspian Sea. Water, Air, and Soil Pollution **62**:1-11.
**Keywords:** bivalve/ Caspian Sea/ concentration/ consumption/ crude oil/ drilling mud/ effects/ fertility/ invertebrate/ marine invertebrate/ Ofour/ oil/ oxygen/ salt water/ shrimp/ species/ survival/ weight
**Notes:** Assessment of the effects of oil drilling agents and water-soluble fractions of crude oil separately or combined on invertebrates of the Caspian Sea. Exposed a shrimp and a bivalve to varying concentrations of three agents in drilling muds and several concentrations of WSF combined with the agents. Measured survival, oxygen consumption, and weight gain for all three agents. Also measured effect on fertility in the shrimp and survival of its offspring.

**Katayama, Y., T. Oura, M. Iizuka, I. Orita, K. J. Cho, I. Y. Chung, M. Okada**, 2003. Effects of spilled oil on microbial communities in a tidal flat. Marine Pollution Bulletin **47**:85-90.
**Keywords:** analysis/ community/ composition/ DNA/ experiment/ fuel oil/ microbes/ oil/ Oten/ petroleum/ salt water/ tidal flat/ toxicity
**Notes:** A laboratory tidal simulator was used to evaluate the effect of fuel oil on indiginous microbial communities. The experiment lasted 2 mos. Microbes were classified as susceptible or non-susceptible to the toxic effects of petroleum. Analysis of bacterial DNA was used to track changes in the microbial community composition.

**Kauss, P. B., T. C. Hutchinson**, 1975. The effects of water-soluble petroleum components on the growth of *Chlorella vulgaris* Beijerinck. Environmental Pollution **9**:157-174.
**Keywords:** algae/ aromatic hydrocarbons/ assay/ benzene/ concentration/ crude oil/ effects/ experiment/ fresh water/ freshwater plant/ growth/ motor oil/ naphthalene/ oil/ Oseven/ petroleum/ solubility/ toluene/ xylene
**Notes:** A green algae was used in a flask culture assay to determine the effects of the water-soluble fractions (WSF) of seven crude oils and outboard motor oil on growth. Duration of the experiment was 10

da. WSF was used fresh or aged 24, 48, or 120 hrs. To assess the effects of specific soluble aromatics, growth assays were performed with benzene, toluene, xylene, and naphthalene in 4-7 concentrations.

**Kazlauskiene, N., G. Svecevicius, M. Z. Vosyliene, D. Marciulioniene, D. Montvydiene**, 2004. Comparative study on sensitivity of higher plants and fish to heavy fuel oil. Environmental Toxicology **19**:451.
**Keywords:** adult/ effects/ embryo/ fish/ fresh water/ freshwater plant/ fuel oil/ genotoxic/ growth/ larvae/ oil/ Oseven/ plant/ rainbow trout/ species/ survival/ toxicity
**Notes:** Heavy fuel oil was mechanically emulsified in water and used in toxicity tests with three species of aquatic plants, and embryos, larvae, and adults of rainbow trout. Tests included 48-hr $EC_{50}$, 96-hr LC50, 14-da EC50, 30-da EC50, 60-da LC50, and 28-da LC50 for survival, growth, physiological and morphological measures, and genotoxic effects (one plant species).

**Keck, R. T., R. C. Heess, J. Wehmiller, D. Maurer**, 1978. Sublethal effects of the water-soluble fraction of Nigerian crude oil on the juvenile hard clams, *Mercenaria mercenaria* (Linne). Environmental Pollution **15**:109-119.
**Keywords:** algae/ clam/ concentration/ crude oil/ depuration/ effects/ experiment/ feeding/ growth/ juvenile/ marine invertebrate/ Nigerian crude oil/ Ofour/ oil/ rate/ salt water/ sublethal
**Notes:** Juvenile hard clams were exposed to Nigerian crude oil for 5 wk followed by a 2-wk depuration period. Clams were subjected to several concentrations of the water-soluble fraction in a 48-hr water-renewal experiment. Measured rate of feeding on algae and growth of clams.

**Keizer, P. D., D. C. Gordon, Jr., J. Dale**, 1977. Hydrocarbons in eastern Canadian marine waters determined by fluorescence spectroscopy and gas-liquid chromatography. Journal of the Fisheries Research Board of Canada **34**:347-353.
**Keywords:** alkane/ aromatic hydrocarbons/ Canada/ chromatography/ depth/ estimate/ estuary/ hydrocarbons/ miscellaneous/ Nova Scotia/ Oeleven/ oil/ origin/ petroleum/ petroleum hydrocarbons/ salt water/ survey
**Notes:** Water samples were collected in 1975 at 2 and 50 m depth from five locations: Bedford Basin (Nova Scotia), Scotian Shelf, Gulf of St. Lawrence, St. Lawrence estuary, and the Sargasso Sea. Samples were analyzed for specific and total *n*-alkanes and total aromatic hydrocarbons. The latter was related to a standard oil (unspecified) to derive a total petroleum hydrocarbon estimate. Results were compared with comment on the likely origin.

**Kendeigh, S. C.**, 1969. Tolerance of cold and Bergmann's Rule. Auk **86**:13-25.
**Keywords:** bird/ metabolism/ Oone/ temperature/ tolerance
**Notes:** A comparison of cold tolerance between passerine and nonpasserine birds and the relation to Bergmann's Rule.

**Kennedy, C., A. P. Farrell**, 2006. Effects of exposure to the water-soluble fraction of crude oil on the swimming performance and the metabolic and ionic recovery postexercise in Pacific herring (*Cupea pallasi*). Environmental Toxicology and Chemistry **25**:2715-2724.
**Keywords:** activity/ assay/ biochemical/ blood/ concentration/ crude oil/ effects/ fish/ herring/ liver/ metabolism/ muscle/ North Slope/ North Slope crude oil/ oil/ Othree/ Pacific/ Pacific herring/ plasma/ recovery/ salt water/ swimming
**Notes:** Pacific herring were exposed to three concentrations (10, 40, 100 ppb) of the water-soluble fraction of North Slope crude oil for up to 8.3 weeks. After varying amounts of exposure, fish were tested for swimming performance and post-performance recovery. Liver, muscle, and blood were sampled. Measured cytochrome P-450 and EROD activity before and after 24 hrs, 96 hrs, 4.3 wks, and 8.3 wks of exposure. Measured plasma cortisol, lactate, Na and Cl ion concentrations, hematocrit, leukocrit, and muscle glycogen before and for 24 hrs after the swimming exercise test.

**Kennicutt, M. C., II**, 1990. Oil spillage in Antarctica. Environmental Science and Technology **24**:620-624.
**Keywords:** Antarctica/ biological effects/ bird/ coast/ community/ diesel/ diesel fuel/ effects/ experiment/ fish/ general effect/ intertidal/ invertebrate/ mammal/ marine invertebrate/ microbes/ Oeight/ oil/ salt water/ subtidal
**Notes:** A preliminary report of the environmental effects of the grounding of the *Bahia Paraiso* off the

coast of Antarctica. The effects of the discharged diesel fuel were assessed by a large team of scientists from the NSF. Presents a description of the early biological effects, hydrocarbon analyses of the spilled oil; and effects on birds, mammals, fish, intertidal and subtidal communities, microbial processes, and some experiments with marine invertebrates.

**Kennicutt, M. C., II, S. T. Sweet**, 1992. Hydrocarbon contamination on the Antarctic penninsula: III. The *Bahia Paraiso* -- two years after the spill. Marine Pollution Bulletin **25**:9-12.
**Keywords:** Antarctic/ Antarctica/ aromatic hydrocarbons/ beach/ concentration/ diesel/ diesel fuel/ effects/ hydrocarbons/ limpet/ marine invertebrate/ Ofour/ salt water/ sediment/ spill/ subtidal
**Notes:** Assessment of the environmental effects and remnants of a diesel fuel spill 2 yrs previous in Arthur Harbor, Antarctica. Subtidal sediment samples from 41 locations (2, 15, and 27 mo post spill) and samples of limpets from 20 locations (1, 2, 14, and 27 mo post spill) were analyzed for concentrations of aromatic hydrocarbons. Beach samples were also collected and anlyzed for aromatic hydrocarbons in 1991.

**Kenworthy, W. J., M. J. Durako, S. M. R. Fatemy, H. Valavi, G. W. Thayer**, 1993. Ecology of seagrasses in northeastern Saudi Arabia one year after the Gulf War oil spill. Marine Pollution Bulletin **27**:213-222.
**Keywords:** abundance/ algae/ biomass/ coast/ density/ macroalgae/ marine plant/ oil/ oil spill/ Osix/ salt water/ Saudi Arabia/ seagrass/ spill/ war
**Notes:** A 20-da cruise dedicated to assessment of seagrasses off the northeast coast of Saudi Arabia 1 yr after the Gulf War oil spill. Sampled four locations, three of which had a nearshore-offshore paired collection. Water was characterized at each location. Measured seagrass frequency, abundance, and biomass; and biomass of macroalgae when it was found. Treated nearshore-offshore pairs as equivalent to oiled-unoiled pairs.

**Keramitsoglou, I., C. Caartalis, P. Kassomenos**, 2003. Decision support system for managing oil spill events. Environmental Management **32**:290-298.
**Keywords:** Crete/ Greece/ miscellaneous/ Oeleven/ oil/ oil spill/ salt water/ spill/ spill response
**Notes:** Description of a decision support system developed by Greece for managing oil spill response actions. The structure of the system is explained and an application of the system to the island of Crete is described.

**Kerley, G. I. H., T. Erasmus, R. P. Mason**, 1985. Effect of moult on crude oil load in a jackass penguin *Spheniscus demersus*. Marine Pollution Bulletin **16**:474-476.
**Keywords:** bird/ crude oil/ molt/ oil/ oiled/ Oone/ penguin/ plumage/ salt water
**Notes:** Assessment of the effect of moult on loss of oil from oiled plumage.

**Kerley, G. I. H., T. Erasmus**, 1986. Oil pollution of Cape gannets: to clean or not to clean? Marine Pollution Bulletin **17**:498-500.
**Keywords:** Africa/ bird/ cleaning/ oil/ oiled/ Oone/ pollution/ rehabilitation/ salt water/ South Africa
**Notes:** An assessment of the utility of cleaning oiled Cape (South Africa) gannets.

**Kerley, G. I. H., C. G. Crellin, T. Erasmus**, 1987. Gravimetric determination of water-repellancy in rehabilitated oiled seabirds. Marine Pollution Bulletin **18**:609-611.
**Keywords:** bird/ cleaning/ oiled/ Oone/ rehabilitation/ salt water
**Notes:** Recommendation for testing for water repellancy of rehabilitated birds before releasing into the wild.

**Kerley, G. I. H., T. Erasmus**, 1987. Cleaning and rehabilitation of oiled jackass penguins. South African Journal of Wildlife Research **17**:64-70.
**Keywords:** bird/ cleaning/ evaluation/ oiled/ Oone/ penguin/ rehabilitation/ salt water/ South Africa/ washing
**Notes:** An evaluation of two washing techniques for cleaning oiled jackass penguins.

**Kerley, G. I. H. and T. Erasmus** 1987. The management of oiled penguins. Pages 465-468 *in* 1987 Oil Spill Conference (Prevention, Behavior, Control, Cleanup). American Petroleum Institute, Washington, DC.
**Keywords:** behavior/ bird/ cleaning/ effects/ oil/ oil spill/ oiled/ Oone/ penguin/ procedure/ rehabilitation/ salt water/ South Africa/ spill
**Notes:** Discussion of the effects of oiling on South African penguins and the procedures for rehabilitation of oiled penguins.

**Kertell, K., R. L. Howard**, 1997. Impoundment productivity in the Prudhoe Bay Oil Field, Alaska: Implications for waterbirds. Environmental Management **21**:779-792.
**Keywords:** Alaska/ bird/ chlorophyll/ fresh water/ freshwater invertebrate/ habitat/ macroinvertebrate/ nitrogen/ oil/ oil field/ Oone/ phosphorus/ productivity/ Prudhoe Bay
**Notes:** Comparison of natural ponds to impoundments caused by oilfield construction (roads, drilling pads) in the Prudhoe Bay oil field. Also evaluated differences among habitat types within impoundments and ponds. Measured macroinvertebrate productivity, chlorophyll *a*, phosphorus, and nitrogen. Study performed during summers of 1991-93 .

**Ketkar, K. W.**, 2002. The Oil Pollution Act of 1990: a decade later. Spill Science Technology Bulletin **7**:45-52.
**Keywords:** analysis/ cost/ evaluation/ miscellaneous/ Oeleven/ oil/ oil spill/ pollution/ regulation/ spill
**Notes:** An evaluation of the effect of the various regulations contained within OPA 1990 on the incidence and consequences of oil spills. Sections on oil spills and vessel traffic accidents, specifics of OPA 1990 and the cost-benefit analysis, and the status of oil spills today compared to 10 yrs ago.

**Khan, A. A., R. W. Coppock, M. M. Schuler, A. K. Sharma, L. E. Lillie**, 1989. Induction of hepatic cytochrome P-450 and xenobiotic metabolizing enzymes in rats gavaged with an Alberta crude oil. Journal of Toxicology and Environmental Health **28**:297-307.
**Keywords:** Alberta/ biochemical/ crude oil/ effects/ enzyme/ mammal/ metabolism/ oil/ Otwo/ rat/ weight
**Notes:** Effects on weight and a variety of biochemical measures of rats receiving oral doses of Alberta crude oil for 4 days.

**Khan, A. A., R. W. Coppock, M. M. Schuler, L. Z. Florence, L. E. Lillie, M. S. Mostrom**, 1996. Biochemical effects of Pembina Cardium crude oil in cattle. Archives of Environmental Contamination and Toxicology **30**:349-355.
**Keywords:** behavior/ biochemical/ biochemistry/ cattle/ crude oil/ dosed/ effects/ fresh water/ ingestion/ mammal/ oil/ Otwo/ physiology
**Notes:** Effects on cattle receiving single oral doses of varying amounts of Pembina Cardium crude oil; clinical signs, physiology, and biochemistry.

**Khan, A. A., R. W. Coppock, M. M. Schuler**, 2001. Effects of multiple exposures of small doses of Pembina Cardium crude oil and diesel in rats. Archives of Environmental Contamination and Toxicology **40**:418-424.
**Keywords:** analysis/ biochemical/ blood/ crude oil/ diesel/ diesel fuel/ dosed/ effects/ experiment/ fresh water/ kidney/ lesions/ liver/ mammal/ metabolism/ oil/ organ/ Otwo/ physiology/ rat/ tissue
**Notes:** Laboratory rats were dosed with either vehicle control, Pembina Cardium crude oil, or diesel fuel on days 1, 3, 5, and 8 of a 10-da experiment. Rats were dosed with either 0.25, 0.50, or 1.25 ml/kg of crude oil; 1.25 ml/kg of diesel fuel; or 1.25 ml/kg of vehicle control. Rats were euthanized on day 10 and blood, kidneys, and liver were removed; all organs were examined for gross lesions. Performed a variety of biochemical analyses on blood, and kidney and liver tissue.

**Khan, A. A., C. Embury, M. M. Schuler, M. N. Hiltz, R. W. Coppock, M. Dziwenka**, 2005. Effects of crude oil and diesel exposures on biochemical activities of polymorphonuclear leukocytes in cattle. Archives of Environmental Contamination and Toxicology **49**:410-414.
**Keywords:** activity/ biochemical/ blood/ cattle/ crude oil/ diesel/ effects/ fuel oil/ ingestion/ mammal/ No.2 fuel oil/ oil/ Otwo/ water
**Notes:** Cattle were exposed to either 10 ml/kg water, 5 ml/kg No. 2 fuel oil, 2.5 ml/kg Pembina Cardium

crude oil, 5 ml/kg crude oil, or 10 ml/kg crude oil on days 1, 14, 28, and 42. Blood was drawn periodically until day 55 and polymorphonuclear leukocytes in blood were analyzed for four biochemical activities.

**Khan, E., W. Virojnagud, T. Ratpukdi**, 2004. Use of biomass sorbents for oil removal from gas station runoff. Chemosphere **57**:681-689.
**Keywords:** biomass/ motor oil/ oil/ Onine/ petroleum/ sorbent/ spill response/ technical/ used motor oil/ water
**Notes:** Description of a test of petroleum absorbence characteristics of kapok fiber, cattail fiber, *Salvina* sp., polyester fiber, wood chips, rice husk, coconut husk, and bagasse. A mixture of water and used motor oil (50 ppm) was passed through the material for periods ranging from 30 to 360 min. Quantity of oil absorbed was measured. Retention ability was determined by rinsing the material with water and measuring the remaining motor oil.

**Khan, M. A. Q., S. M. Al-Ghais, S. Al-Marri**, 1995. Petroleum hydrocarbons in fish from the Arabian Gulf. Archives of Environmental Contamination and Toxicology **29**:517-522.
**Keywords:** accumulation/ Arabian Gulf/ aromatic hydrocarbons/ elimination/ fish/ hydrocarbons/ Othree/ petroleum/ petroleum hydrocarbons/ salt water/ species
**Notes:** Assessment of the accumulation and elimination of aromatic hydrocarbons by several species of fish from the Arabian Gulf.

**Khan, N. A.**, 1992. Impacts of the giant international oil-spill on Jubail, Saudi Arabia. Environmental Conservation **19**:259-261.
**Keywords:** bird/ crude oil/ general effect/ Oeight/ oil/ oil spill/ salt water/ Saudi Arabia/ spill/ war
**Notes:** A superficial description of the arrival at Jubail of the Gulf War oil spill and the proposed and observed consequences of the oil. Some factual comments are made about the effect on birds.

**Khan, R. A., J. W. Kiceniuk**, 1989. Sublethal effects of crude oil on a cold-water marine leech, *Johanssonia arctica*, following chronic exposure. Bulletin of Environmental Contamination and Toxicology **43**:590-596.
**Keywords:** chronic/ cod/ crude oil/ effects/ emergence/ experiment/ food/ Hibernia crude oil/ leech/ marine invertebrate/ Ofour/ oil/ reproduction/ salt water/ sublethal/ survival
**Notes:** Assessment of the effects of the water-soluble fractions (WSF) of Hibernia crude oil on a marine leech. Several experiments conducted: (1) leeches exposed to WSF of 50-100 ppb (49-92 da) and uncontaminated food (cod) or exposed to clean water and food previously exposed (for 92 da) to WSF-contaminated water, (2) leeches exposed to WSF of 50 or 150 ppb for 49 da, and (3) leeches removed from 50 ppb WSF after exposure varying from 9 to 67 da. Measured cocoon production, emergence of young, and survival of young.

**Khan, R. A.**, 1990. Parasitism in marine fish after chronic exposure to petroleum hydrocarbons in the laboratory and to the Exxon Valdez oil spill. Bulletin of Environmental Contamination and Toxicology **44**:759-763.
**Keywords:** Alaska/ chronic/ crude oil/ evaluation/ Exxon Valdez/ fish/ gill/ hydrocarbons/ oil/ oil spill/ Othree/ parasite/ pathology/ petroleum/ petroleum hydrocarbons/ Prince William Sound/ salt water/ species/ spill/ tissue
**Notes:** Evaluation of parasitism in marine fish following exposure to crude oil. Two species experimentally exposed to crude oil in water for 12 weeks and one species collected from Prince William Sound, Alaska. Incidence of parasites in gill tissue and pathological evaluation of gills.

**Khan, R. A.**, 1991. Effect of oil-contaminated sediment on the longhorn sculpin (*Myoxocephalus octodecemspinosus*) following chronic exposure. Bulletin of Environmental Contamination and Toxicology **47**:63-69.
**Keywords:** chronic/ condition/ crude oil/ effects/ experiment/ fish/ gill/ hemoglobin/ Hibernia crude oil/ length/ oil/ organ/ Othree/ parasite/ sculpin/ sediment/ serum/ weight
**Notes:** Assessment of the effects on longhorn sculpin of exposure to oil-contaminated sediment. Exposed sculpin to sediment contaminated with Hibernia crude oil for 6 mo in the primary experiment and two additional trials of 3-4 mo. At 3 and 6 mo, measured weight, length, condition factor, organ somatic

indices, hemoglobin, hematocrit, lymphocytes, melting and freezing point of sera, and parasites on the gill and in the digestive tract.

**Khan, R. A., P. Ryan**, 1991. Long term effects of crude oil on common murres (*Uria aalge*) following rehabilitation. Bulletin of Environmental Contamination and Toxicology **46**:216-222.
**Keywords:** bird/ cleaning/ common murre/ crude oil/ effects/ long-term/ oil/ Oone/ pathology/ rehabilitation/ salt water
**Notes:** Report of pathologic effects in common murres of crude oil exposure after attempted rehabilitation.

**Khan, R. A.**, 1991. Influence of concurrent exposure to crude oil and infection with *Trypanosoma murmanensis* (Protozoa: Mastigophora) on mortality in winter flounder, *Pseudopleuronectes americanus*. Canadian Journal of Zoology **69**:876-880.
**Keywords:** adult/ blood/ crude oil/ effects/ fish/ flounder/ Hibernia crude oil/ juvenile/ oil/ oiled/ organ/ Othree/ parasite/ protozoa/ salt water/ sediment/ survival/ winter flounder
**Notes:** Effects of concurrent or separate exposure of juvenile and adult winter flounder for 8 weeks to oiled sediment and a protozoan parasite; Hibernia crude oil, survival, blood characteristics, organ indicies.

**Khan, R. A., K. Nag**, 1993. Estimation of hemosiderosis in seabirds and fish exposed to petroleum. Bulletin of Environmental Contamination and Toxicology **50**:125-131.
**Keywords:** bird/ crude oil/ fish/ hemosiderosis/ liver/ oil/ Oone/ petroleum/ salt water
**Notes:** Assessment of the incidence of hemosiderosis in the livers of seabirds and fish exposed to crude oil.

**Khan, R. A.**, 1998. Influence of petroleum at a refinery terminal on feral winter flounder, *Pleuronectes americanus*. Bulletin of Environmental Contamination and Toxicology **61**:770-777.
**Keywords:** abundance/ fish/ flounder/ gill/ kidney/ length/ lesions/ liver/ Newfoundland/ Othree/ parasite/ pathology/ petroleum/ refinery/ salt water/ spleen/ weight/ winter flounder
**Notes:** Winter flounder were collected near a refinery in Newfoundland and at a reference site. Flounder were compared for differences between sites. Measured weight, length, lesions in liver, spleen, kidney, and gill, and abundance of parasites.

**Khan, R. A.**, 1999. Study of pearl dace (*Margariscus margarita*) inhabiting a stillwater pond contaminated with diesel fuel. Bulletin of Environmental Contamination and Toxicology **62**:638-645.
**Keywords:** activity/ blood/ cell/ diesel/ diesel fuel/ evaluation/ fish/ fresh water/ Labrador/ liver/ monooxygenase/ Othree/ physiology/ population/ tissue
**Notes:** Comparison between pearl dace collected from a pond (Goose Bay, Labrador) chronically contaminated with diesel fuel and from a reference pond. Measured population and morphological characteristics, performed histological evaluations of numerous tissues, measured MFO activity of liver tissue, and counted white blood cells.

**Khan, R. A.**, 2003. Health of flatfish from localities in Placentia Bay, Newfoundland, contaminated with petroleum and PCBs. Archives of Environmental Contamination and Toxicology **44**:485-492.
**Keywords:** benthic/ blood/ fish/ gill/ health/ heart/ kidney/ lesions/ liver/ Newfoundland/ oil/ Othree/ parasite/ PCB/ petroleum/ refinery/ salt water/ skin/ species/ spleen/ stomach/ tissue
**Notes:** Four species of benthic flatfish were collected from several sites in Placentia Bay, Newfoundland. Sites included an oil refinery terminal, two PCB-contaminated locations, a boat harbor, and two reference locations. Fish were examined for external and internal lesions, blood removed for characterization, tissues (skin, liver, heart, kidney, spleen, stomach, midintestine, gill) were removed for microscopic examination, and the digestive tract examined for parasites.

**Khan, R. A., J. F. Payne**, 2004. Comparative study of oil well drill cuttings and polycyclic aromatic hydrocarbons on parasitism in winter flounder: a dose-response study. Bulletin of Environmental Contamination and Toxicology **73**:652-658.
**Keywords:** aromatic/ aromatic hydrocarbon/ aromatic hydrocarbons/ assay/ coast/ concentration/ crude oil/ cuttings/ experiment/ fish/ flounder/ hydrocarbons/ Newfoundland/ oil/ Othree/ parasite/ salt water/

sand/ spleen/ time/ winter flounder
**Notes:** Winter flounder captured along the coast of Newfoundland were used in a 15-week flow-thru assay assessing the influence of drill mud cuttings and crude oil on ectoparasites. Five concentrations of drill mud cuttings and four concentrations of crude oil (both mixed in sand) were employed. Measured ectoparasites before and at the end of the experiment. Also measured hemosiderin deposits in the spleen.

**Khan, R. A., J. F. Payne**, 2005. Influence of a crude oil dispersant, Corexit 9527, and dispersed oil on capelin (*Mallotus villosus*), Atlantic cod (*Gadus morhua*), longhorn sculpin (*Myoxocephalus octodecemspinosus*), and cunner (*Tautogolabrus adspersus*). Bulletin of Environmental Contamination and Toxicology **75**:50-56.
**Keywords:** Atlantic/ cod/ combination/ Corexit 9527/ crude oil/ cunner/ depuration/ dispersant/ fish/ flow-through/ gill/ Hibernia crude oil/ lesions/ ODthree/ oil/ recovery/ salt water/ sculpin/ species/ survival/ time
**Notes:** The water-soluble fraction (WAF) of Hibernia crude oil, Corexit 9527, and a combination of Corexit 9527 and WAF were tested on three species of marine fish. Exposures were for 4 da in flow-through aquaria followed by a 4-wk recovery period. Measured survival and prevalence and severity of gill lesions after the 4-wk recovery period.

**Khan, S., J. F. Payne, A. D. Rahimtula**, 1986. Mechanisms of petroleum hydrocarbon toxicity: destruction of liver microsomal and mitochondrial calcium pump activities by a Prudhoe Bay crude oil. Journal of Biochemical Toxicology **1**:31-43.
**Keywords:** activity/ biochemical/ crude oil/ effects/ liver/ mammal/ microsome/ mitochondria/ oil/ Otwo/ petroleum/ physiology/ Prudhoe Bay/ Prudhoe Bay crude oil/ rat/ toxicity/ uptake
**Notes:** Effects on rat mitochondrial and microsomal calcium uptake of daily doses (2 days) of Prudhoe Bay crude oil.

**Khan, S., A. M Rahman, J. F. Payne, A. D. Rahimtula**, 1986. Mechanisms of petroleum hydrocarbon toxicity: studies on the response of rat liver mitochondria to Prudhoe Bay crude oil and its aliphatic, aromatic and heterocyclic fractions. Toxicology **42**:131-142.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ crude oil/ effects/ liver/ mammal/ mitochondria/ nonhydrocarbon/ oil/ Otwo/ petroleum/ Prudhoe Bay/ Prudhoe Bay crude oil/ rat/ toxicity
**Notes:** Effects on rat liver mitochondrial function of Prudhoe Bay crude oil and its aliphatic, aromatic, and nonhydrocarbon fractions.

**Khan, S., J. F. Payne, A. D. Rahimtula**, 1986. Mechanisms of petroleum hydrocarbon toxicity: funcitonal changes in rat liver mitochondria after exposure to a Prudhoe Bay crude oil. Toxicology Letters **32**:141-146.
**Keywords:** crude oil/ effects/ liver/ mammal/ mitochondria/ oil/ Otwo/ petroleum/ physiology/ Prudhoe Bay/ Prudhoe Bay crude oil/ rat/ respiration/ toxicity
**Notes:** Effects on respiration of rat liver mitochondria after daily doses (2 days) of Prudhoe Bay crude oil.

**Khan, S., M. Martin, A. D. Rahimtula, J. F. Payne**, 1987. Effect of a Prudhoe Bay crude oil on hepatic and placental drug metabolism in rats. Canadian Journal of Physiology and Pharmacology **65**:2400-2408.
**Keywords:** adult/ crude oil/ effects/ liver/ mammal/ metabolism/ oil/ Otwo/ physiology/ Prudhoe Bay/ Prudhoe Bay crude oil/ rat
**Notes:** Effects on pregnant rats and their fetuses of single and multiple doses of Prudhoe Bay crude oil; measures of hepatic metabolism in adults and fetuses.

**Khan, S., M. Irfan, A. D. Rahimtula**, 1987. The hepatotoxic potential of a Prudhoe Bay crude oil: effect on mouse liver weight and composition. Toxicology **46**:95-105.
**Keywords:** biochemical/ biochemistry/ composition/ crude oil/ dosed/ evaluation/ liver/ mammal/ mouse/ oil/ Otwo/ physiology/ Prudhoe Bay/ Prudhoe Bay crude oil/ toxicity/ weight
**Notes:** Assessment of the liver toxicity of Prudhoe Bay crude oil; laboratory mice dosed with crude oil for 2 days followed by an evaluation of body and liver weight and liver biochemistry.

**Kiceniuk, J. W., W. R. Penrose, W. R. Squires**, 1978. Oil spill dispersants cause bradycardia in a marine fish. Marine Pollution Bulletin **9**:42-45.
**Keywords:** cunner/ dispersant/ fish/ heart/ heart rate/ ODthree/ oil/ oil spill/ rate/ salt water/ spill
**Notes:** Effect on heart rate in a marine fish (cunner) of exposure to two chemical oil dispersants.

**Kiceniuk, J. W., G. L. Fletcher, R. Misra**, 1980. Physiological and morphological changes in a cold torpid marine fish upon acute exposure to petroleum. Bulletin of Environmental Contamination and Toxicology **24**:313-319.
**Keywords:** acute/ biochemistry/ blood/ crude oil/ cunner/ effects/ fish/ oil/ organ/ Othree/ petroleum/ salt water/ Venezuelan crude oil/ weight
**Notes:** Effects on a marine fish (cunner) of 2 weeks of exposure to a surface slick of Venezuelan crude oil; body weight, organ weights, blood characteristics, biochemistry.

**Kiceniuk, J. W., R. A. Khan, M. Dawe, U. Williams**, 1982. Examination of interaction of Trypanosome infection and crude oil exposure on hematology of the longhorn sculpin (*Myoxocephalus octodecemspinosus*). Bulletin of Environmental Contamination and Toxicology **28**:435-438.
**Keywords:** biochemistry/ blood/ crude oil/ fish/ oil/ organ/ Othree/ parasite/ pathology/ salt water/ sculpin/ Venezuelan crude oil/ weight
**Notes:** Assessment of the interaction of protozoan infection and exposure to the water-soluble fraction of Venezuelan crude oil in the longhorn sculpin; body weight, organ weights, biochemistry, blood characteristics, pathology.

**Kiceniuk, J. W., U. P. Williams**, 1987. Sediment hydrocarbon contamination at the site of the Baie Verte, Newfoundland, oil spill. Results of a four year study. Marine Pollution Bulletin **18**:270-274.
**Keywords:** aromatic hydrocarbons/ concentration/ diesel/ diesel fuel/ hydrocarbons/ miscellaneous/ Newfoundland/ Oeleven/ oil/ oil spill/ oiled/ salt water/ sediment/ spill/ time
**Notes:** A spill of diesel oil occurred in 1982 at Baie Verte, Newfoundland. Samples of sediment were collected from oiled and reference sites at 1 m below the water surface at low tide during June of 1982, 1983, 1984, and 1985. The samples were analyzed for six aromatic hydrocarbons and the results converted to diesel fuel concentrations as a standard. Table 3 not referenced and units of measure not indicated.

**Kim, S., E. L. Stair, R. L. Lochmiller, D. P. Raferty, J. L. Schroder, N. T. Basta, J. W. Lish, C. W. Qualls, Jr.**, 2001. Widespread risks of dental fluorosis in cotton rats (*Sigmodon hispidus*) residing on petrochemical waste sites. Journal of Toxicology and Environmental Health, Part A **62**:107-125.
**Keywords:** bone/ concentration/ cotton rat/ fluoride/ fluorosis/ incisor/ lesions/ mammal/ Oklahoma/ Otwo/ rat/ risk/ soil
**Notes:** A total of 573 cotton rats were collected from 12 former petrochemical sites and 12 matched reference sites in Oklahoma, USA between 9/95 and 2/98. After sacrifice, incisors were evaluated for signs of dental lesions (fluorosis) and humeri were analyzed for fluoride concentrations. Soil samples at each site also were analyzed for fluoride concentration.

**Kim, S., E. L. Stair, J. W. Lish, R. L. Lochmiller, D. P. Rafferty, C. W. Qualls, Jr.**, 2001. Evaluation of myelotoxicity in cotton rats (*Sigmodon hispidus*) exposed to environmental contaminants. II. Myelotoxicity associated with petroleum industrial wastes. Journal of Toxicology and Environmental Health, Part A **62**:97-105.
**Keywords:** blood/ bone/ bone marrow/ cell/ cotton rat/ evaluation/ hematoxicity/ mammal/ numbers/ Oklahoma/ Otwo/ petroleum/ petroleum waste/ rat
**Notes:** Twelve cotton rats were collected from each of nine former petroleum waste sites and nine matching reference sites in Oklahoma, USA during 1997 and 1998. Rats were transported to a laboratory facility, blood was collected, and the rats were euthanized. Bone marrow cells were taken from one femur and cultured to determine the number of colony-forming units of granulocyte-macrophage.

**Kim, S., R. L. Lochmiller, E. L. Stair, J. W. Lish, D. P. Rafferty, C. W. Qualls, Jr.**, 2001. Efficacy of histopathology in detecting petrochemical-induced toxicity in wild cotton rats. Environmental Pollution **113**:323-329.

**Keywords:** adult/ cotton rat/ evaluation/ indicator/ mammal/ Otwo/ pathology/ petroleum waste/ rat/ seasonal/ sex/ tissue/ toxicity
**Notes:** Cotton rats were collected from 13 petrochemical sites and 13 matching reference sites. The sites were sampled over a 3-yr period and collections were made during February and September. Six adults of each sex were collected each season at each site. Animals were transported to the laboratory, euthanized, and tissues removed for histopathological evaluation. Results were compared between contaminated and reference sites and between seasons.

**King, J. G., G. A. Sanger** 1979. Oil vulnerability index for marine oriented birds. Pages 227-239 *in* J. C. Bartonek, D. N. Nettleship, editors. Conservation of marine birds of northern North America: papers from the international symposium held at Seattle, Washington, 13-15 May 1975. Wildlife Research Report. U.S. Fish and Wildlife Service, Washington, D.C.
**Keywords:** bird/ environment/ index/ marine environment/ oil/ Oone/ Pacific/ salt water/ species/ spill/ survival/ vulnerability/ conservation/ marine birds/ North America/ Washington
**Notes:** An oil vulnerability index for birds living in or utilizing marine environments. A total of 176 species from the northeast Pacific were classified according to 20 factors affecting survival. Potential point scores ranged from 0 to 5 per factor with a potential total score of 1 to 100. Scores were also derived for bird Families and species were grouped according to point ranges.

**King, K. A., C. A. Lefever**, 1979. Effects of oil transferred from incubating gulls to their eggs. Marine Pollution Bulletin **10**:319-321.
**Keywords:** bird/ effects/ eggs/ embryo/ feathers/ fuel oil/ gull/ No.2 fuel oil/ oil/ Oone/ plumage/ salt water
**Notes:** No. 2 fuel oil applied to breast feathers of incubating laughing gulls; effects on embryos.

**King, K. A., S. Macko, P. L. Parker, E. Payne**, 1979. Resuspension of oil: probable cause of brown pelican fatality. Bulletin of Environmental Contamination and Toxicology **23**:800-805.
**Keywords:** bird/ brown pelican/ endangered species/ oil/ oiled/ Oone/ pelican/ plumage/ residual oil/ salt water/ spill/ Texas
**Notes:** Report of death of an endangered brown pelican due to oiling caused by residual oil from a spill that occurred 6 weeks previously.

**King, K. A., C. J. Stafford, B. W. Cain, A. J. Mueller, H. D. Hall**, 1987. Industrial, agricultural, and petroleum contaminants in cormorants wintering near the Houston Ship Channel, Texas, USA. Colonial Waterbirds **10**:93-99.
**Keywords:** analysis/ bird/ carcass/ cormorant/ hydrocarbons/ Oone/ petroleum/ petroleum hydrocarbons/ salt water/ Texas/ tissue/ wintering
**Notes:** Report of the analysis of cormorant carcass tissue for petroleum hydrocarbons at the beginning and end of the wintering period.

**Kingston, P. F.**, 1992. Impact of offshore oil production installations on the benthos of the North Sea. ICES Journal of Marine Science **49**:45-53.
**Keywords:** benthic/ community/ concentration/ distance/ diversity/ marine invertebrate/ North Sea/ numbers/ offshore/ Ofour/ oil/ oil platform/ petroleum hydrocarbons/ population/ review/ salt water/ sediment/ sources/ species
**Notes:** Overall assessment of the effect of offshore oil installations on benthos of the North Sea. Reviews data from other sources on a variety of measures related to distance from oil platform; number of benthic species, numbers of individuals, diversity, taxa comparisons between sites, sediment hydrocarbon concentrations, and several biological measures related to sediment hydrocarbon concentrations.

**Kingston, P. F., I. M. T. Dixon, S. Hamilton, D. C. Moore**, 1995. The impact of the *Braer* oil spill on the macrobenthic infauna of the sediments off the Shetland Islands. Marine Pollution Bulletin **30**:445-459.
**Keywords:** benthic/ community/ diversity/ effects/ infauna/ marine invertebrate/ Ofour/ oil/ oil spill/ population/ salt water/ sediment/ Shetland/ species/ spill/ trend
**Notes:** Assessment of the effects on benthos of the *Braer* oil spill off the Shetland Islands in January 1993. Samples of sediment and benthos were collected from three locations in April and May 1993.

Measured sediment characteristics and identified species, then calculated diversity indices and identified species trends.

**Kireeva, N. A., G. M. Khanislamova, E. M. Tarasenko**, 2005. Biological testing of oil-polluted and reclaimed soils based on the survival of springtails (Collembola). Russian Journal of Ecology **36**:361-364.
**Keywords:** abundance/ bacteria/ crude oil/ experiment/ freshwater invertebrate/ microbes/ Ofive/ oil/ soil/ species/ survival/ time/ toxicity/ weathered
**Notes:** Soil treated with 0, 1, 2, 5, or 10% crude oil and incubated for 3-180 days was used to test toxicity to a species of springtail. A parallel set of soil samples was treated with a bacterial soil reclamation product (Bacispecin). Survival was determined on day 5 of exposure and life span of all springtails was recorded. Also measured the abundance of hydrocarbon-metabolizing microorganisms (bacteria?) and the total hydrocarbon content of soil at the start of each experiment.

**Kirk, J. L., J. N. Klironomos, H. Lee, J. T. Trevors**, 2005. The effects of perennial ryegrass and alfalfa on microbial abundance and diversity in petroleum contaminated soil. Environmental Pollution **133**:455-465.
**Keywords:** abundance/ alfalfa/ bacteria/ biodegradation/ bioremediation/ combination/ community/ diversity/ DNA/ effects/ freshwater plant/ fungi/ hydrocarbons/ inorganic/ microbes/ nutrients/ Oten/ petroleum/ petroleum hydrocarbons/ plant/ ryegrass/ soil/ storage/ TPH
**Notes:** Soil containing 31,000 ppm of total petroleum hydrocarbons (TPH) from a former petroleum storage site was used to evaluate the effect of plants on the soil microbial community. Perennial ryegrass, alfalfa, or a combination of the two were planted in pots containing the petroleum-contaminated soil. Duration of the study was 7 weeks. Measured the TPH and inorganic nutrients in the soil, measured the abundance of heterotrophic and petroleum-degrading bacteria on a weekly basis, and performed a DNA assessment of the microbial community at the beginning and at the end of the study.

**Klein, S. A., D. Jenkins**, 1983. The toxicity of jet fuels to fish -- II. The toxicity of JP-8 to flagfish (*Jordanella floridae*) and rainbow trout (*Salmo gairdneri*) and golden shiners (*Notemigonus chysoleucas*). Water Research **17**:1213-1220.
**Keywords:** accumulation/ acute/ bioassay/ depuration/ development/ effects/ fish/ flagfish/ fresh water/ golden shiner/ growth/ jet fuel/ Othree/ rainbow trout/ reproduction/ species/ toxicity
**Notes:** Assessment of the effects of the water-soluble fraction of jet fuel (JP-8) on growth, development, and reproduction in three species of fresh water fish; 96 hr acute bioassay, 4 month continuous-flow bioassay, accumulation and depuration also measured.

**Klekowski, E. J., Jr., J. E. Corredor, J. M. Morell, C. A. Del Castillo**, 1994. Petroleum pollution and mutation in mangroves. Marine Pollution Bulletin **28**:166-169.
**Keywords:** alkane/ coast/ concentration/ hydrocarbons/ mangrove/ marine plant/ mutation/ Osix/ PAH/ petroleum/ plant/ pollution/ salt water/ saturated hydrocarbons/ sediment/ unresolved complex mixture
**Notes:** Seven sites along the coast of Puerto Rico were sampled for sediment and surveyed for the presence of mangrove plants with chlorophyll-deficient mutations. The sediment was analyzed for resolved alkanes, unresolved complex mixture of saturated hydrocarbons, and PAHs as chrysene equivalents. Concentrations of hydrocarbons were compared to the frequency of chlorophyll-deficient mutations.

**Klerks, P. L., J. A. Nyman, S. Bhattacharyya**, 2004. Relationship between hydrocarbon measurements and toxicity to a chironomid, fish larva and daphnid for oils and oil spill chemical treatments in laboratory freshwater marsh microcosms. Environmental Pollution **129**:345-353.
**Keywords:** aromatic hydrocarbons/ combination/ Corexit 9500/ Corexit 9580/ crude oil/ diesel/ diesel fuel/ fish/ fresh water/ freshwater invertebrate/ Louisiana crude oil/ microcosm/ ODnine/ oil/ oil spill/ petroleum/ sediment/ South Louisiana crude oil/ spill/ technical/ time/ toxicity/ TPH
**Notes:** Laboratory microcosms using sediments from two freshwater marshes were mixed with one of nine combinations of South Louisiana crude oil, diesel fuel, no petroleum, Corexit 9500, Corexit 9580, and no chemical cleaner. Water and sediment-water mixture was taken from the microcosms on days 1, 7, 31, and 186 for toxicity determinations with medaka fish (96 hrs), young daphnids (48 hrs), and chironomid larva (96 hrs). Hydrocarbon content of the sediment at sampling time was quantified in

several general ways to test the toxic predictability of the measures (TPH by three measures, total targeted aromatic hydrocarbons, principal components results, and several individual aromatic hydrocarbons).

**Knap, A. H., P. J. LeB. Williams**, 1982. Experimental studies to determine the fate of petroleum hydrocarbons from refinery effluent on an estuarine system. Environmental Science and Technology **16**:1-4.
**Keywords:** biodegradation/ degradation/ effluent/ estuarine/ evaporation/ fate/ hydrocarbons/ Onine/ petroleum/ petroleum hydrocarbons/ refinery/ salt water/ sediment/ technical/ United Kingdom
**Notes:** An assessment of the fate of petroleum hydrocarbons from refinery effluent in the water and sediment of Southampton Water, United Kingdom. Evaluated the processes of biodegradation, evaporation, and adsorption of hydrocarbons to estuarine sediments.

**Knap, A. H., P. J. LeB. Williams, E. Lysiak**, 1982. Petroleum hydrocarbons in sediments of Southampton Water estuary. Marine Environmental Research **7**:235-249.
**Keywords:** aliphatic hydrocarbons/ alkane/ analysis/ aromatic hydrocarbons/ distance/ England/ estuary/ hydrocarbons/ miscellaneous/ Oeleven/ petroleum/ petroleum hydrocarbons/ refinery/ salt water/ sediment/ survey
**Notes:** A total of 21 samples of surface sediments were collected from various locations near and at distance from a large petroleum refinery in the Southampton Water estuary, England. Samples were fractionated and quantified. Resolved alkanes (n-16 to n-27) were quantified as a group. Several sediment cores were analyzed by increments.

**Knap, A. H., J. E. Solbakken, R. E. Dodge, T. D. Sleeter, S. J. Wyers, K. H. Palmork**, 1982. Accumulation and elimination of (9-$^{14}$C) phenanthrene in the reef-building coral (*Diploria strigosa*). Bulletin of Environmental Contamination and Toxicology **28**:281-284.
**Keywords:** accumulation/ coral/ depuration/ elimination/ evaluation/ flow-through/ labelled/ marine invertebrate/ Ofour/ petroleum/ phenanthrene/ salt water/ uptake
**Notes:** Evaluation of the uptake and depuration by reef coral of radio-labelled phenanthrene as a surrogate for petroleum. Coral exposed for 24 hr to labelled phenanthrene in a flow-through laboratory system and monitored for 10 da for depuration.

**Knap, A. H., S. C. Wyers, R. E. Dodge, T. D. Sleeter, H. R. Frith, S. R. Smith, and C. B. Cook** 1985. The effects of chemically and physically dispersed oil on the brain coral *Diploria strigosa* (Dana) -- a summary review. Pages 547-551 *in* 1985 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), API Publication 4385. American Petroleum Institute, Washington, DC.
**Keywords:** Arabian Light crude oil/ behavior/ brain/ coral/ Corexit 9527/ crude oil/ depuration/ dispersant/ effects/ flow-through/ growth/ hydrocarbons/ light/ long-term/ marine invertebrate/ monitoring/ ODfour/ oil/ oil spill/ photosynthesis/ recovery/ review/ salt water/ spill/ survival/ uptake
**Notes:** Summary of 3 yrs of laboratory and field work on the effects on reef coral of Arabian light crude oil with or without dispersants (Corexit 9527 or BP 1100WD). Exposure of coral for up to 24 hrs in a flow-through laboratory system was followed by recovery periods of up to 20 da. Measured survival, behavior, uptake and depuration of hydrocarbons, photosynthesis, and skeletal growth. In some studies, corals were exposed in the field. Some corals exposed in the laboratory were transferred to field sites for long-term monitoring in excess of 1 yr.

**Knap, A. H.**, 1987. Effects of chemically dispersed oil on the brain coral, *Diploria strigosa*. Marine Pollution Bulletin **18**:119-122.
**Keywords:** Arabian Light crude oil/ behavior/ brain/ coral/ Corexit 9527/ crude oil/ depuration/ effects/ evaluation/ flow-through/ growth/ light/ lipid/ long-term/ marine invertebrate/ metabolism/ ODfour/ oil/ photosynthesis/ salt water/ survival/ uptake
**Notes:** Evaluation of the effects of chemically dispersed Arabian Light crude oil on coral in a flow-through experimental system supplemented by a field study. Corals exposed for 6 or 24 hr to either crude oil, crude oil plus Corexit 9527, or crude oil plus BP 1100 WD in the lab. Field exposure employed placing exposure chambers over coral on the sea floor and and injecting dispersed crude oil into the chamber for

6 hr. Measured hydrocarbon uptake and depuration, lipid metabolism and photosynthesis, survival, behavior, and long-term (1 yr) growth after exposure.

**Knowles, R., C. Wishart**, 1977. Nitrogen fixation in Arctic marine sediments: effect of oil and hydrocarbon fractions. Environmental Pollution **13**:133-149.
**Keywords:** aerobic/ aliphatic hydrocarbons/ anaerobic/ Arctic/ aromatic hydrocarbons/ bacteria/ Beaufort Sea/ biodegradation/ Canada/ condition/ crude oil/ hydrocarbons/ incubation/ microbes/ nitrogen/ Norman Wells crude oil/ numbers/ oil/ organic/ Oten/ salt water/ sampling/ sediment/ weathered
**Notes:** Sediment samples from the Beaufort Sea and Eskimo Lakes in northwest Canada were used in laboratory assessment of the nitrogen fixing capability of sediment microbes under cold environmental conditions. Unweathered or weathered Norman Wells crude oil or one of four aliphatic and one aromatic hydrocarbons were added to the sediments either with or without various organic supplements. In addition, some incubations were performed with or without supplements only. Aerobic and anaerobic conditions were compared. Duration of incubation was up to 35 da. Numbers of nitrogen fixing bacteria were estimated from two of the sampling sites.

**Kocan, R. M., M. B. Matta, S. M. Salazar**, 1996. Toxicity of weathered coal tar for shortnose sturgeon (*Acipenser brevirostrum*) embryos and larvae. Archives of Environmental Contamination and Toxicology **31**:161-165.
**Keywords:** aromatic hydrocarbons/ coal/ coal tar/ concentration/ effects/ embryo/ fish/ hydrocarbons/ larvae/ Othree/ sediment/ sturgeon/ survival/ toxicity/ weathered
**Notes:** Assessment of the toxic effects of weathered coal tar deposits in sediments of the Connecticut River on embryos and larvae of shortnose sturgeon; survival, sediment concentrations of aromatic hydrocarbons.

**Koning, C. W., S. E. Hrudey**, 1992. Sensory and chemical characterization of fish tainted by exposure to oil sand wastewaters. Water Science and Technology **25**:27-34.
**Keywords:** Alberta/ analysis/ bile/ chemical analysis/ evaluation/ fish/ fresh water/ oil/ oil sands/ Othree/ sand/ taint/ waste water
**Notes:** Evaluation of the potential for fish tainting caused by the extraction wastewaters from the oil sands area of Alberta; four wastewater preparations, chemical analysis of fillet, bile, and treated wastewater.

**Kornilios, S., P. G. Drakopoulos, C. Dounas**, 1998. Pelagic tar, dissolved/dispersed petroleum hydrocarbons and plastic distribution in the Cretan Sea, Greece. Marine Pollution Bulletin **36**:989-993.
**Keywords:** dissolved/ distribution/ Greece/ hydrocarbons/ litter/ miscellaneous/ Oeleven/ petroleum/ petroleum hydrocarbons/ plastic/ salt water/ sampling/ survey/ tar ball
**Notes:** Survey of the distribution of dissolved or dispersed petroleum hydrocarbons, floating tar, and plastic litter in the Cretan Sea, Greece. Samples collected from 25 sampling stations in July 1997.

**Koster, A. SJ., J. A. M. Van Den Biggelaar**, 1980. Abnormal development of *Dentalium* due to the *Amoco Cadiz* oil spill. Marine Pollution Bulletin **11**:166-169.
**Keywords:** Amoco Cadiz/ bivalve/ crude oil/ development/ embryo/ female/ France/ larvae/ marine invertebrate/ Ofour/ oil/ oil spill/ reproduction/ salt water/ spill
**Notes:** Comparison of reproduction of the bivalve, *Dentalium vulgare*, in females collected before the Amoco Cadiz spill with those collected from coastal France after the spill. Measured development of embryos and larvae.

**Koth, T., E. Vauk-Hentzelt**, 1988. Influence of plumage and stomach oiling on body and organ growth in young kittiwakes. Marine Pollution Bulletin **19**:71-73.
**Keywords:** bird/ effects/ GI tract/ growth/ kittiwake/ liver/ nestling/ oiled/ Oone/ organ/ pathology/ plumage/ salt water/ stomach/ weight
**Notes:** Measurements on dead oiled kittiwake nestlings and fledglings found on Helgoland (German Bight) revealed effects on liver weight and body weight.

**Krahn, M. M., L. J. Kittle, Jr., W. D. MacLeod, Jr.**, 1986. Evidence for exposure of fish to oil spilled into the Columbia River. Marine Environmental Research **20**:291-298.
**Keywords:** aromatic hydrocarbons/ bile/ fish/ fresh water/ hydrocarbons/ metabolite/ oil/ Othree/ petroleum/ residual oil/ spill/ sturgeon
**Notes:** Assessment of petroleum exposure of white sturgeon downriver of a spill of heavy residual oil in the Columbia River, WA; measured metabolites of aromatic hydrocarbons in bile.

**Krahn, M. M., D. G. Burrows, G. M. Ylitalo, D. W. Brown, C. A. Wigren**, 1992. Mass spectrometric analysis for aromatic compounds in bile of fish sampled after the *Exxon Valdez* oil spill. Environmental Science and Technology **26**:116-126.
**Keywords:** analysis/ aromatic hydrocarbons/ bile/ Exxon Valdez/ fish/ hydrocarbons/ metabolite/ oil/ oil spill/ Othree/ pollock/ salmon/ salt water/ species/ spill
**Notes:** Analysis of pollock and salmon bile for presence of metabolites of aromatic hydrocarbons following the Exxon Valdez spill.

**Krahn, M. M., G. M. Ylitalo, J. Buzitis, J. L. Bolton, C. A. Wigren, S.-L. Chan, U. Varanasi**, 1993. Analyses for petroleum-related contaminants in marine fish and sediments following the Gulf oil spill. Marine Pollution Bulletin **27**:285-292.
**Keywords:** Arabian Gulf/ aromatic hydrocarbons/ bile/ fish/ Gulf oil spill/ hydrocarbons/ metabolite/ oil/ oil spill/ Othree/ salt water/ sediment/ species/ spill/ war
**Notes:** Analyses of fish bile and sediments from the Arabian Gulf 1 year after the Gulf War (1991) for the presence of aromatic hydrocarbons and their metabolites. Fish species was the sheiry (*Lethrinus kallopterus*).

**Krause, P. R.**, 1995. Spatial and temporal variability in receiving water toxicity near an oil effluent discharge site. Archives of Environmental Contamination and Toxicology **29**:523-529.
**Keywords:** California/ discharges/ effects/ effluent/ eggs/ fertilization/ marine invertebrate/ Ofour/ oil/ oil field/ produced water/ salt water/ sampling/ sea urchin/ sperm/ toxicity/ transect/ urchin/ waste water
**Notes:** Assessment of the effects on eggs and sperm of the purple sea urchin of a produced- water discharge from onshore oil fields. Eggs and sperm exposed to receiving waters from a sampling transect over a 2-yr period (spatial and temporal aspects), dilutions of the effluent, and a confirmation study performed to confirm that the effluent discharge was the actual cause of the effects observed. Measured fertilization success.

**Krebs, C. T., K. A. Burns**, 1977. Long-term effects of an oil spill on population of the salt-marsh crab *Uca pugnax*. Science **197**:484-487.
**Keywords:** adult/ behavior/ concentration/ crab/ density/ diet/ effects/ experiment/ fuel oil/ hydrocarbons/ juvenile/ long-term/ marine invertebrate/ No.2 fuel oil/ Ofour/ oil/ oil spill/ petroleum/ petroleum hydrocarbons/ population/ ratio/ salt marsh/ salt water/ sediment/ sex/ spill/ survival/ tissue
**Notes:** Field and laboratory assessment of the effect on salt marsh crabs of the No. 2 fuel oil spill at West Falmouth in 1969. Related petroleum hydrocarbons in sediment to crab density, adult sex ratios, juvenile settlement, overwinter survival, hydrocarbons in tissue, and burrow construction during the 7-yr period after the spill. Evaluated the effect of fuel oil in the diet on behavior in a laboratory experiment.

**Kroening, S. J., D. W. M. Leung, L. G. Greenfield, C. Galilee**, 2001. Losses of diesel oil by volatilisation and effects of diesel oil on seed germination and seedling growth. Environmental Technology **22**:1117.
**Keywords:** diesel/ diesel fuel/ effects/ emergence/ fresh water/ freshwater plant/ germination/ growth/ length/ oil/ Oseven/ roots/ ryegrass/ seed/ seedling/ soil/ time
**Notes:** The evaporative potential of diesel fuel over a 300-da period was determined by exposing diesel fuel, diesel fuel in soil, diesel fuel exposed to wind, and diesel fuel protected from wind. Ryegrass seeds were soaked in diesel fuel for 0, 2, 4, 8, 12, or 24 wks before testing for germination (2 wks). Seeds were tested exposed to ambient air or the volatile fractions of fresh diesel. Measured percent germination, root length, and percent shoot emergence.

**Kuehn, R. L., K. D. Berlin, W. E. Hawkins, G. K. Ostrander**, 1995. Relationships among petroleum refining, water and sediment contamination, and fish health. Journal of Toxicology and Environmental

Health **46**:101-116.
**Keywords:** chemical characteristics/ community/ diversity/ effects/ effluent/ fish/ fresh water/ health/ Othree/ pathology/ petroleum/ refinery/ sediment/ species/ species diversity/ stream/ Texas
**Notes:** Assessment of the effects of refinery effluents on fish species and chemical characteristics of water and sediment in three Texas streams; species diversity, community similarity, pathology.

**Kuhnhold, W. W.** 1972. The influence of crude oils on fish fry. Pages 315-318 *in* M. Ruivo, editor. Marine Pollution and Sea Life. Fishing News (Books) Ltd., London.
**Keywords:** behavior/ cod/ crude oil/ effects/ eggs/ fish/ fry/ herring/ larvae/ malformation/ oil/ Othree/ plaice/ pollution/ salt water/ survival
**Notes:** Effects on cod eggs and cod, herring, and plaice larvae of exposure to the water-soluble fractions of three crude oils, a physical dispersion of one crude oil, and a chemical dispersion of one crude oil; survival, malformations, behavior.

**Kulik, N., A. Goi, M. Trapido, T. Tuhkanen**, 2006. Degradation of polycyclic aromatic hydrocarbons by combined chemical pre-oxidation and bioremediation in creosote contaminated soil. Journal of Environmental Management **78**:382-391.
**Keywords:** aromatic/ aromatic hydrocarbon/ aromatic hydrocarbons/ bioremediation/ creosote/ degradation/ hydrocarbons/ incubation/ microbes/ Oten/ PAH/ sand/ soil/ time
**Notes:** Samples of sand or peat were spiked with creosote and treated with either a two- or three-phase ozonation process for 3 or 4 periods of time (30-300 min). Mixtures were incubated for 24 hrs. PAH content (seven PAHs) was measured before and after the ozonation and incubation.

**Kurelec, B., S. Britvic, M. Rijavec, W. E. G. Muller, R. K. Zahn**, 1977. Benzo(a)pyrene monooxygenase induction in marine fish - molecular response to oil pollution. Marine Biology **44**:211-216.
**Keywords:** biomarker/ condition/ crude oil/ diesel/ diesel fuel/ dispersant/ fish/ monooxygenase/ ODthree/ oil/ pollution/ salt water/ species/ spill
**Notes:** Assessment of the induction of benzo(a)pyrene monooxygenase in two fish species under experimental conditions and at spill sites; diesel fuel, crude oil, biomarker.

**Kvenvolden, K. A., F. D. Hostettler, J. B. Rapp, P. R. Carlson**, 1993. Hydrocarbons in oil residues on beaches of islands of Prince William Sound, Alaska. Marine Pollution Bulletin **26**:24-29.
**Keywords:** Alaska/ aliphatic hydrocarbons/ alkane/ analysis/ aromatic hydrocarbons/ beach/ crude oil/ cycloalkane/ Exxon Valdez/ fate/ fingerprinting/ hydrocarbons/ North Slope/ North Slope crude oil/ oil/ oil spill/ Onine/ petroleum/ Prince William Sound/ residual oil/ salt water/ sediment/ spill/ sterane/ survey/ technical/ terpane/ time
**Notes:** A survey of petroleum residues (eight samples) on rocks and sediment from the shores of six islands affected by the Exxon Valdez oil spill, and fresh North Slope crude oil. Samples were collected 17 mos after the spill and analyzed for linear and branched alkanes, terpanes, steranes, and triaromatic steranes. Results were used to determine the geochemical fate of the petroleum.

**Lacerda, L. D., C. E. Rezende, A. R. C. Ovalle, C. E. V. Carvalho**, 2004. Mercury distribution in continental shelf sediments from two offshore oil fields in southeastern Brazil. Bulletin of Environmental Contamination and Toxicology **72**:178-185.
**Keywords:** Brazil/ coast/ concentration/ distribution/ mercury/ miscellaneous/ Oeleven/ offshore/ oil field/ salt water/ sediment
**Notes:** Sediment samples were collected from the inner continental shelf and around two offshore oil well platforms on the outer continental shelf off the coast of Brazil. Sediments were collected at 250, 500, 1,000, and 3,000 m from the platforms. Samples were analyzed for Hg concentrations.

**Lambert, G., D. B. Peakall, B. J. R. Philogene, F. R. Engelhardt**, 1982. Effect of oil and oil dispersant mixtures on the basal metabolic rate of ducks. Bulletin of Environmental Contamination and Toxicology **29**:520-524.
**Keywords:** bird/ Corexit 9527/ crude oil/ dispersant/ duck/ mallard/ metabolism/ ODone/ oil/ physiology/ Prudhoe Bay/ Prudhoe Bay crude oil/ rate/ salt water
**Notes:** Effect on mallard metabolic rate of exposure to undispersed and dispersed Prudhoe Bay crude oil.

**Lancaster, J. E., M. G. Pawson, G. D. Pickett, S. Jennings**, 1998. The impact of the 'Sea Empress' oil spill on seabass recruitment. Marine Pollution Bulletin **36**:677-688.
**Keywords:** abundance/ activity/ age/ condition/ effects/ England/ feeding/ fish/ growth/ oil/ oil spill/ Othree/ recruitment/ salt water/ spill
**Notes:** Assessment of the effects of the Sea Empress oil spill on seabass in the Bristol Channel, England. Measured abundance and year class strength of 0-group bass, length-weight, age, condition and feeding activity, date of arrival in nursery areas, and growth.

**Lance, B. K., D. B. Irons, S. J. Kendall, L. L. McDonald** , 2001. An evaluation of marine bird population trends following the *Exxon Valdez* oil spill, Prince William Sound, Alaska. Marine Pollution Bulletin **42**:298-309.
**Keywords:** Alaska/ bird/ crude oil/ estimate/ evaluation/ Exxon Valdez/ offshore/ oil/ oil spill/ oiled/ Oone/ population/ Prince William Sound/ salt water/ sampling/ shoreline/ spill/ survey/ time/ transect/ trend
**Notes:** An evaluation of bird surveys in Prince William Sound following the *Exxon Valdez* oil spill. The Sound was divided into three sampling strata; shoreline, nearshore, and offshore. Randomly-selected subsets of established shoreline transects and two transects within randomly-selected 5-min latitude and longitude blocks (nearshore and offshore) were used to identify and enumerate birds during March (1990, 1991, 1993, 1994, 1996, 1998) and July (1989, 1990, 1991, 1993, 1996, 1998). Population estimates were analyzed for trends in the oiled area and for trends in the oiled area compared to the unoiled area.

**Lanctot, R., B. Goatcher, K. Scribner, S. Talbot, B. Pierson, D. Esler, D. Zwiefelhofer**, 1999. Harlequin duck recovery from the *Exxon Valdez* oil spill: a population genetics perspective. Auk **116**:781-791.
**Keywords:** adult/ Alaska/ analysis/ bird/ blood/ diversity/ duck/ Exxon Valdez/ genetic/ harlequin duck/ oil/ oil spill/ Oone/ population/ Prince William Sound/ recovery/ salt water/ spill
**Notes:** Adult ($\geq$ 1 yr old) harlequin ducks were sampled (blood) from four locations in Prince William Sound and four locations in the Kodiak Archipelago and Alaska Peninsula. Performed a genetic analysis on four biparental, two sex-linked, and one maternally inherited marker. Calculated measures of genetic diversity for all markers.

**Landis, W. G., A. J. Markiewicz, R. A. Matthews, G. B. Matthews**, 2000. A test of the community conditioning hypothesis: persistence of effects in model ecological structures dosed with the jet fuel JP-8. Environmental Toxicology and Chemistry **19**:327-336.
**Keywords:** algae/ community/ dosed/ effects/ fresh water/ freshwater invertebrate/ freshwater plant/ growth/ invertebrate/ jet fuel/ microbes/ microcosm/ miscellaneous/ model/ Oeleven/ persistence/ short-term/ species/ structure/ time/ toxicity
**Notes:** A standard aquatic microcosm test (63 da) and a 126 da aquatic microcosm test were used to evaluate the community effects of JP-8 water-soluble fraction (WSF) and their retention over time. The microcosms had 16 species of algae, invertebrates, and microbes. The 126 da test was done with 0, 1, 5, or 15 % WSF. Short-term toxicities of WSF were determined with 96-hr algal growth inhibition tests on three species of algae and a 48-hr toxicity test on *D. magna*.

**Lane, F. W., A. D. Bauer, H. F. Fisher, and P. N. Harding** 1926. Appendix V: Effect of oil pollution on marine and wild life. Pages 171-181 *in* Report of the U.S. Commissioner of Fisheries for 1925. Document. U.S. Bureau of Fisheries, Washington, DC.
**Keywords:** Atlantic/ bird/ bivalve/ combination/ effects/ experiment/ fish/ fishery/ general effect/ Gulf of Mexico/ Mexico/ Oeight/ oil/ petroleum/ pollution/ salt water
**Notes:** This is an old investigation into the effects of oil pollution on bivalves, fish, and waterfowl in the Atlantic and Gulf of Mexico coastal areas. A combination of interviews, reports of experiments, and site inspections. An interesting historical account.

**Lane, P. A., J. D. Vandermeulen, M. J. Crowell, and D. G. Patriquin** 1987. Impact of experimentally dispersed crude oil on vegetation in a northwestern Atlantic salt marsh -- preliminary observations. Pages 509-514 *in* Proceedings 1987 Oil Spill Conference, API Publication 4452. American Petroleum Institute, Washington, D.C.
**Keywords:** Atlantic/ biomass/ Corexit 9527/ creek/ crude oil/ density/ dispersant/ effects/ marine plant/

ODsix/ oil/ oil spill/ salt marsh/ salt water/ Spartina/ spill/ treatment/ vegetation
**Notes:** The first year of results for field and greenhouse studies of the effects of undispersed and chemically-dispersed crude oil on *Spartina* spp. vegetation. In the field study, vegetation quadrats were established in three zones (creek edge, midmarsh, high marsh). In the greenhouse study, marsh 'plugs' of vegetation were place in plastic buckets that were watered to simulate the water regime of the three marsh zones. Treatments consisted of control, artificially-weathered crude oil, Corexit 9527 dispersant, or crude oil plus dispersant. At 59 or 70 da post-exposure, quadrats and buckets were measured for biomass, reproductive biomass, shoot height, shoot density, and stem density of flowering shoots.

**Lange, R.** 1985. A 100 tons experimental oil spill at Halten Bank, off Norway. Pages 503-505 *in* 1985 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), API Publication 4385. American Petroleum Institute, Washington, DC.
**Keywords:** behavior/ coast/ composition/ crude oil/ degradation/ density/ experiment/ marine invertebrate/ microbes/ movement/ Norway/ nutrients/ Ofour/ oil/ oil spill/ plankton/ salt water/ species/ spill
**Notes:** Summary description of a large experimental crude oil spill off the coast of Norway in 1982. Movement of spilled oil was tracked for 1 wk. A variety of experiments dealt with microbial degradation of oil, nutrient turnover, and density and species composition of plankton.

**Lannergren, C.**, 1978. Net- and nanoplankton: effects of an oil spill in the North Sea. Botanica Marina **21**:353-356.
**Keywords:** activity/ assimilation/ Bravo/ carbon/ chlorophyll/ concentration/ effects/ hydrocarbons/ marine plant/ North Sea/ oil/ oil field/ oil spill/ Osix/ phytoplankton/ radionuclide/ salt water/ size/ spill/ total hydrocarbons
**Notes:** A blow-out occurred on the Bravo platform of the Ekofisk oil field in 1977. Between 4 and 9 da after the blow-out began, 24 stations around the platform were sampled for phytoplankton. Water samples were treated with a radioactive carbon source, incubated for 3.5-5 da, separated into three size classes, and assessed for chlorophyll *a* concentration and carbon assimilation. Water was analyzed for 'total hydrocarbons' and compared to the metabolic activity of the phytoplankton.

**Lapinskiene, A., P. Martinkus, V. Rebzdaite**, 2006. Eco-toxicological studies of diesel and biodiesel fuels in aerated soil. Environmental Pollution **142**:432-437.
**Keywords:** activity/ biodegradation/ biodiesel/ biomass/ carbon/ carbon dioxide/ concentration/ diesel/ diesel fuel/ experiment/ incubation/ microbes/ Oten/ soil/ time
**Notes:** A comparative assessment of biodegradation of diesel fuel and biodiesel fuel in a laboratory soil experiment. Varying concentrations (1, 3, 6, 9, 12%) of diesel and biodiesel fuel were incubated for 6 da, after which total $CO_2$ production and dehydrogenase activity were determined. At the end of 45 da of incubation the transformed diesel fuels were divided into carbon dioxide, humus compounds, intermediate biodegradation products plus microorganism biomass, and remaining non-biodegraded fuels.

**Lara, R. J., A. Asteasuain, C. Rusansky, R. Asteasuain**, 1995. Distribution of petroleum hydrocarbons in waters of the Bahia Blanca Bay, Argentina. Marine Pollution Bulletin **30**:281-283.
**Keywords:** Argentina/ aromatic hydrocarbons/ concentration/ crude oil/ depth/ distribution/ estuary/ hydrocarbons/ miscellaneous/ Oeleven/ oil/ petroleum/ petroleum hydrocarbons/ salt water
**Notes:** Water samples at 1 m depth were collected at five locations during 22 cruises occurring between 10/1990 and 2/1993. Aromatic hydrocarbons were measured and compared to a local standard crude oil for estimating total hydrocarbon concentrations.

**LaRoche, G., R. Eisler, C. M. Tarzwell**, 1970. Bioassay procedures for oil and oil dispersant toxicity evaluation. Journal of the Water Pollution Control Federation **42**:1982-1989.
**Keywords:** bioassay/ dispersant/ evaluation/ fish/ grass/ grass shrimp/ lethal/ marine invertebrate/ mummichog/ Ofour/ oil/ procedure/ salt water/ sand worm/ shrimp/ species/ survival/ toxicity
**Notes:** A description of recommended procedures for performing screening bioassays (lethality) of oil and oil dispersants. Authors recommend use of at least three species, e.g., mummichog, sandworm, and grass shrimp for tests lasting 96 hr.

**Larsen, E. M., S. A. Richardson**, 1990. Some effects of a major oil spill on wintering shorebirds at Grays Harbor, Washington. Northwestern Naturalist **71**:88-92.
**Keywords:** bird/ Bunker C/ effects/ fuel oil/ oil/ oil spill/ oiled/ Oone/ plumage/ population/ salt water/ shorebird/ spill/ Washington/ wintering
**Notes:** Oiling of wintering shorebirds caused by No. 6 fuel oil from the barge Nestucca in Grays Harbor, Washington.

**Larson, R. A., L. L. Hunt, D. W. Blankenship**, 1977. Formation of toxic products from a #2 fuel oil by photooxidation. Environmental Science and Technology **11**:492-496.
**Keywords:** concentration/ fuel oil/ light/ oil/ Onine/ peroxide/ petroleum/ phenol/ photooxidation/ sunlight/ technical/ toxicity/ turbidity/ yeast
**Notes:** An early report assessing the production by light irradiation of toxic compounds derived from petroleum. Number 2 fuel oil was subjected to UV radiation equivalent to normal sunlight for 165 hrs. The oil was sampled periodically and measured for concentrations of peroxides, phenols, acidity, total carbonyl compounds, and turbidity. Toxicity of the oil was monitored by applying it to yeast cultures.

**Latimer, J. S., J. G. Quinn**, 1998. Aliphatic petroleum and biogenic hydrocarbons entering Narragansett Bay from tributaries under dry weather conditions. Estuaries **21**:91-107.
**Keywords:** aliphatic hydrocarbons/ biogenic/ condition/ crankcase oil/ fresh water/ fuel oil/ gasoline/ hydrocarbons/ miscellaneous/ Oeleven/ oil/ petroleum/ saturated hydrocarbons/ sources/ time/ unresolved complex mixture
**Notes:** Determination of hydrocarbons entering Narragansett Bay from four rivers during dry conditions. Sampled water every 2 wk from Oct. 1, 1990 to Aug. 4, 1991 and analyzed for saturated hydrocarbons. Identified anthropogenic sources as either gasoline, No. 2 fuel oil, No. 6 fuel oil, used crankcase oil, or unresolved complex mixture.

**Laubier, L.**, 1980. The Amoco Cadiz oil spill: an ecological impact study. Ambio **9**:268-324.
**Keywords:** Amoco Cadiz/ coast/ crude oil/ degradation/ effects/ fish/ France/ general effect/ intertidal/ marine invertebrate/ marine plant/ Oeight/ oil/ oil spill/ overview/ pollution/ sediment/ species/ spill/ subtidal/ time/ weathered
**Notes:** An overview of the results of 2 yrs of post-spill assessment of the Amoco Cadiz crude oil spill off the Brittany coast of France. Contains sections on research planning and general background; major scientific findings on coastal, atmospheric, ocean, and sediment pollution; weathering and biodegredation; intertidal and subtidal disturbances; and effects on exploited species.

**Laughlin, R., O. Linden**, 1983. Oil pollution and Baltic mysids: acute and chronic effects of the water soluble fractions of light fuel oil on the mysid shrimp *Neomysis integer*. Marine Ecology Progress Series **12**:29-41.
**Keywords:** acute/ ammonia/ ammonium/ chronic/ concentration/ consumption/ effects/ experiment/ flow-through/ fuel oil/ light/ marine invertebrate/ No.1 fuel oil/ Ofour/ oil/ oxygen/ petroleum hydrocarbons/ pollution/ salt water/ shrimp/ solubility/ survival/ temperature
**Notes:** Assessment of the effects of water-soluble fractions of No. 1 fuel oil on mysid shrimp in experiments using flow-through aquaria. Shrimp were kept at four temperatures (6, 10, 15, or 20 C) and subjected to either chronic (2 wk) or acute exposure. Measured survival, oxygen consumption, ammonium excretion, and hydrocarbon concentrations.

**Laughlin, R. B. Jr, J. Ng, H. E. Guard**, 1981. Hormesis: a response to low environmental concentrations of petroleum hydrocarbons. Science **211**:705-707.
**Keywords:** concentration/ crab/ development/ growth/ hormesis/ hydrocarbons/ jet fuel/ marine invertebrate/ Ofour/ petroleum/ petroleum hydrocarbons/ rate/ salt water/ survival/ weight
**Notes:** Exposed zoeal stage mud crabs to varying concentrations of water-soluble fraction of jet fuel (JP5) for 5 da or the duration of zoeal development (11-14 da). Measured survival, rate of development, and megalop weight. An example of hormetic response to chemical challenge.

**Laughlin, R. B., Jr., L. G. L. Young, J. M. Neff**, 1978. A long-term study of the effects of water-soluble fractions of No. 2 fuel oil on the survival, development rate, and growth of the mud crab *Rhithropanopeus*

*harrisii*. Marine Biology **47**:87-95.
**Keywords:** bioassay/ concentration/ crab/ development/ effects/ fuel oil/ growth/ hatching/ long-term/ marine invertebrate/ naphthalene/ No.2 fuel oil/ Ofour/ oil/ rate/ ratio/ salt water/ sex/ static/ survival
**Notes:** Mud crabs exposed to five concentrations of the water-soluble fraction of No. 2 fuel oil for 6 mo after hatching. Employed a static bioassay. Measured concentrations of three naphthalenes in water, development rate, growth, and sex ratio.

**Laughlin, R. B., Jr., J. M. Neff**, 1981. Ontogeny of respiratory and growth responses of larval mud crabs *Rhithropanopeus harrisii* exposed to different temperatures, salinities and naphthalene concentrations. Marine Ecology Progress Series **5**:319-332.
**Keywords:** combination/ concentration/ crab/ growth/ hatching/ marine invertebrate/ naphthalene/ Ofour/ rate/ respiration/ salinity/ salt water/ temperature
**Notes:** Larval mud crabs exposed continuously from hatching through the first crab stage to 75, 150, or 300 ppb of naphthalene in water at combinations of three levels of salinity and temperature. Respiration rates determined for 2nd and 4th zoeal, megalops, and first crab stage. An osmotic-shock respiratory response was assessed in one salinity group. Also weighed crabs in the megalops stage.

**Lavado, R., G. Janer, C. Porte**, 2006. Steroid levels and steroid metabolism in the mussel *Mytilus edulis*: the modulating effect of dispersed crude oil and alkylphenols. Aquatic Toxicology **78S**:S65-S72.
**Keywords:** activity/ analysis/ bivalve/ crude oil/ digestive gland/ enzyme/ flow-through/ gill/ gonads/ marine invertebrate/ metabolism/ mussel/ North Sea/ North Sea crude oil/ Ofour/ oil/ oil field/ PAH/ phenol/ produced water/ salt water/ steroid
**Notes:** Mussels were exposed for 3 weeks in a continuous flow-through system to either 0.5 ppm North Sea crude oil, 0.5 ppm crude oil plus a mixture of 0.1 ppm alkylated phenols and 0.1 ppm PAHs, or the carrier (0.2 ppm acetone) alone. Authors refer to dispersed crude oil but they do not describe how the oil was dispersed. After 3 weeks, the gonads, digestive gland, gills, and mantle were removed for enzyme and steroid analysis. Measured free and total testosterone and estradiol, P450-aromatase activity, and estradiol sulfotransferase activity.

**Lavarias, S., H. Heras, R. J. Pollero**, 2004. Toxicity, uptake, and release of the water-soluble fraction of crude oil in different developing stages of the prawn *Macrobrachium borellii*. Archives of Environmental Contamination and Toxicology **47**:215-222.
**Keywords:** adult/ aromatic/ aromatic hydrocarbon/ aromatic hydrocarbons/ assay/ concentration/ crude oil/ depuration/ development/ eggs/ embryo/ experiment/ freshwater/ freshwater invertebrate/ hatching/ hydrocarbons/ larvae/ light/ Ofive/ oil/ prawn/ release/ static/ tissue/ toxicity/ uptake
**Notes:** The water-soluble fraction (WSF) of an Argentinian light crude oil was used in laboratory experiments to determine toxicity to eggs, larvae, and adults of a freshwater prawn. Adults and larvae were exposed to five concentrations of WSF for 96 hr in a static renewal assay; the $LC_{50}$ was calculated. Embryos were exposed to the same concentrations as in the $LC_{50}$ experiment; exposure was either 96 hr for late-stage development or until hatching for newly-laid eggs. Adult prawns were exposed to one concentration of WSF for 96 hr in the study of uptake and release; prawn were sampled at 3, 6, 12, 24, and 96 hr for uptake and at 10 da for subsequent depuration. WSF and prawn tissue were analyzed for selected aromatic hydrocarbons.

**Lavarias, S., R. J. Pollero, H. Heras**, 2006. Activation of lipid catabolism by the water-soluble fraction of petroleum in the crustacean *Macrobrachium borellii*. Aquatic Toxicology **77**:190-196.
**Keywords:** adult/ Argentina/ assay/ biochemical/ crude oil/ crustacean/ embryo/ fresh water/ freshwater invertebrate/ light/ lipid/ metabolism/ Ofive/ oil/ petroleum/ shrimp
**Notes:** Adults and embryos of a shrimp were exposed to the water-soluble fraction of Punta Loyola light crude oil (Argentina) for 7 da. After one week, several biochemical assays were performed to determine if lipid catabolism was increased in adults and embryos.

**Law, A. T.**, 1995. Toxicity study of the oil dispersant Corexit 9527 on *Macrobrachium rosenbergii* (de Man) egg hatchability by using a flow-through bioassay technique. Environmental Pollution **88**:341-343.
**Keywords:** bioassay/ concentration/ Corexit 9527/ dispersant/ eggs/ flow-through/ hatchability/ hatching/ marine invertebrate/ ODfour/ oil/ prawn/ rate/ salt water/ toxicity

**Notes:** Exposure of a prawn in a flow-through bioassay to five concentrations of Corexit 9527 in water. Eggs were exposed until hatching (about 12 da). Measured hatching rate.

**Law, R., E. Andrulewicz**, 1983. Hydrocarbons in water, sediment and mussels from the southern Baltic Sea. Marine Pollution Bulletin **14**:289-293.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ crude oil/ Ekofisk crude oil/ hydrocarbons/ marine invertebrate/ miscellaneous/ mussel/ Oeleven/ oil/ salt water/ sediment/ survey/ total hydrocarbons
**Notes:** Samples of water (3), sediment (8), and mussels (3) were collected from the extreme southern Baltic Sea during the period 1978-82. Samples were analyzed for total hydrocarbons (fluorescence, Ekofisk crude oil equivalents) and selected aliphatic (20) and aromatic (17) hydrocarbons.

**Law, R. J.**, 1978. Determination of petroleum hydrocarbons in water, fish and sediments following the Ekofisk blow-out. Marine Pollution Bulletin **9**:321-324.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ Bravo/ crude oil/ fish/ general effect/ hydrocarbons/ marine invertebrate/ North Sea/ Oeight/ oil/ petroleum/ petroleum hydrocarbons/ salt water/ sediment/ shellfish
**Notes:** An environmental assessment in the vicinity of the North Sea Ekofisk 'Bravo' blow-out. Following the onset of crude oil discharge into the North Sea, collections were made of sea water from 26 stations, fish and shellfish from two stations, and surface sediments from five stations. Analyzed all samples for selected aliphatic and aromatic hydrocarbons.

**Law, R. J.**, 1980. Changes in the composition of oil from the "Amoco Cadiz". Science of the Total Environment **15**:37-49.
**Keywords:** aliphatic hydrocarbons/ Amoco Cadiz/ analysis/ aromatic hydrocarbons/ composition/ crude oil/ degradation/ hydrocarbons/ miscellaneous/ mousse/ Oeleven/ oil/ salt water/ sediment/ shoreline/ spill/ survey/ time
**Notes:** Floating oil and mousse from 12 locations were sampled during the period 3/78 to 3/79 and analyzed for aliphatic and aromatic hydrocarbons. Sediment samples (39) were collected from 14 locations along the shoreline of Brittany during the period 5/78 to 3/79 and similarly analyzed. The purpose of the survey was to document changes in the composition of spilled oil from the Amoco Cadiz spill of 3/78.

**Law, R. J., J. L. Biscaya**, 1994. Polycyclic aromatic hydrocarbons (PAH) -- problems and progress in sampling, analysis and interpretation. Marine Pollution Bulletin **29**:235-241.
**Keywords:** analysis/ aromatic hydrocarbons/ hydrocarbons/ interpretation/ Onine/ PAH/ review/ sampling/ technical
**Notes:** A critical review of the analytical methodology and problems associated with PAH sampling, analysis, and data interpretation.

**Law, R. J., C. A. Kelly, K. L. Graham, R. J. Woodhead, P. E. J. Dyrynda, and E. A. Dyrynda** 1997. Hydrocarbons and PAH in fish and shellfish from southwest Wales following the *Sea Empress* oil spill in 1966. Pages 205-211 *in* 1997 International Oil Spill Conference. Improving Environmental Protection. Progress, Challenges, Responsibilities. American Petroleum Institute, Washington, DC.
**Keywords:** aromatic hydrocarbons/ concentration/ crude oil/ crustacean/ England/ fish/ fuel oil/ hydrocarbons/ marine invertebrate/ oil/ oil spill/ Othree/ PAH/ protection/ salt water/ shellfish/ spill/ total hydrocarbons/ Wales
**Notes:** Measurement of the concentration of PAHs and total hydrocarbons in finfish, shellfish, and crustaceans during the 6 mo following the Sea Empress oil spill near Milford Haven, England, 1996.

**Lawler, G. C., W.-A. Loong, J. L. Laseter**, 1978. Accumulation of saturated hydrocarbons in tissues of petroleum-exposed mallard ducks (*Anas platyrhynchos*). Environmental Science and Technology **12**:47-51.
**Keywords:** accumulation/ analysis/ bird/ chemical analysis/ crude oil/ dosed/ duck/ hydrocarbons/ Louisiana/ Louisiana crude oil/ mallard/ oil/ Oone/ saturated hydrocarbons/ South Louisiana crude oil/ tissue

**Notes:** Results of chemical analysis for saturated hydrocarbons of several tissues from mallard ducks dosed with South Louisiana crude oil for 14 days.

**Lawler, G. C., W.-A. Loong, J. L. Laseter**, 1978. Accumulation of aromatic hydrocarbons in tissues of petroleum-exposed mallard ducks (*Anas platyrhynchos*). Environmental Science and Technology **12**:51-54.
**Keywords:** accumulation/ analysis/ aromatic hydrocarbons/ bird/ chemical analysis/ crude oil/ dosed/ duck/ hydrocarbons/ Louisiana/ Louisiana crude oil/ mallard/ oil/ Oone/ South Louisiana crude oil/ tissue
**Notes:** Results of chemical analysis for aromatic hydrocarbons in several tissues of mallards dosed with South Louisiana crude oil for 14 days.

**Lawler, G. C., J. P. Holmes, D. M. Adamkiewicz, M. I. Shields, J. Y. Monnat, and J. L. Laseter** 1979. Characterization of petroleum hydrocarbons in tissues of birds killed in the *Amoco Cadiz* oil spill. Pages 573-583 *in* Amoco Cadiz. Fate and Effects of the Oil Spill. Centre National pour L'Exploitation des Oceans, Paris, France.
**Keywords:** Amoco Cadiz/ analysis/ aromatic hydrocarbons/ bird/ chemical analysis/ effects/ fate/ hydrocarbons/ liver/ muscle/ oil/ oil spill/ Oone/ petroleum/ petroleum hydrocarbons/ salt water/ saturated hydrocarbons/ species/ spill/ tissue
**Notes:** Results of the chemical analysis for petroleum hydrocarbons of muscle and liver tissue of several species of seabirds found washed ashore in the area affected by the Amoco Cadiz oil spill.

**Lawler, G. C., J. P. Holmes, B. J. Fiorito, and J. L. Laseter** 1979. Quantification of petroleum hydrocarbons in selected tissues of male mallard ducklings chronically exposed to South Louisiana crude oil. Pages 583-612 *in* C. C. Bates, editor. Conference on Assessment of Ecological Impacts of Oil Spills. American Institute of Biological Sciences, Arlington, VA.
**Keywords:** age/ aromatic hydrocarbons/ bird/ crude oil/ diet/ duck/ duckling/ hatching/ heart/ hydrocarbons/ kidney/ liver/ Louisiana/ Louisiana crude oil/ male/ mallard/ methods/ oil/ oil spill/ Oone/ petroleum/ petroleum hydrocarbons/ saturated hydrocarbons/ South Louisiana crude oil/ spill/ tissue/ toxicity
**Notes:** A detailed description of the analytical methods employed to analyze tissue from male mallard ducklings exposed to South Louisiana crude oil. Ducklings were fed diets containing 0, 0.025, 0.25, 2.5, or 5.0 % crude oil from hatching until 8 wks of age. Heart, liver, and kidney were removed and analyzed for saturated and aromatic hydrocarbons. Results were discussed with respect to previously reported toxic responses in ducklings.

**Le Dreau, Y., F. Jacquot, P. Doumenq, M. Guiliano, J. C. Bertrand, G. Mille**, 1997. Hydrocarbon balance of a site which had been highly and chronically contaminated by petroleum wastes of a refinery (from 1956 to 1992). Marine Pollution Bulletin **34**:456-468.
**Keywords:** aliphatic hydrocarbons/ analysis/ aromatic hydrocarbons/ effluent/ hydrocarbons/ miscellaneous/ Oeleven/ petroleum/ petroleum hydrocarbons/ petroleum waste/ refinery/ salt water/ sampling/ sediment/ sterane/ terpane
**Notes:** Analysis of sediment cores taken at eight stations along intervals from a French refinery toward the open ocean. The refinery ceased discharging effluents 2 yr prior to the sampling. Hydrocarbons analyzed by GC/MS (aliphatic & aromatic profiles, terpanes, steranes).

**Le Dreau, Y., F. Gilbert, P. Doumenq, L. Asia, J-C. Bertrand, G. Mille**, 1997. The use of hopanes to track *in situ* variations in petroleum composition in surface sediments. Chemosphere **34**:1663-1672.
**Keywords:** alkane/ composition/ degradation/ hopane/ isoprenoid/ Onine/ petroleum/ rate/ ratio/ salt water/ saturated hydrocarbons/ sediment/ technical
**Notes:** Experimentation to demonstrate the utility of using hopanes to measure the rate of degradation of less stable saturated petroleum compounds. Compared with the frequently-used ratios of *n*-alkanes and isoprenoids. Used marine sediments as a test medium.

**Le Hir, M., C. Hily**, 2002. First observations in a high rocky-shore community after the *Erika* oil spill (December 1999, Brittany, France). Marine Pollution Bulletin **44**:1243-1252.
**Keywords:** algae/ bivalve/ coast/ community/ France/ fuel oil/ gastropod/ habitat/ intertidal/ macroalgae/

marine invertebrate/ marine plant/ offshore/ Ofour/ oil/ oil spill/ oiled/ periwinkle/ rocky shore/ salt water/ sampling/ spill
**Notes:** A spill of heavy fuel oil affected the coast of western France in12/99. The intertidal flora and fauna of three habitat types (exposed bedrock, crevices, boulders) located on an offshore island were monitored on a monthly basis from 4/00 through 12/00. Sampling sites were classified as either non-oiled, oiled and not washed, or oiled and washed). All organisms within permanent quadrates were identified and counted, or classified as percent of surface area covered.

**Le Lourd, P.**, 1977. Oil pollution in the Mediteranean Sea. Ambio **6**:317-320.
**Keywords:** bivalve/ environment/ fish/ general effect/ marine invertebrate/ Mediterranean/ Oeight/ oil/ pollution/ risk/ salt water/ sources
**Notes:** A 1977 description of the state of oil pollution in the Mediterranean (title is mispelled) Sea. Sections on sources of oil pollution, oil transportation, total input, impact on the environment, accident risks, and regional concerns.

**Ledet, E. J., J. L. Laseter**, 1974. Alkanes at the air-sea interface from offshore Louisiana and Florida. Science **186**:261-263.
**Keywords:** alkane/ analysis/ composition/ Florida/ Louisiana/ offshore/ Onine/ origin/ technical
**Notes:** Surface water samples (118) were collected over a 12-mo period from offshore Louisiana and Florida. The samples were analyzed for alkane composition and the results were used to determine their origin.

**Lee, B., J. Yi**, 1999. A statistical approach for determining the environmental impact of polynuclear aromatic hydrocarbons in an oil spill-contaminated coastal area. Environmental Pollution **105**:391-396.
**Keywords:** aromatic hydrocarbons/ estimate/ hydrocarbons/ miscellaneous/ Oeleven/ oil/ oil spill/ PAH/ pollution/ procedure/ salt water/ sediment/ statistics
**Notes:** A total of 167 sediment samples were collected fromYeosu Bay, South Korea; oil contamination ranged from reference to severely polluted. Samples were analyzed for 16 PAHs and the results subjected to a statistical procedure designed to estimate the severity of PAH contamination at a given site.

**Lee, C. L., M.-T. Hsieh, M.-D. Fang**, 2005. Aliphatic and polycyclic aromatic hydrocarbons in sediments of Kaohsiung Harbour and adjacent coast, Taiwan. Environmental Monitoring and Assessment **100**:217-234.
**Keywords:** aliphatic hydrocarbons/ alkane/ analysis/ aromatic/ aromatic hydrocarbon/ aromatic hydrocarbons/ coast/ guidelines/ harbour/ hydrocarbons/ miscellaneous/ Oeleven/ PAH/ ratio/ salt water/ sediment/ unresolved complex mixture
**Notes:** A total of 22 surface sediment samples were collected in Kaohsiung Harbour (Taiwan) and the nearshore ocean. Analyzed sediments for alkanes, unresolved complex mixture, and total PAHs. Compared results to harbors around the world. Employs diagnostic ratios, sediment quality guidelines, and principal components analysis.

**Lee, J. H., G. Talaska**, 1999. Effects of kerosene cleaning on the formation of DNA adducts in the skin and lung tissues of mice dermally exposed to used gasoline engine oil. Journal of Toxicology and Environmental Health, Part A **56**:463-470.
**Keywords:** cleaning/ DNA/ DNA adduct/ effects/ experiment/ gasoline/ kerosene/ lung/ mammal/ motor oil/ oil/ Otwo/ skin/ tissue/ used motor oil
**Notes:** Determination of the effect of dermally-applied used engine oils on DNA adduct formation in laboratory mice. Mice were exposed to used engine oil alone, kerosene alone, used engine oil application followed in 1 hr by a kerosene wash, and used engine oil application followed in 8 hrs by a kerosene wash. Applications were made daily for 5 consecutive days. Measured total DNA adducts in skin and lung after completion of the experiment. Beware of a mislabelled x-axis for Fig. 1.

**Lee, K., S. DeMora**, 1999. *In situ* bioremediation strategies for oiled shoreline environments. Environmental Technology **20**:783-794.
**Keywords:** bioremediation/ commentary/ environment/ guidelines/ marine environment/ microbes/

nutrients/ oil/ oiled/ Oten/ petroleum/ review/ salt water/ shoreline
**Notes:** Review and commentary on bioremediation as a strategy for petroleum removal from shoreline environments. Discusses bioaugmentation, biostimulation with nutrients and oxidizers, phytoremediation, enhanced dispersion of oil, and field experiences. Presents operational guidelines for use of bioremediation strategies in the marine environment.

**Lee, R. F., C. Ryan, M. L. Neuhauser**, 1976. Fate of petroleum hydrocarbons taken up from food and water by the blue crab *Callinectes sapidus*. Marine Biology **37**:363-370.
**Keywords:** aromatic hydrocarbons/ blood/ blue crab/ concentration/ crab/ depuration/ fate/ flow-through/ food/ gill/ gonads/ hepatopancreas/ hydrocarbons/ marine invertebrate/ metabolism/ muscle/ Ofour/ paraffin/ petroleum/ petroleum hydrocarbons/ salt water/ stomach/ uptake
**Notes:** Measurement of uptake from water and food of radiolabeled paraffinic and aromatic hydrocarbons by immature blue crabs in flow-through aquaria. Crabs exposed for 2 da and then transferred to clean water for measurement of depuration. Uptake from water measured in gill, blood hepatopancreas, stomach, and muscle. Uptake from food measured in stomach, blood, hepatopancreas, gill, muscle, gonad, and excreted material. Measured radiolabeled concentrations, excretion, and metabolism.

**Lee, R. F., J. W. Anderson**, 1977. Fate and effect of naphthalenes: controlled ecosystem pollution experiment. Bulletin of Marine Science **27**:127-134.
**Keywords:** bioassay/ copepod/ degradation/ depth/ ecosystem/ effects/ experiment/ fate/ fuel oil/ general effect/ marine invertebrate/ mesocosm/ methods/ microbes/ naphthalene/ No.2 fuel oil/ Oeight/ oil/ pollution/ rate/ salt water/ sediment/ zooplankton
**Notes:** An experiment showing the fate and effects of a mixture of naphthalenes (160 ppb) in a large mesocosm enclosure; the experiment lasted 21 da. A supplemental study employed standard bioassay methods to determine the $LD_{50s}$ of No. 2 fuel oil for an exposed ctenophore and a copepod. Water was sampled from various depths within the enclosure on 8 of the 21 da and analyzed for naphthalenes. Sediment was collected on 4 da and similarly analyzed. Rates of microbial degradation were calculated. Zooplankton were sampled on 3 da and analyzed for the presence of naphthalenes.

**Lee, R. F.** 1977. Fate of petroleum hydrocarbons in marine animals. Pages 40C-1-40C-4 *in* Oceans 77 Conference. Institute of Electrical and Electronics Engineers, New York.
**Keywords:** benthic/ bivalve/ crustacean/ effects/ fate/ fish/ general effect/ hydrocarbons/ marine invertebrate/ Oeight/ petroleum/ petroleum hydrocarbons/ review/ salt water/ zooplankton
**Notes:** An early review and summarization of knowledge about the fate (but not effects) of petroleum hydrocarbons in marine fauna. Specific sections on bivalves, benthic worms, benthic crustaceans, zooplankton, and fish.

**Lee, R. F., W. S. Gardner, J. W. Anderson, J. W. Blaylock, J. Barwell-Clarke**, 1978. Fate of polycyclic aromatic hydrocarbons in controlled ecosystem enclosures. Environmental Science and Technology **12**:832-837.
**Keywords:** aromatic hydrocarbons/ bivalve/ concentration/ crude oil/ degradation/ depth/ depuration/ ecosystem/ fate/ general effect/ hydrocarbons/ marine invertebrate/ mesocosm/ microbes/ Oeight/ oil/ oyster/ Prudhoe Bay crude oil/ salt water/ sediment/ uptake
**Notes:** Three polyethylene enclosures were used to investigate the fate of aromatic hydrocarbons in a mesocosm enclosure during a 17-day period. One enclosure received Prudhoe Bay crude oil enriched with seven aromatic hydrocarbons, another received radiolabeled benzo(a)pyrene, and the third was a control. Measured the water concentrations of six aromatics at two depths and one aromatic plus the radiolabeled benzo(a)pyrene at three depths; the sediment concentrations of all seven aromatics; estimated photochemical oxidation and microbial degradation; and hydrocarbon uptake and depuration by oysters.

**Lee, R. F., B. Dornseif, F. Gonsoulin, K. Tenore, R. Hanson**, 1981. Fate and effects of a heavy fuel oil spill on a Georgia salt marsh. Marine Environmental Research **5**:125-143.
**Keywords:** aromatic hydrocarbons/ biomass/ bivalve/ concentration/ crab/ degradation/ density/ effects/ fate/ fuel oil/ general effect/ hydrocarbons/ marine invertebrate/ microbes/ No.5 fuel oil/ Oeight/ oil/ oil spill/ salt marsh/ seasonal/ sediment/ snail/ spill/ time/ treatment

**Notes:** A 1 ac patch of salt marsh in coastal Georgia was treated with 40 gal of No. 5 fuel oil supplemented with three aromatic hydrocarbons followed by a second treatment of 20 gal of the same supplemented fuel oil in a subsection 1 mo later. Monitored the treated and control areas for 150 da post-application. Measured microbial density and function, and concentrations of the supplemented aromatics in the sediment. Saltmarsh biota (bivalves, snails, crabs) were collected at multiple sites for a year prior to oil treatment and every 2 mos after the treatment. Determined seasonal variation in biota density and biomass and measured concentrations of the three supplemented aromatics in the biota.

**Lee, R. F., D. S. Page**, 1997. Petroleum hydrocarbons and their effects in subtidal regions after major oil spills. Marine Pollution Bulletin **34**:928-940.
**Keywords:** benthic/ concentration/ effects/ fish/ general effect/ hydrocarbons/ infauna/ macrofauna/ marine invertebrate/ Oeight/ oil/ oil spill/ petroleum/ petroleum hydrocarbons/ region/ review/ salt water/ sediment/ spill/ subtidal/ toxicity
**Notes:** Review of published information on the effects of petroleum hydrocarbons on subtidal regions after major oil spills. Discusses hydrocarbon concentrations, sedimentation, sediment toxicity, effects on fish, benthic macrofauna and benthic infauna.

**Lee, R. F.**, 2003. Photo-oxidation and photo-toxicity of crude and refined oils. Spill Science Technology Bulletin **8**:157-162.
**Keywords:** crude oil/ discharges/ miscellaneous/ Oeleven/ oil/ petroleum/ photooxidation/ phototoxicity/ refined oil/ review/ salt water/ spill
**Notes:** A short but concise review of the role of photo-oxidation and photo-toxicity in marine petroleum spills and discharges.

**Lee, W. Y., M. F. Welch, J. A. C. Nicol**, 1977. Survival of two species of amphipods in aqueous extracts of petroleum oils. Marine Pollution Bulletin **8**:92-94.
**Keywords:** adult/ amphipod/ bioassay/ concentration/ crude oil/ fuel oil/ Louisiana/ Louisiana crude oil/ marine invertebrate/ No.2 fuel oil/ Ofour/ oil/ petroleum/ salt water/ South Louisiana crude oil/ species/ static/ survival/ time/ toxicity
**Notes:** Assessment of the toxicity of the water-soluble-fraction (WSF) of No. 2 fuel oil and South Louisiana crude oil to adults of two species of marine amphipods. Amphipods were exposed in a static bioassay to WSF concentrations varying from 2 to 50%. One species exposed for 14 da, the other for 30 da. Measured survival three times per wk.

**Lee, W. Y.**, 1977. The effects of the water soluble fractions of No. 2 fuel oil on the survival and behaviour of coastal and oceanic zooplankton. Environmental Pollution **12**:279-292.
**Keywords:** behavior/ bioassay/ effects/ experiment/ fuel oil/ marine invertebrate/ No.2 fuel oil/ Ofour/ oil/ salt water/ solubility/ static/ survival/ time/ zooplankton
**Notes:** Assessment of the effects of the water-soluble-fraction (WSF) of No. 2 fuel oil on coastal and oceanic zooplankton using static bioassays. The coastal zooplankton experiment used dilutions of 1, 5, 10, 20, and 50% WSF and an exposure time of 48 hr. Survival was checked at hours 1, 3, 6, 10, 16, 24, 36, and 48. The oceanic zooplankton experiment used dilutions of 1, 10, 20, 30, 40, and 50% WSF and an exposure time of 72 hrs. Survival was checked at hours 1, 6, 10, 16, 24, 36, and 72. Measured survival and behavior of zooplankton.

**Lee, W. Y.**, 1978. Chronic sublethal effects of the water soluble fractions of No. 2 fuel oils on the marine isopod, *Sphaeroma quadridentatum*. Marine Environmental Research **1**:5-17.
**Keywords:** adult/ chronic/ effects/ experiment/ fuel oil/ growth/ isopod/ juvenile/ marine invertebrate/ New Jersey/ No.2 fuel oil/ Ofour/ oil/ reproduction/ salt water/ solubility/ sublethal/ survival
**Notes:** Juvenile marine isopods exposed to the water-soluble-fraction (WSF) of a No. 2 fuel oil (Baytown) for 7 mos. Offspring were kept in clean sea water. Measured survival, growth, and reproduction of adults and survival of offspring. In another experiment, adult isopods were exposed to the WSF of four different fuel oils (Baton Rouge, Baytown, Montana, and New Jersey) for 1 mo. Measured survival and reproduction.

**Lee, W. Y., K. Winters, J. A. C. Nicol**, 1978. The biological effects of the water-soluble fractions of a No. 2 fuel oil on the planktonic shrimp, *Lucifer faxoni*. Environmental Pollution **15**:167-183.
**Keywords:** activity/ bioassay/ biological effects/ composition/ effects/ experiment/ feeding/ fuel oil/ marine invertebrate/ No.2 fuel oil/ Ofour/ oil/ rate/ respiration/ salt water/ shrimp/ static/ survival/ weathered
**Notes:** Assessment of the effects of the water-soluble-fractions (WSF) of No. 2 fuel oil on a planktonic shrimp. One experiment used 1, 10, 20, 30, 40, or 50% of fresh WSF in a static bioassay for 14 da. Another experiment used 1, 10, 20, 30, 40, or 50% of weathered (48 hrs) No. 2 fuel oil in a static bioassay for 14 da. Measured composition of the WSF, and survival, feeding rate, activity, and respiration of the shrimp.

**Lee, W. Y., J. A. C. Nicol**, 1978. Individual and combined toxicity of some petroelum aromatics to the marine amphipod *Elasmopus pectenicrus*. Marine Biology **48**:215-222.
**Keywords:** adult/ amphipod/ aromatic hydrocarbons/ bioassay/ combination/ concentration/ fuel oil/ marine invertebrate/ No.2 fuel oil/ Ofour/ oil/ petroleum hydrocarbons/ salt water/ static/ toxicity
**Notes:** Assessment of the toxicity of a range of concentrations of the water-soluble-fraction (WSF) of No. 2 fuel oil and four of it's aromatic consitituents to an adult marine amphipod. A static bioassay was used to expose amphipods to the WSF for 7 da or to the aromatics for 96 hr. All possible combinations (16) of the four were tested. $LC_{50s}$ were calculated for all test substances.

**Lee, W. Y., J. A. C. Nicol**, 1980. Toxicity of a fuel oil to the eggs of *Parhyale hawaiensis* and *Amphitohoe valida* (amphipoda). Marine Environmental Research **3**:297-305.
**Keywords:** amphipod/ bioassay/ development/ eggs/ embryo/ female/ fuel oil/ hatching/ juvenile/ marine invertebrate/ No.2 fuel oil/ Ofour/ oil/ salt water/ species/ static/ survival/ toxicity
**Notes:** Assessment of the toxicity of the water-soluble-fraction (WSF) of No.2 fuel oil to the developing embryos and juveniles of two species of marine amphipods. Embryos of one species were exposed in static bioassays to 10, 20, 30, or 40% WSF until hatching; juveniles were exposed for a further 7 da. Egg-carrying females of the second species were exposed to 10, 20, or 30% WSF for 5 da. Measured survival and development of embryos.

**Lee, W. Y., A. Morris, D. Boatwright**, 1980. Mexican oil spill: a toxicity study of oil accommodated in seawater on marine invertebrates. Marine Pollution Bulletin **11**:231-234.
**Keywords:** amphipod/ community/ composition/ crude oil/ evaluation/ invertebrate/ Ixtoc/ Ixtoc I crude oil/ juvenile/ marine invertebrate/ Ofour/ oil/ oil spill/ salt water/ spill/ survival/ toxicity/ weathered/ zooplankton
**Notes:** Evaluation of the toxicity of weathered Ixtoc I crude oil on marine invertebrates. Exposed juvenile amiphods and a community of natural zooplankton to dilutions (1, 10, 20, 30, 40, and 50%) of water-accommodated, weathered crude oil. Amphipods were exposed for 7 da and the natural zooplankton for 96 hr. Measured survival and chemical composition of the test mixture.

**Lee, Y.-Z., F. A. Leighton, D. B. Peakall, R. J. Norstrom, P. J. O'Brien, J. F. Payne, A. D. Rahimtula**, 1985. Effects of ingestion of Hibernia and Prudhoe Bay crude oils on hepatic and renal mixed function oxidase in nestling herring gulls (*Larus argentatus*). Environmental Research **36**:248-255.
**Keywords:** bird/ chicks/ crude oil/ dosed/ effects/ gull/ herring/ herring gull/ Hibernia crude oil/ ingestion/ metabolism/ nestling/ oil/ Oone/ Prudhoe Bay/ Prudhoe Bay crude oil/ salt water
**Notes:** Effects on metabolic responses of herring gull chicks of dosing with Prudhoe Bay and Hibernia crude oils.

**Lee, Y.-Z., P. J. O'Brien, J. F. Payne, A. D. Rahimtula**, 1986. Toxicity of petroleum crude oils and their effect on xenobiotic metabolizing enzyme activities in the chicken embryo *in ovo*. Environmental Research **39**:153-163.
**Keywords:** activity/ bird/ chicken/ crude oil/ effects/ egg shell/ eggs/ embryo/ enzyme/ Hibernia crude oil/ metabolism/ oil/ Oone/ petroleum/ Prudhoe Bay/ Prudhoe Bay crude oil/ shell/ survival/ toxicity
**Notes:** Effects on metabolism and survival of chicken embryos as a result of application of Prudhoe Bay and Hibernia crude oils to the egg shell.

**Lefcort, H., K. A. Hancock, K. M. Maur, D. C. Rostal**, 1997. The effects of used motor oil,silt, and the water mold *Saprolegnia parasitica* on the growth and survival of mole salamanders (Genus *Ambystoma*).

Archives of Environmental Contamination and Toxicology **32**:383-388.
**Keywords:** amphibian/ development/ effects/ experiment/ fresh water/ growth/ motor oil/ oil/ OthreeA/ salamander/ sediment/ survival/ used motor oil/ water mold
**Notes:** Assessment of the effects of used motor oil and silt on the growth and development of larval mole salamanders; four-part experiment, survival, growth,susceptibility of water mold.

**Leighton, F. A., D. B. Peakall, R. G. Butler**, 1983. Heinz-body hemolytic anemia from the ingestion of crude oil: a primary toxic effect in marine birds. Science **220**:871-873.
**Keywords:** anemia/ Atlantic/ bird/ crude oil/ dosed/ gull/ herring/ herring gull/ ingestion/ marine birds/ oil/ Oone/ Prudhoe Bay/ Prudhoe Bay crude oil/ puffin/ red blood cell/ salt water
**Notes:** Report of hemolytic anemia in young herring gulls and Atlantic puffins dosed with Prudhoe Bay crude oil.

**Leighton, F. A., Y. Z. Lee, A. D. Rahimtula, P. J. O'Brien, D. B. Peakall**, 1985. Biochemical and functional disturbances in red blood cells of herring gulls ingesting Prudhoe Bay crude oil. Toxicology and Applied Pharmacology **81**:25-31.
**Keywords:** anemia/ biochemical/ bird/ blood/ cell/ crude oil/ effects/ gull/ herring/ herring gull/ oil/ Oone/ Prudhoe Bay/ Prudhoe Bay crude oil/ red blood cell/ salt water
**Notes:** Effects on red blood cells of herring gulls as a result of dosing with Prudhoe Bay crude oil.

**Leighton, F. A.**, 1985. Morphological lesions in red blood cells from herring gulls and Atlantic puffins ingesting Prudhoe Bay crude oil. Veterinary Pathology **22**:393-402.
**Keywords:** anemia/ Atlantic/ bird/ blood/ cell/ crude oil/ dosed/ effects/ gull/ herring/ herring gull/ lesions/ oil/ Oone/ Prudhoe Bay/ Prudhoe Bay crude oil/ puffin/ red blood cell/ salt water
**Notes:** Effects on red blood cells of herring gulls and Atlantic puffins of dosing for 4-5 days with Prudhoe Bay crude oil.

**Leighton, F. A.**, 1990. The systemic toxicity of Prudhoe Bay crude and other petroleum oils to CD-1 mice. Archives of Environmental Contamination and Toxicology **19**:257-262.
**Keywords:** Arabian Light crude oil/ blood/ Bunker C/ crude oil/ effects/ fuel oil/ light/ liver/ Louisiana/ mammal/ mineral oil/ oil/ Otwo/ pathology/ petroleum/ physiology/ Prudhoe Bay/ Prudhoe Bay crude oil/ South Louisiana crude oil/ spleen/ thymus/ toxicity
**Notes:** Effects on laboratory mice of varying doses of Prudhoe Bay, South Louisiana, and Arabian Light crude oils, Bunker C fuel oil, and mineral oil for 5 days; blood characteristics, liver, spleen, and thymus.

**Leighton, F. A.** 1991. The toxicity of petroleum oils to birds: an overview. Pages 43-57 *in* J. White, L. Frink, T. M. Williams, and R. W. Davis, editors. The Effects of Oil on Wildlife. The Sheridan Press, Hanover, PA.
**Keywords:** bird/ effects/ oil/ Oone/ overview/ pathology/ petroleum/ petroleum oil/ physiology/ population/ review/ toxicity
**Notes:** A general review of the literature on toxic effects of petroleum on birds.

**Lenihan, H. S., J. S. Oliver, J. M. Oakden, M. D. Stephenson**, 1990. Intense and localized benthic marine pollution around McMurdo Station, Antarctica. Marine Pollution Bulletin **21**:422-430.
**Keywords:** Antarctica/ benthic/ fish/ hydrocarbons/ infauna/ liver/ marine invertebrate/ metals/ muscle/ Ofour/ petroleum/ petroleum hydrocarbons/ pollution/ salt water/ sediment
**Notes:** Sampled sediment at various locations around McMurdo Sound, Antarctica and analyzed for total petroleum hydrocarbons and selected metals. Analyzed metals in fish liver and muscle and in a benthic worm. Sampled and classified the benthic infauna at the same sites where sediments were collected.

**Lerniere, S., C. Cossu-Leguille, A. Bispo, M.-J. Jourdain, M.-C. Lanhers, D. Burnel, P. Vasseur**, 2004. Genotoxicity related to transfer of oil spill pollutants from mussels to mammals via food. Environmental Toxicology **19**:387-395.
**Keywords:** assay/ bivalve/ bone/ bone marrow/ cell/ diet/ DNA/ food/ France/ genetic/ mammal/ marine invertebrate/ mussel/ oil/ oil spill/ Otwo/ PAH/ rat/ salt water/ spill/ tissue/ toxicity/ transfer
**Notes:** Marine mussels were collected along coastal France from uncontaminated, mildly contaminated,

and heavily contaminated sites (Erika oil spill). The mussels were fed to laboratory rats for 30 da. Rats were sampled after 15 and 30 da on diet. Bone marrow was analyzed for DNA damage with the single-cell gel electrophoresis (Comet) assay and counts were made of micronucleated bone marrow cells. Mussel tissue was analyzed for a suite of 16 PAHs.

**Leung, S. S. C., M. D. MacKinnon, R. E. H. Smith**, 2001. Aquatic reclamation in the Athabasca, Canada, oil sands: naphthenate and salt effects on phytoplankton communities. Environmental Toxicology and Chemistry **20**:1532-1543.
**Keywords:** age/ Alberta/ analysis/ Canada/ chlorophyll/ community/ conductivity/ dissolved/ effects/ experiment/ fresh water/ freshwater invertebrate/ model/ multivariate/ nitrogen/ oil/ oil sands/ Oseven/ oxygen/ pH/ phosphorus/ phytoplankton/ sand
**Notes:** An assessment of the effects on indigenous phytoplankton (local lake) of the water from eight settling basins containing process waters from oil sands extraction operations in Alberta, Canada. The process waters varied in age from fresh (current input) to 8 years old. Filtered water from each source basin was inoculated with a sample of water from the local lake and monitored for 14 da; the experiment was performed twice. Measured dissolved oxygen, pH, conductivity, chlorophyll *a*, total phosphorus, total nitrogen, and total naphthenic acids. Phytoplankton were identified and analyzed with a percentage model affinity analysis and a canonical correspondence analysis.

**Leung, T. S., R. V. Bulkley**, 1979. Effects of petroleum hydrocarbons on length of incubation and hatching success in the Japanese medaka. Bulletin of Environmental Contamination and Toxicology **23**:236-243.
**Keywords:** behavior/ benzene/ concentration/ crude oil/ effects/ eggs/ experiment/ fish/ fresh water/ hatching/ hydrocarbons/ incubation/ length/ movement/ oil/ Othree/ petroleum/ petroleum hydrocarbons/ solubility/ toluene/ xylene
**Notes:** A series of experiments documenting the effects of the water soluble fraction (WSF) of a crude oil from Wyoming on the developing eggs of Japanese Medaka. (1) 8-day-old eggs exposed to four concentrations of WSF for 96 hr, (2) 0 to 9-day-old eggs exposed to one concentration of WSF for 24, 48, or 96 hrs, (3) opercular movements in 8-day-old eggs exposed to one concentration of WSF, (4) opercular movements in 8-day-old eggs exposed to benzene, toluene, or xylene.

**Levine, E. A., J. Pinckney, and T. Montello** 1995. Follow-up study on oiled vegetation cutting along the Delaware River. Pages 465-472 *in* 1995 International Oil Spill Conference, API 4620. American Petroleum Institute, Washington, D.C.
**Keywords:** Arrow/ condition/ crude oil/ Delaware River/ fresh water/ freshwater plant/ oil/ oil spill/ oiled/ Oseven/ remediation/ shoreline/ spill/ vegetation/ Venezuelan crude oil
**Notes:** Field assessment of vegetation cutting following a spill of heavy Venezuelan crude oil into the Delaware River near Philadelphia, PA. Oiled shoreline vegetation (phragmites, arrow arum, bulrush) was cut and removed at some high priority cleanup sites. Oiled and uncut, oiled and cut, and unoiled vegetation was revisited at 3 mos and 12 mos post-spill to assess the condition of the vegetation.

**Levings, S. C., S. D. Garrity**, 1994. Effects of oil spills on fringing red mangroves (R*hizophora mangle*): losses of mobile species associated with submerged prop roots. Bulletin of Marine Science **54**:782-794.
**Keywords:** algae/ crude oil/ density/ effects/ evaluation/ habitat/ isopod/ mangrove/ marine invertebrate/ marine plant/ Ofour/ oil/ oil spill/ Panama/ roots/ salt water/ species/ spill
**Notes:** Evaluation of the effects of the 1986 Bahia las Minas oil spill in coastal Panama on fringing red mangrove habitat. Selected 4-5 study sites each in open coastal habitat and sheltered coastal habitat along with controls for each. Measured the density of submerged mangrove prop roots and their use by foliose red algae (yrs 2-5 post-spill) and boring isopods (yrs 3-5 post-spill).

**Levings, S. C., S. D. Garrity, K. A. Burns**, 1994. The Galeta oil spill. III. Chronic reoiling, long-term toxicity of hyrocarbon residues and effects on epibiota in the mangrove fringe. Estuarine and Coastal and Shelf Science **38**:365-395.
**Keywords:** chronic/ concentration/ condition/ crude oil/ effects/ evaluation/ experiment/ fresh water/ long-term/ mangrove/ marine invertebrate/ marine plant/ movement/ mussel/ Ofour/ oil/ oil spill/ oyster/ Panama/ plant/ roots/ salt water/ spill/ stream/ toxicity/ transplant

**Notes:** Evaluation of the effects of the Bahia las Minas oil spill on mangroves in coastal Panama during the 5 yrs post-spill. Four to five sites were selected in (1) open sea coastal mangroves, (2) edges of channels and lagoons, and (3) banks of streams or man-made cuts draining interior mangroves or uplands. Measured amount of chronic reoiling from trapped crude oil, concentration of oil in oysters and false mussels, condition of mangrove roots, and percent cover of sessile plants and animals on the roots. Also performed a transplant experiment involving movement of false mussels from unoiled freshwater sites to previously-oiled freshwater sites.

**Levy, E. M.**, 1980. Oil pollution and seabirds: Atlantic Canada 1976-77 and some implications for northern environments. Marine Pollution Bulletin **11**:51-56.
**Keywords:** Atlantic/ bird/ Canada/ environment/ oil/ Oone/ pollution/ population/ salt water/ spill
**Notes:** An assessment of the oil pollution situation in Atlantic Canada and implications for cold environments.

**Levy, E. M.**, 1983. Commentary: what impact will the oil industry have on seabirds in the Canadian Arctic? Arctic **36**:1-4.
**Keywords:** Arctic/ bird/ Canada/ commentary/ development/ oil/ Oone/ petroleum development/ population/ salt water
**Notes:** Assessment of the threat to seabird populations of oil development in the Canadian Arctic.

**Lewis, S. J. and R. A. Malecki** 1983. Reproductive success of great black-backed and herring gulls in response to egg oiling. Pages 98-113 *in* D. Rosie and S. N. Barnes, editors. The Effects of Oil on Birds: Physiological Research, Clinical Applications and Rehabilitation. Tri-State Bird Rescue and Research, Inc., Wilmington, DE.
**Keywords:** adult/ bird/ crude oil/ effects/ eggs/ embryo/ fuel oil/ great black-backed gull/ gull/ herring/ herring gull/ Kuwait/ Kuwait crude oil/ No.2 fuel oil/ oil/ oiled/ Oone/ plumage/ rehabilitation/ salt water
**Notes:** Great Black-backed and herring gulls, Kuwait crude oil, and No. 2 fuel oil were used in an assessment of the effects of egg oiling and plumage oiling of incubating adults in a natural setting.

**Lewis, S. J., R. A. Malecki**, 1984. Effects of egg oiling on Larid productivity and population dynamics. Auk **101**:584-592.
**Keywords:** bird/ effects/ eggs/ embryo/ fuel oil/ great black-backed gull/ gull/ herring/ herring gull/ No.2 fuel oil/ oil/ oiled/ Oone/ population/ productivity/ salt water
**Notes:** Results of applying No. 2 fuel oil to the eggs of great black-backed and herring gulls in a natural setting.

**Li, G., X. Zhang, W. Huang**, 2000. Enhanced bioremediation of petroleum hydrocarbons in polluted soil. Journal of Environmental Science and Health **A35**:177-188.
**Keywords:** bacteria/ bioremediation/ degradation/ effluent/ evaluation/ experiment/ humidity/ hydrocarbons/ microbes/ oil/ oiled/ Oten/ petroleum/ petroleum hydrocarbons/ plant/ rate/ soil/ tilling
**Notes:** Evaluation of biodegredation of oiled soil in a valley contaminated by effluents from petrochemical plants. Petroleum in the soil was quantified (up to 20% oil), naturally-occuring bacteria were cultured and identified, and experiments were conducted to enhance the degradation rate. Measured natural rate of degradation and the changes caused by adding bacteria, tilling the soil, and adjusting the humidity.

**Li, H., Y. Zhang, C. G. Zhang, G. X. Chen**, 2005. Effect of petroleum-containing wastewater irrigation on bacterial diversities and enzymatic activities in a paddy soil irrigation area. Journal of Environmental Quality **34**:1073-1080.
**Keywords:** activity/ analysis/ chemical characteristics/ China/ colony/ diversity/ DNA/ enzyme/ fresh water/ hydrocarbons/ microbes/ oil/ Oten/ petroleum/ petroleum hydrocarbons/ refinery/ respiration/ soil/ time/ TPH/ waste water/ water
**Notes:** Thirteen sites in irrigated cropland downstream from an oil refinery in China were sampled for surface soil. Some sites have been irrigating with refinery wastewater for 50 yrs and others switched to ground or surface water irrigation 10-30 yrs ago. Measured physical and chemical characteristics of the soil samples, total petroleum hydrocarbons, bacterial colony forming units, PCR analysis of DNA

extracted from soil, soil dehydrogenase, soil hydrogen peroxidase, soil polyphenol oxidase, soil urease, and substrate-induced respiration.

**Li, M., C. Garrett**, 1998. The relationship between oil droplet size and upper ocean turbulence. Marine Pollution Bulletin **36**:961-970.
**Keywords:** emulsion/ fresh water/ oil/ Onine/ petroleum hydrocarbons/ pressure/ salt water/ size/ technical/ viscous shear
**Notes:** An examination of the physical mechanisms that generate oil droplets and determine their size.

**Lin, Q., I. A. Mendelssohn**, 1996. A comparative investigation of the effects of South Louisiana crude oil on the vegetation of fresh, brackish and salt marshes. Marine Pollution Bulletin **32**:202-209.
**Keywords:** biomass/ concentration/ crude oil/ density/ effects/ fresh water/ freshwater plant/ growth/ Louisiana/ Louisiana crude oil/ marine plant/ oil/ organic/ Osix/ photosynthesis/ plant/ rate/ redox potential/ regrowth/ residual oil/ Sagittaria/ salt water/ soil/ South Louisiana crude oil/ Spartina/ vegetation/ wetland
**Notes:** An assessment of the effects of South Louisiana crude oil on vegetation from salt, brackish, and freshwater wetlands. *Spartina alterniflora, S. patens,* and *Sagittaria lancifolia* were exposed to either 0, 4, 8, 16, or 24 $l/m^2$ and monitored for 4 mos. Measured photosynthetic rate, plant stem density, above ground biomass, soil redox potential, residual oil concentrations in soil, and soil organic content. Vegetation regrowth was measured 9 mos after oil application.

**Lin, Q., I. A. Mendelssohn**, 1998. The combined effects of phytoremediation and biostimulation in enhancing habitat restoration and oil degradation of petroleum contaminated wetlands. Ecological Engineering **10**:263-274.
**Keywords:** biomass/ concentration/ crude oil/ degradation/ density/ effects/ fertilizer/ habitat/ Louisiana/ Louisiana crude oil/ marine plant/ miscellaneous/ Oeleven/ oil/ petroleum/ restoration/ salt water/ soil/ South Louisiana crude oil/ Spartina/ species/ transplant/ vegetation/ wetland
**Notes:** Louisiana marsh sod treated with 4,8,16, or 24 liters per $m^2$ of South Louisiana crude oil. Above ground vegetation clipped after 9 mos, allowed to regrow from rhizomes, and clipped again at 15 mos after oil application. At 2 yrs post-application, two spartina species were transplanted to the sod with or without the addition of fertilizer. The transplanted spartina was harvested at 6 mos and 12 mos after transplantation. Petroleum concentration in the soil was determined at 2 yrs and 3 yrs post-application. Measured above ground biomass and stem density.

**Lin, Q., I. A. Mendelssohn, K. Carney, N. P. Bryner, W. D. Walton**, 2002. Salt marsh recovery and oil spill remediation after in-situ burning: effects of water depth and burn duration. Environmental Science and Technology **36**:576-581.
**Keywords:** aromatic hydrocarbons/ biomass/ burning/ depth/ diesel/ diesel fuel/ effects/ hydrocarbons/ marine plant/ oil/ oil spill/ oiled/ Osix/ petroleum/ petroleum hydrocarbons/ recovery/ remediation/ salt marsh/ salt water/ soil/ spill/ temperature/ time
**Notes:** An assessment of the effects of in-situ burning as a remediation tool in salt marshes. Circular portions of salt marsh were relocated and treated with unweathered diesel fuel or no diesel fuel. Oiled and non-oiled salt marsh was further divided into portions that had 10, 2, or 0 cm of water on the surface, or a water table 10 cm below the salt marsh surface. Oiled and non-oiled portions were then subjected to either a 400-second or a 1,400 second burn. Measured above ground biomass 7 mo after the burn, total petroleum hydrocarbons in the soil 1 da after the burn, total specific aromatic hydrocarbons in the soil 1 da after the burn, and peak soil temperatures during the burn.

**Lin, Q., I. A. Mendelssohn, K. Carney, S. M. Miles, N. P. Bryner, W. D. Walton**, 2005. In-situ burning of oil in coastal marshes. 2. Oil spill cleanup efficiency as a function of oil type, marsh type, and water depth. Environmental Science and Technology **39**:1855-1860.
**Keywords:** aliphatic hydrocarbons/ alkane/ aromatic hydrocarbons/ burning/ crude oil/ depth/ diesel/ diesel fuel/ freshwater/ freshwater plant/ hopane/ Louisiana/ Louisiana crude oil/ marine plant/ oil/ oil spill/ Onine/ PAH/ petroleum/ plant/ sediment/ soil/ South Louisiana crude oil/ spill/ spill response/ technical/ time/ vegetation/ water
**Notes:** The effect of burning on marsh plants was determined with vegetation cores from three types of

marsh (salt, brackish, freshwater), with or without South Louisiana crude oil or diesel fuel, and either unburned or burned with three water depths. Burn time was 700 sec. The crude oil and diesel fuel on the water or soil surface was sampled before and immediately after the burn. Surface sediment (0-4 cm) was sampled after the burn. Both petroleum and sediment were analyzed for selected PAHs and alkanes (nC-10 through nC-35, pristane, phytane, hopane).

**Lin, Q., I. A. Mendelssohn, N. P. Bryner, W. D. Walton**, 2005. In-situ burning of oil in coastal marshes. 1. Vegetation recovery and soil temperature as a function of water depth, oil type, and marsh type. Environmental Science and Technology **39**:1848-1854.
**Keywords:** biomass/ burning/ crude oil/ density/ depth/ diesel/ diesel fuel/ freshwater/ freshwater plant/ Louisiana/ Louisiana crude oil/ marine plant/ oil/ Onine/ plant/ recovery/ soil/ South Louisiana crude oil/ species/ spill response/ survival/ technical/ temperature/ time/ vegetation/ water
**Notes:** The effect of burning on marsh plants was determined with vegetation cores from three types of marsh (salt, brackish, freshwater), with or without South Louisiana crude oil or diesel fuel, and either unburned or burned with three water depths. Burn time was 700 sec. After burning, the recovery of plants (four species) was monitored for 12 mos. Measured soil temperature below the burn, plant survival, plant stem density, and aboveground biomass.

**Lindau, C. W., R. D. Delaune, A. Jugsujinda, E. Sajo**, 1999. Response of *Spartina alterniflora* vegetation to oiling and burning of applied oil. Marine Pollution Bulletin **38**:1216-1220.
**Keywords:** biomass/ burning/ carbon/ carbon fixation/ crude oil/ density/ growth/ Louisiana/ Louisiana crude oil/ marine plant/ oil/ oiled/ Osix/ plant/ recovery/ salt water/ South Louisiana crude oil/ Spartina/ vegetation
**Notes:** Assessment of the effect on *Spartina alterniflora* of oiling and burning. Field plots were established in Spartina marshes and classified as unoiled, oiled, and oiled + burned; the oil was South Louisiana crude oil. Measured plant height and stem density at 2, 4, 12, 16, 41, 46, and 50 wks after oiling or burning. Measured carbon fixation at 2, 3, 5, 9, 41, 46, and 50 wks after oiling or burning. Measured above-ground biomass at 16 and 52 wks.

**Lindau, C. W., R. D. Delaune**, 2000. Vegetative response of *Sagittaria lancifolia* to burning of applied crude oil. Water, Air, and Soil Pollution **121**:161-172.
**Keywords:** biomass/ burning/ carbon/ carbon fixation/ crude oil/ density/ effects/ fresh water/ freshwater plant/ growth/ Louisiana/ Louisiana crude oil/ oil/ oiled/ Oseven/ plant/ recovery/ Sagittaria/ South Louisiana crude oil/ time/ treatment
**Notes:** Assessment of the the effects of oiling and burning on *Sagittaria lancifolia* in a freshwater marsh in Louisiana. Twelve plots (unoiled, oiled, oiled and burned) were treated in August and then repeated on 12 different plots in April. South Louisiana crude oil was used. In the August study, live stem density and plant growth were measured 1, 5, 9, 36, 42, 44, 48, and 52 wks after treatment; carbon fixation was measured eight times; and above ground biomass was harvested at 53 wks. In the April study, live stem density, plant growth, and carbon fixation were measure 3, 6, 9, 11, 15, and 19 wks after treatment; above ground biomass was harvested at 20 wks.

**Linden, O.**, 1975. Acute effects of oil and oil/dispersant mixture on larvae of Baltic herring. Ambio **4**:130-133.
**Keywords:** acute/ behavior/ crude oil/ dispersant/ effects/ fish/ herring/ larvae/ malformation/ ODthree/ oil/ salt water/ survival/ Venezuelan crude oil
**Notes:** Effects on Baltic herring larvae of exposure to physically dispersed and chemically dispersed (two dispersants) Venezuelan crude oil; survival, behavior, malformations.

**Linden, O.**, 1976. Effects of oil on the amphipod *Gammarus oceanicus*. Environmental Pollution **10**:239-250.
**Keywords:** adult/ amphipod/ behavior/ crude oil/ effects/ evaluation/ experiment/ fuel oil/ growth/ juvenile/ long-term/ marine invertebrate/ No.1 fuel oil/ No.4 fuel oil/ Ofour/ oil/ reproduction/ salt water/ static/ survival/ Venezuelan crude oil
**Notes:** Evaluation of the effects of Venezuelen crude oil, No. 1 fuel oil, or No. 4 fuel oil on a marine amphipod. An oil and seawater mixture was shaken and allowed to stand for 1 hr before static exposures

began. A series of experiments determined 48 hr $LC_{50}$ for adults and juveniles, long-term (60 da) effects of low levels of the three oils, long-term (60 da) effects of the water-soluble portion of the crude oil mixture, and the long-term (30da) post-exposure effect of 100 or 300 ppm crude oil and seawater mixture as a single dose for 48 hr. Measured survival, behavior, growth, and reproduction.

**Linden, O.**, 1976. The influence of crude oil and mixtures of crude oil/dispersants on the ontogenic development of the Baltic herring, *Clupea harengus membras* L. Ambio **5**:136-140.
**Keywords:** activity/ crude oil/ development/ dispersant/ effects/ eggs/ fish/ growth/ hatching/ heart/ herring/ larvae/ malformation/ ODthree/ oil/ rate/ salt water/ survival/ Venezuelan crude oil
**Notes:** Effects of physically dispersed and chemically dispersed (three dispersants) Venezuelan crude oil on eggs and larvae of the Baltic herring; hatching sucess, malformations, activity, heart beat rate, larval survival, larval malformations, and larval growth.

**Linden, O.**, 1976. Effects of oil on the reproduction of the amphipod Gammarus oceanicus. Ambio **5**:36-37.
**Keywords:** amphipod/ concentration/ crude oil/ effects/ experiment/ juvenile/ marine invertebrate/ Ofour/ oil/ reproduction/ salt water/ Venezuelan crude oil/ weathered
**Notes:** Effects of a shaken mixture of Venezuelan crude oil and sea water on reproduction of a marine amphipod. In one experiment, a single level of exposure (1 ppm nominal, 0.3-0.4 ppm actual) was used to determine its effect on production of juveniles. In a second experiment, concentrations of 1, 10, 20, or 40 ppm (weathered for 24 hrs) were used for 192 hrs; measured tendency to move into the precopulatory stage.

**Linden, O.**, 1977. Sublethal effects of oil on mollusc species from the Baltic Sea. Water, Air, and Soil Pollution **8**:305-313.
**Keywords:** behavior/ burrowing/ clam/ crude oil/ effects/ evaluation/ intertidal/ Iranian crude oil/ marine invertebrate/ mollusc/ mussel/ Ofour/ oil/ salt water/ snail/ species/ sublethal
**Notes:** Evaluation of the sublethal effects of aged (24 hr) water-soluble-fraction of Iranian crude oil on the blue mussel, an intertidal snail, and the Baltic clam. Measured byssus formation in blue mussels, burrowing behavior in Baltic clams, and crawling behavior in the snail.

**Linden, O.**, 1978. Biological effects of oil on early development of the Baltic herring *Clupea harengus membras* . Marine Biology **45**:273-283.
**Keywords:** activity/ biological effects/ crude oil/ development/ effects/ eggs/ fertilization/ fish/ fuel oil/ growth/ hatching/ heart/ herring/ larvae/ malformation/ No.1 fuel oil/ oil/ Othree/ rate/ salt water/ survival/ time
**Notes:** Effects on eggs (three developmental stages) and larvae of the Baltic herring of exposure to the water-soluble fractions of No. 1 fuel oil and two crude oils; fertilization, malformations, hatching success, activity, heart beat rate, hatching time, larval survival, larval malformations, and larval growth.

**Linden, O., J. R. Sharp, R. Laughlin, Jr., J. M. Neff**, 1979. Interactive effects of salinity, temperature and chronic exposure to oil on the survival and developmental rate of embryos of the estuarine killifish *fundulus heteroclitus*. Marine Biology **51**:101-109.
**Keywords:** chronic/ concentration/ development/ effects/ embryo/ estuarine/ fish/ fuel oil/ No.2 fuel oil/ oil/ Othree/ rate/ salinity/ salt water/ survival/ temperature
**Notes:** Effects on embryos of the killifish of exposure to varying concentrations of the water-soluble fraction of No. 2 fuel oil, three salinities, and three temperatures; survival and development.

**Linden, O., R. Elmgren, P. Boehm**, 1979. The Tsesis oil spill: its impact on the coastal ecosystem of the Baltic Sea. Ambio **8**:244-253.
**Keywords:** bivalve/ community/ ecosystem/ effects/ fish/ fuel oil/ general effect/ marine invertebrate/ Oeight/ oil/ oil spill/ overview/ phytoplankton/ salt water/ shoreline/ spill/ time/ Tsesis/ zooplankton
**Notes:** An overview of the spill chronology and response to the 1977 Tsesis oil spill, and discussion of the effect of the spilled fuel oil on biota. Biological sections on pelagic effects, shorelines, soft bottom communities, and fish.

**Linden, O., R. Laughlin, Jr., J. R. Sharp, J. M. Neff**, 1980. The combined effect of salinity, temperature and oil on the growth pattern of embryos of the killifish, *Fundulus heteroclitus* Walbaum. Marine Environmental Research **3**:129-144.
**Keywords:** combination/ concentration/ development/ effects/ embryo/ fish/ fuel oil/ growth/ malformation/ No.2 fuel oil/ oil/ Othree/ salinity/ salt water/ sublethal/ temperature
**Notes:** Sublethal effects on killifish embryos of exposure to varying concentrations of the water-soluble fraction of No. 2 fuel oil under varying temperature and salinity combinations; development and malformations.

**Linden, O., J. Mattsson, and M. Notini** 1983. A spill of light fuel oil in the Baltic Sea. Pages 517-520 *in* 1983 Oil Spill Conference, API 4356. American Petroleum Institute, Washington, DC.
**Keywords:** benthic/ Bunker C/ diesel/ diesel fuel/ evaluation/ fish/ fuel oil/ general effect/ light/ littoral/ marine invertebrate/ No.1 fuel oil/ No.6 fuel oil/ Oeight/ oil/ oil spill/ overview/ salt water/ spill/ time
**Notes:** An overview and summary of a 1 year evaluation of the consequences for Baltic Sea fauna of a spill of a mixture of No. 1 fuel oil, diesel fuel, and bunker C fuel oil. Results are presented in sections on the pelagic zone, benthic zone, and littoral zone.

**Linden, O., A. Rosemarin, A. Londskog, C. Hoglund, S. Johansson**, 1987. Effects of oil and oil dispersant on an enclosed marine ecosystem. Environmental Science and Technology **21**:374-382.
**Keywords:** abundance/ activity/ alkane/ bacteria/ community/ composition/ concentration/ crude oil/ degradation/ dispersant/ ecosystem/ effects/ Forties Field crude oil/ general effect/ growth/ hydrocarbons/ invertebrate/ marine invertebrate/ marine plant/ mesocosm/ microbes/ mussel/ ODeight/ oil/ periphyton/ phytoplankton/ plant/ population/ productivity/ salt water/ sand/ time/ total hydrocarbons/ zooplankton
**Notes:** Six experimental pools (mesocosms) were created with sea water, clean sand, bladderwracks (*Fucus*) attached to stones, and the invertebrates attached to the imported plants and stones. After 1 mo stabilization, Forties crude oil was added to two pools, crude oil plus Corexit 9550 dispersant was added to two pools, and two pools were used as controls. Identified all biota present in the pools and analyzed for total hydrocarbons in water. Over a 4-mo period, measured concentrations of alkanes in blue mussels, abundance of heterotropic bacteria, photosynthetic activity of phytoplankton and periphyton, growth of *Fucus*, estimated net ecosystem productivity, abundance and taxonomic composition of zooplankton, and selected physiological effects on certain invertebrates.

**Lindstedt-Siva, J., P. H. Albers, K. W. Fucik, and N. G. Maynard** 1984. Ecological considerations for the use of dispersants in oil spill response. Pages 363-377 *in* T. E. Allen, editor. Oil spill chemical dispersants: research, experience, and recommendations: a symposium. ASTM Special Technical Publication. American Society for Testing and Materials, Philadelphia, PA.
**Keywords:** bird/ coral/ coral reef/ dispersant/ grass/ guidelines/ habitat/ mammal/ marine invertebrate/ marine plant/ ODeight/ oil/ oil spill/ rocky shore/ salt water/ seagrass/ spill/ spill response/ technical/ beach/ Florida
**Notes:** General discussion of the considerations for use of chemical dispersants in different habitats and on different groups of animals. Covers coral reefs, sea grasses, rocky shores, bird habitats, and marine mammal habitats.

**Lindstedt-Siva, J., D. W. Chamberlain, and E. R. Mancini** 1987. Environmental aspects of the *Arco Anchorage* oil spill, Port Angeles, Washington. Pages 407-410 *in* 1987 Oil Spill Conference, API 4452. American Petroleum Institute, Washington, DC.
**Keywords:** Alaska/ beach/ biological effects/ bird/ crude oil/ effects/ fate/ general effect/ marine invertebrate/ methods/ North Slope/ Oeight/ oil/ oil spill/ petroleum/ restoration/ salt water/ sediment/ spill/ spill response/ tissue/ Washington
**Notes:** A description of the spill chronology, spill response, petroleum fate, and biological effects of a spill of North Slope (Alaska) crude oil from the *Argo Anchorage* in coastal Washington (USA). Sections on response actions, effects on birds; presence of oil in sediment, water, and tissue; and beach restoration methods.

**Lindstrom, J. E., J. F. Braddock**, 2002. Biodegradation of petroleum hydrocarbons at low temperature in the presence of the dispersant Corexit 9500. Marine Pollution Bulletin **44**:739-747.

**Keywords:** Alaska/ biodegradation/ carbon/ composition/ Corexit 9500/ crude oil/ degradation/ dispersant/ effects/ experiment/ growth/ hydrocarbons/ microbes/ mineralization/ North Slope crude oil/ ODten/ oil/ petroleum/ petroleum hydrocarbons/ residual oil/ temperature/ weathered
**Notes:** Alaska North Slope crude oil was used in an assessment of the degradation of crude oil at low temperatures (8 C). Innoculated flask batch cultures contained either culture medium only, crude oil only, dispersant only, a 1:10 mixture of dispersant and crude oil, or a 1:20 mixture of dispersant and crude oil. One set of cultures was run with fresh crude oil and one with 'weathered' crude oil (35 da). A separate experiment was set up for determining culture growth in dispersant only, fresh oil only, and 1:10 dispersed oil only (7 da). A third experiment to determine effects on residual composition of crude oil was performed with sterile culture medium and oil with or without dispersant, and inoculated culture medium with or without dispersant was conducted for 2 mo. Measured carbon mineralization, culture growth, and composition of residual oil.

**Linkins, A. E., L. A. Johnson, K. R. Everett, and R. M. Atlas** 1984. Oil spills: damage and recovery in Tundra and Taiga. Pages 135-155 *in* J. Cairns, Jr., A. L. Buikema, Jr., editors. Restoration of Habitats impacted by Oil Spills. Butterworth Publishers, Boston.
**Keywords:** fresh water/ freshwater plant/ general effect/ habitat/ Oeight/ oil/ oil spill/ petroleum/ recovery/ region/ restoration/ spill/ taiga/ tundra
**Notes:** A comprehensive assessment of the consequences of oil spills in the Tundra and Taiga regions of the world. Authors present sections on background, cleanup, restoration, and conclusions.

**Lipcius, R. N., C. A. Coyne, B. A. Fairbanks, D. H. Hammond, P. J. Mohan, D. J. Nixon, J. J. Staskiewicz, H. Heppner**, 1980. Avoidance response of mallards to colored and black water. Journal of Wildlife Management **44**:511-518.
**Keywords:** avoidance/ behavior/ bird/ dye/ evaluation/ mallard/ oil/ oil slick/ Oone
**Notes:** Evaluation of colored dyes as potential deterrents for keeping water birds away from oil slicks; mallards used in an experimental apparatus.

**Lipiatou, E., A. Saliot**, 1991. Hydrocarbon contamination of the Rhone Delta and western Mediterranean. Marine Pollution Bulletin **22**:297-304.
**Keywords:** alkane/ aromatic hydrocarbons/ distance/ hydrocarbons/ Mediterranean/ miscellaneous/ Oeleven/ PAH/ salt water/ sediment
**Notes:** Sediments were collected at varying distances from the mouth of the Rhone River in the Mediterranean Sea. The top centimeter was analyzed for non-aromatic hydrocarbons, n-alkanes, and PAHs. Results were compared to results of other sediment studies performed in the Mediterranean.

**Lipscomb, T. P., R. K. Harris, R. B. Moeller, J. M. Pletcher, R. J. Haebler, B. E. Ballachey**, 1993. Histopathologic lesions in sea otters exposed to crude oil. Veterinary Pathology **30**:1-11.
**Keywords:** crude oil/ Exxon Valdez/ fur/ lesions/ mammal/ oil/ oil spill/ oiled/ Otwo/ pathology/ Prudhoe Bay crude oil/ rehabilitation/ salt water/ sea otter/ spill
**Notes:** Pathologic findings for oiled sea otters that died at rehabilitation centers after the Exxon Valdez oil spill.

**Liste, H.-H., I. Prutz**, 2006. Plant performance, dioxygenase-expressing rhizosphere bacteria, and biodegradation of weathered hydrocarbons in contaminanted soil. Chemosphere **62**:1411-1420.
**Keywords:** aromatic hydrocarbons/ bacteria/ biodegradation/ bioremediation/ experiment/ freshwater plant/ germination/ hydrocarbons/ microbes/ Oseven/ PAH/ petroleum/ petroleum hydrocarbons/ plant/ seed/ soil/ species/ survival/ weathered/ weight
**Notes:** Contaminated soil from a former manufactured gas plant was used in a phytoremediation experiment. Thirteen species were planted as seeds in the soil and grown for 116 da. Measured germination, plant survival, and dry weight of shoot. Identified and quantified the soil bacteria associated with each species. In a second experiment, six species germinated in uncontaminated soil were transplanted to contaminated soil and grown for 68 da. The soil was then analyzed for total petroleum hydrocarbons and the quantity of 16 selected PAHs. The quantity of total petroleum hydrocarbons in the soil of the second experiment is cited as being less than the sum of the 16 PAHs; something is wrong.

**Literathy, P., S. Haider, O. Samhan, G. Morel**, 1989. Experimental studies on biological and chemical oxidation of dispersed oil in seawater. Water Science and Technology **21**:845-856.
**Keywords:** alkane/ aromatic hydrocarbons/ concentration/ condition/ crude oil/ degradation/ dispersant/ experiment/ Kuwait/ Kuwait crude oil/ light/ ODnine/ oil/ oxygen/ petroleum/ salt water/ technical/ total hydrocarbons
**Notes:** A set of five experiments were performed to evaluate biological and chemical oxidation of crude oil in seawater. Kuwait crude oil and several chemical dispersants were added to seawater as either crude oil alone, dispersant alone, or crude oil plus dispersant. Duration of the experiments ranged from 6 to 90 da and were perform under light and dark conditions. Biological oxygen demand and photosynthetic oxygen production, petroleum concentrations, and dispersant concentrations were measured at intervals during the experiments.

**Little, D. I. and D. L. Scales** 1987. The persistence of oil stranded on sediment shorelines. Pages 433-438 *in* 1987 Oil Spill Conference. American Petroleum Institute, Washington, D.C.
**Keywords:** analysis/ chemical analysis/ concentration/ crude oil/ intertidal/ mousse/ oil/ oil spill/ Onine/ persistence/ refined oil/ salt water/ sediment/ shoreline/ spill/ technical/ time
**Notes:** An assessment of the persistence of crude oil and refined oil 'mousse' on intertidal sediments of a variety of shoreline types. Seven sites were used and residence was monitored as percent oil cover and by chemical analysis for total hydrocarbon concentration.

**Little, D. I. and A. E. Little** 1991. Estuarine oil spill effects in the context of dispersant use changes. Pages 507-518 *in* 1991 International Oil Spill Conference, API Publication 4529. American Petroleum Institute, Washington, D.C.
**Keywords:** aliphatic hydrocarbons/ analysis/ aromatic hydrocarbons/ beach/ bird/ chemical analysis/ crude oil/ dispersant/ effects/ England/ estuarine/ estuary/ general effect/ gravel/ hydrocarbons/ marine invertebrate/ marine plant/ monitoring/ Oeight/ oil/ oil spill/ oiled/ rocky shore/ salt marsh/ salt water/ sampling/ sediment/ spill/ survey/ time/ vegetation
**Notes:** An overall assessment of the effects of the 1988 El Omar oil spill (crude oil) at Milford Haven, England. General assessments were made at all heavily oiled areas and at sites used for rocky shore monitoring efforts prior to the oil spill. A gravel beach site and a salt marsh site were used for intensive sampling of sediment cores and vegetation. An oiled bird survey was performed 8 da after the spill. A survey of macrobenthos and hydrocarbons in sediments of the inner estuary was performed 4 mos after the spill. Chemical analysis was for total aliphatics and total aromatics.

**Little, E. E., L. Cleveland, R. Calfee, M. G. Barron**, 2003. Assessment of the photoenhanced toxicity of a weathered oil to the tidewater silverside. Environmental Toxicology and Chemistry **19** :926-932.
**Keywords:** combination/ concentration/ crude oil/ experiment/ fish/ irradiance/ juvenile/ oil/ oil field/ Othree/ photoenhanced/ salt water/ static/ survival/ toxicity/ ultraviolet/ weathered
**Notes:** Weathered crude oil collected from an abandoned oil field was used to generate a water-accomodated-fraction (WAF) for use in a 7-da static renewal experiment with the tidewater silverside. Juvenile fish were exposed to varying combinations of WAF concentrations and amounts of UV irradiance. Measured survival.

**Liu, B., R. P. Romaire, R. D. Delaune, C. W. Lindau**, 2006. Field investigation on the toxicity of Alaska North Slope crude oil (ANSC) and dispersed ANSC crude to Gulf killifish, eastern oyster and white shrimp. Chemosphere **62**:520-526.
**Keywords:** Alaska/ bivalve/ Corexit 9500/ crude oil/ dispersant/ experiment/ fish/ hydrocarbons/ Louisiana/ marine invertebrate/ North Slope/ North Slope crude oil/ ODthree/ oil/ oyster/ parameters/ petroleum/ petroleum hydrocarbons/ shrimp/ Spartina/ survival/ toxicity/ water/ wetland
**Notes:** Alaskan crude oil plus Corexit 9500 dispersant were used in field and laboratory assessments of toxicity to killifish, oyster, and shrimp. The field study was conducted in a coastal Louisiana Spartina wetland where test organisms were placed in enclosures with crude oil alone (30 ppm) or crude oil plus dispersant (30 ppm) for 24 hrs. Tidal flow moved through the containers. The laboratory exposures to crude oil and crude oil plus dispersant were to determine the 96 hr LC50. Measured survival, total petroleum hydrocarbons, and several water quality parameters in the field experiment.

**Liu, D.**, 1983. Fate of oil dispersants in aquatic environment. Science of the Total Environment **32**:93-98.
**Keywords:** biodegradation/ cell/ dispersant/ environment/ experiment/ fate/ fresh water/ ODnine/ oil/ oxygen/ refinery/ soil/ technical
**Notes:** An assessment of the fate of chemical oil dispersants in a bacterial culture taken from refinery soil. Five dispersants were used in a 60 min culture experiment; measured oxygen consumption and culture cell yield.

**Livingstone, D. R.**, 1987. Seasonal responses to diesel oil and subsequent recovery of the cytochrome P-450 monooxygenase system in the common mussel, *Mytilus edulis* L., and the periwinkle, *Littorina littorea* L. Science of the Total Environment **65**:3-20.
**Keywords:** activity/ concentration/ diesel/ digestive gland/ flow-through/ marine invertebrate/ mixed-function oxidase/ monooxygenase/ mussel/ Ofour/ oil/ PAH/ periwinkle/ recovery/ salt water/ seasonal/ time/ tissue
**Notes:** Exposure of the blue mussel (4-8 mo) and a periwinkle (16-24 mo) to 30 ppb or 129 ppb of diesel oil in flow-through outdoor basins and then allowed to depurate for 2-9 mo in clean water. Tissue samples (digestive gland and whole animal) were collected three times per year and analyzed for P450 activity and concentrations of 2-3 ring PAHs.

**Lizarraga-Partida, M. L., F. B. Izquierdo-Vicuna, I. Wong-Chang**, 1991. Marine bacteria on the Campeche Bank oil field. Marine Pollution Bulletin **22**:401-405.
**Keywords:** bacteria/ crude oil/ Gulf of Mexico/ Mexico/ microbes/ oil/ oil field/ Oten/ salt water/ sampling/ sediment
**Notes:** Bimonthly sampling of water and sediment (for 14 mos) from beneath the production platforms of the Campeche Bank oil field, four nearby areas, and from a separate cruise in the southern Gulf of Mexico. Measured heterotrophic bacteria and oil-degrading bacteria.

**Llorente, G. A., A. Farran, X. Ruiz, J. Albaiges**, 1987. Accumulation and distribution of hydrocarbons, polychlorobyphenyls, and DDT in tissues of three species of Anatidae from the Ebro Delta (Spain). Archives of Environmental Contamination and Toxicology **16**:563-572.
**Keywords:** accumulation/ algae/ alkane/ bird/ DDT/ distribution/ duck/ freshwater plant/ hydrocarbons/ Oone/ PCB/ salt water/ Spain/ species/ tissue
**Notes:** Assessment of hydrocarbons, PCBs, and DDT in five tissues of three duck species from the Ebro Delta of Spain.

**Lock, M. A., R. R. Wallace, D. R. Barton**, 1981. The effects of synthetic crude oil on microbial and macroinvertebrate benthic river communities: Part II -- The response of an established community to contamination by synthetic crude oil. Environmental Pollution (Series A) **24**:263-275.
**Keywords:** Alberta/ algae/ bacteria/ baseline/ benthic/ Canada/ chemical characteristics/ chlorophyll/ community/ concentration/ crude oil/ effects/ fresh water/ freshwater invertebrate/ gas oil/ kerosene/ macroinvertebrate/ microbes/ Ofive/ oil/ oil sands/ population/ river/ sand/ stream/ time/ treatment/ water
**Notes:** Bricks dipped in oil sands crude oil or its naphtha, kerosene, and gas oil components were placed in a northern Alberta, Canada stream during mid-May. Control bricks were sampled to determine baseline bacteria, chlorophyll *a*, and macroinvertebrate concentrations in June followed by treatment of all the crude oil bricks. All bricks were sampled for bacteria, chlorophyll *a*, and macroinvertebrates in July, August, October and December. Physical and chemical characteristics of the river water were determine on a monthly basis from April through December.

**Lock, M. A., R. R. Wallace, D. R. Barton**, 1981. The effects of synthetic crude oil on microbial and macroinvertebrate benthic river communities -- part I: colonisation of synthetic crude oil contaminated substrata. Environmental Pollution (Series A) **24**:207-217.
**Keywords:** bacteria/ benthic/ Canada/ cell/ chlorophyll/ colonization/ community/ crude oil/ effects/ fresh water/ freshwater invertebrate/ light/ macroinvertebrate/ microbes/ numbers/ Ofive/ oil/ population
**Notes:** Assessment of the effect of synthetic crude oil on the microbial and macroinvertebrates of a northern Canada river. Bricks soaked in oil were place in a normal light and low light (artificially maintained) portion of the river. Bricks were removed after 30 da. Colonizing bacteria were counted,

chlorophyll *a* quantified, the number of colonizing algal cells per unit area counted, and colonizing macroinvertebrates were identified and counted.

**Lockhart, W. L., R. Wagemann, J. W. Clayton, B. Graham, D. Murray**, 1975. Chronic toxicity of a synthetic tri-aryl phosphate oil to fish. Environmental Physiology and Biochemistry **5**:361-369.
**Keywords:** activity/ blood/ cholinesterase/ chronic/ effects/ fish/ fresh water/ lubricating oil/ necropsy/ oil/ Othree/ phosphate/ physiology/ rainbow trout/ synthetic oil/ toxicity
**Notes:** Effects on rainbow trout of exposure to a synthetic lubricating oil (IMOL S-140) for 4 months: cholinesterase activity, blood chemistry, physiology, necropsy.

**Lomholt, J. P.**, 1976. The development of the oxygen permeability of the avian egg shell and its membranes during incubation. Journal of Experimental Zoology **198**:177-184.
**Keywords:** bird/ development/ egg shell/ eggs/ incubation/ Oone/ oxygen/ permeability/ shell
**Notes:** Assessment of the oxygen permiability of avian egg shells during incubation.

**Long, S. M., K. J. Ryder, D. A. Holdway**, 2003. The use of respiratory enzymes as biomarkers of petroleum hydrocarbon exposure in *Mytilus edulis planulatus*. Ecotoxicology and Environmental Safety **55**:261-270.
**Keywords:** biochemistry/ biomarker/ bivalve/ concentration/ crude oil/ enzyme/ experiment/ gill/ hydrocarbons/ marine invertebrate/ mussel/ oil/ Othree/ PAH/ petroleum/ petroleum hydrocarbons/ salt water/ sediment/ time/ tissue
**Notes:** The effect of petroleum on respiratory enzymes of *M. edulis* was determined with two experiments. The first involved the water-accomodated fraction of Bass Strait crude oil in three concentrations for a 96 hr exposure. Mussels were sampled at 0, 24, 48, and 96 hrs and the gills analyzed for citrate synthase and lactate dehydrogenase. The second experiment involved sediment mixed with 0, 0.2, 1, or 5 ml crude oil/kg dry sediment for a period of exposure of 6 months. Mussel gills were sampled at 2 wks, 1 mo, 2 mos, 4 mos, and 6 mos and analyzed as in the first experiment. Also analyzed the stock water and sediment for total petroleum hydrocarbons and mussel soft tissue for the sum of 16 PAHs.

**Longwell, A. C.**, 1977. A genetic look at fish eggs and oil. Oceanus **20**:46-58.
**Keywords:** Argo Merchant/ Bunker C/ cell/ cell division/ development/ effects/ eggs/ embryo/ fish/ fuel oil/ genetic/ malformation/ No.2 fuel oil/ oil/ oil spill/ Othree/ salt water/ spill
**Notes:** Effects of No. 6 and No. 2 fuel oils from the Argo Merchant oil spill (1976) on fish egg development; cell division, embryo malformations.

**Lonning, S., B. E. Hagstrom**, 1976. Deleterious effects of Corexit 9527 on fertilization and development. Marine Pollution Bulletin **7**:124-126.
**Keywords:** Corexit 9527/ crude oil/ development/ dispersant/ effects/ eggs/ fertilization/ fish/ marine invertebrate/ ODthree/ oil/ salt water/ sea urchin/ species/ urchin
**Notes:** Effects of Corexit 9527 alone or incombination with crude oil on the fertilization and development of eggs of four species of sea urchin and three species of fish.

**Lonning, S., B. E. Hagstrom**, 1978. A toxicological evaluation of a plastic oil absorbant. Marine Pollution Bulletin **9**:276-278.
**Keywords:** chloride/ combination/ copepod/ crude oil/ dispersant/ Ekofisk crude oil/ embryo/ evaluation/ experiment/ fish/ larvae/ marine invertebrate/ miscellaneous/ ODeleven/ oil/ plastic/ salt water/ sea urchin/ toxicity/ urchin
**Notes:** A series of laboratory experiments were performed with sea urchin gametes and embryos, larvae of flatfish, and copepods to determine the toxicity of a plastic oil absorbant called "Oil Killer". Methylene chloride extracts of the oil absorbent and Ekofish crude oil were used alone or in combination to challenge test organisms.

**Lopes, C. F., J. C. C. Milanelli, V. A. Prosperi, E. Zanardi, A. C. Truzzi**, 1997. Coastal monitoring program of Sao Sebastiao Channel: assessing the effects of 'Tebar V' oil spill on rocky shore populations. Marine Pollution Bulletin **34**:923-927.

**Keywords:** barnacle/ beach/ Brazil/ density/ effects/ marine invertebrate/ monitoring/ mussel/ Ofour/ oil/ oil spill/ pipeline/ population/ rocky shore/ salt water/ spill/ toxicity
**Notes:** Assessment of the effects of a coastal pipeline rupture north of Sao Paulo, Brazil. Laboratory toxicity tests and beach assessments of mussel and barnacle density used to measure effect.

**Lord, D. A., I. H. Kerley, R. M. Randall, J. S. V. Reddering, E. H. Schumann, W. E. Bricknell, S. Rowe, and R. P. Mason** 1987. The *Kapodistrias* grounding and oil spill Cape Recife, South Africa. Pages 33-38 *in* 1987 Oil Spill Conference (Prevention, Behavior, Control, Cleanup). American Petroleum Institute, Washington, DC.
**Keywords:** Africa/ behavior/ bird/ coast/ dispersant/ effects/ fuel oil/ ODone/ oil/ oil spill/ salt water/ shellfish/ South Africa/ spill/ spill response
**Notes:** Report of the consequences of the grounding of the MV Kapodistrias off the coast of South Africa. Small amounts of fuel oil escaped. Description of the spill response and the effects on birds and shellfish.

**Lorensten, S.-H., T. Anker-Nilssen**, 1993. Behavior and oil vulnerability of fulmars *Fulmarus glacialis* during an oil spill experiment in the Norwegian Sea. Marine Pollution Bulletin **26**:144-146.
**Keywords:** behavior/ bird/ crude oil/ experiment/ fulmar/ Norway/ oil/ oil spill/ Oone/ salt water/ spill/ vulnerability
**Notes:** Results of an experimental spill of crude oil designed to determine the behavioral response of fulmars to surface oil.

**Louati, A., B. Elleuch, M. Kallel, A. Saliot, J. Dagaut, J. Oudot**, 2001. Hydrocarbon contamination of coastal sediments from the Sfax area (Tunisia), Mediterranean Sea. Marine Pollution Bulletin **42**:445-452.
**Keywords:** alkane/ coast/ cycloalkane/ evaluation/ hopane/ hydrocarbons/ Mediterranean/ methods/ miscellaneous/ Oeleven/ salt water/ sampling/ saturated hydrocarbons/ sediment/ sterane/ total hydrocarbons/ transect/ unresolved complex mixture
**Notes:** An evaluation of the saturated hydrocarbons in the sediments off the coast of Sfax, Tunisia. Four transects radiating outward from a coastal site next to industrial outflows contained a total of 18 sampling locations. Measured total hydrocarbons with two analytical methods and measured alkanes and cycloalkanes with three analytical methods. Determined the source of hydrocarbon contamination by analyzing the unresolved complex mixture, steranes, and hopanes.

**Loya, Y., B. Rinkevich**, 1979. Abortion effect in corals induced by oil pollution. Marine Ecology Progress Series **1**:77-80.
**Keywords:** bioassay/ colony/ concentration/ coral/ crude oil/ Iranian crude oil/ larvae/ marine invertebrate/ Ofour/ oil/ planulae/ pollution/ reproduction/ salt water/ species/ static
**Notes:** Exposure of five colonies of a coral species to the water-soluble-fraction (WSF) of Iranian crude oil. Five concentrations of the WSF were used in static bioassays. Measured the extrusion of planulae larvae by the coral after 1 hr and 6 hrs of exposure.

**Loynachan, T. E.**, 1978. Low-temperature mineralization of crude oil in soil. Journal of Environmental Quality **7**:494-500.
**Keywords:** aerobic/ anaerobic/ bacteria/ biodegradation/ combination/ crude oil/ experiment/ fungi/ incubation/ microbes/ mineralization/ nutrients/ oil/ Oten/ petroleum/ Prudhoe Bay/ Prudhoe Bay crude oil/ soil/ time
**Notes:** A series of laboratory experiments was conducted to evaluate biodegradation of Prudhoe Bay crude oil in Alaskan soils. Contrasts included one soil from a petroleum contaminated area and one reference soil, two levels of oil addition to soil, disturbance of mixture vs nondisturbance, sawdust addition, and nutrient enhancement with N, P, and S in various combinations. Incubation period was 115 da. Production of $CO_2$ was measured eight times during the studies. Counts of aerobic and anaerobic bacteria were made on four occasions and counts of fungi and actinomycetes were made on two occasions.

**Lucas, Z., C. MacGregor**, 2006. Characterization and source of oil contamination on the beaches and seabird corpses, Sable Island, Nova Scotia, 1996-2005. Marine Pollution Bulletin **52**:778-789.
**Keywords:** beach/ bird/ carcass/ feathers/ fuel oil/ Nova Scotia/ oil/ oiled/ oiling/ Oone/ salt water/ species/ spill/ tanker/ washing

**Notes:** During the summers of 1996-2005, seabird carcasses on Sable Island, Nova Scotia were examined for oiling, oiled feathers and beach tar were collected, and species were determined. Tar samples were identified as to type of oil and likely source (tanker, fuel oil, bilge washing). Found 2343 oiled carcasses and identified at least 74 marine oil discharge events.

**Lunel, T., J. Rusin, N. Bailey, C. Halliwell, and L. Davies** 1997. The net environmental benefit of a successful dispersant operation at the *Sea Empress* incident. Pages 185-194 *in* 1997 International Oil Spill Conference, API 4651. American Petroleum Institute, Washington, D.C.
**Keywords:** analysis/ chemical analysis/ coast/ crude oil/ dispersant/ England/ estimate/ miscellaneous/ ODeleven/ oil/ oil spill/ salt water/ spill/ Wales/ water column
**Notes:** A quantified estimate of the benefit of using chemical oil dispersants at the site of the *Sea Empress* oil spill off the coast of Wales, England. The crude oil spill was released over 8 days and treated with dispersants on 7 days. Monitored efficacy by remote sensing and chemical analysis of the water column.

**Lusimbo, W. S., F. A. Leighton**, 1996. Effects of Prudhoe Bay crude oil on hatching success and associated changes in pipping muscles in embryos of domestic chickens (*Gallus gallus)*. Journal of Wildlife Diseases **32**:209-215.
**Keywords:** bird/ chicken/ condition/ crude oil/ effects/ egg shell/ embryo/ hatching/ muscle/ oil/ oiled/ Oone/ pathology/ physiology/ Prudhoe Bay/ Prudhoe Bay crude oil
**Notes:** Assessment of the condition of pipping muscles in chicken embryos exposed to oil by eggshell oiling with Prudhoe Bay crude oil.

**Lutcavage, M. E., P. L. Lutz, G. D. Bossart, D. M. Hudson**, 1995. Physiologic and clinicopathologic effects of crude oil on loggerhead sea turtles. Archives of Environmental Contamination and Toxicology **28**:417-422.
**Keywords:** behavior/ biochemistry/ blood/ condition/ crude oil/ effects/ juvenile/ Louisiana/ Louisiana crude oil/ oil/ oil slick/ OthreeR/ pathology/ physiology/ reptile/ salt water/ South Louisiana crude oil/ turtle/ weathered
**Notes:** Effects on juvenile loggerhead sea turtles of exposure (96 hr) to an oil slick of weathered (48 hr) South Louisiana crude oil under experimental conditions; behavior, blood characteristics, biochemistry, pathology, physiology.

**Lye, C. M.**, 2000. Impact of oestrogenic substances from oil production at sea. Toxicology Letters **112-113**:265-272.
**Keywords:** alkyphenol/ drilling mud/ effects/ endocrine/ evaluation/ miscellaneous/ offshore/ oil/ Oten/ PAH/ review/ salt water
**Notes:** A review and evaluation of the potential oestrogenic effects of substances discharged from offshore oil production platforms. Discussion focuses on PAHs in drilling muds and alkylphenols present in rig washes. Examines the concerns for each and discusses the results of several field studies.

**Lytle, J. S. and T. F. Lytle** 1983. Potential damage of oil wastes in coastal estuary sediments. Pages 491-500 *in* 1983 Oil Spill Conference, API 4356. American Petroleum Institute, Washington, DC.
**Keywords:** aliphatic hydrocarbons/ ammonia/ amphipod/ aromatic hydrocarbons/ bioassay/ estuary/ fish/ general effect/ hydrocarbons/ marine invertebrate/ Mississippi/ Oeight/ oil/ oil spill/ physical characteristics/ plant/ refinery/ salt water/ sediment/ sheepshead minnow/ shrimp/ spill
**Notes:** Assessment of the toxic potential of sediments near four chemical plants (including a large refinery) near Pascagoula, Mississippi. Surface and core samples of sediments were analyzed for aliphatic and aromatic hydrocarbons; and the core sediments were analyzed for chemical and physical characteristics. Surface sediments were used in 96-hr bioassays using mysid shrimp, sheepshead minnows, killifish, and an amphipod.

**Lytle, J. S. and T. F. Lytle** 1987. The role of *Juncus roemerianus* in cleanup of oil-polluted sediments. Pages 495-501 *in* Proceedings 1987 Oil Spill Conference, API Publication 4452. American Petroleum Institute, Washington, D.C.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ chronic/ crude oil/ experiment/ hydrocarbons/

Juncus/ leaves/ marine plant/ naphthalene/ oil/ oil spill/ Osix/ petroleum/ petroleum hydrocarbons/ salt water/ sediment/ Spartina/ spill/ uptake
**Notes:** A series of experiments on the uptake of petroleum hydrocarbons by *Juncus roemerianus* and *Spartina alterniflora*. In one experiment, crude oil was spilled on an experimental pond and leaf shoots were collected and analyzed for aliphatic and aromatic hydrocarbons 3, 6, and 12 mos later. In a second experiment, crude oil was injected into the sediment of quadrat plots for 5 consecutive days; leaves were collected and analyzed 6 mos and 12 mos later. In a third experiment, sediment and leaves from *Juncus* were collected from four locations with chronic petroleum contamination and one reference site, and analyzed for petroleum hydrocarbons. In a fourth experiment, performed two field trials of single compound uptake by *Juncus*; leaves were analyzed for naphthalene or 1-octadecene.

**Maccarone, A. D., J. N. Brzorad**, 1995. Effects of an oil spill on the prey populations and foraging behavior of breeding wading birds. Wetlands **15**:397-407.
**Keywords:** behavior/ bird/ Bunker C/ effects/ fish/ foraging/ fuel oil/ marine invertebrate/ New Jersey/ New York/ No.2 fuel oil/ oil/ oil spill/ Oone/ population/ salt water/ shrimp/ spill
**Notes:** Report of the effects on foraging by wading birds of several spills of No. 2 and No. 6 fuel oils into the Arthur Kill and Kill Van Kull between NY and NJ in 1990.

**MacDonald, B. A., M. L. H. Thomas**, 1982. Growth reduction in the soft-shell clam *Mya arenaria* from a heavily oiled lagoon in Chedabucto Bay, Nova Scotia. Marine Environmental Research **6**:145-156.
**Keywords:** age/ Arrow/ Bunker C/ clam/ growth/ length/ marine invertebrate/ Nova Scotia/ Ofour/ oiled/ reduction/ salt water/ shell/ spill/ tissue/ weight
**Notes:** Soft shell clams were collected from Chedabucto Bay, Nova Scotia (*Arrow* spill of 1970) after the Bunker C spill and 9 yrs later at the same site and at an unoiled site. Measured tissue weights, shell weight, shell length, clam age, and external morphology of the shell.

**MacDonald, I. R.**, 1998. Oil spills. Scientific American **Nov.**:57-61.
**Keywords:** crude oil/ general effect/ Gulf of Mexico/ Mexico/ Oeight/ oil/ oil seep/ oil spill/ petroleum/ petroleum hydrocarbons/ salt water/ spill
**Notes:** A general description of natural oil seeps in the Gulf of Mexico. Author uses historical records, modern assessments of floating oil, and naturalist observations on the adaptation of living organisms to the presence of naturally occurring petroleum.

**MacFarlane, G. R., D. J. Reid, C. A. Esguerra**, 2004. Sublethal behavioral effects of the water accommodated fractions of crude oil to gastropod molluscs. Bulletin of Environmental Contamination and Toxicology **72**:1025-1031.
**Keywords:** activity/ aliphatic hydrocarbons/ aromatic hydrocarbons/ assay/ Australia/ concentration/ crude oil/ gastropod/ marine invertebrate/ mollusc/ movement/ Ofour/ oil/ salt water/ species/ sublethal
**Notes:** Water-accommodated fraction (WAF) of crude oil was used in a laboratory assay of locomotor response in four species of Australian gastropods. Gastropods were exposed for 24 hrs to one of five WAF concentrations. Locomotor activity was measured immediately after exposure began and after 24 hrs. Measured the 'total' aliphatic and aromatic hydrocarbon concentrations of the WAF.

**Mackay, D., A. Watson, C. Ng, and S. Nadeau** 1979. Behavior and effectiveness of dispersants at sea and at shorelines. Pages 447-452 *in* 1979 Oil Spill Conference, API 4308. American Petroleum Institute, Washington, DC.
**Keywords:** Alberta/ Alberta crude oil/ beach/ behavior/ cleaning/ Corexit 7664/ Corexit 8667/ Corexit 9527/ crude oil/ dispersant/ effectiveness/ experiment/ fuel oil/ movement/ No.6 fuel oil/ ODnine/ oil/ oil spill/ salt water/ sand/ shoreline/ spill/ technical
**Notes:** Laboratory experiments employing an apparatus that simulated sea surface state and an apparatus that simulated oil moving onto the shoreline were conducted to evaluate the effectiveness of chemical dispersants. Measured turbulence and dispersion characteristics of sea state and movement of oil (Alberta blend crude and No. 6 fuel oil) onto sandy and rocky shorelines. Compared crude oil and fuel oil without dispersant and with either Corexit 9527, BP 1100WD, Corexit 7664, Corexit 8667, or BP 1100X. Also, evaluated the effect of dispersants on the ease of cleaning beach sand.

**Mackey, A. P., M. Hodgkinson**, 1996. Assessment of the impact of naphthalene contamination on mangrove fauna using behavioral bioassays. Bulletin of Environmental Contamination and Toxicology **56**:279-286.
**Keywords:** Australia/ bioassay/ concentration/ gastropod/ long-term/ mangrove/ marine invertebrate/ naphthalene/ Ofour/ rate/ salt water/ sediment/ short-term/ snail/ species/ time
**Notes:** Assessment of the effect of various concentrations of naphthalene on a species of gastropod found in the coastal mangroves of Australia. Collected sediments from two sites in the Brisbane River to determine actual concentrations. Performed short-term (a few min) and long-term (60 min) laboratory exposures of snails. Short-term exposures were conducted at various times during the day. Measured crawling rate of snails as they left contaminated water.

**Mackie, P. R., K. J. Whittle, R. Hardy**, 1974. Hydrocarbons in the marine environment. I. *n*-Alkanes in the Firth of Clyde. Estuarine and Coastal Marine Science **2**:359-374.
**Keywords:** aliphatic hydrocarbons/ alkane/ benthic/ environment/ fish/ general effect/ hydrocarbons/ invertebrate/ marine environment/ marine invertebrate/ Oeight/ plankton/ salt water/ sediment/ species
**Notes:** An assessment of alkanes in the Firth of Clyde. Samples (apparantly composite) were collected of surface film, surface water, middle-depth water, sediment, benthic invertebrates, plankton, and fish (four species) from a local market. All samples were analyzed for a suite of alkanes.

**Mackie, P. R., H. M. Platt, R. Hardy**, 1978. Hydrocarbons in the marine environment. II. Distribution of *n*-alkanes in the fauna and environment of the sub-antarctic island of South Georgia. Estuarine and Coastal Marine Science **6**:301-313.
**Keywords:** aliphatic hydrocarbons/ alkane/ beach/ benthic/ distribution/ environment/ fish/ freshwater plant/ fuel oil/ general effect/ hydrocarbons/ invertebrate/ marine environment/ marine invertebrate/ Oeight/ oil/ plant/ salt water/ sediment/ soil/ species/ storage/ stream
**Notes:** An assessment of alkanes in the environment of a harbor on South Georgia Island. Sediments were collected from six sites in an old whaling station harbor and two sites in a nearby lake. Benthic invertebrates were collected from three of the harbor sites. Also collected were two fish species, a soil sample from the bank of a coastal stream, a sample of native plants, fuel oil from a storage tank at the whaling station, beach tar, and a composite water sample. All samples were analyzed for alkanes.

**Mackie, P. R., R. Hardy, E. I. Butler, P. M. Holligan, M. F. Spooner**, 1978. Early samples of oil in water and some analyses of zooplankton. Marine Pollution Bulletin **9**:296-297.
**Keywords:** Amoco Cadiz/ concentration/ English Channel/ hydrocarbons/ marine invertebrate/ Ofour/ oil/ petroleum/ petroleum hydrocarbons/ salt water/ zooplankton
**Notes:** Water and zooplankton samples were collected shortly after the wreck of the Amoco Cadiz in 1978. Water samples were collected beneath the slick and outside the slick. Zooplankton were collected at three locations in the English Channel. Both water and zooplankton were analyzed for petroleum hydrocarbons.

**Macko, S. A., S. M. King**, 1980. Weathered oil: effect on hatchability of heron and gull eggs. Bulletin of Environmental Contamination and Toxicology **25**:316-320.
**Keywords:** bird/ crude oil/ effects/ eggs/ gull/ hatchability/ heron/ Libyan crude oil/ Louisiana/ oil/ Oone/ salt water/ spill/ Texas/ weathered
**Notes:** Effects of weathered and fresh Libyan crude oil on hatchability of eggs of Louisiana herons and laughing gulls in coastal Texas.

**Macko, S. A., P. L. Parker, A. V. Botello**, 1981. Persistence of spilled oil in a Texas salt marsh. Environmental Pollution (Series B) **2**:119-128.
**Keywords:** aromatic hydrocarbons/ crude oil/ hydrocarbons/ isotope/ oil/ oiled/ Onine/ persistence/ pipeline/ ratio/ salt marsh/ salt water/ saturated hydrocarbons/ sediment/ spill/ technical/ Texas/ time/ unsaturated hydrocarbons/ weathered
**Notes:** A pipeline rupture at Harbor Island, TX resulted in the oiling of shallow coastal marshes with crude oil. Sediment samples were collected from three locations within the afffected area; it is unclear if the sediments were combined. Collections were made from the upper 5 cm of sediment at 1 da, 1 mo, 2

mos, 6 mos, 18 mos, and 2 yrs after the spill. Sediments were analyzed for saturated and unsaturated (aromatic) hydrocarbons, and $^{14}C$ isotope ratios.

**MacLennan, A. S.**, 1986. Oil pollution in the Cromarty Firth and inshore Moray Firth. Proceedings of the Royal Society of Edinburgh **91B**:275-282.
**Keywords:** bird/ England/ history/ marine invertebrate/ oil/ oil spill/ Oone/ pollution/ population/ review/ salt water/ spill
**Notes:** Review of oil spill incidents in Moray Firth (1975-84) and Cromarty Firth (1970-84) in England with special attention to sea birds.

**Madany, I. M., A. Al-Haddad, A. Jaffar, E.-S. Al-Shirbini**, 1994. Spatial and temporal distribution of aromatic petroleum hydrocarbons in the cdoastal waters of Bahrain. Archives of Environmental Contamination and Toxicology **26**:185-190.
**Keywords:** Arabian Gulf/ aromatic hydrocarbons/ Bahrain/ crude oil/ distribution/ hydrocarbons/ miscellaneous/ Oeleven/ oil/ petroleum/ petroleum hydrocarbons/ salt water/ shoreline/ survey
**Notes:** A total of 50 water samples were collected from around the island of Bahrain during summer and winter of 1992. Samples were analyzed for aromatic hydrocarbons and expressed as chrysene and Bahrain crude oil equivalents. Results were grouped according to shoreline utilization and compared to the coastal areas of other countries bordering on the Arabian Gulf.

**Madill, R. E. A., M. T. Orzechowski, G. Chen, B. G. Brownlee, N. J. Bunce**, 2001. Preliminary risk assessment of the wet landscape option for reclamation of oil sands mine tailings: bioassays with mature fine tailings pore water. Environmental Toxicology **16**:197-208.
**Keywords:** acute/ aromatic hydrocarbons/ assay/ bioassay/ degradation/ enzyme/ fresh water/ liver/ mammal/ microbes/ Microtox/ mutation/ oil/ oil sands/ Oten/ pore water/ rat/ risk/ risk assessment/ sand/ toxicity
**Notes:** A toxicological assessment of the pore water from oil sands tailings. Pore water was extracted and analyzed for aromatic compounds. Degradation of aromatic compounds by endogenous microbes was quantified over a 129-da period. Acute toxicity was measured by Microtox assay. Rat livers were used for *in vivo* assessments of the Ah receptor binding affinity and cytochrome P-450 enzyme induction capabilities of constituent aromatic compounds. Mutagenicity tests were performed with the Ames Salmonella assays.

**Mageau, C., F. R. Engelhardt, E. S. Gilfillan, P. D. Boehm**, 1987. Effects of short-term exposure to dispersed oil in Arctic invertebrates. Arctic **40**:162-171.
**Keywords:** Arctic/ behavior/ bivalve/ clearance/ concentration/ Corexit 9527/ crude oil/ effects/ enzyme/ experiment/ flow-through/ hydrocarbons/ invertebrate/ marine invertebrate/ metabolism/ ODfour/ oil/ oil spill/ salt water/ sea urchin/ short-term/ species/ spill/ time/ tissue/ urchin
**Notes:** Follow-up experiments to the 1981 Baffin Island Oil Spill field experiment. An experimental flow-through system constructed near the site of the original oil spill. Three species tested; two bivalves and a sea urchin. Test animals exposed to a chemically-dispersed mixture of Lagomedio crude oil and Corexit 9527 for 18 hrs. The exposure time was partitioned into 3 6-hr periods with different concentrations per period. Two sequences were used; 0.5, 5.0, 0.2 ppm or 10, 100, 5 ppm followed by clearance periods of either 7 or 21 da. Measured several types of behavior in each species, several measures of metabolic function and tissue enzymes, and hydrocarbon concentrations in water and tissue.

**Mahaney, P. A.**, 1994. Effects of freshwater petroleum contamination on amphibian hatching and metamorphosis. Environmental Toxicology and Chemistry **13**:259-265.
**Keywords:** algae/ amphibian/ concentration/ crankcase oil/ effects/ eggs/ fresh water/ growth/ hatching/ metamorphosis/ oil/ OthreeA/ petroleum/ tadpole/ treefrog
**Notes:** Effects of experimental exposure to three concentrations of used crankcase oil on hatching success of green treefrog eggs, tadpole growth, metamorphosis, and algal growth.

**Mahoney, B. M., H. H. Haskin**, 1980. The effects of petroleum hydrocarbons on the growth of phytoplankton recognized as food forms for the eastern oyster, *Crassostrea virginica* gmelin. Environmental Pollution (Series A) **22**:123-132.

**Keywords:** concentration/ crude oil/ effects/ food/ fuel oil/ growth/ hydrocarbons/ marine invertebrate/ marine plant/ Nigerian crude oil/ No.2 fuel oil/ oil/ Osix/ oyster/ petroleum/ petroleum hydrocarbons/ phytoplankton/ population/ salt water/ species/ time
**Notes:** Five species of phytoplankton (one with three clones) were exposed to varying concentrations of the water-soluble-fractions (WSF) of Nigerian crude oil and No. 2 fuel oil. Culture periods were 7-8 da. Measured growth of the cultures according to WSF concentration and time.

**Mahoney, B. M. S., G. S. Noyes**, 1982. Effects of petroleum on feeding and mortality of the American oyster. Archives of Environmental Contamination and Toxicology **11**:527-531.
**Keywords:** adult/ clay/ concentration/ condition/ crude oil/ depuration/ effects/ feeding/ fuel oil/ index/ marine invertebrate/ Nigerian crude oil/ No.2 fuel oil/ Ofour/ oil/ oyster/ petroleum/ rate/ salt water/ sediment/ shell/ time/ weight
**Notes:** Assessment of the effects on adult American oysters of exposure to water concentrations of No. 2 fuel oil (0.05, 0.50 ppm), Nigerian crude oil (0.15, 0.50 ppm), and clay sediment (0.50 ppm). Exposure times were either 7 wks followed by 7 wks of depuration or 11 wks followed by 8 wks of depuration. Measured death, body weight, shell weight, condition index, and feeding (filtering) rate.

**Maki, A. W., W. E. Bishop**, 1979. Acute toxicity studies of surfactants to *Daphnia magna* and *Daphnia pulex*. Archives of Environmental Contamination and Toxicology **8**:599-612.
**Keywords:** acute/ adult/ anionic/ bioassay/ daphnia/ effects/ interactions/ marine invertebrate/ nonionic/ ODfour/ salt water/ species/ static/ structure/ surfactant/ toxicity
**Notes:** Conducted a series of static bioassays of the effects of anionic and nonionic surfactants on adults of two Daphnia species. Duration of exposure was 48 hr. Determined the influence of surfactant chemical structure, suspended solids, water hardness, and previous surfactant exposures on acute toxicity.

**Maki, A. W.**, 1990. The *Exxon Valdez* oil spill: initial environmental impact assessment. Environmental Science and Technology **25**:24-29.
**Keywords:** bird/ crude oil/ crustacean/ effects/ Exxon Valdez/ fishery/ general effect/ habitat/ intertidal/ mammal/ monitoring/ Oeight/ oil/ oil spill/ salt water/ sea otter/ shellfish/ shoreline/ spill
**Notes:** An early assessment of the effects of the Exxon Valdez oil spill (an Exxon perspective). The author presents sections on the design of the assessment program, shoreline habitat, intertidal biota, water quality, fisheries, shellfish and crustaceans, wildlife (birds and sea otters), bird and wildlife monitoring.

**Maki, H., T. Sasaki, S. Harayama**, 2001. Photo-oxidation of biodegraded crude oil and toxicity of the photo-oxidized products. Chemosphere **44**:1145-1151.
**Keywords:** alkane/ Arabian Light crude oil/ aromatic hydrocarbons/ crude oil/ crustacean/ degradation/ light/ microbes/ oil/ Oten/ photooxidation/ salt water/ sunlight/ toxicity/ weathered
**Notes:** Arabian Light crude oil was artificially weathered and then subjected to nutrient-enhanced microbial degradation for 3 wks. The remaining degraded crude oil was exposed to sunlight for 3 wks. The biodegraded and photo-oxidized crude oils were analyzed for hydrocarbon content. The water-soluble fraction of the photo-oxidized crude oil was used in a toxicity test with the crustacean *Artemia*. Comparisons were made between microbially-degraded crude oil irradiated or not irradiated by sunlight.

**Maki, H., N. Hirayama, T. Hiwatari, K. Kohata, H. Uchiyama, M. Watanabe, F. Yamasaki, M. Furuki**, 2003. Crude oil bioremediation field experiment in the Sea of Japan. Marine Pollution Bulletin **47**:74-77.
**Keywords:** alkane/ Arabian Light crude oil/ beach/ bioremediation/ concentration/ crude oil/ experiment/ fertilizer/ fluorine/ intertidal/ Japan/ microbes/ naphthalene/ oil/ Oten/ phenanthrene/ salt water/ sand/ time/ weathered
**Notes:** Beach sand was mixed with artificially-weathered Arabian light crude oil, wrapped in polyester net envelopes, and placed in acrylic vessels with perforated sides. The vessels were placed in the intertidal zone for 3 mos. Synthetic N and P fertilizer granules were placed in some envelopes. Measured the concentrations of N and P and the concentrations of alkanes, naphthalenes, fluorenes, dibenzothiophenes, and phenanthrenes on days 0, 21, 42, 63, and 84.

**Maki, H., M. Utsumi, H. Koshikawa, T. Hiwatari, K. Kohata, H. Uchiyama, M. Suzuki, T. Noguchi, T. Yamasaki, M. Furuki, M. Watanabe**, 2003. Intrinsic biodegradation of heavy oil from *Nakhodka* and the effect of exogenous fertilization at a coastal area of the Sea of Japan. Water, Air, and Soil Pollution **145**:123-138.
**Keywords:** alkane/ biodegradation/ chlorophyll/ community/ composition/ concentration/ DNA/ experiment/ fertilization/ fuel oil/ Japan/ microbes/ nitrogen/ oil/ oiled/ Oten/ PAH/ phosphorus/ spill
**Notes:** Oiled cobble stones from a 2-year-old spill of heavy fuel oil in the Sea of Japan were used in a biodegradation experiment. Stones were either unfertilized or fertilzed and placed in containers at the lower end of the tidal zone for 105 days. Stones were sampled periodically and analyzed for alkanes, total saturate fraction, and selected PAHs. The water inside and outside of the field vessel was periodically sampled for dissolved nitrogen, dissolved phosphorus, and chlorophyll *a* concentration. Polymerase chain reaction and gel electrophoresis were used to detect changes in the composition of the microbial community of the water in the experimental field vessel.

**Maksimenko, O. E., N. A. Chervyakov, T. I. Karkishko, N. V. Glotov**, 1997. Dynamics of reestablishment of vegetation in an anthropogenically disturbed sphagnum bog in the territory of an oil field in the Middle Ob region. Russian Journal of Ecology **28**:243-247.
**Keywords:** crude oil/ fresh water/ freshwater plant/ oil/ oil field/ Oseven/ plant/ region/ restoration/ Russia/ species/ time/ vegetation
**Notes:** A description of the consequences to plants of several months of leakage from an oil field retention reservoir in Russia. Measured coverage of plant species four times during a 6-yr period and compared vegetative changes in plowed bog land to that of unplowed land.

**Malallah, G., M. Afzal, S. Gulshan, D. Abraham, M. Kurian, M. S. I. Dhami**, 1996. *Vicia faba* as a bioindicator of oil pollution. Environmental Pollution **92**:213-217.
**Keywords:** amino acids/ assay/ biochemistry/ bioindicator/ biomass/ chlorophyll/ composition/ concentration/ crude oil/ fresh water/ freshwater plant/ growth/ Kuwait/ oil/ oil lakes/ oil spill/ oiled/ Oseven/ phenol/ plant/ pollution/ protein/ seedling/ soil/ spill/ total hydrocarbons/ war
**Notes:** Seedlings of the plant (*Vica faba*) were used in a pot assay of the effect of hydrocarbon-contaminated soil from the oil lakes area of Kuwait (Gulf War oil spill) on plant growth and biochemistry. Five concentrations of the contaminated soil were used to grow the plants for 30 da. Plants from an oiled soil group and the control were analyzed for height, biomass, moisture content; chlorophyll, pheophytin, and carotenoid content; total proteins, phenols, free amino acids, fatty acid composition, and sugars. The potting soil was analyzed for salt and total hydrocarbon content.

**Malallah, G., M. Afzal, G. Murin, A. Murin, D. Abraham**, 1997. Genotoxicity of oil pollutiion on some species of Kuwait flora. Biologia Bratislava **52**:61-70.
**Keywords:** analysis/ bioindicator/ crude oil/ effects/ freshwater plant/ genotoxic/ germination/ growth/ Kuwait/ Kuwait crude oil/ oil/ Oseven/ plant/ roots/ salt water/ seed/ species/ war
**Notes:** Assessment of the effects on terrestrial plants in Kuwait of oil contamination following the Gulf War. Fifteen plants chosen as bioindicators and subjected to pollen abortion analysis, meiotic analysis, and mitotic analysis; also seed germination and the effects of an oil-water extract on root growth.

**Maldonado, C., J. M. Bayona, L. Bodineau**, 1999. Sources, distribution, and water column processes of aliphatic and polycyclic aromatic hydrocarbons in the northwestern Black Sea water. Environmental Science and Technology **33**:2693-2702.
**Keywords:** aliphatic hydrocarbons/ alkane/ aromatic hydrocarbons/ Black Sea/ carbon/ dissolved/ distribution/ hydrocarbons/ miscellaneous/ nitrogen/ Oeleven/ organic carbon/ PAH/ particulate/ salt water/ sources/ temperature/ water column
**Notes:** An assessment of hydrocarbons in the northwestern portion of the Black Sea. A total of 28 subsurface particulate and 11 subsurface and deep dissolved hydrocarbon samples were collected in 1995. Analyzed the water for aliphatic and aromatic (PAHs) hydrocarbons, particulate organic carbon, and particulate organic nitrogen. Quantified selected individual alkanes and PAHs. Also sampled vertical water profiles at three locations and measured PAHs, fluoresence, and temperature.

**Malins, D. C., H. O. Hodgins**, 1981. Petroleum and marine fishes: a review of uptake, disposition, and effects. Environmental Science and Technology **15**:1272-1280.
**Keywords:** acute/ behavior/ chronic/ concentration/ effects/ fish/ metabolism/ Othree/ pathology/ petroleum/ review/ salt water/ uptake
**Notes:** Review of petroleum uptake, disposition, and effects in marine fish; acute, chronic, metabolism, behavior, pathology.

**Malins, D. C.**, 1982. Alterations in the cellular and subcellular structure of marine teleosts and invertebrates exposed to petroleum in the laboratory and field: a critical review. Canadian Journal of Fisheries and Aquatic Sciences **39**:877-889.
**Keywords:** biochemistry/ effects/ environment/ fish/ hydrocarbons/ invertebrate/ marine environment/ marine invertebrate/ model/ oil/ Othree/ pathology/ petroleum/ petroleum hydrocarbons/ physiology/ refined oil/ review/ salt water/ structure/ toxicity
**Notes:** A 1982 review of the effects of individual petroleum compounds, model mixtures of hydrocarbons, fractions of petroleum, and whole crude and refined oil on cellular and subcellular structure and function of marine fish and invertebrates. Separate sections on laboratory studies and observed effects in the marine environment.

**Mancini, E. R., J. Lindstedt-Siva, and D. W. Chamberlain** 1989. Environmental impacts of the 1985 *Arco Anchorage* oil spill: 1988 conclusions. Pages 459-462 *in* 1989 Oil Spill Conference, API 4479. American Petroleum Institute, Washington, D.C.
**Keywords:** Alaska/ analysis/ bird/ crude oil/ damage assessment/ effects/ fish/ general effect/ invertebrate/ kelp/ marine invertebrate/ monitoring/ North Slope/ North Slope crude oil/ Oeight/ oil/ oil spill/ population/ salt water/ sediment/ spill/ time/ tissue
**Notes:** An environmental assessment (up to 2 yrs later) of the effects of the Arco Anchorage spill of Alaska North Slope crude oil at Port Angeles, WA in late 1985. Sections on spill monitoring and damage assessment, Ediz Hook monitoring (sediments, invertebrate populations and tissue analyses, fish tissue analysis), birds, and kelp beds.

**Mancini, E. R., D. W. Chamberlain, M. A. Lowe, M. Fishchel, E. J. Greenwood, and S. Rankin** 1995. Fate and effects of crude oil in a southern California stream drainage. Pages 399-406 *in* 1995 International Oil Spill Conference, API Publication 4620. American Petroleum Institute, Washington, D.C.
**Keywords:** analysis/ benthic/ bird/ BTEX/ California/ chemical analysis/ community/ crude oil/ effects/ fate/ freshwater invertebrate/ freshwater plant/ general effect/ hydrocarbons/ macroinvertebrate/ Oeight/ oil/ oil spill/ petroleum/ petroleum hydrocarbons/ pipeline/ population/ sediment/ spill/ stream/ survey/ time/ vegetation
**Notes:** An April 1993 pipeline rupture spilled San Joaquin Valley crude oil into a stream in southern California; the oil flowed 12 km downstream. Water was collected for 5 wks and sediments were collected until September. Riparian vegetation was assessed in April and July. Avian surveys were conducted in April and June. Benthic macroinvertebrates were sampled in April and September. Chemical analysis of water and sediment was for total petroleum hydrocarbons and BTEX compounds.

**Mancini, S. A., G. Lacrampe-Couloume, H. Jonker, B. M. Van Breukelen, J. Groen, F. Volkering, B. S. Lollar**, 2002. Hydrogen isotopic enrichment: an indicator of biodegradation at a petroleum hydrocarbon contaminated field site. Environmental Science and Technology **36**:2464-2470.
**Keywords:** analysis/ benzene/ biodegradation/ carbon/ distance/ ethylbenzene/ fresh water/ indicator/ isotope/ Netherlands/ Onine/ petroleum/ petroleum hydrocarbons/ plume/ pollution/ ratio/ technical
**Notes:** Description of the use of compound-specific isotope analysis (carbon and hydrogen in this instance) to determine the occurrence of biodegradation of benzene and ethylbenzene in contaminated groundwater. Location of the study is an industrial site in The Netherlands. Isotope ratios were compared between the source product and product from wells placed at varying distances along the subsurface discharge plume.

**Mankki, J., J. Vauras**, 1974. Littoral fish populations after an oil tanker disaster in the Finnish SW archipelago. Annales Zoologici Fennici **11**:120-126.
**Keywords:** age/ condition/ crude oil/ dispersant/ effects/ fish/ growth/ length/ littoral/ ODthree/ oil/ oil spill/

population/ salt water/ spill/ tanker/ weight
**Notes:** Assessment of the effects on fish populations of a crude oil spill that occurred two years previous in an area of the Baltic Sea; chemical dispersants were used on the spilled oil. Fish were caught in nearshore waters and characterized by age, growth, condition, and regression of log length on log weight.

**Manny, B. A., D. Kenaga**, 1991. The Detroit River: effects of contaminants and human activities on aquatic plants and animals and their habitats. Hydrobiologia **219**:269-279.
**Keywords:** activity/ bacteria/ benthic/ bird/ concentration/ condition/ effects/ fish/ fresh water/ freshwater invertebrate/ general effect/ habitat/ macroinvertebrate/ Oeight/ oil/ PAH/ petroleum/ phytoplankton/ plant/ review/ sediment/ sources/ zooplankton
**Notes:** A review and assessment of the polluted condition of the Detroit River. Contains sections on a description of the river habitat, various sources of contamination (including oil and grease and PAHs), concentrations of contaminants in river sediments, and the effects of these combined contaminants on bacteria, phytoplankton, zooplankton, benthic macroinvertebrates, fish, and birds.

**Mansuy, L., R. P. Philp, J. Allen**, 1997. Source identification of oil spills based on the isotopic composition of individual components in weathered oil samples. Environmental Science and Technology **31**:3417-3425.
**Keywords:** analysis/ chromatography/ composition/ experiment/ isotope/ methods/ oil/ oil spill/ Onine/ petroleum/ procedure/ ratio/ spill/ technical/ weathered
**Notes:** Isotopic analysis of individual compounds in weathered oil samples. Results of experiments with gas chromatography/isotope ratio mass spectrometry (GS/IRMS) as a supplemental method to standard GC/MS or GC procedures for comparing spilled petroleum with presumed source petroleum. Method is promoted for situations involving extensively weathered petroleum.

**Margesin, R., F. Schinner**, 1999. Biodegradation of diesel oil by cold-adapted microorganisms in presence of sodium dodecyl sulfate. Chemosphere **38**:3463-3472.
**Keywords:** anionic/ bacteria/ biodegradation/ concentration/ degradation/ diesel/ diesel fuel/ experiment/ fresh water/ hydrocarbons/ incubation/ microbes/ ODten/ oil/ petroleum/ petroleum hydrocarbons/ soil/ species/ sulfate/ surfactant/ time
**Notes:** Assessment of the influence of the anionic surfactant sodium dodecyl sulfate (SDS) on hydrocarbon degradation by cold-adapted soil microbes and the ability of the microbes to degrade the surfactant. Liquid and soil cultures and a bacterial inoculum comprised of two species of bacteria were used to evaluate SDS and diesel fuel degradation. Employed five concentrations of SDS, one concentration of diesel fuel, and the presence or absence of bacterial inoculum in several experiments. Measured total petroleum hydrocarbons and SDS concentrations after 2, 4, 7, 10, 15, 21, and 32 da of incubation.

**Marin, J. A., T. Hernandez, C. Garcia**, 2005. Bioremediation of oil refinery sludge by landfarming in semiarid conditions: influence on soil microbial activity. Environmental Research **98**:185-195.
**Keywords:** activity/ biodegradation/ biomass/ bioremediation/ carbon/ chemical characteristics/ condition/ experiment/ hydrocarbons/ land farming/ microbes/ Microtox/ nutrients/ oil/ Oten/ rate/ refinery/ soil/ time/ total hydrocarbons/ water
**Notes:** Refinery sludge was added to soil at a rate of 5-6% total hydrocarbon content and mixed into the soil with a tractor once a month. No nutrients or water were added. The experiment lasted 11 mos during which the soil was sampled at 1, 3, 5, 7, 9, and 11 mos. Measured soil and sludge chemical characteristics, total hydrocarbons, microbial biomass carbon, and dehydrogenase, urease, protease, phosphatase, and B-glucosidase activities. Also performed a Microtox assessment according to the same monthly schedule.

**Marquez-Rocha, F. J., V. Hernandez-Rodriguez, M. T. Lamela**, 2001. Biodegradation of diesel oil in soil by a microbial consortium. Water, Air, and Soil Pollution **128**:313-320.
**Keywords:** bacteria/ biodegradation/ degradation/ diesel/ evaluation/ freshwater invertebrate/ fungi/ microbes/ oil/ Oten/ remediation/ soil/ species
**Notes:** Evaluation of the ability of a bacterial culture to degrade diesel oil. The culture was grown on pure diesel oil, diesel-contaminated soil in laboratory flasks, and diesel-contaminated soil in a pilot-scale trial.

The degradation effect of a species of fungus (alone or added to the culture) was also tested in the laboratory trial, and the degradation enhancement potential of $NH_4NO_3$ was tested in the pilot-scale trial.

**Marsh, R.**, 2003. A database of archived drilling records of the drill cuttings piles at the North West Hutton oil platform. Marine Pollution Bulletin **46**:587-593.
**Keywords:** cuttings/ drilling fluids/ drilling mud/ miscellaneous/ North Sea/ Oeleven/ oil/ oil platform/ risk/ salt water/ toxicity
**Notes:** Archived records of drilling fluids and chemical additives used during the lifetime of a deactivated (1991) North Sea oil drilling platform were evaluated for the environmental risk posed by the drill cuttings pile on the ocean floor. Estimated inputs, losses, and toxicity of a large number of chemical compounds.

**Marshall, P. A., G. J. Edgar**, 2003. The effect of the *Jessica* grounding on subtidal invertebrate and plant communities at the Galapagos wreck site. Marine Pollution Bulletin **47**:284-295.
**Keywords:** Bunker C/ community/ diesel/ diesel fuel/ fuel oil/ invertebrate/ marine invertebrate/ marine plant/ Ofour/ oil/ salt water/ subtidal/ tanker/ transect
**Notes:** The grounded tanker *Jessica* discharged Bunker C and diesel fuel oil in the Galapagos Islands. Twelve 100 m transects were run from the grounding site and sampled at 10 m intervals for subtidal plants and invertebrates. Mobile invertebrates were classed as present or absent; sessile plants and animals were identified and the percent cover was estimated.

**Martin-Skilton, R., R. Thibaut, C. Porte**, 2006. Endocrine alteration in juvenile code and turbot exposed to dispersed crude oil and alkylphenols. Aquatic Toxicology **78S**:S57-S64.
**Keywords:** alkyphenol/ aromatic hydrocarbons/ Atlantic/ biochemical/ blood/ cod/ crude oil/ endocrine/ fish/ gonads/ juvenile/ liver/ North Sea/ North Sea crude oil/ offshore/ oil/ oil field/ Othree/ PAH/ produced water/ salt water/ soluble/ turbot/ water
**Notes:** Juvenile Atlantic cod and juvenile turbot were exposed for 3 weeks to either 0.5 ppm North Sea crude oil, 0.5 ppm of crude oil plus 0.1 ppm of a mixture of alkyphenols (as found in produced water of offshore platforms), or 30 ppb of nonylphenol. Authors refer to 'dispersed' crude oil but they say nothing about how the oil was dispersed and only water soluble PAHs were measured. After 3 weeks, blood, gonads and livers were collected. Biochemical analyses included testosterone, 17B-estradiol (E2), P450 aromatase, 17B-hydroxysteroid dehydrogenases, UDP-glucuronosyltransferase, and estradiol-sulfotransferase.

**Martin, L. K., Jr., M. C. Black**, 1996. Biomarker assessment of the effects of petroleum refinery contamination on channel catfish. Ecotoxicology and Environmental Safety **33**:81-87.
**Keywords:** biomarker/ blood/ catfish/ concentration/ effects/ fish/ fresh water/ genetic/ genotoxic/ indicator/ metabolism/ metals/ oil/ osmoregulation/ Othree/ petroleum/ refinery/ sediment/ stress
**Notes:** Assessment of the effects of an abandoned oil refinery on caged channel catfish using a suite of indicators; metabolism, blood, osmoregulation, genetic. Emphasis was on the metals in water and sediment at the contaminated site.

**Martinez-Abrain, A., A. Velando, D. Oro, M. Genovart, C. Gerique, M. A. Bartolome, E. Villuendas, B. Sarzo**, 2006. Sex-specific mortality of European shags after the Prestige oil spill: demographic implications for the recovery of colonies. Marine Ecology Progress Series **318**:271-276.
**Keywords:** bird/ carcass/ coast/ colony/ estimate/ model/ oil/ oil spill/ Oone/ population/ rate/ recovery/ reproduction/ salt water/ sex/ Spain/ spill
**Notes:** Carcasses of the European shag were collected along the southern coast of Galacia (Spain) between one and eight mos after the Prestige oil spill. Carcasses were aged and sexed and the results used in stochastic model estimates of population trajectories. This is a noteworthy case study because local colonies of the shag had been declining at a 5% annual rate for the decade prior to the spill.

**Martinez-Jeronimo, F., R. Villasenor, G. Rios, F. Espinosa-Chavez**, 2005. Toxicity of the crude oil water-soluble fraction and kaolin-adsorbed crude oil on *Daphnia magna* (Crustacea: Anomopoda). Archives of Environmental Contamination and Toxicology **48**:444-449.
**Keywords:** acute/ age/ chronic/ clay/ crude oil/ daphnia/ fresh water/ freshwater invertebrate/ Ofive/ oil/ reproduction/ size/ survival/ time/ toxicity

**Notes:** Seven Mexican crude oils were evaluated for toxicity to Daphnia magna. Employed the water-soluble fraction (WAF) and crude oil adsorbed onto kaolin clay particles as exposure media. Performed a 48-hr acute toxicity test (WAF and kaolin) and a 21-da chronic toxicity test (kaolin). The latter included measuring survival, age at time of first reproduction, number of clutches, mean slutch size and total progeny.

**Marty, D., A. Bianchi, C. Gatellier**, 1979. Effects of three oil spill dispersants on marine bacterial populations. I. Preliminary study. Quantitative evolution of aerobes. Marine Pollution Bulletin **10**:285-287.
**Keywords:** bacteria/ concentration/ dispersant/ effects/ evaluation/ fuel oil/ marine invertebrate/ microbes/ numbers/ ODfour/ oil/ oil spill/ population/ salt water/ spill
**Notes:** Evaluation of the effect on marine bacterial populations of additions of three chemical oil dispersants with or without fuel oil. Several concentrations of the dispersants without fuel oil were monitored for 5 da. Fuel oil with or without several concentrations of dispersants were monitored for 83 da. Measured number of bacteria per unit volume of water.

**Marty, G. D., J. W. Short, D. M. Dambach, N. H. Willits, R. A. Heintz, S. D. Rice, J. J. Stegeman, D. E. Hinton**, 1997. Ascites, premature emergence, increased gonadal cell apoptoxis, and cytochrome P4501A induction in pink salmon larvae continuously exposed to oil-contaminanted gravel during development. Canadian Journal of Zoology **75**:989-1007.
**Keywords:** alkane/ analysis/ aromatic hydrocarbons/ cell/ concentration/ crude oil/ development/ eggs/ emergence/ fish/ gravel/ growth/ larvae/ metabolism/ monooxygenase/ oil/ Othree/ pathology/ pink salmon/ Prudhoe Bay/ Prudhoe Bay crude oil/ salmon/ salt water/ sediment/ survival/ weathered
**Notes:** Exposure of pink salmon larvae to four concentrations of weathered Prudhoe Bay crude oil in sediment; fertilized eggs placed on sediment, larvae retained until 13 da post-emergence. Sampled at 4 wk before emergence, at emergence, and 13 da post-emergence; survival, growth, thorough macro- and micropathology assessment, P4501A (CYP1A) induction by immunohistochemistry, and aromatic and alkane analysis of gravel, incubator air, and larvae.

**Marty, G. D., J. E. Hose, M. D. McGurk, E. D. Brown, D. E. Hinton**, 1997. Histopathology and cytogenetic evaluation of Pacific herring larvae exposed to petroleum hydrocarbons in the laboratory or in Prince William Sound, Alaska, after the *Exxon Valdez* oil spill. Canadian Journal of Fisheries and Aquatic Sciences **54**:1846-1857.
**Keywords:** Alaska/ concentration/ crude oil/ eggs/ evaluation/ Exxon Valdez/ fish/ hatching/ herring/ hydrocarbons/ larvae/ lesions/ oil/ oil spill/ oiled/ Othree/ Pacific/ Pacific herring/ pathology/ petroleum/ petroleum hydrocarbons/ Prince William Sound/ Prudhoe Bay/ Prudhoe Bay crude oil/ salt water/ spill
**Notes:** Pacific herring larvae were collected from oiled and reference sites in Prince William Sound shortly after the 1989 Exxon Valdez spill and subjected to histopathological examination. Herring eggs were exposed to varying concentrations of Prudhoe Bay crude oil in laboratory exposure studies and subjected to histopathological examination within 24 hr of hatching. Lesions from the two studies were compared.

**Marty, G. D., M. S. Okihiro, E. D. Brown, D. Hanes, D. E. Hinton**, 1999. Histopathology of adult Pacific herring in Prince William Sound, Alaska, after the *Exxon Valdez* oil spill. Canadian Journal of Fisheries and Aquatic Sciences **56**:419-426.
**Keywords:** adult/ Alaska/ aromatic hydrocarbons/ Exxon Valdez/ fish/ fluorine/ gonads/ herring/ kidney/ lesions/ liver/ muscle/ naphthalene/ oil/ oil spill/ oiled/ Othree/ ovary/ Pacific/ Pacific herring/ phenanthrene/ Prince William Sound/ salt water/ spill/ spleen/ stomach/ testes/ viscera
**Notes:** Pacific herring were sampled from reference and oiled locations in April 1989, April 1990, October 1990, April 1991, and October 1991. Described lesions in liver, kidney, and spleen. Measured total aromatics, naphthalenes, fluorenes, and phenanthrenes in viscera and gonad in April 1989; and total aromatics and naphthalenes in viscera, ovary, testes, stomach contents, and muscle in April 1990.

**Marty, J. C., A. Saliot**, 1976. Hydrocarbons (normal alkanes) in the surface microlayer of seawater. Deep-Sea Research **23**:863-873.
**Keywords:** aliphatic hydrocarbons/ alkane/ Atlantic/ coast/ English Channel/ hydrocarbons/

Mediterranean/ miscellaneous/ Oeleven/ salt water/ survey
**Notes:** Surface water samples were collected during 1972-73 from the English Channel, the western Mediterrean Sea, and the Northwest African coast. Samples were analyzed for *n*-alkane content.

**Mason, R. P.**, 1987. A comparison of fluorescence and GC for the determination of petroleum hydrocarbons in mussels. Marine Pollution Bulletin **18**:528-533.
**Keywords:** aliphatic hydrocarbons/ analysis/ aromatic hydrocarbons/ coast/ hydrocarbons/ mussel/ Onine/ petroleum/ petroleum hydrocarbons/ South Africa/ technical
**Notes:** Mussels were collected from a number of locations along the coast of South Africa and subjected to analysis by GC and fluorescence spectroscopy. The results were compared to see if fluorescence spectroscopy is a satisfactory substitute for the more complicated GC analysis.

**Massoud, M. S., F. Al-Abdali, A. N. Al-Ghadban, M. Al-Sarawi**, 1996. Bottom sediments of the Arabian Gulf -- II. TPH and TOC contents as indicators of oil pollution and implications for the effect and fate of the Kuwait oil slick. Environmental Pollution **93**:271-284.
**Keywords:** Arabian Gulf/ carbon/ crude oil/ fate/ Gulf oil spill/ hydrocarbons/ indicator/ Kuwait/ miscellaneous/ Oeleven/ oil/ oil slick/ organic/ organic carbon/ petroleum/ petroleum hydrocarbons/ pollution/ sediment/ TOC/ TPH
**Notes:** Total petroleum hydrocarbons and total organic carbon in sediments of the Arabian Gulf.

**Massoud, M. S., F. Al-Abdali, A. N. Al-Ghadban**, 1998. The status of oil pollution in the Arabian Gulf by the end of 1993. Environment International **24**:11-22.
**Keywords:** Arabian Gulf/ carbon/ crude oil/ hydrocarbons/ metals/ miscellaneous/ Oeleven/ oil/ organic/ organic carbon/ petroleum/ petroleum hydrocarbons/ pollution/ salt water/ sediment/ spill
**Notes:** Collected core samples from bottom of Arabian Gulf in 1993 and compared findings with results of core samples collected in 1992. Measured total organic carbon, total petroleum hydrocarbons, and trace metals.

**Masteller, E.** 1985. Environmental contaminants - fish and wildlife concerns. Pages 9 pp 1985 Annual Meeting, Pennsylvania Chapter, The Wildlife Society and Central Pennsylvania Chapter, The American Fisheries Society. Unpublished, Pennsylvania State University.
**Keywords:** brine water/ chemical characteristics/ density/ effects/ fish/ fishery/ flow-through/ fresh water/ freshwater invertebrate/ general effect/ marine invertebrate/ marine plant/ Oeight/ oil/ oil field/ Pennsylvania/ petroleum/ petroleum hydrocarbons/ plant/ salt water/ society/ stream/ taxonomy
**Notes:** An extended abstract of a presentation on the environmental effects of oil extraction operations in the Allegheny National Forest (Pennsylvania). Presents background information, water chemistry, and insect density for several taxonomic groups in four streams that flow through the oil well area. Also presents a table of petroleum effects on marine plants and animals that was extracted from an EPA publication.

**Masteller, E. C.** 1981. The impact of oil drilling operations on aquatic insects. Pennsylvania State University, Behrend College, Erie, PA. 63 pp.
**Keywords:** activity/ chemical characteristics/ community/ fresh water/ freshwater invertebrate/ Ofive/ oil/ oil field/ Pennsylvania/ physical characteristics/ population/ sediment/ stream
**Notes:** Report of the effect of oil drilling activities on the aquatic insect populations of three streams in the Allegheny National Forest of western Pennsylvania. Sampled the flying stage of aquatic insects during the summer of 1980; identified and counted individuals. Determined the physical and chemical characteristics of stream water and the physical characteristics of sediment.

**Masteller, E. C.** 1987. The influence of oil drilling operations and crude oil on the biological community. Pages 164-181 *in* S. K. Majumdar, F. J. Brenner, E. W. Miller, editors. Environmental Consequences of Energy Production: Problems and Prospects. The Pennsylvania Academy of Science,
**Keywords:** algae/ bird/ community/ crude oil/ ecosystem/ effects/ fish/ fresh water/ freshwater invertebrate/ freshwater plant/ general effect/ invertebrate/ microbes/ mollusc/ Oeight/ oil/ overview/ petroleum/ plant/ procedure
**Notes:** An overview of the environmental effects of terrestrial oil drilling operations. Presents introductory

sections on petroleum characteristics, terrestrial drilling procedures, and general ecosystem effects; and brief biological effect sections on microbes, algae, vascular plants, invertebrates (rivers and lakes), molluscs, fish, and birds.

**Mathers, E. M., D. F. Houlihan, M. J. Cunningham**, 1992. Estimation of saithe *Pollachius virens* growth rates around the Beryl oil platforms in the North Sea: a comparison of methods. Marine Ecology Progress Series **86**:31-40.
**Keywords:** biochemistry/ crude oil/ fish/ growth/ metabolism/ methods/ North Sea/ oil/ oil platform/ organ/ Othree/ rate/ saithe/ salt water/ time
**Notes:** Growth and metabolic rates of a fish (saithe) around oil platforms in the North Sea are compared to the same rates in open ocean saithe; platform fish sampled four times in a 1-year period.

**Mathews, C. P., S. Kedid, N. I. Fita, A. Al-Yahya, K. Al-rasheed**, 1993. Preliminary assessment of the effects of the 1991 Gulf War on Saudi Arabian prawn stocks. Marine Pollution Bulletin **27**:251-271.
**Keywords:** decline/ effects/ evaluation/ fishery/ Gulf oil spill/ marine invertebrate/ Ofour/ oil/ oil spill/ plankton/ population/ prawn/ salt water/ spill/ survey/ war
**Notes:** An evaluation of the decline of the Saudi Arabian prawn fishery in the Persian Gulf after the Gulf War. Analyzes the fishery before and after the war with catch data and plankton surveys. Discussion of the possible effects of the Gulf War oil spill and oil well fires on prawn populations.

**Mathis, B. J., T. C. Dorris**, 1968. Community structure of benthic macroinvertebrates in an intermittent stream receiving oil field brines. American Midland Naturalist **80**:428-439.
**Keywords:** benthic/ brine water/ community/ conductance/ discharges/ dissolved/ evaluation/ fresh water/ freshwater invertebrate/ invertebrate/ macroinvertebrate/ Ofive/ oil/ oil field/ Oklahoma/ oxygen/ population/ stream/ structure/ turbidity
**Notes:** Evaluation of the effect on stream macroinvertebrates of oil field brine discharges in Oklahoma. Sampled water and benthic macroinvertebrates at one station above and six stations below a major discharge location on a monthly basis for 1 yr. Measured turbidity, specific conductance, and dissolved oxygen, and identified and counted individual invertebrates.

**Matsumoto, G., T. Hanya**, 1981. Comparative study on organic constituents in polluted and unpolluted inland aquatic environments -- I. Features of hydrocarbons for polluted and unpolluted waters. Water Research **15**:217-224.
**Keywords:** aliphatic hydrocarbons/ alkane/ analysis/ effluent/ environment/ hydrocarbons/ Japan/ Onine/ plant/ pollution/ soil/ stream/ technical/ treatment
**Notes:** Water samples were collected from rivers (11 sites), a night soil treatment plant effluent, a sewage treatment plant, and an incineration plant effluent in the vicinity of Tokyo (polluted), and from streams reservoirs, and ponds on relatively clean islands (unpolluted). *n* -alkanes were analyzed in all samples, and squalane and the UCMH were quantified for the polluted samples around Tokyo.

**Matsuo, A. Y. O., B. R. Woodin, C. M. Reddy, A. L. Val, J. J. Stegeman**, 2006. Humic substances and crude oil induce cytochrome P450 1A expression in the Amazonian fish species *Colossoma macropomum* (Tambaqui). Environmental Science and Technology **40**:2851-2858.
**Keywords:** activity/ analysis/ biochemical/ concentration/ crude oil/ evaluation/ experiment/ fish/ fresh water/ gill/ juvenile/ liver/ microsomal/ oil/ Othree/ species/ tissue
**Notes:** A juvenile Amazonian fish was exposed to either a commercial humic substance, crude oil, or humic substance plus crude oil for 96 hrs. A separate experiment evaluated varying concentrations of a natural and a commercial humic substance. Liver tissue was removed for P450 (microsomal EROD and BROD) activity analysis and gill and liver tissue were used for immunohistochemical evaluation.

**Mattie, D. R., G. B. Marit, C. D. Flemming, J. R. Cooper** , 1995. The effects of JP-8 jet fuel on male Sprague-Dawley rats after a 90-day exposure by oral gavage. Toxicology and Industrial Health **11**:423-435.
**Keywords:** biochemistry/ blood/ dosed/ effects/ jet fuel/ male/ mammal/ metabolite/ numbers/ organ/ Otwo/ pathology/ rat/ rate/ tissue/ urine/ weight
**Notes:** Male laboratory rats dosed daily for 90 da with 750, 1500, or 3000 mg/kg of JP-8 jet fuel.

Measured blood and urine chemistry, JP-8 and metabolites in blood and urine, body weight, organ weights, and performed pathological examination of a large number of tissues.

**Mattsson, J., C. Lehtinen**, 1985. Increased levels of petroleum hydrocarbons in the surface sediments of Swedish coastal waters. Marine Pollution Bulletin **16**:390-395.
**Keywords:** aliphatic hydrocarbons/ alkane/ analysis/ hydrocarbons/ methods/ miscellaneous/ Oeleven/ petroleum/ petroleum hydrocarbons/ salt water/ sediment/ survey
**Notes:** Swedish coastal sediments were sampled in 1974-75 and again in 1982, when 61 of the same sites were re-visited. The 1982 samples were analyzed with the same methods used on the 1974-75 samples. Analysis was only for the paraffin-naphthene fraction.

**Maynard, D. J., D. D. Weber**, 1981. Avoidance reactions of juvenile coho salmon (*Oncorhynchus kisutch*) to monocyclic aromatics. Canadian Journal of Fisheries and Aquatic Sciences **38**:772-778.
**Keywords:** aromatic hydrocarbons/ avoidance/ benzene/ concentration/ fish/ fresh water/ juvenile/ Othree/ salmon/ toluene/ xylene
**Notes:** Avoidance response of juvenile coho salmon exposed to varying concentrations of benzene, toluene, *o*-xylene or a mixture of all three.

**Mazet, J. A. K., I. A. Gardner, D. A. Jessup, J. H. Rittenburg**, 1997. Field assay for the detection of petroleum products on wildlife. Bulletin of Environmental Contamination and Toxicology **59**:513-519.
**Keywords:** assay/ bird/ detection/ feathers/ fur/ mammal/ Onine/ PAH/ petroleum/ petroleum products/ soil/ technical
**Notes:** Description of a portable workstation for detection of PAH in soil that was modified to serve as an inexpensive field detection device for PAHs on feathers or fur.

**Mazet, J. A. K., I. A. Gardner, D. A. Jessup, L. J. Lowenstine**, 2001. Effects of petroleum on mink applied as a model for reproductive success in sea otters. Journal of Wildlife Diseases **37**:686-692.
**Keywords:** Bunker C/ cleaning/ crude oil/ diet/ effects/ experiment/ female/ fuel oil/ ingestion/ mammal/ mink/ model/ North Slope/ North Slope crude oil/ oil/ oil slick/ Otwo/ petroleum/ reproduction/ salt water/ sea otter/ short-term/ survival/ time
**Notes:** Female ranch mink were use in two experiments to determine the effects of Alaskan North Slope crude oil and Bunker C fuel oil on reproductive success. One experiment consisted of short-term (1 min) exposure, 60 da prior to breeding, to an oil slick of either petroleum substance, followed by self cleaning. A second experiment consisted of 500 ppm in the diet of either petroleum substance for 60 da prior to breeding. Surviving female offspring were bred the following year in a second generation experiment. Measured survival and reproductive performance.

**Mazet, J. K., I. A. Gardner, D. A. Jessup, L. J. Lowenstine, W. M. Boyce**, 2000. Evaluation of changes in hematologic and clinical biochemical values after exposure to petroleum products in mink (*Mustela vison*) as a model for assessment of sea otters (*Enhydra lutris*). American Journal of Veterinary Research **61**:1197-1203.
**Keywords:** biochemical/ blood/ Bunker C/ crude oil/ diet/ effects/ evaluation/ female/ fuel oil/ mammal/ mink/ model/ North Slope/ North Slope crude oil/ oil/ Otwo/ petroleum/ petroleum products/ reproduction/ salt water/ sea otter/ serum
**Notes:** As assessment of the systemic effects of North Slope crude oil and Bunker C fuel oil on yearling female ranch mink. Mink with exposed to either a 1.5 cm layer of crude oil or fuel oil on sea water 8 wks prior to breeding (exposure method referenced but not described in text); or fed a diet containing 500 ppm crude oil or fuel oil from 8 wks prior to breeding until the kits were weaned. Blood samples were collected 1 wk after exposure began and after weaning of kits. Serum was separated from cellular material and analyzed for a variety of biochemicals. Blood minus serum was characterized according to a variety of hematologic characteristics. Hematologic and serum values were used in an effort to predict reproductive success.

**McAuliffe, C. D.**, 1976. Surveillance of the marine environment for hydrocarbons. Marine Science Communications **2**:13-42.
**Keywords:** Atlantic/ degradation/ environment/ estimate/ hydrocarbons/ marine environment/

miscellaneous/ Oeleven/ review/ salt water/ sediment
**Notes:** An early but very thorough review of the known information on hydrocarbons in the marine environment. Sections on hydrocarbons in the water and sediment, estimates of quantities of hydrocarbons in the North Atlantic, and the degradation process in marine environments.

**McAuliffe, C. D., J. C. Johnson, S. H. Greene, G. P. Canevari, T. D. Searl**, 1980. Dispersion and weathering of chemically treated crude oils on the ocean. Environmental Science and Technology **14**:1509-1418.
**Keywords:** analysis/ aromatic hydrocarbons/ coast/ concentration/ crude oil/ depth/ dispersant/ hydrocarbons/ New Jersey/ ODnine/ oil/ oil spill/ salt water/ saturated hydrocarbons/ spill/ technical/ water column
**Notes:** Four experimental crude oil spills were conducted off the coast of New Jersey in 1978 using Murban and LaRosa crude oils. The oil was either dispersed immediately or delayed for 2 hrs. Water was collected from the water column beneath the dispersed oil at depths of 1, 3, 6, and 9 m and analyzed for $C_1$-$C_{10}$ aromatic and saturated hydrocarbons.

**McAuliffe, C. D.** 1987. Organism exposure to volatile/soluble hydrocarbons from crude oil spills -- a field and laboratory comparison. Pages 275-288 *in* 1987 Oil Spill Conference, API 4452. American Petroleum Institute, Washington, DC.
**Keywords:** alkane/ aromatic hydrocarbons/ bioassay/ crude oil/ dispersant/ effects/ experiment/ fish/ hydrocarbons/ invertebrate/ marine invertebrate/ ODfour/ oil/ oil spill/ petroleum/ petroleum hydrocarbons/ review/ salt water/ spill
**Notes:** A review of the effects on marine fish and invertebrates of exposure to water-soluble petroleum hydrocarbons. The author compares the results of laboratory exposures to exposures observed at oil spills and field experiments. Presents a large amount of data on crude oil and specific hydrocarbon solublilities in tables and figures, and consolidates results from many aquatic bioassays.

**McAuliffe, C. D.** 1989. The use of chemical dispersants to control oil spills in shallow nearshore waters. Pages 49-72 *in* L. M. Flaherty, editor. Oil Dispersants: New Ecological Approaches. ASTM Special Technical Publication 1018. American Society for Testing and Materials, Philadelphia.
**Keywords:** biological effects/ crude oil/ dispersant/ effects/ fate/ methods/ miscellaneous/ ODeleven/ oil/ oil spill/ review/ salt water/ spill/ spill response/ technical
**Notes:** A review of the issue of chemical dispersant use in shallow nearshore waters. Sections on fate of spilled oil, biological effects of dispersed and nondispersed crude oils, a discussion of two oil spill scenarios, spill control methods, spill response decisions, and planning for dispersant use.

**McCarthy, L. T., Jr.** 1977. Considerations for field use of dispersants. Pages 399-401 *in* 1977 Oil Spill Conference. American Petroleum Institute, Washington, D.C.
**Keywords:** condition/ dispersant/ ODnine/ oil/ oil spill/ spill/ technical
**Notes:** An assessment of the conditions and considerations that characterize an oil spill and the decision to use chemical dispersants. An early EPA perspective.

**McCormick-Ray, M. G.**, 1987. Hemocytes of *Mytilus edulis* affected by Prudhoe Bay crude oil emulsion. Marine Pollution Bulletin **22**:107-122.
**Keywords:** adult/ bivalve/ crude oil/ effects/ emulsion/ flow-through/ hemocytes/ marine invertebrate/ mussel/ Ofour/ oil/ Prudhoe Bay/ Prudhoe Bay crude oil/ salt water/ spawning/ storage/ tissue
**Notes:** A flow-through laboratory system was used to determine the effects on adult *Mytilus edulis* mussels of exposure to Prudhoe Bay crude oil. Mussels were exposed to 390 or 740 ppb of crude oil in water emulsion for 9 wks and examined after 4-5 wks and 8-9 wks. Counted several hemocytes in hemolymph and estimated spawing stage by quantifying percentage of mantle tissue used for follicles or storage.

**McDonald, S. J., M. C. Kennicutt, II, H. Liu, S. H. Safe** , 1995. Assessing aromatic hydrocarbon exposure in Antarctic fish captured near Palmer and McMurdo Stations, Antarctica. Archives of Environmental Contamination and Toxicology **29**:232-240.
**Keywords:** activity/ Antarctic/ Antarctica/ aromatic hydrocarbons/ bile/ cell/ concentration/ diesel/ diesel

fuel/ effects/ experiment/ fish/ hydrocarbons/ metabolism/ metabolite/ Othree/ PAH/ petroleum/ petroleum hydrocarbons/ rat/ salt water/ sediment/ tissue
**Notes:** Assessment of the effects on Antarctic fish near Palmer Station of exposure to petroleum hydrocarbons in the ocean, in laboratory experiments with baP and diesel fuel, and with rat hepatoma cells; metabolic activity and concentrations of PAH in bile, tissues, and sediment.

**McEwan, E. H., A. F. C. Koelink**, 1973. The heat production of oiled mallards and scaup. Canadian Journal of Zoology **51**:27-31.
**Keywords:** bird/ crude oil/ experiment/ fresh water/ mallard/ metabolism/ oiled/ Oone/ physiology/ plumage/ rehabilitation/ scaup
**Notes:** Experiment on the thermal consequences of plumage oiling of mallards and scaup. Also, comments on the lack of success of rehabilitation of the oiled birds.

**McEwan, E. H.**, 1978. The effect of crude oils on salt gland sodium secretion of orally imposed salt loads in glaucous-winged gulls, *Larus glaucescens*. Canadian Journal of Zoology **56**:1212-1213.
**Keywords:** bird/ Bunker C/ crude oil/ diesel/ diesel fuel/ effects/ glaucous-winged gull/ gull/ juvenile/ oil/ Oone/ physiology/ salt gland/ salt water
**Notes:** Effects on salt gland sodium secretion of juvenile glaucous-winged gulls of oral doses of Bunker C or diesel fuel.

**McEwan, E. H., P. M. Whitehead**, 1978. Influence of weathered crude oil on liver enzyme metabolism of testosterone in gulls. Canadian Journal of Zoology **56**:1922-1924.
**Keywords:** bird/ crude oil/ dosed/ effects/ enzyme/ glaucous-winged gull/ gull/ juvenile/ liver/ metabolism/ oil/ Oone/ physiology/ salt water/ weathered
**Notes:** Effects on liver enzyme metabolism of testosterone in juvenile glaucous-winged gulls caused by dosing with weathered crude oil.

**McEwan, E. H., P. M. Whitehead**, 1980. Uptake and chearance of petroleum hydrocarbons by the glaucous-winged gull (*Laras glaucescens*) and the mallard duck (*anas platyrhynchos*) . Canadian Journal of Zoology **58**:723-726.
**Keywords:** bird/ Bunker C/ crude oil/ diesel/ diesel fuel/ duck/ elimination/ glaucous-winged gull/ gull/ hydrocarbons/ labelled/ mallard/ oil/ Oone/ petroleum/ petroleum hydrocarbons/ uptake
**Notes:** Tritiated crude oil, Bunker C, and diesel fuel were fed to glaucous-winged gulls and mallards. Uptake and elimination was measured.

**McGill, P. A., M. E. Richmond**, 1979. Hatching success of great black-backed gull eggs treated with oil. Bird-Banding **50**:108-113.
**Keywords:** bird/ effects/ egg shell/ eggs/ embryo/ fuel oil/ great black-backed gull/ gull/ hatchability/ hatching/ Maine/ No.2 fuel oil/ oil/ oiled/ Oone/ salt water
**Notes:** Effects on embryos of great black-backed gulls of eggshell oiling with No. 2 fuel oil; Appledore Island, Maine.

**McGrath, E. A., M. M. Alexander**, 1979. Observations on the exposure of larval bullfrogs to fuel oil. Transactions of the Northeast Section of The Wildlife Society **36**:45-51.
**Keywords:** amphibian/ aromatic hydrocarbons/ behavior/ bullfrog/ Bunker C/ concentration/ development/ effects/ fresh water/ fuel oil/ ingestion/ oil/ OthreeA/ pathology/ society
**Notes:** Effects on larval bullfrogs, at several stages of development, of exposure to several concentrations of No. 6 fuel oil (Bunker C); ingestion, behavior, pathology.

**McGrath, J. A., T. F. Parkerton, F. L. Hellweger, D. M. DiToro**, 2005. Validation of the narcosis target lipid model for petroleum products: gasoline as a case study. Environmental Toxicology and Chemistry **24**:2382-2394.
**Keywords:** algae/ aliphatic hydrocarbons/ aromatic/ aromatic hydrocarbon/ aromatic hydrocarbons/ behavior/ composition/ concentration/ daphnia/ experiment/ fresh water/ gasoline/ juvenile/ lipid/ model/ narcosis/ Onine/ petroleum/ petroleum products/ rainbow trout/ survival/ technical/ toxicity/ water
**Notes:** The narcosis target lipid model (NTLM) was validated for use with gasoline. Data were provided

from a set of experiments wherein algae, juvenile rainbow trout, and water flea (daphnia) were exposed to five concentrations of the water-accomodated fractions (WAF) of six types of gasoline for 96 hr. The WAF was refreshed at 24, 48, and 72 hr. Test chambers were monitored for survival and abnormal behavior at 3, 24, 48, 72, and 96 hr. The six gasolines and the exposure solutions were analyzed for aliphatic and aromatic hydrocarbon composition.

**McGuinness, K. A.**, 1990. Effects of oil spills on macro-invertebrates of saltmarshes and mangrove forests in Botany Bay, New South Wales, Australia. Journal of Experimental Marine Biology and Ecology **142**:121-135.
**Keywords:** Australia/ crab/ crude oil/ density/ effects/ evaluation/ habitat/ history/ light/ macroinvertebrate/ mangrove/ marine invertebrate/ Ofour/ oil/ oil spill/ oiled/ roots/ salt marsh/ salt water/ seedling/ short-term/ snail/ species/ spill/ treatment/ Wales/ weathered
**Notes:** Evaluation of the effects of spilled crude oil on macroinvertebrates of saltmarsh and mangrove habitat in Botany Bay, Australia. Five sites (three with a history of oiling, two with no such history) were selected for evaluation of effects of previous oiling incidents. One previously unoiled site was used for experimental oiling to determine short-term effects. The experimental treatments were control, once oiled, and twice oiled (6 mos between oiling). Experimental oil was artificially weathered Dubai Light Crude oil. Measured densities of three species of snails, crab holes, mangrove roots, and mangrove seedlings.

**McKelvey, R. W., I. Robertson, P. E. Whitehead**, 1980. Effect of non-petroleum oil spills on wintering birds near Vancouver. Marine Pollution Bulletin **11**:169-171.
**Keywords:** bird/ Canada/ nonpetroleum oil/ oil/ oil spill/ Oone/ petroleum/ petroleum oil/ plumage/ salt water/ spill/ vegetable oil/ wintering
**Notes:** Effect on birds of spills of vegetable oil compared to petroleum oil in Vancouver (Canada) harbor.

**McKeown, B. A., G. L. March**, 1978. The acute effect of Bunker C oil and an oil dispersant on: 1 serum glucose, serum sodium and gill morphology in both freshwater and seawater acclimated rainbow trout ( *Salmo gairdneri*). Water Research **12**:157-163.
**Keywords:** acute/ biochemistry/ Bunker C/ combination/ detergent/ dispersant/ fish/ fresh water/ fuel oil/ gill/ glucose/ ODthree/ oil/ pathology/ rainbow trout/ salt water/ serum
**Notes:** Freshwater and seawater acclimated rainbow trout were exposed for 96 hr to Bunker C fuel oil, Oilsperse 43 detergent, or a combination; biochemistry, gill pathology.

**McKeown, B. A., G. L. March**, 1978. The effects of Bunker C oil and an oil dispersant: part 2 -- effects on the accumulation of chlorine-labelled Bunker C oil in various fish tissues. Marine Environmental Research **1**:119-123.
**Keywords:** accumulation/ Bunker C/ dispersant/ effects/ fish/ fresh water/ fuel oil/ gill/ kidney/ labelled/ liver/ muscle/ ODthree/ oil/ rainbow trout/ tissue
**Notes:** Accumulation of Bunker C fuel oil in gill, liver, kidney, and muscle of rainbow trout exposed to labelled fuel oil, either undispersed or chemically dispersed with Oilsperse 43.

**McKeown, B. A.**, 1981. Long-term sublethal and short-term high dose effects of physically and chemically dispersed oil on accumulation and clearance from various tissues of juvenile coho salmon, *Oncorhynchus kisutch*. Marine Environmental Research **5**:295-300.
**Keywords:** accumulation/ Alaska/ clearance/ crude oil/ dispersant/ effects/ fish/ fresh water/ gill/ hydrocarbons/ juvenile/ kidney/ labelled/ liver/ long-term/ muscle/ ODthree/ oil/ salmon/ salt water/ short-term/ sublethal/ tissue/ uptake
**Notes:** Long- (64 da) and short-term (24 da) exposure of juvenile coho salmon to labelled Alaska crude oil and BP1100X chemical dispersant; uptake and clearance, gill, kidney, liver, muscle.

**McKinley, V. L., T. W. Federle, J. R. Vestal**, 1982. Effects of petroleum hydrocarbons on plant litter microbiota in an Arctic lake. Applied Environmental Microbiology **43**:129-135.
**Keywords:** Arctic/ assay/ crude oil/ decomposition/ diesel/ diesel fuel/ effects/ experiment/ fresh water/ freshwater invertebrate/ gasoline/ hexane/ hydrocarbons/ leaves/ lipid/ litter/ microbes/ mineralization/ motor oil/ Ofive/ oil/ petroleum/ petroleum hydrocarbons/ plant/ Prudhoe Bay/ Prudhoe Bay crude oil/

toluene
**Notes:** Assessment of the effect of Prudhoe Bay crude oil, diesel fuel, or toluene on the leaf litter microbes of an Alaskan Lake. Laboratory assay involved exposure of microbes and litter to 3 ml test material per liter of water for 12 hrs; measured response as acetate incorporation into lipid and ATP content of litter. A second experiment evaluated lignocellulose mineralization over a 21-da period after exposure to crude oil, diesel fuel, motor oil, gasoline, hexane, or toluene (0.1 ml of 2% mixtures); used $^{14}C$ acetate and lignocellulose.

**McLachlan, A., B. Harty**, 1982. Effects of crude oil on the supralittoral meiofauna of a sandy beach. Marine Environmental Research **7**:71-79.
**Keywords:** Arabian Light crude oil/ beach/ concentration/ crude oil/ depth/ dispersant/ effects/ harpacticoid/ light/ marine invertebrate/ meiofauna/ nematode/ ODfour/ oil/ oligochaete/ oxygen/ petroleum/ salt water/ sand/ sandy beach/ weathered
**Notes:** Assessment of the effects on meiofauna of a South African sandy beach of exposure to Arabian light crude oil. Experimental plots treated with fresh crude oil, crude oil weathered for 1.5 mos, fresh crude oil mixed with a chemical dispersant, and weathered crude oil placed at the water table (20 cm below the sand surface). Plots sampled after 1 and 5 mos. Measured concentrations of nematodes, oligochaetes, and harpacticoids, oxygen concentration at 15-20 cm depth, and petroleum concentrations at depth.

**McLaren, P.**, 1985. Behavior of diesel fuel on a high energy beach. Marine Pollution Bulletin **16**:191-196.
**Keywords:** aromatic hydrocarbons/ beach/ behavior/ Canada/ coast/ crude oil/ diesel/ diesel fuel/ fate/ gasoline/ hydrocarbons/ miscellaneous/ movement/ Oeleven/ oil/ salt water/ sampling/ sediment/ shoreline/ spill/ time/ transect
**Notes:** A spill of diesel fuel and gasoline occured in March 1984 on the northeast coast of the Queen Charlotte Islands, Canada. Three parallel sampling transects were set up and sampled 2 da after the spill, at the end of March, and at the end of April. Sediments were analyzed for aromatic hydrocarbons and compared to crude oil standards. Primarily an assessment of the movement and fate of the spilled oil within the shoreline sediments during the tidal cycle.

**McLusky, D. S.**, 1982. The impact of petrochemical effluent on the fauna of an intertidal estuarine mudflat. Estuarine and Coastal and Shelf Science **14**:489-499.
**Keywords:** biomass/ density/ discharges/ effluent/ England/ estuarine/ estuary/ evaluation/ intertidal/ marine invertebrate/ Ofour/ petroleum waste/ plant/ redox potential/ salt water/ sources/ transect
**Notes:** Evaluation of the Kinneil intertidal area of the Forth estuary in England. Multiple sources of effluent discharge from petrochemical plants, sewage plants, and a power plant. Intertidal fauna were sampled twice annually from 1975 to 1980 along parallel transects extending away from the sources of effluent. Measured faunal density, biomass, and redox potential.

**McLusky, D. S., M. McCrory**, 1989. A long-term study of an estuarine mudflat subject to industrial pollution. Scientia Marina **53**:717-724.
**Keywords:** benthic/ community/ diversity/ estuarine/ estuary/ invertebrate/ long-term/ marine invertebrate/ Ofour/ pollution/ population/ salt water/ Scotland/ sediment/ time
**Notes:** A long-term study of benthic invertebrates in the mudflats of the Forth estuary of Scotland. Sediment samples were collected every summer from 1976 through 1986 from 89 stations. Invertebrates were identified and counted. Results were analyzed with several statistical techniques; diversity indicies were also calculated.

**McLusky, D. S., T. Martins**, 1998. Long-term study of an estuarine mudflat subjected to petro-chemical discharges. Marine Pollution Bulletin **36**:791-798.
**Keywords:** abundance/ ammonia/ ammonium/ discharges/ diversity/ effluent/ estuarine/ estuary/ infauna/ intertidal/ long-term/ marine invertebrate/ Ofour/ pollution/ reduction/ refinery/ salt water/ Scotland/ species/ species diversity/ toxicity/ trend
**Notes:** Infauna of the Kinneil intertidal area within the Forth estuary of Scotland were studied from 1976 to 1997 at 90 fixed locations. Measured abundance of each species, diversity indicies, BOD, suspended

solids, ammonia, and refinery discharges. Also compared toxicity of refinery effluent in 1986 and 1995. Compared trend in pollution reduction with measured biological responses.

**McMurry, S. T., R. L. Lochmiller, K. McBee, C. W. Qualls, Jr.**, 1999. Indicators of immunotoxicity in populations of cotton rats (*Signodon hispidus*) inhabiting an abandoned oil refinery. Ecotoxicology and Environmental Safety **42**:223-235.
**Keywords:** blood/ condition/ cotton rat/ effects/ immune response/ indicator/ mammal/ oil/ organ/ Otwo/ physiology/ population/ rat/ refinery/ soil/ time/ weight
**Notes:** Assessment of the effects of soil contaminants at an abandoned oil refinery on the immune function of wild cotton rats. Sampled cotton rats at three refinery and three reference sites at four times between January 1991 and September 1992. Measured general immunological and condition indicators, organ weights, blood and immune organ characteristics, and several indicators of immune function.

**McNab, W. M., Jr.**, 1999. Comparisons of geochemical signatures of biotransformation of fuel hydrocarbons in groundwater. Environmental Monitoring and Assessment **59**:257-274.
**Keywords:** biotransformation/ diesel/ diesel fuel/ environment/ fresh water/ gasoline/ ground water/ hydrocarbons/ indicator/ interpretation/ mass balance/ monitoring/ Onine/ petroleum hydrocarbons/ plume/ spill/ technical
**Notes:** Six subsurface spills of aviation fuel, diesel fuel, or gasoline at military bases were used to determine the best geochemical measures to use as indirect measures of hydrocarbon biotransformation. Nine indicators of (1) the local redox environment and (2) measures involving mass balance determinations were evaluated. Results useful for the collection and interpretation of groundwater monitoring data.

**McOrist, S., C. Lenghaus**, 1992. Mortalities of little penguins (*Eudyptula minor*) following exposure to crude oil. Veterinary Record **130**:161-162.
**Keywords:** Australia/ bird/ crude oil/ effects/ oil/ oil spill/ Oone/ pathology/ penguin/ physiology/ rehabilitation/ salt water/ spill
**Notes:** First known report of the effects of a crude oil spill on little penguins; Australia.

**Meeks, D. G.**, 1980. Performance of some oil dispersants on oil slicks of varying thickness. Marine Pollution Bulletin **11**:348-352.
**Keywords:** dispersant/ effectiveness/ fuel oil/ kerosene/ mixing/ mousse/ ODnine/ oil/ oil slick/ salt water/ technical/ time
**Notes:** An assessment of the effectiveness of several chemical dispersants (BP 1100X, BP 1000 WD, and an experimental formulation) under varying slick thicknesses of 'fuel oil', fuel oil plus kerosine, or mousse; soaking time, and thoroughness of mixing.

**Megharaj, M., I. Singleton, N. C. McClure, R. Naidu**, 2000. Influence of petroleum hydrocarbon contamination on microalgae and microbial activities in a long-term contaminated soil. Archives of Environmental Contamination and Toxicology **38**:439-445.
**Keywords:** activity/ alkane/ assay/ biomass/ diesel/ effects/ enzyme/ fresh water/ freshwater plant/ growth/ hydrocarbons/ long-term/ microalgae/ microbes/ miscellaneous/ Oseven/ PAH/ petroleum/ petroleum hydrocarbons/ population/ soil/ species
**Notes:** An assessment of the effects of petroleum-contaminated soil on microbes and microalgae. Soil samples were collected from a site where diesel engines had been cleaned. Total petroleum hydrocarbons (PAHs and alkanes) were determined in subsamples of the soil and the subsamples were classified as uncontaminated or low, medium low, medium, medium high, and high contamination. Two species of microalgae found in the soil were used in a laboratory assay of the effects of the soil on microalgal population growth. Microbial biomass and soil enzyme activity was determined with fresh soil samples from the site.

**Meier, P. G., R. R. Rediske**, 1984. Oil and PCB interactions on the uptake and excretion in midges. Bulletin of Environmental Contamination and Toxicology **33**:225-232.
**Keywords:** concentration/ depuration/ evaluation/ experiment/ fresh water/ freshwater invertebrate/ interactions/ mineral oil/ Ofive/ oil/ PCB/ petroleum/ rate/ substrate/ uptake

**Notes:** Experimental evaluation of the effect on PCB (Aroclor 1242) uptake and excretion of the presence of simulated petroleum contamination (mineral oil). Second instar midges exposed to substrate containing Aroclor and either of three concentrations of mineral oil for 30 da. In a second experiment, the midges were similarly exposed for 24 da followed by a 7-da depuration period. Measured uptake and depuration rates.

**Melancon, M. J., Jr., J. J. Lech**, 1978. Distribution and elimination of napththalene and 2-methylnaphthalene in rainbow trout during short- and long-term exposures. Archives of Environmental Contamination and Toxicology **7**:207-230.
**Keywords:** accumulation/ bile/ blood/ distribution/ elimination/ fish/ gill/ hydrocarbons/ labelled/ liver/ long-term/ metabolite/ muscle/ naphthalene/ Othree/ rainbow trout/ short-term/ whole body
**Notes:** Accumulation and elimination by rainbow trout of labelled naphthalene and 2-methylnaphthalene and its metabolites in fat, bile, muscle, liver, gill, blood, and whole fish. Short-term exposure for 8 hrs and longer-term for 4 wks.

**Mendelssohn, I. A., M. W. Hester, and J. M. Hill** 1993. Assessing the recovery of coastal wetlands from oil spills. Pages 141-145 *in* Proceedings 1993 International Oil Spill Conference, API 4580. American Petroleum Institute, Washington, D.C.
**Keywords:** condition/ crude oil/ effects/ evaluation/ Louisiana/ Louisiana crude oil/ marine plant/ oil/ oil spill/ oiled/ Osix/ photograph/ pipeline/ rate/ recovery/ salt water/ spill/ transect/ vegetation/ wetland
**Notes:** An assessment of the effects of a 1985 pipeline rupture (Louisiana crude oil) on the vegetation and the possible effects on natural loss rate of Louisiana wetlands. Two mos after the spill, the affected site was divided into a heavily oiled core (20 ha), intermediate (possibly oiled) wetland on both sides, and areas beyond the intermediate wetland that served as controls. Fifteen transects were established and evaluated for vegetation condition; the evaluation was repeated 4 yrs later. Aerial photographs were used to quantify wetland loss in all areas between 1950 and 1990.

**Menon, N. N., N. R. Menon**, 1999. Uptake of polycyclic aromatic hydrocarbons from suspended oil borne sediments by the marine bivalve *Sunetta scripta*. Aquatic Toxicology **45**:63-69.
**Keywords:** aromatic hydrocarbons/ bivalve/ hydrocarbons/ marine invertebrate/ Ofour/ oil/ oiled/ PAH/ salt water/ sediment/ tissue/ turbidity/ uptake
**Notes:** A marine bivalve was exposed to oiled sediments in either a low turbitity or high turbitity state. Period of exposure was 0, 5, or 10 da. Measured the total PAH content of water, sediment and bivalve tissue.

**Menzie, C. A.**, 1982. The environmental implications of offshore oil and gas activities. Environmental Science and Technology **16**:454A-472A.
**Keywords:** activity/ acute/ development/ discharges/ drilling fluids/ fish/ general effect/ invertebrate/ marine invertebrate/ marine plant/ monitoring/ Oeight/ offshore/ oil/ oil field/ plankton/ review/ salt water/ toxicity
**Notes:** A review of the environmental consequences of discharges from offshore oil and gas exploration, development, and production wells. Sections on discharged materials; acute toxicity of drilling fluids to marine plankton, invertebrates, and fish; field monitoring programs; and research considerations.

**Mercurio, P., K. A. Burns, A. Negri**, 2004. Testing the ecotoxicology of vegetable versus mineral based lubricating oils: 1. Degradation rates using tropical marine microbes. Environmental Pollution **129**:165-173.
**Keywords:** degradation/ incubation/ lubricating oil/ mangrove/ microbes/ oil/ Oten/ petroleum/ salt water/ sediment/ vegetable oil
**Notes:** Micro-organisms from reef and mangrove sediments were incubated in the laboratory in the presence of either a petroleum- or a vegetable-based lubricant used in 2-stroke and 4-stroke boat engines, or a petroleum- or vegetable-based hydraulic fluid. The incubation period was 14 days and degradation was measured on days 0, 7, and 14. Lubricants were analyzed by infrared spectroscopy, GC-FID, and GC-MS.

**Mercurio, P., K. A. Burns, J. Cavanagh**, 2004. Testing the ecotoxicology of vegetable versus mineral based lubricating oils: 2. Induction of mixed function oxidase enzymes in barramundi, *Lates calcarifer*, a tropical fish species. Environmental Pollution **129**:175-182.
**Keywords:** activity/ assay/ concentration/ corn oil/ enzyme/ fish/ flow-through/ liver/ lubricating oil/ metabolism/ oil/ Othree/ petroleum/ protein/ salt water/ species
**Notes:** Sexually immature male barramundi were used in a flow-through laboratory assay of the effects of vegetable and petroleum oils on the induction of cytochrome P-450 (EROD) activity. Fish were injected with a single dose of either of two concentrations of a known P-450 inducer (*B*-naphthoflavone), four concentrations of corn oil, four concentrations of a petroleum-based lubricating oil, or four concentrations of a vegetable-based lubricating oil. Fish were killed after 4 days and the liver removed for determination of EROD activity, cytochrome P-450 concentrations, and total protein concentrations.

**Mercurio, P., A. P. Negri, K. A. Burns, A. J. Heyward**, 2004. The ecotoxicology of vegetable versus mineral based lubricating oils: 3. Coral fertilization and adult corals. Environmental Pollution **129**:183-194.
**Keywords:** activity/ adult/ assay/ concentration/ coral/ fertilization/ lubricating oil/ marine invertebrate/ Ofour/ oil/ petroleum/ salt water/ survival/ toxicity/ vegetable oil
**Notes:** Lubricating oils made from vegetable oil and petroleum were evaluated for their toxicity to corals. Water-accomodated fractions (WAF) of vegetable- and a petroleum-based motor lubricants were prepared 24 hrs prior to use. An egg fertilization study used seven concentrations of one vegetable and one petroleum WAF during a 4-hr assay. Adult corals were exposed for 48 hrs to five concentrations of either petroleum WAF or one of three formulations of vegetable oil WAF. Measured survival, percent fertilization, dinoflagellate density, PSII activity of dinoflagellates, and WAF composition.

**Merkl, N., R. Schultze-Kraft, C. Infante**, 2005. Phytoremediation in the trophics - influence of heavy crude oil on root morphological characteristics of graminoids. Environmental Pollution **138**:86-91.
**Keywords:** bioremediation/ crude oil/ experiment/ freshwater plant/ grass/ growth/ length/ oil/ Oseven/ plant/ root/ roots/ soil/ species/ time/ Venezuela
**Notes:** Soil was mixed with a heavy crude oil (5 % w/w) and used in a plant growth experiment with three species of grasses. Duration of the study was 90 da. At the end, roots were removed and characterized according to root length, root surface area, average root diameter, and root volume.

**Meudec, A., J. Dussauze, E. Deslandes, N. Poupart**, 2006. Evidence for bioaccumulation of PAHs within internal shoot tissues by a halophytic plant artificially exposed to petroleum-polluted sediments. Chemosphere **65**:474-481.
**Keywords:** accumulation/ Bunker C/ evaluation/ experiment/ France/ fuel oil/ marine plant/ oil/ Osix/ PAH/ petroleum/ plant/ root/ roots/ salt marsh/ salt water/ sediment/ time/ tissue/ uptake
**Notes:** A salt marsh plant (glasswort) and associated sediment from coastal France were used in an evaluation of the bioaccumulation potential of PAH from petroleum. Sediment was treated with either 0.2, 2, or 20% Bunker C fuel oil and plants were grown in the treated sediment for one week. Shoots were then clipped; shoots and roots were analyzed separately for 16 individual PAH. Another group of plants were grown in 0.2% fuel oil for six weeks; plants were sampled and analyzed weekly. Treated sediment was analyzed for PAH at the beginning and end of each experiment.

**Meyerhoff, R. D.**, 1975. Acute toxicity of benzene, a component of crude oil, to juvenile striped bass (*Morone saxatilis*). Journal of the Fisheries Research Board of Canada **32**:1864-1866.
**Keywords:** acute/ aromatic hydrocarbons/ benzene/ crude oil/ fish/ juvenile/ mammal/ oil/ Othree/ salt water/ striped bass/ toxicity
**Notes:** Determination of the 96 hr LC50 for benzene using juvenile striped bass; discussion of the toxic action of benzene in mammals and fish.

**Michael, A. D., B. Brown**, 1978. Effects of laboratory procedure on fuel oil toxicity. Environmental Pollution **15**:277-287.
**Keywords:** amphipod/ assay/ bioassay/ effects/ evaporation/ fuel oil/ marine invertebrate/ miscellaneous/ Oeleven/ oil/ procedure/ salt water/ sand/ static/ temperature/ time/ toxicity
**Notes:** An assessment of the effects of laboratory assay procedures on the consequences of amphipod exposure to No. 2 fuel oil in static bioassay. Compared presence and absence of sand; rapid, slow, and

no stirring; 'aging' of oil-sea water mixtures; evaporation from flask; and water temperature. Assays ran for 100-250 hrs and measured percent of deaths.

**Michel, J. and M. O. Hayes** 1993. Persistence and weathering of *Exxon Valdez* oil in the intertidal zone -- 3.5 years later. Pages 279-286 *in* 1993 International Oil Spill Conference, API Publication4580. American Petroleum Institute, Washington, D.C.
**Keywords:** Alaska/ Exxon Valdez/ intertidal/ miscellaneous/ Oeleven/ oil/ oil spill/ PAH/ persistence/ Prince William Sound/ salt water/ sediment/ spill/ survey/ time/ treatment/ weathered
**Notes:** Intertidal surveys were performed at 18 locations in Prince William Sound, Alaska between 9/89 and 8/92. Four locations received no treatment, whereas the rest were subjected to hot-water flushing, nutrient addition, manual removal, berm relocation or sediment tilling. Sediment samples were analyzed for a suite of 34 PAHs.

**Michel, J. and B. L. Benggio** 1995. Testing and use of shoreline cleaning agents during the *Morris J. Berman* oil spill. Pages 197-202 *in* 1995 International Oil Spill Conference, API 4620. American Petroleum Institute, Washington, D.C.
**Keywords:** beach/ behavior/ Bunker C/ cleaning/ Corexit 7664/ Corexit 9580/ dispersant/ effectiveness/ fuel oil/ miscellaneous/ ODeleven/ oil/ oil spill/ pressure/ salt water/ shoreline/ spill
**Notes:** A test of the efficacy of two shoreline cleaning agents (Corexit 9580, PES-51) and an after-cleaning flushing agent (7664). Tested materials on sandstone beach rock and on a rock riprap beach affected by a spill of No. 6 fuel oil. Test design consisted of control; hot water pressure wash; Corexit 9580, flush, hot water pressure wash; PES-51, flush, ambient pressure wash; and Corexit 9580, 7664 flush, ambient pressure wash. Visual comparisons, observations of the behavior of released oil, and ability to recover released oil were used to determine relative effectiveness.

**Michel, J., D. French, F. Csulak, and M. Sperduto** 1997. Natural resource impacts from the *North Cape* oil spill. Pages 841-850 *in* 1997 International Oil Spill Conference, API Publication 4651. American Petroleum Institute, Washington, D.C.
**Keywords:** benthic/ bird/ coast/ community/ effects/ fish/ fuel oil/ general effect/ heating oil/ lobster/ marine invertebrate/ marine plant/ movement/ natural resource/ No.2 fuel oil/ Oeight/ oil/ oil spill/ population/ Rhode Island/ salt water/ sediment/ spill/ time
**Notes:** Description of a NRDA of a January 1996 spill of home heating oil (No. 2 fuel oil) off the coast of Rhode Island. Presents a description of the oil movement and the NRDA organizational approach to evaluating natural resource damage. The primary areas of focus were salt pond communities, marine communities, and birds. Only the immediate effects of the spill are described; the rest of the work is ongoing or planned. Presents a summary of assessment results as of August 1996.

**Michel, J., M. O. Hayes**, 1999. Weathering patterns of oil residues eight years after the *Exxon Valdez* oil spill. Marine Pollution Bulletin **38**:855-863.
**Keywords:** Alaska/ beach/ Exxon Valdez/ gravel/ hydrocarbons/ miscellaneous/ North Slope crude oil/ Oeleven/ oil/ oil spill/ PAH/ petroleum/ petroleum hydrocarbons/ Prince William Sound/ salt water/ spill/ weathered
**Notes:** This report is part of an ongoing assessment of the weathering of oil from the *Exxon Valdez* spill in Prince William Sound, Alaska. In 1997, a total of 14 sample sites, at nine locations, were geomorphologically described and sampled for remnant petroleum. Weathered oil was analyzed for total petroleum hydrocarbons and a suite of 42 PAHs.

**Middaugh, D. P., D. D. Whiting**, 1995. Responses of embryonic and larval inland silversides, *Menidia beryllina*, to No. 2 fuel oil and oil dispersants in seawater. Archives of Environmental Contamination and Toxicology **29**:535-539.
**Keywords:** combination/ concentration/ Corexit 7664/ development/ dispersant/ effects/ eggs/ fish/ fuel oil/ malformation/ No.2 fuel oil/ ODthree/ oil/ physiology/ salt water/ survival
**Notes:** Effects on eggs of inland silversides of exposure to varying concentrations of the water-soluble concentrations of No. 2 fuel oil and Corexit 7664 and 9527, singly and in combination; survival, development, physiology, malformation.

**Middaugh, D. P., M. E. Shelton, Jr. C. L. McKenney, G. Cherr, P. J. Chapman, L. A. Courtney**, 1998. Preliminary observations on responses of embryonic and larval Pacific herring, *Clupea pallasi*, to neutral fraction biodegradation products of weathered Alaska North Slope oil. Archives of Environmental Contamination and Toxicology **34**:188-196.
**Keywords:** Alaska/ behavior/ biodegradation/ concentration/ crude oil/ degradation/ effects/ embryo/ experiment/ fish/ growth/ hatching/ herring/ larvae/ malformation/ North Slope/ North Slope crude oil/ oil/ Othree/ Pacific/ Pacific herring/ salt water/ survival/ weathered
**Notes:** Effects of water-soluble fraction of weathered Alaskan North Slope crude oil on embryos and larvae of Pacific herring. Crude oil weathered in water for 2-3 da and by microbial degradation for 14 more da. Embryos at 4, 48, or 96 hr postfertilization were exposed to concentrations of 1, 10, or 100% of the WSF and monitored until hatching (performed twice). A second experiment followed growth of selected test groups for 10 da posthatching. Measured survival, malformations, and behavior.

**Middaugh, D. P., P. J. Chapman, M. E. Shelton, C. L. McKenney, Jr., L. A. Courtney**, 2002. Effects of fractions from biodegraded Alaska North Slope crude oil on embryonic inland silversides, *Menidia beryllina*. Archives of Environmental Contamination and Toxicology **42**:236-243.
**Keywords:** Alaska/ aromatic hydrocarbons/ composition/ crude oil/ development/ effects/ embryo/ fish/ incubation/ microbes/ North Slope/ North Slope crude oil/ oil/ Othree/ polar compounds/ Prince William Sound/ salt water/ saturated hydrocarbons/ solubility/ species/ toxicity/ weathered
**Notes:** Alaska North Slope crude oil was artificially weathered and then treated with three different species of microbes from Prince William Sound. The water soluble fractions (WSF) of each incubation (14 da) was used in toxicity tests (7-10 da) with embryos of the inland silverside. The most toxic WSF was divided into saturated, aromatic, and polar subfractions for a second round consisting of two tests; the results were compared to those of the combined subfractions. Measured characteristics of embryo development and cardiac contractions, and composition of the WSF.

**Middleditch, B. S., E. S. Chang, B. Basile**, 1979. Alkanes in plankton from the Buccaneer oilfield. Bulletin of Environmental Contamination and Toxicology **21**:421-427.
**Keywords:** alkane/ biogenic/ coast/ concentration/ distance/ hydrocarbons/ marine invertebrate/ Ofour/ oil/ oil field/ petroleum/ petroleum hydrocarbons/ plankton/ salt water/ Texas/ zooplankton
**Notes:** Zooplankton samples (16) were collected at varying distances from two oil drilling platforms in the Buccaneer oil field off the coast of Texas. Samples were analyzed for alkanes in the range $C_{12}$ - $C_{37}$ plus pristane and phytane. Results interpreted as petroleum hydrocarbons or biogenic hydrocarbons.

**Middleditch, B. S., E. S. Chang, B. Basile**, 1979. Alkanes in barnacles (*Balanus tintinnabulum*) from the Buccaneer oilfield. Bulletin of Environmental Contamination and Toxicology **23**:6-12.
**Keywords:** alkane/ barnacle/ concentration/ crude oil/ Gulf of Mexico/ marine invertebrate/ Mexico/ Ofour/ oil field/ salt water/ shell/ tissue
**Notes:** Assessment of alkane concentrations in barnacles collected from the production platforms and well jackets of the Buccaneer oilfield in the Gulf of Mexico. Barnacle samples were divided into surface and subsurface samples. Measured alkane concentrations of tissue and shell.

**Middleditch, B. S., B. Basile, E. S. Chang**, 1979. Alkanes in seawater in the vicinity of the buccaneer oilfield. Bulletin of Environmental Contamination and Toxicology **21**:413-420.
**Keywords:** aliphatic hydrocarbons/ alkane/ concentration/ Gulf of Mexico/ hydrocarbons/ Mexico/ miscellaneous/ Oeleven/ oil field/ salt water/ water column
**Notes:** Alkane hydrocarbons in the water of the Buccaneer oilfield of the Gulf of Mexico were determined on a north-south axis that extended up to 20 km from the center of the oilfield. Between June 1976 and March 1977, a total of 76 water samples from the surface, mid-depth, and bottom of the water column were collected. The water was analyzed for straight-chain alkanes plus phytane and pristane.

**Middleditch, B. S., E. S. Chang, B. Basile, S. R. Missler**, 1979. Alkanes in fish from the Buccaneer oilfield. Bulletin of Environmental Contamination and Toxicology **22**:249-257.
**Keywords:** alkane/ coast/ fish/ liver/ muscle/ oil field/ Othree/ petroleum/ species/ Texas
**Notes:** Presence of natural and petroleum alkanes in the muscle and liver of a variety of marine fish caught from the vicinity of the Buccaneer oilfield off the coast of Texas.

**Middleditch, B. S., B. Basile, E. S. Chang**, 1982. Alkanes in shrimp from the Buccaneer oil field. Bulletin of Environmental Contamination and Toxicology **29**:18-23.
**Keywords:** alkane/ concentration/ crude oil/ evaluation/ Gulf of Mexico/ marine invertebrate/ Mexico/ Ofour/ oil/ oil field/ salt water/ shrimp/ species
**Notes:** An evaluation of the alkane content of five species of shrimp collected around two production platforms in the Buccaneer oil field of the Gulf of Mexico. Measured alkane concentration and compared GC patterns.

**Mielbrecht, E. E., M. F. Wolfe, R. S. Tjeerdema, M. L. Sowby**, 2005. Influence of a dispersant on the bioaccumulation of phenanthrene by topsmelt (*Atherinops affinis*). Ecotoxicology and Environmental Safety **61**:44-52.
**Keywords:** accumulation/ analysis/ Corexit 9527/ crude oil/ dispersant/ experiment/ fish/ food/ food chain/ marine invertebrate/ marine plant/ metabolite/ ODthree/ oil/ phenanthrene/ phytoplankton/ Prudhoe Bay/ rotifer/ salt water/ transfer/ water
**Notes:** The influence of a chemical dispersant (Corexit 9527) on the transfer of crude oil (Prudhoe Bay) through a food chain was determined with a laboratory experiment involving a phytoplankton, a rotifer, a fish (topsmelt). Fish were exposed to either the water-accomodated fraction of crude oil alone or chemically-dispersed crude oil in water medium or as food (pre-exposed rotifers) for 12 hrs. Fish were sampled and analyzed for phenanthrene and metabolites at 0.25, 0.5, 1, 2, 4, 6, 8, and 12 hrs. Remaining fish were depurated in clean water for another 12 hrs and sampled for similar phenanthrene analysis at 0.25, 0.5, 1, 2, 4, and 12 hrs.

**Mignucci-Giannoni, A. A.**, 1999. Assessment and rehabilitation of wildlife affected by an oil spill in Puerto Rico. Environmental Pollution **104**:323-333.
**Keywords:** biological effects/ bird/ Bunker C/ coast/ effects/ fish/ fuel oil/ general effect/ marine invertebrate/ No.6 fuel oil/ Oeight/ oil/ oil spill/ oiled/ rehabilitation/ salt water/ species/ spill/ turtle
**Notes:** Report of the biological effects of the grounding of the barge *Morris J. Berman* off the north coast of Puerto Rico in 1994. A list of 5687 individual oiled organisms comprising 152 species is presented, along with results of the attempted rehabilitation of sea turtles and birds.

**Millemann, R. E., S. J. Tumminia, J. L. Forte, K. L. Daniels**, 1984. Comparative toxicities of coal- and shale-derived crude oils and a petroleum-derived fuel oil to the freshwater snails *Helisoma trivolvis* and *Physa gyrina*. Environmental Pollution (Series A) **33**:23-38.
**Keywords:** acute/ adult/ assay/ coal/ concentration/ crude oil/ development/ embryo/ fresh water/ freshwater/ freshwater invertebrate/ fuel oil/ gastropod/ Ofive/ oil/ shale oil/ snail/ species/ survival/ synthetic oil/ toxicity
**Notes:** The water-soluble fractions (WSF) of coal- and shale-derived oils and No. 2 fuel oil were evaluated for acute toxicity to adults of two snail species and to their embryos and newly hatched young. Preliminary tests determined the test concentrations for the 48 hr $LC_{50}$ assays. Differing ranges of WSF concentrations were used on embryos and newly hatched young (exposed for 5-7 da). Measured survival and normality of embryonic development.

**Miller, D. S., D. B. Peakall, W. B. Kinter**, 1978. Ingestion of crude oil: sublethal effects in herring gull chicks. Science **199**:315-317.
**Keywords:** bird/ chicks/ crude oil/ effects/ gull/ herring/ herring gull/ ingestion/ Kuwait/ Kuwait crude oil/ Louisiana/ Louisiana crude oil/ oil/ Oone/ pathology/ physiology/ salt water/ South Louisiana crude oil/ sublethal
**Notes:** Effects on herring gull chicks of ingestion of doses of Kuwait or South Louisiana crude oils.

**Miller, D. S., R. G. Butler, W. Trivelpiece, S. Janes-Butler, S. Green, B. Peakall, G. Lambert, D. B. Peakall**, 1980. Crude oil ingestion by seabirds: possible metabolic and reproductive effects. Bulletin of the Mount Desert Island Biological Laboratory **20**:137-138.
**Keywords:** adult/ behavior/ bird/ crude oil/ dispersant/ dosed/ effects/ gull/ herring/ herring gull/ ingestion/ nestling/ ODone/ oil/ physiology/ Prudhoe Bay/ Prudhoe Bay crude oil/ salt water
**Notes:** Effects on nestling herring gulls and breeding adult Leach's petrels of dosing with Prudhoe Bay crude oil and chemical dispersant plus crude oil (gulls only).

**Miller, D. S., D. J. Hallett, D. B. Peakall**, 1982. Which components of crude oil are toxic to young seabirds? Environmental Toxicology and Chemistry **1**:39-44.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ bird/ chicks/ crude oil/ gull/ herring/ herring gull/ Louisiana/ Louisiana crude oil/ oil/ Oone/ salt water/ South Louisiana crude oil/ weight
**Notes:** Determination of the portions of South Louisiana crude oil responsible for weight loss in herring gull chicks.

**Miller, G. J., D. W. Connell**, 1980. Occurrence of petroleum hydrocarbons in some Australian seabirds. Australian Wildlife Research **7**:281-293.
**Keywords:** accumulation/ alkane/ Australia/ biogenic/ bird/ hydrocarbons/ Oone/ origin/ petroleum/ petroleum hydrocarbons/ salt water/ species/ uptake
**Notes:** Report of the presence of petroleum hydrocarbons and hydrocarbons of biogenic origin in several species of seabirds from coastal Australia. Also, discussion of petroleum uptake and accumulation.

**Miller, M. C., J. R. Stout, V. Alexander**, 1986. Effects of a controlled under-ice oil spill on invertebrates of an arctic and a subarctic stream. Environmental Pollution (Series A) **42**:99-132.
**Keywords:** Alaska/ Arctic/ colonization/ crude oil/ drift/ effects/ fresh water/ freshwater invertebrate/ ice/ invertebrate/ Ofive/ oil/ oil spill/ oiled/ Prudhoe Bay/ Prudhoe Bay crude oil/ spill/ stream/ substrate
**Notes:** Assessment of the effects of a winter oil spill on stream invertebrates in Alaska. Prudhoe Bay crude oil (18 liters) was added below the ice to two streams (one arctic, one subarctic). Drift nets and a Hess sampler were used to measure insect drift and bottom dwelling insects both before and after the oil addition. Artificial substrate samplers consisting of oiled (24 hr weathering) and nonoiled rocks were placed in streams above and below the oil; substrate was checked for insect colonization in the following spring.

**Mills, M. A., T. J. McDonald, J. S. Bonner, M. A. Simon, R. L. Autenrieth**, 1999. Method for quantifying the fate of petroleum in the environment. Chemosphere **39**:2563-2582.
**Keywords:** analysis/ aromatic hydrocarbons/ composition/ degradation/ environment/ fate/ Onine/ petroleum/ polar compounds/ saturated hydrocarbons/ sediment/ soil/ technical
**Notes:** The authors present a method for the analysis of petroleum in water, sediment, and soil that is recommeded for use in environmental fate studies. The method consists of a total extractable materials analysis, a gross composition analysis (saturate, aromatic, polar fractions), and a target compound analysis of 62 specific compounds. An example of the use of the method is provided.

**Mills, M. A., J. S. Bonner, T. J. McDonald, C. A. Page, R. L. Autenrieth**, 2003. Intrinsic bioremediation of a petroleum-impacted wetland. Marine Pollution Bulletin **46**:887-899.
**Keywords:** Arabian Light crude oil/ aromatic hydrocarbons/ biodegradation/ bioremediation/ crude oil/ estuarine/ heating oil/ hydrocarbons/ microbes/ No.2 fuel oil/ oil/ Oten/ PAH/ salt water/ sampling/ saturated hydrocarbons/ sediment/ spill/ Texas/ time/ wetland
**Notes:** Ruptured piplines carrying home heating oil and Arabian light crude oil were moved by floodwaters into an estuarine wetland in coastal Texas. Twenty-one sampling plots were established within seven blocks. Sediments were collected beginning 44 da after the spill on days 0 (44 da post-spill), 19, 26, 33, 40, 64, 85, 113, 159, 188, and 343 da post-spill. Natural biodegradation was evaluted over time and spatially. Sediments were analyzed for 28 saturated and 34 PAH hydrocarbons.

**Minchew, C. D., J. D. Yarbrough**, 1977. The occurrence of fin rot in mullet (*Mugil cephalus*) associated with crude oil contamination of an estuarine pond-ecosystem. Journal of Fish Biology **10**:319-323.
**Keywords:** bacteria/ crude oil/ Empire Mix crude oil/ estuarine/ fin/ fin rot/ fish/ mullet/ oil/ Othree/ salt water/ stress
**Notes:** Description of fin rot in mullet exposed to Empire Mix crude oil spilled on outdoor ponds; study lasted 56 da following the introduction of oil.

**Mironov, O. G., T. L. Shchekaturina**, 1979. Oil change in excretory products of mussels (*Mytilus galloprovincialis*). Marine Pollution Bulletin **10**:232-234.
**Keywords:** alkane/ aromatic hydrocarbons/ composition/ concentration/ crude oil/ experiment/ faeces/ hydrocarbons/ marine invertebrate/ mussel/ Ofour/ oil/ petroleum/ petroleum hydrocarbons/ salt water

**Notes:** Experiment with mussels in aquaria conducted to determine change in petroleum composition between crude oil in the water and petroleum hydrocarbons in faeces. Mussels acclimated for 2-3 da, exposed to emulsified oil for 10 da, and transferred to clean water for 10 da. Measured alkane and aromatic concentrations in faeces.

**Moldan, A., P. Chapman, H. O. Fourie**, 1979. Some ecological effects of the *Venpet* -- *Venoil* collision. Marine Pollution Bulletin **10**:60-63.
**Keywords:** beach/ Bunker C/ crude oil/ effects/ estuary/ evaluation/ fish/ fuel oil/ general effect/ Iranian crude oil/ marine invertebrate/ Oeight/ oil/ rocky shore/ salt water/ South Africa/ spill/ time
**Notes:** An early evaluation of the environmental consequences of a collision between a ship carring Iranian crude oil and another ship fueled with Bunker C fuel oil. The oil remained at sea for 11 da and then came ashore between Cape Town and Port Elizabeth, South Africa. Affected sites were visited monthly for 3 consecutive months after the spill. Sections on spill chronology, rocky shores, beaches, and estuaries.

**Moldan, A., A. Westphal**, 1994. SANCCOB: the South African National Foundation for the Conservation of Coastal Birds. Penquin Conservation **7**:13-16.
**Keywords:** bird/ conservation/ history/ humans/ Oone/ penguin/ population/ rehabilitation/ salt water/ South Africa
**Notes:** Description of the organization SANCCOB, its history, and some history of African penguins and their encounters with humans.

**Moles, A., S. D. Rice, S. Korn**, 1979. Sensitivity of Alaskan freshwater and anadromous fishes to Prudhoe Bay crude oil and benzene. Transactions of the American Fisheries Society **108**:408-414.
**Keywords:** adult/ alevin/ benzene/ concentration/ crude oil/ eggs/ fish/ fishery/ fresh water/ fry/ juvenile/ oil/ Othree/ Prudhoe Bay/ Prudhoe Bay crude oil/ smolt/ society/ species/ survival
**Notes:** Sensitivity of nine species of Alaskan freshwater and anadromous fish to varying concentrations of the water-soluble concentrations of benzene or Prudhoe Bay crude oil. Juveniles or adults of most species were tested; eggs, alevins, fry, or smolts of four salmonids were also tested.

**Moles, A.**, 1980. Sensitivity of parasitized coho salmon fry to crude oil, toluene, and naphthalene. Transactions of the American Fisheries Society **109**:293-297.
**Keywords:** crude oil/ fish/ fishery/ fresh water/ fry/ larvae/ mussel/ naphthalene/ oil/ Othree/ parasite/ Prudhoe Bay/ Prudhoe Bay crude oil/ salmon/ society/ toluene
**Notes:** Effect of parasitism by freshwater mussel larvae on the sensitivity of coho salmon fry to the water-soluble fraction of Prudhoe Bay crude oil, toluene, or naphthalene; use of 96 hr LC50 test.

**Moles, A., S. Bates, S. D. Rice, S. Korn**, 1981. Reduced growth of coho salmon fry exposed to two petroleum components, toluene and naphthalene, in fresh water. Transactions of the American Fisheries Society **110**:430-436.
**Keywords:** concentration/ effects/ fish/ fishery/ fresh water/ fry/ growth/ length/ naphthalene/ Othree/ petroleum/ salmon/ society/ toluene/ weight
**Notes:** Effects on the growth of coho salmon fry of exposure to varying concentrations of toluene or naphthalene; exposed for 40 days, growth measured as dry weight, wet weight, and length.

**Moles, A., S. D. Rice**, 1983. Effects of crude oil and naphthalene on growth, caloric content, and fat content of pink salmon juveniles in seawater. Transactions of the American Fisheries Society **112**:205-211.
**Keywords:** concentration/ Cook Inlet crude oil/ crude oil/ effects/ fish/ fishery/ growth/ juvenile/ naphthalene/ oil/ Othree/ pink salmon/ salmon/ salt water/ society
**Notes:** Effects on growth, caloric content, and fat content of juvenile pink salmon exposed to varying concentrations of naphthalene or the water-soluble fraction of Cook Inlet crude oil; exposed for 40 da in saltwater.

**Moles, A., M. M. Babcock, S. D. Rice**, 1987. Effects of oil exposure on pink salmon, *Oncorhynchus gorbuscha*, alevins in a simulated intertidal environment. Marine Environmental Research **21**:49-58.

**Keywords:** alevin/ concentration/ Cook Inlet crude oil/ crude oil/ development/ effects/ environment/ fish/ fresh water/ growth/ hatching/ intertidal/ oil/ Othree/ pink salmon/ salmon/ salt water/ survival
**Notes:** Effects of varying concentrations of the water-soluble fraction of Cook Inlet crude oil on growth and development of pink salmon alevins 5 or 60 da after hatching. Used fresh water or a simulated freshwater to saltwater tidal cycle for a 30 da exposure period.

**Moles, A.**, 1998. Sensitivity of ten aquatic species to long-term crude oil exposure. Bulletin of Environmental Contamination and Toxicology **61**:102-107.
**Keywords:** bioassay/ Cook Inlet crude oil/ crude oil/ crustacean/ echinoderm/ fish/ flow-through/ long-term/ marine invertebrate/ Ofour/ oil/ salt water/ species/ static
**Notes:** Exposure of two fish, four crustacean, one echinoderm, and three mollusk species to a 4-da and a 28-da flow-through bioassay using the WSF of Cook Inlet crude oil. Compared LC50 results to published data on the LC50s of 4-da static and 4-da flow-through bioassays.

**Moles, A., B. L. Norcross**, 1998. Effects of oil-laden sediments on growth and health of juvenile flatfishes. Canadian Journal of Fisheries and Aquatic Sciences **55**:605-610.
**Keywords:** crude oil/ effects/ fin/ fin rot/ fish/ GI tract/ gill/ growth/ health/ juvenile/ liver/ North Slope/ North Slope crude oil/ oil/ oiled/ Othree/ Pacific/ parasite/ pathology/ salt water/ sand/ sediment/ sole/ species/ tissue
**Notes:** Assessment of the effects of oiled sediment on the growth of three species of juvenile flatfish (yellowfin sole, rock sole, Pacific halibut). Flatfish were exposed for 90 da to either mud or sand sediment containing either 1% or 2% North Slope crude oil. Measured growth, caudal fin erosion, GI tract parasites, and pathology of gill and liver tissue.

**Moles, A.**, 1999. Parasitism, feeding rate, and hydrocarbon uptake of pink shrimp *Pandalus borealis* fed a crude oil contaminated diet. Bulletin of Environmental Contamination and Toxicology **62**:259-265.
**Keywords:** aromatic hydrocarbons/ concentration/ Cook Inlet crude oil/ crude oil/ diet/ experiment/ feeding/ hepatopancreas/ male/ marine invertebrate/ muscle/ mussel/ Ofour/ oil/ parasite/ rate/ salt water/ shrimp/ solubility/ uptake
**Notes:** Male pink shrimp fed mussels previously exposed to the water soluble fraction (WSF) of Cook Inlet crude oil. Used three stocks of oil-exposed mussels. Shrimp fed mussels for 77 da. Experiment conducted in laboratory tanks. Measured death, prevalence of a parasite, feeding rate, and aromatic hydrocarbon concentrations in shrimp muscle and hepatopancreas.

**Moles, A., T. L. Wade**, 2001. Parasitism and phagocytic function among sand lance *Ammodytes hexapterus* Pallas exposed to crude oil-laden sediments. Bulletin of Environmental Contamination and Toxicology **66**:528-535.
**Keywords:** Alaska/ bioassay/ crude oil/ fish/ gill/ hydrocarbons/ immune response/ labelled/ North Slope/ North Slope crude oil/ oil/ Othree/ Pacific/ parasite/ petroleum/ petroleum hydrocarbons/ salt water/ sand/ sediment
**Notes:** Pacific sand lance were exposed to artificially-weathered Alaska North Slope crude oil in sediment for 90 da in a flow-thru bioassay. Sand lance were exposed to either 0, 10 or 61 ppm of total petroleum hydrocarbons. Fish were sampled for superoxide production, phagocyte function, and gill parasites. [The X-axis of Fig. 1 is labelled 28 ppm instead of 10 ppm].

**Molina-Barahona, L., R. Rodriguez-Vazquez, M. Hernandez-Velasco, C. Vega-Jarquin, O. Zapata-Perez, A. Mendoza-Cantu, A. Albores**, 2004. Diesel removal from contaminated soils by biostimulation and supplementation with crop residues. Applied Soil Ecology **27**:165-175.
**Keywords:** bioremediation/ concentration/ corn/ diesel/ diesel fuel/ evaluation/ experiment/ humidity/ incubation/ microbes/ Oten/ ratio/ soil/ sugar cane/ time
**Notes:** Soil was contaminated with diesel fuel and used in an evaluation of the utility of crop residue as a soil amendment. Experiment tested two crop residues (corn, sugar cane) at two residue concentrations, two C:N ratios, and two humidities over a 109 da incubation period. Characterized the diesel fuel, quantified the hydrocarbon-degrading microbes three times, measured $CO_2$ production 11 times, and measured the diesel fuel removal at the end of the study. Also compared the results of this study with four other published bioremediation systems.

**Molina-Barahona, L., L. Vega-Loyo, M. Guerrero, S. Ramirez, I. Romero, C. Vega-Jarquin, A. Albores**, 2005. Ecotoxicological evaluation of diesel-contaminated soil before and after a bioremediation process. Environmental Toxicology **20**:100-109.
**Keywords:** biomass/ bioremediation/ concentration/ corn/ daphnia/ diesel/ diesel fuel/ evaluation/ freshwater invertebrate/ freshwater plant/ germination/ growth/ incubation/ microbes/ nematode/ oat/ Oten/ plant/ ratio/ root/ seed/ soil/ time/ toxicity/ wheat
**Notes:** Soil was collected, characterized, and mixed with diesel fuel, adjusted C:N:P ratio, and amended with corn residue. Duration of incubation was 80 da. Measured microbial concentrations three times, $CO_2$ production 14 times, and diesel fuel removal at the end of the study. Soil samples on days 0, 1, and 80 were tested for phytotoxicity (seed germination, root elongation, plant growth, total biomass) using oats, wheat, and safflower. Also tested toxicity of bioremediated soil at the end of 80 da on *Daphnia magna* and a nematode.

**Monahan, T. P. and A. W. Maki** 1991. The *Exxon Valdez* 1989 wildlife rescue and rehabilitation program. Pages 131-136 *in* Proceedings 1991 International Oil Spill Conference, 4529. American Petroleum Institute, Washington, D.C.
**Keywords:** bird/ cost/ eagle/ Exxon Valdez/ mammal/ miscellaneous/ Oeleven/ oil/ oil spill/ raptor/ rehabilitation/ rescue/ salt water/ sea otter/ spill
**Notes:** A description of the wildlife rescue and rehabilitation program for the *Exxon Valdez* oil spill. Eight centers were established; three for otters, four for birds, and one for raptors. Over 140 boats and five aircraft were dedicated to the effort at a cost of $45M. Presents a general description of the facilities, results of the rehabilitation efforts, and lessons learned.

**Monson, D. H., D. F. Doak, B. E. Ballachey, A. Johnson, J. L. Bodkin**, 2000. Long-term impacts of the *Exxon Valdez* oil spill on sea otters, assessed through age-dependent mortality patterns. Proceedings of the National Academy of Sciences **97**:6562-6567.
**Keywords:** age/ Alaska/ carcass/ distribution/ effects/ Exxon Valdez/ long-term/ mammal/ model/ oil/ oil spill/ Otwo/ population/ Prince William Sound/ rate/ salt water/ sea otter/ spill/ survival
**Notes:** Carcasses of sea otters collected from portions of western Prince William Sound, Alaska from 1976 through 1998 were aged and analyzed with demographic models. Age distributions grouped as 1976-85, 1989 pre-spill, 1989 spill, 1990-91, and 1992-98. Estimated post-spill effects on age-specific survival rates.

**Moore, J., F. Bunker, S. Evans, D. Rostron, B. Bullimore, A. Little, J. Hodges, Y. Chamberlain, R. Crump, P. Dyrynda, J. Cremona, and A. Worley** 1997. *Sea Empress* spill: impacts on marine and coastal habitats. Pages 213-216 *in* 1997 International Oil Spill Conference. Improving Environmental Protection. Progress, Challenges, Responsibilities. API Publication. American Petroleum Institute, Washington, D.C.
**Keywords:** algae/ bivalve/ coast/ community/ eelgrass/ effects/ freshwater plant/ general effect/ grass/ habitat/ intertidal/ invertebrate/ lichen/ macroalgae/ marine invertebrate/ marine plant/ Ofour/ oil/ oil spill/ plant/ protection/ salt marsh/ snail/ spill/ vegetation/ Wales/ crustacean
**Notes:** A report of the general effects of the Sea Empress oil spill on marine plant and invertebrate communities of the southwest coast of Wales. Plants included salt marsh vegetation, dune grasses, intertidal macroalgae, eelgrass, and lichens. Invertebrates included bivalves, snails, and crustaceans.

**Moore, M. N., R. K. Pipe, S. V. Farrar**, 1982. Lysosomal and microsomal responses to environmental factors in *Littorina littorea* from Sullom Voe. Marine Pollution Bulletin **13**:340-345.
**Keywords:** biochemical/ cell/ evaluation/ gastropod/ indicator/ marine invertebrate/ microsome/ mussel/ Ofour/ oil/ oil terminal/ salt water/ Scotland/ tissue
**Notes:** Evaluation of the effect of proximity to the Sullom Voe Oil Terminal on biochemical characteristics of a marine gastropod. Samples collected from four exposed sites and a control. Measured several biochemical indicators of function in the digestive cells of mussel tissue.

**Moore, S. F., R. L. Dwyer**, 1974. Effects of oil on marine organisms: a critical assessment of published data. Water Research **8**:819-827.
**Keywords:** accumulation/ biological effects/ bird/ composition/ discharges/ effects/ fish/ general effect/

habitat/ marine invertebrate/ marine plant/ Oeight/ oil/ petroleum/ review/ salt water/ species
**Notes:** A review of the effects of petroleum on marine organisms. Authors look at all published literature up to 1973. Sections on basic organism responses, relation of oil composition to biological effects, toxic effects on individual species, hydrocarbon accumulation, surface coating, habitat alteration, and several examples of environmental discharges.

**Moore, S. F., D. B. McLaughlin**, 1978. Design of field experiments to determine the ecological effects of petroleum in intertidal ecosystems. Water Research **12**:1091-1099.
**Keywords:** ecosystem/ effects/ experiment/ intertidal/ invertebrate/ marine invertebrate/ marine plant/ miscellaneous/ Oeleven/ petroleum/ plant/ salt water/ statistics
**Notes:** An assessment of statistical characteristics of field experiment designs for use in the intertidal zone. Specifically, for non-mobile plants and invertebrates.

**Moraitou-Apostolopoulou, M., G. Verriopoulos, I. Karakassis**, 1986. Effects of pre-exposure on the tolerance of *Artemia salina* to oil and oil dispersant. Marine Pollution Bulletin **17**:72-76.
**Keywords:** copepod/ crude oil/ dispersant/ effects/ marine invertebrate/ methods/ ODfour/ oil/ petroleum/ respiration/ salt water/ tolerance
**Notes:** Assessment of the influence of pre-exposure on the tolerance of a marine copepod to petroleum and dispersant exposure. Exposed copepods to crude oil (dispersions), finasol OSR 2, crude oil and Finasol OSR 2, or Finasol OSR 5 for periods of 2 to 5 da; some exposures were followed by equivalent periods in clean water. Pre-exposed copepods were then tested with 48 hr $LC_{50}$ tests or measurement of respiration. [Presentation of methods and results is confusing; editors and reviewers failed on this one].

**Morales-Caselles, C., N. Jimenez-Tenorio, M. L. Gonzalez de Canales, C. Sarasquete**, 2006. Ecotoxicity of sediments contaminated by the oil spill associated with the tanker "Prestige" using juveniles of the fish *Sparus aurata*. Archives of Environmental Contamination and Toxicology **51**:652-660.
**Keywords:** activity/ Bunker C/ concentration/ effects/ fish/ fuel oil/ gill/ juvenile/ liver/ metabolism/ metals/ oil/ oil spill/ Othree/ PAH/ salt water/ sediment/ Spain/ spill/ tanker/ tissue
**Notes:** Sediment from coastal northwest Spain (three sites) affected by the Prestige oil spill (Bunker C fuel oil) plus positive and negative sediment controls were used to determine the effects of sediment-bound fuel oil on juvenile fish (seabream). Exposure was for two mos. Sediments were physically characterized and analyzed for 16 PAH and nine metals. After two mos of exposure the fish were evaluated for tissue damage (liver and gill), metallothionein concentration, and mixed function oxidase activity (EROD).

**Morelli, I. S., G. I. Vecchioli, M. T. Del Panno, M. T. Painceira**, 2001. Effect of petrochemical sludge concentrations on changes in mutagenic activity during soil bioremediation process. Environmental Toxicology and Chemistry **20**:2179-2183.
**Keywords:** activity/ aromatic hydrocarbons/ bioremediation/ concentration/ microbes/ mutation/ Oten/ PAH/ petroleum waste/ soil/ treatment/ weight
**Notes:** Assessment of the mutagenicity of petrochemical sludge applied to soil. The Ames test was used to monitor the mutagenicity of soil amended to either 1.25, 2.5, 5, or 10 % by weight of sludge. Soil extract was tested on days 0, 44, 90, 180, and 373 of treatment. Also measured dehydrogenase activity and the concentration of 12 PAHs in the soil on days 0 and 69 for 1.25, 2.5, and 5 % amendments, and on days 0, 69, and 373 for 10 % amendment.

**Morgan, P., R. J. Watkinson**, 1990. Assessment of teh potential for *in situ* bioremediation of hydrocarbon-contaminated soils. Water Science and Technology **22**:63-68.
**Keywords:** biodegradation/ bioremediation/ crude oil/ evaluation/ experiment/ hydrocarbons/ inorganic/ lubricating oil/ microbes/ nutrients/ oil/ Oten/ plant/ population/ soil/ storage/ total hydrocarbons
**Notes:** An evaluation of the potential for bioremediation at three different polluted sites; a crude oil unloading facility, a lubricating oil blending plant, and a gas station with a leaking storage tank. Soils were characterized, total hydrocarbons measured, and microbial populations identified. One soil was used in an experiment with several levels of inorganic nutrient addition. Recommendations were made for each of the sites.

**Morita, A., Y. Kusaka, Y. Deguchi, A. Moriuchi, Y. Nakanaga, M. Iki, S. Miyazaki, K. Kawahara**, 1999. Acute health problems among the people engaged in the cleanup of the Nakhodka oil spill. Environmental Research Section A **81**:185-194.
**Keywords:** activity/ acute/ Bunker C/ cleaning/ condition/ fuel oil/ health/ humans/ Japan/ medical/ miscellaneous/ Oeleven/ oil/ oil spill/ salt water/ spill
**Notes:** A total of 282 men and women residents of a coastal town in Japan were interviewed about their activities and health condition during the cleanup of the Nakhodka oil spill (Bunker C fuel oil). Activities, use of protective clothing, and medical complaints were categorized.

**Morris, R. J., M. E. Dawson, A. P. M. Lockwood**, 1982. The identification of some lipophilic contaminants in the gill neutral lipids of *Gammarus duebeni*. Marine Pollution Bulletin **13**:13-18.
**Keywords:** amphipod/ aromatic hydrocarbons/ gill/ hydrocarbons/ lipid/ marine invertebrate/ Ofour/ salinity/ salt water/ tissue
**Notes:** A comparison of the contaminants in gill versus body tissue of a marine amphipod. Two groups of amphipods were kept in either 2 ppt (parts per thousand) or 36 ppt salinity for 2 mos. Gills were removed and analyzed for lipids, aromatic hydrocarbons, and other contaminants.

**Morton, B., R. S. S. Wu**, 1977. The toxic effects of hydrocarbons upon the naupliar and adult stages of *Balanus* (Crustacea: Cirripedia). Marine Pollution Bulletin **8**:232-236.
**Keywords:** activity/ adult/ barnacle/ dispersant/ effects/ hydrocarbons/ kerosene/ marine invertebrate/ motility/ nauplii/ ODfour/ salt water/ species/ survival
**Notes:** Evaluated the effects of kerosene and the chemical dispersants BP 1002, Bukomkleen, and Chemkleen on two species of barnacle. Nauplii exposed to 2.5, 5, 10, or 25 ppm BP 1002 or 10, 25, 50, or 100 ppm kerosene for 1 hr. Adults exposed to 10, 50, 100, or 500 ppm BP 1002 for 24 or 48 hrs. A 16-hr comparative assessment was made by exposing adult barnacles to 50 ppm of BP 1002, kerosene, Chemkleen, or Bukomkleen. Measured motility and death for nauplii and either cirral activity or death for adults.

**Mott, S. C., P. H. Groenevelt, R. P. Voroney**, 1990. Biodegradation of a gas oil applied to aggregates of different sizes. Journal of Environmental Quality **19**:257-260.
**Keywords:** biodegradation/ gas oil/ incubation/ microbes/ oil/ Oten/ particle size/ refinery/ size/ soil/ waste oil
**Notes:** A refinery waste oil was used in a test of the importance of soil particle size in biodegradation. Three size classes sieved from the test soil were combined with the refinery waste and incubated for 14 da, after which the two larger classes of particles were ground to the same size as the smallest particle class and incubation was resumed for 10 more da. Measured $CO_{2\ \text{production}}$.

**Moyano, M., H. Moresco, J. Blanco, M. Rosadilla, A. Caballero**, 1993. Baseline studies of coastal pollution by heavy metals, oil and PAHs in Montevideo. Marine Pollution Bulletin **26**:461-464.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ hydrocarbons/ intertidal/ metals/ miscellaneous/ Oeleven/ oil/ PAH/ pollution/ salt water/ sediment/ Uruguay
**Notes:** A baseline assessment of six metals, 24 aliphatic hydrocarbons, and 18 aromatic hydrocarbons in the sediments (intertidal?) of coastal Uruguay next to Montevideo.

**Mudge, S.**, 1997. Can vegetable oils outlast mineral oils in the marine environment? Marine Pollution Bulletin **34**:213.
**Keywords:** degradation/ environment/ intertidal/ marine environment/ mineral oil/ miscellaneous/ Oeleven/ oil/ spill/ sunflower oil/ vegetable oil
**Notes:** Retention of spilled sunflower oil in the intertidal zone.

**Mudge, S. M.**, 2002. Reassessment of the hydrocarbons in Prince William Sound and the Gulf of Alaska: identifying the source using partial least-squares. Environmental Science and Technology **36**:2354-2360.
**Keywords:** Alaska/ analysis/ chemical analysis/ Exxon Valdez/ Gulf of Alaska/ hydrocarbons/ Onine/ Prince William Sound/ salt water/ sources/ statistics/ technical
**Notes:** A statistical analysis by partial least-squares of two large analytical chemistry data sets (NOAA

and EXXON) generated by analysis of Prince William Sound and Gulf of Alaska water. The purpose of the analysis is to identify sources of hydrocarbons and their relative significance.

**Mueller, A. J. and C. H. Mendoza** 1983. The Port Bolivar, Texas oil spill -- a case history of oiled bird survival. Pages 521-523 *in* 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup). American Petroleum Institute, Washington, DC.
**Keywords:** behavior/ bird/ cleaning/ history/ oil/ oil spill/ oiled/ Oone/ origin/ rehabilitation/ salt water/ spill/ survival/ Texas/ waterfowl
**Notes:** Account of an oil spill of unknown origin near Port Bolivar, Texas and its effect on local waterfowl. Also, a description of the cleaning of oiled birds.

**Mueller, D. C., J. S. Bonner, S. J. McDonald, R. L. Autenrieth**, 1999. Acute toxicity of estuarine wetland sediments contaminated by petroleum. Environmental Technology **20**:875-882.
**Keywords:** acute/ aromatic hydrocarbons/ bioassay/ concentration/ crude oil/ estuarine/ fuel oil/ gasoline/ hydrocarbons/ Microtox/ miscellaneous/ Oeleven/ oil/ petroleum/ petroleum hydrocarbons/ pipeline/ salt water/ saturated hydrocarbons/ sediment/ spill/ time/ toxicity/ wetland
**Notes:** Assessment of the acute toxicity of sediments in a riverine wetland affected by several pipeline ruptures involving fuel oil, crude oil, and gasoline. Twenty-one permanent plots were established and sampled 10 times between 1.5 and 7.5 mos after the spill. Measured total extractable materials, total petroleum hydrocarbons, total target saturates, total target aromatics, concentrations of individual analytes, and a microtox bioassay to establish temporal and spatial toxicity.

**Mueller, D. C., J. S. Bonner, S. J. McDonald, R. L. Autenrieth, K. C. Donnelly, K. Lee, K. Doe, J. Anderson**, 2003. The use of toxicity bioassays to monitor the recovery of oiled wetland sediments. Environmental Toxicology and Chemistry **22**:1945-1955.
**Keywords:** amphipod/ Arabian Light crude oil/ assay/ bioassay/ biomarker/ bioremediation/ crude oil/ cycloalkane/ hopane/ intertidal/ microbes/ Microtox/ nitrate/ oil/ oiled/ Onine/ PAH/ recovery/ salt water/ sediment/ technical/ time/ toxicity/ wetland
**Notes:** A large wetland bioremediation project was conducted along the San Jacinto River near Houston, TX. A total of 21 experimental plots in the intertidal zone were treated and followed for 140 days. The plots consisted of six oiled (artificially-weathered Arabian light crude oil) controls, six oiled and nutrient (diammonium phosphate pellets) amended, six oiled and nutrient amended plus potassium nitrate, and three unoiled controls. Sediment cores were collected from all plots at 10 times during the study. Sampled sediment was used in six bioassays (Microtox 100% elutriate test, Microtox Solid Phase Test, an amphipod assay, P450 reporter gene system, Toxi-ChromoPad test, and a salmonella/microsome assay). Sediments were also analyzed for 26 *n*-alkanes, pristane, phytane, 37 PAHs, and a cycloalkane biomarker (hopane).

**Multiple**, 1993. Numerous abstracts of reports from the Exxon Valdez oil spill. Pacific Seabird Group Bulletin **20**:44-47.
**Keywords:** Alaska/ bird/ effects/ Exxon Valdez/ oil/ oil spill/ Oone/ population/ Prudhoe Bay crude oil/ rehabilitation/ restoration/ salt water/ species/ spill
**Notes:** Numerous abstracts of reports of the effects of the Exxon Valdez oil spill on bird populations, individual species, rehabilitation, and restoration.

**Muniz, P., E. Danulat, B. Yannicelli, J. Garcia-Alonso, G. Medina, M. C. Bicego**, 2004. Assessment of contamination by heavy metals and petroleum hydrocarbons in sediments of Montevideo Harbour (Uruguay). Environment International **29**:1019-1028.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ harbour/ metals/ miscellaneous/ Oeleven/ petroleum/ petroleum hydrocarbons/ pollution/ salt water/ sediment/ time/ Uruguay
**Notes:** The sediments of Montevideo Harbor (Uruguay) were sampled at eight locations during the summer and winter of 1998. Samples were analyzed for eight metals, aliphatic hydrocarbons, and a set of 20 aromatic hydrocarbons.

**Munoz, D., M. Guiliano, P. Doumenq, F. Jacquot, P. Scherrer, G. Mille**, 1997. Long term evolution of petroleum biomarkers in mangrove soil (Guadeloupe). Marine Pollution Bulletin **34**:868-874.

**Keywords:** Arabian Light crude oil/ biomarker/ crude oil/ degradation/ fingerprinting/ hydrocarbons/ indicator/ light/ long-term/ mangrove/ oil/ Onine/ origin/ petroleum/ petroleum hydrocarbons/ salt water/ soil/ spill/ technical
**Notes:** Report of the degredation of petroleum hydrocarbons in mangrove soil during an 8-year period following a spill of Arabian Light crude oil. Analyses performed at 1, 4, and 8-years post-spill. Emphasis was on identifying compounds that would be good indicators of progressive degredation and that would be sufficiently resistant to be useful as 'identifiers' of the origin of the oil.

**Murray, A. P., B. J. Richardson, C. F. Gibbs**, 1991. Bioconcentration factors for petroleum hydrocarbons, PAHs, LABs and biogenic hydrocarbons in the blue mussel. Marine Pollution Bulletin **22** :595-603.
**Keywords:** aromatic hydrocarbons/ Australia/ benzene/ biogenic/ dissolved/ hydrocarbons/ marine invertebrate/ mussel/ Ofour/ oil/ PAH/ particulate/ petroleum/ petroleum hydrocarbons/ refinery/ salt water/ tissue/ total hydrocarbons/ urban
**Notes:** Determination of bioconcentration factors for hydrocarbons in the blue mussel. Water and mussel (cultured, placed on site for 3 mos) samples were collected from a site subject to urban drainage, near an oil refinery, and from two reference sites in coastal Australia. Water was analyzed for particulate and dissolved total hydrocarbons, aromatics, biogenic hydrocarbons, total linear alkyl benzenes, and three specific aromatics. Mussels were analyzed for the same set of analytes in tissue. Bioconcentration factors were calculated.

**Murray, M.**, 1987. Oil spill rehabilitation: results & recommendations for the future. Wildlife Journal **10**:17-20.
**Keywords:** bird/ oil/ oil spill/ oiled/ Oone/ physiology/ procedure/ rehabilitation/ salt water/ spill
**Notes:** Critical assessment of oiled bird rehabilitation procedures after the *Apex Houston* spill.

**Myers, A. A., T. Southgate, T. F. Cross**, 1980. Distinguishing the effects of oil pollution from natural cyclical phenomena on the biota of Bantry Bay, Ireland. Marine Pollution Bulletin **11**:204-207.
**Keywords:** barnacle/ effects/ gastropod/ Ireland/ marine invertebrate/ mussel/ numbers/ Ofour/ oil/ petroleum hydrocarbons/ pollution/ salt water/ sampling/ species/ tanker/ transect
**Notes:** An attempt to separate the influence of spilled 'oil' from a tanker from the influence of natural phenomena. One species of barnacle, two species of mussel, and one species of gastropod were monitored with sampling transects from July 1978 through July 1979 at three sites in Bantry Bay, Ireland. Numbers of organisms or percent cover (mussels) were measured.

**Mysore, D., T. Viraraghavan, Y.-C. Jin**, 2004. Removal of oil by vermiculite. Fresenius Environmental Bulletin **13**:560-567.
**Keywords:** evaluation/ mineral oil/ miscellaneous/ Oeleven/ oil/ petroleum/ spill response/ time
**Notes:** An evaluation of the petroleum sorption capacity of expanded and hydrophobized vermiculite. Oils used in the study were standard (light) mineral oil, canola oil, and Kutwell (KUT45). Determined the absorption capacity for pure oils and oils on a water medium, and the time to maximum absorption for all oils.

**Mysore, D., T. Viraraghavan, J. Yee-Chung**, 2005. Treatment of oily waters using vermiculite. Water Research **39** :2643-2653.
**Keywords:** absorption/ clay/ cutting oil/ effectiveness/ effluent/ mineral oil/ miscellaneous/ Oeleven/ oil/ pH/ refinery/ remediation/ time/ treatment/ vegetable oil/ water
**Notes:** The effectiveness of expanded vermiculite and hydrophobized vermiculite were determined with a laboratory assessment with standard mineral oil, canola oil, Kutwell cutting oil, and refinery effluent. Characterized both types of vermiculite, measured absorption time at four pHs, and determined oil removal capacities. Results were compared to the removal efficiencies of bentonite, powdered organo clay, and organo clay/anthracite determined in another study.

**Nadal, M., M. Schuhmacher, J. L. Domingo**, 2004. Metal pollution of soils and vegetation in an area with petrochemical industry. Science of the Total Environment **321**:59-69.
**Keywords:** concentration/ health/ metals/ miscellaneous/ Oeleven/ pollution/ refinery/ risk/ soil/ Spain/

urban/ vegetation
**Notes:** Twenty-four sites in a county in southeast Spain were sampled for soil (24) and chard (12). The samples were analyzed for concentrations of seven metals. Sample sites included industrial zones (many refineries), urban zones, residential zones, and several sites outside the county in 'unpolluted' areas. Metal concentrations were interpreted for their relation to human health risk.

**Nagelkerken, I. A., A. O. Debrot**, 1995. Mollusc communities of tropical rubble shores of Curacao: long-term (7+ years) impacts of oil pollution. Marine Pollution Bulletin **30**:592-598.
**Keywords:** beach/ community/ crude oil/ density/ long-term/ marine invertebrate/ mollusc/ Ofour/ oil/ oil spill/ pollution/ refined oil/ salt water/ species/ spill/ structure/ tar cover/ transect
**Notes:** Comparison of the long-term impact of crude and refined oil spills on the mollusc communities of Curacao. Selected four polluted (subjected to many spills $\geq$ 7 yrs previously) and four similar, but unpolluted, sites. Used transects to measure beach zone width, percent tar cover, mollusc density, and mollusc species density, and compared mollusc community structure.

**Naidenko, V. V., O. M. Grechkanev**, 2002. The state of components of the biota as an indicator of disturbances in natural ecosystems exposed to petrochemical pollution. Russian Journal of Ecology **33**:62-64.
**Keywords:** distance/ ecosystem/ freshwater invertebrate/ indicator/ length/ Ofive/ petroleum waste/ plant/ pollution/ species/ weight
**Notes:** A large petrochemical plant in Siberia generates large amounts of atmospheric pollutants. Authors collected and examined one species of beetle and one species of fly at distances from the plant of 0, 1, 10, and 15 km. Morphological characters were measured for the beetles and food for the flies was prepared using melted snow from the sampled sites. Measured body weight and length of the flies.

**Nakatani, R. E., A. E. Nevissi**, 1991. Effect of Prudhoe Bay crude oil on the homing of coho salmon in marine waters. North American Journal of Fisheries Management **11**:160-166.
**Keywords:** crude oil/ dispersant/ fish/ homing/ ODthree/ oil/ Prudhoe Bay/ Prudhoe Bay crude oil/ salmon/ salt water
**Notes:** Effect on homing of 2-3 year-old coho salmon exposed for 1 hr to Prudhoe Bay crude oil, chemically dispersed crude oil, or dispersant alone.

**Namkoong, W., E.-Y. Hwang, J.-S. Park, J.-Y. Choi**, 2002. Bioremediation of diesel-contaminated soil with composting. Environmental Pollution **119**:23-31.
**Keywords:** activity/ alkane/ bioremediation/ carbon dioxide/ compost/ degradation/ diesel/ diesel fuel/ experiment/ fresh water/ hydrocarbons/ microbes/ nutrients/ Oten/ petroleum/ petroleum hydrocarbons/ remediation/ soil/ time
**Notes:** An assessment of the amount of amendments needed to produce the best remediation of soil contaminated with diesel fuel. Soil containing 10,000 ppm of diesel fuel was mixed with either 10, 30, 50, or 100 % of sewage sludge or compost. Also, sludge only, compost only, 50 % sewage sludge with biocide, and 50 % compost with biocide were used. The experiment last 30 da. Measured total petroleum hydrocarbons, n-alkanes only, percent volatilization and degradation, $CO_2$ production, and dehydrogenase activity.

**Nance, J. M.**, 1991. Effects of oil/gas field produced water on the macrobenthic community in a small gradient estuary. Hydrobiologia **220**:189-204.
**Keywords:** abundance/ community/ concentration/ discharges/ diversity/ effects/ estuarine/ estuary/ evaluation/ hydrocarbons/ index/ marine invertebrate/ Ofour/ oil/ oil field/ produced water/ salinity/ salt water/ sampling/ sediment/ species/ stream
**Notes:** An evaluation of the effects of produced water from coastal oil wells on macrobenthos of an estuarine stream. Seventeen sampling stations were located from the stream mouth to 7,700 m upstream and sampled monthly for 1 yr. Sampling stations were located above and below a major produced-water discharge site. Measured salinity, sediment hydrocarbon concentration, species abundance, and calculated index of diversity.

**Nava, M. E., F. R. Engelhardt**, 1980. Compartmentalization of ingested labelled petroleum in tissues and bile of the American eel (*Anguilla rostrata*). Bulletin of Environmental Contamination and Toxicology **24**:879-885.
**Keywords:** accumulation/ bile/ blood/ brain/ concentration/ crude oil/ eel/ elimination/ fish/ gill/ heart/ hydrocarbons/ kidney/ labelled/ liver/ muscle/ Othree/ petroleum/ petroleum hydrocarbons/ tissue
**Notes:** Accumulation and elimination of labelled petroleum hydrocarbons from tissues and bile of the American eel; exposure by five daily doses at two petroleum concentrations, concentrations measured for 12 da in bile, liver,kidney, blood, heart, gill, muscle, and brain.

**Nava, M. E., F. R. Engelhardt**, 1982. Induction of mixed function oxidases by petroleum in the American eel, *Anguilla rostrata*. Archives of Environmental Contamination and Toxicology **11**:141-145.
**Keywords:** blood/ brain/ concentration/ crude oil/ eel/ effects/ fish/ fresh water/ gill/ heart/ intestine/ kidney/ liver/ metabolism/ mixed-function oxidase/ muscle/ oil/ Othree/ petroleum/ protein
**Notes:** Effects on induction of benzo(a)pyrene hydroxylase in liver, kidney, gill, muscle, intestine, heart, blood, and brain, and cytochrome P-450 in liver of American eels exposed to five daily doses of varying concentrations of crude oil; eels were monitored for 12 da after dosing. Also measured protein content of hepatic postmitochondrial fraction.

**Navas, J. M., M. Babin, S. Casado, C. Fernandez, J. V. Tarazona**, 2006. The Prestige oil spill: A laboratory study about the toxicity of the water-soluble fraction of the fuel oil. Marine Pollution Bulletin **62**:S352-S355.
**Keywords:** activity/ acute/ algae/ assay/ Bunker C/ cell/ chlorophyll/ concentration/ fuel oil/ growth/ marine invertebrate/ marine plant/ Ofour/ oil/ oil spill/ PAH/ protein/ reproduction/ salt water/ Spain/ species/ spill/ toxicity/ uptake
**Notes:** The water-soluble fraction of Bunker C fuel oil from the Prestige oil spill was tested for toxicity to RTG-2 cells, an algal species, and a cladoceran species. Measured B-galactosidase activity, neutral-red uptake, EROD, and protein content of cells for the RTG-2 cells. Measured growth inhibition (chlorophyll concentration, individual counts) for the algae. Measured acute toxicity and reproduction for the cladoceran. Used a series of dilutions for the assays and measured the total PAH content of each dilution.

**Nayar, S., B. P. L. Goh, L. M. Chou**, 2005. Environmental impacts of diesel fuel on bacteria and phytoplankton in a tropical estuary assessed using *in situ* mesocosms. Ecotoxicology **14**:397-412.
**Keywords:** aromatic/ aromatic hydrocarbon/ aromatic hydrocarbons/ bacteria/ biodegradation/ chlorophyll/ concentration/ diesel/ diesel fuel/ estuary/ experiment/ hydrocarbons/ marine plant/ mesocosm/ microbes/ Oten/ PAH/ parameters/ phytoplankton/ salt water/ sediment/ Singapore/ water
**Notes:** Surface and subsurface water and sediments from Ponggol estuary, Singapore were collected biweekly for 1 year and analyzed for aromatic hydrocarbons. Water quality parameters were also measured. Mean and maximum concentrations of PAHs in water and sediment were used in onsite mesocosms. Diesel fuel equivalent to the desired PAH concentrations was added to clean sediment or clean water in the mesocosms. Duration of the mesocosm experiment was 5 da. Measured (daily) phytoplankton production, chlorophyll *a* concentration, phytoplankton counts, autotrophic bacterial counts, heterotrophic bacterial counts, and heterotrophic bacterial production.

**Nechev, J. T., S. V. Khotimchenko, A. P. Ivanova, K. L. Stefanov, S. D. Dimitrova-Konaklieva, S. Andreev, S. S. Popov**, 2002. Effect of diesel fuel pollution on the lipid composition of some wide-spread Black Sea algae and invertebrates. Verlag der Zeitschrift for Naturforschung C **57**:339-343.
**Keywords:** algae/ biomass/ Black Sea/ diesel fuel/ fatty acids/ invertebrate/ lipid/ marine invertebrate/ marine plant/ mussel/ No.2 fuel oil/ Ofour/ pollution/ snail
**Notes:** Two species of green algae, one mussel species, and one snail species from the Black Sea were exposed for 3 da to 100 ppm diesel fuel in a laboratory aquarium (no mention of sample size, replicates, or biomass). Measured lipid composition and fatty acid composition of each species.

**Neff, J., T. Sauer, L. Osborn, P. Tazik, and L. Reitsema** 1995. An oil spill in an Illinois lake: ecological and human health assessment. Pages 415-420 *in* Proceedings 1995 International Oil Spill Conference, API 4620. American Petroleum Institute, Washington, D.C.

**Keywords:** benthic/ crude oil/ effects/ fish/ fresh water/ freshwater invertebrate/ freshwater plant/ general effect/ health/ humans/ Louisiana/ Louisiana crude oil/ macrophyte/ Oeight/ oil/ oil spill/ PAH/ plant/ South Louisiana crude oil/ spill/ survey/ time
**Notes:** Assessment of the biological and human health consequences of a spill of South Louisiana crude oil into an electric power plant cooling lake in Illinois, USA. Surveys began 9 da after the spill in 1985 and continued intermittently through August 1991. The lake was divided into zones of contamination and evaluated for effects on aquatic macrophytes, benthic fauna, and fish. Fish fillets from contaminated portions of the lake were analyzed for priority pollutant PAHs.

**Neff, J. M., B. A. Cox, D. Dixit, J. W. Anderson**, 1976. Accumulation and release of petroleum-derived aromatic hydrocarbons by four species of marine animals. Marine Biology **38**:279-289.
**Keywords:** accumulation/ aliphatic hydrocarbons/ aromatic hydrocarbons/ brain/ clam/ concentration/ depuration/ digestive gland/ fish/ flow-through/ fuel oil/ gall/ general effect/ gill/ heart/ hydrocarbons/ liver/ marine invertebrate/ muscle/ Oeight/ oil/ oyster/ release/ salt water/ shrimp/ species/ static/ time/ tissue
**Notes:** Exposure of a clam, oyster, fish, and shrimp to either 1% oil-in-water dispersion of No. 2 fuel oil for 4 da in a static system or 8 hrs in a flow-through system; or to the water-soluble fraction for 24 hrs in a static system. Depuration times ranged from 24 hrs to 672 hrs. A radio-labelled study with clams and benzo(a)pyrene had a depuration period of 1392 hrs. Measured selected aliphatic and aromatic hydrocarbons with most of the emphasis on selected aromatic hydrodrocarbons. Measured concentrations in clam and oyster tissue and exposure water; in head, abdomen, gills, exoskeleton, digestive gland, and exposure water of shrimp; and in gut, liver, gall, gills, heart, brain, and muscle of fish.

**Neff, J. M., R. E. Hillman, R. S. Carr, R. L. Buhl, J. I. Lahey**, 1987. Histopathologic and biochemical responses in Arctic marine bivalve molluscs exposed to experimentally spilled oil. Arctic **40**:220-229.
**Keywords:** Arctic/ biochemical/ bivalve/ condition/ crude oil/ effects/ experiment/ marine invertebrate/ mollusc/ ODfour/ oil/ oil spill/ pathology/ salt water/ species/ spill/ sublethal/ tissue
**Notes:** Assessment of the sublethal effects on two species of bivalve mollusc of experimental spills of chemically-dispersed and nondispersed crude oil. Part of the Baffin Island Oil Spill Project (BIOS). Sampled bivalves before exposure, immediately after exposure, 2 wks after exposure, and 1 yr after exposure. Determined histopathologic condition and measured a variety of soft tissue biochemicals.

**Neff, J. M., M. H. Bothner, N. J. Macielek, J. F. Grassle**, 1989. Impacts of exploratory drilling for oil and gas on the benthic environment of Georges Bank. Marine Environmental Research **27**:77-114.
**Keywords:** activity/ analysis/ barium/ benthic/ community/ concentration/ diversity/ environment/ epifauna/ fish/ general effect/ Georges Bank/ infauna/ marine invertebrate/ monitoring/ Oeight/ oil/ photograph/ population/ salt water/ sediment/ time
**Notes:** Description of a 3-yr monitoring program to assess the impacts of exploratory drilling for oil and gas in the Georges Bank. A total of 46 stations were established during 12 surverys carried out over a 4-yr period that covered before, during, and after drilling activities. Sediment samples and underwater photography were employed. Sediments were characterized and analyzed for concentrations of barium and chromium. Demersal fish and epifauna were identified from photographs. Infauna were identified and counted; diversity indices were calculated. Cluster analysis was used to analyze the benthic infaunal community.

**Neff, J. M., S. Ostazeski, W. Gardiner, I. Stejskal**, 2000. Effects of weathering on the toxicity of three offshore Australian crude oils and a diesel fuel to marine animals. Environmental Toxicology and Chemistry **19**:1809-1821.
**Keywords:** acute/ bioassay/ composition/ crude oil/ diesel/ diesel fuel/ effects/ evaporation/ fish/ larvae/ marine invertebrate/ offshore/ Ofour/ oil/ salt water/ sand/ sea urchin/ shrimp/ species/ static/ toxicity/ urchin/ weathered
**Notes:** Three Australian crude oils and an Australian diesel fuel were characterized for weathering (evaporation), chemical composition, and toxicity to six species of temperate and tropical marine animals. All oils were weathered for the equivalent of 1-3 hr, 0.5-1 da, and 2-5 da; water-accommodated fractions (WAF) were prepared for each. Test animals (fish, shrimp, mysids, sea urchin larvae or sand dollar larvae) were exposed to serial dilutions of 0, 8, 16, 64, and 100% WAF in 60 or 96-hr static acute bioassays; calculated LC & $EC_{50s}$.

**Neff, J. M., A. E. Bence, K. R. Parker, D. S. Page, J. S. Brown, P. D. Boehm**, 2006. Bioavailability of polycyclic aromatic hydrocarbons from buried shoreline oil residues thirteen years after the *Exxon Valdez* oil spill: a multispecies assessment. Environmental Toxicology and Chemistry **25**:947-961.
**Keywords:** aromatic/ aromatic hydrocarbon/ aromatic hydrocarbons/ bivalve/ clam/ crab/ crustacean/ Exxon Valdez/ fish/ general effects/ hazard/ health/ hydrocarbons/ intertidal/ lettuce/ marine invertebrate/ marine plant/ mussel/ Oeight/ oil/ oil spill/ oiled/ PAH/ risk assessment/ salt water/ sea lettuce/ sediment/ shoreline/ spill/ time/ transect
**Notes:** Subsurface sediment samples were collected from parallel shoreline transects in the intertidal zone (low intertidal, middle intertidal, upper intertidal) at 17 previously oiled sites, three unoiled reference sites, and four sites previously oiled by human activites. In addition, seven types of biota (mussels, clams, fish, worms, hermit crabs, sea lettuce, and whelks were also collected along the transects. All samples were analyzed for PAHs. Evaluated the results in terms of health hazard to wildlife consuming the sampled biota.

**Neff, J. M., S. Johnsen, T. K. Frost, T. I. Roe Utvik, G. S. Durell**, 2006. Oil well produced water discharges to the North Sea. Part II: Comparison of deployed mussels (*Mytilus edulis*) and the DREAM model to predict ecological risk. Marine Environmental Research **62**:224-246.
**Keywords:** bivalve/ discharges/ distance/ estimate/ marine invertebrate/ methods/ miscellaneous/ model/ mussel/ North Sea/ Norway/ Oeleven/ offshore/ oil/ oil field/ PAH/ produced water/ risk/ salt water/ tissue/ water
**Notes:** A comparison of two methods (DREAM model and deployed mussels) to estimate ecological risk from produced water discharges at two offshore oil and gas production fields (Norway). Analyzed water, produced water, and mussel tissue for PAH, decalins, and dibenzothiophenes. Caged mussels were deployed for one month at several distances from discharges.

**Negri, A. P., A. J. Heyward**, 2000. Inhibition of fertilization and larval metamorphosis of the coral *Acropora millepora* (Ehrenberg, 1834) by petroleum products. Marine Pollution Bulletin **41**:420-427.
**Keywords:** Australia/ bioassay/ concentration/ coral/ Corexit 9527/ crude oil/ dispersant/ fertilization/ marine invertebrate/ metamorphosis/ ODfour/ offshore/ oil/ petroleum/ petroleum products/ produced water/ salt water
**Notes:** The water accomodated fraction (WAF) of an Australian crude oil, production water from an offshore platform, and a dispersant (Corexit 9527) were used in a laboratory bioassay with coral. Exposure groups were WAF only, WAF + 1% dispersant, WAF + 10% dispersant, 1% dispersant only, 10% dispersant only, and production water. Determined the dilution of each mixture that produced no observed effect and significant inhibition of fertilization and subsequent metamorphosis.

**Nellemann, C., R. D. Cameron**, 1998. Cumulative impacts of an evolving oil-field complex on the distribution of calving caribou. Canadian Journal of Zoology **76**:1425-1430.
**Keywords:** Alaska/ caribou/ density/ development/ distribution/ female/ fresh water/ mammal/ oil field/ Otwo/ Prudhoe Bay/ reproduction/ survey/ transect
**Notes:** An assessment of the distribution and terrain use of caribou, particularly calving females, in the Kuparuk Development Area west of Prudhoe Bay, Alaska. Aerial surveys were performed annually 1987-90 and in 1992. Caribou were counted and classified, and the density of roads in each survey transect was determined.

**Nelson-Smith, A.** 1970. Effects of oil on marine plants and animals. Pages 273-291 *in* J. I. Waddington, editor. Water Pollution by Oil, Aviemore, Scotland.
**Keywords:** biological effects/ bird/ cleaning/ dispersant/ effects/ fish/ general effect/ marine invertebrate/ marine plant/ Oeight/ oil/ oil spill/ petroleum/ plant/ pollution/ review/ salt water/ spill
**Notes:** A review of the effects of petroleum on marine plants and animals. Sections on mechanical damage, toxic effects, observed effects at oil spills, and the biological effects of cleaning options. The paper is followed with the recorded comments of many persons who participated in a discussion period.

**Nelson-Smith, A.** 1977. Recovery of some British rocky seashores from oil spills and cleanup operations. Pages 191-207 *in* J. Cairns, Jr., K. L. Dickson, E. E. Herricks, editors. Recovery & Restoration of Damaged Ecosystems. University of Virginia Press, Charlottesville, VA.

**Keywords:** dispersant/ ecosystem/ effects/ general effect/ intertidal/ marine invertebrate/ marine plant/ ODeight/ oil/ oil spill/ recovery/ refinery/ restoration/ salt water/ spill
**Notes:** A generalized discussion of the effects of oil spills and chemical dispersants on the intertidal fauna and flora of Great Britain. Emphasis is on the *Torrey Canyon* oil spill and the extensive refinery operations around Milford Haven.

**Nelson, W. G.**, 1981. Inhibition of barnacle settlement by Ekofisk crude oil. Marine Ecology Progress Series **5**:41-43.
**Keywords:** barnacle/ crude oil/ effects/ Ekofisk crude oil/ experiment/ intertidal/ larvae/ marine invertebrate/ mixing/ Ofour/ oil/ rocky shore/ salt water/ weathered
**Notes:** Assessement of the effects of Ekofisk crude oil on barnacle settlement in the rocky intertidal zone. In one experiment, weathered (mechanical mixing with seawater for 3 d) crude oil was applied as either 2 l per $m^2$ or three consecutive daily applications of 0.67 l per $m^2$ . In a second experiment, weathered oil was applied as 2 l per $m^2$ and scraped off after 1 hr. Measured the amount of larval settlement after 3, 4, 5, 9, and 27 da.

**Nelson, W. G.**, 1982. Experimental studies of oil pollution on the rocky intertidal community of a Norwegian fjord. Journal of Experimental Marine Biology and Ecology **65**:121-138.
**Keywords:** abundance/ barnacle/ community/ crude oil/ experiment/ intertidal/ marine invertebrate/ Oeight/ oil/ oiled/ plant/ pollution/ population/ salt water/ shoreline
**Notes:** A series of three intertidal oiling experiments were perfomed with crude oil in a Norwegian fjord. Exper. 1 was the comparison of two different applications of oil. Exper. 2 was the comparison of a single application versus applications at five consecutive low tides. Exper. 3 was a single application on a moderately protected site versus on a moderately exposed site. Identified, determined abundance, and estimated mean cover of plant and animal taxa at 1-4 wks post exposure. Also measured percent of dead barnacles during exper. 3.

**Nevissi, A. E., R. E. Nakatani**, 1990. Effects of crude oil spill on homing migration of Pacific salmon. Northwest Environmental Journal **6**:79-84.
**Keywords:** behavior/ crude oil/ dispersant/ effects/ fish/ homing/ migration/ ODthree/ oil/ oil spill/ overview/ Pacific/ review/ salmon/ salt water/ species/ spill
**Notes:** Overview of research conducted on the effect of crude oil and chemically dispersed crude oil on the homing behavior of Pacific salmonids; some of the work was performed by the authors.

**Newey, S., R. Seed**, 1995. The effects of the *Braer* oil spill on rocky intertidal communities in south Shetland, Scotland. Marine Pollution Bulletin **30**:274-280.
**Keywords:** abundance/ community/ composition/ diversity/ effects/ general effect/ intertidal/ marine invertebrate/ marine plant/ Oeight/ oil/ oil spill/ salt water/ Scotland/ Shetland/ species/ spill
**Notes:** An assessment of the effects of the *Braer* oil spill on intertidal flora and fauna of south Shetland. Between June and August, 29 sites were surveyed for low, middle, and upper intertidal community composition. Only the mid- and upper community results are presented; identified species, estimated relative abundance, and calculated indicies of diversity.

**Newman, S. H., D. W. Anderson, M. H. Ziccardi, J. G. Trupkiewicz, F. S. Tseng, M. M. Christopher, J. G. Zinkl**, 2000. An experimental soft-release of oil-spill rehabilitated American coots (*Fulica americana*): II. Effects on health and blood parameters. Environmental Pollution **107**:295-304.
**Keywords:** activity/ bird/ blood/ condition/ crude oil/ effects/ experiment/ fresh water/ health/ numbers/ oil/ oil spill/ Oone/ parameters/ pathology/ physiology/ release/ serum/ spill/ wetland
**Notes:** Rehabilitated (crude oil spill) and reference coots were transferred to experimental wetlands and compared for post-release physiological effects. This appears to be a companion study to Anderson et al. (2000) but the activity dates and oil spill description are different. All birds (n = 42 for rehabilitated and reference) were sampled for blood at the beginning of the study (56 da post oil exposure); smaller numbers were subsequently sampled at 81, 108, and 140 da post-exposure. Necropsied 11 rehabilitated coots that died during the experiment. Measured blood serum chemistries, blood characteristics, and pathological condition of dead rehabilitated coots.

**Newton, L. C., J. D. McKenzie**, 1995. Echinoderms and oil pollution: a potential stress assay using bacterial symbionts. Marine Pollution Bulletin **31**:453-456.
**Keywords:** assay/ bacteria/ brittlestar/ cuttings/ drilling mud/ echinoderm/ evaluation/ experiment/ marine invertebrate/ miscellaneous/ North Sea/ Ofour/ oil/ oil spill/ oil-based/ pollution/ salt water/ species/ spill/ stress/ symbiotic/ tissue/ weight
**Notes:** Evaluation of the effect of oil contamination on the symbiotic bacteria of three species of echinoderms (brittlestars). In one experiment, brittlestars were exposed to 1/10, 1/100, or 1/1000 dilutions of oil-based drill cuttings for 2 wk; cuttings were replaced daily. In a second experiment, one brittlestar was subjected to a single exposure of a 1/1000 dilution and monitored for 2 wk. In addition, all three species were collected from sites in the North Sea following the *Braer* oil spill. Measured the number of bacteria per unit weight of homogenized arm tissue.

**Nichols, J. A., I. C. White**, 1979. Aerial application of dispersants in Bantry Bay following the *Betelgeuse* incident. Marine Pollution Bulletin **10**:193-197.
**Keywords:** Arabian crude oil/ coast/ crude oil/ dispersant/ England/ miscellaneous/ ODeleven/ oil/ oil spill/ salt water/ spill/ spill response
**Notes:** An account of the first known use of aircraft to apply chemical oil dispersants to a marine oil spill. The spill of Arabian crude oil along the coast of England was treated with BP 1100 WD concentrate.

**Nichols, J. A. and H. D. Parker** 1985. Dispersants: comparison of laboratory tests and field trials with practical experience at spills. Pages 421-427 *in* 1985 Oil Spill Conference, API Publication 4385. American Petroleum Institute, Washington, D.C.
**Keywords:** dispersant/ effectiveness/ evaluation/ ODnine/ oil/ oil spill/ review/ salt water/ spill/ technical
**Notes:** A review and evaluation of data on effectiveness of chemical dispersants. Sections on laboratory testing, sea trials, and experience at oil spills. Authors discuss the shortcomings of current knowledge and present recommendations for further research.

**Nicholson, B. L., A. N. Perakis, J. W. Bulkley**, 2003. Environmental Assessment. Seaborne petrochemical spill analysis within the United States, 1992-1999. Environmental Management **31**:532-545.
**Keywords:** analysis/ evaluation/ miscellaneous/ Oeleven/ oil/ oil spill/ salt water/ spill/ tanker
**Notes:** An assessment of accidental marine oil spills in U.S. waters during the period 1992-99. Discusses mandates of OPA90, tanker design, spills from failure incidents, spills from accidents, and provides concluding comments.

**Nicholson, G. J., T. Theodoropoulos, G. J. Fabris**, 1994. Hydrocarbons, pesticides, PCB and PAH in Port Phillip Bay (Victoria) sand flathead. Marine Pollution Bulletin **28**:115-120.
**Keywords:** Australia/ fish/ hydrocarbons/ liver/ muscle/ Othree/ PAH/ PCB/ pesticide/ petroleum/ petroleum hydrocarbons/ salt water/ sand/ survey
**Notes:** Results of a survey of the petroleum hydrocarbons, pesticides, PCBs, and select PAHs in muscle and liver of sand flathead fish from Port Phillip Bay, Australia.

**Nicol, J. A. C., W. H. Donahue, R. T. Wang, K. Winters**, 1977. Chemical composition and effects of water extracts of petroleum on eggs of the sand dollar *Melitta quinquiesperforata*. Marine Biology **40**:309-316.
**Keywords:** aromatic hydrocarbons/ composition/ crude oil/ development/ effects/ eggs/ fertilization/ fuel oil/ hydrocarbons/ Kuwait/ Kuwait crude oil/ marine invertebrate/ motility/ No.2 fuel oil/ Ofour/ oil/ oxygen/ permeability/ petroleum/ respiration/ salt water/ sand/ sperm/ uptake
**Notes:** Determined the effects of water-soluble fractions (WSF) of No. 2 fuel oil and Kuwait crude oil on the eggs and sperm of sand dollars. Eggs and sperm were exposed to 50% Kuwait WSF or 2 - 50% No. 2 fuel oil WSF. Measured the aromatic hydrocarbon content of the fuel oil WSF, permeability of exposed eggs to water, fertilization, cleavage, larval development, motility of sperm, and oxygen uptake of sperm.

**Nicolotti, G., S. Egli**, 1998. Soil contamination by crude oil: impact on the mycorrhizosphere and on the revegetation potential of forest trees. Environmental Pollution **99**:37-43.
**Keywords:** biomass/ colonization/ concentration/ crude oil/ effects/ fresh water/ freshwater plant/ fungi/

growth/ length/ Norway/ oil/ Oseven/ poplar/ roots/ seedling/ soil/ species/ spruce
**Notes:** Effects of various concentrations of crude oil in soil (0.1, 1, 5, 10, 20, 50 g/kg) on the growth of seedlings of Norway spruce and poplar and on the ability of ecotomycorrhizal fungi to colonize the seedlings. Tested 10 species of fungi. All tests conducted at 0-42 da post oil contamination. Measured shoot length and biomass and percent colonization of roots.

**Nihoul, C., J.-P. Ducrotoy**, 1994. Impact of oil on the marine environment: policy of the Paris Commission on operational discharges from the offshore industry. Marine Pollution Bulletin **29**:323-329.
**Keywords:** community/ cuttings/ discharges/ effects/ environment/ general effect/ marine environment/ North Sea/ Oeight/ offshore/ oil/ petroleum/ policy/ produced water/ salt water/ spill
**Notes:** A report on offshore oil discharges in the North Sea by the Paris Commission. Sections on the impact on the marine environment, operational discharges, inputs, effects of production water, effects of drilling operations, accidental spills, and the Paris Commission's programs and measures. Columns in Figure 1 are mislabelled.

**Nisbet, I. C. T.** 1975. Conservation of marine birds in northern North America -- a summary. Pages 1-16 *in* J. C. Bartonek, D. N. Nettleship, editors. Conservation of marine birds of northern North America: papers from the international symposium held at the Seattle Hyatt House, Seattle, Washington, 13-15 May 1975. Wildlife research report. U.S. Fish and Wildlife Service, Washington, D.C.
**Keywords:** bird/ conservation/ marine birds/ North America/ oil/ Oone/ pollution/ population/ salt water/ spill/ Washington/ natural resource/ fish
**Notes:** Summary of a conference dedicated to assessing the status of marine birds in North America; oil pollution is mentioned as the primary anthropogenic threat to bird populations.

**Nishigima, F. N., R. R. Weber, M. C. Bicego**, 2001. Aliphatic and aromatic hydrocarbons in sediments of Santos and Cananeia, SP, Brazil. Marine Pollution Bulletin **42**:1064-1072.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ Brazil/ coast/ estuarine/ hydrocarbons/ miscellaneous/ Oeleven/ salt water/ sediment
**Notes:** Surface sediments were collected from estuarine and harbor areas of an industrial and heavily populated area and from a sparsly populated area on the coast of Brazil. Nine sediment samples were collected from each area. Sediments were analyzed for *n*-alkanes and aromatic hydrocarbons.

**Nocentini, M., D. Pinelli, F. Fava**, 2000. Bioremediation of a soil contaminated by hydrocarbon mixtures: the residual concentration problem. Chemosphere **41**:1115-1123.
**Keywords:** bacteria/ biodegradation/ biomass/ bioremediation/ combination/ concentration/ consumption/ diesel/ diesel fuel/ hydrocarbon mixture/ hydrocarbons/ kerosene/ microbes/ microcosm/ mineral oil/ oil/ Oten/ oxygen/ petroleum/ petroleum hydrocarbons/ soil/ statistics/ time
**Notes:** Assessment of the biodegradation in three soils of kerosene, diesel fuel, or lubricating mineral oil. Glass bottle microcosms were used over a 275 da period to incubate and degrade the contaminated soils. Two control microcosms were used but there was no replication of the nine experimental combinations (hence, no statistics). Measured total petroleum hydrocarbons, oxygen consumption, and bacterial biomass.

**Noel, L. E., R. H. Pollard, W. B. Ballard, M. A. Cronin**, 1998. Activity and use of active gravel pads and tundra by caribou, *Rangifer tarandus granti*, within the Prudhoe Bay oil field, Alaska. Canadian Field-Naturalist **112**:400-409.
**Keywords:** activity/ Alaska/ avoidance/ behavior/ caribou/ composition/ evaluation/ gravel/ mammal/ mosquito/ oil/ oil field/ Otwo/ Prudhoe Bay/ size/ tundra
**Notes:** Evaluation of the timing, activity, duration of use, and response to disturbance of caribou, in relation to parasitic insect activity, on oil field gravel pads and tundra within 1000 m of roads and pads. Used ground observations and time-lapse videography from late June through July. Also recorded insect avoidance behavior, group size, and group composition.

**Norton, D. W.**, 1977. Oil in the Arctic. 1. Historical, environmental and regional perspectives. Interdisciplinary Science Review **2**:207-214.
**Keywords:** Alaska/ Arctic/ evaluation/ miscellaneous/ Oeleven/ oil/ oil field/ pipeline/ policy/ pollution/

Prudhoe Bay
**Notes:** An evaluation of the relation of Arctic oil to environmental, political, and social concerns in Alaska during the mid-1970s. A good background document for understanding the evolution of the Alaskan pipeline and the exploitation of the Prudhoe Bay oil field.

**Nounou, P.**, 1980. The oil spill age. Fate and effects of oil in the marine environment. Ambio **9**:29-302.
**Keywords:** age/ community/ effects/ environment/ fate/ general effect/ hydrocarbons/ marine environment/ Oeight/ oil/ oil spill/ petroleum/ petroleum hydrocarbons/ salt water/ spill/ toxicity/ treatment
**Notes:** A general treatment of the subject of petroleum in the marine environment as known in 1980. Sections on the fate of hydrocarbons, toxicological effects on marine organisms, and ecological impact on the marine environment.

**Nour El-Din, N. M., M. A. R. Abdel-Moati**, 2001. Accumulation of trace metals, petroleum hydrocarbons, and polycyclic aromatic hydrocarbons in marine copepods from the Arabian Gulf. Bulletin of Environmental Contamination and Toxicology **66**:110-117.
**Keywords:** accumulation/ alkane/ Arabian Gulf/ aromatic hydrocarbons/ coast/ copepod/ hydrocarbons/ marine invertebrate/ metals/ Ofour/ PAH/ petroleum/ petroleum hydrocarbons/ Qatar/ salt water
**Notes:** Copepod samples were collected from a reference site and locations near the west (n = 2) and east coasts (n = 20) of Qatar during the summer and winter. Copepods were analyzed for a suite of alkanes, 16 PAHs, and six metals. The purpose of the study was to document the current status of coastal contamination from increasing coastal industrialization.

**Nulton, C. P., D. E. Johnson**, 1981. Aromatic hydrocarbons in marine tissues from the central Gulf of Mexico. Journal of Environmental Science and Health **A16**:271-288.
**Keywords:** aromatic hydrocarbons/ concentration/ condition/ crab/ crude oil/ fish/ gill/ gonads/ Gulf of Mexico/ hydrocarbons/ liver/ macroinvertebrate/ marine invertebrate/ Mexico/ muscle/ oil/ Othree/ oyster/ salt water/ shrimp/ species/ tissue
**Notes:** Assessment of aromatic hydrocarbons in the muscle of demersal fish and macroinvertebrates and the muscle, liver, and gill or gonads from pelagic fish sampled from the northern Gulf of Mexico; purpose was to establish a baseline condition before extensive oil drilling.

**Nunes, P., P. E. Benville, Jr.**, 1978. Acute toxicity of the water-soluble fraction of Cook Inlet crude oil to the Manila clam. Marine Pollution Bulletin **9**:324-331.
**Keywords:** acute/ aromatic hydrocarbons/ benzene/ bioassay/ clam/ concentration/ Cook Inlet crude oil/ crude oil/ hydrocarbons/ marine invertebrate/ methods/ Ofour/ oil/ salt water/ static/ survival/ toxicity
**Notes:** Determination of the acute toxicity to Manila clams of the water-soluble fraction (WSF) of Cook Inlet crude oil. Investigators employed experimental exposure methods; a 14-da continuous-flow bioassay using the WSF, a 96-hr continuous-flow bioassay using benzene only, a 96-hr continuous-flow bioassay using WSF and clams from a pristine and a polluted area, a 96-hr static bioassay using WSF, and an 8-da continuous-flow bioassay using WSF. Measured water concentrations of six aromatic hydrocarbons and survival of clams.

**Nunes, P., P. E. Benville, Jr.**, 1979. Uptake and depuration of petroleum hydrocarbons in the Manila clam, *Tapes semidecussata* Reeve. Bulletin of Environmental Contamination and Toxicology **21**:719-726.
**Keywords:** aromatic hydrocarbons/ bioassay/ clam/ concentration/ Cook Inlet crude oil/ crude oil/ depuration/ evaluation/ hydrocarbons/ marine invertebrate/ Ofour/ oil/ petroleum/ petroleum hydrocarbons/ salt water/ tissue/ uptake
**Notes:** Evaluation of the uptake and depuration of Manila clams exposed to the water-soluble fraction (WSF) of Cook Inlet crude oil. Clams exposed to WSF in a continuous-flow bioassay for 8 da followed by 14 da of depuration. Measured concentrations of six aromatic hydrocarbons in the water and in clam soft tissue.

**Nunes, P., P. E. Benville, Jr.**, 1979. Effects of the water-soluble fraction of Cook Inlet crude oil on the marine alga, *Dunalliela tertiolecta*. Bulletin of Environmental Contamination and Toxicology **21**:727-732.
**Keywords:** algae/ concentration/ Cook Inlet crude oil/ crude oil/ effects/ growth/ marine plant/ oil/ Osix/ population/ salt water

**Notes:** Exposure of a marine algae to six concentrations of the water-soluble fraction of Cook Inlet crude oil. Culture duration was 72 hr. Measured growth of the culture [*x* and *y* axis of Fig. 1 not labelled].

**Nwokolo, E., L. O. C. Ohale**, 1986. Growth and anatomical characteristics of pullet chicks fed diets contaminated with crude petroleum. Bulletin of Environmental Contamination and Toxicology **37**:441-447.
**Keywords:** bird/ chicken/ chicks/ concentration/ crude oil/ diet/ feeding/ growth/ oil/ Oone/ organ/ petroleum/ survival/ weight
**Notes:** Results of feeding chicks (chickens) diets containing varying concentrations of crude oil; survival, body weight, and organ weights were measured.

**Nyman, M., M. Bergknut, M. L. Fant, H. Raunio, M. Jestoi, C. Bengs, A. Murk, J. Koistinen, C. Backman, O. Pelkonen, M. Tysklind, T. Hirvi, E. Helle**, 2003. Contaminant exposure and effects in Baltic ringed and grey seals as assessed by biomarkers. Marine Environmental Research **55**:73-99.
**Keywords:** age/ Arctic/ biochemical/ biomarker/ blood/ blubber/ Canada/ concentration/ condition/ DDT/ effects/ grey seal/ liver/ mammal/ Otwo/ PCB/ plasma/ pollution/ ringed seal/ salt water/ seal/ Svalbard
**Notes:** Baltic ringed seals (29) and grey seals (30) were collected from Bothnian Bay, Finland. Reference ringed seals (29) were collected from Svalbard, the Arctic and grey seals (20) were collected from Sable Island, Canada. Liver, blubber, and blood were collected from the seals. Age and condition of seals were estimated. Livers were analyzed for Hg, Se, Cd, Pb, total DDT, and total PCBs. Blood was analyzed for cytochrome P450, blood characteristics, and a suite of biochemicals. Vitamin A and E concentrations were determined in liver, blubber, and blood plasma. Results were evaluated for their potential as biomarkers of environmental pollution.

**O'Clair, C. E., S. D. Rice**, 1985. Depression of feeding and growth rates of the seastar *Evasterias troschelii* during long-term exposure to the water-soluble fraction of crude oil. Marine Biology **84**:331-340.
**Keywords:** aromatic hydrocarbons/ bioassay/ concentration/ Cook Inlet crude oil/ crude oil/ effects/ feeding/ flow-through/ gonads/ growth/ hydrocarbons/ long-term/ marine invertebrate/ mussel/ Ofour/ oil/ rate/ salt water/ survival/ weight
**Notes:** Determined the effects of the water-soluble fraction (WSF) of Cook Inlet crude oil on the feeding and growth rates of a seastar. The seastar predator and its prey (mussel) were exposed to six concentrations of WSF for 28 da in a flow-through bioassay. Measured concentrations of 10 aromatic hydrocarbons in the water, survival of seastars, feeding characteristics, growth rates, and weights of seastar pyloric caeca and gonads.

**O'Sullivan, A. J.**, 1978. The *Amoco Cadiz* oil spill. Marine Pollution Bulletin **9**:123-128.
**Keywords:** Amoco Cadiz/ Arabian crude oil/ beach/ biological effects/ coast/ crude oil/ effects/ France/ general effect/ Oeight/ oil/ oil spill/ salt water/ spill
**Notes:** An early account of events following the 1978 wreck of the *Amoco Cadiz* off the Brittany coast of France. Presented are sections on the sequence of events, beach clean-up, appearance of the oil, biological effects, studies underway, and preliminary conclusions.

**Obbard, J. P., K. L. Ng, R. Xu**, 2004. Bioremediation of petroleum contaminated beach sediments: use of crude palm oil and fatty acids to enhance indigenous biodegradation. Water Air and Soil Pollution **157**:149-161.
**Keywords:** activity/ aliphatic hydrocarbons/ alkane/ analysis/ Arabian Light crude oil/ bacteria/ beach/ biodegradation/ bioremediation/ crude oil/ experiment/ fatty acids/ hydrocarbons/ inorganic/ light/ microbes/ microcosm/ nutrients/ oil/ Oten/ palm oil/ petroleum/ sand/ sediment/ tilling/ weathered
**Notes:** Beach sand was spiked with Arabian light crude oil, weathered with tilling for 15 da, and supplemented with inorganic nutrients. Experimental microcosms consisted of biotic and abiotic controls or amended with either crude palm oil, mynstic acid, oleic acid, linoleic acid, or palmitic acid. Amendments occurred on days 0, 12, and 20. The duration of the experiment was 30 da. Sediments were sampled on days 0, 5, 9, 20, and 30 for determination of microbial dehydrogenase activity and analysis of selected alkane hydrocarbons. Dehydrogenase activity was also determined on day 2. Hydrocarbon degrading bacteria were quantified on days 0 and 30, except for the abiotic control which was quantified 3 hr after sterilization.

**Odu, C. T. I.**, 1978. The effect of nutrient application and aeration on oil degradation in soil. Environmental Pollution **15**:235-240.
**Keywords:** ammonia/ ammonium/ bacteria/ biodegradation/ combination/ concentration/ crude oil/ degradation/ fungi/ incubation/ microbes/ Nigerian crude oil/ nutrients/ oil/ Oten/ respiration/ soil/ sulfate/ time
**Notes:** Soil was combined with two concentrations of Nigerian crude oil plus water, nutrients (undefined), ammonium sulfate, and aeration/nonaeration in various combinations. The combinations were incubated for 12 wks. The soil was chemically characterized and the concentrations of bacteria and fungi determined. Soil containers were sampled at weeks 2, 4, 8, and 12. The higher oil concentration containers were subjected to a respiration measurement and microbe concentrations were measured at the end of the incubation period.

**Ogata, M., Y. Miyake, S. Kira, K. Matsunaga, M. Imanaka**, 1977. Transfer to fish of petroleum paraffins and organic sulfur compounds. Water Research **11**:333-338.
**Keywords:** accumulation/ Arabian Light crude oil/ crude oil/ eel/ fish/ fresh water/ light/ monoaromatic/ oil/ organic/ organic sulfur/ organoleptic/ Othree/ paraffin/ petroleum/ sulfur/ transfer
**Notes:** Exposure of eels to Arabian Light crude oil and the subsequent accumulation of straight and branched chain paraffins, monoaromatics, and organic sulfur compounds; eels exposed for up to 15 da, organoleptic test also.

**Ogboghodo, I. A., E. K. Iruaga, I. O. Osemwota, J. U. Chokor**, 2004. An assessment of the effects of crude oil pollution on soil properties, germination and growth of maise (*Zea mays*) using two crude types -- Forcados Light and Escravos Light. Environmental Monitoring and Assessment **96**:143-152.
**Keywords:** concentration/ corn/ crude oil/ effects/ experiment/ freshwater plant/ germination/ growth/ light/ oil/ Oseven/ plant/ pollution/ seed/ soil/ toxicity
**Notes:** Two types of crude oil were mixed with soil and used in three toxicity experiments with corn seeds. The first experiment employed four concentrations of crude oil mixed in soil 1 wk before seeding. The second experiment employed the same concentrations but the oil was added 2 wks after seeding when corn plants were 35-45 cm high. The third experiment was similar to the second except that concentrations were lower than in the first two experiments. Measured seed germination and plant growth. Chemical properties of soils were determined 6 wks after the higher amounts of crude oil were added.

**Ogboghodo, I. A., E. B. Erebor, I. O. Osemwota, H. H. Isitekhale**, 2004. The effects of application of poultry manure to crude oil polluted soils on maize (*Zea mays*) growth and soil properties. Environmental Monitoring and Assessment **96**:153-161.
**Keywords:** biomass/ corn/ crude oil/ effects/ experiment/ freshwater plant/ germination/ growth/ light/ nutrients/ oil/ Oseven/ plant/ seed/ soil
**Notes:** Three quantities (plus control) of crude oil (Escravos light) were applied to soil and allowed to stand for 2 wks. Three quantities of poultry manure were then added to the soils, mixed in, and allowed to stand for 2 more wks. Corn seeds were then planted and monitored for 6 wks. Measured seed germination, plant height, and biomass yield. Also determined properties of the manure, starting soil, and soil at the end of the experiment.

**Oh, Y.-S., D.-S. Sim, S.-J. Kim**, 2001. Effects of nutrients on crude oil biodegradation in the upper intertidal zone. Marine Pollution Bulletin **42**:1367-1372.
**Keywords:** Arabian Light crude oil/ biodegradation/ coast/ concentration/ crude oil/ degradation/ effects/ experiment/ fertilizer/ indicator/ intertidal/ light/ microbes/ microcosm/ nutrients/ oil/ Oten/ population/ pore water/ rate/ ratio/ release/ salt water/ sand
**Notes:** Laboratory microcosms simulating a marine coast line were used to evaluate the effect of nutrient enhancement on the microbial degradation of crude oil. Sand was mixed with Arabian light crude oil and a mixture of hydrocarbon-degrading microorganisms. Fertilizer, as slow release pellets, was added in two concentrations. The experiment ran for 100 da. Measured inorganic nutrients in pore water, microbe population change in sand and pore water, degradation rates of petroelum fractions, and molecular ratios used as indicators of degradation.

**Ohwada, K., M. Nishimura, M. Wada, H. Nomura, A. Shibata, K. Okamoto, K. Toyoda, A. Yoshida, H. Takada, M. Yamada**, 2003. Study of the effect of water-soluble fractions of heavy-oil on coastal marine organisms using enclosed ecosystems, mesocosms. Marine Pollution Bulletin **47**:1-6.
**Keywords:** bacteria/ chlorophyll/ community/ concentration/ ecosystem/ experiment/ marine plant/ mesocosm/ microbes/ miscellaneous/ oil/ Osix/ petroleum/ residual oil/ salt water/ sediment/ solubility/ water column
**Notes:** Experimental mesocosms were used to determine the effect of heavy residual oil on marine water column organisms. The water soluble fraction of the residual oil was added to a low exposure (X) tank and a high exposure (3X) tank. Each tank had seawater and sediment. Experiment duration was 1 wk. Measured bacteria, heterotrophic nano-flagellates, viruses, chlorophyll *a* concentration, and petroleum concentrations in each tank.

**Oka, N., M. Okuyama**, 2000. Nutritional status of dead oiled rhinoceros auklets (*Cerorhinca monocerata*) in the southern Japan Sea. Marine Pollution Bulletin **40**:340-347.
**Keywords:** bird/ bone/ bone marrow/ condition/ evaluation/ fishery/ Japan/ lipid/ liver/ muscle/ nutrition/ oiled/ Oone/ salt water/ tissue/ weight/ whole body
**Notes:** Evaluation of the nutritional status of dead oiled and non-oiled (fishery by-catch and predation) rhinoceros auklets from the Japan Sea (oiled) and four other locations. All birds were necropsied and tissues removed. Compared mass, moisture, and lipid of whole body, liver, muscle, uropygial gland, and bone marrow. Performed a number of regressions of paired measures.

**Okoh, A. I., G. O. Babalola, M. K. Bakare**, 1996. Microbial densities and physicochemical quality of some crude oil flow stations' saver pit effluents in the Niger Delta areas of Nigeria. Science of the Total Environment **187**:73-78.
**Keywords:** chemical analysis/ crude oil/ density/ effluent/ fresh water/ microbes/ Nigeria/ oil/ Oten/ region/ waste water
**Notes:** Examination of saver pit effluents from crude oil flow stations in the Niger Delta region of Nigeria. Measured wastewater characteristics and microbial densities during October, November, December, and January.

**Okpolwasili, G. C., L. O. Odokuma**, 1994. Tolerance of *Nitrobacter* to toxicity of some Nigerian crude oils. Bulletin of Environmental Contamination and Toxicology **52** :388-395.
**Keywords:** bacteria/ concentration/ crude oil/ fresh water/ freshwater invertebrate/ incubation/ Nigerian crude oil/ nitrification/ Ofive/ oil/ respiration/ survival/ toxicity
**Notes:** Determination of the effect of six Nigerian crude oils on *Nitrobacter* bacteria. Bacteria were subjected to one of four concentrations of crude oil for a 4-hr incubation period. Measured survival, respiration, and nitrite utilization, and calculated LC, EC, and $IC_{50}$ concentrations.

**Olagbende, O. T., G. O. Ede, L. E. D. Inyang, E. R. Gundlach, E. S. Gilfillan, D. S. Page**, 1999. Scientific and cleanup response to the Idoho-QIT oil spill, Nigeria. Environmental Technology **20**:1213-1222.
**Keywords:** cleaning/ crude oil/ general effect/ long-term/ Nigeria/ Oeight/ offshore/ oil/ oil spill/ pipeline/ salt water/ short-term/ spill/ survey
**Notes:** A description of the scientific and cleanup response to an offshore pipeline rupture near Eket, Nigeria. Results are presented for the cleanup effort and the short-term environmental surveys. Longer-term studies are described but no results are presented.

**Oleszczuk, P., S. Baran**, 2003. Degradation of individual polycyclic aromatic hydrocarbons (PAHs) in soil polluted with aircraft fuel. Polish Journal of Environmental Studies **12**:431-437.
**Keywords:** aromatic hydrocarbons/ aviation gasoline/ degradation/ hydrocarbons/ microbes/ Oten/ PAH/ pollution/ soil
**Notes:** Soils from two sites vulnerable to PAH pollution were collected and used in a degradation study of aircraft fuel. Containers of soil were contaminated with aircraft fuel and monitored for 362 da. Samples were collected on days 7, 25, 105, 191, and 362 and analyzed for 10 PAHs. Soil chemical and physical properties of the sampled soils were also determined.

**Olivera, F. L., R. C. Loehr, B. C. Coplin, H. Eby, M. T. Webster**, 1998. Prepared bed land treatment of soils containing diesel and crude oil hydrocarbons. Journal of Soil Contamination **7**:657-674.
**Keywords:** analysis/ bioremediation/ crude oil/ diesel/ diesel fuel/ hydrocarbons/ microbes/ Microtox/ oil/ Oten/ petroleum/ petroleum hydrocarbons/ soil/ toxicity/ treatment
**Notes:** A field-scale, prepared-bed land treatment unit was used to bioremediate soil containing 30-40 yr-old crude oil and soil containing 3-yr-old diesel fuel. Both soils were fertilized and sampled monthly for total petroleum hydrocarbon analysis, a suite of soil characteristics, and tested for toxicity (Microtox). The treatment units were operated for slightly more than a year for both soils.

**Olla, B. L., A. J. Bejda, W. H. Pearson**, 1983. Effects of oiled sediment on the burrowing behaviour of the hard calm, *Mercenaria mercenaria*. Marine Environmental Research **9**:183-193.
**Keywords:** behavior/ burrowing/ clam/ concentration/ crude oil/ depth/ effects/ evaluation/ experiment/ juvenile/ marine invertebrate/ Ofour/ oil/ oiled/ Prudhoe Bay/ Prudhoe Bay crude oil/ rate/ salt water/ sand/ sediment/ substrate
**Notes:** Evaluation of the effect of Prudhoe Bay crude oil on the burrowing behavior of juvenile hard clams. Two identical experiments were performed wherein the clams were placed in sand containing 10,000 ppm crude oil. Exposure lasted for 96 hr followed by removal to clean sand for another 96 hr. Measured total oil concentration in sand substrate, rate of clam burrowing, and depth of burial after 96 hr.

**Olla, B. L., A. J. Bejda, A. L. Studholme, W. H. Pearson** , 1984. Sublethal effects of oiled sediment on the sand worm, *Nereis (Neanthes) virens*: induced changes in burrowing and emergence. Marine Environmental Research **13**:121-139.
**Keywords:** behavior/ burrowing/ concentration/ crude oil/ effects/ emergence/ evaluation/ experiment/ hydrocarbons/ marine invertebrate/ Ofour/ oil/ oiled/ petroleum hydrocarbons/ Prudhoe Bay/ Prudhoe Bay crude oil/ salt water/ sand/ sand worm/ sediment/ sublethal/ total hydrocarbons/ transfer/ weathered
**Notes:** Evaluation of the effect on the burrowing behavior of sand worms of exposure to Prudhoe Bay crude oil. Two experiments were conducted. One experiment used two concentrations of fresh crude oil weathered in the aquarium for 24 hr before the sand worms were introduced to oiled sediment for 96 hrs. A second experiment used five concentrations of crude oil weathered for 24 to 240 hr before sand worm introduction for 12 hrs. Worms from both experiments were subsequently removed and transferred to clean sand for further observation. Measured total hydrocarbons in the sand, emergence and burrowing behavior during oil exposure, and emergence and burrowing behavior after transfer to clean sand.

**Olson, J. J., G. L. Mills, B. E. Herbert, P. J. Morris**, 1999. Biodegradation rates of separated diesel components. Environmental Toxicology and Chemistry **18**:2448-2453.
**Keywords:** alkane/ aromatic hydrocarbons/ biodegradation/ concentration/ diesel/ diesel fuel/ experiment/ hydrocarbon mixture/ hydrocarbons/ microbes/ Oten/ petroleum hydrocarbons/ rate
**Notes:** Determination of biodegradation rates for three classes of hydrocarbons in diesel fuel. Fractionated diesel fuel into *n*-alkanes, branched and cyclic alkanes, aromatics, and a composite of the fractions. The hydrocarbon mixtures were each subjected to a 35-da microbial batch culture experiment. Measured hydrocarbon concentrations during the test period.

**Omoregie, E., B. C. Ufodike**, 2000. Effects of water soluble fractions of crude oil on growth of the Nile tilapia, *Oreochromis niloticus* (L.). Bulletin of Environmental Contamination and Toxicology **64**:601-605.
**Keywords:** behavior/ bioassay/ concentration/ crude oil/ effects/ feeding/ fingerling/ fish/ fresh water/ growth/ light/ oil/ Othree/ solubility/ static/ weight
**Notes:** Fingerling Nile tilapia were exposed to five concentrations of the water-soluble fraction of Bonny light crude oil for 10 wks in a static bioassay; concentrations were renewed daily. Measured characteristics of exposure water and weight gain of fish; also recorded feeding behavior.

**Omoregie, E.**, 2002. Acute toxicity of water soluble fractions of crude oil to the Nile tilapia, *Oreochromis niloticus* (L.). Bulletin of Environmental Contamination and Toxicology **68**:623-629.
**Keywords:** acute/ bioassay/ concentration/ crude oil/ fin/ fish/ fresh water/ oil/ Othree/ rate/ respiration/ solubility/ static/ survival/ toxicity
**Notes:** A determination of the acute toxicity of crude oil to Nile tilapia in a static 96 hr bioassay. Five concentrations (10, 5, 2.5, 1.25, 0.625 ml/l) and a control group were used. Determined $LD_{50}$ and

measured operculum ventilation rates and tail fin beat frequencies. The title and heading within Table 3 are in error.

**Onianwa, P. C.**, 1995. Petroleum hydrocarbon pollution of urban topsoil in Ibadan City, Nigeria. Environment International **21**:341-343.
**Keywords:** concentration/ hydrocarbons/ miscellaneous/ Nigeria/ Oeleven/ petroleum/ petroleum hydrocarbons/ pollution/ soil/ total hydrocarbons/ urban
**Notes:** Measurement of the concentration of total hydrocarbons in topsoil from seven types of areas within Ibadan City, Nigeria.

**Onwumere, B. G., A. A. Oladimeji**, 1990. Accumulation of metals and histopathology in *Oreochromis niloticus* exposed to treated NNPC Kaduna (Nigeria) pegroleum refinery effluent. Ecotoxicology and Environmental Safety **19**:123-134.
**Keywords:** accumulation/ acute/ concentration/ effects/ effluent/ fingerling/ fish/ fresh water/ growth/ long-term/ metals/ Nigeria/ Othree/ pathology/ petroleum/ refinery/ survival
**Notes:** Effects on tilapia fingerlings of acute (96 hr) or long-term (8 wk) exposure to varying concentrations of petroleum refinery effluent for 96 hr; survival, growth, pathology, and metal accumulation.

**Orbell, J. D., E. K. Tan, M. Coutts, S. W. Bigger, L. N. Ngeh**, 1999. Cleansing oiled feathers -- magnetically. Marine Pollution Bulletin **38**:219-221.
**Keywords:** bird/ cleaning/ crude oil/ emulsion/ feathers/ motor oil/ oil/ oiled/ Oone/ petroleum/ salt water/ structure
**Notes:** Description of a method of removing petroleum from bird feathers that utilizes iron powder. Tested the method on three crude oils, a motor oil, and a crude oil-sea water emulsion. Measured removal of petroleum with each cleaning cycle and evaluated feather structure after cleaning was finished.

**Ordzie, C. J., G. C. Garofalo**, 1981. Lethal and sublethal effects of short term acute doses of Kuwait crude oil and a dispersant Corexit 9527 on bay scallops *Argopecten irradians* (Lamark) and two predators at different temperatures. Marine Environmental Research **5**:195-210.
**Keywords:** acute/ bivalve/ Corexit 9527/ crude oil/ depuration/ dispersant/ effects/ gastropod/ Kuwait/ Kuwait crude oil/ lethal/ marine invertebrate/ ODfour/ oil/ oyster/ oyster drill/ salt water/ scallop/ short-term/ starfish/ sublethal/ survival/ temperature/ time
**Notes:** Assessment of the effects on bay scallops, starfish, and oyster drill of the water-soluble fractions of Kuwait crude oil, Corexit 9527, and an oil:dispersant mixture. Survival of scallops was determined with six stock solutions varying from 6.25% to 100% at three water temperatures. Exposure lasted 6 hr followed by 5 da of depuration. Survival of starfish and oyster drill was determined with three stock solutions ranging from 12.5% to 100% at two and one water temperatures, respectively. A 5-da period of depuration followed. Scallop response to predators, starfish response times for predatory posturing, and oyster drill response to prey was determined with survivors from the 12.5% exposure at three, two, and one temperatures, respectively.

**Oritsland, N. A., F. R. Engelhardt, F. A. Juck, R. J. Hurst, P. D. Watts**, 1981. Effect of crude oil on polar bears. Volume 24. Indian and Northern Affairs Canada, Ottawa.
**Keywords:** abnormalities/accumulation/biochemical/blood/clearance/crude oil/effects/evaluation/hydrocarbons/mammal/metabolism/oil/oiled/Otwo/pathology/petroleum hydrocarbons/physiology/polar bear/salt water/skin/survival/temperature/tissue
**Notes:** An assessment of the effects on polar bears of crude oil exposure. Three polar bears were externally oiled and subjected to a variety of evaluations. Measured survival (two died), resting and active metabolism, skin temperature, accumulation and clearance of hydrocarbons, blood and biochemical characteristics, and tissue abnormalities.

**Ormond, R. F. G., S. Caldwell**, 1982. The effect of oil pollution on the reproduction and feeding behavior of the sea anemone *Actinia equina*. Marine Pollution Bulletin **13**:118-122.
**Keywords:** adult/ behavior/ crude oil/ effects/ experiment/ feeding/ fish/ gonads/ juvenile/ Kuwait/ Kuwait

crude oil/ marine invertebrate/ monoaromatic/ North Sea/ North Sea crude oil/ numbers/ Ofour/ oil/ paraffin/ planulae/ pollution/ reproduction/ salt water/ sea anemone/ static
**Notes:** Investigators used four experiments to assess the effects of North Sea and Kuwait crude oils on a sea anemone. Experiment 1: adult anemone exposed to crude oils in a static aquaria test for 14 wks. Water and oil replaced weekly. Weekly counts made of the numbers of planulae and juveniles emitted by adults, behavior, and feeding response. Experiment 2: adult anemone exposed as in the first experiment to either crude oils, paraffins or monoaromatics. Experiment 3: adult anemone exposed to filter paper soaked in either fish extract, crude oil + fish extract, paraffins + fish extract, crude oil only, monoaromatics + fish extract, paraffins only, monoaromatics only, or seawater only. Experiment 4: gonads from the anemones in Exp. 1 were removed after 18 wks and examined histologically.

**Ormseth, O. A., M. Ben-David**, 2000. Ingestion of crude oil: effects on digesta retention times and nutrient uptake in captive river otters. Journal of Comparative Physiology B **170**:419-428.
**Keywords:** Alaska/ analysis/ blood/ crude oil/ diet/ digestion/ effects/ food/ ingestion/ isotope/ male/ mammal/ North Slope/ North Slope crude oil/ nutrients/ oil/ Otwo/ Prince William Sound/ rate/ river otter/ salt water/ time/ tissue/ uptake/ weathered
**Notes:** Fifteen wild male river otters were captured from northwestern Prince William Sound, Alaska and acclimated in captivity for 2.5 mos. Otters were placed in one of three experimental groups: control, low-dose (50 ppm weathered North Slope crude oil in diet), and high-dose (500 ppm weathered crude oil in diet). Oil exposure continued for 100 da. Otters were sampled for blood and tissue every 3 wks. Glass beads place in food were used to determine relative digesta passage rates. Stable isotope analysis was used on food items, crude oil, and fecal matter to determine absorption of crude oil and changes in digestion efficiency.

**Osamor, C. A. and R. C. Ahlert**. 1981. Oil slick dispersal mechanics. U.S. Environmental Protection Agency, Washington, D.C. **EPA-600/S2-81-199**. 3 pp.
**Keywords:** behavior/ dispersal/ dispersant/ evaluation/ experiment/ fresh water/ ODnine/ oil/ oil slick/ salt water/ technical
**Notes:** A project summary of a large study of the spreading and dissolution behavior of 12 oils. Both fresh and salt water were utilized. Five commercial dispersants were used in laboratory experiments designed to produce a physical and chemical description of the consequences of dispersant use, agitation, and the type of water (fresh or salt).

**Ostazeski, S. A., S. C. Macomber, L. G. Roberts, A. D. Uhler, K. R. Bitting, and R. Hiltabrand** 1997. The environmental behavior of Orimulsion spilled on water. Pages 469-477 *in* 1997 International Oil Spill Conference. Improving Environmental Protection. Progress, Challenges, Responsibilities. API Publication. American Petroleum Institute, Washington, DC.
**Keywords:** behavior/ composition/ fate/ fresh water/ oil/ oil spill/ Onine/ Orimulsion/ physical characteristics/ protection/ salt water/ spill/ technical/ weathered
**Notes:** Chemical composition, physical characteristics, behavior in fresh and salt water, and weathering of Orimulsion.

**Ostgaard, K., I. Eide, A. Jensen**, 1984. Exposure of phytoplankton to Ekofisk crude oil. Marine Environmental Research **11**:183-200.
**Keywords:** algae/ aromatic hydrocarbons/ cell/ chlorophyll/ concentration/ crude oil/ Ekofisk crude oil/ growth/ hydrocarbons/ marine plant/ naphthalene/ oil/ Osix/ phytoplankton/ population/ salt water/ species
**Notes:** Three species of algae were exposed to the water-soluble fraction of Ekofisk crude oil or naphthalene. Employed batch culture (4 da duration) and a closed culture system (8 da duration). Algal growth was measured as cell or chlorophyll *a* concentrations. Analyzed culture medium for aromatic hydrocarbons.

**Osuji, L. C., C. M. Onojake**, 2006. Field reconnaissance and estimation of petroleum hydrocarbon and heavy metal contents of soils affected by the Ebocha-8 oil spillage in Niger Delta, Nigeria. Journal of Environmental Management **79**:133-139.
**Keywords:** carbon/ cell/ chloride/ conductivity/ fresh water/ hydrocarbons/ metals/ miscellaneous/ Nigeria/ Oeleven/ oil/ oil field/ oil spill/ organic/ organic carbon/ petroleum/ petroleum hydrocarbons/ pH/

pollution/ salt water/ sampling/ soil/ spill/ sulphate
**Notes:** An oil spill polluted site and an unpolluted site in the Niger Delta were chosen for an assessment of the presence of petroleum hydrocarbons and selected metals. A 100-cell grid was placed on each site and 33 cells were randomly chosen for soil sampling (surface and subsurface). Soil samples were analyzed for total extractable hydrocarbons, Ni, Cu, Pb, Cd, V, total organic carbon, total organic matter, conductivity, percent moisture, pH, chloride, and sulphate.

**Otitoloju, A. A.**, 2004. Crude oil plus dispersant: always a boon or bane? Ecotoxicology and Environmental Safety **60**:198-202.
**Keywords:** Biosolve/ concentration/ crude oil/ dispersant/ marine invertebrate/ Nigerian crude oil/ ODfour/ oil/ prawn/ salt water/ toxicity
**Notes:** A marine prawn was used to evaluate the toxicity of a Nigerian crude oil and a newly approved chemical dispersant (Biosolve). Crude oil and dispersant were used in a range of concentrations to determine the 24, 48, 72, and 96 hr $LC_{50}$ and $LC_{95}$ concentrations of each. Mixtures of crude oil and dispersant (9:1, 6:1, 4:1) were used to determine the 96 hr $LC_{50}$.

**Ou, S., J. Zheng, J. Zheng, B. J. Richardson, P. K. S. Lam**, 2004. Petroleum hydrocarbons and polycyclic aromatic hydrocarbons in the surficial sediments of Xiamen Harbour and Yuan Dan Lake, China. Chemosphere **56**:107-112.
**Keywords:** alkane/ aromatic/ aromatic hydrocarbon/ aromatic hydrocarbons/ chemical analysis/ China/ harbour/ hydrocarbons/ miscellaneous/ Oeleven/ PAH/ petroleum/ petroleum hydrocarbons/ salt water/ sediment
**Notes:** Nine surface sediment samples were collected from Xiamen Harbor (formerly Hong Kong) and two sediment samples from an adjacent lake. Sediments were analyzed for pristane, phytane, $C_{10}$-$C_{26}$ alkanes, UCM, and 25 PAHs.

**Oudot, J., P. Fusey, M. Van Praet, J. P. Feral, F. Gaill** , 1981. Hydrocarbon weathering in seashore invertebrates and sediments over a two-year period following the *Amoco Cadiz* oil spill: influence of microbial metabolism. Environmental Pollution (Series A) **26**:93-110.
**Keywords:** aliphatic hydrocarbons/ Amoco Cadiz/ aromatic hydrocarbons/ bacteria/ composition/ concentration/ crude oil/ hydrocarbons/ invertebrate/ marine invertebrate/ metabolism/ microbes/ oil/ oil spill/ Oten/ salt water/ sediment/ shoreline/ spill/ time
**Notes:** Sediments and shoreline invertebrates were collected 5/78, 1/79, 2/79, and 1/80 from coastal areas of Brittany affected by the 3/78 Amoco Cadiz oil spill. Sediments and invertebrates were analyzed for aliphatic and aromatic hydrocarbons. Concentrations of heterotrophic and hydrocarbon-adapted bacteria were determined for the sediment samples. Emphasis was on documenting changes in the composition of the spilled crude oil.

**Oudot, J., F. X. Merlin, P. Pinvidic**, 1998. Weathering rates of oil components in a bioremediation experiment in estuarine sediments. Marine Environmental Research **45**:113-125.
**Keywords:** aliphatic hydrocarbons/ Arabian Light crude oil/ aromatic hydrocarbons/ asphaltene/ biodegradation/ bioremediation/ crude oil/ cycloalkane/ estuarine/ evaluation/ experiment/ fertilizer/ France/ intertidal/ light/ microbes/ oil/ Oten/ rate/ resin/ salt water/ sediment/ temperature
**Notes:** Evaluation of the influence of a slow-release fertilizer on the biodegradation of an artificially-weathered Arabian Light crude oil in the intertidal zone at the mouth of the Aulne River (France). Experimental plots were treated with crude oil and then some plots were treated with fertilizer 2 wks later, followed by reapplication of fertilizer at monthly intervals. Experimental duration was 35 wks. Sediment was sampled after 2, 4, 8, 16, 27, and 35 wks. Measured DO, temperature, $CO_2$, quantity of microbes, N, P; and quantified aliphatics, cycloalkanes, aromatics, and resins+alphaltenes.

**Oviatt, C., J. Frithsen, J. Gearing, P. Gearing**, 1982. Low chronic additions of No.2 fuel oil: chemical behavior, biological impact and recovery in a simulated estuarine environment. Marine Ecology Progress Series **9**:121-136.
**Keywords:** aromatic hydrocarbons/ behavior/ benthic/ biological effects/ chlorophyll/ chronic/ concentration/ effects/ environment/ estuarine/ experiment/ fuel oil/ general effect/ hydrocarbons/ microcosm/ No.2 fuel oil/ nutrients/ Oeight/ oil/ phytoplankton/ procedure/ recovery/ respiration/ salt water/

saturated hydrocarbons/ sediment/ time/ water column/ zooplankton
**Notes:** Outdoor estuarine microcosms (three exposure and three control) were used to assess the chemical behavior and biological effects of No. 2 fuel oil. Three experiments were conducted; fuel oil added twice weekly for 5.5 mos to maintain190 ppb in water column, same addition procedure for 4 mos to maintain 90 ppb, and a 13-mos recovery experiment following the 90 ppb exposure. Measured chlorophyll concentration, $^{14}C$ production, nutrient concentrations, zooplankton identified and quantified, benthic fauna identified and quantified, benthic respiration and nutrient flux, and saturated and aromatic hydrocarbons concentrations in water and sediment.

**Ovuru, S. S., D. N. Ezeasor**, 2004. Morphological alterations in liver tissues from rabbits exposed to crude oil contaminated diets. Bulletin of Environmental Contamination and Toxicology **73**:132-138.
**Keywords:** abnormalities/ blood/ crude oil/ diet/ female/ liver/ male/ mammal/ Nigerian crude oil/ oil/ Otwo/ pathology/ rabbit/ sex/ tissue/ toxicity
**Notes:** Domestic rabbits (male and female) were exposed for 84 da to Nigerian crude oil mixed in the diet. Diets contained 0, 0.05, 0.10, 0.15, or 0.20% crude oil. Two animals of each sex from each group were sampled for blood and necropsied; liver tissue was removed for histological examination. Measured total and conjugated bilirubins, aspartate transaminase, alkaline transaminase, and alkaline phosphatase in blood, and described tissue abnormalities in the liver.

**Owens, E. H., W. Robson, B. Humphrey, D. Hope, and J. R. Harper** 1987. The fate of stranded oil four years after an experimental spill on a sheltered gravel beach. Pages 473-478 *in* Proceedings 1987 Oil Spill Conference, API 4452. American Petroleum Institute, Washington, D.C.
**Keywords:** aliphatic hydrocarbons/ beach/ Canada/ composition/ crude oil/ degradation/ fate/ gravel/ hydrocarbons/ intertidal/ miscellaneous/ Oeleven/ oil/ oil spill/ petroleum/ salt water/ sediment/ spill/ time/ total hydrocarbons/ weathered
**Notes:** Four years after an experimental nearshore spill of Lago Medio crude oil in the Northwest Territories, Canada, the site was revisited. Surface oil was mapped and classified, sediment samples from the upper, middle, and lower intertidal areas were analyzed for total extractable hydrocarbons and composition of the aliphatic fraction. Calculated a petroleum budget and compared all results to similar information gathered in 1981, 1982, and 1983.

**Oyewo, E. O.**, 1986. The acute toxicity of three oil dispersants. Environmental Pollution (Series A) **41**:23-31.
**Keywords:** acute/ behavior/ concentration/ crab/ dispersant/ effects/ fingerling/ fish/ marine invertebrate/ mullet/ ODthree/ oil/ salinity/ salt water/ toxicity
**Notes:** Effects on mullet fingerlings and hermit crabs of exposure to varying concentrations of three chemical dispersants (Conco-K, Foremost, BP 1100X) in two salinities; 24,48, and 96 hr LC50, behavior.

**Pacheco, M., M. A. Santos**, 2001. Biotransformation, endocrine, and genetic responses of *Anguilla anguilla* L. to petroleum distillate products and environmentally contaminated waters. Environmental Research Section B **49**:64-75.
**Keywords:** activity/ assay/ biochemistry/ biotransformation/ blood/ cell/ concentration/ diesel/ diesel fuel/ eel/ endocrine/ fish/ gasoline/ genetic/ genotoxic/ glucose/ liver/ microsome/ No.2 fuel oil/ Othree/ PAH/ petroleum/ plasma/ protein/ red blood cell/ salt water
**Notes:** European eels were used in a laboratory and field assessment of petroleum-contaminated water. Water-soluble fractions (WSF) of diesel fuel and gasoline were prepared and used in laboratory assays of 3 hrs, 4 hrs, 2 da, 3 da, 4 da, and 6 da exposure to 2.5% diesel WSF or 0.25 % gasoline WSF. Measured genotoxic damage in red blood cells, liver EROD activity, liver ALT, microsomal protein and supernatant protein, plasma lactate, glucose, and cortisol concentrations. Water was analyzed for PAHs. In the field, eels were placed in cages and left at two coastal sites for 1 or 3 da; a companion laboratory study exposed eels for 1 or 3 da to low-tide or high-tide water from a coastal site. Measured liver biochemistry and genotoxic damage.

**Padros, J., E. Pelletier, R. Siron, D. Delille**, 1999. Fate of a new silicone-based oil-treating agent and its effects on marine microbial communites. Environmental Toxicology and Chemistry **18**:819-827.
**Keywords:** bacteria/ combination/ community/ concentration/ degradation/ effects/ estuarine/ evaluation/

fate/ marine plant/ mesocosm/ miscellaneous/ Oeleven/ oil/ petroleum/ phytoplankton/ recovery/ salt water/ silicone/ spill response/ treatment
**Notes:** Evaluation of the effects of a silicone-based oil-treating agent on natural microbial communities and the degradation of petroleum. Used estuarine mesocosms over a 9-wk period. Treatments consisted of oil alone, agent alone, or a combination of the two. Measured several water quality characteristics, oil concentrations, bacteria, and phytoplankton.

**Page, D. S., J. C. Foster, and P. M. Fickett** 1989. Long-term weathering of *Amoco Cadiz* oil in soft intertidal sediments. Pages 401-405 *in* 1989 Oil Spill Conference, API Publication 4479. American Petroleum Institute, Washington, D.C.
**Keywords:** aliphatic hydrocarbons/ Amoco Cadiz/ aromatic hydrocarbons/ concentration/ degradation/ estuary/ France/ hydrocarbons/ intertidal/ long-term/ microbes/ oil/ oil spill/ Oten/ salt water/ sediment/ spill/ time/ total hydrocarbons/ weathered
**Notes:** Surface sediment samples were collected from four locations in the Aber Benoit estuary (heavily affected by the 1978 wreck of the *Amoco Cadiz)* of France during the period 1979-1986 and from a reference coastal site in 1986. Sediments were analyzed for concentrations of oil and gas, aliphatic hydrocarbons, aromatic hydrocarbons, and total hydrocarbons.

**Page, D. S., P. D. Boehm, G. S. Douglas, A. E. Bence**, 1996. The natural petroleum hydrocarbon background in subtidal sediments of Prince William Sound, Alaska, USA. Environmental Toxicology and Chemistry **15**:1266-1281.
**Keywords:** Alaska/ analysis/ aromatic hydrocarbons/ fingerprinting/ hydrocarbons/ miscellaneous/ Oeleven/ petroleum/ petroleum hydrocarbons/ Prince William Sound/ salt water/ sampling/ sediment/ sources/ subtidal
**Notes:** Three years of sampling subtidal sediments (649 total) in Prince William Sound and coastal areas to the east are presented. A detailed analysis was made of the aromatic hydrocarbons with the purpose of identifying various sources of petroleum hydrocarbons.

**Page, D. S., P. D. Boehm, G. S. Douglas, A. E. Bence, W. A. Burns, P. J. Mankiewicz**, 1997. An estimate of the annual input of natural petroleum hydrocarbons to seafloor sediments in Prince William Sound, Alaska. Marine Pollution Bulletin **34**:744-749.
**Keywords:** Alaska/ estimate/ hydrocarbons/ miscellaneous/ Oeleven/ oil seep/ petroleum/ petroleum hydrocarbons/ Prince William Sound/ salt water/ sediment
**Notes:** Assessment of the annual deposition of natural petroleum hydrocarbons to ocean sediments in Prince William Sound, Alaska.

**Page, D. S., P. D. Boehm, G. S. Douglas, A. E. Bence, W. A. Burns, P. J. Mankiewicz**, 1998. Petroleum sources in the western Gulf of Alaska/Shelikoff Strait area. Marine Pollution Bulletin **36** :1004-1012.
**Keywords:** Alaska/ aromatic hydrocarbons/ condition/ crude oil/ evaluation/ Gulf of Alaska/ hydrocarbons/ miscellaneous/ Oeleven/ oil/ petroleum/ salt water/ saturated hydrocarbons/ sediment/ sources/ tar ball
**Notes:** Evaluation of the sources of petroleum in the western Gulf of Alaska to establish baseline conditions. Analyzed 15 sources (crude oil, tar balls, sediment, oil-in-water) of petrogenic hydrocarbons for saturate and aromatic hydrocarbons.

**Page, D. S., P. D. Boehm, G. S. Douglas, A. E. Bence, W. A. Burns, P. J. Mankiewicz**, 1999. Pyrogenic polycyclic aromatic hydrocarbons in sediments record past human activity: a case study in Prince William Sound, Alaska. Marine Pollution Bulletin **38**:247-260.
**Keywords:** activity/ Alaska/ analysis/ aromatic hydrocarbons/ burning/ creosote/ Exxon Valdez/ humans/ hydrocarbons/ miscellaneous/ Oeleven/ oil/ PAH/ Prince William Sound/ pyrogenic/ salt water/ sediment/ sources/ weathered
**Notes:** Determination of the sources of polyaromatic hydrocarbons (PAH) in the nearshore sediments of western Prince William Sound, Alaska. Samples collected from 1989 to 1992. Results of chemical analyses compared to PAH profiles for weathered Exxon Valdez oil, average petrogenic background,

creosote, weathered Monterey oil, wood burning, and human habitation. Used 'source allocation analysis' to determine the proportional sources of PAH for 5 locations in the Sound.

**Page, D. S., P. D. Boehm, W. A. Stubblefield, K. R. Parker, E. S. Gilfillan, J. M. Neff, A. W. Maki**, 2002. Hydrocarbon composition and toxicity of sediments following the *Exxon Valdez* oil spill in Prince William Sound, Alaska, USA. Environmental Toxicology and Chemistry **21**:1438-1450.
**Keywords:** Alaska/ amphipod/ analysis/ chemical analysis/ community/ composition/ crude oil/ Exxon Valdez/ infauna/ marine invertebrate/ Ofour/ oil/ oil spill/ petroleum/ Prince William Sound/ recovery/ salt water/ sediment/ shoreline/ spill/ time/ toxicity
**Notes:** A presentation of the results of the Shoreline Ecology Program (Exxon sponsored) that spanned the years 1990-99 following the 1989 Exxon Valdez oil spill. Presents a large amount of summarized material on chemical analysis of petroleum in sediments, toxicity of sediments to amphipods, and community composition of sediment infauna.

**Page, D. S., R. J. Huggett, J. J. Stegeman, K. R. Parker, B. Woodin, J. S. Brown, A. E. Bence**, 2004. Polycyclic aromatic hydrocarbon sources related to biomarker levels in fish from Prince William Sound and the Gulf of Alaska. Environmental Science and Technology **38**:4928-4936.
**Keywords:** activity/ Alaska/ aromatic/ aromatic hydrocarbon/ aromatic hydrocarbons/ bile/ biomarker/ chemical analysis/ Exxon Valdez/ fish/ Gulf of Alaska/ hydrocarbons/ oil/ oiled/ Onine/ PAH/ petroleum/ Prince William Sound/ pyrogenic/ salt water/ sediment/ sources/ spill/ steroid/ subtidal/ technical/ time/ tissue/ weathered
**Notes:** Surface sediment and fish were collected in 1999 and 2000 from 17 sites within Prince William Sound (spill path & oiled, spill path & not oiled, out of spill path) and three sites in the Gulf of Alaska. Sediments were analyzed for PAH, saturate biomarkers, and triaromatic steroids. Fish (rockfish and halibut) were analyzed for bile fluorescent aromatic contaminants, EROD activity, and tissue immunohistochemistry. Some of the results were reported elsewhere. The source of hydrocarbons was allocated among four categories; heavily weathered Exxon Valdez oil, Monterey source petroleum, old regional subtidal, and pyrogenic PAH.

**Page, D. S., J. S. Brown, P. D. Boehm, A. E. Bence, J. M. Neff**, 2006. A hierarchial approach measures the aerial extent and concentration levels of PAH-contaminated shoreline sediments at historic industrial sites in Prince William Sound, Alaska. Marine Pollution Bulletin **52**:367-379.
**Keywords:** activity/ Alaska/ aromatic hydrocarbons/ bivalve/ clam/ concentration/ marine invertebrate/ miscellaneous/ mussel/ Oeleven/ PAH/ pollution/ Prince William Sound/ salt water/ sediment/ shoreline/ time/ tissue
**Notes:** More than 50 sites of former human activity during the period 1900-1950 in Prince William Sound were evaluated for possible detailed sediment assessments. Nine sites were selected and ~20 sediment samples plus samples of clams and mussels were collected at each location. Sediments were analyzed by a colorimetric test, GC/MS, and immunochemical PAH quantification for 41 selected PAHs. Clam and mussel tissue was also analyzed for 41 selected PAHs.

**Page, G. W., H. R. Carter, and R. G. Ford** 1990. Numbers of seabirds killed or debilitated in the 1986 *Apex Houston* oil spill in central California. Pages 164-174 *in* S. G. Sealy, editor. Auks at sea: proceedings of an International Symposium of the Pacific Seabird Group, Pacific Grove, California, 17 December 1987. Studies in Avian Biology. Cooper Ornithological Society, San Diego, CA.
**Keywords:** bird/ California/ carcass/ coast/ crude oil/ estimate/ model/ numbers/ oil/ oil spill/ Oone/ population/ salt water/ spill/ auks/ Pacific
**Notes:** An estimation, by carcass deposition model, of the number of birds killed or debilitated by the Apex Houston crude oil spill off the coast of central California.

**Pahl, J. W., I. A. Mendelssohn, C. B. Henry, Jr., T. J. Hess**, 2003. Recovery trajectories after in situ burning of an oiled wetland in coastal Louisiana, USA. Environmental Management **31**:236-251.
**Keywords:** alkane/ aromatic hydrocarbons/ biomass/ burning/ crude oil/ density/ hydrocarbons/ Louisiana/ marine plant/ oil/ oiled/ Osix/ pipeline/ recovery/ salt water/ soil/ spill/ time/ transect/ vegetation/ wetland
**Notes:** A brackish water wetland in coastal Louisiana was affected by a pipeline rupture of gas

condensate (similar to a light crude oil). Investigators established two sampling transects in an area oiled and burned, an area oiled and not burned, and an area not affected by the spill. Vegetation was sampled six times over a 3-yr period following the spill; measured percent cover, stem density, and biomass. Soil was sampled after oiling but before the burn, after the burn, and at a reference site, and analyzed for alkanes and selected aromatic hydrocarbons.

**Paine, M. D., W. C. Leggett, J. K. McRuer, K. T. Frank**, 1991. Effects of incubation in oiled sediment on emergence of capelin (*Mallotus villosus*) larvae. Canadian Journal of Fisheries and Aquatic Sciences **48**:2228-2239.
**Keywords:** crude oil/ effects/ eggs/ emergence/ fish/ growth/ hatching/ Hibernia crude oil/ incubation/ larvae/ oil/ oiled/ Othree/ salt water/ sediment
**Notes:** Effect on capelin eggs of exposure to sediment contaminated with Hibernia crude oil for 28 da; hatching and emergence success, larval growth.

**Paine, R. T., L. Ruesink, A. Sun, E. L. Soulanille, M. J. Wonham, C. D. G. Harley, D. R. Brumbaugh, D. L. Secord**, 1996. Trouble on oiled waters: Lessons from the *Exxon Valdez* oil spill. Annual Review of Ecology and Systematics **27**:197-235.
**Keywords:** activity/ bird/ crude oil/ Exxon Valdez/ fish/ injury/ mammal/ marine invertebrate/ marine plant/ miscellaneous/ Oeleven/ oil/ oil spill/ oiled/ restoration/ review/ salt water/ spill/ spill response
**Notes:** Critical assessment of the Exxon Valdex oil spill response and the associated injury assessment studies. Concludes with recommendations for future research activity.

**Parker, B. L., J. D. Brammer, M. E. Whalon, W. O. Berry**, 1976. Chronic oil contamination and aquatic organisms with emphasis on Diptera: status and bibliography. Water Research Bulletin **12**:291-305.
**Keywords:** chronic/ commentary/ Diptera/ effects/ fresh water/ freshwater invertebrate/ invertebrate/ Ofive/ oil/ petroleum/ review
**Notes:** A review and commentary of the effects of petroleum on aquatic invertebrates with special attention given to freshwater insects (Diptera). Author includes a bibliograph of nearly 200 references dealing with studies and reports relevant to the topic of petroleum and dipteran insects.

**Parker, E. F., W. D. Burgos**, 1999. Degradation patterns of fresh and aged petroleum-contaminated soils. Environmental Engineering Science **16**:21-29.
**Keywords:** degradation/ diesel/ diesel fuel/ microbes/ motor oil/ oil/ Oten/ petroleum/ petroleum hydrocarbons/ refinery/ respiration/ soil/ time
**Notes:** Assessment of the microbial degradation patterns for petroleum-contaminated soil from a land farm and from the grounds of a refinery that had been inactive for 20 yrs. Uncontaminated soil from both locations were treated with fresh petroleum (motor oil or diesel fuel) that closely resembled the hydrocarbon profile of the contaminated soil at each location. Soils were placed in glass bottles, a nutrient buffer solution was added, and respiration was measured for 40 da.

**Parnell, J. F., M. A. Shields, D. Frierson, Jr.**, 1984. Hatching success of brown pelican eggs after contamination with oil. Colonial Waterbirds **7**:22-24.
**Keywords:** bird/ brown pelican/ Bunker C/ eggs/ endangered species/ fuel oil/ hatching/ oil/ oiled/ Oone/ pelican/ salt water/ spill
**Notes:** Account of the oiling of endangered brown pelican eggs by a spill of Bunker C fuel oil on the Cape Fear River in North Carolina.

**Parr, S. J., R. J. Haycock, and M. E. Smith** 1997. The impact of the *Sea Empress* oil spill on birds of the Pembrokeshire coast and islands. Pages 217-225 *in* 1997 International Oil Spill Conference. Improving Environmental Protection. Progress, Challenges, Responsibilities. API Publication. American Petroleum Institute, Washington, DC.
**Keywords:** bird/ coast/ composition/ effects/ estimate/ numbers/ oil/ oil spill/ Oone/ population/ protection/ salt water/ species/ spill/ Wales
**Notes:** Report of the effects of the Sea Empress oil spill on birds along the coast of southwest Wales. Description of the numbers and species composition of dead birds and the results of population counts before and after the spill in nearby areas. Estimates of the population consequences of the spill.

**Parra-Pardi, G., E. A. Sutton, and N. E. Rincon** 1985. Effects of petroleum on algal blooms in Lake Maracaibo. Pages 373-377 *in* Proceedings 1985 Oil Spill Conference, API Publication 4385. American Petroleum Institute, Washington, D.C.
**Keywords:** algae/ carbon/ cell/ chlorophyll/ combination/ community/ concentration/ crude oil/ effects/ experiment/ growth/ inorganic/ marine plant/ metals/ nutrients/ oil/ oil spill/ Osix/ petroleum/ petroleum hydrocarbons/ pH/ phytoplankton/ population/ salt water/ spill
**Notes:** Laboratory and field study to assess the effects of petroleum on algal growth in Lake Maracaibo, Venezuela. Algal cultures in the experimental portion were placed *in situ* on the lake during April, May, June, and September. Algae were exposed to combinations of crude oil, N & P nutrients, and chelating agents for 7 or 14 da. The cultures were characterized at the start of the experiment; at termination, cells were counted, chlorophyll *a* concentrations determined, and pH, alkalinity, and total inorganic carbon measured. Phytoplankton were also identified and classified into three divisions and principal genera. Field samples of water were collected from 10 stations over a 1-yr period. Samples were characterized, chlorophyll *a* measured, and phytoplankton classified.

**Parrish, J. K., P. D. Boersma**, 1995. Muddy waters. American Scientist **83**:112-115.
**Keywords:** bird/ common murre/ crude oil/ estimate/ Exxon Valdez/ oil/ oil spill/ Oone/ population/ Prudhoe Bay crude oil/ salt water/ species/ spill
**Notes:** Discussion critical of the high estimates of seabird deaths caused by the Exxon Valdez oil spill; special detail for the common murre.

**Parsons, K. C.** 1994. The Arthur Kill oil spills: biological effects in birds. Pages 215-237 *in* J. Burger, editor. Before and After an Oil Spill: the Arthur Kill. Rutgers Univ. Press, New Brunswick.
**Keywords:** activity/ biological effects/ bird/ effects/ foraging/ New Jersey/ New York/ oil/ oil spill/ Oone/ population/ reproduction/ salt water/ spill/ wintering
**Notes:** Effects on birds of the multiple oil spills occurring in the Arthur Kill and Kill van Kull between New Jersey and New York during 1990. Assessments of wintering and breeding bird populations, reproductive activity, and foraging activity.

**Parsons, K. C.**, 1996. Recovering from oil spills: the role of proactive science in mitigating adverse effects. Colonial Waterbirds **19**:149-153.
**Keywords:** bird/ commentary/ effects/ fish/ marine invertebrate/ New Jersey/ New York/ oil/ oil spill/ Oone/ salt water/ shrimp/ spill/ survey
**Notes:** Commentary on the usefulness of good baseline information for assessing the effects of the multiple oil spills occurring in the harbor area between New York and New Jersey in 1990.

**Parsons, T. R., P. J. Harrison, J. C. Acreman, H. M. Dovey, P. A. Thompson, C. M. Lalli**, 1984. An experimental marine ecosystem response to crude oil and Corexit 9527: part 2 -- biological effects. Marine Environmental Research **13**:265-275.
**Keywords:** bacteria/ biological effects/ chlorophyll/ Corexit 9527/ crude oil/ dispersant/ ecosystem/ effects/ evaluation/ glucose/ marine invertebrate/ mesocosm/ nitrate/ ODfour/ oil/ phytoplankton/ population/ productivity/ Prudhoe Bay/ Prudhoe Bay crude oil/ salt water/ treatment/ uptake/ zooplankton
**Notes:** Evaluation of the biological effects in a pelagic ecosystem of Prudhoe Bay crude oil, with or without a chemical dispersant (Corexit 9527). Three large mesocosms were used and samples were collected every 2-3 da beginning the day before treatment and ending 17 or 18 da after treatment. Measured nitrate and nitrite, silicate, chlorophyll *a*, primary productivity (phytoplankton), bacteria, relative heterotrophic uptake (glucose production), and changes in populations of four categories of phytoplankton and zooplankton.

**Pastor, D., J. Sanchez, C. Porte, J. Albaiges**, 2001. The *Aegean Sea* oil spill in the Galicia coast (NW Spain). I. Distribution and fate of the crude oil and combustion products in subtidal sediments. Marine Pollution Bulletin **42**:895-904.
**Keywords:** Aegean Sea/ aliphatic hydrocarbons/ aromatic hydrocarbons/ coast/ crude oil/ distribution/ fate/ hydrocarbons/ miscellaneous/ movement/ Oeleven/ oil/ oil spill/ salt water/ sediment/ Spain/ spill/ sterane/ subtidal/ terpane/ time
**Notes:** Surface sediment samples were collected from the coast of Spain during April, July, September,

and November after the December 1992 grounding of the *Aegean Sea*. Samples were collected from nine sites, several of which were divided into 0-5 cm and 5-10 cm strata. Sediments and parent crude oil were analyzed for aliphatic and aromatic hydrocarbons. Terpanes and steranes were used to monitor movement and presence of the oil.

**Paton, G. I., C. O. Iroegbu, J. J. C. Dawson**, 2003. Microbiological characterisation of a diesel contaminated beach site. Marine Pollution Bulletin **46**:903-906.
**Keywords:** beach/ diesel/ diesel fuel/ hydrocarbons/ intertidal/ microbes/ Oten/ petroleum/ petroleum hydrocarbons/ salt water/ Scotland/ sediment/ spill/ toxicity
**Notes:** Intertidal sediment in the River Dee estuary (Scotland) was affected by a spill of diesel fuel from storage tanks. Forty sediment samples were collected and analyzed for total petroleum hydrocarbons. The samples were used for microbe quantification and toxicity testing with two genetically engineered bacterial 'biosensors'.

**Pattee, O. H., J. C. Franson**, 1982. Short-term effects of oil ingestion on American kestrels (*Falco sparverius* ). Journal of Wildlife Diseases **18**:235-241.
**Keywords:** bird/ crude oil/ effects/ evaluation/ fresh water/ ingestion/ Ixtoc/ oil/ Oone/ pathology/ physiology/ raptor/ short-term/ toxicity/ weathered
**Notes:** Evaluation of the toxicity of ingested weathered oil from the Ixtoc well blowout to American kestrels.

**Patten, S. M., Jr., L. R. Patten** 1978. Effects of petroleum exposure on the breeding ecology of the Gulf of Alaska herring gull group (*Larus argentatus* x *Larus glaucescens*). Pages 199-215 *in* D. A. Wolfe, editor. Marine Biological Effects of OCS Petroleum Development. National Oceanic and Atmospheric Administration, Washington.
**Keywords:** Alaska/ biological effects/ bird/ crude oil/ development/ effects/ eggs/ glaucous-winged gull/ Gulf of Alaska/ gull/ herring/ herring gull/ North Slope/ North Slope crude oil/ oil/ oiled/ Oone/ petroleum/ petroleum development/ reproduction/ salt water/ species
**Notes:** Effects on reproduction of two gull species of egg oiling with North Slope crude oil.

**Patton, J. F., M. P. Dieter**, 1980. Effects of petroleum hydrocarbons on hepatic function in the duck. Comparative Biochemistry and Physiology **65C**:33-36.
**Keywords:** aromatic hydrocarbons/ bird/ diet/ duck/ effects/ hydrocarbons/ liver/ mallard/ Oone/ paraffin/ petroleum/ petroleum hydrocarbons/ physiology
**Notes:** Assessment of liver function of mallard ducks fed diets containing paraffin or aromatic mixtures.

**Pauzi Zakaria, M., T. Okuda, H. Takada**, 2001. Polycyclic aromatic hydrocarbon (PAHs) and hopanes in stranded tar-balls on the coasts of peninsular Malaysia: applications of biomarkers for identifying sources of oil pollution. Marine Pollution Bulletin **42**:1357-1366.
**Keywords:** aromatic hydrocarbons/ biomarker/ coast/ hopane/ Malaysia/ oil/ Onine/ PAH/ pollution/ ratio/ salt water/ saturated hydrocarbons/ sources/ tar ball/ technical
**Notes:** Authors use hopanes (large saturates) as biomarker compounds to identify sources of tarballs deposited on the coast of Malaysia. Collected 20 samples from 18 locations and analyzed for hopanes and PAHs.

**Payne, J. F.**, 1975. Field evaluation of benzopyrene hydroxylase induction as a monitor for marine petroleum pollution. Science **191**:945-946.
**Keywords:** cunner/ evaluation/ fish/ indicator/ metabolism/ monitoring/ Newfoundland/ Othree/ petroleum/ petroleum hydrocarbons/ pollution/ salt water
**Notes:** Results of a field test of the utilility of benzopyrene hydroxylase induction as an indicator of the presence of petroleum pollution.

**Payne, J. F.**, 1977. Mixed function oxidases in marine organisms in relation to petroleum hydrocarbon metabolism and detection. Marine Pollution Bulletin **8**:112-116.
**Keywords:** activity/ Atlantic/ crude oil/ detection/ flow-through/ marine invertebrate/ metabolism/ mixed-function oxidase/ Ofour/ oil/ petroleum/ petroleum hydrocarbons/ pollution/ salt water/ survey/ Venezuelan

crude oil
**Notes:** Survey of basal mixed function oxidase (MFO) activity in marine organisms of the northwest Atlantic and attempts to induce MFO activity in the same organisms. Used flow-through aquaria treated with emulsified Venezuelan crude oil for exposures of 1 wk. Intent was to identify organisms for use as monitors of petroleum pollution.

**Payne, J. F., I. Martins, A. Rahimtula**, 1978. Crankcase oils: are they a major mutagenic burden in the aquatic environment? Science **200**:329-330.
**Keywords:** crankcase oil/ crude oil/ environment/ fuel oil/ general effect/ liver/ metabolite/ motor oil/ mutation/ No.2 fuel oil/ Oeight/ oil/ PAH/ petroleum/ rat/ used motor oil
**Notes:** An assessment of the mutagenic potential of crude oils, No. 2 fuel oil, motor oils, and used motor oils. Used motor oil was fractionated into six fractions and liver extracts from rats and trout previously exposed to the petroleum source were used to test the PAH metabolites.

**Payne, J. F., L. L. Fancey**, 1982. Effect of long term exposure to petroleum on mixed function oxygenases in fish: further support for use of the enzyme system in biological monitoring. Chemosphere **11**:207-213.
**Keywords:** cod/ crude oil/ environment/ enzyme/ fish/ flounder/ indicator/ long-term/ metabolism/ mixed-function oxidase/ monitoring/ oil/ Othree/ petroleum/ pollution/ salt water/ sculpin/ sediment/ time/ Venezuelan crude oil
**Notes:** Assessment of the utility of mixed-function oxidase induction as an indicator of petroleum pollution (Venezuelen crude oil) over long periods of time; codfish, sculpins, flounder, 3-5 mo exposure in a laboratory environment, contaminated water and sediment.

**Payne, J. F.**, 1982. Critique of "Petroleum and marine fishes: a review of uptake disposition and effects". Environmental Science and Technology **16**:370-372.
**Keywords:** accumulation/ critique/ fish/ metabolism/ Othree/ petroleum/ population/ review/ salt water/ survival/ uptake
**Notes:** A critical review of the publication "Petroleum and marine fishes: a review of uptake disposition and effects" by D.C. Malins and H.O. Hodgins, 1981, Environ. Sci. Technol. 15:1272.

**Payne, J. F., J. Kiceniuk, R. Misra**, 1983. Sublethal effects of petroleum hydrocarbons on adult American lobsters (*Homarus americanus*). Canadian Journal of Fisheries and Aquatic Sciences **40**:705-717.
**Keywords:** adult/ amino acids/ blood/ cell/ condition/ crude oil/ effects/ evaluation/ flow-through/ hydrocarbons/ lobster/ marine invertebrate/ Ofour/ oil/ organ/ petroleum/ petroleum hydrocarbons/ plasma/ red blood cell/ salt water/ sublethal/ Venezuelan crude oil/ weathered/ weight
**Notes:** Evaluation of the effects of Venezuelan crude oil on American lobsters held in a large flow-through aquarium. Crude oil was added weekly, after removal of weathered surface oil, to the surface of the aquarium. After 14 wks of exposure, measured body and organ weights, condition indicies, blood plasma constituents, blood electrolytes, water content, red blood cell characteristics, and plasma amino acids and their analogs.

**Payne, J. F., L. L. Fancey, J. Hellou, M. J. King, G. L. Fletcher**, 1995. Aliphatic hydrocarbons in sediments: a chronic toxicity study with winter flounder (*Pleuronectes americanus*) exposed to oil well drill cuttings. Canadian Journal of Fisheries and Aquatic Sciences **52**:2724-2735.
**Keywords:** aliphatic hydrocarbons/ biochemistry/ blood/ chronic/ concentration/ condition/ cuttings/ drilling fluids/ effects/ experiment/ fish/ flounder/ hydrocarbons/ oil/ organ/ Othree/ pathology/ petroleum hydrocarbons/ salt water/ sediment/ toxicity/ weight/ winter flounder
**Notes:** Assessment of the effects of aliphatic hydrocarbons (from drilling fluids in drill cuttings) on winter flounder in an 80 da chronic exposure experiment; concentrations in fish and sediment, weight, organ condition, biochemistry, mixed-function oxygenase induction, blood characteristics, pathology.

**Peakall, D. B., D. S. Miller, and W. B. Kinter** 1979. Physiological techniques for assessing the impact of oil on seabirds. Pages 52-60 *in* E. E. Kenaga, editor. Avian and Mammalian Wildlife Toxicology. American Society for Testing and Materials, Philadelphia, PA.

**Keywords:** bird/ black guillemot/ herring gull/ methods/ oil/ oil spill/ Oone/ organ/ physiology/ salt water/ spill/ weight
**Notes:** Proposed methods for the physiological assessment of seabird "wrecks" to determine the role of oil spills in the observed death and debilitation.

**Peakall, D. B., D. Hallett, D. S. Miller, R. G. Butler, W. B. Kinter**, 1980. Effects of ingested crude oil on black guillemots: a combined field and laboratory study. Ambio **9**:28-30.
**Keywords:** bird/ black guillemot/ crude oil/ dosed/ effects/ growth/ guillemot/ Louisiana/ Louisiana crude oil/ oil/ Oone/ pathology/ physiology/ salt water/ South Louisiana crude oil/ weathered
**Notes:** Effects on young black guillemots of single doses of weathered South Louisiana crude oil; growth, physiological measures, and some pathology.

**Peakall, D. B., J. Tremblay, W. B. Kinter, D. S. Miller**, 1981. Endocrine dysfunction in seabirds caused by ingested oil. Environmental Research **24**:6-14.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ bird/ crude oil/ effects/ endocrine/ growth/ Louisiana/ Louisiana crude oil/ oil/ Oone/ physiology/ Prudhoe Bay/ Prudhoe Bay crude oil/ salt water/ South Louisiana crude oil/ species
**Notes:** Effects on endocrine function of three species of seabirds from single doses of South Louisiana crude oil, its aliphatic or aromatic fractions, or Prudhoe Bay crude oil.

**Peakall, D. B., D. J. Hallett, J. R. Bend, G. L. Foureman, D. S. Miller**, 1982. Toxicity of Prudhoe Bay crude oil and its aromatic fractions to nestling herring gulls. Environmental Research **27**:206-215.
**Keywords:** aromatic hydrocarbons/ bird/ Corexit 9527/ crude oil/ dispersant/ effects/ gull/ herring/ herring gull/ liver/ nestling/ ODone/ oil/ organ/ physiology/ Prudhoe Bay/ Prudhoe Bay crude oil/ salt water/ toxicity/ weight
**Notes:** Effects on nestling herring gulls of single doses of Prudhoe Bay crude oil, Prudhoe Bay fractions, crude oil mixed with Corexit 9527, or Corexit 9527 alone.

**Peakall, D. B., D. S. Miller, W. B. Kinter**, 1983. Toxicity of crude oils and their fractions in nestling herring gulls -- 1. Physiological and biochemical effects. Marine Environmental Research **8**:63-71.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ biochemical/ bird/ crude oil/ effects/ growth/ gull/ herring/ herring gull/ Louisiana/ Louisiana crude oil/ nestling/ oil/ Oone/ physiology/ salt water/ South Louisiana crude oil/ toxicity/ weight
**Notes:** Effects on nestling herring gulls of single doses of South Louisiana crude oil and its aliphatic and aromatic fractions; growth and physiological characteristics measured.

**Peakall, D. B., D. A. Jeffrey, D. S. Miller**, 1985. Weight loss of herring gulls exposed to oil and oil emulsion. Ambio **14**:108-110.
**Keywords:** bird/ Corexit 9527/ crude oil/ dispersant/ effects/ emulsion/ experiment/ feathers/ gull/ herring/ herring gull/ ODone/ oil/ oiled/ physiology/ Prudhoe Bay/ Prudhoe Bay crude oil/ salt water/ weight
**Notes:** Experiment 1: Effects on food-deprived fledgling herring gulls of single doses of Prudhoe Bay crude oil, crude oil plus Corexit 9527, or Corexit 9527. Experiment 2: Effects on fledgling herring gulls of oiling breast feathers with Prudhoe Bay crude oil or crude oil plus Corexit 9527.

**Peakall, D. B., P. G. Wells, D. Mackay**, 1987. A hazard assessment of chemically dispersed oil spills and seabirds. Marine Environmental Research **22**:91-106.
**Keywords:** bird/ dispersant/ effects/ hazard/ ODone/ oil/ oil spill/ salt water/ spill/ toxicity/ vulnerability
**Notes:** Assessment of the positive and negative aspects of chemically dispersed oil spills with regard to the effects on seabirds.

**Peakall, D. B., R. J. Norstrom, D. A. Jeffrey, F. A. Leighton**, 1989. Induction of hepatic mixed function oxidases in the herring gull (*Larus argentatus*) by Prudhoe Bay crude oil and its fractions. Comparative Biochemistry and Physiology **94C**:461-463.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ bird/ crude oil/ effects/ gull/ herring/ herring gull/ liver/ metabolism/ nestling/ oil/ Oone/ physiology/ Prudhoe Bay/ Prudhoe Bay crude oil/ salt water

**Notes:** Effects on liver function of nestling herring gulls from single doses of Prudhoe Bay crude oil or their aromatic and aliphatic fractions.

**Peakall, D. B., D. A. Jeffrey, D. Boersma**, 2087. Mixed-function oxidase activity in seabirds and its relationship to oil pollution. Comparative Biochemistry and Physiology **88C**:151-154.
**Keywords:** activity/ adult/ Atlantic/ baseline/ bird/ crude oil/ dosed/ enzyme/ female/ guillemot/ gull/ herring/ herring gull/ liver/ male/ metabolism/ microsomal/ mixed-function oxidase/ nestling/ oil/ Oone/ pollution/ Prudhoe Bay/ Prudhoe Bay crude oil/ puffin/ salt water
**Notes:** Adult herring gulls, Leach's petrels, guillemots, and Atlantic puffins were used for determinations of six baseline measures of hepatic microsomal enzyme activity in both males and females. Herring gulls were categorized according to either 7, 14, or 21 days after completion of clutch. Adult puffins were dosed with 0.5 mg/kg Prudhoe Bay crude oil and nestling puffins were dosed for 4 days with either 0.3 or 1 ml/kg/day crude oil. Adults were assessed for five of the six measures the day after dosing and the nestlings were assessed for all six of the measures after the fourth day of dosing.

**Pearson, W. H., P. C. Sugarman, D. L. Woodruff, J. W. Blaylock**, 1980. Detection of petroleum hydrocarbons by the Dungeness crab, *Cancer magister*. Fishery Bulletin **78**:821-826.
**Keywords:** aromatic hydrocarbons/ behavior/ concentration/ crab/ crude oil/ detection/ hydrocarbons/ marine invertebrate/ naphthalene/ Ofour/ oil/ petroleum/ petroleum hydrocarbons/ Prudhoe Bay/ Prudhoe Bay crude oil/ rate/ salt water/ saturated hydrocarbons/ static
**Notes:** Determination of the detection ability of Dungeness crabs for petroleum in the water. Crabs were exposed with a static test system to either the water-soluble fraction (WSF) of Prudhoe Bay crude oil or a saturated solution of naphthalene in water. Measured the WSF in water for concentrations of one, two, and three-ringed aromatics and measured the antennular flicking rate of the crabs for 1 min before and after introduction of the WSF or naphthalene.

**Pearson, W. H., S. E. Miller, J. W. Blaylock**, 1981. Detection of the water-soluble fraction of crude oil by the blue crab, *Callinectes sapidus*. Marine Environmental Research **5**:3-11.
**Keywords:** antennule/ behavior/ blue crab/ concentration/ crab/ crude oil/ detection/ flow-through/ juvenile/ marine invertebrate/ Ofour/ oil/ Prudhoe Bay/ Prudhoe Bay crude oil/ rate/ salt water
**Notes:** Determination of the ability of juvenile blue crabs to detect the water-soluble fraction (WSF) of Prudhoe Bay crude oil. Used a flow-through system with fresh WSF mixed daily. Measured water concentration of WSF and antennular flicking rate of the crabs.

**Pearson, W. H., D. L. Woodruff, P. C. Sugarman**, 1981. Effects of oiled sediment on predation on the littleneck clam, *Protothaca staminea*, by the Dungeness crab, *Cancer magister*. Estuarine and Coastal and Shelf Science **13**:445-454.
**Keywords:** clam/ concentration/ crab/ crude oil/ depth/ effects/ experiment/ intertidal/ marine invertebrate/ Ofour/ oil/ oiled/ petroleum/ predation/ Prudhoe Bay/ Prudhoe Bay crude oil/ salt water/ sand/ sediment/ species
**Notes:** A field and a lab experiment were used to determine the effect of petroleum exposure on the predation of clams by a species of crab. In 13 da and 29 da field experiments, cage enclosures were placed in the intertidal zone and contained either oiled (1% Prudhoe Bay crude oil) or unoiled sand and clams. In a 19 da laboratory experiment, clams were buried at two depths in either oiled or unoiled sand prior to introduction of crabs. In a subsequent 21 da laboratory experiment, clams were introduced to oiled or unoiled sand and permitted to burrow in the absence of crabs. Measured total oil concentration in the sand, predation of clams, and depth of clams in the sand.

**Pearson, W. H., P. C. Sugarman, D. L. Woodruff, B. L. Olla**, 1981. Impairment of the chemosensory antennular flicking response in the dungeness crab, *Cancer magister*, by petroleum hydrocarbons. Fishery Bulletin **79**:641-647.
**Keywords:** antennule/ behavior/ clam/ concentration/ crab/ crude oil/ detection/ experiment/ flow-through/ food/ hydrocarbons/ marine invertebrate/ monoaromatic/ Ofour/ oil/ petroleum/ petroleum hydrocarbons/ Prudhoe Bay/ Prudhoe Bay crude oil/ rate/ recovery/ salt water/ total hydrocarbons
**Notes:** Determined the effect on food detection of dungeness crabs of exposure to the water-soluble fraction (WSF) of Prudhoe Bay crude oil. Exposure to the WSF was in a flow-through system for 24 hrs

prior to presentation of clam extract. Clean seawater was then used for a subsequent 24 and 48 hr assessment of the recovery of the ability to detect the clam extract. In a second experiment, detection was tested after 1 hr on clean seawater. Measured water concentrations of total hydrocarbons and of monoaromatics, and antennular flicking rate of the crabs.

**Pearson, W. H., D. L. Woodruff, P. C. Sugarman**, 1984. The burrowing behavior of sand lance, *Ammodytes hexapterus:* effects of oil-contaminated sediment. Marine Environmental Research **11**:17-32.
**Keywords:** activity/ behavior/ burrowing/ concentration/ crude oil/ effects/ experiment/ flow-through/ hydrocarbons/ length/ marine invertebrate/ monoaromatic/ Ofour/ oil/ oiled/ Prudhoe Bay/ Prudhoe Bay crude oil/ salt water/ sand/ sediment/ weight
**Notes:** Performed two laboratory experiments with flow-through aquaria to determine the effect of Prudhoe Bay crude oil on the burrowing activity of sand lance. In one experiment, sand lance were exposed to clean sand & clean water, clean sand & oiled water, oiled sand & clean water, or oiled water & oiled sand; nominal oil in sand was 1000 ppm. In the second experiment, sand lance were exposed to clean water & oiled sand at either 100, 1000, or 10,000 ppm oil. Measured total hydrocarbon and monoaromatic concentrations in sand and water and length and wet weight of sand lance. Sand lance activity was observed hourly for 4 da.

**Peckol, P., S. C. Levings, S. D. Garrity**, 1990. Kelp response following the *World Prodigy* oil spill. Marine Pollution Bulletin **21**:473-476.
**Keywords:** algae/ chlorophyll/ condition/ experiment/ fuel oil/ growth/ kelp/ marine plant/ No.2 fuel oil/ oil/ oil spill/ Osix/ pigment/ procedure/ Rhode Island/ salt water/ species/ spill/ subtidal
**Notes:** Growth experiments on two species of subtidal kelp were performed in West Cove, Rhode Island, USA during 1985-87. After the *World Prodigy* spill (No. 2 fuel oil) in June 1989, the procedures were repeated in July 1989. Kelp were anchored in position for 2 wks. Kelp were assessed for condition at the beginning and end of the study. Measured growth and the pigments chlorophyll *a* & *c* and fucoxanthin.

**Pelletier, E., R. Siron**, 1999. Silicone-based polymers as oil spill treatment agents. Environmental Toxicology and Chemistry **18**:813-818.
**Keywords:** beach/ bivalve/ oil/ oil spill/ Onine/ petroleum/ polymer/ recovery/ rocky shore/ salt water/ sand/ shell/ silicone/ spill/ spill response/ technical/ treatment
**Notes:** An experimental testing of the ability of silicone-based polymers to encapsulate and solidify petroleum spills. Tested on three surfaces; rough (rocks and bivalve shells), beach sand, and open water. Discusses chemical reactions, recovering efficiency, properties and environmental considerations, toxicological properties, and limitations of use.

**Pellitier, E., S. Ouellet, M. Paquet**, 1991. Long-term chemical and cytochemical assessment of oil contamination in estuarine intertidal sediments. Marine Pollution Bulletin **22**:273-281.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ bivalve/ Bunker C/ cell/ concentration/ degradation/ estuarine/ estuary/ fresh water/ freshwater invertebrate/ fuel oil/ hydrocarbons/ intertidal/ long-term/ miscellaneous/ mussel/ Oeleven/ oil/ sediment/ spill/ time/ tissue
**Notes:** Samples of mussels and intertidal sediment were collected 4/86, 5/86, 6/86, 7/86, 10/86, 4/87, 9/87, and 4/89 at two sites along the St. Lawrence Estuary affected by the December1985 grounding of the barge *Point-Levis*. Collections were also made a reference site 50 km upstream (Matane River) of the spill area. Measured concentrations of n-alkanes and selected aromatic hydrocarbons in sediment and mussel tissue, and lysosomal hexosaminidase in digestive cells of mussels.

**Pena-Mendez, E. Ma., Ma. S. Astorga-Espana, F. J. Garcia-Montelongo**, 2001. Chemical fingerprinting applied to the evaluation of marine oil pollution in the coasts of Canary Islands (Spain). Environmental Pollution **111**:177-187.
**Keywords:** alkane/ analysis/ aromatic hydrocarbons/ Canary Islands/ coast/ evaluation/ fingerprinting/ hydrocarbons/ limpet/ oil/ Onine/ PAH/ pollution/ salt water/ Spain/ species/ technical/ tissue
**Notes:** Two limpet species were sampled at three sites on the southeast coast of Tenerife, Canary Islands for a 3-yr period. Limpet tissue was analyzed for alkane and aromatic hydrocarbons to establish pattern recognition. Total alkanes and PAHs were compared to data from other studies at the Canary

Islands and at sites throughout the world. Principal components analysis was performed on alkanes and PAHs of both species.

**Pena-Vazquez, E., J. Villanueva-Alonso, A. Bermejo-Barrera, P. Bermejo-Barrera**, 2006. Arsenic and antimony distribution in the Ria de Arousa: before and after the Prestige oil tanker sinking. Journal of Environmental Monitoring **8**:641-648.
**Keywords:** concentration/ distribution/ estuary/ fuel oil/ metals/ miscellaneous/ No.2 fuel oil/ Oeleven/ oil/ oil spill/ river/ salt water/ Spain/ spill/ tanker/ time/ water/ water column
**Notes:** Water samples were collected at 22 sites in the lower Ria de Arousa (Spain) and at 10 sites in the upper Ria de Arousa and associated rivers before and after the Prestige oil spill. Water was collected at the surface, mid-depth, and near the bottom. Samples were analyzed for As and Sb concentrations.

**Pena, E., J. E. Conde, F. G. Montelongo**, 1996. Evaluation of *Osilinus attratus* as a bioindicator organism to monitor oil pollution in the Canary Islands. Archives of Environmental Contamination and Toxicology **31**:444-452.
**Keywords:** alkane/ aromatic hydrocarbons/ bioindicator/ Canary Islands/ coast/ evaluation/ hydrocarbons/ marine invertebrate/ monitoring/ Ofour/ oil/ petroleum/ petroleum hydrocarbons/ pollution/ salt water/ species/ winkle
**Notes:** Evaluation of a marine winkle as a species suitable for monitoring petroleum pollution. Collected samples from three locations along the coast of Tenerife (Canary Islands) during 1990-91 and analyzed them for n-alkanes and aromatic hydrocarbons.

**Pendoley, K.**, 1992. Hydrocarbons in Rowley Shelf (Western Australia) oysters and sediments. Marine Pollution Bulletin **24**:210-225.
**Keywords:** alkane/ aromatic hydrocarbons/ Australia/ concentration/ hydrocarbons/ marine invertebrate/ offshore/ Ofour/ oil field/ oyster/ salt water/ sediment
**Notes:** Determination of baseline hydrocarbon concentrations in sediments and oysters of the Rowley Shelf of Western Australia prior to the initiation of drilling in several offshore oilfields. Collected oysters from 8 sites and sediments from 11 sites in 1986 and 1988. Analyzed sediments and oysters for n-alkanes and aromatics.

**Penn, T., T. Tomasi**, 2002. Calculating resource restoration for an oil discharge in Lake Barre, Louisiana, USA. Environmental Management **29**:691-702.
**Keywords:** crude oil/ damage assessment/ Louisiana/ miscellaneous/ natural resource/ Oeleven/ oil/ pipeline/ restoration/ salt water/ spill
**Notes:** A Texaco pipeline rupture in May 1997 discharged crude oil into Lake Barre, LA. This is a report of a cooperative (trustees and Texaco) natural resource damage assessment and restoration proposal for the spill. Emphasis is on the quantitative determination of compensatory restoration.

**Percy, J. A.**, 1976. Responses of Arctic marine crustaceans to crude oil and oil-tainted food. Environmental Pollution **10**:155-162.
**Keywords:** activity/ amphipod/ Arctic/ avoidance/ behavior/ crude oil/ crustacean/ experiment/ feeding/ food/ isopod/ marine invertebrate/ Ofour/ oil/ oiled/ salt water/ static/ weathered
**Notes:** Assessment of the behavioral response of two marine amphipods and one marine isopod to three crude oils and oil-tainted food in static laboratory experiments. Determined the avoidance of fresh or weathered crude oil and the effect of pre-exposure on avoidance by measuring the occurrence of crustaceans in the vicinity of "oil zones". Determined feeding response to tainted food by measuring feeding activity on oiled and unoiled food.

**Percy, J. A., T. C. Mullin**, 1977. Effects of crude oil on the locomotory activity of Arctic marine invertebrates. Marine Pollution Bulletin **8**:35-40.
**Keywords:** activity/ amphipod/ Arctic/ behavior/ coelenterate/ concentration/ crude oil/ crustacean/ effects/ evaluation/ invertebrate/ marine invertebrate/ movement/ Ofour/ oil/ recovery/ salt water/ short-term
**Notes:** Assessment of the effect of exposure to crude oils on the water movement of a marine amphipod and a marine coelenterate. Crustaceans were exposed for 24 hrs to either of three concentrations of

seawater dispersions of three crude oils. Locomotor activity after exposure was measured and scored. One assessment was done after a 24 hr recovery period. The coelenterate was also used in a short-term evaluation of activity inhibition wherein observations were made hourly for 6 hrs.

**Percy, J. A.**, 1977. Responses of Arctic marine benthic crustaceans to sediments contaminated with crude oil. Environmental Pollution **13**:1-10.
**Keywords:** amphipod/ Arctic/ behavior/ benthic/ combination/ concentration/ crude oil/ crustacean/ distribution/ isopod/ marine invertebrate/ Ofour/ oil/ oiled/ salt water/ sediment/ species
**Notes:** Assessment of the behavioral responses to oiled sediment of several marine amphipod and isopod species. Sediments were contaminated with four different concentrations of four crude oils (16 combinations). Crustaceans were offered contaminated and clean sediment for 1 or 2 hr, followed by a count of the distribution of individuals.

**Pereira, M. G., S. M. Mudge, J. Latchford**, 2003. Vegetable oil spills on salt marsh sediments; comparison between sunflower and linseed oils. Marine Environmental Research **56**:367-385.
**Keywords:** aerobic/ anaerobic/ bacteria/ depth/ England/ fatty acids/ lipid/ microbes/ oil/ oil spill/ Oten/ pH/ redox potential/ salt marsh/ salt water/ sampling/ sediment/ spill/ sulfate/ temperature/ time/ vegetable oil
**Notes:** A simulated spill of sunflower and linseed oils was performed in a small area of salt marsh in southwest England over a period of 6 mos. Temperature, pH, and redox potential were measured in sediment cores down to 30 cm on days 0, 3, 7, 14, 21, 28, 60, and 180 for temperature, 0, 21, and 180 for pH, and 0, 3, and 180 for redox. Lipids and fatty acids were measured on all sampling days. Measured the amount of heterotrophic aerobic and anaerobic bacteria through day 60, and the amount of oil degrading aerobic and anaerobic bacteria and sulfate reducing bacteria through day 180. Compared the results for the two types of vegetable oils.

**Pereira, M. G., S. M. Mudge**, 2004. Cleaning oiled shores: laboratory experiments testing the potential use of vegetable oil biodiesels. Chemosphere **54**:297-304.
**Keywords:** beach/ cleaning/ crude oil/ experiment/ gravel/ mesocosm/ microcosm/ Oeleven/ oil/ oiled/ petroleum/ remediation/ salt water/ sand/ shoreline/ vegetable oil/ weathered
**Notes:** A series of laboratory experiments were performed to evaluate the potential of vegetable oil biodiesels for cleaning petroleum-contaminated shorelines. Batch experiments employed fine sand, weathered light Brent crude oil, five volumes of soybean biodiesel and two volumes of waste cooking oil biodiesel. Microcosm experiments employed fine beach sand, unweathered light Brent crude oil, and three volumes of rapeseed biodiesel; water was added to simulate tides and the resultant runoff water was sampled on days 0, 1, 2, 3, 4, and 14. Mesocosm experiments employed either cobbles, gravel, coarse sand, or fine sand; weathered light Enterprise crude oil, and one volume of soybean biodiesel. Water was periodically added to simulate tidal flushing and the resultant runoff was sampled on days 0, 1, 2, 3, 4, and 14. Runoff water was analyzed for petroleum and biodiesel compounds (gravimetrically).

**Perkins, J. S.**, 1983. Oiled Magellanic penguins in Golfo San Jose, Argentina. Marine Pollution Bulletin **14**:383-387.
**Keywords:** Argentina/ bird/ coast/ oiled/ Oone/ penguin/ reproduction/ salt water
**Notes:** Report of oiled Magellanic penguins on the coast of Argentina.

**Perrollaz, D. C. and J. A. Rash** 1990. Analysis of sea otter (*Enhydra lutris*) fur for crude oil contamination. Pages 82-87 *in* International Association of Aquatic Animal Medicine, 21.
**Keywords:** Alaska/ analysis/ chromatography/ crude oil/ fur/ mammal/ oil/ Otwo/ procedure/ Prudhoe Bay crude oil/ salt water/ sea otter/ spill/ otter
**Notes:** Description of a procedure using thin layer chromatography and fur for identifying sea otters that have come in contact with spilled oil.

**Perry, M. C., F. Ferrigno, F. H. Settle**, 1978. Rehabilitation of birds oiled on two mid-Atlantic estuaries. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies **32**:318-325.
**Keywords:** bird/ Chesapeake/ Delaware/ estuary/ oil/ oil spill/ oiled/ Oone/ rehabilitation/ review/ salt

water/ spill
**Notes:** Review of bird losses from oil spills in the Chesapeake and Delaware Bay estuaries between 1973-78 and the results of oiled-bird rehabilitation efforts.

**Persad, D., W. Rajkumar**, 1995. A synoptic view of the levels of dispersed/dissolved petroleum hydrocarbons (DDPH) and heavy metals in the south-eastern Caribbean Sea. Marine Pollution Bulletin **30**:487-489.
**Keywords:** aromatic hydrocarbons/ Caribbean/ hydrocarbons/ metals/ miscellaneous/ Oeleven/ petroleum/ petroleum hydrocarbons/ salt water/ Trinidad
**Notes:** Surface water samples were collected on two cruises (1991, 1993) north of Trinidad. The water from one cruise (13 stations) was analyzed for total aromatic hydrocarbons.

**Peso-Aguiar, M. C., D. H. Smith, R. C. F. Assis, L. M. Santa-Isabel, S. Peixinho, E. P. Gouveia, T. C. A. Almeida, W. S. Anadrade, C. R. G. Carqueija, F. Kelmo, G. Carrozzo, C. V. Rodrigues, G. C. Carvalho, A. C. S. Jesus**, 2000. Effects of petroleum and its deriviatives in benthic communities at Baia de Todos os Santos/Todos os Santos Bay, Bahia, Brazil. Aquatic Ecosystem Health & Management **3**:459-470.
**Keywords:** analysis/ benthic/ Brazil/ carbon/ chemical analysis/ community/ concentration/ diversity/ effects/ index/ intertidal/ invertebrate/ marine invertebrate/ metals/ Ofour/ PAH/ petroleum/ refinery/ salt water/ sediment/ time/ transport/ unresolved complex mixture
**Notes:** A bay heavily affected by petroleum extraction, refining, and transport was subjected to an assessment of benthic invertebrates. Sediment samples were collected from the upper, middle, and lower zones of the intertidal area on a quarterly basis for 2 years. Invertebrates were identified and quantified; diversity and community metrics were utilized in the analysis. The results were compared to concentrations of metals, *n*-alkanes, PAHs, and the unresolved complex mixture, as well as the carbon preference index. The chemical analyses were performed in a previous study.

**Peteiro, L. G., J. M. F. Babarro, U. Labarta, M. J. Fernandez-Reiriz**, 2006. Growth of *Mytilus galloprovincialis* after the *Prestige* oil spill. ICES Journal of Marine Science **63**:1005-1013.
**Keywords:** bivalve/ Bunker C/ experiment/ fuel oil/ growth/ harvest/ length/ marine invertebrate/ mussel/ Ofour/ oil/ oil spill/ salt water/ seed/ shell/ Spain/ spill/ time/ tissue/ weight
**Notes:** Seed mussels from three locations along the Galacian coastline of northwest Spain (Prestige Bunker C fuel oil spill of Nov 2002) were used in a growth experiment covering the entire period from seed establishment to harvest (Feb 2003 - Feb 2004). Mussels sampled monthly. Measured shell length and tissue weight.

**Peters, E. C., P. A. Meyers, P. P. Yevich, N. J. Blake**, 1981. Bioaccumulation and histopathological effects of oil on a stony coral. Marine Pollution Bulletin **12**:333-339.
**Keywords:** accumulation/ analysis/ assay/ colony/ coral/ depuration/ effects/ flow-through/ fuel oil/ gonads/ marine invertebrate/ No.2 fuel oil/ Ofour/ oil/ ova/ petroleum hydrocarbons/ salt water/ sperm/ tissue
**Notes:** Determination of hydrocarbon accumulation in corals exposed to either 0.1 or 0.5 ppm water-accomodated fractions (WAF) of No. 2 fuel oil in a flow-through assay. Corals were exposed for 12 wks; some colonies were exposed for 10 wks followed by 2 wks of depuration. Corals were sampled for tissue hydrocarbon analysis before, during, and after exposure. Also, examined corals at 2-wk intervals for tissue atrophy and presence of gonads, ova, or sperm.

**Petersen, S. P., B. Kruse, K. Jensen**, 1991. Degradation of low toxicity drilling mud base oil in sediment cores. Marine Pollution Bulletin **22**:452-455.
**Keywords:** alkane/ bacteria/ biodegradation/ concentration/ degradation/ Denmark/ drilling mud/ hydrocarbons/ microbes/ offshore/ oil/ Oten/ petroleum/ petroleum hydrocarbons/ salt water/ sediment/ time/ total hydrocarbons/ toxicity
**Notes:** Sediment cores from the offshore sea floor (Denmark) were used in a laboratory assessment of the biodegradability of drilling mud in surface sediments. Surface sediment was mixed with drilling mud and incubated for 66 da. Sampled the sediments five times during the study and analyzed for total

petroleum hydrocarbons, four individual alkanes, redox profile, and concentrations of oil degrading bacteria.

**Peterson, C. H., L. L. McDonald, R. H. Green, W. P. Erickson**, 2001. Sampling design begets conclusions: the statistical basis for detection of injury to and recovery of shoreline communities after the 'Exxon Valdez' oil spill. Marine Ecology Progress Series **210**:255-283.
**Keywords:** Alaska/ community/ detection/ effects/ Exxon Valdez/ Gulf of Alaska/ habitat/ injury/ intertidal/ oil/ oil spill/ Onine/ Prince William Sound/ recovery/ review/ salt water/ sampling/ shoreline/ spill/ statistics/ technical
**Notes:** A review of the sampling designs and statistical analyses employed in four studies of the effects on intertidal biota of the *Exxon Valdez* oil spill in Prince William Sound, Alaska. Evaluated the Shoreline Ecology Program (Exxon), the Coastal Habitat Injury Assessment (Exxon Valdez Oil Spill Trustee Council), the Gulf of Alaska study (Exxon), and the NOAA Hazmat study.

**Peterson, C. H., S. D. Rice, J. W. Short, D. Esler, J. L. Bodkin, B. E. Ballachey, D. B. Irons**, 2003. Long-term ecosystem response to the Exxon Valdez oil spill. Science **302**:2082-2086.
**Keywords:** ecosystem/ Exxon Valdez/ general effect/ long-term/ Oeight/ oil/ oil spill/ persistence/ population/ Prince William Sound/ review/ salt water/ spill
**Notes:** A review of the response of the Prince William Sound ecosystem to the Exxon Valdez oil spill. Sections on acute-phase mortality, persistence of the oil, long-term population impacts, and implications of changing paradigms of oil ecotoxicity.

**Pezeshki, S. R., R. D. Delaune**, 1993. Effect of crude oil on gas exchange functions of *Juncus roemerianus* and S*partina alterniflora*. Water, Air, and Soil Pollution **68**:461-468.
**Keywords:** crude oil/ experiment/ growth/ Juncus/ leaves/ marine plant/ oil/ oiled/ Osix/ photosynthesis/ plant/ salt water/ Spartina/ species/ wetland
**Notes:** Two coastal wetland plant species were exposed to Mexican Sour crude oil in a pair of experiments. In the first experiment, potted plants were immersed in an oil and water mixture for 4 hrs, then transferred to a growth chamber. Net photosynthesis was measured on partially-oiled leaves twice a day for 4.5 wks. In the second experiment, the entire plant was submerged in the oily water, then transferred to a growth chamber for the same measurements of net photosynthesis. The number of new shoots and the height of the new shoots also was determined.

**Pezeshki, S. R., A. Jugsujinda, R. D. Delaune**, 1998. Responses of selected U.S. Gulf Coast marsh macrophyte species to oiling and commercial cleaners. Water, Air, and Soil Pollution **107**:185-195.
**Keywords:** Arabian crude oil/ cleaning/ coast/ conductance/ Corexit 9580/ crude oil/ dispersant/ effectiveness/ evaluation/ Louisiana/ Louisiana crude oil/ macrophyte/ marine plant/ ODsix/ oil/ oiled/ photosynthesis/ plant/ respiration/ salt water/ shoreline/ South Louisiana crude oil/ species
**Notes:** Evaluation of the effectiveness of a shoreline cleaner (Corexit 9580) in removing crude oil from three species of Gulf Coast (USA) macrophytes. Plants were subjected to cleaner only, South Louisiana crude oil only, Arabian medium crude oil only, or crude oils followed by cleaning 2 da later with cleaner. Measured stomatal conductance, photosynthesis, and respiration.

**Pezeshki, S. R., M. W. Hester, Q. Lin, J. A. Nyman**, 2000. The effects of oil spill and clean-up on dominant US Gulf coast marsh macrophytes: a review. Environmental Pollution **108**:129-139.
**Keywords:** activity/ cleaning/ coast/ effects/ fresh water/ freshwater plant/ leaves/ macrophyte/ marine plant/ methods/ oil/ oil spill/ Osix/ petroleum/ review/ salt water/ soil/ spill/ vegetation/ wetland
**Notes:** A review of the effects of petroleum spills and clean-up methods on Gulf Coast (USA) wetland macrophytes. Discussion sections deal with physically induced effects, chemically induced effects, fouling of leaves versus fouling of soils, seasonality, inter- and intraspecies sensitivity to oil, effects of clean-up activities on vegetation, and indirect effects.

**Pezeshki, S. R., R. D. Delaune, A. Jugsujinda**, 2001. The effects of crude oil and the effectiveness of cleaner application following oiling on US Gulf of Mexico coastal marsh plants. Environmental Pollution **112**:483-489.
**Keywords:** biomass/ carbon/ carbon fixation/ cleaning/ conductance/ Corexit 9580/ crude oil/ dispersant/

effectiveness/ effects/ experiment/ fresh water/ freshwater plant/ growth/ Gulf of Mexico/ Louisiana/ Louisiana crude oil/ marine plant/ Mexico/ ODsix/ oil/ oiled/ petroleum/ plant/ Sagittaria/ salt water/ seasonal/ South Louisiana crude oil/ Spartina/ time/ transpiration/ treatment/ vegetation/ wetland
**Notes:** An assessment of the efficacy of a petroleum chemical dispersant in fresh and brackish water wetlands. Plots containing either saltwater vegetation (*Spartina patens*) or freshwater vegetation (*Sagittaria lancifolia*) were treated with South Louisiana crude oil only, crude oil plus Corexit 9580 2 da after oiling, or no treatment. Measured stomatal conductance, transpiration, and photosynthetic carbon fixation at 4, 8, and 12 wks post-treatment for *Spartina* and at 2, 6, 8, and 12 wks for *Sagittaria.* Also, the number of live and dead plants, new shoots, and plant height were measured at unspecified intervals (but not at the beginning of the experiment). Above-ground biomass was measured at the end of the first growing season for *Spartina* and at the end of the second growing season for *Sagittaria*.

**Pfeiffer, C. J., L. V. Sharova, L. Gray**, 2000. Functional and ultrastructural cell pathology induced by fuel oil in cultured dolphin renal cells. Ecotoxicology and Environmental Safety **47**:210-217.
**Keywords:** apoptosis/ Atlantic/ cell/ dolphin/ fuel oil/ mammal/ No.1 fuel oil/ oil/ Otwo/ pathology/ rate/ salt water/ survival
**Notes:** Assessment of the effect of No. 1 fuel oil on renal cells derived from the Atlantic spotted dolphin. Cells were exposed to 1.5, 4.7, 15, 30, or 150 ppm fuel oil mixtures for 12 hrs. Measured survival, extracellular acidification, cell cycle phases, and rate of apoptosis.

**Phillips, C., J. Clayton, J. Evans, W. Hom**, 1998. Evidence for long-range transport of a low to medium molecular-weight petroleum product off central California, USA. Environmental Toxicology and Chemistry **17**:1662-1672.
**Keywords:** alkane/ California/ crude oil/ evaluation/ isoprenoid/ offshore/ Onine/ PAH/ petroleum/ petroleum products/ salt water/ sediment/ sterane/ suspended sediment/ technical/ terpane/ transport
**Notes:** Evaluation of possible long-range transport of a refined petroleum product used as a diluent in onshore platforms in Southern California. Suspended sediments from offshore areas analyzed for normal alkanes, isoprenoids, PAHs, terpanes, and steranes. Principal components analyzis used on data.

**Phillips, D. J. H., B. J. Richardson, A. P. Murray, J. G. Fabris**, 1992. Trace metals, organochlorines and hydrocarbons in Port Phillip Bay, Victoria: a historical review. Marine Pollution Bulletin **25**:200-217.
**Keywords:** Australia/ history/ hydrocarbons/ metals/ miscellaneous/ Oeleven/ organochlorines/ PAH/ petroleum/ petroleum hydrocarbons/ review/ salt water/ sources/ total hydrocarbons
**Notes:** This review paper contains a section on petroleum hydrocarbon contamination in Port Phillip Bay, Australia beginning with studies in the 1970s. Information on various sources of hydrocarbons with emphasis on total hydrocarbons and PAHs.

**Phillips, J.**, 1974. Oiled seabirds successfully cleaning their plumage. British Birds **67**:483.
**Keywords:** bird/ cleaning/ England/ gull/ oiled/ Oone/ plumage/ salt water
**Notes:** Report of the oiling and subsequent cleaning of an oiled Bonaparte's gull on coastal England. Letter written to the journal in response to a previously published article on the same subject.

**Piatt, J. F., C. J. Lensink**, 1989. *Exxon Valdez* bird toll. Nature **342**:865-866.
**Keywords:** Alaska/ bird/ Exxon Valdez/ oil/ oil spill/ Oone/ population/ salt water/ species/ spill
**Notes:** Early report on the estimation of bird losses from the Exxon Valdez oil spill and their population consequences.

**Piatt, J. F., C. J. Lensink, W. Butler, M. Kendziorek, D. R. Nysewander**, 1990. Immediate impact of the 'Exxon Valdez' oil spill on marine birds. Auk **107**:387-397.
**Keywords:** Alaska/ bird/ Exxon Valdez/ marine birds/ oil/ oil spill/ Oone/ population/ Prudhoe Bay crude oil/ salt water/ spill
**Notes:** Early assessment of the losses of seabirds from the Exxon Valdez oil spill in Alaska.

**Piatt, J. F., H. R. Carter, and D. N. Nettleship** 1991. Effects of oil pollution on marine bird populations. Pages 125-141 *in* J. White, L. Frink, T. M. Williams, and R. W. Davis, editors. The Effects of Oil on Wildlife. The Sheridan Press, Hanover, PA.

**Keywords:** bird/ effects/ history/ marine birds/ oil/ Oone/ pollution/ population/ salt water/ spill
**Notes:** Assessment of the effect of oil pollution on marine bird populations; discussion of the difficulties of association between spills and population status and presentation of several case histories.

**Piatt, J. F., T. I. Van Pelt**, 1997. Mass-mortality of guillemots (*Uria aalge*) in the Gulf of Alaska in 1993. Marine Pollution Bulletin **34**:656-662.
**Keywords:** Alaska/ bird/ carcass/ estimate/ experiment/ guillemot/ Gulf of Alaska/ numbers/ Oone/ persistence/ population/ salt water/ starvation
**Notes:** Report of large die-off of guillemots in the Gulf of Alaska during the first half of 1993. Carcass deposition and persistence experiments used to estimate true numbers of dead birds. Discussion of possible causes of deaths and comparisons made to other reports of large-scale seabird losses.

**Piehler, M. F., J. G. Swistak, J. L. Pinckney, H. W. Paerl**, 1997. Sub-lethal effects of coastal petroleum pollution on *Spartina alterniflora* stem epiphytes. Chemosphere **35**:2665-2674.
**Keywords:** chlorophyll/ concentration/ diesel/ diesel fuel/ effects/ long-term/ marine plant/ Osix/ petroleum/ pollution/ productivity/ salt water/ short-term/ Spartina/ sublethal/ weathered
**Notes:** Effects of diesel fuel on stem epiphytes of *Spartina alternaflora*. Portions of field-collected stems were subjected to either short-term (3 hr) or long-term (48 hr) exposure to varying concentrations (87-17,400 ppm short-term, 0.87-435 ppm long-term) of weathered diesel fuel. Measured $N_2$ fixation, primary productivity, and chlorophyll *a* concentrations.

**Piehler, M. F., J. G. Swistak, J. L. Pinckney, H. W. Paerl**, 1999. Stimulation of diesel fuel biodegradation by indigenous nitrogen fixing bacterial consortia. Microbial Ecology **38**:69-78.
**Keywords:** abundance/ bacteria/ biodegradation/ carbon/ community/ concentration/ corn/ diesel/ diesel fuel/ experiment/ marina/ mesocosm/ microbes/ Microtox/ nitrogen/ organic carbon/ Oten/ particulate/ population/ productivity/ remediation/ salt water/ structure/ toxicity
**Notes:** A determination of the utility of particulate organic carbon enhancement as a method of nitrogen enhancement for microbial remediation of waters contaminated by diesel fuel. Water collected at a marina and a non-marina site on Bogue Sound, North Carolina was used in laboratory and mesocosm experiments with four concentrations of diesel fuel and with or without ground corn stalks; duration of the experiments was 32 da and 4 wks. Measured biodegradation, $N_2$ fixation, bacterial productivity, bacterial abundance, number of hydrocarbon degrading bacteria, toxicity (Microtox) of the laboratory solutions, and the magnitude and structure of the bacterial community adhering to the corn stalk particles via SEM.

**Piehler, M. F., J. S. Maloney, H. W. Paerl**, 2002. Bacterioplanktonic abundance, productivity and petroleum hydrocarbon biodegradation in marinas and other coastal waters in North Carolina, USA. Marine Environmental Research **54**:157-168.
**Keywords:** abundance/ bacteria/ bioassay/ biodegradation/ community/ diesel/ diesel fuel/ incubation/ marina/ microbes/ Oten/ petroleum/ petroleum hydrocarbons/ population/ productivity/ salt water
**Notes:** Seventeen monthly water samples were collected from two marinas and one non-marina site on Bogue Sound, North Carolina. Determined total bacterial abundance, number of petroleum hydrocarbon degrading bacteria, and hexadecane biodegradation (1-wk incubation). Also performed a bioassay to determine the response of the bacterial community to a diesel fuel addition (3-da incubation). Measured bacterial abundance, number of hydrocarbon degraders, and bacterial productivity in the bioassay.

**Pierce, V.** 1991. The effects of the Arabian Gulf oil spill on wildlife. Pages 370-375 *in* 1991 Proceedings American Association of Zoo Veterinarians. AAZV, Calgary, Canada.
**Keywords:** activity/ Arabian Gulf/ effects/ environment/ general effect/ Gulf oil spill/ Oeight/ oil/ oil spill/ rehabilitation/ rescue/ salt water/ spill/ war
**Notes:** An early report of the effects of the Gulf War oil spill on the environment. Descriptions of activities at the Saudi wildlife rescue center, general effects on the environment, and effects on wildlife.

**Pierce, V.** 1991. Pathology of wildlife following a #2 fuel oil spill. Pages 58-66 *in* J. White and L. Frink, editors. The Effects of Oil on Wildlife. The Sheridan Press, Hanover, PA.
**Keywords:** bird/ condition/ effects/ fuel oil/ necropsy/ New Jersey/ New York/ No.2 fuel oil/ oil/ oil spill/ Oone/ pathology/ salt water/ species/ spill/ technical

**Notes:** Results of the necropsy of birds killed in the No. 2 fuel oil spill between NJ and NY in 1990. Also, technical guidance for others who have to perform necropsies under such conditions.

**Pineiro, M. E. A., M. A. L. Yusty, S. T. C. Gonzalez-Barros, J. S. Lozano**, 1996. Aliphatic hydrocarbon levels in turbot and salmon farmed close to the site of the *Aegean Sea* oil spill. Bulletin of Environmental Contamination and Toxicology **57**:811-815.
**Keywords:** Aegean Sea/ aliphatic hydrocarbons/ concentration/ crude oil/ fish/ hydrocarbons/ oil/ oil spill/ organoleptic/ Othree/ salmon/ salt water/ sampling/ spill/ turbot
**Notes:** Presence of aliphatic hydrocarbons in turbot and salmon from fish farms located close to the site of the Aegean Sea oil spill; sampling done over a two-year period, organoleptic results also reported.

**Plante-Cuny, M. R., C. Salen-Picard, C. Grenz, R. Plante, E. Alliot, C. Barranguet**, 1993. Experimental field study of the effects of crude oil, drill cuttings and natural biodeposits on microphyto- and macrozoobenthic communities in a Mediterranean area. Marine Biology **117**:355-366.
**Keywords:** amino acids/ ammonium/ Arabian Light crude oil/ chlorophyll/ coast/ community/ concentration/ crude oil/ cuttings/ density/ effects/ experiment/ feces/ France/ general effect/ intertidal/ invertebrate/ light/ macrofauna/ marine invertebrate/ marine plant/ Mediterranean/ mesocosm/ microalgae/ mussel/ Oeight/ oil/ oxygen/ pigment/ population/ pore water/ salt water/ sediment/ time/ treatment
**Notes:** Four experimenal 'in situ' mesocosms were established in the intertidal zone of a shallow bay along the Mediterranean coast of France. Treatments were enclosed control, unenclosed control, Arabian light crude oil, drill cuttings, and biological deposits (feces and pseudofeces of mussels). The experiment began in July and lasted until May of the next year. Measured ammonium and oxygen fluxes at the sediment surface, organic matter and amino acids in pore water, chlorophyll *a* and degraded pigment concentrations in sediment, microphytic concentrations in sediment, and macrobenthic density.

**Platt, H. M.**, 1978. Assessment of the macrobenthos in an Antarctic environment following recent pollution abatement. Marine Pollution Bulletin **9**:149-153.
**Keywords:** Antarctic/ benthic/ biomass/ carbon/ chlorophyll/ effects/ environment/ fuel oil/ general effect/ grain/ marine invertebrate/ Oeight/ oil/ pollution/ salt water/ sediment/ time/ whale
**Notes:** Assessment of the effects of pollution (whale byproducts, fuel oil) in an Antarctic cove used as a whaling station from 1904 to 1965. Collected sediment samples from seven sites. Measured sediment characteristics (type, grain size, carbon content, total chlorophyll *a* and metabolized pigment) and identified and quantified the benthic fauna. Compared the benthic biomass data with other cold water locations.

**Plaza, G., G. Nalecz-Jawecki, K. Ulfig, R. L. Brigmon**, 2005. Assessment of genotoxic activity of petroleum hydrocarbon-bioremediated soil. Ecotoxicology and Environmental Safety **62**:415-420.
**Keywords:** activity/ aliphatic hydrocarbons/ assay/ bioremediation/ carbon/ cations/ depth/ fertilizer/ genotoxic/ hydrocarbons/ ions/ metals/ microbes/ organic/ organic carbon/ Oten/ PAH/ petroleum/ petroleum hydrocarbons/ refinery/ soil/ surfactant
**Notes:** An engineered biopile of refinery sludge was bioremediated for 4 years. Mineral fertilizers and a surfactant were added and half of the pile was actively aerated. The biopile was annually sampled at 23 locations and two depths. Samples were analyzed for total petroleum hydrocarbons, nonpolar hydrocarbons, total petroleum organic carbon, polar aliphatics, total PAHs, 16 priority PAHs, selected ions and cations, metals, and several other physiochemical properties. Microbial activity was measured according to dehydrogenase activity. Two genotoxicity assays (SOS chromotest, umu test), with and without S9 activation, were employed after 4 years.

**Pochop, P. A., J. L. Cummings, J. E. Steuber, C. A. Yoder**, 1998. Effectiveness of several oils to reduce hatchability of chicken eggs. Journal of Wildlife Management **62**:395-398.
**Keywords:** bird/ chicken/ corn/ corn oil/ effectiveness/ eggs/ hatchability/ hatching/ incubation/ mineral oil/ oil/ Oone/ vegetable oil
**Notes:** A test of the effectiveness of six oils in preventing hatching of chicken eggs. Compared castor oil, corn oil, linseed oil, safflower oil, soybean oil, and white mineral oil at 5 or 16 days of incubation. Measured hatching success.

**Pokarzhevskii, A. D., O. A. Goryachev, Z. V. Filimonova, Z. N. Pushnikova**, 2003. Toxic effects of crude oil-saturated soils on the survival and reproduction of the enchytraeid *Enchytraeus cryptius* in a short term testing experiment. Fresenius Environmental Bulletin **12**:844-847.
**Keywords:** crude oil/ earthworm/ freshwater invertebrate/ Ofive/ oil field/ reproduction/ short-term/ soil/ survival
**Notes:** Soil contaminated by crude oil in an oil field was used in a laboratory exposure study using earthworms. Worms were exposed for 4 wks to either artificial soil or one of six dilutions of the contaminated soil. Measured survival and reproduction.

**Pollard, S. J. T., M. Whittaker, G. C. Risden**, 1999. The fate of heavy oil wastes in soil microcosms I: a performance assessment of biotransformation indices. Science of the Total Environment **226**:1-22.
**Keywords:** activity/ aromatic hydrocarbons/ biotransformation/ crude oil/ evaluation/ fate/ fuel oil/ incubation/ microcosm/ Nigerian crude oil/ No.6 fuel oil/ nutrients/ oil/ Onine/ petroleum/ saturated hydrocarbons/ soil/ technical
**Notes:** An evaluation of seven indices of biotransformation of petroleum in soil microcosms. Nigerian crude oil, blended ballast oil, and No. 6 fuel oil were mixed with soil and nutrients to stimulate microbial activity; microcosm incubation lasted for 9 mos. Sampled soil at days 0, 2, 4, 8, 16, 32, 64, 128, and 256 days and analyzed for selected saturates and aromatics; then calculated indices.

**Pollard, S. J. T., J. G. Farmer, D. M. Knight, P. J. Young**, 2002. Matrix effects in applying mono- and polyclonal ELISA systems to the analysis of weathered oils in contaminated soil. Environmental Pollution **117**:5-8.
**Keywords:** analysis/ effects/ immune response/ methods/ oil/ Onine/ petroleum/ soil/ technical/ weathered
**Notes:** A comparison of the ability of mono- and polyclonal ELISA systems to determine the amount of solvent extractable matter in soils containing weathered petroleum. Contaminated soils from five areas of a former combined steelworks and coke production facility were collected. Within each site, samples were collected from 'high', 'medium', and 'low' soil contamination.

**Pollet, I., L. Bendell-Young**, 2000. Amphibians as indicators of wetland quality in wetlands formed from oil sands effluent. Environmental Toxicology and Chemistry **19**:2589-2597.
**Keywords:** abnormalities/ Alberta/ amphibian/ biomass/ Canada/ development/ effluent/ fresh water/ frog/ indicator/ oil/ oil sands/ OthreeA/ population/ sand/ sources/ survival/ tadpole/ wetland
**Notes:** Water of five wetlands from the oil sands area of Alberta, Canada were evaluated for their abilility to support amphibians. Tadpoles of the boreal toad were exposed to waters of four of the wetlands for 96 hrs; measured survival, development, and biomass change. Wood frog tadpoles from three different source populations were exposed to waters of all five wetlands for 28 da; measured survival, development (including deformities), and biomass change.

**Pollino, C. A., D. A. Holdway**, 2002. Toxicity testing of crude oil and related compounds using early life stages of the crimson-spotted rainbowfish (*Melanotaenia fluviatilis*). Ecotoxicology and Environmental Safety **52**:180-189.
**Keywords:** abnormalities/ crude oil/ dispersant/ effects/ embryo/ experiment/ fish/ fresh water/ hatchability/ larvae/ naphthalene/ ODthree/ oil/ survival/ toxicity
**Notes:** A large set of laboratory experiments dealing with the effects of crude oil, two chemical dispersants, dispersant-oil mixtures, and naphthalene on embryos and larvae of the crimson-spotted rainbowfish. Established an exposure series for each substance and ran the exposures for 96 hr. Determined hatchability, survival, and developmental abnormalities, and calculated $LC_{50s}$.

**Ponat, A.**, 1988. Effects of water soluble crude oil fractions on cirral beat frequency in *Balanus balanoides*. Bulletin of Environmental Contamination and Toxicology **41**:759-764.
**Keywords:** Arabian crude oil/ assay/ barnacle/ behavior/ concentration/ crude oil/ effects/ feeding/ marine invertebrate/ North Sea/ Ofour/ oil/ salt water/ Saudi Arabian crude oil/ solubility/ static
**Notes:** Determination of the effect of one concentration of water-soluble fraction of either Venezuelan or Saudi Arabian crude oil on the cirral beat frequencey of a North Sea barnacle. Barnacles were exposed

for 3 hrs in a static assay and then transferred to clean sea water for up to 5 da. Cirral beats counted before, during, and after exposure.

**Pontasch, K. W., M. A. Brusven**, 1988. Diversity and community comparison indices: assessing macroinvertebrate recovery following a gasoline spill. Water Research **22**:619-626.
**Keywords:** community/ creek/ diversity/ effects/ fresh water/ freshwater invertebrate/ gasoline/ macroinvertebrate/ Ofive/ recovery/ spill
**Notes:** Effects of a gasoline spill on macroinvertebrates in Woldl Lodge Creek, ID. Two diversity indices and seven community comparison indices were used over a 16-month period to compare the spill site with reference areas.

**Poremba, K.**, 1993. Influence of synthetic and biogenic surfactants on the toxicity of water-soluble fractions of hydrocarbons in sea water determined with the bioluminescence inhibition test. Environmental Pollution **80**:25-29.
**Keywords:** biogenic/ bioluminescence/ concentration/ crude oil/ dispersant/ Ekofisk crude oil/ hydrocarbons/ marine invertebrate/ Microtox/ naphthalene/ ODfour/ oil/ phenol/ salt water/ surfactant/ toxicity/ weathered
**Notes:** Determined the effect of three biogenic and three synthetic surfactants on the toxicity of the water-soluble fractions of Ekofisk crude oil (weathered and unweathered), phenol, and naphthalene. Measured the concentration of naphthalene in water and the inhibition of microbial bioluminescence (Microtox test).

**Porte, C., X. Biosca, D. Pastor, M. Sole, J. Albaiges**, 2000. The *Aegean Sea* oil spill. 2. Temporal study of the hydrocarbons accumulation in bivalves. Environmental Science and Technology **34**:5067-5075.
**Keywords:** accumulation/ Aegean Sea/ aliphatic hydrocarbons/ bivalve/ coast/ crude oil/ cycloalkane/ hydrocarbons/ light/ marine invertebrate/ Ofour/ oil/ oil spill/ PAH/ salt water/ sources/ Spain/ species/ spill/ sterane/ time/ tissue/ triterpane
**Notes:** A temporal assessment of the hydrocarbon content of bivalves affected by the 1992 grounding of the *Aegean Sea* (light crude oil) off the Galacia coast of Spain. Four species of bivalves were collected 3, 6, 9, 12, and 34 mos after the spill. Soft tissue was analyzed for aliphatics, PAHs, and conserved cycloalkanes (triterpanes, steranes) used as source markers.

**Posthuma, J.**, 1977. The composition of petroleum. Rapports et Proces-Verbaux des Reunions Conseil International pour l'Exploration de la Mer **171**:7-16.
**Keywords:** composition/ crude oil/ oil/ Onine/ petroleum/ petroleum hydrocarbons/ technical/ treatment
**Notes:** A very readable treatment of a difficult subject. The author covers the basics of petroleum composition and the subsurface formation of crude oil.

**Potter, D., E. D. Booth, H. C. A. Brandt, R. W. Loose, R. A. J. Priston, A. S. Wright, W. P. Watson**, 1999. Studies on the dermal and systemic bioavailability of polycyclic aromatic compounds in high viscosity oil products. Archives of Toxicology **73**:129-140.
**Keywords:** aromatic hydrocarbons/ benzo[a]pyrene/ blood/ DNA/ humans/ mammal/ miscellaneous/ mouse/ oil/ Oten/ petroleum/ petroleum products/ skin/ uptake/ viscosity
**Notes:** An assessment of the effect of viscosity on the uptake of hazardous components of petroleum products. Applied nine petroleum products of varying viscosity in either of two quantities to the bare skin of laboratory mice and *in vitro* human skin; exposure was maintained for 6 hrs. Petroleum products contained $^{14}$C-labelled benzo(a)pyrene. Measured benzo(a)pyrene in mouse and human skin DNA and mouse blood.

**Poulton, B. C., S. E. Finger, S. A. Humphrey**, 1997. Effects of a crude oil spill on the benthic invertebrate community in the Gasconade river, Missouri. Archives of Environmental Contamination and Toxicology **33**:268-276.
**Keywords:** benthic/ community/ crude oil/ diversity/ effects/ fresh water/ freshwater invertebrate/ hydrocarbons/ invertebrate/ macroinvertebrate/ Missouri/ Ofive/ oil/ oil spill/ petroleum/ petroleum hydrocarbons/ pipeline/ sediment/ spill
**Notes:** Effects of a crude oil spill (pipeline rupture) on the benthic macroinvertebrate communities of the

Gasconade River in Missouri. Study began several months after the spill and ended 18 mos after the spill. Sampled invertebrates, calculated community and diversity indices, and measured total petroleum hydrocarbons in sediments.

**Poulton, B. C., E. V. Callahan, R. D. Hurtubise, B. G. Mueller**, 1998. Effects of an oil spill on leafpack-inhabiting macroinvertebrates in the Chariton River, Missouri. Environmental Pollution **99**:115-122.
**Keywords:** benthic/ crude oil/ density/ diversity/ effects/ evaluation/ fresh water/ freshwater invertebrate/ leaves/ macroinvertebrate/ Missouri/ Ofive/ oil/ oil spill/ pipeline/ species/ spill/ stream
**Notes:** Evaluation of a crude oil spill from a ruptured pipeline on the Chariton River, Missouri 1 yr after the spill. Artificial leaf packs composed of leaves from five species of trees were placed at two sites upstream and three sites downstream of the spill 1 mo and 13 mos after the spill. Measured six benthic metrics and the density and taxa richness for four functional groups (collectors, predators, scrapers, shredders).

**Prasad, M. S.**, 1988. Sensitivity of branchial mucous to crude oil toxicity in a freshwater fish, *Colisa fasciatus*. Bulletin of Environmental Contamination and Toxicology **41**:754-758.
**Keywords:** concentration/ crude oil/ effects/ fish/ fresh water/ gill/ India/ lethal/ oil/ Othree/ pathology/ sublethal/ toxicity
**Notes:** Effects on the striped gourami of exposure to varying concentrations (lethal and sublethal) of a local crude oil; lethal exposure was 2-24 hr, sublethal exposure was 15 da, pathology of gills.

**Prasad, M. S.**, 1989. Effects of crude oil on the air-breathing organs of the striped gourami, *Colisa fasciatus* : a SEM study. Ecotoxicology and Environmental Safety **18**:211-218.
**Keywords:** concentration/ crude oil/ effects/ fish/ fresh water/ oil/ organ/ Othree/ pathology/ tissue
**Notes:** Effect on air breathing organs of the striped gourami of exposure to varying concentrations of crude oil; exposure ranged from 12 hr to 15 da, tissue examined by scanning electron microscope.

**Prasad, M. S.**, 1991. SEM study on the effects of crude oil on the gills and air breathing organs of climbing perch, *Anabas testudineus*. Bulletin of Environmental Contamination and Toxicology **47**:882-889.
**Keywords:** bioassay/ concentration/ crude oil/ effects/ evaluation/ fish/ fresh water/ gill/ oil/ organ/ Othree/ pathology/ static/ tissue
**Notes:** Evaluation of the effects of varying concentrations (100-500 ppm) of crude oil on epithelia of gills and air breathing organs of the climbing perch. Perch were exposed to solutions in a static bioassay for 12 hrs to 15 da. Used electron microscopy to examine tissue surface.

**Price, A. R. G., C. P. Mathews, R. W. Ingle, K. Al-rasheed**, 1993. Abundance of zooplankton and penaeid shrimp larvae in the western Gulf: analysis of pre-war (1991) and post-war data. Marine Pollution Bulletin **27**:273-278.
**Keywords:** abundance/ analysis/ density/ Gulf oil spill/ larvae/ marine invertebrate/ Ofour/ salt water/ sampling/ shrimp/ zooplankton
**Notes:** Comparison of densities of zooplankton and penaeid shrimp larvae in 1992 with densities in 1976 or 1978. All sampling was performed at the same two nearshore sites in the western Gulf of Arabia.

**Price, A. R. G., T. J. Wrathall, P. A. H. Medley, A. H. Al-Moamen**, 1993. Broadscale changes in coastal ecosystems of the western Gulf following the 1991 Gulf War. Marine Pollution Bulletin **27**:143-147.
**Keywords:** coast/ ecosystem/ estimate/ general effect/ miscellaneous/ Oeight/ oil/ pollution/ salt water/ survey/ time/ war
**Notes:** A generalized rapid assessment of environmental change (flora and fauna) was carried out in 1991, 6 mo after the end of the Gulf War. Thirty-five of 53 sites along the Saudi Arabian coast surveyed in 1986 were repeated for the 1991 survey, and 10 of these were repeated again in 1992. Results are compared to estimate the ecological impact of oil pollution from the war.

**Price, A. R. G.**, 1998. Impact of the 1991 Gulf War on the coastal environment and ecosystems: current status and future prospects. Environment International **24**:91-96.
**Keywords:** Arabian Gulf/ coast/ ecosystem/ effects/ environment/ general effect/ Gulf oil spill/ humans/ Oeight/ oil/ oil spill/ recovery/ salt water/ spill/ war

**Notes:** Assessment of the status of the Arabian Gulf 5 yrs after the Gulf War oil spill. Comments on the effects of the war and contemporary exploitation by humans of the coastal areas.

**Prince, R. C., R. Varadaraj, R. J. Fiocco, R. R. Lessard** , 1999. Bioremediation as an oil spill response tool. Environmental Technology **20**:891-896.
**Keywords:** bioremediation/ commentary/ dispersant/ fertilizer/ microbes/ oil/ oil spill/ Oten/ petroleum/ petroleum hydrocarbons/ population/ salt water/ shoreline/ spill/ spill response
**Notes:** A commentary on bioremediation as a method of removing spilled petroleum. Discussion of the use of chemical dispersants (Exxon products), shoreline cleaners (Exxon products), and the stimulation of shoreline microbial populations with applications of N and P fertilizers.

**Prince, R. C., E. H. Owens, G. A. Sergy**, 2002. Weathering of an Arctic oil spill over 20 years: the BIOS experiment revisited. Marine Pollution Bulletin **14**:1236-1242.
**Keywords:** Arctic/ Canada/ crude oil/ degradation/ estimate/ experiment/ gravel/ hopane/ intertidal/ microbes/ oil/ oil spill/ Oten/ salt water/ sediment/ spill
**Notes:** A 20-yr assessment of the status of the crude oil used in the 1981 BIOS experiment on Baffin Island (Canada). Six samples of surface gravel, subsurface material, oily sediments, and floating oil in a small pit were collected from one spill site, and four samples of surface and subsurface intertidal sediment were collected from a second site. A conserved hopane marker was used to estimate the percent loss of original crude oil.

**Pritchard, P. H., C. F. Costa**, 1991. EPA's Alaska oil spill bioremediation project. Environmental Science and Technology **25**:372-379.
**Keywords:** Alaska/ biodegradation/ bioremediation/ crude oil/ degradation/ Exxon Valdez/ fertilizer/ microbes/ nitrogen/ oil/ oil spill/ Oten/ phosphorus/ salt water/ spill
**Notes:** A description of the EPA ORD response to the *Exxon Valdez* oil spill in 1989. Personnel set up a demonstration project on enhanced bioremediation of beached crude oil emphasizing the addition of nitrogen and phosphorus fertilizers.

**Proffitt, C. E., D. J. Devlin, M. Lindsey**, 1995. Effects of oil on mangrove seedlings grown under different environmental conditions. Marine Pollution Bulletin **30**:788-793.
**Keywords:** condition/ effects/ experiment/ growth/ leaves/ light/ lubricating oil/ mangrove/ marine plant/ oil/ Osix/ plant/ salt water/ seedling/ size/ species/ survival
**Notes:** Seedlings of two species of mangrove were grown in pots and exposed to fresh lubricating oil. Seedlings were exposed to either no oil, a one-time addition of a large amount of oil, or weekly additions of a small amount of oil. Duration of the experiment was 58 wks. Half of the plants were kept indoors under laboratory lighting and the other half was kept outdoors for 16 wks and then brought into the laboratory. Measured survival, stem growth, number of leaves produced, and maximum leaf size.

**Proffitt, C. E., D. J. Devlin**, 1998. Are there cumulative effects in red mangroves from oil spills during seedling and sapling stages? Ecological Applications **8**:121-127.
**Keywords:** Bunker C/ crude oil/ effects/ fuel oil/ growth/ Louisiana/ Louisiana crude oil/ mangrove/ marine plant/ No.6 fuel oil/ oil/ oil spill/ Osix/ petroleum/ plant/ previous exposure/ salt water/ seedling/ South Louisiana crude oil/ spill
**Notes:** Assessment of the effects on red mangrove seedling propagules and saplings of multiple exposures to petroleum. Seedling propagules exposed to No. 6 fuel oil, monitored for effects for 34 mos, exposed to South Louisiana crude oil, and monitored for another 12 mos. Multiple measures of plant growth and comparisons made to evaluate level of exposure and significance of previous exposure to No. 6 fuel oil.

**Propst, T. L., R. L. Lochmiller, C. W. Qualls, Jr., K. McBee**, 1999. In situ (mesocosm) assessment of immunotoxicity risks to small mammals inhabiting petrochemical waste sites. Chemosphere **38**:1049-1067.
**Keywords:** blood/ cotton rat/ immune response/ lymph node/ mammal/ mesocosm/ Oklahoma/ organ/ Otwo/ petroleum waste/ refinery/ risk/ spleen/ weight
**Notes:** Wild cotton rats were captured and used in mesocosm studies at three contaminated

petrochemical sites and three reference sites in Oklahoma. The 3 m x 3 m mesocosms were used for 8-week trials in summer and winter, and a 4-week trial was held during another summer. At the end of the studies, animals were euthanized, body and organ weights measured, and a blood sample removed. Special emphasis was placed on measuring immune organs (spleen, lymph nodes) and immune properties of blood. Several tests were preformed to determine immune function.

**Prouse, N. J., D. C. Gordon, Jr., P. D. Keizer**, 1976. Effects of low concentrations of oil accommodated in sea water on the growth of unialgal marine phytoplankton culture. Journal of the Fisheries Research Board of Canada **33**:810-818.
**Keywords:** algae/ alkane/ aromatic hydrocarbons/ composition/ concentration/ crude oil/ effects/ experiment/ fuel oil/ growth/ hydrocarbons/ Kuwait/ marine plant/ No.2 fuel oil/ oil/ Osix/ phytoplankton/ salt water/ Venezuelan crude oil
**Notes:** A series of 10 experiments to assess the effects of low concentrations of the water-accommodated fractions of Kuwait and Venezuelan crude oils, and No. 2 fuel oil, to single-species cultures of marine phytoplankton. Preliminary tests were performed to determine changes in aromatic and and alkane composition in water after 30 min and after 12 da, with and without algae. Multiple trials employing varying concentrations of oil were performed for each of the test oils. Duration of trials ranged from 9 to 16 da. Measured growth of algal culture and aromatic hydrocarbons in the water at the beginning and end of each trial.

**Quintero, S., C. Diaz**, 1994. Aliphatic hydrocarbons in fish from the Canary Islands. Marine Pollution Bulletin **28**:44-49.
**Keywords:** aliphatic hydrocarbons/ Canary Islands/ concentration/ fish/ hydrocarbons/ oil/ oil spill/ Othree/ refinery/ salt water/ species/ spill/ tanker
**Notes:** Baseline information on aliphatic hydrocarbons in fish caught at the Canary Islands; a site of heavy tanker traffic, several recent oil spills, and an oil refinery.

**Radwan, S., N. Sorkhoh, I. El-Nemr**, 1995. Oil biodegradation around roots. Nature **376**:302.
**Keywords:** analysis/ biodegradation/ crude oil/ freshwater plant/ hydrocarbons/ microbes/ oil/ oiled/ Oten/ petroleum/ petroleum hydrocarbons/ plant/ roots/ soil
**Notes:** A report of the ability of petroleum tolerant plants to contribute to the biodegradation of oiled soil in the Kuwaiti desert. Microorganisms associated with the roots of certain desert and crop plants were identified and an analysis of the soil hydrocarbons was performed to determine which classes of petroleum hydrocarbons were being preferentially metabolized.

**Radwan, S. S., R. H. Al-Hasan, N. Ali, S. Salamah, M. Khanafer**, 2005. Oil-consuming microbial consortia floating in the Arabian Gulf. International Biodeterioration and Biodegradation **56**:28-33.
**Keywords:** Arabian Gulf/ bacteria/ biodegradation/ consumption/ crude oil/ growth/ microbes/ oil/ Oten/ salt water/ water
**Notes:** Picocyanobacteria strains were isolated from the surface waters of the Arabian Gulf and the effect of their presence on hydrocarbon-degrading bacteria determined. Four common genera of bacteria were related to specific strains of picocyanobacteria. Cultures (24 hr) were used to determine the influence of picocyanobacteria on growth and hydrocarbon consumption ($C_{18}$, phenathrene, crude oil) of hydrocarbon-utilizing bacteria.

**Rafferty, D. P., R. L. Lochmiller, S. Kim, C. W. Qualls, J. Schroder, N. Basta, K. McBee**, 2000. Fluorosis risks to resident hispid cotton rats on land-treatment facilities for petrochemical wastes. Journal of Wildlife Diseases **36**:636-645.
**Keywords:** concentration/ cotton rat/ effects/ female/ fluoride/ fluorosis/ land farming/ lesions/ male/ mammal/ metals/ Otwo/ petroleum waste/ plant/ rat/ risk/ seasonal/ soil
**Notes:** Three sites formerly used for land-farming wastes from petrochemical plants, and matched reference sites, were used to determine the effects of fluorides on cotton rats. Rats were collected during winter and summer of 7/95-3/97 during four trapping sessions each season, with 3 wks separating seasons. Rats were toe-clipped, sexed, weighed, presence or absence of dental lesions noted, and female and male reproductive status noted. Twenty rats were removed from each site and examined under magnification for severity of dental lesions. The humeri of each of the twenty rats was analyzed for

fluoride, Sr, Pb, Zn, and Ti. Soils from each trapping site were sampled and analyzed for fluoride concentrations.

**Rafferty, D. P., R. L. Lochmiller, K. McBee, C. W. Qualls, N. Basta**, 2001. Immunotoxicity risks associated with land-treatment of petrochemical wastes revealed using an in situ rodent model. Environmental Pollution **112**:73-87.
**Keywords:** adrenal/ blood/ cell/ concentration/ cotton rat/ fresh water/ hemoglobin/ hydrocarbons/ immune response/ kidney/ liver/ lymph node/ mammal/ metals/ model/ Oklahoma/ Otwo/ PAH/ petroleum/ petroleum hydrocarbons/ platelet/ protein/ rat/ red blood cell/ risk/ seasonal/ serum/ soil/ spleen/ treatment
**Notes:** Cotton rats were collected during winter and summer from five former petrochemical land treatment sites and five matched reference sites in Oklahoma, USA. Twelve rats were collected from each site during each season and taken to a laboratory facility. Rats were anesthetized, sampled for blood, killed, and processed. Blood was analyzed for white and red blood cell count, platelet count, hematocrit, hemoglobin, mean corpuscular volume, mean corpuscular hemoglobin, mean corpuscular hemoglobin concentration, and total serum protein. Peritoneal exudate cells and splenocytes were collected and mononuclear lymphocytes were counted in popliteal lymph notes of sacrificed rats. Determined phytohemagglutin-hypersensitivity and lymphoproliferative responsiveness of splenocytes. Also weighed liver, kidneys, adrenal glands, spleen and popliteal lymph nodes. Soil samples from each site were analyzed for total petroleum hydrocarbons, seven PAHs, and four metals.

**Rahn, H., R. A. Ackerman, C. V. Paganelli**, 1977. Humidity in the avian nest and egg water loss during incubation. Physiological Zoology **50**:269-283.
**Keywords:** bird/ eggs/ humidity/ incubation/ nest/ Oone
**Notes:** Description of the dynamics of water loss from the avian egg and the relation with nest humidity.

**Rahn, H., C. V. Paganelli**, 1990. Gas fluxes in avian eggs: driving forces and the pathway for exchange. Comparative Biochemistry and Physiology **95A**:1-15.
**Keywords:** behavior/ bird/ condition/ egg shell/ eggs/ incubation/ movement/ nest/ numbers/ Oone/ pores/ review/ shell/ temperature
**Notes:** Review of gas movement through avian egg shells; discussion of pore number, egg temperature, nest conditions, and incubation behavior.

**Ralph, P. J., M. D. Burchett**, 1998. Impact of petrochemicals on the photosynthesis of *Halophila ovalis* using chlorophyll fluorescence. Marine Pollution Bulletin **36**:429-436.
**Keywords:** chlorophyll/ combination/ concentration/ Corexit 9527/ crude oil/ dispersant/ marine plant/ oil/ Osix/ photosynthesis/ pigment/ salt water/ seagrass/ species
**Notes:** Exposure of a species of seagrass to three concentrations of the water-soluble fraction of Bass Strait crude oil, Corexit 9527, and a combination of crude oil and dispersant for 96 hr. Measured chlorophyll fluorescence and photosynthetic pigment.

**Ramachandran, S. D., P. V. Hodson, C. W. Khan, K. Lee**, 2004. Oil dispersant increases PAH uptake by fish exposed to crude oil. Ecotoxicology and Environmental Safety **59**:300-308.
**Keywords:** activity/ aliphatic hydrocarbons/ assay/ concentration/ crude oil/ dispersant/ fish/ fresh water/ juvenile/ liver/ metabolism/ ODthree/ oil/ PAH/ rainbow trout/ static/ tissue/ uptake
**Notes:** The water-accomodated fractions of three undispersed and chemically-dispersed (Corexit EC9500) crude oils were used in 48 hr static (renewed at 24 hr) assays with juvenile rainbow trout. Measured EROD activity in liver tissue after the 48 hr exposure. Also measured the concentration in water of selected PAH and the total hydrocarbon (aliphatics) concentrations.

**Ramachandran, S. D., M. J. Sweezey, P. V. Hodson, M. Boudreau, S. C. Courtenay, K. Lee, T. King, J. A. Dixon**, 2006. Influence of salinity and fish species on PAH uptake from dispersed crude oil. Marine Pollution Bulletin **52**:1182-1189.
**Keywords:** activity/ concentration/ Corexit 9500/ crude oil/ dispersant/ experiment/ fish/ juvenile/ metabolism/ mummichog/ ODthree/ oil/ PAH/ rainbow trout/ salinity/ salt water/ species/ uptake/ water/ weathered
**Notes:** Juvenile rainbow trout and mummichogs were used in a 48-hr exposure experiment with the

water-accomodated fraction of artificially-weathered MESA crude oil and chemically-dispersed (Corexit 9500) weathered crude oil. Salinity of test water was either 0% or 15% for trout and 15% or 30% for mummichog. Measured the hepatic EROD activity at the end of the study. Calculated median effect concentrations for EROD induction by fish in the various test groups.

**Ramsay, M. A., R. P. J. Swannell, W. A. Shipton, N. C. Duke, R. T. Hill**, 2000. Effect of bioremediation on the microbial community in oiled mangrove sediments. Marine Pollution Bulletin **41**:413-419.
**Keywords:** Australia/ bacteria/ bioremediation/ community/ crude oil/ effects/ fertilizer/ intertidal/ mangrove/ microbes/ oil/ oiled/ Oten/ region/ remediation/ salt water/ sediment/ time/ treatment
**Notes:** An assessment of the effects of bioremediation on microbes in the surface sediment of the intertidal zone. Nine plots, three each of control, crude oil only, and crude oil plus remediation, were located in the mid-tidal region within a mangrove forest of coastal Australia. Remediation consisted of aeration and the addition of fertilizer. Sediment samples were collected before treatment, at 1, 2, 3, 4, 9, and 12 mos post-treatment, and the bacteria were identified and quantified.

**Randall, R., B. Randall**, 1986. The Kapodistrias affair -- another oiling incident affecting seabirds. Bokmakierie **38**:37-40.
**Keywords:** Africa/ bird/ coast/ oiled/ Oone/ penguin/ population/ rehabilitation/ salt water/ South Africa/ species
**Notes:** An account of the grounding of the Kapodistrias on the coast of South Africa; emphasis on the rehabilitation efforts for oiled birds plus general comments on other aspects.

**Randall, R. M., B. M. Randall, J. Bevan**, 1980. Oil pollution and penguins -- is cleaning justified? Marine Pollution Bulletin **11**:234-237.
**Keywords:** Africa/ bird/ cleaning/ coast/ oil/ oiled/ Oone/ penguin/ pollution/ rehabilitation/ salt water/ South Africa
**Notes:** Assessment of the justification for rehabilitating oiled penguins from the coast of South Africa.

**Randolph, R. C., J. T. Hardy, S. W. Fowler, A. R. G. Price, W. H. Pearson**, 1998. Toxicity and persistence of nearshore sediment contamination following the 1991 Gulf War. Environment International **24**:33-42.
**Keywords:** amphipod/ beach/ Gulf oil spill/ hydrocarbons/ Kuwait/ marine invertebrate/ Ofour/ oil/ oil spill/ persistence/ petroleum/ petroleum hydrocarbons/ salt water/ Saudi Arabia/ sediment/ spill/ static/ toxicity/ war
**Notes:** Toxicity assessment of sediment samples collected at 11 beach sites at four tidal elevations in Kuwait and Saudi Arabia 30 mo after the 1991 Gulf oil spill. Conducted 10-day static toxicity tests with a marine amphipod. Also measured petroleum hydrocarbons in sediment.

**Ranwell, D. S.** 1968. Extent of damage to coastal habitats due to the *Torrey Canyon* incident. Pages 39-47 *in* J. D. Carthy, D. R. Arthur, editors. The Biological effects of oil pollution on littoral communities: proceedings of a symposium held at the Orielton Field Centre, Pembroke, Wales, on 17th, 18th and 19th February 1968. Field Studies. Field Studies Council, London.
**Keywords:** coast/ crude oil/ effects/ general effect/ habitat/ intertidal/ invertebrate/ marine invertebrate/ marine plant/ movement/ Oeight/ oil/ oil spill/ salt water/ shoreline/ spill/ vegetation/ biological effects/ pollution/ littoral/ community/ Wales
**Notes:** A description of the damage to done to coastal habitats from the *Torrey Canyon* oil spill in 1967. Author describes the movement of the crude oil from Cornwall to the coast of Brittany and describes the effect on all types of shorelines. Specific descriptions of the effects on intertidal vegetation and some invertebrates.

**Rao, G. S., K. P. Pandya**, 1978. Toxicity of petroleum products: effects on alkaline phosphatase and lipid peroxidation. Environmental Research **16**:174-178.
**Keywords:** benzene/ biochemical/ effects/ gasoline/ glucose/ lipid/ mammal/ Otwo/ petroleum/ petroleum products/ rat/ toxicity
**Notes:** Rats were injected intraperitoneally with either benzene, Iomex, petroleum ether, or gasoline and

monitored for 20 da. Measured effect on lipid peroxidation, alkaline phosphatase, and glucose 6-phosphatase after 3 hr, 24 hr, and over a 1, 3, 5, 7, 17, 20 da sequence.

**Rao, P., S. Ankam, M. Ansari, A. G. Gavane, A. Kumar, V. I. Pandit, P. Nema**, 2005. Monitoring of hydrocarbon emissions in a petroleum refinery. Environmental Monitoring and Assessment **108**:123-132.
**Keywords:** emissions/ hydrocarbons/ India/ miscellaneous/ monitoring/ Oeleven/ petroleum/ petroleum hydrocarbons/ refinery/ sources
**Notes:** An assessment of the fugative emissions of a typical petroleum refinery in India. Authors describe refinery emission sources, potentially hazardous compounds in the emissions, and various control measures employed to reduce emissions. The results are presented for monitoring total ground level hydrocarbons at 41 sites around and within a refinery.

**Rappaport, A., L. H. Zincone, Jr., and P. Fricke** 1981. The media and oil spills: does the press cause damage perceptions. Pages 707-712 *in* 1981 Oil Spill Conference. American Petroleum Institute, Washington, DC.
**Keywords:** Argo Merchant/ miscellaneous/ newspaper/ Oeleven/ oil/ oil spill/ spill
**Notes:** An assessment of the influence of media coverage of oil spills on the perceptions of the public about the spill. The authors use the wreck of the Argo Merchant, and the reports thereof in six newspapers, to evaluate the nature of the coverage and the effect on the public.

**Rattner, B. A., W. C. Eastin, Jr.**, 1981. Plasma corticosterone and thyroxine concentrations during chronic ingestion of crude oil in mallard ducks (*Anas platyrhynchos*). Comparative Biochemistry and Physiology **68C**:103-107.
**Keywords:** adrenal/ bird/ chronic/ concentration/ crude oil/ diet/ duck/ duckling/ ingestion/ mallard/ oil/ Oone/ physiology/ plasma/ Prudhoe Bay/ Prudhoe Bay crude oil/ stress
**Notes:** Assessment of thyroid and adrenal function in mallard ducklings fed diets containing varying amounts of Prudhoe Bay crude oil for 18 weeks.

**Rattner, B. A.**, 1981. Tolerance of adult mallards to subacute ingestion of crude petroleum oil. Toxicology Letters **8**:337-342.
**Keywords:** adult/ bird/ crude oil/ diet/ ingestion/ mallard/ oil/ Oone/ petroleum/ physiology/ Prudhoe Bay/ Prudhoe Bay crude oil/ subacute/ tolerance/ weight
**Notes:** Response of adult mallards to Prudhoe Bay crude oil in their diet for 7 days; weights and physiological measures.

**Rattner, B. A., E. L. Flickinger, D. J. Hoffman**, 1993. Morphological, biochemical, and histopathological indices and contaminant burdens of cotton rats (*Sigmodon hispidus*) at three hazardous waste sites near Houston, Texas,USA. Environmental Pollution **79**:85-93.
**Keywords:** biochemical/ biochemistry/ concentration/ cotton rat/ hazardous waste/ health/ hydrocarbons/ mammal/ metabolism/ organochlorines/ Otwo/ pathology/ petroleum/ petroleum hydrocarbons/ rat/ weight
**Notes:** Assessment of health of cotton rats at three hazardous waste sites near Houston, TX; measures of biochemistry, pathology, body weight, and concentrations of organochlorines and petroleum hydrocarbons.

**Rattner, B. A., J. L. Capizzi, K. A. King, L. J. LeCaptain, M. J. Melancon**, 1995. Exposure and effects of oilfield brine discharges on western sandpipers (*Calidris mauri*) in Nueces Bay, Texas. Bulletin of Environmental Contamination and Toxicology **54**:683-689.
**Keywords:** aliphatic hydrocarbons/ analysis/ aromatic hydrocarbons/ bird/ brine water/ discharges/ effects/ hydrocarbons/ metabolism/ Nueces Bay/ oil/ oil field/ Oone/ sandpiper/ Texas/ weight
**Notes:** Assessment of the exposure to and effects of oil in brine water discharges by western sandpipers of coastal Texas; weights, physiological measures, and hydrocarbon analysis.

**Rayburn, J. R., P. S. Glas, S. S. Foss, W. S. Fisher**, 1996. Characterization of grass shrimp (*Palaemonetes pugio*) embryo toxicity tests using the water soluble fraction of Number 2 fuel oil. Marine Pollution Bulletin **32**:860-866.
**Keywords:** embryo/ evaluation/ fuel oil/ grass/ grass shrimp/ marine invertebrate/ No.2 fuel oil/ Ofour/ oil/

salt water/ shrimp/ size/ solubility/ survival/ toxicity
**Notes:** Experimental modification of an established toxicity test employing grass shrimp. Investigators used the water-soluble fraction (WSF) of No. 2 fuel oil to test a shorter exposure period, reduced sample size, and reduced amounts of toxicant. Used 5, 8, 10, 20, and 40 % WSF for evaluation of embryo survival. Calculated $LC_{50}$ values, determined embryo survival, and assessed differences among broods.

**Readman, J. W., S. W. Fowler, J.-P. Villeneuve, C. Cattini, B. Oregioni, L. D. Mee**, 1992. Oil and combustion-product contamination of the Gulf marine environment following the war. Nature **358**:662-665.
**Keywords:** aliphatic hydrocarbons/ alkane/ aromatic hydrocarbons/ bivalve/ coast/ concentration/ degradation/ environment/ fish/ hydrocarbons/ Kuwait/ marine environment/ marine invertebrate/ miscellaneous/ mollusc/ Oeleven/ oil/ Qatar/ salt water/ Saudi Arabia/ sediment/ time/ total hydrocarbons/ United Arab Emirates/ war/ weathered
**Notes:** A set of sediment (14), bivalve mollusc (9), and fish (17) samples were collected along the coast of Kuwait, Saudi Arabia, Qatar, United Arab Emirates, and Oman during the summer of 1991. Measured the concentrations of total hydrocarbons, resolved and unresolved aliphatic hydrocarbons, total alkanes within a specific range, resolved aromatic hydrocarbons, and pyrene.

**Readman, J. W., I. Tolosa, A. T. Law, J. Bartocci, S. Azemard, T. Hamilton, L. D. Mee, A. Wagener, M. Le Tissier, C. Roberts, N. Downing, A. R. G. Price**, 1996. Discrete bands of petroleum hydrocarbons and molecular organic markers identified within massive coral skeletons. Marine Pollution Bulletin **32**:437-443.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ coral/ fingerprinting/ hydrocarbons/ Kuwait/ marine invertebrate/ offshore/ Onine/ petroleum/ petroleum hydrocarbons/ salt water/ Saudi Arabia/ sterols/ technical/ time
**Notes:** Corals were collected from an island offshore to Kuwait and offshore to Saudi Arabia. The coral was sectioned, dated, and analyzed for aliphatic and aromatic hydrocarbons, and sterols. Results were used to link deposited hydrocarbons to their source.

**Readman, J. W., J. Bartocci, I Tolosa, S. W. Fowler, B Oregioni, M. Y. Abdulraheem**, 1996. Recovery of the coastal marine environment in the Gulf following the 1991 war-related oil spills. Marine Pollution Bulletin **32**:493-498.
**Keywords:** aliphatic hydrocarbons/ Arabian Gulf/ aromatic hydrocarbons/ coast/ environment/ Gulf oil spill/ hydrocarbons/ Kuwait/ marine environment/ miscellaneous/ Oeleven/ oil/ oil spill/ recovery/ salt water/ Saudi Arabia/ sediment/ spill/ time/ war
**Notes:** Nearshore surface sediments were collected in 1991, 1992, and 1993 from six sites along coastal Saudi Arabia and in 1992 and 1993 from two sites along coastal Kuwait. Sediments were analyzed for total and individual aliphatic and aromatic hydrocarbons.

**Readman, J. W., G. Fillmann, I. Tolosa, J. Bartocci, J.-P. Villeneuve, C. Catinni, L. D. Mee**, 2002. Petroleum and PAH contamination of the Black Sea. Marine Pollution Bulletin **44**:48-62.
**Keywords:** alkane/ Black Sea/ coast/ hydrocarbons/ miscellaneous/ Oeleven/ PAH/ petroleum/ petroleum hydrocarbons/ pollution/ salt water/ sediment
**Notes:** Surface sediment samples were collected at 35 locations around the coast of the Black Sea and analyzed for petroleum hydrocarbons. Analyzed for straight-chain and branched alkanes and PAHs. Compared the results to hydrocarbon contamination in other parts of the world.

**Reardon, K. F., D. C. Mosteller, J. B. Rogers, N. M. DuTeau, K.-H. Kim**, 2002. Biodegradation kinetics of aromatic hydrocarbon mixtures by pure and mixed bacterial cultures. Environmental Health Perspectives **110**:1005-1011.
**Keywords:** aromatic hydrocarbons/ bacteria/ benzene/ biodegradation/ combination/ degradation/ hydrocarbon mixture/ hydrocarbons/ microbes/ model/ Oten/ phenol/ toluene
**Notes:** Authors attempted to refine the accuracy of models depicting bacterial degradation of aromatic hydrocarbons. Used two strains of bacteria, alone and in combination, to degrade benzene, toluene, phenol, and mixtures of these aromatics. Results were used to improve a model for substrate mixtures.

**Reddin, A., G. N. Prendeville**, 1981. Effect of oils on cell membrane permeability in *Fucus serratus* and *Laminaria digitata*. Marine Pollution Bulletin **12**:339-342.
**Keywords:** aviation kerosine/ cell/ diesel/ diesel fuel/ gasoline/ intertidal/ leaves/ macroalgae/ marine plant/ oil/ Osix/ permeability/ plant/ salt water/ species/ white spirit
**Notes:** Leaves of two species of intertidal macroalgae were dipped in either gasoline, white spirit distillate, aviation fuel, or diesel fuel for 1 min. Discs of leaf material were removed at intervals of 1, 2, 3, 6, and 12 hrs after exposure and assessed for leakage of electrolytes from plant cells.

**Reddy, C. M., J. G. Quinn**, 1999. GC-MS analysis of total petroleum hydrocarbons and polycyclic aromatic hydrocarbons in seawater samples after the *North Cape* oil spill. Marine Pollution Bulletin **38**:126-135.
**Keywords:** analysis/ aromatic hydrocarbons/ coast/ detection/ fuel oil/ hydrocarbons/ methods/ No.2 fuel oil/ oil/ oil spill/ Onine/ petroleum/ petroleum hydrocarbons/ recovery/ Rhode Island/ salt water/ spill/ technical/ TPH
**Notes:** Description of a GC-MS method for measuring total petroleum hydrocarbons and polycyclic aromatic hydrocarbons during the same run. Accuracy, recoveries, and detection limits are comparable to conventional methods. Used to analyze seawater samples from the *North Cape* oil spill (No. 2 fuel oils) off the coast of Rhode Island.

**Reddy, C. M., J. G. Quinn**, 2001. The *North Cape* oil spill: hydrocarbons in Rhode Island coastal waters and Point Judith Pond. Marine Environmental Research **52**:461.
**Keywords:** alkane/ analysis/ aromatic hydrocarbons/ concentration/ depth/ fuel oil/ hydrocarbons/ miscellaneous/ No.2 fuel oil/ Oeleven/ oil/ oil spill/ Rhode Island/ salt water/ spill/ time
**Notes:** The collection and analysis of 54 water samples from the 1996 *North Cape* spill of No. 2 fuel oil. Samples were collected at various depths from the coastal area during the period 4-132 da post spill. Unfiltered water was analyzed for a suite of aromatic hydrocarbons and alkanes in the $nC_{11}$ to $nC_{25}$ range. Comparison of surface and bottom samples on day 7 and over time at one site.

**Reddy, C. M., T. I. Eglinton, A. Hounshell, H. K. White, L. Xu, R. B. Gaines, G. S. Frysinger**, 2002. The West Falmouth oil spill after thirty years: the persistence of petroleum hydrocarbons in marsh sediments. Environmental Science and Technology **36**:4754-4760.
**Keywords:** alkane/ anaerobic/ analysis/ aromatic hydrocarbons/ depth/ fuel oil/ hydrocarbons/ miscellaneous/ No.2 fuel oil/ Oeleven/ oil/ oil spill/ persistence/ petroleum/ petroleum hydrocarbons/ salt water/ sediment/ spill/ time/ unresolved complex mixture/ weathered
**Notes:** A 30-yr update on persistence of No. 2 fuel oil in anoxic sediments of Wild Harbor. A sediment core was analyzed at several depths for total petroleum hydrocarbons and for individual alkane and aromatic compounds. Compared results with analysis of fresh and weathered No. 2 fuel oil.

**Reddy, M. S., N. L. Lahiry, R. J. Rao, B. Panda**, 1970. Influence of oil coating of eggs on oil penetration into the shell membranes and albumen during storage at room temperature. Indian Poultry Gazette **53&54**:1-4.
**Keywords:** bird/ chicken/ egg shell/ eggs/ oil/ Oone/ pores/ shell/ spray/ storage/ temperature
**Notes:** Assessment of the penetration ability of "oil" applied to chicken eggs in preparation for storage.

**Redig, P. T., J. White, J. Scott, J. Dunnette, P. Lind, and B. Talbot** 1990. A medical assessment of bald eagles from Prince William Sound in the wake of the Exxon lube job. Pages 171-174 *in* Annual Conference of the Association of Avian Veterinarians, 1990.
**Keywords:** Alaska/ bald eagle/ bird/ blood/ eagle/ medical/ Oone/ physiology/ Prince William Sound/ Prudhoe Bay crude oil/ salt water/ spill
**Notes:** Results of the analyses of blood samples collected from bald eagles trapped in Prince William Sound during the summer of 1989.

**Reed, M., M. L. Spaulding, E. Lorda, H. Walker, S. B. Saila**, 1984. Oil spill fishery impact assessment modeling: the fisheries recruitment problem. Estuarine and Coastal and Shelf Science **19**:591-610.
**Keywords:** development/ eggs/ fate/ fish/ fishery/ Georges Bank/ larvae/ Maine/ model/ oil/ oil spill/ Othree/ population/ recruitment/ region/ salt water/ spill/ transport

**Notes:** Development of a fisheries model for assessment of the effect of oil spills on fish recruitment in the Georges Bank - Gulf of Maine region. The model consistes of an oil spill fates model, a continental shelf hydrodynamics model, an ichthyoplankton transport and fates model, and a fish population model.

**Reed, M., D. French, J. Calambokidia, and J. Cubbage**. 1987. Simulation modeling of the effects of oil spills on population dynamics of northern fur seals. U.S. Dept. of the Interior, Minerals Management Service, Washington, DC. **MMS 86-0045**. 142 pp.
**Keywords:** Alaska/ effects/ estimate/ fur/ fur seal/ mammal/ model/ oil/ oil spill/ Otwo/ population/ salt water/ seal/ simulation/ spill
**Notes:** Use of population models to estimate the effects of two oil spill scenarios on populations of fur seals in Alaska.

**Reid, D. J., G. R. MacFarlane**, 2003. Potential biomarkers of crude oil exposure in the gastropod mollusc, *Austrocochlea porcata*: laboratory and manipulative field studies. Environmental Pollution **126**:147-155.
**Keywords:** activity/ aliphatic hydrocarbons/ aromatic hydrocarbons/ biomarker/ concentration/ crude oil/ experiment/ flow-through/ gastropod/ intertidal/ lipid/ marine invertebrate/ mollusc/ Ofour/ oil/ petroleum/ salt water/ survival
**Notes:** A laboratory and a field experiment with a gastropod and the water-accomodated fraction of an Australian crude oil blend were used to evaluate a biomarker for petroleum exposure. Laboratory exposure concentrations were 0, 1.25, 2.5, 12.5, 25, 50, and 100% of the WAF. Duration was 96 hrs and animals were checked for survival at 24, 48, and 96 hrs. WAF was sampled at 0, 24, 48, and 96 hrs and analyzed for selected aliphatic and aromatic compounds. The field experiment was performed in the intertidal zone with flow-through plastic enclosures and the application of crude oil and seawater mixtures at concentrations of 0, 12.5, 25, 50, and 100% crude oil. Survival was checked after 24, 48, 96 hrs, 1 wk, and 2 wks. Gastropods were analyzed for glutathione, glutathione peroxidase, and lipid peroxidase activity.

**Reid, P. C.**, 1987. The importance of the planktonic ecosystem of the North Sea in the context of oil and gas development. Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences **316**:587-602.
**Keywords:** biomass/ development/ ecosystem/ fish/ hydrocarbons/ marine invertebrate/ marine plant/ North Sea/ Ofour/ oil/ petroleum hydrocarbons/ phytoplankton/ plankton/ population/ salt water/ structure/ time/ zooplankton
**Notes:** An assessement of the energy budget of a portion of the North Sea ecosystem. Calculations were made for annual production of phytoplankton, zooplankton, fish, benthos, detritus, and oil and gas. Data on North Sea phytoplankton and zooplankton were collected between 1948 and 1982. Temporal changes in population structure and biomass of plankton are compared with hydrocarbon production during this 35-year period.

**Reimer, A. A.**, 1975. Effects of crude oil on the feeding behavior of the zoanthid *Palythoa variabilis*. Environmental Physiology and Biochemistry **5**:258-266.
**Keywords:** amino acids/ assay/ behavior/ Bunker C/ concentration/ coral/ crude oil/ diesel/ diesel fuel/ effects/ feeding/ fuel oil/ ingestion/ marine invertebrate/ Ofour/ oil/ petroleum/ petroleum products/ salt water/ species/ static
**Notes:** Polyps of a coral species were tested for the effects of exposure to either diesel or Bunker C fuel oil. Exposed polyps in static assays to pieces of filter paper containing amino acids, glutathione, proline analogs, or the petroleum products while in clean water. Measured ingestion response to untreated paper for up to 96 hrs. Then determined ingestion response to untreated paper while polyps were immersed in three differenct concentrations of diesel in water. A final test on ingestion of untreated paper was performed after 30 min immersion in pure diesel or Bunker C oil.

**Renault, S., E. Paton, G. Nilsson, J. J. Zwiazek, M. D. MacKinnon**, 1999. Responses of boreal plants to high salinity oil sands tailings water. Journal of Environmental Quality **28**:1957-1962.
**Keywords:** concentration/ effects/ fresh water/ freshwater plant/ injury/ ions/ nutrients/ oil/ oil sands/ Oseven/ plant/ produced water/ salinity/ sand/ seedling/ species/ survival/ time

**Notes:** Assessment of the effects of produced water from oil sands processing on boreal plants. Seedlings of six species were exposed, hydroponically, to several concentrations of the produced water for 4 wks. Solutions were prepared with either Hoagland's solution or supplemental NaCl and $Na_2SO_4$ to simulate the anticipated increase in salinity that would occur over time. Measured ions and nutrients in the solutions, elements within seedlings after 4 wks, seedling survival, and signs of plant injury.

**Rezende, C. E., L. D. Lacerda, A. R. C. Ovalle, C. M. M. Souza, A. A. R. Gobo, D. O. Santos**, 2002. The effect of an oil drilling operation on the trace metal concentrations in offshore bottom sediments of the Campos Basin oil field, SE Brazil. Marine Pollution Bulletin **44**:680-684.
**Keywords:** Brazil/ concentration/ drilling mud/ metals/ miscellaneous/ Oeleven/ offshore/ oil/ oil field/ salt water/ sampling/ sediment/ time
**Notes:** The effect of offshore drilling on metal concentrations in surface sediment was determined in offshore Brazil. Sampling sites were 250, 500, 1,000, and 3,000 m from the well and sampled 3 da and 7 mos after drilling began. Sediments were also collected 250, 500, and 1,000 m from a reference site. Analyzed sediments for concentrations of 12 metals.

**Richardson, B. J., G. J. Zheng, E. S. C. Tse, S. B. DeLuca-Abbott, S. Y. M. Siu, P. K. S. Lam**, 2003. A comparison of polycyclic aromatic hydrocarbon and petroleum hydrocarbon uptake by mussels (*Perna viridis*) and semi-permeable membrane devices (SPMDs) in Hong Kong coastal waters. Environmental Pollution **122**:223-227.
**Keywords:** aliphatic hydrocarbons/ alkane/ analysis/ aromatic hydrocarbons/ mussel/ Onine/ PAH/ petroleum/ salt water/ SPMD/ technical/ uptake
**Notes:** Mussels and SPMDs were both used at five sites in Hong Kong coastal waters to compare their relative abilities to accumulate petroleum compounds. Measured 15 PAHs, total *n*-alkanes, and UCM.

**Richardson, M. G., M. Heubeck, D. Lea, P. Reynolds**, 1982. Oil pollution, seabirds, and operational consequences, around the Northern Isles of Scotland. Environmental Conservation **9**:315-321.
**Keywords:** bird/ marine birds/ numbers/ oil/ oil terminal/ oiled/ Oone/ pollution/ salt water/ Scotland/ spill
**Notes:** Assessment of the incidence of seabird oiling around the Northern Isles of Scotland during 1978-81. Descriptions of bird losses and actions taken to reduce the increased numbers that were correlated with the opening of the Sollom Voe Terminal.

**Richmond, S. A., J. E. Lindstrom, J. F. Braddock**, 2001. Effects of chitin on microbial emulsification, mineralization potential, and toxicity of Bunker C fuel oil. Marine Pollution Bulletin **42**:773-779.
**Keywords:** assay/ beach/ Bunker C/ cell/ crab/ degradation/ density/ effects/ experiment/ fuel oil/ microbes/ Microtox/ mineralization/ oil/ oiled/ Oten/ PAH/ rate/ respiration/ salt water/ sand/ shell/ toxicity
**Notes:** An assessment of the degradation enhancement potential of crab shell chitin. Collected oiled and unoiled beach sand and sea water. The sand was incubated for 5 wks in a Bushnell-Haas mineral salts medium (BH);enumerated the heterotrophs and emulsifiers (microbes). Conducted a series of experiments over a 6-7 wk period on microbe response to BH, BH + chitin, and sea water + chitin. Measured cell density of emulsifiers and heterotrophs, $CO_2$ respiration, mineralization rates of PAHs, and Microtox assay toxicity.

**Riffaldi, R., R. Levi-Minzi, R. Cardelli, S. Palumbo, A. Saviozzi**, 2006. Soil biological activities in monitoring the bioremediation of diesel oil-contaminated soil. Water Air Soil Pollution **170**:3-15.
**Keywords:** activity/ bioremediation/ carbon/ compost/ diesel/ diesel fuel/ hydrocarbons/ microbes/ monitoring/ No.2 fuel oil/ nutrients/ organic/ organic carbon/ Oten/ petroleum/ petroleum hydrocarbons/ remediation/ respiration/ soil/ time/ treatment
**Notes:** Soil was spiked with 10,000 ppm of diesel fuel and apportioned into four treatments plus an uncontaminated control. Contaminated treatments were sterilized soil, normal soil, soil supplemented with N and P nutrients, and soil supplemented with compost. Treatments were incubated for 100 da in the dark. Samples were collected at 10, 20, 35, 55, 75, and 100 da and analyzed for total petroleum hydrocarbons, organic carbon, soil respiration, ATP measures, dehydrogenase activity, lipase activity, and B-glucosydase activity.

**Rigger, D.** 1997. Edible oils: are they really that different? Pages 59-61 *in* 1997 International Oil Spill Conference. Improving Environmental Protection. Progress, Challenges, Responsibilities. American Petroleum Institute, Washington, D.C.
**Keywords:** miscellaneous/ nonpetroleum oil/ Oeleven/ oil/ oil spill/ protection/ regulation/ spill/ vegetable oil
**Notes:** Critical assessment of the rational for passage of the Edible Oils Regulatory Reform Act. Presents several case studies of edible oil spills.

**Rike, A. G., K. B. Haugen, M. Borresen, B. Engene, P. Kolstad**, 2003. In situ biodegradation of petroleum hydrocarbons in frozen arctic soils. Cold Regions Science and Technology **37**:97-120.
**Keywords:** Arctic/ biodegradation/ chemical characteristics/ concentration/ degradation/ hydrocarbons/ microbes/ Norway/ nutrients/ Oten/ petroleum/ petroleum hydrocarbons/ rate/ soil/ temperature/ time/ TPH
**Notes:** An assessment of microbial degradation of subsurface petroleum hydrocarbons in a cold climate environment. In situ measurements at three soil depths (0.7, 2.0, 3.5 m) were made at a contaminated and an uncontaminated site on Spitsbergen, Norway. Measured temperature, soil chemical characteristics, soil nutrients, hydrocarbon concentrations (TPH and five separate compounds), and microbes (classified and quantified) from October through February. Estimated hydrocarbon degradation rates based on soil gas measurements.

**Riley, R. G., B. L. Thomas, J. W. Anderson, R. M. Bean**, 1980. Changes in the volatile hydrocarbon content of Prudhoe Bay crude oil treated under different simulated weathering conditions. Marine Environmental Research **4**:109-119.
**Keywords:** aliphatic hydrocarbons/ analysis/ aromatic hydrocarbons/ condition/ crude oil/ hydrocarbons/ oil/ Onine/ petroleum hydrocarbons/ Prudhoe Bay crude oil/ salt water/ saturated hydrocarbons/ sunlight/ technical/ unsaturated hydrocarbons/ weathered
**Notes:** Three outdoor seawater tanks were layered with Prudhoe Bay crude oil and subjected to either of three weathering scenarios for 24 da; violent weather, calm conditions with sunlight, or calm conditions without sunlight. Ambient physical conditions were monitored. On days 1, 2, 4, 8, 16, and 24, oil samples were collected and analyzed for saturated and unsaturated hydrocarbons.

**Riley, R. T., M. C. Mix, R. L. Schaffer, D. L. Bunting**, 1981. Uptake and accumulation of naphthalene by the oyster *Ostrea edulis*, in a flow-through system. Marine Biology **61**:267-276.
**Keywords:** accumulation/ assay/ concentration/ degradation/ evaluation/ experiment/ flow-through/ gill/ marine invertebrate/ metabolism/ metabolite/ microbes/ muscle/ naphthalene/ Ofour/ oyster/ salt water/ static/ uptake
**Notes:** Assessment of the uptake, accumulation, and metabolism of naphthalene by an oyster and microbes in a flow-through experimental assay. Evaluation of microbial degradation performed with or without streptomycin in the water; concentrations of metabolites determined in water. Uptake and metabolism of naphthalene by oysters determined with flow-through and static ($^{14}C$) experiments. Measured concentrations of naphthalene and metabolites in adductor muscle, body, and gills.

**Rinkevich, B., Y. Loya** 1977. Harmful effects of chronic oil pollution on a Red Sea scleractinian coral population. Pages 585-591 *in* Third International Coral Reef Symposium. University of Miami, Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
**Keywords:** chronic/ colony/ condition/ coral/ coral reef/ crude oil/ effects/ gonads/ Iranian crude oil/ marine invertebrate/ numbers/ Ofour/ oil/ planulae/ pollution/ population/ rate/ Red Sea/ reproduction/ salt water/ solubility/ survival
**Notes:** A comparison of coral populations at a chronically-polluted site and an unpolluted reference site in the northern Gulf of Eilat. More than 300 colonies were sampled during the course of the 1.5 yr study. Colonies were visited every 3 wks. Determined the percent of colonies in breeding condition, condition of the gonads, number of planulae released, effect of oil on settlement rate of planulae in the field and on settlement rate and survival in the laboratory (water soluble fraction of Iranian crude oil in the lab), and the annual death rate of colonies.

**Rinkevich, R., Y. Loya**, 1979. Laboratory experiments on the effects of crude oil on the Red Sea coral *Stylophora pistillata*. Marine Pollution Bulletin **10**:328-330.

**Keywords:** colony/ coral/ crude oil/ effects/ evaluation/ experiment/ female/ flow-through/ gonads/ Iranian crude oil/ marine invertebrate/ Ofour/ oil/ Red Sea/ reproduction/ salt water/ survival
**Notes:** Laboratory evaluation of the effects of Iranian crude oil on reproduction of a Red Sea coral. One hundred small and eight large colonies of coral were transferred to four large flow-through tanks. Corals were exposed weekly to crude oil that was added to the water surface and then removed after 24 hr. Exposure continued for 6 mo. Measured the number of female gonads per polyp after 2 mos for the large colonies (upper part of tanks) and after 6 mos for the small colonies (lower part of the tanks). Also determined survival.

**Ritchie, G. D., K. R. Still, W. K. Alexander, A. F. Nordholm, C. L. Wilson, J. Rossi III, D. R. Mattie**, 2001. A review of the neurotoxicity risk of selected hydrocarbon fuels. Journal of Toxicology and Environmental Health, Part B **4**:223-312.
**Keywords:** behavior/ diesel/ diesel fuel/ effects/ gasoline/ jet fuel/ kerosene/ mammal/ miscellaneous/ Oeleven/ pathology/ physiology/ review/ risk/ toxicity
**Notes:** A review of the neurological effects of hydrocarbon fuels, primarily gasoline, jet fuel, diesel fuel, and kerosene. References include both human and laboratory animal studies.

**Ritchie, G. D., K. R. Still, J. Rossi, III, M. Y. V. Bekkedal, A. J. Bobb, D. P. Arfsten**, 2003. Biological and health effects of exposure to kerosene-based jet fuels and performance additives. Journal of Toxicology and Environmental Health, Part B **6**:357-451.
**Keywords:** effects/ health/ humans/ jet fuel/ kerosene/ mammal/ Otwo/ review/ risk/ risk assessment
**Notes:** A very comprehensive review and risk assessment of the effects of kerosene-based jet fuels on humans and laboratory mammals. Approximately 180-200 references.

**Rittinghaus, H.**, 1956. About the "indirect" propagation of the oil plague in a sea-bird refuge (in German). Ornithologische Mitteilungen **8**:43-46.
**Keywords:** bird/ effects/ eggs/ hatchability/ marine birds/ North Sea/ oil/ oiled/ Oone/ plumage/ reproduction/ salt water
**Notes:** Account of the severe oiling of an island in the North Sea just prior to the arrival of breeding seabirds; observations of the effects of remaining oil on the breeding effort.

**Roberson, A., J. Berger**, 1981. The toxicity of the dispersant Corexit 9527 and oil-dispersant mixtures to ciliate protozoa. Chemosphere **10**:33-39.
**Keywords:** bioassay/ concentration/ Corexit 9527/ crude oil/ dispersant/ effects/ emulsion/ growth/ marine invertebrate/ ODfour/ oil/ population/ protozoa/ rate/ salt water/ species/ static/ toxicity
**Notes:** Assessed the effects of Corexit 9527 on the growth rate of protozoan populations. Performed static bioassays wherein five species of protozoa were exposed to either varying concentrations of Corexit 9527, crude oil emulsion, or crude oil mixed with several concentrations of Corexit 9527. Measured growth rate of each species population.

**Robertson, M. J.** 1978. Occurrence and effects of chronic, low-level oil contamination in a population of sooty terns (*Sterna fuscata*). Manomet Bird Observatory, Manomet, MA. 42 pp.
**Keywords:** bird/ chronic/ colony/ effects/ Florida/ oil/ oiled/ Oone/ plumage/ population/ salt water/ tern
**Notes:** Report of the incidence of plumage oiling and an assessment of the consequences thereof for a colony of sooty terns on the Dry Tortugas, FL during the period 1962-77.

**Robineau, D., P. Fiquet**, 1994. Cetaceans of Dawhat ad-Dafi and Dawhat al-Musallamiya (Saudi Arabia) one year after the Gulf War oil spill. Courier Forschunginstitut Senckenberg **166**:76-80.
**Keywords:** Arabian Gulf/ beach/ crude oil/ effects/ Gulf oil spill/ mammal/ oil/ oil spill/ Otwo/ population/ salt water/ Saudi Arabia/ spill/ war
**Notes:** Beach and aerial assessment of the effects of the Gulf oil spill on cetaceans in a portion of the Arabian Gulf; conducted 1 year after the spill.

**Rocke, T. E., T. M. Yuill, R. D. Hinsdill**, 1984. Oil and related toxicant effects on mallard immune defenses. Environmental Research **33**:343-352.
**Keywords:** bird/ Bunker C/ Corexit 9527/ crude oil/ dispersant/ dosed/ effects/ fuel oil/ immune response/

mallard/ ODone/ oil/ South Louisiana crude oil
**Notes:** Effects on mallard immune response to dosing with varying amounts of crude oil, Bunker C fuel oil, Corexit 9527, or mixtures of Corexit 9527 and oil for 28 days.

**Rockne, K. J., S. E. Strand**, 1998. Biodegradation of bicyclic and polycyclic aromatic hydrocarbons in anaerobic enrichments. Environmental Science and Technology **32**:3962-3967.
**Keywords:** anaerobic/ aromatic hydrocarbons/ bacteria/ biodegradation/ hydrocarbons/ microbes/ nitrate/ Oten/ PAH/ rate/ salt water/ sediment/ sulfate
**Notes:** Assessment of the ability of bacteria from anaerobic creosote-contaminated sediments to degrade polycyclic aromatic hydrocarbons. Fluidized bed reactors innoculated with contaminated sediments were supplied with either sulfate or nitrate and a mixture of four PAHs. Measured rate of biodegradation.

**Roesijadi, G., D. L. Woodruff, J. W. Anderson**, 1978. Bioavailability of naphthalenes from marine sediments artificially contaminated with Prudhoe Bay crude oil. Environmental Pollution **15**:223-229.
**Keywords:** bivalve/ clam/ crude oil/ depuration/ hydrocarbons/ marine invertebrate/ miscellaneous/ naphthalene/ Oeleven/ oil/ organic/ Prudhoe Bay/ Prudhoe Bay crude oil/ salt water/ sand/ sediment/ total hydrocarbons/ uptake
**Notes:** Clean sediment and organic detritus were combined with Prudhoe Bay crude oil and placed in aquaria containing clams. Clams were exposed to sediment with 90-2750 ppm total hydrocarbons and 0.45-11.96 ppm total naphthalenes for 15 da. Also, clams were exposed to detritus containing radiolabelled methylnaphthalene and Prudhoe Bay crude oil for 7 da followed by a 24-hr period of depuration for some clams. Analyzed sediment, water, detritus, and clams for total naphthalenes (sand exposure) and a single naphthalene for the detritus exposure.

**Rogers, K. M., M. M. Savard**, 1999. Detection of petroleum contamination in river sediments from Quebec City region using GC-IRMS. Organic Geochemistry **30**:1559-1569.
**Keywords:** analysis/ Canada/ chemical analysis/ fingerprinting/ intertidal/ isotope/ Onine/ petroleum/ region/ sediment/ technical
**Notes:** Surface and subsurface sediments from the intertidal zone were collected from six sites along the shore of the St. Lawrence River near Quebec City, Canada. Sediments were analyzed using GC, GC-MS, and GC-IRMS methodology. Authors discuss the merits of GC-IRMS in petroleum analysis and source identification.

**Rogerson, A., J. Berger, M. Grosso**, 1982. Acute toxicity of ten crude oils on the survival of the rotifer *Asplanchna sieboldi* and sublethal effects on rates of prey consumption and neonate production. Environmental Pollution (Series A) **29**:179-187.
**Keywords:** acute/ bioassay/ consumption/ crude oil/ effects/ evaluation/ feeding/ fresh water/ freshwater invertebrate/ neonate/ Ofive/ oil/ rate/ reproduction/ rotifer/ static/ sublethal/ survival/ toxicity
**Notes:** Evaluation of the effect on a rotifer of varying amounts (5-200 *u*l per ml of culture medium) of 10 crude oils in 18 hr static bioassays. Measured survival, feeding rates, reproduction, and life span.

**Rojas-Avelizapa, N. G., E. Cervantes-Gonzalez, R. Cruz-Camarillo, L. I. Rojas-Avelizapa**, 2002. Degradation of aromatic and asphaltenic fractions by *Serratia liquefasciens* and *Bacillus sp.* Bulletin of Environmental Contamination and Toxicology **69**:835-842.
**Keywords:** aromatic hydrocarbons/ asphaltene/ bacteria/ concentration/ degradation/ food/ fungi/ Mexico/ microbes/ Oten/ petroleum/ soil
**Notes:** Soil collected from near a petrochemical facility in Mexico was subjected to chemical extraction for aromatic and asphaltene fractions. The fractions were used as a food source for a mixed culture of bacteria and fungi derived from the contaminated soil. Experimental cultures were run for 102 hrs for the aromatic fraction and 168 hrs for the asphaltene fraction. Samples of culture were analyzed every 6 hrs for petroleum fraction and microbe concentration.

**Ronconi, R. A., C. C. St.Clair**, 2006. Efficacy of a radar-activated on-demand system for deterring waterfowl from oil sands tailings ponds. Journal of Applied Ecology **43**:111-119.
**Keywords:** activity/ bird/ Canada/ combination/ fresh water/ light/ methods/ oil/ oil sands/ Oone/ radar/ sand/ shorebird/ waste water/ waterfowl

**Notes:** An assessment of avian deterrence methods for oil sands tailing ponds in Canada. Compared a continuously functioning system of propane cannons and human effigies with an on-demand radar-activated system of propane cannon, strobe light, animated peregrin falcon effigy, and peregrine falcon calls. A control area had no deterrent activity. Various combinations of deterrent were used with the computer-based on-demand system. Provides recommendations for deterring birds from oil sands ponds.

**Rosell, M. LaCorte S., C. Forner, H.-P. Rohns, R. Irmscher, D. Barcelo**, 2005. Fate of gasoline oxygenates in conventional and multilevel wells of a contaminated groundwater table in Dusseldorf, Germany. Environmental Toxicology and Chemistry **24**:2785-2795.
**Keywords:** BTEX/ degradation/ fate/ fresh water/ gasoline/ Germany/ ground water/ miscellaneous/ monitoring/ monoaromatic/ Oeleven/ time/ water
**Notes:** Ground water contamination from a leak at a gasoline station was monitored for 2 yrs (2001-03) with 14 monitoring wells. Two of the wells were multi-level. Water samples were analyzed for additives, their degradation products, and the BTEX monoaromatics.

**Rosenberg, D. M., A. P. Wiens**, 1976. Community and species responses of Chironomidae (Dipteria) to contamination of fresh waters by crude oil and petroleum products, with special reference to the Trail River, Northwest Territories. Journal of the Fisheries Research Board of Canada **33**:1955-1963.
**Keywords:** Canada/ Chironomidae/ colonization/ community/ crude oil/ experiment/ fresh water/ freshwater invertebrate/ Norman Wells crude oil/ Ofive/ oil/ oiled/ petroleum/ petroleum products/ population/ species/ substrate
**Notes:** Assessment of the effect of crude oil on the colonization of aquatic insects on artificial substrate in the Trail River of Canada. Oiled (Norman Wells crude oil) and unoiled rock substrates were placed on the river bottom in two experiments in the summer of 1972 and one experiment in the summer or 1973; substrates remained in place for 57-335 da. Substrate was sampled at irregular intervals, chironomids were identified and counted, and the oil remaining on the substrate was determined.

**Rosenberg, D. M., A. P. Wiens, O. A. Saether**, 1977. Response to crude oil contamination by *Cricotopus (Cricotopus) bicinctus* and *C. (C.) mackenziensis* (Diptera: Chironomidae) in the Fort Simpson area, Northwest Territories. Journal of the Fisheries Research Board of Canada **34**:254-261.
**Keywords:** Chironomidae/ colonization/ crude oil/ Diptera/ evaluation/ fresh water/ freshwater invertebrate/ life cycle/ Norman Wells crude oil/ Ofive/ oil/ population/ species/ substrate
**Notes:** Evaluation of the effect of crude oil on colonization of river substrate by, and on the expected life cycle of, two species of Chironomidae. Artifical substrate samplers filled with stones were dipped in Norman Wells crude oil and placed on the bottom of the Trail River, N.W.T. for periods ranging from 28 to 335 da. Individuals were removed, identified, counted, and classified according to instar stage. Reference collections were made from the Trail and Martin rivers.

**Rosenberg, D. M., A. P. Wiens, and J. F. Flannagan** 1980. Effects of crude oil contamination on Ephemeroptera in the Trail River, Northwest Territories, Canada. Pages 443-455 *in* J. F. Flannagan, K. E. Marshall, editors. Advances in Ephemeroptera Biology. Plenum Publishing Corporation,
**Keywords:** Canada/ colonization/ community/ crude oil/ diversity/ effects/ evaluation/ fresh water/ freshwater invertebrate/ index/ indicator/ Norman Wells crude oil/ Ofive/ oil/ petroleum/ pollution/ population/ species/ species diversity/ substrate
**Notes:** Evaluation of the effect of crude oil on Ephemeroptera colonization of rock substrate in the Trail River. Artificial substrate samplers filled with stones were dipped in Norman Wells crude oil and placed on the river bottom for periods ranging from 28 to 335 da. Colonizers were identified and counted. Also calculated an index of diversity and recommended certain species as indicators of petroleum pollution.

**Rossi, S. S., J. W. Anderson**, 1975. Toxicity of water-soluble fractions of No. 2 fuel oil and South Louisiana crude oil to selected stages in the life history of the polychaete, *Neanthes arenaceodentata*. Bulletin of Environmental Contamination and Toxicology **16**:18-24.
**Keywords:** adult/ bioassay/ concentration/ crude oil/ evaluation/ fuel oil/ history/ invertebrate/ juvenile/ Louisiana/ Louisiana crude oil/ marine invertebrate/ No.2 fuel oil/ Ofour/ oil/ polychaete/ salt water/ South Louisiana crude oil/ static/ survival/ toxicity

**Notes:** Evaluation of the toxicity of water-soluble fractions (WSF) of No. 2 fuel oil and South Louisiana crude oil to life stages of a marine polychaete. Used static bioassays to expose 4, 18, 32, or 40 segment juveniles and 48 or 60 segment adults to five concentrations of WSF for 96 hr. Measured death and calculated $TL_m$ values for 24, 48, and 96 hr. Compared results with those of other marine invertebrates.

**Rossi, S. S., J. W. Anderson, G. S. Ward**, 1976. Toxicity of water-soluble fractions of four test oils for the polychaetous annelids, *Neanthes arenaceodentata* and *Capitella capitata*. Environmental Pollution **10**:9-18.
**Keywords:** annelid/ aromatic hydrocarbons/ bioassay/ Bunker C/ concentration/ crude oil/ fuel oil/ Kuwait/ Kuwait crude oil/ Louisiana/ Louisiana crude oil/ marine invertebrate/ naphthalene/ Ofour/ oil/ paraffin/ polychaete/ salt water/ South Louisiana crude oil/ species/ static/ time/ tissue/ toxicity
**Notes:** Assessment of the toxicity of the water-soluble fractions (WSF) of South Louisiana crude oil, Kuwait crude oil, No. 2 fuel oil, and bunker C fuel oil to two species of marine polychaetes. Used a static bioassay to expose individual worms to five concentrations of the WSF for 96 hr. Calculated the TLm values at 24, 48, and 96 hr, concentrations of naphthalenes in test water over time, and concentrations of naphthalenes, total aromatics, and total paraffins in polychaete tissue.

**Rossi, S. S., J. W. Anderson**, 1977. Accumulation and release of fuel-oil-derived diaromatic hydrocarbons by the polychaete *Neanthes arenaceodentata*. Marine Biology **39**:51-55.
**Keywords:** accumulation/ aromatic hydrocarbons/ bioassay/ concentration/ depuration/ eggs/ female/ fuel oil/ hydrocarbons/ juvenile/ larvae/ male/ marine invertebrate/ naphthalene/ No.2 fuel oil/ Ofour/ oil/ polychaete/ release/ salt water/ sex/ static
**Notes:** Assessment of the accumulation and loss of napthalenes by a marine polychaete. Male and gravid female polychaetes were exposed in a static bioassay to a 25% concentration of No. 2 fuel oil water-soluble-fraction for 1 hr. This was followed by a depuration period, during which the females released their eggs. Measured the concentrations of naphthalenes in both sexes and in the released eggs, trochophore larvae, and juveniles.

**Rossi, S. S., J. W. Anderson**, 1977. Effect of No. 2 fuel oil and South Louisiana crude oil water-soluble fractions on hemoglobin compensation and hypoxia tolerance in the polychaetous annelid, *Neanthes arenaceodentata* (Moore). Marine Science Communications **3**:117-131.
**Keywords:** annelid/ bioassay/ concentration/ crude oil/ dissolved/ fuel oil/ hemoglobin/ Louisiana/ Louisiana crude oil/ marine invertebrate/ No.2 fuel oil/ Ofour/ oil/ oxygen/ polychaete/ salt water/ South Louisiana crude oil/ static/ survival/ tissue
**Notes:** A marine polychaete was exposed in a static bioassay to several concentrations of the water-soluble fraction of either No. 2 fuel oil or South Louisiana crude oil for 11 da. Some of the test groups were subjected to water containing reduced oxygen. Measured survival, dissolved oxygen, and hemoglobin concentration of tissue.

**Rossi, S. S., J. M. Neff**, 1978. Toxicity of polynuclear aromatic hydrocarbons to the polychaete *Neanthes arenaceodentata*. Marine Pollution Bulletin **9**:220-223.
**Keywords:** adult/ aromatic hydrocarbons/ assay/ concentration/ hydrocarbons/ marine invertebrate/ Ofour/ polychaete/ salt water/ solubility/ species/ static/ survival/ toxicity
**Notes:** Assessment of the toxicity of 10 polynuclear aromatic hydrocarbons to young adults of a species of marine polychaetes. Static laboratory assays were used to expose polychaetes to one of 10 aromatic hydrocarbons for 96 hrs. Measured survival, calculated $TL_m$, solubilities of the hydrocarbons, and concentrations of test hydrocarbons in the exposure water.

**Rossi, S. S., J. W. Anderson**, 1978. Effects of No. 2 fuel oil water-soluble-fractions on growth and reproduction in *Neanthes arenaceodentata (Polychaeta: Annelida)*. Water, Air, and Soil Pollution **9**:155-170.
**Keywords:** adult/ bioassay/ concentration/ depuration/ dissolved/ effects/ fuel oil/ growth/ hatching/ hydrocarbons/ juvenile/ larvae/ lethal/ marine invertebrate/ naphthalene/ No.2 fuel oil/ Ofour/ oil/ polychaete/ reproduction/ salt water/ static/ sublethal/ tissue
**Notes:** Assessement of the effects of water-soluble fractions (WSF) of No. 2 fuel oil on growth and reproduction of a marine polychaete. Exposed hatched larvae, juveniles, and adults to several sublethal

concentrations of WSF in static bioassays. Exposed unhatched larvae to lethal and sublethal concentrations of WSF. Unhatched larvae exposed on day 4 or day 7. Hatched larvae exposed for 13 da followed by 11 da of depuration. Juveniles exposed for 28 da. Adults exposed for three generations. Measured larval hatching success and growth, juvenile growth, reproductive success of adults, total dissolved hydrocarbons and naphthalenes in water, and naphthalenes in polychaete tissue.

**Rossi, S. S., J. W. Anderson**, 1978. Petroleum hydrocarbon resistance in the marine worm *Neanthes arenaceodentata* (Polychaeta: Annelida), induced by chronic exposure to No. 2 fuel oil. Bulletin of Environmental Contamination and Toxicology **20** :513-521.
**Keywords:** adult/ bioassay/ chronic/ concentration/ crude oil/ depuration/ evaluation/ female/ fuel oil/ juvenile/ larvae/ Louisiana/ Louisiana crude oil/ male/ marine invertebrate/ metabolism/ No.2 fuel oil/ Ofour/ oil/ petroleum/ petroleum hydrocarbons/ polychaete/ rate/ salt water/ South Louisiana crude oil/ sublethal/ survival
**Notes:** Evaluation of petroleum hydrocarbon resistence in a marine polychaete. Exposed male and female polychaetes to three sublethal concentrations of the water-soluble fraction of No. 2 fuel oil for three generations (9 mos). Then performed 96 hr bioassays on adults, juveniles, and larvae of each generation; used South Louisiana crude oil and No. 2 fuel oil as challenge oils. Bioassays were performed after continuous chronic exposure, after a 7-da depuration period, or after a 14-day depuration period. Measured survival ($TL_m$) and rate of metabolic conversion of $^{14}C$-naphthalene.

**Rossi, S. S., G. W. Rommel, and A. A. Benson** 1979. Comparison of hydrocarbons in benthic fish from Coal Oil Point and Tanner Bank, California. Pages 573-577 *in* 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup). American Petroleum Institute, API Publication 4308, Washington, D.C.
**Keywords:** alkane/ aromatic hydrocarbons/ behavior/ benthic/ California/ coal/ coal oil/ coast/ concentration/ fish/ hydrocarbons/ oil/ oil spill/ Othree/ salt water/ species/ spill/ unresolved complex mixture
**Notes:** Comparison of hydrocarbons in three species of benthic marine fish from Coal Oil Point and Tanner Bank off the coast of southern California; no aromatic hydrocarbons detected, only alkanes and unresolved complex mixtures.

**Rothermich, M. M., L. A. Hayes, D. R. Lovley**, 2002. Anaerobic, sulfate-dependent degradation of polycyclic aromatic hydrocarbons in petroleum-contaminated harbor sediment. Environmental Science and Technology **36**:4811-4817.
**Keywords:** anaerobic/ aromatic hydrocarbons/ condition/ degradation/ evaluation/ hydrocarbons/ incubation/ microbes/ microcosm/ naphthalene/ Oten/ PAH/ phenanthrene/ salt water/ sediment/ sulfur/ time
**Notes:** An evaluation of PAH degradation in contaminated sediments of Boston Harbor. Emphasis is on the sulfate-reducting microbes that metablolize PAHs under anaerobic conditions. Also evaluated PAH degredation in harbor sediments from Latvia. Used $^{14}C$ naphthalene and $^{14}C$ phenanthrene. Monitored the degredation of 14 PAHs in Boston Harbor sediment for 338 da of microcosm incubation and in Latvia sediments for 90 da of microcosm incubation.

**Rotterman, L. M., C. Monnett**, 2002. Length-mass and total body length of adult female sea otters in Prince William Sound before and after the *Exxon Valdez* oil spill. Marine Mammal Science **18**:977-993.
**Keywords:** adult/ capture/ crude oil/ Exxon Valdez/ female/ length/ mammal/ oil/ oil spill/ oiled/ Otwo/ Prince William Sound/ salt water/ sea otter/ spill/ time/ weight
**Notes:** Female sea otters were captured before and after the *Exxon Valdez* oil spill from eastern portion of the sound and the western portion (oiled) of the sound. Captures were made in 1984, 1987, 1989, and 1990 in the eastern area and 1977, 1980, 1981, 1989, and 1990 in the western area. Animals were weighed, body lengths measured, aged, and pregnancy determined. Body length and body mass were compared before and after the spill and between areas.

**Roubal, W. T., T. K. Collier, D. C. Malins**, 1977. Accumulation and metabolism of carbon-14 labeled benzene, naphthalene, and anthracene by young coho salmon (*Oncorhynchus kisutch*). Archives of Environmental Contamination and Toxicology **5**:513-529.
**Keywords:** accumulation/ anthracene/ aromatic hydrocarbons/ benzene/ carbon-14/ concentration/ fate/

fish/ food/ fresh water/ metabolism/ naphthalene/ Othree/ salmon/ tissue
**Notes:** Fate of carbon-14 labeled benzene, naphthalene, and anthracene in the food of young coho salmon or injected by intraperitoneal injuction; tissue accumulation, metabolism.

**Roubal, W. T., S. I. Stranahan, D. C. Malins**, 1978. The acumulation of low molecular weight aromatic hydrocarbons of crude oil by coho salmon (*Oncorhynchus kisutch*) and starry flounder (*Platichthys stellatus*). Archives of Environmental Contamination and Toxicology **7**:237-244.
**Keywords:** accumulation/ aromatic hydrocarbons/ benzene/ crude oil/ fish/ flounder/ hydrocarbons/ muscle/ naphthalene/ oil/ Othree/ Prudhoe Bay/ Prudhoe Bay crude oil/ salmon/ salt water/ smolt/ solubility/ weight
**Notes:** Accumulation of benzenes and naphthalenes in muscle of smolt coho salmon and starry flounder; exposed to water soluble fraction of Prudhoe Bay Crude for 2 weeks (salmon) and 6 weeks (flounder).

**Rougee, L., C. A. Downs, R. H. Richmond, G. K. Ostrander** , 2006. Alteration of normal cellular profiles in the scleractinian coral (*Pocillopora damicornis*) following laboratory exposure to fuel oil. EnvironmentalToxicology and Chemistry **25**:3181-3187.
**Keywords:** bioassay/ biochemical/ condition/ coral/ fuel oil/ marine invertebrate/ metabolism/ Ofour/ oil/ porphyrin/ protein/ salt water/ water
**Notes:** Coral was exposed for 24 hrs to the water-accommodated fraction of 180 marine fuel oil (0.25, 1, 4 g of fuel oil/liter of sea water). Analyzed portions of coral for measures of protein metabolic condition, oxidative damage and response, porphyrin metabolism, and xenobiotic response.

**Rowland, S., P. Donkin, E. Smith, E. Wraige**, 2001. Aromatic hydrocarbon "humps" in the marine environment: unrecognized toxins? Environmental Science and Technology **35**:2640-2644.
**Keywords:** algae/ aromatic hydrocarbons/ assay/ bivalve/ coast/ concentration/ crude oil/ England/ feeding/ marine environment/ marine invertebrate/ miscellaneous/ monoaromatic/ mussel/ North Sea/ North Sea crude oil/ Oeleven/ oil/ salt water/ unresolved complex mixture
**Notes:** Mussels were exposed for 24 hrs to either of five concentrations of the monoaromatic UCM of a North Sea crude oil. Subsequent feeding assays measured the ability to remove algae from a clean water environment. Mussels were then analyzed for monoaromatic UCM concentrations. Field collected samples from three polluted and one clean site along the coast of England were analyzed for monoaromatic UCM concentrations.

**Rozas, L. P., T. J. Minello, C. B. Henry**, 2000. An assessment of potential oil spill damage to salt marsh habitats and fishery resources in Galveston Bay, Texas. Marine Pollution Bulletin **40** :1148-1160.
**Keywords:** annelid/ aromatic hydrocarbons/ benthic/ crustacean/ density/ fish/ fishery/ general effect/ habitat/ hydrocarbons/ infauna/ marine invertebrate/ mollusc/ oil/ oil spill/ Othree/ petroleum/ petroleum hydrocarbons/ salt marsh/ salt water/ sampling/ sediment/ shoreline/ spill/ Texas/ water column
**Notes:** An assessment of the relation between sediment hydrocarbons and aquatic animals in salt marsh habitats of Galveston Bay. Collected 100 samples of water-column organisms, benthic infauna, and sediments from 10 locations along the shoreline during fall of 1995 and spring of 1996. Identified and determined the mean water density of fish and crustaceans. Identified and determined the density of annelids, crustaceans, and molluscs in sediment. Determined thd mean environmental characteristics of sampling sites. Measured total petroleum hydrocarbons, mid-range petroleum hydrocarbons, and high-range petroleum hydrocarbons. Also presented a profile of aromatic hydrocarbons. Compared animal densities with other site variables in a stepwise multiple regression.

**Rudneva, I. I., T. L. Chesalina, N. S. Kuz'minova**, 2000. Responses of juvenile Black Sea mullet to pollution with fuel oil. Russian Journal of Ecology **31**:304-306.
**Keywords:** analysis/ behavior/ biochemical/ Black Sea/ emulsion/ experiment/ fish/ fuel oil/ juvenile/ mullet/ oil/ Othree/ pollution/ salt water/ static/ whole body
**Notes:** Juvenile fish were exposed for 5 da to either 2,500 or 5,000 ppm of 'fuel oil' emulsions in static laboratory experiments. Observed behavior and measured several biochemical compounds derived from whole body analysis.

**Ruggerone, G. T., D. E. Rogers**, 2003. Multi-year effects of high densities of sockeye salmon spawners on juvenile salmon growth and survival: a case study from the *Exxon Valdez* oil spill. Fisheries Research **63**:379-392.
**Keywords:** Alaska/ crude oil/ density/ Exxon Valdez/ fish/ growth/ indicator/ juvenile/ oil/ oil spill/ Otwo/ population/ salmon/ salt water/ spill/ survival/ time
**Notes:** Authors investigated the sockeye salmon populations in six lakes or river systems in southwest Alaska for periods of time between 1970 and 1997. Fish scales were collected and measured as an indicator of growth. Growth was related to density of spawners.

**Rutherford, P. M., D. K. Banerjee, S. M. Luther, M. R. Gray, M. J. Dudas, W. B. McGill, M. A. Pickard, M. J. Salloum**, 1998. Slurry-phase bioremediation of creosote and petroleum-contaminated soils. Environmental Technology **19**:683-696.
**Keywords:** alkane/ biodegradation/ bioremediation/ concentration/ conductivity/ creosote/ degradation/ effects/ hydrocarbons/ microbes/ organic/ Oten/ PAH/ petroleum/ petroleum hydrocarbons/ pH/ soil
**Notes:** Assessment of a biodegradation process used on four soil types contaminated with either creosote or petroleum hydrocarbons. Soils were inoculated with a microbial culture and supplemented with N, P, and S additions. The effect of degradation was followed for 10 wks. Measured pH, electrical conductivity, the negative effect of HgCl addition, and concentrations of PAHs specific to creosote, total extractable organics, and individual alkanes.

**Sabate, J., M. Vinas, A. M. Solanas**, 2006. Bioavailability assessment and environmental fate of polycyclic aromatic hydrocarbons in biostimulated creosote-contaminated soil. Chemosphere **63**:1648-1659.
**Keywords:** aromatic/ aromatic hydrocarbon/ aromatic hydrocarbons/ assay/ biodegradation/ bioremediation/ creosote/ fate/ hydrocarbons/ microbes/ Microtox/ nitrogen/ Oten/ PAH/ phosphorus/ soil/ time/ treatment/ water
**Notes:** Creosote-contaminated soil was subjected to three bioremediation treatments; no treatment, water and periodic aeration, and water and periodic aeration plus nitrogen and phosphorus amendment. Duration was 200 da. Soils were sampled six times and analyzed for 14 PAHs. Bioavailable and non-bioavailable portions were determined. A microtox assay was performed four times on the soils.

**Sabourin, T. D., R. E. Tullis**, 1981. Effect of three aromatic hydrocarbons on respiration and heart rates of the mussel, *Mytilus californianus*. Bulletin of Environmental Contamination and Toxicology **26**:729-736.
**Keywords:** aromatic hydrocarbons/ benzene/ benzo[a]pyrene/ bioassay/ concentration/ consumption/ heart/ heart rate/ hydrocarbons/ marine invertebrate/ mussel/ Ofour/ oxygen/ rate/ respiration/ salt water/ static/ toluene
**Notes:** Marine mussels exposed to the water-soluble fractions of either benzene, toluene, or benzo(a)pyrene in a static bioassay for 24 hours. Measured heart rate, rate of oxygen consumption, and concentration of test hydrocarbons in the exposure water.

**Saeed, T., H. Al-hashash, K. Al-Matrouk**, 1998. Assessment of the changes in the chemical composition of the crude oil spilled in the Kuwait desert after weathering for five years. Environment International **24**:141-152.
**Keywords:** aromatic hydrocarbons/ asphaltene/ composition/ crude oil/ Kuwait/ miscellaneous/ Oeleven/ oil/ PAH/ resin/ saturated hydrocarbons/ weathered
**Notes:** Assessment of the changes in chemical composition of crude oil spilled in the Kuwait desert after 5 yr of weathering. Measured asphaltene, saturate, aromatic, and resin fractions, and specific PAHs of three or more aromatic rings.

**Salanitro, J. P., P. B. Dorn, M. H. Huesemann, K. O. Moore, I. A. Rhodes, L. M. R. Jackson, T. E. Vipond, M. M. Western, H. L. Wisniewski**, 1997. Crude oil hydrocarbon bioremediation and soil ecotoxicity assessment. Environmental Science and Technology **31**:1769-1776.
**Keywords:** assay/ bioassay/ bioremediation/ BTEX/ carbon/ concentration/ corn/ crude oil/ degradation/ earthworm/ experiment/ fresh water/ freshwater invertebrate/ freshwater plant/ germination/ growth/ hydrocarbons/ light/ microbes/ Microtox/ oat/ oil/ organic/ organic carbon/ Oten/ petroleum/ petroleum hydrocarbons/ plant/ seed/ soil/ survival/ toxicity/ wheat

**Notes:** Two soils (low and high organic carbon) were mixed with light, medium, or heavy crude oils (initial concentrations of 4,000-27,000 mg/kg total petroleum hydrocarbons) and monitored for degradation and toxicity. Earthworm bioassays employed five concentrations of treated soil and were performed throughout the experiment. A Microtox assay was performed throughout the experiment. Seed germination and plant growth assays (21 da) were performed with corn, wheat, and oats on control and 8- or 10-mo bioremediated soil. Measured total petroleum hydrocarbons, oil and grease, BTEX, saturate hydrocarbons, soil leaching potential, earthworm survival, Microtox survival, seed germination, and plant growth.

**Salazar, S.**, 2003. Impacts of the Jessica oil spill on sea lion (*Zalophus wollebaeki*) populations. Marine Pollution Bulletin **47**:313-318.
**Keywords:** Bunker C/ colony/ diesel fuel/ effects/ mammal/ oil/ oil spill/ Otwo/ population/ salt water/ sea lion/ spill
**Notes:** An assessment of the effects of the *Jessica* oil spill in the Galapagos Islands on sea lions in 12 colonies. Pre-spill data was compared to information collected during the 11 mos after the spill.

**Samain, J. F., J. Moal, A. Coum, J. R. Le Coz, J. Y. Daniel**, 1980. Effects of the "Amoco Cadiz" oil spill on zooplankton. A new possibility of ecophysiological survey. Helgolander Meeresuntersuchungen **33**:225-235.
**Keywords:** Amoco Cadiz/ coast/ community/ composition/ diet/ effects/ enzyme/ France/ marine invertebrate/ Ofour/ oil/ oil spill/ population/ ratio/ salt water/ seasonal/ species/ spill/ survey/ zooplankton
**Notes:** Report of an indirect assessment method to characterize zooplankton populations. Zooplankton were sampled at various sites off the coast of northern France, including the vicinity of the Amoco Cadiz spill over a period of 1 yr. Samples (total zooplankton or several individual species) analyzed for the digestive enzymes amylase and trypsin. Ratios of the enzymes used to show seasonal changes in diet or community composition, and contrast polluted areas with unpolluted areas.

**Sammut, M., G. Nickless**, 1978. Petroleum hydrocarbons in marine sediments and animals from the island of Malta. Environmental Pollution **16**:17-30.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ bivalve/ coast/ fish/ hydrocarbons/ marine invertebrate/ miscellaneous/ mullet/ mussel/ Oeleven/ oyster/ petroleum/ petroleum hydrocarbons/ salt water/ sediment
**Notes:** Sediment, sea squirts, mullet (flesh and gut separated), mussels, and oysters were collected at 15 locations along the coast of Malta in 1975. Measured total aliphatic and aromatic hydrocarbons and quantified specific aromatic hydrocarbons.

**Samuels, W. B., K. J. Lanfear**, 1982. Simulations of seabird damage and recovery from oilspills in the Northern Gulf of Alaska. Journal of Environmental Management **15**:169-182.
**Keywords:** Alaska/ bird/ common murre/ development/ glaucous-winged gull/ Gulf of Alaska/ gull/ hazard/ model/ offshore/ oil field/ Oone/ population/ recovery/ salt water/ simulation
**Notes:** A modelling exercise to determine potential hazard to glaucous-winged gulls and common murres of the Northern Gulf of Alaska of offshore oilfield development; population recovery and hazard estimation components.

**Samuels, W. B., A. Ladino**, 1984. Calculations of seabird population recovery from potential oilspills in the mid-Atlantic region of the United States. Ecological Modelling **21**:63-84.
**Keywords:** analysis/ bird/ development/ gull/ hazard/ herring/ herring gull/ model/ offshore/ oil field/ Oone/ population/ recovery/ region/ salt water/ tern
**Notes:** Modelling study of the population recovery potential of herring gulls and common terns and a hazard analysis of offshore oilfield development operations in the mid-Atlantic Outer Continental Shelf.

**Sanders, H. L.**, 1977. The West Falmouth spill -- Florida, 1969. Oceanus **20**:15-24.
**Keywords:** benthic/ Florida/ fuel oil/ general effect/ interpretation/ invertebrate/ marine invertebrate/ Massachusetts/ No.2 fuel oil/ Oeight/ oil/ oil spill/ salt water/ sampling/ spill/ time/ weathered
**Notes:** A retrospective assessment of the biological consequences of the West Falmouth, MA oil spill

(No. 2 fuel oil) in 1969. Authors describe the chronology of spill events, weathering of oil, biological (benthic invertebrates) sampling that occurred 1969-73, and the interpretation of the sample results.

**Sanders, H. L., J. F. Grassle, G. R. Hampson, L. S. Morse, S. Garner-Price, C. C. Jones**, 1980. Anatomy of an oil spill: long-term effects from the grounding of the barge Florida off West Falmouth, Massachusetts. Journal of Marine Research **38**:265-380.
**Keywords:** barge Florida/ benthic/ bivalve/ community/ concentration/ degradation/ effects/ fish/ Florida/ fuel oil/ general effect/ intertidal/ invertebrate/ long-term/ marine invertebrate/ Massachusetts/ No.2 fuel oil/ Oeight/ oil/ oil spill/ population/ salt water/ sediment/ spill/ subtidal/ time/ weathered
**Notes:** A very good and detailed account of the No. 2 fuel oil spill caused by grounding of the barge *Florida* off West Falmouth, MA in 1969. Authors describe spill chronology, weathering of the oil, oil in sediments, and the effects on benthic invertebrates and fish. Collected samples from 14 subtidal and intertidal sites and a reference site during the period 1969-74 and performed many statistical analyses on the invertebrate community data.

**Santas, R., A. Korda, A. Tenente, K. Buchholz, P. H. Santas**, 1999. Mesocosm assays of oil spill bioremediation with oleophilic fertilizers: Inipol, F1 or both? Marine Pollution Bulletin **38** :44-48.
**Keywords:** alkane/ assay/ biodegradation/ bioremediation/ crude oil/ fertilizer/ fish/ fish meal/ Iranian crude oil/ mesocosm/ microbes/ oil/ oil spill/ Oten/ petroleum/ salt water/ spill
**Notes:** Assessment of the biodegradation of Iranian crude oil in three mesocosms. Added biodegradation enhancement products Inipol EAP-22 (oleophilic) or F1 (fish meal) to two mesocosms; measured alkane biodegradation at the water surface and below the surface.

**Sarkar, D., M. Ferguson, R. Datta, S. Birnbaum**, 2005. Bioremediation of petroleum hydrocarbons in contaminated soils: Comparison of biosolids addition, carbon supplementation, and monitored natural attenuation. Environmental Pollution **136**:187-195.
**Keywords:** bioremediation/ biosolid/ carbon/ diesel/ diesel fuel/ fertilizer/ hydrocarbons/ incubation/ inorganic/ methods/ microbes/ No.2 fuel oil/ Oten/ petroleum/ petroleum hydrocarbons/ plant/ population/ rate/ soil/ time/ treatment
**Notes:** Soil was treated with diesel fuel and bioremediated with two methods of biostimulation. One treatment was with biosolid pellets from a sewage treatment plant at two rates of application and the other was with inorganic fertilizer at two rates of application. Duration of incubation was 8 weeks. Microbial populations and total petroleum hydrocarbons were measured at the beginning of the study and at weekly intervals thereafter.

**Sarojini, R., A. K. Khan, R. Nagabhushanam**, 1989. Effect of petroleum hydrocarbons (petrol and diesel) on the physiology of the crab, *Barytelphusa cunicularis*. I - Oxygen consumption. Journal of Environmental Biology **10**:363-365.
**Keywords:** bioassay/ concentration/ consumption/ crab/ diesel/ diesel fuel/ fresh water/ freshwater invertebrate/ gasoline/ hydrocarbons/ Ofive/ oxygen/ petroleum/ petroleum hydrocarbons/ physiology/ static
**Notes:** Exposure of a freshwater crab to four concentrations of either diesel fuel or gasoline for 24, 48, 72, or 96 hrs in a static bioassay. Measured oxygen consumption.

**Saterbak, A., R. J. Toy, B. J. McMain, M. P. Williams, P. B. Dorn**, 2000. Ecotoxicological and analytical assessment of effects of bioremediation on hydrocarbon-containing soils. Environmental Toxicology and Chemistry **19**:2643-2652.
**Keywords:** bioremediation/ composition/ corn/ crude oil/ earthworm/ effects/ freshwater invertebrate/ freshwater plant/ germination/ length/ lettuce/ lubricating oil/ microbes/ mustard/ oil/ Oten/ petroleum hydrocarbons/ plant/ remediation/ reproduction/ roots/ seed/ soil/ sources/ survival/ tilling/ toxicity/ wheat
**Notes:** The second of two reports of a toxicological and analytical assessment of eight hydrocarbon-containing (5,000 - 30,000 ppm) soils (field collected). The sources of contamination ranged from 3 mos to > 5 yrs and involved crude oil, crude oil and brine, and lubricating oil. Pre-remediation characterization of chemical composition and toxicity were reported in the first publication but referenced in this report. Soils were bioremediated over an 11-13 mo period with N & P additions and periodic tilling. Hydrocarbon content was measured during and after remediation. Earthworms were used in a post-remediation 14-da

survival test; reproduction was also measured. Lettuce, wheat, corn, and mustard seeds were used for seed germination tests and root length production during and after remediation.

**Sauer, T. and P. Boehm** 1991. The use of defensible analytical chemical measurements for oil spill natural resource damage assessment. Pages 363-369 *in* 1991 Oil Spill Conference. American Petroleum Institute, Washington, D.C.
**Keywords:** analysis/ damage assessment/ Exxon Valdez/ hydrocarbons/ methods/ natural resource/ oil/ oil spill/ Onine/ petroleum/ petroleum hydrocarbons/ spill/ technical
**Notes:** Authors argue for the inclusion of analytical methods specific for petroleum hydrocarbons in the list of EPA 'approved' methods for NRDA cases involving petroleum spills. This discussion was prompted by controversy over analytical methods used in the damage assessments for the Exxon Valdez oil spill of 1989.

**Sauer, T., J. Neff, and L. Reitsema** 1995. An oil spill in an Illinois lake: environmental exposure assessment. Pages 407-414 *in* 1995 International Oil Spill Conference, API Publication 4620. American Petroleum Institute, Washington, D.C.
**Keywords:** analysis/ crude oil/ evaluation/ fresh water/ Louisiana/ Louisiana crude oil/ miscellaneous/ Oeleven/ oil/ oil spill/ PAH/ pipeline/ sampling/ sediment/ South Louisiana crude oil/ spill/ time
**Notes:** A continued evaluation of the consequences of a 1985 pipeline rupture of South Louisiana crude oil into a lake in Illinois. Biotic and abiotic studies were performed 1989-91; this report deals with the sediment sampling only. Surface and subsurface sediment samples were collected at 26 locations during the period and analyzed for 41 PAHs.

**Sauer, T. C., J. S. Brown, P. D. Boehm, D. V. Aurand, J. Michel, M. O. Hayes**, 1993. Hydrocarbon source identification and weathering characterization of intertidal and subtidal sediments along the Saudi Arabian coast after the Gulf War oil spill. Marine Pollution Bulletin **27**:117-134.
**Keywords:** analysis/ Arabian Gulf/ coast/ crude oil/ fingerprinting/ Gulf oil spill/ hydrocarbons/ intertidal/ Iranian crude oil/ Kuwait/ oil/ oil spill/ Onine/ PAH/ petroleum/ salt water/ saturated hydrocarbons/ Saudi Arabia/ sediment/ spill/ subtidal/ technical/ time/ weathered
**Notes:** In 1992, a total of about 200 samples of intertidal and subtidal surface and subsurface sediments were collected along the Gulf coast of Saudi Arabia. The samples were analyzed for numerous saturated hydrocarbons and PAHs. A similar analysis was performed on Kuwait, Light Arabian, and Iranian crude oils. The results were used to determine the petroleum source and stage of weathering.

**Sauer, T. C., J. Michel, M. O. Hayes, D. V. Aurand**, 1998. Hydrocarbon characterization and weathering of oiled intertidal sediments along the Saudi Arabian coast two years after the Gulf War oil spill. Environment International **24**:43-60.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ coast/ crude oil/ hydrocarbons/ intertidal/ miscellaneous/ Oeleven/ oil/ oil spill/ oiled/ salt water/ sediment/ shoreline/ spill/ war/ weathered
**Notes:** Assessment of the weathering of crude oil along the Saudi Arabian coast two yr after the Gulf War oil spill of 1991. Collected surface and subsurface samples from shoreline sediments and performed detailed analyses of the hydrocarbon content. Compared results with geomorphic characteristics of collection sites.

**Savabieasfahani, M., R. L. Lochmiller, D. M. Janz**, 1999. Elevated ovarian and thymic cell apoptosis in wild cotton rats inhabiting petrochemical-contaminated terrestrial ecosystems. Journal of Toxicology and Environmental Health, Part A **57**:521-527.
**Keywords:** apoptosis/ cell/ cotton rat/ DNA/ ecosystem/ evaluation/ female/ mammal/ Otwo/ ovary/ rat/ thymus/ tissue
**Notes:** Determination of the amount of apoptotic cell death in the ovary and thymus of wild female cotton rats occupying a former petrochemical complex. Cotton rats were collected from five petrochemical sites and five matching reference sites. Measured DNA integrity of ovarian and thymic tissue, counted uterine scars, and performed a histological evaluation of follicles.

**Scarlett, A., T. S. Galloway, M. Canty, E. L. Smith, J. Nilsson**, 2005. Comparative toxicity of two oil dispersants, superdispersant-25 and Corexit 9527, to a range of coastal species. Environmental

Toxicology and Chemistry **24**:1219-1227.
**Keywords:** amphipod/ assay/ bivalve/ concentration/ Corexit 9527/ dispersant/ feeding/ general effect/ grass/ indicator/ marine invertebrate/ marine plant/ mussel/ ODeight/ oil/ rate/ recovery/ salt water/ sea anemone/ seagrass/ species/ static/ survival/ toxicity
**Notes:** A marine amphipod, a mussel, an anemone, and a seagrass were used in toxicity assays of two chemical oil dispersants (Corexit 9527, Superdispersant-25). Assays were a 48 hr static exposure period followed by a 72 hr period of recovery. The amphipod was exposed to seven concentrations of dispersant, and the mussel, sea anemone, and sea grass to 5 concentrations. Measured survival, feeding rates of the mussel after 48 hr of exposure to one concentration, lack of response by sea anemone, and several photosynthetic indicators for the sea grass.

**Scheier, A., D. Gominger**, 1976. A preliminary study of the toxic effects of irradiated vs. non-irradiated water soluble fractions of #2 fuel oil. Bulletin of Environmental Contamination and Toxicology **16**:595-603.
**Keywords:** bioassay/ concentration/ effects/ experiment/ fish/ fuel oil/ general effect/ grass/ grass shrimp/ light/ marine invertebrate/ No.2 fuel oil/ Oeight/ oil/ phototoxicity/ salt water/ shrimp/ solubility/ species/ time/ toxicity/ ultraviolet
**Notes:** A study of the effects of the water-soluble fraction (WSF) of No. 2 fuel oil on grass shrimp and four species of fish. Test organisms were exposed to varying concentration of the WSF for 96 hr in a continuous-flow bioassay. The WSF was prepared either in the dark or in the presence of an indoor sunlamp. Effects of exposure to irradiated (ultra violet light from lamp) or non-irradiated WSF are compared. A second series of experiments utilized floating fuel oil (irradiated) on water for 24 hrs, 72 hrs, or 6 da and then removing the WSF. This is early documentation of the ultra-violet toxicity enhancement phenomena that attracted much attention from toxicologists in the 1990s.

**Schifter, I., C. Gonzalez-Macias, A. Miranda, E. Lopez-Salinas**, 2005. Air emissions assessment from offshore oil activities in Sonda de Campeche, Mexico. Environmental Monitoring and Assessment **109**:135-145.
**Keywords:** activity/ air/ emissions/ Mexico/ miscellaneous/ Oeleven/ offshore/ oil/ oil field/ petroleum/ pollution/ release/ salt water/ sources/ storage/ survey
**Notes:** Authors surveyed the sources of air emissions in the main off-shore oil production area of Mexico. Categorized the sources into flares, internal combustion, evaporative releases from storage facilities, uncontrolled fugitive emissions, and coastal traffic and fishing. Compared results of the survey to other major oil company operations.

**Schirmer, K., D. J. Tom, N. C. Bols, J. P. Sherry**, 2001. Ability of fractionated petroleum refinery effluent to elicit cyto- and photocytotoxic responses and to induce 7-ethosyresorufin-*O*-deethylase activity in fish cell lines. Science of the Total Environment **271**:61-78.
**Keywords:** activity/ assay/ cell/ effluent/ fish/ fresh water/ Othree/ particulate/ petroleum/ rainbow trout/ refinery/ toxicity
**Notes:** A large and complex study wherein effluent from an Ontario refinery was fractionated into aqueous and particulate phases, as well as a concentrated extract of the effluent, and tested for cellular response on cell cultures derived from rainbow trout and brown bullhead. Evaluated direct cyto- and photocyto-toxicity, induction of EROD activity, and indirect cytotoxicity.

**Schloesser, D. W., T. A. Edsall, B. A. Manny, S. J. Nichols**, 1991. Distribution of *Hexagenia* nymphs and visible oil in sediments of the upper Great Lakes connecting channels . Hydrobiologia **219**:345-352.
**Keywords:** burrowing mayfly/ density/ distribution/ fresh water/ freshwater invertebrate/ Great Lakes/ mayfly/ nymphs/ Ofive/ oil/ oiled/ sediment
**Notes:** Nymphs of the burrowing mayfly were sampled at 250 stations in the connecting channels of the upper Great Lakes (St. Marys River, St. Clair River, Lake St. Clair, and Detroit River). Nymph densities were determined and compared among sections of the connecting channels and between sediments with and without visible oil.

**Scholten, M. and J. Kuiper** 1987. The effects of oil and chemically dispersed oil on natural phytoplankton communities. Pages 255-257 *in* Proceedings 1987 Oil Spill Conference, API Publication 4452. American Petroleum Institute, Washington, D.C.

**Keywords:** abundance/ cell/ chlorophyll/ community/ composition/ concentration/ crude oil/ ecosystem/ effects/ experiment/ Forties Field crude oil/ fuel oil/ light/ marine plant/ model/ mousse/ Nigerian crude oil/ ODsix/ oil/ oil spill/ overview/ phytoplankton/ plankton/ population/ salt water/ species/ spill/ tidal flat
**Notes:** An overview of seven experiments performed with model plankton ecosystems and model tidal flat ecosystems. Only reports on the main phytoplankton results for studies involving phytoplankton exposure to water-soluble fraction of fuel oil, Nigerian light crude oil, Forties crude oil in nitrogen-poor sea water, Forties crude oil and chemically-dispersed Forties, fraction 2 oil, and fuel oil mousse. Measured chlorophyll concentrations, abundance of algal cells, primary production, and species composition.

**Scholten, M. C. Th., C. C. Karman, S. Huwer**, 2000. Ecotoxicological risk assessment related to chemicals and pollutants in off-shore oil production. Toxicology Letters **112-113**:283-288.
**Keywords:** effluent/ Europe/ miscellaneous/ Oeleven/ offshore/ oil/ petroleum/ risk/ risk assessment/ salt water/ waste water
**Notes:** Discussion of risk assessment of chemicals and pollutants from offshore oil production in northwest Europe. Presentation of a computerized program called CHARM that facilitates both risk assessment and risk management.

**Schratzberger, M., F. Daniel, C. M. Wall, R. Kilbride, S. J. Macnaughton, S. E. Boyd, H. L. Rees, K. Lee, R. P. J. Swannell**, 2003. Response of estuarine meio-and macrofauna to in situ bioremediation of oil-contaminated sediment. Marine Pollution Bulletin **46**:430-443.
**Keywords:** analysis/ bioremediation/ coast/ community/ concentration/ crude oil/ England/ estuarine/ fertilizer/ intertidal/ macrofauna/ marine invertebrate/ microbes/ nematode/ nitrogen/ Ofour/ oil/ oiled/ petroleum/ petroleum hydrocarbons/ phosphorus/ salt water/ sediment/ weathered
**Notes:** An intertidal area on the coast of southwest England was used to establish three blocks of experimental plots. Weathered Forties crude oil was used. Each block had plots containing a control, a defaunated control, oiled sediment, oiled sediment plus slow-release fertilizer, and oiled sediment plus liquid fertilizer. Sediment samples were collected for total petroleum hydrocarbon analysis during weeks 0, 11, 16, and 45. Nitrogen and phosphorous concentrations were measured during weeks 0, 2, and 16. Nematodes and macrofauna were identified and quantified during weeks 0, 3, 7, 11, and 45.

**Schreiner, C., Q. Bui, R. Breglia, D. Burnett, F. Koschier, P. Podhasky, L. Lapadula, R. White**, 1997. Toxicity evaluation of petroleum blending streams: reproductive and developmental effects of hydrodesulfurized kerosine. Journal of Toxicology and Environmental Health **52**:211-229.
**Keywords:** concentration/ consumption/ development/ effects/ evaluation/ female/ food/ fresh water/ kerosene/ male/ mammal/ organ/ Otwo/ pathology/ petroleum/ rat/ reproduction/ skin/ stream/ survival/ toxicity/ weight
**Notes:** Laboratory rats exposed to five concentrations of hydrodesulfurized kerosine applied daily to the shaved backs of males (8 wk) and females (7 wk); survival, weights, food consumption, birth, and lactation. Males killed at 8 wk, females and young killed at 4 da post-partum; body weight, organ weights, offspring development, macro- and microscopic pathology.

**Schroder, J. L., N. T. Basta, D. P. Rafferty, R. L. Lochmiller, S. Kim, C. W. Qualls, K. McBee**, 1999. Soil and vegetation fluoride exposure pathways to cotton rats on a petrochemical-contaminated landfarm. Environmental Toxicology and Chemistry **18**:2028-2033.
**Keywords:** accumulation/ bone/ cotton rat/ dental fluorosis/ evaluation/ fluoride/ fluorine/ fluorosis/ freshwater plant/ mammal/ Oklahoma/ Otwo/ petroleum/ rat/ refinery/ risk/ soil/ vegetation
**Notes:** An evaluation of the risk of fluoride accumulation in small mammals inhabiting landfarms used to degrade wastes from petroleum refining. Measured the fluorine content of soil, vegetation, and bone of cotton rats from the vicinity of an old refinery in Oklahoma and from a reference site. Also estimated the severity of dental fluorosis.

**Schroder, J. L., N. T. Basta, R. L. Lochmiller, D. P. Rafferty, M. Payton, S. Kim, C. W. Qualls, Jr.**, 2000. Soil contamination and bioaccumulation of inorganics on petrochemical sites. Environmental Toxicology and Chemistry **19**:2066-2072.
**Keywords:** concentration/ cotton rat/ fluorine/ fluorosis/ incisor/ inorganic/ lesions/ mammal/ metals/ Otwo/ petroleum waste/ rat/ soil/ uptake

**Notes:** Twelve petrochemical-contaminated sites and 12 matched reference sites were evaluated for uptake of metals and F by local rodents. Sampled soils and cotton rats from all 24 sites over a 3-year period (four matched pairs per year). Measured soil characteristics and concentrations of Ba, Cd, Co, Cr, Cu, Ni, Pb, Sr, Ti, V, Zn, and F. Cotton rat humeri were analyzed for Ba, Cr, Pb, Sr, Zn, Ti, and F; incisors were examined for dental lesions (fluorosis).

**Schroder, J. L., N. T. Basta, M. Payton, J. A. Wilson, R. I. Carlson, D. M. Janz, R. L. Lochmiller**, 2003. Ecotoxicological risks associated with land treatment of petrochemical wastes. I. Residual soil contamination and bioaccumulation by cotton rats (*Sigmodon hispidus*). Journal of Toxicology and Environmental Health, Part A **66**:305-325.
**Keywords:** bone/ cotton rat/ fluoride/ hydrocarbons/ incisor/ kidney/ lesions/ mammal/ metals/ Otwo/ PAH/ petroleum/ petroleum hydrocarbons/ petroleum waste/ rat/ remediation/ risk/ seasonal/ soil
**Notes:** Cotton rats were collected from five petrochemical landfarms and matched reference sites during summer and winter of 1998-2000. Soils were collected from each site and analyzed for soil characteristics,12 metals and fluoride, 16 PAHs, and total petroleum hydrocarbons. Bone was analyzed for metals and fluoride. Kidney was analyzed for metals. Incisors were evaluated for frequency and severity of dental lesions.

**Schultz, D. and L. B. Tebo, Jr.** 1975. Boone Creek oil spill. Pages 583-587 *in* 1975 Conference on Prevention and Control of Oil Pollution. American Petroleum Institute, Washington, DC.
**Keywords:** algae/ benthic/ creek/ diesel/ diesel fuel/ effects/ fish/ fresh water/ freshwater invertebrate/ freshwater plant/ invertebrate/ oil/ oil spill/ Othree/ periphyton/ pollution/ sediment/ South Carolina/ spill/ time
**Notes:** Results of a spill of diesel fuel into a creek in South Carolina; effects on fish, periphyton, and benthic invertebrates, and residence time in sediments.

**Schultz, D. P., W. W. Johnson, and A. B. Berkner** 1983. A unique oiled bird rehabilitation operation -- Myrtle Beach, South Carolina, February 1981. Pages 525-528 *in* 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), API Publication 4356, API 4356. American Petroleum Institute, Washington, D.C.
**Keywords:** beach/ behavior/ bird/ coast/ loon/ oil/ oil spill/ oiled/ Oone/ origin/ rehabilitation/ salt water/ South Carolina/ species/ spill
**Notes:** Account of an oiled bird rehabilitation effort for several species of loons on the coast of South Carolina after a spill of unknown origin.

**Schultz, T. W., S. T. Perry, J. N. Dumont**, 1978. Reduced toxicity of an aqueous coal-conversion effluent following waste disposal treatment. Bulletin of Environmental Contamination and Toxicology **20**:633-639.
**Keywords:** aqueous/ assay/ behavior/ coal/ concentration/ effluent/ fresh water/ freshwater/ freshwater invertebrate/ growth/ Ofive/ population/ respiration/ solvent/ stream/ synthetic oil/ toxicity/ treatment/ waste water/ water
**Notes:** Treated waste water from a solvent refined coal process (sand-filter stream and carbon-filter stream) were tested for toxicity in a laboratory assay employing a freshwater ciliate. Ciliates were exposed to concentrations of 25, 50, 75, and 100% of both effluents for 24 hr; measured changes in shape and behavior. Respiration was measured in a separate 24 hr assay using concentraions of 5, 10, 15, and 20% sand-filter stream effluent. Population growth was measured in a separate 72 hr assay using concentrations of 5, 10, 15, 20, and 25% sand-filter stream effluent.

**Scopa, A., G. Salzano, L. Scrano, S. A. Bufo, M. G. Bonomo**, 2006. Preliminary assessment of microbial community recovery after an accidental oil spill by molecular analysis. Fresenius Environmental Bulletin **15**:1-7.
**Keywords:** analysis/ bioremediation/ community/ crude oil/ DNA/ microbes/ oil/ oil spill/ oiled/ Oten/ petroleum/ recovery/ soil/ spill/ time/ transect
**Notes:** Soil was sampled one month and one year after an accidental crude oil spillage in southern Italy. Polluted samples and a reference soil were physically and chemically (including total petroleum hydrocarbon content) characterized. Samples along two transects at each location were combined and

used in a molecular (DNA) analysis of soil microbes (total community DNA extraction). Intent was to use community DNA change to measure the progress of natural bioremediation of the oiled soil.

**Scott, B. F., E. Nagy, J. P. Sherry, B. J. Dutka, V. Glooschenko, N. B. Snow, and P. J. Wade** 1979. Ecological effects of oil-dispersant mixtures in fresh water. Pages 585-571 *in* 1979 Oil Spill Conference, API Publication 4308. American Petroleum Institute, Washington, DC.
**Keywords:** algae/ bacteria/ chlorophyll/ concentration/ Corexit 9527/ crude oil/ dispersant/ effects/ fresh water/ freshwater invertebrate/ freshwater plant/ fungi/ general effect/ mesocosm/ Norman Wells crude oil/ ODeight/ oil/ oil spill/ phytoplankton/ spill/ time/ water column/ zooplankton
**Notes:** The effects on water column organisms of exposure to Norman Wells crude oil with or without a chemical dispersant (Corexit 9527) was determined with four outdoor mesocosms. Each mesocosm was monitored for 7 mos prior to exposure and on days 1, 7, 14, 27, 41, and 55 after exposure. Oil concentrations were also determined at hours 1, 4, and 48 after crude oil and dispersant were added. Measured water characteristics, phytoplankton, zooplankton, bacteria (two types), fungi, attached filamentous algae, surface insects, and chlorophyll *a*. Phytoplankton were identified to Class.

**Seip, K. L.**, 1984. The *Amoco Cadiz* oil spill -- at a glance. Marine Pollution Bulletin **15**:218-230.
**Keywords:** Amoco Cadiz/ bird/ coast/ crude oil/ effects/ fate/ France/ general effect/ marine invertebrate/ marine plant/ Oeight/ oil/ oil spill/ petroleum/ review/ spill/ time/ wetland
**Notes:** A review of the effects of the 1978 Amoco Cadiz crude oil spill off the Brittany coast of France. The review occurs 5 yr post spill and includes data from multiple studies covering petroleum fate, vertebrate and nonvertebrate animals, coastal and wetland flora, and social effects.

**Seip, K. L., E. Sandersen, F. Mehlum, J. Ryssdal**, 1991. Damages to seabirds from oil spills: comparing simulation results and vulnerability indexes. Ecological Modelling **53**:39-59.
**Keywords:** bird/ common eider/ eiders/ guillemot/ index/ kittiwake/ model/ oil/ oil spill/ Oone/ population/ salt water/ simulation/ species/ spill/ vulnerability
**Notes:** Simulation modelling for estimating harm to seabird populations from oil spills; results are compared to a vulnerability index system. Three species of birds (kittiwake, common guillemot, common eider) are used in the comparisons.

**Seiser, P. E., L. K. Duffy, A. D. McGuire, D. D. Roby, G. H. Golet, M. A. Litzow**, 2000. Comparison of pigeon guillemot, *Cepphus columba*, blood parameters from oiled and unoiled areas of Alaska eight years after the *Exxon Valdez* oil spill. Marine Pollution Bulletin **40**:152-164.
**Keywords:** adult/ Alaska/ biochemistry/ bird/ blood/ chicks/ crude oil/ effects/ Exxon Valdez/ guillemot/ oil/ oil spill/ oiled/ Oone/ parameters/ plasma/ population/ Prince William Sound/ Prudhoe Bay crude oil/ salt water/ spill/ time
**Notes:** Pigeon guillemot chicks and adults from oiled and unoiled portions of Prince William Sound and adults from Kachemak Bay, Alaska were sampled to determine any lingering effects of the 1989 oil spill. Blood was sampled from chicks 20 da and 30 da after hatch, and once from adults. Blood was analyzed for haematological characteristics and plasma biochemistry; results were compared over time and between oiled and unoiled locations.

**Sen-Gupta, R., T. W. Kureishy**, 1981. Present state of oil pollution in the northern Indian Ocean. Marine Pollution Bulletin **12**:295-301.
**Keywords:** depth/ Indian Ocean/ miscellaneous/ nets/ Oeleven/ oil/ oil slick/ petroleum/ pollution/ salt water/ survey/ tar ball/ total hydrocarbons
**Notes:** A large-scale survey of petroleum pollution in the northern Indian Ocean (Arabian Sea and Bay of Bengal) was performed ~1979-80. Water was sampled at three depths, visual observations were made of oil slicks and floating tarballs, and neuston nets were used to collect sub-surface tar balls. Water samples were analyzed for total hydrocarbon content.

**Sen Gupta, R., S. P. Fondekar, R. Alagarsamy**, 1993. State of oil pollution in the northern Arabian Sea after the 1991 Gulf oil spill. Marine Pollution Bulletin **27**:85-91.
**Keywords:** Arabian Gulf/ bacteria/ coast/ concentration/ depth/ environment/ fish/ Gulf oil spill/ hydrocarbons/ India/ marine environment/ miscellaneous/ Oeleven/ oil/ oil slick/ oil spill/ oxygen/ pollution/

salt water/ sediment/ spill/ survey/ tar ball/ total hydrocarbons/ zooplankton
**Notes:** Two survey cruises (3/91, 9/91) were undertaken to sample the marine environment of the northern Arabian Sea adjacent to the west coast of India for evidence of pollution from the Gulf oil spill. Sampled water and measured oxygen concentrations at several depths, looked for oil slicks and tar balls, collected zooplankton and fish samples, collected a few sediment samples, and determined the percent presence of oil-degrading bacteria in water. Analyzed water, sediment, and biota for total hydrocarbons.

**Sergy, G. A.** 1985. The Baffin Island oil spill (BIOS) project: a summary. Pages 571-575 *in* 1985 Oil Spill Conference, API Publication4385. American Petroleum Institute, Washington, DC.
**Keywords:** bacteria/ benthic/ Canada/ crude oil/ degradation/ effects/ fate/ general effect/ marine invertebrate/ microbes/ Oeight/ oil/ oil spill/ review/ shoreline/ spill/ time/ water column/ weathered
**Notes:** A review and summary of the results of a 4-yr study of the effects of an experimental crude oil spill at Baffin Island, NW Territories, Canada. Sections on background, nearshore, and shoreline; covering crude oil fate, water column bacteria, and benthic biota.

**Serrano, A., M. Gallego, J. L. Gonzalez**, 2006. Assessment of natural attenuation of volatile aromatic hydrocarbons in agricultural soil contaminated with diesel fuel. Environmental Pollution **144**:203-209.
**Keywords:** aromatic/ aromatic hydrocarbon/ aromatic hydrocarbons/ depth/ diesel/ diesel fuel/ fate/ hydrocarbons/ miscellaneous/ Oeleven/ soil/ time
**Notes:** The fate of diesel fuel spilled on an experimental soil (previously used in agriculture) plot was determined over a 50-da period. Twelve volatile aromatic hydrocarbons were measured at three depths and the disappearance was attributed to either volatilization or dissipation.

**Serrazanetti, G. P., L. S. Conte, E. Carpene, C. Bergami, S. Fonda-Umani**, 1991. Distribution of aliphatic hydrocarbons in plankton of Adriatic Sea open waters. Chemosphere **23**:925-938.
**Keywords:** aliphatic hydrocarbons/ biogenic/ distribution/ hydrocarbons/ marine invertebrate/ marine plant/ Ofour/ petroleum/ plankton/ salt water/ sources
**Notes:** Plankton of the Adriatic Sea were collected in the spring and late summer. Samples were analyzed for aliphatic hydrocarbons and the results were used to determine the source of the hydrocarbons (biogenic or petroleum).

**Sexstone, A., R. M. Atlas**, 1977. Mobility and biodegradability of crude oil in Arctic tundra soils. Developments in Industrial Microbiology **18**:673-684.
**Keywords:** Alaska/ aliphatic hydrocarbons/ Arctic/ behavior/ crude oil/ depth/ fresh water/ hydrocarbons/ microbes/ oil/ Oten/ Prudhoe Bay/ Prudhoe Bay crude oil/ soil/ time/ total hydrocarbons/ tundra
**Notes:** An early study of the behavior of spilled Prudhoe Bay crude oil on tundra soil. Two quantities of crude oil were spilled on test plots established on four physical forms of tundra soil and sampled five times at 2-wk intervals during July and August. Samples were collected at three soil depths and analyzed for total extractable hydrocarbons and aliphatic hydrocarbons.

**Seys, J., H. Offringa, J. Van Waeyenberge, P. Meire, E. Kuijken**, 2002. An evaluation of beached bird monitoring approaches. Marine Pollution Bulletin **44**:322-333.
**Keywords:** beach/ bird/ evaluation/ methods/ monitoring/ Oone/ rehabilitation/ salt water/ spill
**Notes:** Evaluation of four methods of monitoring beached birds (weekly, monthly, annually, birds submitted to wildlife rehabilitation centers). Used information gathered during seven winters (1993-99).

**Seys, J., H. Offringa, P. Meire, J. Van Waeyenberge, E. Kuijken**, 2002. Long-term changes in oil pollution off the Belgian coast: evidence from beached bird monitoring. Belgian Journal of Zoology **132**:111-118.
**Keywords:** beached bird survey/ bird/ coast/ density/ long-term/ monitoring/ oil/ oiled/ Oone/ pollution/ rate/ salt water/ survey/ time/ trend
**Notes:** Annual beached bird surveys are performed in Belgium during February. Authors used a dataset of 37 yrs (1962-99) to look for long term trends in density (birds/km), taxonomic groups, and rate of oiling (oiled birds/total birds).

**Shailaji, M. S.**, 1988. The influence of dissolved petroleum hydrocarbon residues on natural phytoplankton biomass. Marine Environmental Research **25**:315-324.
**Keywords:** Arabian crude oil/ aromatic hydrocarbons/ biomass/ chlorophyll/ concentration/ crude oil/ depth/ dissolved/ hydrocarbons/ India/ light/ marine plant/ nutrients/ oil/ Osix/ petroleum/ petroleum hydrocarbons/ phytoplankton/ salt water/ species/ transect
**Notes:** Water was collected from 1, 10, and 30 m depths along two transects in the southern Bay of Bengal, India and analyzed for aromatic hydrocarbons and chlorophyll *a* concentrations. Several water nutrients also were measured. A phytoplankton species was cultured for 96 hrs in the presence of filtered water from 1 m depth or artificial sea water spiked with varying amounts of water-soluble fraction of light Arabian crude oil; measured chlorophyll *a*.

**Shakir Hanna, S. H., R. W. Weaver**, 2002. Earthworm survival in oil contaminated soil. Plant and Soil **240**:127-132.
**Keywords:** Arabian Light crude oil/ concentration/ crude oil/ earthworm/ experiment/ freshwater invertebrate/ Ofive/ oil/ soil/ survival/ toxicity/ weathered
**Notes:** A series of earthworm survival experiments was performed using soil mixed with varying concentrations of Arabian light crude oil. The first experiment involved *E. fetida* in soil containing either 0.5, 1, 1.5, 2, or 2.5 ppm of either unweathered or artificially weathered crude oil for 15 da. The second experiment used *L. terrestris* in soil containing either 0, 0.5, 1, or 1.5 ppm unweathered crude oil for 15 da. The third experiment used *L. terrestris* and either 0, 0.5, 1, 05 1.5 ppm unweathered crude oil in a 15-da experiment permitting the earthworms to move from the contaminated portion of a container to an uncontaminated portion. The fourth experiment determined survival of *L. terrestris* in contaminated soil bioremediated for 1 yr with either no bulking agent, sawdust, hay, or vermiculate; duration of this experiment was 25 da.

**Sharma, V. K., K. Rhudy, R. Brooks, S. Hollyfield, F. G. Vazquez**, 1997. Petroleum hydrocarbons in sediments of upper Laguna Madre. Marine Pollution Bulletin **34**:229-234.
**Keywords:** hydrocarbons/ miscellaneous/ Oeleven/ petroleum/ petroleum hydrocarbons/ salt water/ sediment/ survey/ Texas
**Notes:** Survey of petroleum hydrocarbons in the sediment of a portion of the upper Laguna Madre.

**Sharma, V. K., S. D. Hicks, W. Rivera, F. G. Vazquez**, 2000. Hydrocarbon contamination in sediments of Nueces Bay, Texas. Bulletin of Environmental Contamination and Toxicology **65**:253-260.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ biological effects/ effects/ hydrocarbons/ miscellaneous/ Nueces Bay/ Oeleven/ salt water/ sediment/ sources/ Texas
**Notes:** Sediments were collected from 12 locations in Nueces Bay, Texas and analyzed for aliphatic and aromatic hydrocarbons. Results were interpreted for source determination and implications for biological effects.

**Sharma, V. K., S. D. Hicks, W. Rivera, F. G. Vazquez**, 2002. Characterization and degradation of petroleum hydrocarbons following an oil spill into a coastal environment of south Texas, U.S.A. Water, Air, and Soil Pollution **134**:111-127.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ concentration/ crude oil/ degradation/ environment/ hydrocarbons/ light/ miscellaneous/ Oeleven/ oil/ oil spill/ petroleum/ petroleum hydrocarbons/ pipeline/ sediment/ spill/ stream/ Texas/ time
**Notes:** A 1994 pipeline rupture resulted in the discharge of light crude oil into a Texas coastal stream. Sediments from the stream bank and channel bottom were collected at 11 sites during months 1, 2, 3, 4, 6, and 12. Measured concentrations of 22 aliphatic and 16 aromatic hydrocarbons.

**Sharp, B. E.**, 1996. Post-release survival of oiled, cleaned seabirds in North America. Ibis **138**:222-228.
**Keywords:** bird/ cleaning/ commentary/ North America/ oiled/ Oone/ rehabilitation/ salt water/ survival
**Notes:** Assessment of the post-release survival of rehabilitated oiled seabirds in North America and a commentary on the utility of cleaning oiled birds.

**Shaw, D. G., L. M. Cheek, A. J. Paul**, 1977. Uptake and release of petroleum by intertidal sediments at Port Valdez, Alaska. Estuarine and Coastal Marine Science **5**:429-430.

**Keywords:** Alaska/ composition/ crude oil/ experiment/ hydrocarbons/ intertidal/ microbes/ oil/ oiled/ Oten/ petroleum/ petroleum hydrocarbons/ Prudhoe Bay/ Prudhoe Bay crude oil/ release/ salt water/ sediment/ time/ uptake
**Notes:** An early experiment to determine the potential for intertidal sediment in Alaska (Port Valdez) to retain spilled crude oil (Prudhoe Bay crude oil). Two quantities of crude oil were added on five consecutive days to 'contained' plots of intertidal sediment at low tide. The surface sediment was sampled on days 3, 5, 7, 15, 29, 44, and 60 after the first oiling and analyzed for total extractable hydrocarbons. Gas chromatogram tracings were used to show the changes in crude oil composition over time.

**Shaw, D. G., J. N. Wiggs**, 1980. Hydrocarbons in the intertidal environment of Kachemak Bay, Alaska. Marine Pollution Bulletin **11**:297-300.
**Keywords:** Alaska/ bivalve/ clam/ coal/ environment/ hydrocarbons/ intertidal/ limpet/ marine invertebrate/ mussel/ Ofour/ salt water/ saturated hydrocarbons/ sea urchin/ sediment/ snail/ species/ terpenoid/ unsaturated hydrocarbons/ urchin
**Notes:** Assessment of the hydrocarbons in the bivalves, sediment, and coal of five locations within Kachemak Bay, Alaska. Sampled three species of limpet, two clams, two mussels, one snail, and one urchin for hydrocarbons. Analyzed samples for saturated, unsaturated, and terpenoid hydrocarbons.

**Shaw, D. G.**, 1992. The *Exxon Valdez* oil-spill: ecological and social consequences. Environmental Conservation **19**:253-258.
**Keywords:** Alaska/ cleaning/ commentary/ crude oil/ effects/ Exxon Valdez/ general effect/ methods/ Oeight/ oil/ oil spill/ Prince William Sound/ salt water/ spill/ time
**Notes:** A commentary on the consequences of the 1989 Exxon Valdez oil spill in Prince William Sound, Alaska. The author discusses the cleanup methods, biotic effects, economic and social effects, and governmental response.

**Shaw, D. G., H. R. Bader**, 1996. Environmental science in a legal context: the *Exxon Valdez* experience. Ambio **25**:430-434.
**Keywords:** CERCLA/ damage assessment/ Exxon Valdez/ legal/ miscellaneous/ mitigation/ natural resource/ Oeleven/ oil/ oil spill/ petroleum/ restoration/ salt water/ spill
**Notes:** Critical assessment of the legal aspects of the Exxon Valdez oil spill. Consequences of the CERCLA requirements for data collection are evaluated in terms of problems produced for both scientists and lawyers; several suggestions for improvement.

**Shelton, M. E., P. J. Chapman, S. S. Foss, W. S. Fisher**, 1999. Degradation of weathered oil by mixed marine bacteria and the toxicity of accumulated water-soluble material to two marine crustacea. Archives of Environmental Contamination and Toxicology **36**:13-20.
**Keywords:** bacteria/ crude oil/ degradation/ embryo/ grass/ grass shrimp/ larvae/ marine invertebrate/ miscellaneous/ North Slope/ North Slope crude oil/ oil/ Oten/ petroleum hydrocarbons/ salt water/ shrimp/ survival/ toxicity/ weathered
**Notes:** Artificially-weathered Alaskan North Slope crude oil degraded by four different mixtures of marine bacteria over periods of 7 or 14 da. Compared to the degradation in a sterile control and a nutrient-limited version of one of the marine bacteria mixtures. Embryos of grass shrimp were exposed for 12 da to the water-soluble fractions (WSF) of all experimental groups. Larvae of mysid shrimp were exposed to WSF from the sterile control and one of the bacteria mixtures. Measured survival of embryos and larvae and analyzed the recovered WSF.

**Sherry, J. P., B. F. Scott, E. Nagy, B. J. Dutka**, 1994. Investigation of the sublethal effects of some petroleum refinery effluents. Journal of Aquatic Ecosystem Health **3**:129-137.
**Keywords:** acute/ algae/ alkane/ bacteria/ Canada/ chronic/ effects/ effluent/ fish/ fresh water/ freshwater invertebrate/ freshwater plant/ general effect/ genetic/ microbes/ Microtox/ Oeight/ PAH/ petroleum/ plant/ refinery/ sublethal
**Notes:** Effluents from two Ontario, Canada petroleum refineries were used in a battery of acute (48-hr, 96-hr, Microtox, Toxi-Chromotest), chronic and sublethal (3 or 7 da, 120-hr, 96-hr), and genetic (SOS-

Chromotest) tests. Used bacteria, algae, aquatic plants, cladocerans, and fish. Also analyzed the effluents for alkanes and priority pollutant PAHs.

**Shin, K.-H., H. Jung, P. Chang, H. Choi, K.-W. Kim**, 2005. Earthworm toxicity during chemical oxideation of diesel-contaminated sand. Environmental Toxicology and Chemistry **24**:1924-1929.
**Keywords:** chemical analysis/ diesel/ diesel fuel/ earthworm/ freshwater invertebrate/ Ofive/ risk/ sand/ soil/ survival/ toxicity/ weathered
**Notes:** The toxic risk to earthworms of in-situ ozonation of diesel-contaminated sand was determined with an experimental ozonation test chamber. Diesel fuel was weathered for 2 wks and added to a large quantity of sand. Ozonation was continued for 20 da and was monitored at a grid of locations within the test chamber. Diesel-contaminated sand was sampled before and at the end of the 20 ozonation period, at nine locations within the test chamber. Sand samples were used as part of an artificial soil mixture that evaluated toxicity to earthworms over a 14-da period. Test chamber sand was characterized, the diesel content of all sand and soil samples was measured, and earthworms were weighed at 2-da intervals.

**Shin, W. S., J. H. Pardue, W. A. Jackson, S. J. Choi**, 2001. Nutrient enhanced biodegradation of crude oil in tropical salt marshes. Water, Air, and Soil Pollution **131**:135-152.
**Keywords:** alkane/ ammonia/ ammonium/ aromatic hydrocarbons/ biodegradation/ concentration/ crude oil/ degradation/ fertilizer/ hydrocarbons/ incubation/ Louisiana/ Louisiana crude oil/ microbes/ mineralization/ nitrogen/ oil/ Oten/ rate/ salt water/ sediment/ South Louisiana crude oil/ time
**Notes:** Sediment cores were removed from two sites along coastal Louisiana and used in a laboratory assessment of microbial degradation of South Louisiana crude oil. Cores from one site were either microbially supressed (chemical additive), untouched, or enhanced by one of three concentrations of fertilizer. Cores from the other sites were either microbially supressed, untouched, or enhanced by one concentration of fertilizer. A radio-labelled alkane and an aromatic compound were added to the sediment. Measured mineralization rates of the radio-labelled compounds, $CO_2$ production, and porewater ammonia nitrogen during a 100 da incubation period. Also measured the concentration, after 8 wks, of 12 alkanes and 7 aromatics.

**Short, J. W., R. A. Heintz**, 1997. Identification of *Exxon Valdez* oil in sediments and tissues from Prince William Sound and the northwestern Gulf of Alaska based on a PAH weathering model. Environmental Science and Technology **31**:2375-2384.
**Keywords:** Alaska/ concentration/ crude oil/ development/ Exxon Valdez/ gravel/ Gulf of Alaska/ miscellaneous/ model/ mussel/ Oeleven/ oil/ PAH/ Prince William Sound/ salt water/ sediment/ tissue/ weathered
**Notes:** Development of a PAH weathering model used to assess weathering of crude oil in a large number of field samples from Prince William Sound, Alaska. Used gravel coated with four quantities of crude oil and then weathered for 6 mos. Field samples consisted of sediment and mussel tissue. Measured concentrations of selected PAH in field samples and experimental gravel.

**Short, J. W., M. R. Lindeberg, P. M. Harris, J. M. Maselko, J. J. Pella, S. D. Rice**, 2004. Estimate of oil persisting on the beaches of Prince William Sound 12 years after the *Exxon Valdez* oil spill. Environmental Science and Technology **38**:19-25.
**Keywords:** beach/ crude oil/ estimate/ Exxon Valdez/ miscellaneous/ North Slope crude oil/ Oeleven/ oil/ oil spill/ oiled/ petroleum/ Prince William Sound/ remediation/ spill/ survey/ time
**Notes:** A large scale stratified random sampling project to estimate the oil remaining in Prince William Sound beaches from the Exxon Valdez oil spill. Sampling occurred within categories of heavy, medium, and light oiling. Samples were analyzed gravimetrically and with GC-MS. Results were compared to previous surveys and current estimates were made of the quantity of oil remaining and the percent of petroleum attributable to the Exxon Valdez spill.

**Short, J. W., J. M. Maselko, M. R. Lindeberg, P. M. Harris, S. D. Rice**, 2006. Vertical distribution and probability of encountering intertidal Exxon Valdez oil on shorelines of three embayments within Prince William Sound, Alaska. Environmental Science and Technology **40** :3723-3729.
**Keywords:** Alaska/ bird/ crude oil/ distribution/ duck/ Exxon Valdez/ intertidal/ mammal/ miscellaneous/ Oeleven/ oil/ oil spill/ oiled/ otter/ petroleum/ Prince William Sound/ salt water/ sampling/ sea otter/

sediment/ shoreline/ spill/ time/ toxicity
**Notes:** A total of 32 shoreline segments at three locations on the north side of Knight Island, Prince William Sound were examined for the visible presence of petroleum in surface and subsurface sediments. All shorelines were heavily oiled during the 1989 spill. Each shoreline was divided into five 1-m tidal elevation intervals (-0.2 to +4.8 m) for sampling purposes. Results were compared to those from a similar study in 2001. Calculated oil encounter probabilities for animals (sea otters, ducks) that forage in and on the sediments of shoreline areas.

**Shriadah, M. A.**, 1999. Oil contamination along oil tanker routes off the United Arab Emirates (the Arabian Gulf and the Gulf of Oman). Bulletin of Environmental Contamination and Toxicology **63**:203-210.
**Keywords:** Arabian Gulf/ aromatic hydrocarbons/ concentration/ depth/ Gulf of Oman/ hydrocarbons/ miscellaneous/ Oeleven/ oil/ petroleum/ salt water/ tanker/ United Arab Emirates
**Notes:** Determination of petroleum contamination in portions of the Arabian Gulf and Gulf of Oman. Collected 288 water samples (surface and 10-m depth) between October 1995 and September 1996. Analyzed water for aromatic hydrocarbons.

**Shriadah, M. A.**, 2001. Petroleum hydrocarbon concentrations in Arabian Gulf fish tissues. Bulletin of Environmental Contamination and Toxicology **67**:560-567.
**Keywords:** Arabian Gulf/ aromatic hydrocarbons/ coast/ concentration/ fish/ length/ lipid/ Othree/ petroleum/ petroleum hydrocarbons/ salt water/ seasonal/ species/ tissue/ TPH/ United Arab Emirates/ weight
**Notes:** Fish of eight species were collected in winter and summer from commercial fishermen plying the waters of the Arabian Gulf off the coast of the United Arab Emirates. Measured length and weight of each fish and the lipid and total petroleum hydrocarbon (THP; aromatic) content of fish tissue (unspecified). Compared fish weight and lipid content to TPH and compared the winter and summer seasons.

**Shriadah, M. A.**, 2003. Tar contamination on beaches of the United Arab Emirates. Bulletin of Environmental Contamination and Toxicology **70**:680-687.
**Keywords:** beach/ coast/ miscellaneous/ Oeleven/ petroleum/ salt water/ sampling/ survey/ tar ball/ United Arab Emirates
**Notes:** Authors conducted beach surveys in 1996 and 1997 for tar balls along the west and east coasts of the United Arab Emirates. A total of 10 beaches containing 43 sampling sites were used. Tar balls were counted and weighed.

**Shriadah, M. M. A.**, 1998. Impacts of an oil spill on the marine environment of the United Arab Emirates along the Gulf of Oman. Marine Pollution Bulletin **36**:876-879.
**Keywords:** aromatic hydrocarbons/ carbon/ concentration/ crude oil/ environment/ Gulf of Oman/ hydrocarbons/ intertidal/ Iranian crude oil/ marine environment/ miscellaneous/ Oeleven/ offshore/ oil/ oil spill/ organic/ organic carbon/ salt water/ sampling/ sediment/ spill/ United Arab Emirates
**Notes:** Assessment of the contamination caused by a spill of Iranian crude oil in the Gulf of Oman, March 1994. Sampled offshore water (surface, subsurface) and interdidal sediment and water. Analyzed water for aromatic hydrocarbons and sediment for aromatic hydrocarbons and organic carbon. Sampling performed twice in April and once in July and November.

**Siddiqui, S., W. A. Adams**, 2002. The fate of diesel hydrocarbons in soils and their effect on the germination of perennial ryegrass. Environmental Toxicology **17**:49-62.
**Keywords:** aliphatic hydrocarbons/ analysis/ aromatic hydrocarbons/ concentration/ degradation/ diesel fuel/ freshwater plant/ germination/ incubation/ microbes/ nutrients/ Oseven/ respiration/ ryegrass/ seed/ soil
**Notes:** Two soils, one clean and one from a site subjected to periodic diesel fuel leakage, were collected and used in several laboratory studies. The clean soil was mixed with diesel to achieve either 0, 0.64, 1.6, 4, 5, or 13.6 % diesel in soil. The contaminated soil received 5 % diesel, with or without N and P nutrients. The mixtures were allowed to incubate at constant temperature for 600 da. Soil respiration was measured daily for 30 da, bacterial counts and length of fungal hyphal length on days 3, 11, and 30, and soils analyzed at days 0, 3, 11, 30, 60, 150, 365, and 600 for aliphatic hydrocarbons and several

aromatic hydrocarbons. Determined the effect of all treatment groups at weeks 0, 3, 5, 9, and 24 of incubation on 7-da germination of perennial ryegrass seeds. Germination of the same seeds was also determined by exposing seeds to individual aliphatic hydrocarbons (9) and aromatic hydrocarbons (3) at eight concentrations for 2 wks.

**Sidhu, A., W. J. Mitsch**, 1987. Water pollution from oil and gas recovery in eastern Kentucky watersheds. Water Research Bulletin **23**:943-953.
**Keywords:** anion/ brine water/ cations/ conductivity/ effluent/ fresh water/ miscellaneous/ Oeleven/ oil/ oil field/ pH/ pollution/ recovery
**Notes:** Two watersheds in eastern Kentucky that received brine effluent from oil and gas field operations were sampled in 1984. Water was collected from five surface water sites in each watershed, four brine ponds, and four wells. Samples were collected during March, June, July, and September. Water and brine effluent were characterized for pH, conductivity and selected anions and cations.

**Siljeholm, J.**, 1993. An assessment of water pollution from refineries in the USA and western Europe. Hazardous Waste & Hazardous Materials **10**:365-376.
**Keywords:** cod/ composition/ discharges/ effluent/ Europe/ evaluation/ fresh water/ miscellaneous/ Oeleven/ oil/ organic/ petroleum/ pollution/ refinery/ salt water/ TOC/ treatment/ waste water
**Notes:** An evaluation of the chemical composition of refinery effluents in western Europe and the Uninted States. Waste water treatment systems are examined at different types of refineries and total petroleum discharges are shown for the period 1969-1987. Polar organic matter in current (late 1980s) refinery discharges are discussed with a European case study and data from the U.S. Polar organics were estimated as BOD, TOC, and COD, and compared to total petroleum (oil & grease).

**Silsby, G. C.** 1968. The chemistry of detergents. Pages 7-14 *in* J. D. Carthy, D. R. Arthur, editors. The Biological effects of oil pollution on littoral communities: proceedings of a symposium held at the Orielton Field Centre, Pembroke, Wales, on 17th, 18th and 19th February 1968. Field Studies. Field Studies Council, London.
**Keywords:** biological effects/ community/ detergent/ dispersant/ effects/ ODnine/ oil/ oil spill/ pH/ pollution/ spill/ surfactant/ technical/ littoral/ Wales
**Notes:** A presentation on the basic chemistry of detergents and surfactants with particular reference to how they work on floating oil.

**Simonato, J. D., A. C. Albinati, C. B. R. Marinez**, 2006. Effects of the water soluble fraction of diesel fuel oil on some functional parameters of the neotropical freshwater fish *Prochilodus lineatus* Valenciennes. Bulletin of Environmental Contamination and Toxicology **76**:505-511.
**Keywords:** acute/ analysis/ assay/ biochemical/ blood/ chloride/ concentration/ diesel/ diesel fuel/ effects/ experiment/ fish/ fresh water/ freshwater/ fuel oil/ glucose/ liver/ No.2 fuel oil/ oil/ Othree/ parameters/ plasma/ soluble/ static/ water
**Notes:** Fish were exposed in a static assay to the water-soluble fraction (WSF) of diesel fuel for either 24, 48, 96 hrs (acute exposure) or 15 da (subchronic exposure). The WSF fraction was renewed at 7 da in the subchronic experiment. Blood was analyzed for plasma osmolality, plasma chloride concentration, and plasma glucose. Liver was analyzed for glutathione-S-transferase and catalase analysis.

**Simons, E. A. and M. Akin** 1987. Dead endangered species in a California oil spill. Pages 417-418 *in* 1987 Oil Spill Conference (Prevention, Behavior, Control, Cleanup). American Petroleum Institute, Washington, DC.
**Keywords:** behavior/ bird/ brine water/ California/ endangered species/ fresh water/ mammal/ oil/ oil field/ oil spill/ Otwo/ rat/ species/ spill/ waste water
**Notes:** Report of the death of 11 endangered (state) giant kangaroo rats in California due to an overflow of brine water from an oilfield.

**Simpson, K. W.**, 1980. Abnormalities in the tracheal gills of aquatic insects collected from streams receiving chlorinated or crude oil wastes. Freshwater Biology **10**:581-583.
**Keywords:** abnormalities/ crude oil/ effluent/ evaluation/ fresh water/ freshwater invertebrate/ gill/ growth/ larvae/ nymphs/ Ofive/ oil/ oil field/ Pennsylvania/ respiration/ stream/ tissue/ waste water

**Notes:** Caddisfly larvae were sampled from the Allegheny River after it flowed through the northwest Pennsylvania oil field area. Trachael gills were inspected for tissue damage or abnormal growth. Similar evaluation described for a site receiving chlorinated wastewater effluents in New York (stoneflies and caddisflies).

**Simpson, R. D., S. D. A. Smith, A. R. Pople**, 1995. The effects of a spillage of diesel fuel on a rocky shore in the sub-Antarctic region (Macquarie Island). Marine Pollution Bulletin **31**:367-371.
**Keywords:** community/ diesel/ diesel fuel/ effects/ invertebrate/ kelp/ littoral/ marine invertebrate/ multivariate/ Ofour/ oiled/ region/ rocky shore/ salt water/ shoreline/ spill/ structure/ sublittoral/ substrate
**Notes:** Assessment of the effects of a spill of marine diesel fuel on the shoreline of a sub-Antarctic island 6 mos after the spill. Two oiled and two unoiled locations were sampled; evaluated biota on rocky substrate in the littoral and sublittoral zones and the invertebrate community structure of the giant kelp. Used univariate and multivariate analyses to compare sites.

**Singer, M. M., D. L. Smalheer, R. S. Tjeerdema, M. Martin**, 1990. Toxicity of an oil dispersant to the early life stages of four California marine species. Environmental Toxicology and Chemistry **9**:1387-1395.
**Keywords:** bioassay/ California/ concentration/ Corexit 9527/ dispersant/ embryo/ experiment/ fish/ flow-through/ general effect/ juvenile/ kelp/ larvae/ lethal/ marine invertebrate/ marine plant/ Oeight/ oil/ salt water/ species/ toxicity/ zoospore
**Notes:** A flow-through bioassay experiment was used to determine the toxicity of a chemical dispersant (Corexit 9527) to zoospores of giant kelp, embryos of red abalone, 4-d-old juvenile mysids, and 10-d-old larvae of topsmelt. Kelp and abalone were tested for 48 hrs, and mysid and topsmelt for 96 hrs. Endpoints were nonlethal for kelp and abalone, and lethal for mysid and topsmelt. Bioassay water was analyzed for concentrations of dispersant. Calculated LC, EC, and NOEC concentrations.

**Singer, M. M., S. George, D. Benner, S. Jacobson, R. S. Tjeerdema, M. L. Sowby**, 1993. Comparative toxicity of two oil dispersants to the early life stages of two marine species. Environmental Toxicology and Chemistry **12**:1855-1863.
**Keywords:** abnormalities/ bioassay/ concentration/ dispersant/ embryo/ flow-through/ juvenile/ marine invertebrate/ ODfour/ oil/ salt water/ species/ survival/ toxicity
**Notes:** Assessment of the toxicity of two oil dispersants (Slik-A-Way, Nokomis 3) to red abalone embryos and juveniles of the forest mysid. Exposure was for 48 or 96 hrs in a flow-through laboratory bioassay using five concentrations of dispersant. Measured survival, developmental abnormalities among abalone embryos, and concentrations of dispersants in exposure water.

**Singer, M. M., S. George, S. Jacobson, I. Lee, R. S. Tjeerdema, M. L. Sowby**, 1994. Comparative effects of oil dispersants to the early life stages of topsmelt (*Atherinops affinis*) and kelp (*Macrocystis pyrifera*). Environmental Toxicology and Chemistry **13**:649-655.
**Keywords:** concentration/ dispersant/ effects/ fish/ growth/ kelp/ larvae/ marine plant/ ODthree/ oil/ salt water/ toxicity/ zoospore
**Notes:** Toxicity of several concentrations of two oil dispersants (Nokomis 3, Slik-A-Way) to larvae of topsmelt and zoospores of giant kelp; 96 hr test for topsmelt and 48 hr test for kelp. Measures of death for topsmelt and growth for kelp.

**Singer, M. M., S. George, S. Jacobson, I. Lee, L. L. Weetman, R. S. Tjeerdema, M. L. Sowby**, 1995. Acute toxicity of the oil dispersant Corexit 9554 to marine organisms. Ecotoxicology and Environmental Safety **32**:81-86.
**Keywords:** abnormalities/ acute/ bioassay/ concentration/ Corexit 9554/ dispersant/ embryo/ fish/ flow-through/ juvenile/ kelp/ larvae/ length/ marine invertebrate/ marine plant/ ODfour/ oil/ salt water/ survival/ toxicity/ zoospore
**Notes:** Assessment of the toxicity of the oil dispersant Corexit 9554 to embryos of the red abalone, juvenile kelp forest mysids, larvae of the top smelt, and motile zoospores of the giant kelp. Exposure was in a flow-through bioassay for 48 or 96 hrs using five dispersant concentrations. Measured survival, developmental abnormalities in the abalone embryos, germ tube length of kelp zoospores, and dispersant concentrations in exposure water.

**Singer, M. M., S. George, S. Jacobson, I. Lee, L. L. Weetman, R. S. Tjeerdema, M. L. Sowby**, 1996. Comparison of acute aquatic effects of the oil dispersant Corexit 9500 with those of other Corexit series dispersants. Ecotoxicology and Environmental Safety **35**:183-189.
**Keywords:** abnormalities/ acute/ bioassay/ concentration/ Corexit 9500/ dispersant/ effects/ embryo/ flow-through/ juvenile/ kelp/ marine invertebrate/ ODfour/ oil/ salt water/ survival/ toxicity
**Notes:** Assessment of the toxicity of the oil dispersant Corexit 9500 to embryos of the red abalone and juveniles of the kelp forest mysid. Exposure was in a flow-through bioassay for 48 or 96 hrs using five dispersant concentrations. Measured survival, developmental abnormalities of abalone embryos, and concentration of dispersant in the exposure water.

**Singer, M. M., S. George, I. Lee, S. Jacobson, L. L. Weetman, G. Blondina, R. S. Tjeerdema**, 1998. Effects of dispersant treatment on the acute aquatic toxicity of petroleum hydrocarbons. Archives of Environmental Contamination and Toxicology **34**:177-187.
**Keywords:** abnormalities/ acute/ behavior/ concentration/ Corexit 9527/ crude oil/ dispersal/ dispersant/ effects/ evaluation/ fish/ hydrocarbons/ marine invertebrate/ narcosis/ ODfour/ oil/ petroleum/ petroleum hydrocarbons/ Prudhoe Bay/ Prudhoe Bay crude oil/ salt water/ toxicity/ treatment
**Notes:** Evaluation of the effects of five concentrations of the water-accomodated fraction of Prudhoe Bay crude oil, with and without Corexit 9527 dispersant. Tested with a mysid, red abalone, and the topsmelt. Test duration was either 48 (abalone) or 96 hr. Measured were death and initial narcosis (mysid and topsmelt) or larval abnormality (abalone).

**Singh, A. K., J. P. Gaur**, 1990. Effects of petroleum oils and their paraffinic, asphaltic, and aromatic fractions on photosynthesis and respiration of microalgae. Ecotoxicology and Environmental Safety **19**:8-16.
**Keywords:** algae/ aromatic hydrocarbons/ chlorophyll/ concentration/ crude oil/ diesel/ diesel fuel/ effects/ experiment/ fresh water/ freshwater plant/ gasoline/ kerosene/ microalgae/ oil/ Oseven/ paraffin/ petroleum/ petroleum products/ photosynthesis/ respiration/ species
**Notes:** Five species of microalgae, in a set of experiments, were exposed to three or five concentrations of crude oil, kerosene, gasoline, diesel fuel, or furnace fuel. All oils were analyzed for total paraffin, aromatic, and asphaltic content. After 15 min of exposure to oil added directly to culture suspension, photosyntheis (chlorophyll *a*) and respiration ($O_2$) were measured.

**Singh, A. K., J. P. Gaur**, 1991. Inhibition of $NO_3$, $NH_4$, and $PO^3{}_4$ uptake in *Anabaena doliolum* exposed to a petroleum oil. Ecotoxicology and Environmental Safety **21**:103-108.
**Keywords:** concentration/ crude oil/ fresh water/ freshwater plant/ microalgae/ nutrients/ oil/ Oseven/ petroleum/ petroleum hydrocarbons/ species/ uptake
**Notes:** A species of microalgae was exposed for 120 min to several concentrations of the water-soluble fraction of Assam crude oil. Measured uptake of $NO_3$, $NH_4$, and $PO^3{}_4$ from the culture medium.

**Singh, A. K., H. D. Kumar**, 1991. Inhibitory effect of petroleum oil on photosynthetic electron transport system in the cyanobacterium *Anabaena doliolum*. Bulletin of Environmental Contamination and Toxicology **47**:890-895.
**Keywords:** activity/ assay/ carbon/ carbon fixation/ chlorophyll/ concentration/ condition/ diesel/ diesel fuel/ fresh water/ freshwater invertebrate/ light/ Ofive/ oil/ petroleum/ photosynthesis/ transport/ uptake
**Notes:** Assessment of the effect of diesel oil on the photosynthetic activity of a cyanobacterium in axenic laboratory conditions. Five concentrations of the water-soluble fraction were used to expose the cyanobacteria; concentrations were measured by fluorescence spectroscopy. Measured photosynthesis induction by light, carbon fixation with uptake of $^{14}C$, Hill reaction assays, and chlorophyll *a* concentration.

**Singh, J. G., I. Chang-Yen, V. A. Stoute, L Chatergoon**, 1992. Hydrocarbon levels in edible fish, crabs and mussels from the marine environment of Trinidad. Marine Pollution Bulletin **24**:270-272.
**Keywords:** aromatic hydrocarbons/ coast/ concentration/ crab/ environment/ fish/ marine environment/ miscellaneous/ mussel/ Oeleven/ PAH/ salt water/ Trinidad
**Notes:** Fish, crabs, and mussels were collected during 1986-88 at eight sites along the coast of Trinidad and analyzed for total PAHs. The results are presented as chrysene unit equivalents.

**Siniff, D. B., T. D. Williams, A. M. Johnson, D. L. Garshelis**, 1982. Experiments on the response of sea otters *Enhydra lutris* to oil contamination. Biological Conservation **23**:261-272.
**Keywords:** behavior/ cleaning/ crude oil/ effects/ experiment/ fur/ light/ mammal/ oil/ oiled/ Otwo/ Prudhoe Bay crude oil/ rehabilitation/ salt water/ sea otter
**Notes:** Two experiments (field and lab) were performed on sea otters to assess the effects of light oiling, light oiling and cleaning, and behavioral response to oiled water. The field study employed radio transmitters and the lab study used an above-ground pool.

**Siron, R., G. Giusti, B. Berland, R. Morales-Loo, E. Pelletier**, 1991. Water-soluble petroleum compounds: chemical aspects and effects on the growth of microalgae. Science of the Total Environment **104**:211-227.
**Keywords:** activity/ Arabian Light crude oil/ bioassay/ cell/ composition/ concentration/ crude oil/ degradation/ effects/ evaluation/ growth/ interactions/ light/ marine plant/ microalgae/ Ofive/ oil/ petroleum/ photosynthesis/ salt water/ species/ static/ time
**Notes:** Evaluation of the effects of the water-soluble fraction (WSF) of Arabian Light crude oil on two species of microalgae. Exposure was for up to 14 da using 11 concentrations of WSF in a static laboratory bioassay; WSF-phosphorus interactions were also tested. Measured photosynthetic activity, change in growth of cell cultures, and the composition and degradation over time of the WSF.

**Siron, R., E. Pelletier, D. Delille, S. Roy**, 1993. Fate and effects of dispersed crude oil under icy conditions simulated in mesocosms. Marine Environmental Research **35**:273-302.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ bacteria/ biodegradation/ chlorophyll/ combination/ concentration/ condition/ crude oil/ degradation/ dispersant/ effects/ experiment/ fate/ hydrocarbons/ marine environment/ marine plant/ mesocosm/ microbes/ ODnine/ oil/ phytoplankton/ salt water/ technical/ time
**Notes:** Five temperature-controlled mesocosm tanks were used to simulate cold weather conditions in the marine environment. Forties crude oil, premixed with a combination of three dispersants was added to three tanks in a cascading fashion; the other two tanks served as references. Duration of the experiment was 2 wks. Measured water characteristics chlorophyll-a, phytoplankton, total bacteria, heterotrophic bacteria, oil-degrading bacteria, and concentrations of aliphatic and aromatic hydrocarbons five times during the course of the study.

**Siron, R., E. Pelletier, C. Brochu**, 1995. Environmental factors influencing the biodegradation of petroleum hydrocarbons in cold seawater. Archives of Environmental Contamination and Toxicology **28**:406-416.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ bacteria/ biodegradation/ combination/ condition/ Corexit 9527/ crude oil/ dispersant/ flow-through/ hydrocarbons/ long-term/ oil/ petroleum/ petroleum hydrocarbons/ seasonal/ short-term/ temperature
**Notes:** Large indoor tanks with temperature controls were used to simulate seasonal weather conditions in spring (17 da duration), autumn (26 da), short-term winter (14 da), and long-term winter (63 da). Combinations of two crude oils and two dispersants (Corexit 9527 and a mixture) were used in various scenarios ((crude oil only, dispersed oil, cascading (series of three tanks) flow-through of dispersed oil)). Water was physically characterized and heterotrophic and petroleum-degrading bacteria were quantified. Water was analyzed for aliphatic and aromatic hydrocarbons.

**Siron, R., E. Pelletier, S. Roy**, 1996. Effects of dispersed and adsorbed crude oil on microalgal and bacterial communities of cold seawater. Ecotoxicology **5**:229-251.
**Keywords:** abundance/ aromatic hydrocarbons/ bacteria/ chlorophyll/ community/ composition/ concentration/ crude oil/ dispersant/ effects/ environment/ experiment/ Forties Field crude oil/ hydrocarbons/ marine plant/ mesocosm/ microalgae/ miscellaneous/ oil/ Osix/ salt water/ temperature/ time
**Notes:** A group of five stainless steel tanks (mesocosms) were used to simulate the effects of crude oil in a cold water environment on microalgae and aquatic bacteria. Two tanks received chemically-dispersed (mixture of three dispersants) Forties crude oil, one tank received untreated crude oil, one tank received oil adsorbed to long cotton strips, and one tank was a control. Experiment duration was 63 da. Tank water was regularly analyzed for concentration of aromatic hydrocarbons, concentration of chlorophyll *a*

and phaeopigments, and bacterial abundance. Community composition of microalgae was determined at the time of maximum chlorophyll concentration.

**Sjotun, K., T. E. Lein**, 1993. Experimental oil exposure of *Ascophyllum nodosum* (L.) Le Jolis. Journal of Experimental Marine Biology and Ecology **170**:197-212.
**Keywords:** adult/ aliphatic hydrocarbons/ beach/ crude oil/ experiment/ growth/ hydrocarbons/ length/ macroalgae/ marine plant/ oil/ Osix/ plant/ salt water/ shoreline/ survival/ temperature/ time/ weathered
**Notes:** A macroalgae (germlings and adults) was exposed to artificially-weathered Stratfiord crude oil in indoor and outdoor experiments. The outdoor experiment consisted of a control and an oil-exposed basin where plants were exposed to the oil for 3 da. After exposure, adults were placed among macroalgae on a beach and germlings were placed on an 'artificial' shore along the shoreline. In the indoor experiment, germlings on granite plates were sprayed with oil and kept out of the water for varying periods of time before being placed back in the water. The experiment lasted for 3 wks. Measured water and air temperature, survival of germlings, growth of adult plants, and length of germlings before and after exposure in the indoor experiment. Analyzed the aliphatic hydrocarbons in the unweathered and weathered crude oil applied to the outdoor basins before the experiment, weathered oil after ending the outdoor experiment, and weathered oil used in the indoor experiment.

**Skalski, J. R., D. A. Coats, A. K. Fukuyama**, 2001. Criteria for oil spill recovery: a case study of the intertidal community of Prince William Sound, Alaska, following the *Exxon Valdez* oil spill. Environmental Management **28**:9-18.
**Keywords:** Alaska/ analysis/ community/ criteria/ crude oil/ epifauna/ Exxon Valdez/ infauna/ intertidal/ marine invertebrate/ monitoring/ Ofour/ oil/ oil spill/ oiled/ population/ Prince William Sound/ recovery/ salt water/ sampling/ spill/ time/ transect
**Notes:** A retrospective analysis of monitoring data collected 1989-97 from oiled and uncleaned, oiled and cleaned, and unoiled intertidal areas of Prince William Sound, Alaska. Parallel sampling transects were established in the upper, middle, and lower intertidal zone; sampled epibiota and infauna. Only fauna were used for this analysis. Performed a statistical comparison of data to determine when the oiled and unoiled sites began to parallel each other (defined as recovery) after the spill event.

**Slade, G. J.**, 1982. Effect of Ixtoc I crude oil and Corexit 9527 dispersant on spot (*Leiostomus xanthurus*) egg mortality. Bulletin of Environmental Contamination and Toxicology **29**:525-530.
**Keywords:** combination/ concentration/ Corexit 9527/ crude oil/ dispersant/ effects/ eggs/ fish/ Ixtoc/ Ixtoc I crude oil/ ODthree/ oil/ salt water/ solubility/ spot/ survival
**Notes:** Effects of Ixtoc I crude oil or Corexit 9527 alone or in combination on the survival of eggs of the spot; water soluble fraction of crude oil, seven concentrations plus a control.

**Sleeter, T. D., J. N. Butler**, 1982. Petroleum hydrocarbons in zooplankton faecal pellets from the Sargasso Sea. Marine Pollution Bulletin **13**:54-56.
**Keywords:** aliphatic hydrocarbons/ estimate/ hydrocarbons/ marine invertebrate/ miscellaneous/ Oeleven/ petroleum/ petroleum hydrocarbons/ pollution/ rate/ salt water/ zooplankton
**Notes:** Zooplankton were collected in the Sargasso Sea near Bermuda in 1979 and used in an assessment of the role of zooplankton in removal of petroleum hydrocarbons from seawater. Hexane-extractable hydrocarbons (aliphatics) were quantified in both the zooplankton and their faecal pellets. Faecal production rates were estimated and extrapolated to estimate the amount of hydrocarbons removed from open ocean surface waters.

**Smith, C. J., R. D. Delaune, W. H. Patrick, Jr., J. W. Fleeger**, 1984. Impact of dispersed and undispersed oil entering a Gulf coast salt marsh. Environmental Toxicology and Chemistry **3**:609-616.
**Keywords:** aromatic hydrocarbons/ coast/ community/ copepod/ crude oil/ density/ dispersant/ effects/ general effect/ hydrocarbons/ Louisiana/ Louisiana crude oil/ marine invertebrate/ marine plant/ meiofauna/ nematode/ Oeight/ oil/ polychaete/ salt marsh/ salt water/ sediment/ South Louisiana crude oil/ Spartina/ time
**Notes:** Replicated test plots (n = 4) along the edge of a salt water marsh in Louisiana were used to determine the effects of dispersed and undispersed crude oil. Plots were either controls or exposed to South Louisiana crude oil alone or crude oil plus chemical dispersant (unidentified). Measured total

aromatic hydrocarbons in sediment after 1 da. Measured $CO_2$ fixation of *Spartina alterniflora* on days 6, 13, and 53. Measured meiofauna (nematodes, copepods, polychaetes, total meiofauna) density on days 0, 5, 36, and 77.

**Smith, D. D. and G. H. Holliday** 1979. API/SC-PCO southern California 1978 oil spill test program. Pages 475-482 *in* 1979 Oil Spill Conference, API 4308. American Petroleum Institute, Washington, DC.
**Keywords:** California/ coast/ Corexit 9527/ crude oil/ depth/ dispersant/ effectiveness/ experiment/ marine invertebrate/ miscellaneous/ ODeleven/ oil/ oil slick/ oil spill/ phytoplankton/ salt water/ spill/ wing/ zooplankton
**Notes:** A 2-da field experiment using Alaskan crude oil and chemical dispersants (Corexit 9527, BP 100WD) was performed off the coast of southern California. Eight oil slicks of 5-20 barrels were created and sprayed (helicopter and fixed wing) with dispersant. Water samples were collected at 1, 3, 6, and 9 m depth; phytoplankton at 1 and 3 m depth, and zooplankton by surface tow. Visual observations were made of dispersant effectiveness.

**Smith, D. L., C. E. Proffitt**, 1999. The effects of crude oil and remediation burning on three clones of smooth cordgrass (S*partina alterniflora*) Loisel.). Estuaries **22**:616-623.
**Keywords:** biomass/ burning/ crude oil/ density/ effects/ experiment/ marine plant/ numbers/ oil/ oiled/ Osix/ plant/ remediation/ salt water/ Spartina/ survival/ treatment/ Venezuelan crude oil
**Notes:** Assessment of the effects of oiling and remediation by burning on three clones of smooth cordgrass. A laboratory experiment employed five dosages of Venezuelan crude oil crossed by burning or non-burning. Plants were monitored for 6 mos after treatment. Measured survival, stem height, stem density, number of flowering stems, and plant biomass.

**Smith, E., E. Wraige, P. Donkin, S. Rowland**, 2001. Hydrocarbon humps in the marine environment: synthesis, toxicity, and aqueous solubility of monoaromatic compounds. Environmental Toxicology and Chemistry **20**:2428-2432.
**Keywords:** algae/ aromatic hydrocarbons/ concentration/ environment/ feeding/ hydrocarbons/ marine environment/ marine invertebrate/ monoaromatic/ mussel/ Onine/ rate/ salt water/ solubility/ structure/ technical/ toxicity/ unresolved complex mixture
**Notes:** Mussels were exposed to either of five concentrations (0, 12.5, 25, 50, 100 ppb) of three synthesized monoaromatic hydrocarbons similar in structure to those found in the unresolved complex mixtures of gas chromatographs of hydrocarbon analyses. Mussels were exposed for 24 hrs, then transferred to clean water and fed algae. Measured feeding rate, concentration of monoaromatics, and the water solubilities of the three synthesized monoaromatics.

**Smith, E. S.** 1976. Wildlife mortality assessment survey. St. Lawrence River June 23, 1976, oil spill. NYS DEC - Region 6. Department of Environmental Conservation, State of New York, Albany, NY. 5 pp.
**Keywords:** amphibian/ bird/ Bunker C/ fresh water/ fuel oil/ general effect/ mammal/ Oeight/ oil/ oil spill/ oiled/ region/ reptile/ spill/ survey
**Notes:** A report of the effect on wildlife of a Bunker C fuel oil spill on the St. Lawrence River in 1976. Observations of state personnel, clean-up crews, and local landowners were used to compile a listing of birds, mammals, reptiles, and amphibians that either died or were oiled by the fuel oil.

**Smith, J. D., J. Y. Hauser, J. Bagg**, 1985. Polycyclic aromatic hydrocarbons in sediments of the Great Barrier Reef region, Australia. Marine Pollution Bulletin **16**:110-114.
**Keywords:** aromatic hydrocarbons/ Australia/ coast/ depth/ hydrocarbons/ region/ river/ sediment
**Notes:** Sediment samples were collected in 1982 from varying depths at two harbors, two rivers, two reefs, and a nearshore island of the Queensland, Australia coast. Analyzed sediments for seven aromatic hydrocarbons and compared the results to other areas of the world.

**Smith, R. L., J. A. Cameron**, 1979. Effect of water soluble fraction of Prudhoe Bay crude oil on embryonic development of Pacific herring. Transactions of the American Fisheries Society **108**:70-75.
**Keywords:** crude oil/ development/ eggs/ fish/ fishery/ growth/ herring/ oil/ Othree/ Pacific/ Pacific herring/ Prudhoe Bay/ Prudhoe Bay crude oil/ salt water/ society/ solubility/ survival

**Notes:** Effect on eggs of the Pacific herring of exposure for 4 hr to 6 da to the water soluble fraction of Prudhoe Bay crude oil; survival, growth, development.

**Smith, S. D. A., R. D. Simpson**, 1995. Effects of the 'Nella Dan' oil spill on the fauna of *Durvillaea antarctica* holdfasts. Marine Ecology Progress Series **121**:73-89.
**Keywords:** Antarctica/ aromatic hydrocarbons/ community/ concentration/ diesel/ diesel fuel/ effects/ kelp/ light/ marine invertebrate/ multivariate/ Ofour/ oil/ oil spill/ oiled/ population/ salt water/ sediment/ size/ species/ spill
**Notes:** Assessment of the effects of a spill of light marine diesel fuel along the shore of Macquarie Island. Samples of the holdfasts of a species of kelp were collected a year after the spill at five sites (two heavily oiled, one moderately oiled, two reference). Measured sediment content of holdfasts, aromatic hydrocarbon concentration of the sediment, and volume of holdfast; identified species and measured the size of the four most common species; and performed univariate and multivariate analyses. Used results in intersite comparisons.

**Smith, T. G., J. R. Geraci, D. J. St.Aubin**, 1983. Reaction of bottlenose dolphins, *Tursiops truncatus*, to a controlled oil spill. Canadian Journal of Fisheries and Aquatic Sciences **40**:1522-1525.
**Keywords:** behavior/ condition/ dolphin/ mammal/ mineral oil/ oil/ oil slick/ oil spill/ Otwo/ salt water/ spill
**Notes:** Response of bottlenose dolphins to a simulated oil slick (colored mineral oil) under experimental conditions.

**Smits, J. E., T. D. Williams**, 1999. Validation of immunotoxicology techniques in passerine chicks exposed to oil sands tailings water. Ecotoxicology and Environmental Safety B **44**:105-112.
**Keywords:** Alberta/ bird/ blood/ Canada/ cell/ chicks/ effects/ evaluation/ fresh water/ immune response/ nestling/ oil/ oil sands/ Oone/ organ/ pathology/ red blood cell/ sand/ skin/ weight/ zebra finch
**Notes:** Assessement of the effects on immune function of nestling zebra finches of exposure to tailings water from oil sands extraction operations in Alberta, Canada. Nestlings were given 4 consecutive daily doses of either 70 *u*l tailings water, phosphate-buffered saline, or dexamethasone. Measured PHA skin test response, body mass, hematocrit, and leukocrit at 11 da. Measured body mass, hematocrit, leukocrit, and immune response to sheep red blood cells at 21 da. Also weighed several organs and performed macro- and micropathological evaluations.

**Snedaker, S. C., P. W. Glynn, D. G. Rumbold, E. F. Corcoran**, 1995. Distribution of *n*-alkanes in marine samples from southeast Florida. Marine Pollution Bulletin **30**:83-89.
**Keywords:** aliphatic hydrocarbons/ alkane/ bivalve/ coral/ distribution/ fish/ Florida/ lobster/ marine invertebrate/ miscellaneous/ Oeleven/ offshore/ oyster/ salt water/ sediment/ tissue
**Notes:** Sediments and tissues of fish, lobster, coral, conch, and oysters were collected from offshore southeast Florida and the Florida Keys. Samples were analyzed for *n*-alkanes, pristane, and phytane.

**Snow, N. B. and D. M. Rosenberg**. 1975. The effects of crude oil on the colonization of artificial substrates by zoobenthos organisms. Research and Development Directorate, Freshwater Institute, Winnipeg, Canada. Technical report - Fisheries and Marine Service **No. 551**. 35 pp.
**Keywords:** benthic/ caribou/ chemical characteristics/ colonization/ creek/ crude oil/ development/ discharges/ effects/ experiment/ fresh water/ freshwater invertebrate/ invertebrate/ Norman Wells crude oil/ Ofive/ oil/ stream/ substrate/ technical/ fishery/ river
**Notes:** Assessment of the effect of crude oil on colonization of substrate by stream benthic invertebrates. Used substrate samplers filled with rocks dipped in Norman Wells crude oil and placed in streams for 1 or 2 mos. Performed experiment in low discharge streams (Trail River, Caribou Bar Creek) and high discharge streams (Mackenzie and Liard Rivers). Colonizers were identified and counted and rocks were analyzed for the presence of crude oil. Also characterized the water for physical and chemical characteristics.

**Snow, N. B. and B. F. Scott** 1975. The effect and fate of crude oil spilt on two Arctic lakes. Pages 527-534 *in* 1975 Conference on Prevention and Control of Oil Pollution. American Petroleum Institute, Washington, DC.
**Keywords:** abundance/ Arctic/ chlorophyll/ composition/ concentration/ crude oil/ fate/ freshwater

invertebrate/ freshwater plant/ general effect/ Norman Wells crude oil/ nutrients/ Oeight/ oil/ phytoplankton/ pollution/ species/ time/ water column
**Notes:** Two lakes in the Canadian Arctic were partitioned into a small experimental portion and a larger control area. Pembina crude oil was spilled on one experimental area and Norman Wells crude oil on the other during August 1973. Samples of water and water column biota were collected at weekly intervals for 8 wks. Determined water characteristics, crude oil composition, concentrations of aquatic insects in surface water, abundance of diatom species, and total chlorophyll concentration.

**Snowden, R. J., I. K. E. Ekweozor**, 1987. The impact of a minor oil spillage in the estuarine Niger Delta. Marine Pollution Bulletin **18**:595-599.
**Keywords:** bivalve/ crab/ crude oil/ density/ effects/ estuarine/ estuary/ evaluation/ general effect/ mangrove/ marine invertebrate/ marine plant/ Nigeria/ Nigerian crude oil/ Oeight/ oil/ oiled/ oyster/ polychaete/ roots/ salt water/ sampling/ seedling/ spill/ time/ transect
**Notes:** An evaluation of the effects of barge spill of Nigerian crude oil in the Bonny Estuary of the Niger River delta, Nigeria. Sampling transects were established at two prespill baseline locations in December 1983 and sampled at 6-wk intervals until October 1984. The spill occurred in April 1984; a spill site transect was established and visited three times. Percentage oiling of mangrove prop roots and seedlings was determined at the spill site. Fiddler crab and polychaete densities were determined at all locations. Some information on oyster losses at the spill site.

**Snyder, S. B., J. G. Fox, and O. A. Soave**. 1973. Mortalities in waterfowl following Bunker C fuel exposure. Stanford Medical Center, Stanford, CA. 27,vi-xxi pp.
**Keywords:** analysis/ bird/ Bunker C/ California/ chemical analysis/ fuel oil/ hydrocarbons/ oil/ oil spill/ oiled/ Oone/ pathology/ salt water/ saturated hydrocarbons/ spill/ tissue/ waterfowl
**Notes:** Report of the findings from an examination of birds that died after the San Francisco Bay oil spill of 1971; pathological findings and chemical analysis of Bunker C fuel oil and saturated hydrocarbons in bird tissue.

**Sol, S. Y., L. L. Johnson, B. H. Horness, T. K. Collier**, 2000. Relationship between oil exposure and reproductive parameters in fish collected following the *Exxon Valdez* oil spill. Marine Pollution Bulletin **40**:1139-1147.
**Keywords:** Alaska/ aromatic hydrocarbons/ bile/ blood/ carcass/ concentration/ crude oil/ Dolly Varden/ Exxon Valdez/ fish/ Gulf of Alaska/ hormone/ index/ length/ North Slope/ oil/ oil spill/ Othree/ ovary/ parameters/ phenanthrene/ pollock/ Prince William Sound/ reproduction/ salt water/ sole/ species/ spill/ time/ weight
**Notes:** Three species of fish (dolly varden, yellowfin sole, pollock) were collected from Prince William Sound, Kenai Penninsula, Shelikof Strait, and the Gulf of Alaska during 1989-91. Fish were measured for length, weighed, bile collected, ovary and gutted carcasses weighed, and blood collected. Calculated a gonadosomatic index, measured two reproductive hormones, and quantified the aromatic compounds (naphthaline and phenanthrene wavelenghts; HPLC) in bile.

**Solbakken, J. E., K. H. Palmork**, 1981. Metabolism of phenanthrene in various marine animals. Comparative Biochemistry and Physiology **70C**:21-26.
**Keywords:** bile/ capsule/ dosed/ fish/ flounder/ gonads/ green gland/ intestine/ kidney/ lobster/ marine invertebrate/ metabolism/ metabolite/ Norway/ Othree/ phenanthrene/ rainbow trout/ salt water/ spiny dogfish/ urine
**Notes:** Metabolism of phenanthrene in flounder, rainbow trout, spiny dogfish, and Norway lobster; dosing by capsule, metabolites measured in urine, bile, stomach/intestine, intestine, kidney, green gland, or gonads.

**Solbakken, J. E., A. H. Knap, K. H. Palmork**, 1982. Disposition of (9-$^{14}$C) phenanthrene in a subtropical marine teleost (*Haemulon sciurus*). Bulletin of Environmental Contamination and Toxicology **28**:285-289.
**Keywords:** aromatic hydrocarbons/ bile/ capsule/ dosed/ elimination/ fish/ gonads/ liver/ muscle/ Othree/ phenanthrene/ salt water/ uptake
**Notes:** Uptake and elimination of $^{14}$C labeled phenanthrene by blue-striped grunts; capsule dosing, monitored for 12 days in liver, muscle, gonads, and bile.

**Soler, M., J. O. Grimalt, J. Albaiges**, 1989. Vertical distribution of aliphatic and aromatic hydrocarbons in mussels from the Amposta offshore oil production platform (western Mediterranean). Chemosphere **18**:1809-1819.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ coast/ concentration/ depth/ distribution/ hydrocarbons/ marine invertebrate/ Mediterranean/ mussel/ offshore/ Ofour/ oil/ salt water/ Spain
**Notes:** Determination of the concentrations of hydrocarbons in mussels adhering to the legs of oil production platforms in the Mediterrean off the southern coast of Spain. Mussels were collected at six depths (0 to 48 m) and analyzed for aliphatic and aromatic hydrocarbons. Read this article carefully, it has suffered from translation into English.

**Sommerville, M., T. Lunel, N. Bailey, D. Oland, C. Miles, P. A. Gunter, and T. Waldhoff** 1997. Orimulsion. Pages 479-484 *in* 1997 International Oil Spill Conference. Improving Environmental Protection. Progress, Challenges, Responsibilities. API Publication. American Petroleum Institute, Washington, DC.
**Keywords:** behavior/ detection/ fate/ fresh water/ oil/ oil spill/ Onine/ Orimulsion/ protection/ recovery/ salt water/ spill/ technical
**Notes:** Description of the fate, behavior, containment, recovery, detection, and tracking of Orimulsion in water.

**Sophia, A. J. A., T. Balasubramanian**, 1992. Changes in the physical condition of *Meretrix casta* exposed to water-soluble fractions of refined and crude oil. Archives of Environmental Contamination and Toxicology **22**:471-474.
**Keywords:** aromatic hydrocarbons/ clam/ concentration/ condition/ crude oil/ diesel/ effects/ hydrocarbons/ index/ Kuwait/ Kuwait crude oil/ marine invertebrate/ Ofour/ oil/ salt water/ weight
**Notes:** Determination of the effects on a clam of the water-soluble fraction (WSF) of diesel, engine oil, and Kuwait crude oil. Clams were exposed to several concentrations of the WSF in laboratory tanks for 30 da. Measured concentrations of aromatic hydrocarbons in exposure water, wet and dry weight of clams, and calculated a condition index for the clams.

**Soriano, J. A., L. Vinas, M. A. Franco, J. J. Gonzalz, L. Ortiz, J. M. Bayona, J. Albaiges**, 2006. Spatial and temporal trends of petroleum hydrocarbons in wild mussels from the Galician coast (NW Spain) affected by the *Prestige* oil spill. Science of the Total Environment **370**:80-90.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ Bunker C/ coast/ fuel oil/ hopane/ hydrocarbons/ marine invertebrate/ mussel/ Ofour/ oil/ oil spill/ PAH/ petroleum/ petroleum hydrocarbons/ salt water/ Spain/ spill/ sterane/ terpane/ time/ tissue/ trend
**Notes:** Wild mussels along the northwest coast of Spain were sampled 3, 7, and 12 mos after the Prestige oil spill (Bunker C fuel oil) and analyzed for a set of 13 PAH and an n-alkane profile. Also, analyzed mussel tissue for sterane, terpane, and hopane profiles and compared to the parent oil.

**Southworth, G. R., J. J. Beauchamp, P. K. Schmieder**, 1978. Bioaccumulation potential and acute toxicity of synthetic fuels effluents in freshwater biota: azaarenes. Environmental Science and Technology **12**:1062-1068.
**Keywords:** accumulation/ acute/ coal/ daphnia/ effluent/ elimination/ fresh water/ freshwater/ freshwater invertebrate/ invertebrate/ nitrogen/ Ofive/ synthetic oil/ toxicity
**Notes:** Synthetic fuel (coal derivation) products and waste effluents are high in nitrogen heterocycles. Three examples (isoquinoline, acridine, benz(a)acridine) were used in a set of studies that determined toxicity (24 hr), accumulation (24-48 hr), and elimination (10 da) by freshwater invertebrates (daphnia).

**Spacie, A., P. F. Landrum, G. J. Leversee**, 1983. Uptake, depuration, and biotransformation of anthracene and benzo[a]pyrene in bluegill sunfish. Ecotoxicology and Environmental Safety **7**:330-341.
**Keywords:** anthracene/ benzo[a]pyrene/ biotransformation/ brain/ carcass/ depuration/ elimination/ fish/ fresh water/ gall/ gall bladder/ liver/ metabolism/ Othree/ tissue/ uptake/ viscera
**Notes:** Uptake, elimination, and metabolism of $^{14}C$ labeled anthracene and benzo[a]pyrene was measured in several tissues of bluegill; gall bladder, liver, viscera, brain, carcass.

**Spaulding, M. L., S. B. Saila, E. Lorda, H. Walker, E. Anderson, J. C. Swanson**, 1983. Oil-spill fishery impact assessment model: application to selected Georges Bank fish species. Estuarine and Coastal and Shelf Science **16**:511-541.
**Keywords:** Atlantic/ cod/ eggs/ fish/ fishery/ Georges Bank/ haddock/ herring/ larvae/ Maine/ model/ oil spill/ Othree/ population/ region/ salt water/ seasonal/ simulation/ species/ spill/ survival
**Notes:** Modification of a previously published oil-spill fishery assessment model and application to the Georges Bank - Gulf of Maine region. Simulations performed for spills at two locations for each season of the year; consequences for populations of Atlantic herring, haddock, and Atlantic cod determined.

**Speich, S. M., S. P. Thompson**, 1987. Impacts on waterbirds from the 1984 Columbia River and Whidbey Island, Washington, oil spills. Western Birds **18**:109-116.
**Keywords:** bird/ Bunker C/ fuel oil/ oil/ oil spill/ oiled/ Oone/ salt water/ spill/ Washington/ wintering
**Notes:** Report of bird losses from two spills of Bunker C fuel oil in Puget Sound and the Columbia River, Washington in 1984.

**Speich, S. M., D. A. Manuwal, T. R. Wahl**, 1991. The bird/habitat oil index -- a habitat vulnerability index based on avian utilization. Wildlife Society Bulletin **19**:216-221.
**Keywords:** bird/ contingency/ development/ habitat/ index/ oil/ oil spill/ Oone/ population/ salt water/ species/ spill/ vulnerability
**Notes:** Description of a bird oil index developed to correct shortcomings of the oil vulnerability index of King and Sanger (1979). Useful for development planning and oil spill contingency planning.

**Spies, R. B., P. H. Davis**, 1979. The infaunal benthos of a natural oil seep in the Santa Barbara Channel. Marine Biology **50**:227-237.
**Keywords:** abundance/ benthic/ California/ coast/ community/ general effect/ infauna/ marine invertebrate/ microbes/ Oeight/ oil/ oil seep/ salt water/ sediment/ statistics/ toluene
**Notes:** A natural oil seep site and a comparison site located off the coast of southern California were sampled with sediment cores to determine the effect of oil seeps on benthic infauna. Characterized the sediments, identified and counted the infauna, and analyzed hydrocarbon content according to hexane, toluene, and methanol fractions. Calculated community metrics and made observation of bacterial mats and general abundance of benthic predators.

**Spies, R. B., P. H. Davis**, 1982. Toxicity of Santa Barbara seep oil to starfish embryos: part 3 -- influence of parental exposure and the effects of other crude oils. Marine Environmental Research **6**:3-11.
**Keywords:** concentration/ crude oil/ effects/ embryo/ experiment/ growth/ hydrocarbons/ marine invertebrate/ Ofour/ oil/ oil seep/ petroleum/ petroleum hydrocarbons/ salt water/ starfish/ toxicity
**Notes:** Report of two experiments on the effects on starfish embryos of seep oil from Santa Barbara and three other crude oils. In the first experiment, embryos collected from three locations with differing pre-exposures to petroleum hydrocarbons were exposed for 48 hrs to varying concentrations of the water-soluble fraction (WSF) of seep oil (adaptation experiment). In the second experiment, embryos were exposed for 48 hrs to varying concentrations of the WSF of all four oils (comparative toxicity experiment). Measured growth of exposed embryos.

**Spies, R. B., J. S. Felton, L. Dillard**, 1982. Hepatic mixed-function oxidases in California flatfishes are increased in contaminated environments and by oil and PCB ingestion. Marine Biology **70**:117-127.
**Keywords:** California/ crude oil/ environment/ fish/ food/ ingestion/ liver/ mixed-function oxidase/ oil/ Othree/ PCB/ salt water/ Santa Barbara crude oil/ species
**Notes:** Hepatic mixed-function oxidase induction in two species of California flatfish collected at contaminated coastal sites or experimentally exposed to Santa Barbara crude oil or PCBs in food.

**Spies, R. B., J. J. Stegeman, D. E. Hinton, B. Woodin, R. Smolowitz, M. Okihiro, D. Shea**, 1996. Biomarkers of hydrocarbon exposure and sublethal effects in embiotocid fishes from a natural petroleum seep in the Santa Barbara Channel. Aquatic Toxicology **34**:195-219.
**Keywords:** aromatic hydrocarbons/ bile/ biochemistry/ biomarker/ chronic/ effects/ fish/ gill/ heart/ hydrocarbons/ kidney/ liver/ Othree/ pathology/ petroleum/ salt water/ species/ sublethal
**Notes:** Biomarkers for petroleum exposure in two species of surfperch from the Santa Barbara Channel

compared to reference area: aromatic hydrocarbons in bile; liver, gill, and heart biochemistry; histological examination of gill, liver, and kidney.

**Spooner, M. F.**, 1977. Oil spill in Hong Kong. Marine Pollution Bulletin **8**:62-65.
**Keywords:** beach/ benthic/ depuration/ diesel/ fish/ general effect/ marine invertebrate/ marine plant/ miscellaneous/ monitoring/ Oeight/ oil/ oil spill/ oiled/ plankton/ salt water/ sand/ spill
**Notes:** A largely qualitative description of a spill of heavy marine diesel oil into Hong Kong harbor. Sections on water quality monitoring, affected fish farms, tainting and depuration of fish, plankton, miscellaneous fish and benthic fauna, and oiled beach sand.

**Spooner, M. F., C. J. Corkett**, 1979. Effects of Kuwait oils on feeding rates of copepods. Marine Pollution Bulletin **10**:197-202.
**Keywords:** bioassay/ concentration/ copepod/ crude oil/ dispersant/ effects/ feces/ feeding/ Kuwait/ Kuwait crude oil/ marine invertebrate/ ODfour/ oil/ rate/ recovery/ salt water/ solubility/ species/ static/ survival/ weathered
**Notes:** Effects of weathered or fresh Kuwait crude oil on the feeding rates of four species of marine copepods. Exposure was by static bioassay for 20 hrs. Oils were prepared as either water soluble fractions (two concentrations) or oil suspensions (1, 2, or 10 ppm) with or without a chemical dispersant. Measured survival, recovery, and number of fecal pellets.

**Sprague, J. B., W. J. Logan**, 1979. Separate and joint toxicity to rainbow trout of substances used in drilling fluids for oil exploration. Environmental Pollution **19**:269-282.
**Keywords:** degradation/ dispersant/ drilling fluids/ fish/ fresh water/ ODthree/ oil/ rainbow trout/ surfactant/ survival/ toxicity
**Notes:** Young rainbow trout used to assess the toxicity of 21 materials (including surfactants) likely to be present in oil well drilling fluids; survival, additivity, degradation.

**Squire, J. L., Jr.**, 1992. Effects of the Santa Barbara, Calif., oil spill on the apparent abundance of pelagic fishery resources. Marine Fisheries Review **54**:7-14.
**Keywords:** abundance/ anchovy/ bonito/ California/ crude oil/ effects/ estimate/ fish/ fishery/ mackerel/ oil/ oil spill/ Othree/ Pacific/ salt water/ Santa Barbara crude oil/ species/ spill
**Notes:** Assessment of the effect of the 1969 oil well blowout in the Santa Barbara Channel on the Northern anchovy, Pacific bonito, and jack mackerel; abundance estimates for 1966-72.

**St.Aubin, D. J., J. R. Geraci, T. G. Smith, T. G. Friesen**, 1985. How do bottlenose dolphins, *Tursiops truncatus*, react to oil films under different light conditions? Canadian Journal of Fisheries and Aquatic Sciences **42**:430-436.
**Keywords:** behavior/ condition/ dolphin/ light/ mammal/ mineral oil/ motor oil/ oil/ Otwo/ salt water
**Notes:** Response of bottlenose dolphins to water covered with either clear mineral oil, dark-colored mineral oil, or a thin sheen of motor oil under experimental conditons. Responses tested in daylight and at night.

**Stagg, R. M., A. McIntosh**, 1996. Hydrocarbon concentrations in the northern North Sea and effects on fish larvae. Science of the Total Environment **186**:189-201.
**Keywords:** aromatic hydrocarbons/ concentration/ effects/ fish/ hydrocarbons/ larvae/ mixed-function oxidase/ North Sea/ Othree/ petroleum/ salt water/ survey
**Notes:** Two North Sea surveys in 1993&94 measured petroleum in the water and associated effects on larvae of the sandeel and gadoid; hydrocarbon fluorescence, mixed-function oxidase induction in larvae.

**Stagg, R. M., C. Robinson, A. M. McIntosh, C. F. Moffat, D. W. Bruno**, 1998. The effects of the 'Braer' oil spill, Shetland Isles, Scotland, on P4501A in farmed Atlantic salmon (*Salmo salar*) and the common dab (*Limanda limanda*). Marine Environmental Research **46**:301-306.
**Keywords:** activity/ aromatic hydrocarbons/ Atlantic/ Atlantic salmon/ crude oil/ dab/ effects/ evaluation/ fish/ hydrocarbons/ liver/ metabolism/ oil/ oil spill/ Othree/ pathology/ petroleum/ salmon/ salt water/ Scotland/ sediment/ Shetland/ spill
**Notes:** Evaluation of the effects of the *Braer* oil spill on farmed immature Atlantic salmon and common

dab. Salmon were sampled for 3.5 mos after the spill and common dab were collected April-June 1993-96 at locations with varying petroleum contamination. Ambient water was collected with each sample of salmon and sediment was collected with each sample of common dab. Water and sediment were analyzed for aromatic hydrocarbons and fish livers were analyzed for CYP1A and EROD activity. Livers were also examined microscopically.

**Stainken, D. M.**, 1976. The effect of a No. 2 fuel oil and a South Louisiana crude oil on the behavior of the soft shell clam, *Mya arenaria* L. Bulletin of Environmental Contamination and Toxicology **16**:724-729.
**Keywords:** behavior/ benzene/ bioassay/ clam/ concentration/ crude oil/ emulsion/ fuel oil/ Louisiana/ Louisiana crude oil/ marine invertebrate/ No.2 fuel oil/ Ofour/ oil/ phenol/ salt water/ shell/ South Louisiana crude oil/ static/ temperature
**Notes:** Determination of the effect of oil-in-water emulsions of South Louisiana crude oil, No. 2 fuel oil, benzene, and phenol on the behavior of the soft shell clam. Clams were exposed to five concentrations of each substance for 96 hrs in a static bioassay performed at two water temperatures. Measured mucus secretion and tactile response, and attempted to calculate $LC_{50s}$.

**Stainken, D. M.**, 1976. A descriptive evaluation of the effects of No. 2 fuel oil on the tissues of the soft shell clam, *Mya arenaria* L. Bulletin of Environmental Contamination and Toxicology **16**:730-738.
**Keywords:** bioassay/ clam/ concentration/ effects/ emulsion/ evaluation/ fuel oil/ hydrocarbons/ marine invertebrate/ No.2 fuel oil/ Ofour/ oil/ pathology/ salt water/ shell/ static/ tissue
**Notes:** Assessment of the effects on tissues of the soft shell clam of exposure to No. 2 fuel oil. Clams were exposed for 28 da to one of three concentrations of fuel oil emulsions in a static bioassay. Various tissues were sampled for microscopic examination, mucus samples were collected and analyzed for hydrocarbon content, and water in the exposure tanks was analyzed weekly for hydrocarbon concentration.

**Stansby, M. E.**, 1978. Flavors in fish from petroleum pickup. Marine Fisheries Review **40**:13-17.
**Keywords:** biochemical/ fish/ indicator/ organoleptic/ Othree/ petroleum/ petroleum hydrocarbons/ taint/ taste
**Notes:** Discussion of the relation between fish flavor and its numerous biochemical causes. Particular emphasis on the validity of using fish taste as an indicator of petroleum exposure.

**Stanton, P. B.**, 1975. The hard truth about oil pollution. Massachussetts Wildlife16-19.
**Keywords:** bird/ oil/ oiled/ Oone/ pollution/ population/ rehabilitation/ salt water
**Notes:** Critical assessment of the utility of oiled bird rehabilitation.

**Stark, J. S., M. J. Riddle**, 2003. The effects of petroleum hydrocarbon and heavy metal contamination of marine sediments on recruitment of Antarctic soft-sediment assemblages: a field experimental investigation. Journal of Experimental Marine Biology and Ecology **283**:21-50.
**Keywords:** Antarctic/ Antarctica/ coast/ community/ diesel/ diesel fuel/ effects/ evaluation/ invertebrate/ marine invertebrate/ metals/ multivariate/ Ofour/ oil/ petroleum/ population/ recruitment/ salt water/ sediment/ statistics/ time
**Notes:** An evaluation of petroleum and metal contamination on recruitment of soft-sediment invertebrates in Antarctica. Clean sediments were defaunaed and contaminated with either high metal sediment from the vicinity of a dump site or a mixture of diesel fuel and synthetic lubrication oil and placed in containers at three locations (one clean, one contaminated with metals and petroleum, one with naturally elevated metals) along the coast. Sediments around the experimental sites were sampled with a corer to measure the potential recruitment assemblages. At the end of the experimental period the invertebrate assemblages were identified, quantified, and analyzed with multivariate statistics.

**Staveland, J. T.**, 1979. Effects on hatching in *Littorina littorea* after an oil spill. Marine Pollution Bulletin **10**:255-258.
**Keywords:** capsule/ crude oil/ effects/ eggs/ fertilization/ gastropod/ hatching/ Iranian crude oil/ marine invertebrate/ Norway/ Ofour/ oil/ oil spill/ oiled/ rate/ reproduction/ salt water/ snail/ spill
**Notes:** Assessment of the effects of a spill (Norway) of Iranian crude oil on reproduction in a marine

gastropod. Snails were collected from an oiled area and a reference area and transferred to laboratory containers. Measured fertilization rates, number of eggs per capsule, and hatching success.

**Stavishenko, I. V., S. V. Zalesov, N. A. Luganskii, N. A. Kryazhevskikh, A. E. Morozov**, 2002. Communities of wood-attacking fungi in the region of oil and gas production. Russian Journal of Ecology **33**:161-169.
**Keywords:** brine water/ community/ crude oil/ effects/ fresh water/ fungi/ microbes/ oil/ oil field/ oil spill/ Oten/ region/ spill/ structure
**Notes:** Permanent test plots were established in areas of oil production and paired with similar plots in areas away from the effects of oil production. Dead wood (branches and trees) was recorded and the presence of pathogenic fungi was documented. Community structure and function of the fungi was described and compared between petroleum-affected areas (gas flares, oil spills, brine water) and their respective controls.

**Steadman, B. L., W. A. Stubblefield, T. W. LaPoint, H. L. Bergman, M. S. Kaiser**, 1991. Decreased survival of rainbow trout exposed to No. 2 fuel oil caused by sublethal preexposure. Environmental Toxicology and Chemistry **10**:355-363.
**Keywords:** concentration/ fish/ fresh water/ fuel oil/ juvenile/ lethal/ No.2 fuel oil/ oil/ Othree/ previous exposure/ rainbow trout/ sublethal/ survival
**Notes:** Effect of preexposure of juvenile rainbow trout to varying sublethal concentrations of No. 2 fuel oil on subsequent exposure to lethal concentrations of No. 2 fuel oil. Sublethal preexposure was for 21 da, lethal exposure was for 14 da.

**Stegeman, J. J. and D. J. Sabo** 1975. Uptake and release of petroleum hydrocarbons by marine organisms and some metabolic implications. Pages 339-350 *in* L. E. Cronin and R. E. Smith, editors. Marine Environmental Implications of Offshore Oil and Gas Development in the Baltimore Canyon Region of the Mid-Atlantic Coast. Estuarine Research Federation, Virginia Institute of Marine Science, Wachapreague, VA.
**Keywords:** accumulation/ acute/ chronic/ coast/ development/ effects/ fish/ general effect/ hydrocarbons/ marine invertebrate/ metabolism/ Oeight/ offshore/ oil/ petroleum/ petroleum hydrocarbons/ region/ release/ review/ salt water/ uptake
**Notes:** A review of the topic of uptake, release, and metabolism of petroleum hydrocarbons by marine organisms that is augmented by some supporting information from studies by the authors. Specific sections on accumulation, effects of brief exposure, and effects of chronic exposure.

**Stegeman, J. J.**, 1977. Fate and effects of oil in marine animals. Oceanus **20**:59-66.
**Keywords:** biochemical/ bivalve/ concentration/ crustacean/ effects/ fate/ fish/ hydrocarbons/ marine invertebrate/ metabolism/ oil/ Othree/ overview/ petroleum/ petroleum hydrocarbons/ physiology/ salt water/ tissue
**Notes:** Overview of the metabolic fate and effects of petroleum hydrocarbons taken up by fish, crustaceans, and bivalves. Most of the references are to fish; tissue concentrations, metabolism, physiology.

**Stegeman, J. J.**, 1978. Influence of environmental contamination on cytochrome P-450 mixed-function oxygenases in fish: implications for recovery in the Wild Harbor Marsh. Journal of the Fisheries Research Board of Canada **35**:668-674.
**Keywords:** barge Florida/ benzo[a]pyrene/ biochemical/ fish/ Florida/ fuel oil/ liver/ Massachusetts/ mixed-function oxidase/ mummichog/ No.2 fuel oil/ oil/ oil spill/ Othree/ protein/ recovery/ salt water/ spill
**Notes:** Assessment of hepatic cytochrome P-450 mixed-function oxygenases, benzo[*a*]pyrene hydroxylase, aminopyrine demethylase, and protein in mummichog from Wild Harbor Marsh. Goal was to determine if the No. 2 fuel oil spill 8 yr earlier (barge Florida, 1969) was still affecting fish.

**Steinhauer, M., E. Crecelius, W. Steinhauer**, 1994. Temporal and spatial changes in the concentrations of hydrocarbons and trace metals in the vicinity of an offshore oil-production platform. Marine Environmental Research **37**:129-163.
**Keywords:** aliphatic hydrocarbons/ analysis/ aromatic hydrocarbons/ California/ coast/ concentration/

drilling mud/ hydrocarbons/ metals/ miscellaneous/ monitoring/ Oeleven/ offshore/ oil/ oil field/ oil platform/ salt water/ sediment/ tar ball/ time
**Notes:** Part of a large monitoring study conducted over a 4-yr period (1986-90) around an oil platform off the California coast. At nine sites around the platform, surface sediments and trapped sediment particles were collected before, during, and after drilling. Sediments and drilling mud were analyzed for metals, aliphatic hydrocarbons, and aromatic hydrocarbons. Also, production oil, seep oil, and local tar balls were subjected to hydrocarbon analysis.

**Stekoll, M. S., L. E. Clement, D. G. Shaw**, 1980. Sublethal effects of chronic oil exposure on the intertidal clam *Macoma balthica*. Marine Biology **57**:51-60.
**Keywords:** behavior/ bioassay/ biochemical/ bivalve/ chronic/ clam/ crude oil/ depuration/ effects/ flow-through/ gonads/ intertidal/ marine invertebrate/ Ofour/ oil/ physical characteristics/ Prudhoe Bay/ Prudhoe Bay crude oil/ rate/ respiration/ salt water/ sublethal/ survival
**Notes:** Assessment of the sublethal effects of Prudhoe Bay crude oil on a marine bivalve. Clams were exposed by flow-through bioassay to either 0.03, 0.3, or 3.0 ppm of dispersed crude oil for 6 mos, followed by 2 mos of depuration. Measured survival, four measures of behavior, five measures of physical characteristics, gonad morphology, respiration rate, and eight biochemical characteristics.

**Stekoll, M. S., L. Deysher**, 2000. Response of the dominant alga *Fucus gardneri* (Silva) (Phaeophyceae) to the *Exxon Valdez* oil spill and clean-up. Marine Pollution Bulletin **40**:1028-1041.
**Keywords:** Alaska/ algae/ coast/ crude oil/ effects/ Exxon Valdez/ habitat/ intertidal/ macrophyte/ marine plant/ oil/ oil spill/ oiled/ Osix/ Prince William Sound/ region/ salt water/ spill/ time/ transect
**Notes:** An assessment of the effects of the *Exxon Valdez* oil spill on the intertidal macrophyte (algae) *Fucus gardneri* in three major regions off the southern coast of Alaska (Prince William Sound, Cook Inlet-Kenai, Kodiak-Alaska Peninsula). All erect macrophytes at each of three tidal levels in six transects per site were sampled four times from August 1989 to May 1991. Two or three habitat types were sampled within each major region. Sites were classified as either oiled or non-oiled. Measured physical attributes, percent cover, and egg viability of *Fucus*.

**Stephens, S. M., S. C. Frankling, R. M. Stagg, J. A. Brown**, 2000. Sub-lethal effects of exposure of juvenile turbot to oil produced water. Marine Pollution Bulletin **40**:928-937.
**Keywords:** accumulation/ activity/ aromatic hydrocarbons/ biochemistry/ effects/ fish/ gill/ juvenile/ North Sea/ oil/ Othree/ pathology/ physiology/ produced water/ salt water/ sublethal/ survival/ time/ whole body
**Notes:** Juvenile turbot were exposed to either 0.001, 0.01, 0.1, or 1 % of produced water from a production platform in the North Sea. Exposure was for 6 wks with water changed twice daily the first week and daily the remaining 5 wks. Survival was monitored. Exposure water was analyzed for total aromatics, and fish were sampled at 1, 3, and 6 wks and analyzed for aromatic accumulation, whole body cortisol, EROD activity, and gill structural integrity.

**Stephenson, R.**, 1997. Effects of oil and other surface-active organic pollutants on aquatic birds. Environmental Conservation **24**:121-129.
**Keywords:** bird/ chronic/ effects/ evaluation/ feathers/ oil/ Oone/ organic/ risk
**Notes:** Evaluation of the potential for a variety of organic contaminants (natural or anthropogenic) to lower the surface tension of water, thus posing a chronic or periodic risk of feather wetting in birds.

**Stewart, R. S., Jr., C. Emmons, D. Porfirio, R. J. Wiggers**, 1997. Distribution of multiple oil tolerant and oil degrading bacteria around a site of natural crude oil seepage. Texas Journal of Science **49**:339-344.
**Keywords:** bacteria/ benzene/ crude oil/ depth/ diesel/ diesel fuel/ distance/ distribution/ experiment/ fresh water/ incubation/ microbes/ mineral oil/ oil/ oil seep/ Oten/ petroleum/ sediment/ Texas/ toluene
**Notes:** Documentation of the presence of petroleum-utilizing or petroleum tolerant bacteria around a natural oil seep in Texas. Sediment samples were collected at two distances from an oil catch basin and at three depths. Bacteria were identified and grown in culture. Isolates were tested for their ability to utilize or tolerate crude oil, diesel fuel, mineral oil, toluene, and benzene in 4-5 da incubation experiments.

**Stirling, H. P.**, 1977. Effects of a spill of marine diesel oil on the rocky shore fauna of Lamma Island, Hong Kong. Environmental Pollution **12**:93-117.

**Keywords:** abundance/ bivalve/ crustacean/ diesel/ diesel fuel/ effects/ estimate/ evaluation/ gastropod/ intertidal/ macrofauna/ marine invertebrate/ Ofour/ oil/ petroleum/ rocky shore/ salt water/ seasonal/ species/ spill/ survival/ transect
**Notes:** Evaluation of the effects of a spill of heavy marine diesel oil on the intertidal macrofauna of Lamma Island, Hong Kong. Four sites were selected in two bays of Lamma Island and surveyed by transect. Counts of animals were made weekly for the first month, monthly for 6 mos, monthly for another 6 mos at one site only, and finally, all transects were counted 13 months after the spill. Survival tests (laboratory) were conducted on bivalves, gastropods, and crustaceans collected from all transects; derived estimates of sensitivity to petroleum. Also measured seasonal abundance of several species.

**Stott, G. G., N. H. McArthur, R. Tarpley, V. Jacobs, R. F. Sis**, 1981. Histopathologic survey of ovaries of fish from petroleum production and control sites in the Gulf of Mexico. Journal of Fish Biology **18**:261-269.
**Keywords:** fish/ Gulf of Mexico/ Mexico/ offshore/ oil/ oil field/ Othree/ ovary/ pathology/ petroleum/ salt water/ species/ survey
**Notes:** Examination of ovaries from 11 species of fish collected from an active offshore oil field and reference areas; pathology.

**Stowe, T. J.**, 1982. An oil spillage at a guillemot colony. Marine Pollution Bulletin **13**:237-239.
**Keywords:** bird/ colony/ crude oil/ effects/ England/ guillemot/ oil/ oil spill/ oiled/ Oone/ population/ salt water/ spill
**Notes:** The effects of a crude oil spill on a colony of guillemots breeding on coastal England.

**Stowe, T. J., L. A. Underwood**, 1984. Oil spillages affecting seabirds in the United Kingdom, 1966-1983. Marine Pollution Bulletin **15**:147-152.
**Keywords:** bird/ Europe/ history/ oil/ oil spill/ Oone/ population/ salt water/ species/ spill/ United Kingdom
**Notes:** Account of seabird losses due to oil spills around the United Kingdom from 1966 to 1983; details of losses, comparison to western Europe, and population consequences.

**Strand, J. A., V. I. Cullinan, E. A. Crecelius, T. J. Fortman, R. J. Citterman, M. L. Fleischmann**, 1992. Fate of Bunker C fuel oil in Washington coastal habitats following the December 1988 *NESTUCCA* oil spill. Northwest Science **66**:1-14.
**Keywords:** aliphatic hydrocarbons/ alkane/ aromatic hydrocarbons/ bivalve/ Bunker C/ coast/ fate/ fuel oil/ habitat/ intertidal/ invertebrate/ marine invertebrate/ miscellaneous/ Oeleven/ oil/ oil spill/ PAH/ salt water/ sediment/ spill/ survey/ time/ tissue/ Washington
**Notes:** A follow-up study of the fate of the Bunker C fuel oil spilled along the Washington coast line in December 1988. During a 14-mo period, intertidal sediments were collected at 12 locations and intertidal invertebrates were collected at eight locations. Invertebrates were collected three times during the survey period. Sediments and tissues were analyzed for oil and grease, selected PAHs, and selected alkanes (C9-C36).

**Straughan, D. and B. C. Abbott** 1970. The Santa Barbara oil spill: ecological changes and natural oil leaks. Pages 257-262 *in* J. I. Waddington, editor. Water Pollution by Oil. Unknown, Invernesshire, Scotland.
**Keywords:** benthic/ biological effects/ bird/ California/ degradation/ effects/ fish/ general effect/ marine invertebrate/ marine plant/ movement/ Oeight/ oil/ oil seep/ oil spill/ pollution/ salt water/ spill
**Notes:** A general description of the chronology of the Santa Barbara Channel, California oil spill of 1969. Authors discuss details of the spill events, movement of oil, relation to natural oil seeps, and some preliminary information on biological effects.

**Straughan, D., D. Hadley**, 1978. Experiments with Littorina species to determine the relevancy of oil spill data from southern California to the Gulf of Alaska. Marine Environmental Research **1**:135-163.
**Keywords:** activity/ Alaska/ analysis/ assay/ California/ Canada/ crude oil/ effects/ experiment/ gasoline/ gastropod/ Gulf of Alaska/ kerosene/ marine invertebrate/ Ofour/ oil/ oil spill/ petroleum/ rate/ salt water/ species/ spill/ static/ survival/ temperature
**Notes:** Report of a series of experiments performed on the effects of petroleum on two species of

gastropod (Littorina) collected from Alaska, Canada, and southern California. Static laboratory assays were used to expose individuals to six crude oils, gasoline, and kerosene. Three temperature regimes were used. Individuals were exposed for 6 hrs, then observed for activity at 3 hrs post-exposure, 24 hrs post-exposure, and at 24-hr intervals thereafter for 6 more days. Measured survival and attachment (to the glass container) rates, and performed GC analysis of the crude and refined petroleum types.

**Strobel, C. J., A. H. Brenowitz**, 1981. Effects of Bunker C oil on juvenile horseshoe crabs (*Limulus polyphemus* ). Estuaries **4**:157-159.
**Keywords:** aromatic hydrocarbons/ assay/ Bunker C/ concentration/ crab/ effects/ evaluation/ fuel oil/ hydrocarbons/ juvenile/ length/ marine invertebrate/ molt/ Ofour/ oil/ salt water/ static/ survival
**Notes:** Evaluation of the effects of suspensions of artificially-weathered Bunker C fuel oil on juvenile horseshoe crabs. A static laboratory assay employing five concentrations of suspended fuel oil was used for 58 consecutive da. The stock suspension of fuel oil was renewed every 7 da. Measured survival, length of the intermolt period between molts one and two, and aromatic hydrocarbon concentrations during the 7-da cycles.

**Stromgren, T.**, 1987. Effect of oil and dispersants on the growth of mussels. Marine Environmental Research **21**:239-246.
**Keywords:** Corexit 9527/ crude oil/ dispersant/ dissolved/ effects/ flow-through/ growth/ marine invertebrate/ mussel/ North Sea/ North Sea crude oil/ ODfour/ oil/ salt water
**Notes:** Assessment of the effects of either North Sea crude oil mixed in water or microencapsulated, oil plus one of three chemical dispersants (microencapsulated), oil plus Corexit 9527 mixed in water, or one of three dispersants dissolved in water on mussels. Used a flow-through laboratory system to expose mussels for 170 hrs and then depurate them for 300 hrs. Measured growth of mussels.

**Stromgren, T., M. V. Nielsen**, 1991. Spawning frequency, growth and mortality of *Mytilus edulis* larvae, exposed to copper and diesel oil. Aquatic Toxicology **21**:171-180.
**Keywords:** bioassay/ bivalve/ concentration/ diesel/ diesel fuel/ effects/ flow-through/ growth/ larvae/ marine invertebrate/ mussel/ Ofour/ oil/ salt water/ spawning/ static/ survival
**Notes:** Assessment of the effects on mature and larval mussels of exposure to copper or microencapsulated diesel oil. Mature mussels were exposed to either one of five concentrations of copper or one of five concentraions of diesel oil in a flow-through bioassay for 30 da. Larvae were exposed to either one of five concentrations of copper or one of six concentrations of diesel oil in a static bioassay for 10 da. Measured spawning frequency of mature mussels and survival and growth of larvae.

**Stromgren, T., M. V. Nielsen, L.-O. Reiersen**, 1993. The effect of hydrocarbons and drilling fluids on the fecal pellet production of the deposit feeder *Abra alba*. Aquatic Toxicology **24**:275-286.
**Keywords:** accumulation/ assay/ bivalve/ cod/ concentration/ cuttings/ diesel/ diesel fuel/ drilling fluids/ drilling mud/ effects/ feeding/ hydrocarbons/ liver/ marine invertebrate/ Ofour/ oil/ oil-based/ recovery/ salinity/ salt water/ sediment/ static/ temperature/ tissue/ water-based
**Notes:** Assessment of the effects on fecal pellet production of the bottom feeding bivalve *Abra alba* of exposure to diesel oil, drilling muds, and drilling cuttings. All oils or oil-based substances were microencapsulated. In a series of static assays, mature bivalves were exposed for 5 da to sediment containing either 50-1,000 ppm oil-based mud, 200-5,000 ppm oil-based cuttings, 200-20,000 ppm water-based mud, 10-500 ppm diesel oil, 1,000-100,000 ppm barite, or 50-1,000 ppm cod liver oil. Recovery of fecal pellet production was measured over a 6 da period for two diesel oil concentrations and two oil-based drilling muds. Hydrocarbon accumulation was determined in soft tissue of bivalves exposed to 50 ppm diesel oil. Determined the effect of water temperature and salinity on fecal pellet production.

**Struhsaker, J. W.**, 1977. Effects of benzene (a toxic component of petroleum) on spawning pacific herring, *Clupea harengus pallasi*. Fishery Bulletin **75**:43-49.
**Keywords:** benzene/ concentration/ effects/ eggs/ embryo/ female/ fish/ herring/ larvae/ Othree/ Pacific/ Pacific herring/ petroleum/ salt water/ spawning/ survival/ uptake
**Notes:** Female Pacific herring exposed to two concentrations of benzene for 48 hr just prior to spawing. Measured survival in ovarian eggs, embryos, and larvae through yolk absorption, and benzene uptake.

**Stubblefield, W. A., G. A. Hancock, W. H. Ford, H. H. Prince, and R. K. Ringer** 1995. Evaluation of the toxic properties of naturally weathered *Exxon Valdez* crude oil to surrogate wildlife species. Pages 665-692 *in* P. G. Wells, J. N. Butler, J. S. Hughes, editors. Exxon Valdez Oil Spill: Fate and Effects in Alaskan Waters. ASTM Special Technical Publication. American Society for Testing and Materials, Philadelphia.
**Keywords:** acute/ avoidance/ bird/ crude oil/ duck/ effects/ egg shell/ evaluation/ Exxon Valdez/ fate/ food/ lethal/ mallard/ mammal/ North Slope/ North Slope crude oil/ oil/ oil spill/ Oone/ reproduction/ salt water/ species/ spill/ subacute/ sublethal/ toxicity/ weathered/ technical
**Notes:** An evaluation of the toxic properties of weathered North Slope crude oil from the *Exxon Valdez* oil spill. The investigators used weathered oil from a collection barge (98 da post spill) to conduct a series of standardized studies (6) on mallard ducks and one study on European ferrets. Mallard studies were: (1) acute oral toxicity, (2) subacute dietary toxicity, (3) dietary food avoidance, (4) 14-da dietary toxicity, (5) reproductive toxicity, and (6) direct eggshell application toxicity. The ferret study was a subacute oral toxicity test.

**Sturve, J., L. Hasselberg, H. Falth, M. Celander, L. Forlin**, 2006. Effects of North Sea oil and alkylphenols on biomarker responses in juvenile Atlantic cod (*Gadus morhua*). Aquatic Toxicology **78S**:S73-S78.
**Keywords:** activity/ analysis/ Atlantic/ biochemical/ biomarker/ cod/ crude oil/ effects/ fish/ flow-through/ juvenile/ lipid/ liver/ North Sea/ oil/ oil field/ Othree/ phenol/ produced water/ salt water/ stress
**Notes:** Juvenile Atlantic cod were exposed in a continuous flow-through system for 15 da to either 0.5 ppm Statfjord B (North Sea) crude oil, 0.5 ppm crude oil plus 0.1 ppm alkylated phenols, or 30 ppb nonylphenol. After 15 da, the livers were removed for biochemical analysis. Measured cytochrome P450 (EROD) activity, CYP1A- and CYP3A-proteins, oxidative stress, and lipid peroxidation.

**Suchanek, T. H.**, 1993. Oil impacts on marine invertebrate populations and communities. American Zoologist **33**:510-523.
**Keywords:** community/ ecosystem/ effects/ invertebrate/ marine invertebrate/ Ofour/ oil/ oil spill/ petroleum/ population/ review/ salt water/ spill
**Notes:** A review of the effects of petroleum on marine invertebrates with special emphasis on consequences to populations and ecosystems. Author presents seven case studies of marine oil spills.

**Suderman, B. L., N. H. Marcus**, 2002. The effects of Orimulsion and Fuel Oil #6 on the hatching success of copepod resting eggs in the seabed of Tampa Bay, Florida. Environmental Pollution **120**:787-795.
**Keywords:** Bunker C/ concentration/ copepod/ effects/ eggs/ experiment/ Florida/ fuel oil/ hatching/ marine invertebrate/ microcosm/ nauplii/ No.6 fuel oil/ Ofour/ oil/ Orimulsion/ salt water/ sand/ sediment
**Notes:** Copepod eggs were used in a laboratory experiment to determine the effects of Orimulsion and Fuel Oil #6 on hatching. Test concentrations were determined by a preliminary study. Sediment microcosms of treated sand (control, 700 ppm Orimulsion, 7,000 ppm Orimulsion, 700 ppm Fuel Oil #6, 7,000 ppm Fuel Oil #6) received eggs and retained them for 88 days. Microcosms were sampled on days 0, 8, 16, 41, 60, 74, and 88. Counted the number of nauplii and unhatched eggs.

**Suderman, K., D. Thistle**, 2003. Spills of fuel oil #6 and Orimulsion can have indistinguishable effects on the benthic meiofauna. Marine Pollution Bulletin **46**:49-55.
**Keywords:** abundance/ age/ benthic/ Bunker C/ community/ copepod/ diversity/ effects/ fuel oil/ marine invertebrate/ meiofauna/ microcosm/ nematode/ No.6 fuel oil/ Ofour/ oil/ Orimulsion/ ratio/ salt water/ sediment/ sex/ species/ species diversity/ spill/ toxicity
**Notes:** Experimental microcosms were used to compare the toxicity of water-soluble fractions of #6 fuel oil and Orimulsion; two control microcosms were employed. Sediment meiofauna were sampled (sediment cores) on days 0, 8, 16, 41, 60, 74, and 88 of the study. Measured neutral-lipid content of the sediment, and abundance, species diversity (H'), sex ratio, fecundity, and age structure of copepods. Abundance of nematodes was determined in a subset of the cores from each microcosm.

**Suderman, K., D. Thistle**, 2004. The relative impacts of spills of two alternative fuels on the microalgae of a sandy site: a microcosm study. Marine Pollution Bulletin **49**:473-478.
**Keywords:** abundance/ Bunker C/ chlorophyll/ condition/ experiment/ fuel oil/ grazing/ marine plant/

microalgae/ microcosm/ No.6 fuel oil/ oil/ Orimulsion/ Osix/ pressure/ salt water/ sampling/ sand/ sediment/ spill/ subtidal/ time
**Notes:** Two fuel alternatives (No. 6 Fuel Oil and Orimulsion) were used in a microcosm experiment to determine the effect of each on microalgae. Samples of sediment were taken from nearshore subtidal sediments. Fuels were artificially-weathered for 48 hrs and spread on the microcosm sediment surface in the form of a 1 mm layer of fuel (7,000 ppm) and sand. Sampling occurred on days 0, 8, 16, 41, 60, 74, and 88. Measured microagal abundance, grazing pressure, primary production, and metabolic condition (normalized production).

**Suess, M. J.**, 1976. The environmental load and cycle of polycyclic aromatic hydrocarbons. Science of the Total Environment **6**:239-250.
**Keywords:** aromatic hydrocarbons/ environment/ evaluation/ hydrocarbons/ miscellaneous/ Oeleven/ PAH/ pollution/ review
**Notes:** An early review and evaluation of the presence of PAHs in the global environment. Author uses data on benzo(a)pyrene as an example of PAH increase in the environment.

**Sugai, S. F., J. E. Lindstrom, J. F. Braddock**, 1997. Environmental influences on the microbial degradation of *Exxon Valdez* oil on the shorelines of Prince William Sound, Alaska. Environmental Science and Technology **31**:1564-1572.
**Keywords:** Alaska/ concentration/ crude oil/ degradation/ Exxon Valdez/ hydrocarbons/ microbes/ mineralization/ oil/ Oten/ Prince William Sound/ shoreline/ spill
**Notes:** Assessment of the importance of environmetal influences on the microbial degradation of crude oil from the Exxon Valdez spill; hydrocarbon concentrations, mineralization potential.

**Sugiura, K., M. Ishihara, T. Shimauchi, S. Harayama**, 1997. Physicochemical properties and biodegradability of crude oil. Environmental Science and Technology **31**:45-51.
**Keywords:** biodegradation/ crude oil/ microbes/ oil/ Oten/ SM8
**Notes:** Biodegradability of four crude oils by microbes was compared.

**Svecevicius, G., N. Kazlauskiene, M. Z. Vosyliene**, 2003. Toxic effects of orimulsion on rainbow trout *Oncorhynchus mykiss*. Environmental Science and Pollution Research **10**:281-283.
**Keywords:** adult/ assay/ combination/ embryo/ evaluation/ fish/ fresh water/ gill/ growth/ hatching/ heart/ heart rate/ larvae/ Orimulsion/ Othree/ rainbow trout/ survival/ toxicity
**Notes:** An evaluation of the effects of orimulsion on embryos, larvae, and adults of rainbow trout in semi-static laboratory assays. A combination of 96-hr $LC_{50}$, 28-da, and 60-da tests were employed. Measured survival, heart rate, gill ventilation, total body mass, relative mass increase, hatching duration, amount of hatched larvae, yolk-sac resorption, exit from nest, response of larvae to external stimuli, and growth rate of adults.

**Swannell, R. P. J., D. Mitchell, G. Lethbridge, D. Jones, D. Heath, M. Hagley, M. Jones, S. Petch, R. Milne, R. Croxford, K. Lee**, 1999. A field demonstration of the efficacy of bioremediation to treat oiled shorelines following the *Sea Empress* incident. Environmental Technology **20**:863-873.
**Keywords:** bacteria/ beach/ bioremediation/ concentration/ crude oil/ England/ fertilizer/ fuel oil/ hydrocarbons/ inorganic/ intertidal/ microbes/ Microtox/ nutrients/ oil/ oil spill/ oiled/ Oten/ petroleum/ petroleum hydrocarbons/ salt water/ sediment/ shoreline/ spill/ time/ toxicity/ treatment
**Notes:** Description of a demonstration project in Bullwell Bay, southwest England, after the *Sea Empress* oil spill (Forties crude oil and heavy fuel oil). Preliminary assessments indicted that the beach contained hydrocarbon-degrading bacteria but that N and P might be limiting. Three blocks of three plots each were established to receive either no treatment, liquid nutrients (multiple weekly applications), or slow-release fertilizer pellets (one time application). At 0, 30, and 60 da after nutrient addition ended, measured P and N concentrations in beach sediment, concentrations of total petroleum hydrocarbons in beach sediment, and toxicity of beach sediment according to Microtox. Measures were performed separately for the lower, middle, and upper intertidal portions of each plot. Water was sampled for inorganic N at the experimental site and at Milford Haven on days 7, 16, 31, and 59.

**Swedmark, M., A. Granmo, S. Kollberg**, 1973. Effects of oil dispersants and oil emulsions on marine animals. Water Research **7**:1649-1672.
**Keywords:** bivalve/ cod/ concentration/ crab/ crude oil/ diesel/ dispersant/ effects/ emulsion/ fish/ flounder/ fuel oil/ general effect/ marine invertebrate/ mussel/ ODeight/ oil/ prawn/ salt water/ scallop
**Notes:** Authors tested a number of chemical oil dispersants alone or mixed with crude oil or fuel oils. Tested nine dispersants, Oman crude oil, marine diesel oil, and heavy fuel oil in continuous flow aquaria. Used varying concentrations to determine 96-hr $LC_{50}$ concentrations. Tested cod, flounder, scallop, cockle, mussel, prawn, spider crab, and hermit crab.

**Sydnes, L. K., T. H. Hemmingsen, S. Skare, S. H. Hansen**, 1985. Seasonal variations in weathering and toxicity of crude oil on seawater under Arctic conditions. Environmental Science and Technology **19**:1076-1081.
**Keywords:** Arctic/ concentration/ condition/ crude oil/ dissolved/ eggs/ Ekofisk crude oil/ experiment/ marine invertebrate/ marine plant/ miscellaneous/ Oeleven/ oil/ organic/ oxygen/ petroleum/ photooxidation/ salt water/ sea urchin/ seasonal/ survival/ temperature/ time/ toxicity/ urchin
**Notes:** Ekofisk crude oil spilled on water was used in oil weathering experiments to evaluate the effect of photooxidation on petroleum weathering. Indoor and outdoor experiments were conducted for 14 da during every month of the year. The indoor experiment was performed under three water temperature regimes (either 5, 15, or 23 C). Crude oil spilled on water and kept in the dark was used as a reference. After the 14 da period, seawater samples were used in toxicity tests with a marine diatom and fertilized sea urchin eggs. Measured oxygen content of surface oil and dissolved organic material in water, the concentrations of dissolved organic material in water, compositional change of the water-soluble fraction over time, survival of diatoms and sea urchin eggs, and the photosynthetic capacity of diatoms.

**Symens, P., M. I. Al Salamah** 1993. The impact of the Gulf War oil spills on wetlands and waterfowl in the Arabian Gulf. Pages 24-28 *in* M. Moser, J. van Vessem, editors. Wetland and Waterfowl Conservation in South and West Asia. IWRB Special Publication No. 25 and AWB Publication No. 85. International Waterfowl and Wetlands Research Bureau & Asian Wetland Bureau, Slimbridge, Gloucester, UK.
**Keywords:** Arabian Gulf/ bird/ conservation/ crude oil/ fish/ mammal/ marine invertebrate/ marine plant/ oil/ oil spill/ Oone/ reptile/ salt water/ shrimp/ spill/ turtle/ war/ waterfowl/ wetland
**Notes:** Preliminary assessment of environmental destruction caused by the Gulf War oil spill; information on coastal wetlands, birds, mammals, turtles, fish, and shrimp.

**Symens, P., M. I. Evans**, 1993. Impact of Gulf War oil spills on Saudi Arabian breeding populations of terns *Sterna* in the Arabian Gulf, 1991. Sandgrouse **15**:18-36.
**Keywords:** Arabian Gulf/ bird/ crude oil/ effects/ oil/ oil spill/ oiled/ Oone/ plumage/ population/ reproduction/ salt water/ species/ spill/ tern/ war
**Notes:** Effects on tern species in the Arabian Gulf of the Gulf War oil spill; assessment of populations and breeding success in 1991.

**Symens, P., A. Suhaibani**, 1993. Impact of Gulf War oil spills on wintering seabird populations along the northern Arabian Gulf coast of Saudi Arabia, 1991. Sandgrouse **15**:37-43.
**Keywords:** Arabian Gulf/ bird/ coast/ crude oil/ estimate/ evaluation/ numbers/ oil/ oil spill/ oiled/ Oone/ plumage/ population/ rehabilitation/ salt water/ Saudi Arabia/ spill/ war/ wintering
**Notes:** Account and evaluation of the numbers of wintering seabirds killed by the Gulf War oil spill in the Arabian Gulf during 1991. Also, an account of the rehabilitation efforts for oiled birds.

**Symens, P., A. Suhaibani**, 1994. The impact of the 1991 Gulf War oil spill on bird populations in the northern Arabian Gulf -- a review. Courier Forschunginstitut Senckenberg **166**:47-54.
**Keywords:** Arabian Gulf/ bird/ Gulf oil spill/ habitat/ oil/ oil spill/ Oone/ population/ review/ salt water/ spill/ war/ wintering
**Notes:** Review of the affects on seabirds of the 1991 Gulf oil spill.

**Syvokiene, J, L. Mickeniene**, 2004. Impact of crude oil on bacteriocenosis of the digestive tract of mollusks. Environmental Toxicology **19**:421-424.

**Keywords:** abundance/ bacteria/ biodegradation/ bivalve/ crude oil/ fresh water/ freshwater invertebrate/ microbes/ mollusc/ oil/ Oten/ petroleum/ river/ water
**Notes:** Mollusks were collected from a river and used in a laboratory study of intestinal bacteria responses to petroleum. Mollusks were exposed to either 0, 1, 2, or 4 ppm of crude oil in their aquarium water for 10 da. Intestinal contents were incubated and counts of bacteria were made. Measured the abundance of saprophytic, proteolytic, amylolytic, coliform , and hydrocarbon-degrading bacteria.

**Szaro, R. C.**, 1977. Effects of petroleum on birds. Transactions of the North American Wildlife and Natural Resources Conference **42**:374-381.
**Keywords:** bird/ effects/ natural resource/ oil/ Oone/ petroleum/ physiology/ pollution/ reproduction/ species/ spill/ vulnerability
**Notes:** General presentation on the effects of oil pollution on aquatic birds.

**Szaro, R. C. and P. H. Albers** 1977. Effects of external applications of No. 2 fuel oil on common eider eggs. Pages 164-167 *in* D. A. Wolfe, editor. Pergamon Press, Inc., New York, NY.
**Keywords:** bird/ common eider/ duckling/ effects/ egg shell/ eggs/ eiders/ embryo/ fuel oil/ hatchability/ hatching/ No.2 fuel oil/ oil/ Oone/ salt water/ weight
**Notes:** Effect on embryos of common eiders of eggshell applications of varying amounts of No. 2 fuel oil. Artificially-incubated eggs of the common eider were exposed by eggshell application to either 5 *u*l No. 2 fuel oil, 20 *u*l No. 2 fuel oil, or propylene glycol. Measured hatching success and weight of ducklings.

**Szaro, R. C., M. P. Dieter, G. H. Heinz, J. F. Ferrell**, 1978. Effects of chronic ingestion of South Louisiana crude oil on mallard ducklings. Environmental Research **17**:426-436.
**Keywords:** behavior/ bird/ blood/ chronic/ crude oil/ diet/ duckling/ effects/ growth/ ingestion/ Louisiana/ Louisiana crude oil/ mallard/ oil/ Oone/ organ/ pathology/ physiology/ South Louisiana crude oil/ survival/ tissue
**Notes:** Effects on mallard ducklings of varying amounts of South Louisiana crude oil in the diet (0.025-5%) for 8 weeks. Measured survival, growth, blood chemisty, tissue and organ pathology, and behavior of 7-da old ducklings.

**Szaro, R. C., P. H. Albers, N. C. Coon**, 1978. Petroleum: effects on mallard egg hatchability. Journal of Wildlife Management **42**:404-406.
**Keywords:** bird/ crude oil/ effects/ egg shell/ eggs/ embryo/ fresh water/ fuel oil/ hatchability/ hatching/ Kuwait/ Kuwait crude oil/ Louisiana/ Louisiana crude oil/ mallard/ No.2 fuel oil/ oil/ Oone/ paraffin/ petroleum/ South Louisiana crude oil/ survival/ weight
**Notes:** Effect on mallard embryos of eggshell applications of varying amounts of No. 2 fuel oil, South Louisiana crude oil, Kuwait crude oil, and a paraffin mixture. Measured survival and hatching weight.

**Szaro, R. C.**, 1979. Bunker C fuel oil reduces mallard egg hatchability. Bulletin of Environmental Contamination and Toxicology **22**:731-732.
**Keywords:** bird/ Bunker C/ egg shell/ eggs/ embryo/ fuel oil/ hatchability/ hatching/ incubation/ mallard/ oil/ Oone
**Notes:** Assessment of the effect of Bunker C fuel oil on artificially-incubated mallard eggs. Eggshell applications of 5-50 *u*l of Bunker C fuel oil were made on day 8 of incubation; measured hatching success.

**Szaro, R. C., N. C. Coon, W. Stout**, 1980. Weathered petroleum : effects on mallard egg hatchability. Journal of Wildlife Management **44**:709-713.
**Keywords:** bird/ crude oil/ effects/ egg shell/ eggs/ embryo/ fresh water/ fuel oil/ hatchability/ hatching/ incubation/ mallard/ No.2 fuel oil/ oil/ Oone/ petroleum/ Prudhoe Bay/ Prudhoe Bay crude oil/ weathered
**Notes:** Comparison of the effects of fresh and weathered No. 2 fuel oil and Prudhoe Bay crude oil on mallard embryos. Artificially-incubated eggs exposed by eggshell application to 1-50 *u*l of fresh or weathered oil on day 8 of incubation. Measured hatching success.

**Szaro, R. C., G. Hensler, G. H. Heinz**, 1981. Effects of chronic ingestion of No. 2 fuel oil on mallard ducklings. Journal of Toxicology and Environmental Health **7**:789-799.

**Keywords:** behavior/ bird/ blood/ chronic/ diet/ duckling/ effects/ fuel oil/ growth/ ingestion/ mallard/ No.2 fuel oil/ oil/ Oone/ organ/ pathology/ physiology/ tissue
**Notes:** Effects on mallard ducklings of 0.5 or 5% of No. 2 fuel oil in the diet for 18 weeks. Measured growth, blood chemistry, tissue and organ pathology, and behavior of 9-da-old ducklings.

**Taban, I. C., S. T. Bechmann, S. Torgrimsen, T. Baussant, S. Sanni**, 2004. Detection of DNA damage in mussels and sea urchins exposed to crude oil using comet assay. Marine Environmental Research **58**:701-705.
**Keywords:** assay/ concentration/ crude oil/ detection/ DNA/ marine invertebrate/ mussel/ North Sea/ North Sea crude oil/ Ofour/ oil/ petroleum hydrocarbons/ salt water/ sea urchin/ urchin/ water
**Notes:** Sea urchins and mussels were exposed to mechanically-dispersed North Sea crude oil at concentrations in water of 0.015, 0.06, and 0.25 ppm (mussels) and 0.06 and 0.25 ppm (sea urchins) in a continuous flow system. After 4 weeks (sea urchins) or 5 weeks (mussels), the comet DNA assay was used on sea urchin coelomocytes and mussel haemocytes. Measured the amount of DNA damage.

**Tagaz, M. E., G. R. Plaia, C. H. Deans**, 1985. Responses of macrobenthos colonizing estuarine sediments contaminated with drilling mud containing diesel oil. Bulletin of Environmental Contamination and Toxicology **35**:112-120.
**Keywords:** colonization/ depth/ diesel/ diesel fuel/ diversity/ dominance/ drilling mud/ effects/ estuarine/ index/ marine invertebrate/ No.2 fuel oil/ Ofour/ oil/ pH/ ratio/ salt water/ sand/ sediment
**Notes:** Assessment of the effects of drilling muds and diesel oil on colonization by estuarine macrobenthos. Lime mud (pH 11.5) or barite were mixed with clean sand in ratios of 1:10 and 1:3 and placed in sediment containers at 3 m depth. Containers remained for 8 wks. Colonizing individuals were identified and counted and indicies of diversity, dominance, and dissimilarity were calculated.

**Tagger, S., L. Deveze, J. LePetit**, 1976. The conditions for biodegradation of petroleum hydrocarbons at sea. Marine Pollution Bulletin **7**:172-174.
**Keywords:** aromatic hydrocarbons/ biodegradation/ concentration/ condition/ degradation/ effluent/ experiment/ France/ hydrocarbons/ microbes/ nutrients/ Oten/ petroleum/ petroleum hydrocarbons/ refinery/ salt water
**Notes:** Experiments conducted with refinery (France) wastewater effluent, its aromatic fraction, and its distillate fraction >370 C to determine the ability of selected bacterial cultures to degrade varying concentration of the test materials. Collected samples of surface seawater from the refinery discharge zone and 7.5 km from the discharge zone, added nutrients and refinery effluent, and measured degradation over a 5-da period.

**Tahir, A., T. C. Fletcher, D. F. Houlihan, C. J. Secombes**, 1993. Effect of short-term exposure to oil-contaminated sediments on the immune response of dab, *Limanda limanda* (L.). Aquatic Toxicology **27**:71-82.
**Keywords:** biochemistry/ concentration/ dab/ diesel fuel/ drilling mud/ fish/ immune response/ kidney/ Othree/ pathology/ physiology/ salt water/ sediment/ short-term
**Notes:** Exposure of dab for 4 weeks to sediment containing four different concentrations of diesel-oil based drilling mud; immune response, physiology, biochemistry, pathology, kidney.

**Tahir, A., C. J. Secombes**, 1995. The effects of diesel oil-based drilling mud extracts on immune responses of rainbow trout. Archives of Environmental Contamination and Toxicology **29**:27-32.
**Keywords:** diesel/ diesel fuel/ dosed/ drilling mud/ effects/ experiment/ fish/ fresh water/ immune response/ injection/ kidney/ oil-based/ Othree/ physiology/ rainbow trout
**Notes:** Exposure of rainbow trout to an extract derived from diesel oil-based drilling mud. Trout injected with three different doses and maintained for 6 wks in one experiment and one dose in fish maintained for 8 wks (monitored every 2 wks) in another; immune response, physiology, kidney.

**Tanacredi, J. T.**, 1977. Petroleum hydrocarbons from effluents: detection in marine environment. Journal of the Water Pollution Control Federation **49**:216-226.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ bivalve/ clam/ detection/ effluent/ environment/ estuary/ hydrocarbons/ marine environment/ marine invertebrate/ miscellaneous/ Oeleven/

petroleum/ petroleum hydrocarbons/ plant/ pollution/ salt water/ total hydrocarbons/ treatment/ waste water
**Notes:** Collected effluent samples for 11 consecutive weeks from four wastewater treatment plants around Jamaica Bay, N.Y., surface (0.6 m) water on two occasions from five sites in the bay and two sites outside the bay, and clams from one polluted and one unpolluted site in the bay. Analyzed samples for total hydrocarbons, aromatic hydrocarbons, and aliphatic hydrocarbons.

**Tanacredi, J. T.** 1981. Automotive crankcase oil: detection in a coastal wetlands environment. U.S. Environmental Protection Agency, Washington, D.C. **EPA-600/S2-81-045**. 3 pp.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ bivalve/ crankcase oil/ detection/ effluent/ hydrocarbons/ marine invertebrate/ miscellaneous/ Oeleven/ oil/ salt water/ tissue/ total hydrocarbons/ urban/ wetland
**Notes:** Project summary of a study examining the significance of crankcase oil in an urban nearshore area (Jamaica Bay, NY). Wastewater effluents, surface water, and bivalve tissue were collected and analyzed for total hydrocarbons, total aromatic hydrocarbons, and selected aliphatic and aromatic hydrocarbons.

**Tarshis, I. B.**, 1981. Uptake and depuration of petroelum hydrocarbons by crayfish. Archives of Environmental Contamination and Toxicology **10**:79-86.
**Keywords:** crayfish/ depuration/ fresh water/ freshwater invertebrate/ fuel oil/ hydrocarbons/ naphthalene/ No.2 fuel oil/ Ofive/ oil/ uptake/ whole body
**Notes:** Determination of the uptake by crayfish of $^{14}$C-naphthalene in a water-soluble solution of No. 2 fuel oil. Crayfish exposed for 1, 2, or 4 hrs and then placed in clean water for depuration. Measured uptake after exposure and retention after 24, 48, 72, or 96 hrs of depuration. Evaluated whole body uptake and depuration as well as the same measures for tail flesh, tail skeleton, and cephalothorax.

**Tarshis, I. B., B. A. Rattner**, 1982. Accumulation of $^{14}$C-Naphthalene in the tissues of redhead ducks fed oil-contaminated crayfish. Archives of Environmental Contamination and Toxicology **11**:155-159.
**Keywords:** accumulation/ bird/ crayfish/ duck/ fuel oil/ labelled/ naphthalene/ No.2 fuel oil/ oil/ Oone/ redhead/ solubility/ tissue/ transfer
**Notes:** Experimental documentation of the transfer of $^{14}$C-labelled naphthalene in No. 2 fuel oil to tissues of redhead ducks; ducks were fed crayfish which were previously exposed to the water soluble fraction of the fuel oil.

**Tarzwell, C. M.** 1970. Toxicity of oil and oil dispersant mixtures to aquatic life. Pages 263-272 *in* J. I. Waddington, editor. Water Pollution by Oil. Unknown, Inveresshire, Scotland.
**Keywords:** dispersant/ effects/ fish/ fresh water/ general effect/ marine invertebrate/ Oeight/ oil/ petroleum/ pollution/ review/ salt water/ toxicity
**Notes:** A very dated review and assessment of the effects of petroleum and chemically-dispersed petroleum on aquatic animals. Interesting from a historical perspective because it sums up the state of knowledge before the great increase in petroleum research that occurred during the 1970s.

**Tatem, H. E., B. A. Cox, J. W. Anderson**, 1978. The toxicity of oils and petroelum hydrocarbons to estuarine crustaceans. Estuarine and Coastal Marine Science **6**:365-373.
**Keywords:** aromatic hydrocarbons/ bioassay/ Bunker C/ concentration/ crude oil/ crustacean/ effects/ estuarine/ experiment/ fuel oil/ hydrocarbons/ Kuwait/ Louisiana/ Louisiana crude oil/ marine invertebrate/ No.2 fuel oil/ Ofour/ oil/ petroleum/ petroleum hydrocarbons/ salinity/ salt water/ shrimp/ size/ South Louisiana crude oil/ species/ static/ survival/ temperature/ total hydrocarbons/ toxicity
**Notes:** Experiments on the effects of Bunker C and No.2 fuel oils and Kuwait and South Louisiana crude oils on three species of shrimp. Petroleum exposure was by static bioassay to water-soluble fractions or oil-in-water dispersions for 96 hrs. Also tested were direct mixtures of eight one- and two-ring aromatic hydrocarbons. Effects of salinity and water temperature were determined. Exposure effects on three life stages of one species of shrimp and two or three size classes of the other two species were compared. Concentrations of total hydrocarbons or total aromatic hydrocarbons were determined. Measured survival and calculated $LC_{50s}$.

**Taylor, C., L. K. Duffy, R. T. Bowyer, G. M. Blundell**, 2000. Profiles of fecal porphyrins in river otters following the *Exxon Valdez* oil spill. Marine Pollution Bulletin **40**:1132-1138.
**Keywords:** Alaska/ biomarker/ crude oil/ evaluation/ Exxon Valdez/ feces/ fresh water/ mammal/ oil/ oil spill/ oiled/ Otwo/ petroleum/ porphyrin/ Prince William Sound/ river otter/ salt water/ spill/ time
**Notes:** An evaluation of fecal porphyrins as a potential biomarker for exposure to petroleum in mammals. Measured five porphyrins in river otter feces from an oiled (1990, 1996) and an unoiled area (1996) in Prince William Sound, Alaska and an unoiled reference area (1998) in southeast Alaska.

**Teal, J. M., R. W. Howarth**, 1984. Oil spill studies: a review of ecological effects. Environmental Management **8**:27-44.
**Keywords:** Amoco Cadiz/ Argo Merchant/ Arrow/ barge Florida/ benthic/ biological effects/ Bravo/ Bunker C/ crude oil/ ecosystem/ effects/ fish/ fishery/ Florida/ fuel oil/ general effect/ Ixtoc/ littoral/ marine invertebrate/ marine plant/ No.2 fuel oil/ No.5 fuel oil/ No.6 fuel oil/ ODeight/ oil/ oil spill/ persistence/ plankton/ review/ salt water/ spill/ tanker/ time/ transport/ Tsesis
**Notes:** A review of the biological effects of seven major oil spills and how the effects compare to results from experimental studies. The spills discussed are: barge *Florida* (No. 2 fuel oil), tanker *Arrow* (Bunker C fuel oil), tanker *Argo Merchant* (Bunker C and No. 2 fuel oils), platform Bravo (crude oil), tanker *Tsesis* (No. 5 fuel oil and Bunker C fuel oil), supertanker *Amoco Cadiz* (crude oil), and platform Ixtoc I (crude oil). Text headings include spill descriptions, persistence of oil, transport to the bottom, benthic and littoral effects, planktonic effects, fish and fisheries, nature of spilled oil, inferences from experimental studies, and ecosystem effects.

**Teas, H. J., E. O. Duerr, J. R. Wilcox**, 1987. Effects of South Louisiana crude oil and dispersants on *Rhizophora* mangroves. Marine Pollution Bulletin **18**:122-124.
**Keywords:** crude oil/ dispersant/ effects/ experiment/ Florida/ Louisiana/ Louisiana crude oil/ mangrove/ marine plant/ ODsix/ oil/ salt water/ South Louisiana crude oil/ surfactant/ survival/ time
**Notes:** Twenty-four plots of small mangrove saplings were isolated on a canal bank in Florida by means of two semi-circular lines of oil booms. Plots were treated with either South Louisiana crude oil, crude oil followed by a sea water wash, crude oil followed by a surfactant wash, crude oil and dispersant mixture, sea water only, or dispersant only. Experiment duration was 36 mos. Measured survival of mangroves.

**Teas, H. J., A. H. Lasday, E. L. Luque, R. A. Morales, M. E. De Diego, and J. M. Baker** 1989. Mangrove restoration after the 1986 Refineria Panama oil spill. Pages 433-437 *in* Proceedings 1989 Oil Spill Conference, API Publication 4479. American Petroleum Institute, Washington, D.C.
**Keywords:** experiment/ leaves/ mangrove/ marine plant/ oil/ oil spill/ oiled/ Osix/ Panama/ restoration/ roots/ salt water/ seedling/ soil/ spill/ survival/ time
**Notes:** Experiments on restoration planting of mangrove seedlings in coastal Panama near the site of the Refineria Panama oil spill. Seedlings were planted directly in oiled soil between 3 and 22 mos post-spill (1st experiment) or in holes of two different diameters that were filled with nursery soil (2nd experiment). Measured survival in first experiment; and survival, height, number of leaves, number of branches, and number of prop roots after 13 mos in the second experiment.

**Teruhisa, K., N. Masahiro, K. Hiroshi, Y. Tomoko, Marine Life Research Group of Takeno, O. Kouichi**, 2003. Impacts of the *Nakhodka* heavy-oil spill on an intertidal ecosystem: an approach to impact evaluation using geographical information system. Marine Pollution Bulletin **47**:104.
**Keywords:** benthic/ ecosystem/ evaluation/ intertidal/ invertebrate/ Japan/ macroalgae/ marine invertebrate/ marine plant/ oil/ oil spill/ oiled/ Onine/ pollution/ shoreline/ spill/ tanker/ technical/ time
**Notes:** The tanker *Nakhodka* spilled "heavy oil" in the Sea of Japan which resulted in much shoreline oiling. The authors established 1-$m^2$ quadrats along the intertidal zone and measured the surface coverage of macroalgae during the fall and spring of 1997-2000. Benthic invertebrates were identified and counted at 5-m intervals. Oil pollution was classified as no visible oil, one spot of oil, or more than a spot of oil. Information was displayed with a GIS base-map.

**Tetreault, G. R., M. E. McMaster, D. G. Dixon, J. L. Parrott**, 2003. Using reproductive endpoints in small forage fish species to evaluate the effects of Athabasca oil sands activities. Environmental Toxicology and Chemistry **22**:2775-2782.

**Keywords:** activity/ Alberta/ biochemical/ condition/ effects/ fish/ fresh water/ hormone/ index/ length/ liver/ oil/ oil sands/ Othree/ physiology/ region/ sand/ species/ tissue/ weight
**Notes:** Two species of fish were collected from reference, naturally exposed, and developmentally exposed areas within the oil sands region of Alberta. Measured length, weight, condition factor, liver somatic index, gonadosomatic index, and fecundity (females). Gonad and liver tissues were removed for determination of EROD activity and steroid hormone production.

**Thomas, P., B. R. Woodin, J. M. Neff**, 1980. Biochemical responses of the striped mullet *Mugil cephalus* to oil exposure I. Acute responses -- interrenal activations and secondary stress responses. Marine Biology **59**:141-149.
**Keywords:** accumulation/ acute/ biochemical/ biochemistry/ concentration/ fish/ fuel oil/ juvenile/ mullet/ No.2 fuel oil/ oil/ Othree/ salt water/ stress/ striped mullet
**Notes:** Biochemical response of juvenile striped mullet exposed for 14 da to four concentrations of the water-soluble fraction of No. 2 fuel oil; accumulation, biochemistry.

**Thomas, P., L. Budiantara**, 1995. Reproductive life history stages sensitive to oil and naphthalene in Atlantic croaker. Marine Environmental Research **39**:147-150.
**Keywords:** Atlantic/ Atlantic croaker/ biochemistry/ concentration/ diesel/ diesel fuel/ dissolved/ female/ fish/ history/ naphthalene/ oil/ Othree/ pathology/ salt water
**Notes:** Female Atlantic croaker were exposed to either water-soluble fractions of diesel fuel or dissolved naphthalene at two concentrations for 5 or 8 wks. Measured sexual maturation and performance; biochemistry, histopathology.

**Thomas, R. E., S. D. Rice**, 1986. The effects of salinity on uptake and metabolism of toluene and naphthalene by Dolly Varden, *Salvelinus malma*. Marine Environmental Research **18**:203-214.
**Keywords:** accumulation/ capsule/ Dolly Varden/ dosed/ effects/ fish/ fresh water/ gall/ liver/ metabolism/ metabolite/ muscle/ naphthalene/ Othree/ salinity/ salt water/ tissue/ toluene/ uptake
**Notes:** Assessment of the effects of salinity on accumulation and metabolism of toluene and naphthalene by young Dolly Varden trout. Trout dosed (capsule) with $^{14}$C-labelled toluene or naphthalene and held for 12, 24, or 48 hrs in freshwater or seawater; liver, central nervous system, and muscle for tissue accumulation and gall, liver, central nervous system, and muscle for metabolite accumulation.

**Thomas, W. H., S. S. Rossi, D. L. R. Seibert**, 1981. Effects of some representative petroleum refinery effluent compounds on photosynthesis and growth of natural marine phytoplankton assemblages: Part 1 -- cresols. Marine Environmental Research **4**:203-215.
**Keywords:** chlorophyll/ community/ composition/ concentration/ effects/ effluent/ experiment/ growth/ marine plant/ nutrients/ Osix/ petroleum/ photosynthesis/ phytoplankton/ refinery/ salt water
**Notes:** Seawater phytoplankton were used to test the effects of a cresol mixture on photosynthesis, growth, and community composition. For photosynthesis, phytoplankton were incubated for 48 hrs in seawater containing 12 concentrations of cresol and a $^{14}$C compound. The experiment was repeated for a comparison of two classes of phytoplankton (diatoms, dinoflagellates). For growth and community composition, phytoplankton were incubated for 10 da in seawater containing five concentrations of cresol, with or without supplemental nutrients. Measured $^{14}$C counts, chlorophyll concentration, and taxonomic identification of dominant phytoplankton.

**Thompson, H. C., Jr., R. N. Farragut, M. H. Thompson**, 1977. Relationship of scarlet prawns (*Plesiopenaeus edwardsianus*) to a benthic oil deposit off the north-west coast of Aruba, Dutch West Indies. Environmental Pollution **13**:239-253.
**Keywords:** aliphatic hydrocarbons/ Aruba/ benthic/ coast/ concentration/ crustacean/ evaluation/ hydrocarbons/ marine invertebrate/ Ofour/ oil/ prawn/ salt water
**Notes:** Evaluation of the relation between benthic oil deposits and associated crustaceans in an area of the Dutch West Indies. Eleven bottom samples from oily areas were compared to 10 bottom samples from non-oiled areas. Catch results for total crustaceans and for scarlet prawns in particular are presented. Scarlet prawns were analyzed for concentrations of aliphatic hydrocarbons.

**Thompson, S., G. Eglinton**, 1976. The presence of pollutant hydrocarbons in estuarine epipelic diatom populations. Estuarine and Coastal Marine Science **4**:417-425.
**Keywords:** alkane/ aromatic hydrocarbons/ ecosystem/ England/ estuarine/ estuary/ hydrocarbons/ marine plant/ movement/ Osix/ petroleum/ petroleum hydrocarbons/ population/ salt water/ sediment
**Notes:** Epipelic (sediment surface) diatoms and underlying sediment were collected from the Severn Estuary, England and analyzed for alkanes and aromatics. Results were interpreted in an effort to determine the potential for movement of petroleum hydrocarbons from the sediment into other parts of the marine ecosystem.

**Thorhaug, A. and J. Marcus** 1985. Effects of dispersant and oil on subtropical and tropical seagrasses. Pages 497-501 *in* Proceedings 1985 Oil Spill Conference, API Publication 4385. American Petroleum Institute, Washington, D.C.
**Keywords:** Corexit 9527/ crude oil/ dispersant/ effects/ grass/ growth/ leaves/ Louisiana/ Louisiana crude oil/ marine plant/ ODsix/ oil/ oil spill/ ratio/ salt water/ seagrass/ species/ spill/ survival/ time
**Notes:** Laboratory exposure of three species of sea grasses to Louisiana crude oil and Corexit 9527 dispersant. All species exposed to 0, 75, 750, 1,250, or 5,000 ppm crude oil, with or without dispersant in a 10:1 ratio, for either 5, 10, or 100 hrs. After exposure, the grasses were transferred to clean water and monitored for survival and leaf growth.

**Thorhaug, A., J. Marcus, F. Booker**, 1986. Oil and dispersed oil on subtropical and tropical seagrasses in laboratory studies. Marine Pollution Bulletin **17**:357-361.
**Keywords:** concentration/ Corexit 9527/ crude oil/ dispersant/ growth/ leaves/ Louisiana/ Louisiana crude oil/ marine plant/ oil/ Osix/ ratio/ salt water/ seagrass/ species/ survival
**Notes:** Leaves of three species of seagrasses were exposed to crude oils and dispersant in outdoor aquaria. Murban crude oil was used in concentrations of 75, 750, and 1,250 ppm with or without Corexit 9527 dispersant in ratios of 1:10, 1:20, or 1:30. Louisiana crude oil was used in concentrations of 75, 750, 1,250, and 5,000 ppm with or without Corexit 9527 dispersant in ratios of 1:10, 1:20, or 1:30. Duration of exposure was 5, 10, or 100 hrs. After exposure, the leaves were transferred to clean water and monitored for 14 da. Measured survival and leaf growth.

**Thorhaug, A. and J. H. Marcus** 1987. Preliminary mortality effects of seven dispersants on subtropical/tropical seagrasses. Pages 223-224 *in* Proceedings 1987 Oil Spill Conference, API Publication 4452. American Petroleum Institute, Washington, D.C.
**Keywords:** crude oil/ dispersant/ effects/ Louisiana/ Louisiana crude oil/ marine plant/ ODsix/ oil/ oil spill/ ratio/ salt water/ seagrass/ species/ spill/ survival/ time
**Notes:** Three species of seagrasses were exposed for 100 hrs to either 750 or 1,250 ppm Louisiana crude oil combined with one of seven chemical dispersants (10:1 ratio). After exposure, the seagrasses were transferred to clean water for a 14-da assessment of survival.

**Thorhaug, A., J. Marcus**, 1987. Oil spill clean-up: the effect of three dispersants on three subtropical/tropical seagrasses. Marine Pollution Bulletin **18**:124-126.
**Keywords:** crude oil/ dispersant/ Louisiana/ Louisiana crude oil/ marine plant/ ODsix/ oil/ oil spill/ salt water/ seagrass/ species/ spill/ sunlight/ survival/ time/ weathered
**Notes:** Three species of seagrasses were placed in outdoor aquaria and exposed to crude oil mixed with chemical dispersant. The crude oil was weathered in sunlight for 24 hrs prior to use. Seagrasses were exposed for 5 hrs to either 750 or 1,250 ppm Louisiana crude oil or Murban crude oil mixed 10:1 with one of three chemical dispersants, or for 100 hrs to 750 ppm of either crude oil mixed with one of three chemical dispersants. After exposure, the seagrasses were transferred to clean water and monitored for survival during a 14-da period.

**Thorhaug, A., J. McFarlane, B. Carby, F. McDonald, M. Anderson, B. Miller, V. Gordon, and P. Gayle** 1989. Dispersed oil effects on tropical habitats: preliminary laboratory results of dispersed oil testing on Jamaica corals and seagrass. Pages 455-458 *in* 1989 Oil Spill Conference, API Publication 4479. American Petroleum Institute, Washington, DC.
**Keywords:** Bunker C/ coral/ crude oil/ dispersant/ effects/ experiment/ fuel oil/ growth/ habitat/ health/ marine invertebrate/ marine plant/ ODeight/ oil/ oil spill/ petroleum/ salt water/ seagrass/ species/ spill/

static/ survival/ toxicity/ Venezuelan crude oil
**Notes:** Laboratory experiments (static) were used to determine the toxicity of chemically-dispersed Venezuelan crude oil or Bunker C fuel oil. Used two species of Jamaican seagrasses and three species of Jamaican coral and exposed them for either 6 hr or 10 hrs to either petroleum product alone or petroleum product dispersed with one of the dispersants. After exposure, the seagrasses were monitored for 10 da and the corals for 14 da. Measured survival, growth, and general health of seagrass blades and corals.

**Thorhaug, A.** 1989. Dispersed oil effects on tropical nearshore ecosystems. Pages 257-273 *in* L. M. Flaherty, editor. Oil dispersants: new ecological approaches. ASTM Special Technical Publication. American Society for Testing and Materials, Philadelphia.
**Keywords:** concentration/ coral/ dispersant/ ecosystem/ effects/ evaluation/ mangrove/ marine invertebrate/ marine plant/ ODsix/ oil/ petroleum/ review/ salt water/ seagrass/ species/ spill/ time/ toxicity/ technical
**Notes:** A review and evaluation of the effects of chemical oil dispersants on tropical nearshore ecosystems, particularly seagrasses, mangroves, and corals. Author discusses differences in toxic sensitivity among species, toxic consequences of different concentrations of dispersants, toxicity differences among dispersants, differences in toxicity of oils, and the differential effects of exposure time and seasonality.

**Throndsen, J.**, 1982. Oil pollution and plankton dynamics III. Effects on flagellate communities in controlled ecosystem experiments in Lindaspollene, Norway, June 1980 and 1981. Sarsia **67** :163-169.
**Keywords:** abundance/ community/ Corexit 9527/ crude oil/ depth/ dispersant/ ecosystem/ effects/ Ekofisk crude oil/ evaluation/ experiment/ marine invertebrate/ Norway/ ODfour/ oil/ phytoplankton/ plankton/ pollution/ salt water/ species/ water column
**Notes:** Evaluation of the effect of crude oil and chemical dispersant on a marine phytoplankton community. Enclosed natural water columns were exposed to Ekofisk crude oil for 12 da (1980) or 14 da (1981). One column received Corexit 9527 24 hrs after application of the oil. Water columns were sampled at five depths before the addition of crude oil and at the end of the experiment. Phytoplankton species were identified and their abundance was estimated.

**Tilseth, S., T. S. Solberg, K. Westrheim**, 1984. Sublethal effects of the water-soluble fraction of Ekofisk crude oil on the early larval stages of cod (*Gadus morhua* L.). Marine Environmental Research **11**:1-16.
**Keywords:** behavior/ cod/ concentration/ crude oil/ effects/ Ekofisk crude oil/ embryo/ feeding/ fish/ growth/ larvae/ malformation/ oil/ Othree/ salt water/ sublethal/ survival/ swimming
**Notes:** Effects of exposure of cod embryos (1 wk) and larvae (2 wk) to two concentrations of the water-soluble fraction of Ekofisk crude oil; survival, growth, malformations, swimming and feeding behavior.

**Tkalich, P., E. S. Chan**, 2002. Vertical mixing of oil droplets by breaking waves. Marine Pollution Bulletin **44** :1219-1229.
**Keywords:** degradation/ development/ mixing/ model/ oil/ oil spill/ Onine/ salt water/ spill/ technical/ water column
**Notes:** Development of a mathematical model to describe the vertical mixing of oil by breaking waves. Results are to be used in a future 3-D oil spill model.

**Tollefsen, K.-E., E. F. Finne, R. Romstad, C. Sandberg**, 2006. Effluents from oil production activities contain chemicals that interfere with normal function of intra- and extra-cellular estrogen binding proteins. Marine Environmental Research **62**:S191-S194.
**Keywords:** activity/ assay/ effluent/ endocrine/ endocrine disruption/ fish/ male/ miscellaneous/ Oeleven/ offshore/ oil/ produced water/ protein/ rainbow trout/ refinery/ toxicity/ water
**Notes:** Sea water, offshore oil and gas well produced water, untreated refinery process water, and treated refinery process water were subjected to solid phase extraction. The extracts were used in an assay of toxicity and estrogenic activity in cultures of male rainbow trout hepatocytes. Measured production of vitellogenin.

**Townsend, G. T., R. C. Prince, J. M. Suflita**, 2003. Anaerobic oxidation of crude oil hydrocarbons by the resident microorganisms of a contaminated anoxic aquifer. Environmental Science and Technology **37**:5213-5218.
**Keywords:** Alaska/ aliphatic hydrocarbons/ anaerobic/ crude oil/ experiment/ hydrocarbons/ incubation/ microbes/ naphthalene/ natural gas/ North Sea/ North Slope crude oil/ oil/ Oten/ reduction/ sediment/ sulfate/ time/ weathered
**Notes:** Sediment and aquifer water from a contaminated natural gas field were combined to form a slurry used in an anaerobic laboratory incubation experiment. Slurry mixtures were amended with either weathered Alaska North Slope crude oil or fresh Alba (North Sea) crude oil. The incubation period was 475 da. Measured methane production and sulfate reduction 16 times during the study. Also measured aliphatic hydrocarbons and naphthalenes.

**Trail, P. W.**, 2006. Avian mortality at oil pits in the United States: a review of the problem and efforts for its solution. Environmental Management **38**:532-544.
**Keywords:** bird/ legal/ oil/ oil field/ Oone/ petroleum/ review/ waste oil/ waste water
**Notes:** A review of the problem of avian deaths at waste oil and wastewater pits in oil production areas of the United States. A complete explanation of the historical, legal, inspection, and forensics aspects. Results of identification of bird remains from oil pits during the period 1992 to 2005 are presented.

**Travers, W. B., P. R. Luney**, 1976. Drilling, tankers, and oil spills on the Atlantic outer continental shelf. Science **194**:791-796.
**Keywords:** activity/ Atlantic/ coast/ condition/ discharges/ evaluation/ Gulf of Mexico/ Mexico/ miscellaneous/ Oeleven/ offshore/ oil/ oil field/ oil spill/ petroleum/ risk/ salt water/ spill/ tanker/ transport
**Notes:** An evaluation of the geological conditions affecting the risk of offshore drilling accidents on the Atlantic outer continental shelf. The authors contrast the Atlantic coast with the Gulf of Mexico and the west coast of the U.S., and relate oil discharges from drilling to spillage from petroleum transport activities.

**Trindade, P. V. O., L. G. Sobral, A. C. L. Rizzo, S. G. F. Leite, A. U. Soriano**, 2005. Bioremediation of a weathered and a recently oil-contaminated soils from Brazil: a comparison study. Chemosphere **58**:515-522.
**Keywords:** bacteria/ bioremediation/ Brazil/ crude oil/ experiment/ hydrocarbons/ incubation/ inorganic/ microbes/ oil/ Oten/ petroleum/ petroleum hydrocarbons/ soil/ time/ weathered
**Notes:** Contaminated (4 yrs old, crude oil, 5.4% petroleum hydrocarbons) and uncontaminated soil from the same location was used in an assessment of weathered soil bioremediation. The experiment included a non-contaminated sample, a sterilized freshly-contaminated sample, a freshly-contaminated sample, a freshly-contaminated sample with inorganic nutrient addition and bacteria added, a weathered contaminated sample, and a weathered contaminated sample with inorganic nutrient addition and bacteria added. Incubation was for 41 da. Measured $CO_2$ production during the experiment and total petroleum hydrocarbon content plus total heterotrophic and petroleum degrading bacteria at the beginning and end of the study.

**Trivelpiece, W. Z., R. G. Butler, D. S. Miller, D. B. Peakall**, 1984. Reduced survival of chicks of oil-dosed adult Leach's storm-petrels. Condor **86**:81-82.
**Keywords:** adult/ bird/ chicks/ crude oil/ effects/ growth/ nestling/ oil/ Oone/ organ/ Prudhoe Bay/ Prudhoe Bay crude oil/ salt water/ storm-petrel/ survival/ weight
**Notes:** Effects on adult and nestling Leach's storm petrels of dosing with Prudhoe Bay crude oil; growth and organ weights measured in nestlings.

**Trivelpiece, W. Z., D. G. Ainley, W. R. Frazer, S. G. Trivelpiece**, 1990. Skua survival. Nature **345**:211-212.
**Keywords:** behavior/ bird/ oil/ Oone/ reproduction/ salt water/ skuas/ South Pole/ spill/ survival
**Notes:** Response to a report of oil spill-induced reproductive failure among South Polar skuas in 1989. Followed by a rebuttal from the authors of the report.

**Trucco, R. G., F. R. Engelhardt, B. Stacey**, 1983. Toxicity, accumulation and clearance of aromatic hydrocarbons in *Daphnia pulex*. Environmental Pollution (Series A) **31**:191-202.
**Keywords:** accumulation/ aromatic hydrocarbons/ assay/ benzene/ benzo(a)anthracene/ benzo[a]pyrene/ bioassay/ clearance/ daphnia/ depuration/ fresh water/ freshwater invertebrate/ hydrocarbons/ naphthalene/ Ofive/ phenanthrene/ static/ toxicity/ uptake
**Notes:** Determination of toxicity, uptake, and clearance by *D. pulex* of five aromatic hydrocarbons. Daphnia were exposed in a static bioassay to either benzene, naphthalene, phenanthrene, benzo(a)pyrene, or benzo(a)anthracene for 96 hrs; an $LC_{50}$ was calculated. Daphnia were then exposed to the same aromatics ($^{14}C$-labelled) for 24 hrs in an accumulation assay followed by 72 hrs in clean water for a depuration determination.

**Truett, J. C., M. E. Miller, K. Kertell**, 1997. Effects of arctic Alaska oil development on brant and snow geese. Arctic **50**:138-146.
**Keywords:** activity/ Alaska/ Arctic/ bird/ brant/ development/ distribution/ effects/ fresh water/ humans/ oil/ oil field/ Oone/ population/ predation/ Prudhoe Bay/ release/ reproduction/ review/ snow goose/ structure/ tundra
**Notes:** A review of the effects of oil development activities and structures in the Prudhoe Bay area on local brant and snow goose populations. Authors make use of studies addressing contaminant release, alteration of tundra surface, creation of impoundments, and human activities, and predation.

**Truscott, B., D. R. Idler, G. L. Fletcher**, 1992. Alteration of reproductive steroids of male winter flounder (*Pleuronectes americanus*) chronically exposed to low levels of crude oil in sediments. Canadian Journal of Fisheries and Aquatic Sciences **49**:2190-2195.
**Keywords:** biochemistry/ concentration/ crude oil/ fish/ flounder/ liver/ male/ oil/ Othree/ salt water/ sediment/ steroid/ testes/ Venezuelan crude oil/ weight/ winter flounder
**Notes:** Male winter flounder were exposed to five concentrations of Venezuelan crude oil in sediment for 4 mos; reproductive steroids, liver weight, body weight, testes weight, biochemistry.

**Trust, K. A., D. Esler, B. R. Woodin, J. J. Stegeman**, 2000. Cytochrome P450 1A induction in the sea ducks inhabiting nearshore areas of Prince William Sound, Alaska. Marine Pollution Bulletin **40**:397-403.
**Keywords:** activity/ Alaska/ bird/ blood/ crude oil/ duck/ harlequin duck/ liver/ monooxygenase/ oiled/ Oone/ PCB/ Prince William Sound/ Prudhoe Bay crude oil/ salt water/ spill/ tissue
**Notes:** Barrow's goldeneye and harlequin ducks were sampled from oiled and unoiled portions of Prince William Sound, Alaska in 1996 and 1997. Goldeneyes were shot and the liver removed; harlequins were captured in mist nets, blood collected, and a liver biopsy produced a liver sample. Liver tissue was analyzed for EROD activity and the harlequin blood was analyzed for PCBs.

**Tseng, F. S.** 1993. Care of oiled seabirds: a veterinary perspective. Pages 421-424 *in* Proceedings 1993 International Oil Spill Conference, 4580. American Petroleum Institute, Washington, D.C.
**Keywords:** bird/ effects/ methods/ oil/ oil spill/ oiled/ Oone/ petroleum/ physiology/ rehabilitation/ salt water/ spill/ treatment
**Notes:** A discussion of the primary and secondary direct effects on seabirds of exposure to petroleum, and the adverse effects of prolonged rehabilitation. Methods of treatment are presented for each type of effect.

**Tsutsumi, H., M. Kono, K. Takai, T. Manabe, M. Haraguchi, I. Yamamoto, C. Oppenheimer**, 2000. Bioremediation on the shore after an oil spill from the *Nakhodka* in the Sea of Japan. III. Field tests of a bioremediation agent with microbiological cultures for the treatment of an oil spill. Marine Pollution Bulletin **40**:320-324.
**Keywords:** bacteria/ biodegradation/ bioremediation/ crude oil/ effectiveness/ estimate/ Japan/ microbes/ oil/ oil spill/ Oten/ photograph/ residual oil/ salt water/ spill/ treatment
**Notes:** The effectiveness of a bacterial culture in increasing the biodegradation of heavy crude oil on rocks and concrete blocks was tested for 8 wk. Naturally-oiled rocks and artificially-oiled concrete blocks were placed in wire cages and treated with the bacterial culture once a week. Photographs were taken of each treated and untreated rock once a week before bacterial supplementation. The photos were converted to digital images in black and white and used to estimate the amount of oil left on the surface.

**Tsutsumi, H., Y. Hirota, A. Hirashima**, 2000. Bioremediation on the shore after an oil spill from the *Nakhodka* in the Sea of Japan. II. Toxicity of a bioremediation agent with microbiological cultures in aquatic organisms. Marine Pollution Bulletin **40**:315-319.
**Keywords:** bacteria/ bioassay/ bioremediation/ concentration/ detergent/ dispersant/ eggs/ fertilization/ fish/ food/ Japan/ long-term/ marine invertebrate/ microbes/ ODten/ oil/ oil spill/ oiled/ rate/ salt water/ sea urchin/ shoreline/ species/ sperm/ spill/ static/ survival/ toxicity/ urchin
**Notes:** Assessment of the toxicity of a bacterial culture used on oiled shorelines. Sea urchin eggs and sperm were exposed, in a 5-min static bioassay, to five concentrations (1, 5, 10, 50, 100 ppm) of either bacteria culture, oil dispersant, or a domestic neutral detergent. One fish species was exposed for 1 wk to a 0.1% concentration in water of a concentrated version of the bacterial culture. A second fish species was exposed to a 0.1% concentration in food of the concentrated version for 1 wk and for 1 mo. Measured fertilization rate and short- and long-term survival.

**Tsvetnenko, Y., L. Evans**, 2002. Improved approaches to ecotoxicity testing of petroleum products. Marine Pollution Bulletin **45**:148-156.
**Keywords:** algae/ Australia/ concentration/ crude oil/ density/ evaluation/ microalgae/ mixing/ oil/ Onine/ petroleum/ petroleum products/ procedure/ salt water/ species/ static/ technical/ toxicity
**Notes:** Three species of tropical marine unicellular algae were used in 96 hr static flask tests of the toxicity of four crude oils from the northwest shelf of Western Australia. Water-soluble fractions of each were prepared and quantified during the mixing process. Algal density was measured every 24 hrs. Procedures of WSF preparation were evaluated. Advocated use of a weighted average concentration instead of the nominal concentration because of the volatile nature of these oils.

**Tuvikene, A., S. Huuskonen, K. Koponen, O. Ritola, U. Mauer, P. Lindstrom-Seppa**, 1999. Oil shale processing as a source of aquatic pollution: monitoring of the biologic effects in caged and feral freshwater fish. Environmental Health Perspectives **107**:745-752.
**Keywords:** activity/ blood/ cell/ concentration/ condition/ effects/ enzyme/ evaluation/ fish/ fresh water/ index/ liver/ metabolism/ metals/ micronuclei/ monitoring/ muscle/ oil/ Othree/ PAH/ pollution/ rainbow trout/ red blood cell/ tissue
**Notes:** Evaluation of the effects of the oil shale industry on fish at a site in Estonia. Caged rainbow trout and feral perch and roach were sampled from two exposed and one control location. Measured metabolic enzyme activity, determined micropathology of several tissues, and measured incidence of micronuclei in red blood cells. Also measured the concentration of several metals and PAHs in muscle and liver and calculated a condition factor and a liver somatic index.

**Ullrich, S. O., Jr., R. E. Millemann**, 1983. Survival, respiration, and food assimilation of *Daphnia magna* exposed to petroleum- and coal-derived oils at three temperatures. Canadian Journal of Fisheries and Aquatic Sciences **40**:17-26.
**Keywords:** assimilation/ bioassay/ coal oil/ concentration/ consumption/ daphnia/ diesel/ diesel fuel/ food/ fresh water/ freshwater invertebrate/ Ofive/ oil/ oxygen/ petroleum/ respiration/ static/ survival/ temperature
**Notes:** Determination of the effect of water-soluble fractions (WSF) of diesel fuel or coal-derived oil on *D. magna*. Daphnia exposed by static bioassay to varying concentrations of the WSF at water temperatures of 10, 20, or 25 C for 48 hrs; a 48-hr $LC_{50}$ was calculated for each temperature. Simultaneously measured were oxygen consumption and food consumption.

**Underhill, L. G., P. A. Bartlett, L. Baumann, R. J. M. Crawford, B. M. Dyer, A. Gildenhuys, D. C. Nel, T. B. Oatley, M. Thornton, L. Upfold, A. J. Williams, P. A. Whittington, A. C. Wolfaardt**, 1999. Mortality and survival of African penguins *Spheniscus demersus* involved in the *Apollo Sea* oil spill: an evaluation of rehabilitation efforts. Ibis **141**:29-37.
**Keywords:** Africa/ bird/ coast/ evaluation/ fuel oil/ oil/ oil spill/ oiled/ Oone/ penguin/ population/ rehabilitation/ release/ salt water/ South Africa/ spill/ survival/ time
**Notes:** An assessment of the results of the rehabilitation and release of 4,076 marked African penguins on the coast of South Africa. The penguins were oiled with 'fuel oil' after the sinking of the *Apolo Sea* in 1994. Several intensive searches were maintained for 2 years to document survival of the released penguins.

**Upshall, C., J. F. Payne, J. Hellou**, 1993. Induction of MFO enzymes and production of bile metabolites in rainbow trout (*Oncorhynchus mykiss*) exposed to waste crankcase oil. Environmental Toxicology and Chemistry **12**:2105-2112.
**Keywords:** bile/ biochemistry/ concentration/ crankcase oil/ dosed/ enzyme/ fish/ fresh water/ injection/ juvenile/ metabolite/ mixed-function oxidase/ oil/ Othree/ rainbow trout
**Notes:** Juvenile rainbow trout exposed to waste crankcase oil (injection) for 3 da in a dose- response study (three concentrations) and for 12 da in a time-response study; mixed-function oxidase induction, bile metabolites, biochemistry.

**Urum, K., T. Pekdemir, D. Ross, S. Grigson**, 2005. Crude oil contaminated soil washing in air sparging assisted stirred tank reactor using biosurfactants. Chemosphere **60**:334-343.
**Keywords:** air/ concentration/ crude oil/ Ekofisk crude oil/ experiment/ miscellaneous/ Oeleven/ oil/ ratio/ remediation/ soil/ surfactant/ temperature/ time/ washing/ weathered
**Notes:** An experiment to test soil washing methodology. Ekofisk crude oil was added to soil and half was weathered in a warm oven for 14 d. The weathered and unweathered soil were then washed in a stirred and aerated reactor at four washing termperatures, four surfactant solution volume/soil mass ratios , four surfactant concentrations, four washing times, and two surfactants. Measured crude oil concentrations in the soil at the beginning and during the study.

**Urum, K., S. Grigson, T. Pekdemir, S. McMenamy**, 2006. A comparison of the efficiency of different surfactants for removal of crude oil from contaminated soils. Chemosphere **62**:1403-1410.
**Keywords:** aliphatic hydrocarbons/ aromatic/ aromatic hydrocarbon/ aromatic hydrocarbons/ crude oil/ Ekofisk crude oil/ experiment/ hydrocarbons/ miscellaneous/ ODeleven/ oil/ petroleum/ remediation/ soil/ sulphate/ surfactant/ washing/ weathered
**Notes:** Soil was mixed with Ekofisk crude oil, artificially weathered for 14 d in an oven, and washed with either of three surfactants. The experiment employed two biosurfactants (rhamnolipid and saponin) and a synthetic surfactant (sodium dodecyl sulphate). Soil was analyzed for total petroleum and aliphatic and aromatic hydrocarbons before and after the washing.

**Utvik, T. I. R.**, 1999. Chemical characterisation of produced water from four offshore oil production platforms in the North Sea. Chemosphere **39**:2593-2606.
**Keywords:** analysis/ BTEX/ metals/ miscellaneous/ North Sea/ Oeleven/ offshore/ oil/ oil field/ organic/ organic acid/ PAH/ phenol/ produced water/ radionuclide/ salt water/ total hydrocarbons
**Notes:** Samples of the produced water from four offshore Norwegian oil fields were collected once a day for five consecutive days. The samples were analyzed for BTEX, PAHs, phenols, organic acids, metals, and radionuclides. Results were compared to those from other offshore oil fields in the Norwegian North Sea and subjected to a principal components analysis.

**Uysal, Z., C. Saydam, K. Yilmaz**, 1997. Impact of the recent oil spill (Nassia) in Bosphorus (Turkey) on developmental stages of sea urchin *Paracentrotus lividus* Lam., eggs. Fresenius Environmental Bulletin **6**:584-588.
**Keywords:** assay/ concentration/ crude oil/ development/ effects/ eggs/ evaluation/ marine invertebrate/ Ofour/ oil/ oil spill/ salt water/ sea urchin/ spill/ temperature/ urchin
**Notes:** Evaluation of the effects on various developmental stages sea urchin of varying concentrations of the water-soluble fraction of crude oil collected from the water surface of the Bosphorus after a recent oil spill. Laboratory assays performed at two water temperatures.

**Vaishnav, D. D., L. R. Brown**, 1977. The effects of biocides on the microbial degradation of crude oil. Developments in Industrial Microbiology **18**:697-704.
**Keywords:** bacteria/ carbamates/ crude oil/ degradation/ effects/ estuarine/ evaluation/ growth/ mercury/ microbes/ oil/ organochlorines/ organophosphates/ Oten/ salt water/ sediment
**Notes:** Evaluation of the effects of 112 biocides on a mixed culture of oil-degrading bacteria isolated from estuarine sediments. Forty-six pure cultures isolated from estuarine ponds contaminated with crude oil were used to test 18 selected biocides. Measured growth inhibition of cultures, ability of crude oil to concentrate biocides, and the effect of mercurials, organochlorines, carbamates, and organophosphates on the bacterial degradation of oil.

**Valk, G., E. Hartwig, B. Reineking, E. Schrey, and E. Vauk-Hentzelt** 1990. Extensive investigations into the effects on seabirds of the oil pollution on the German North Sea coast. Pages 288-291 *in* Svein. Myrberget, editor. Transactions of the XIXth IUGB Congress the International Union of Game Biologists, September 1989, Trondheim, Norway. NINA Norwegian Institute for Nature Research, Trondheim, Norway.
**Keywords:** beach/ bird/ coast/ effects/ history/ North Sea/ oil/ oiled/ Oone/ pollution/ population/ region/ salt water/ species/ Norway
**Notes:** Report of the counts of oiled seabirds found on beaches of the German North Sea coast during 1983-88; species identified and regional differences determined.

**Van Colen, C., M. Vincx, S. Degraer**, 2006. Does medium-term emersion cause a mass extinction of tidal flat macrobenthos? -- The case of the *Tricolor* oil pollution prevention in the Zwin nature reserve (Belgium and The Netherlands). Estuarine Coastal and Shelf Science **68**:343-347.
**Keywords:** benthic/ bivalve/ fuel oil/ marine invertebrate/ Netherlands/ Ofour/ oil/ oil spill/ plant/ pollution/ salt marsh/ salt water/ sand/ spill/ tidal flat/ time/ water
**Notes:** Sand barriers were used to prevent a marine fuel oil spill from entering coastal inlets and polluting salt marshes. Tidal flow was restricted for 27 days (Feb-March), after which the barriers were removed. Marsh plants and macrobenthos were emersed in sea water during this time . Samples of macrobenthos were collected before, at 12 and 21 da of emersion, and 26 da after emersion.

**van den Heuvel, M. R., M. Power, M. D. MacKinnon, D. G. Dixon**, 1999. Effects of oil sands related aquatic reclamation on yellow perch (*Perca flavescens*). II. Chemical and biochemical indicators of exposure to oil sands related waters. Canadian Journal of Fisheries and Aquatic Sciences **56**:1226-1233.
**Keywords:** activity/ Alberta/ bile/ biochemical/ Canada/ effects/ enzyme/ fish/ fresh water/ gonads/ hormone/ indicator/ oil/ oil sands/ Othree/ PAH/ produced water/ reproduction/ sand/ size/ steroid
**Notes:** Assessment of the effects of produced water and drainage water from the oil sands area of Alberta, Canada. Yellow perch were sampled in seven natural or man-made ponds or lakes over a 19 mo period. Measured hepatic enzyme activity, bile PAHs, steroid hormones, gonad size, and fecundity.

**van den Heuvel, M. R., M. Power, J. Richards, M. MacKinnon, D. G. Dixon**, 2000. Disease and gill lesions in yellow perch (*Perca flavescens*) exposed to oil sands mining-associated waters. Ecotoxicology and Environmental Safety **46**:334-341.
**Keywords:** blood/ chloride/ disease/ evaluation/ fish/ fresh water/ gill/ health/ lesions/ naphthene/ oil/ oil sands/ Othree/ pathology/ physiology/ plasma/ sand/ tissue
**Notes:** Evaluation of the health of yellow perch in two oil sands impoundments and one oil sands lake, and three reference lakes removed from the oil sands deposits. Fish were transplanted from the oil sands lake to the two oil sands impoundments and sampled 3 or 10 mos later. Measured water characteristics and total napthenates in water. Fish blood plasma was analyzed for Na, chloride, and Ca. Fish were externally examined for signs of disease and gill tissue was examined for lesions.

**Van Gestel, C. A. M., J. J. Van Der Waarde, J. G. M. Derksen, E. E. Van Der Hoek, M. F. X. W. Veul, S. Bouwens, B. Rusch, R. Kronenburg, G. N. M. Stokman**, 2001. The use of acute and chronic bioassays to determine the ecological risk and bioremediation efficiency of oil-polluted soils. Environmental Toxicology and Chemistry **20**:1438-1449.
**Keywords:** acute/ bacteria/ bioassay/ bioremediation/ chronic/ fresh water/ harbour/ history/ invertebrate/ microbes/ Netherlands/ Oten/ petroleum/ plant/ pollution/ risk/ soil
**Notes:** A set of chronic and acute bioassays were employed to determine the ecological risk and bioremediation potential of soils from a harbour facility in The Netherlands with a history of petroleum pollution. Soils were analyzed for a variety of contaminants. Seven acute tests using aquatic (bacteria, invertebrates) and terrestrial (plants, bacteria, invertebrate) organisms were performed with a soil extract. Four chronic tests (4 wks), using a plant and two invertebrates, were performed with the soil. Also performed an assessment of the bacteria in the soil and conducted a pilot bioremediation study for 12 wks.

**Van Gestel, K., J. Mergaert, J. Swings, J. Coosemans, J. Ryckeboer**, 2003. Bioremediation of diesel oil-contaminated soil by composting with biowaste. Environmental Pollution **125**:361-368.

**Keywords:** bioremediation/ compost/ concentration/ degradation/ diesel/ diesel fuel/ incubation/ microbes/ oil/ Oten/ oxygen/ petroleum hydrocarbons/ seed/ soil/ temperature/ time/ toxicity
**Notes:** Two composting bins containing biowaste (one waste only, one with diesel oil contaminated soil) were monitored for 12 wks. A second smaller pair of composting bins were filled with diesel oil contaminated soil; one was maintained at room temperature and the other at composting temperature. Bins were sampled on days 1, 6, 9, 13, 21,27, 34, 41, 48, 55, 62, 69, 76, and 85. Measured temperature, oxygen concentrations of gases, fluorescein diacetate hydrolysis, dry matter content, and diesel fuel concentration. Also identified microbes during sequential phases of incubation and determined the toxicity of the compost mixture to seeds of two plants after 12 wks.

**Van Gundy, J. J.** 1969. The effect of oilfield wastewaters upon the diversity and abundance of macroinvertebrates in a woodland stream. Pennsylvania State University. MS thesis. i-48 leaves.
**Keywords:** abundance/ brine water/ chemical characteristics/ community/ discharges/ diversity/ effects/ fresh water/ freshwater invertebrate/ index/ invertebrate/ macroinvertebrate/ Ofive/ oil field/ Pennsylvania/ sampling/ species/ species diversity/ stream/ waste water
**Notes:** Study of the effects of oilfield wastewater discharges on the aquatic invertebrates of Lewis Run, Allegheny National Forest, Pennsylvania. Author sampled water at five stations on nine dates during a 1 yr period and took four samples of wastewater discharges; provides physical and chemical characteristics. Sampled macroinvertebrates at the five sampling sites; identified species and counted individuals. Calculated species diversity index.

**Van Pelt, T. I., J. F. Piatt**, 1995. Deposition and persistence of beachcast seabird carcasses. Marine Pollution Bulletin **30**:794-802.
**Keywords:** beach/ bird/ carcass/ development/ estimate/ methods/ Oone/ persistence/ population/ rate/ salt water
**Notes:** Development of a method to analyze deposition rates and persistence of beached seabird carcasses so as to provide for estimates of total losses.

**Van Veld, P. A., D. J. Westbrook, B. R. Woodin, R. C. Hale, C. L. Smith, R. J. Huggett, J. J. Stegeman**, 1990. Induced cytochrome P-450 in intestine and liver of spot (*Leiostomus xanthurus*) from a polycyclic aromatic hydrocarbon contaminated environment. Aquatic Toxicology **17**:119-132.
**Keywords:** activity/ aromatic hydrocarbons/ Chesapeake/ concentration/ environment/ fish/ hydrocarbons/ intestine/ liver/ metabolism/ Othree/ PAH/ salt water/ sediment/ spot
**Notes:** Spot were collected at four sites in the Elizabeth River, one site at the mouth of the York River, and one site in the lower Chesapeake Bay. Sediments contained PAH concentrations ranging from 9 to 96,000 ppb; cytochrome P-450 and ethoxyresorufin O-deethylase activity in liver and intestine, sediment PAH concentration.

**Van Vleet, E. S., J. G. Quinn**, 1977. Input and fate of petroleum hydrocarbons entering the Providence River and Upper Narragansett Bay from wastewater effluents. Environmental Science and Technology **11**:1086-1092.
**Keywords:** effluent/ fate/ hydrocarbons/ miscellaneous/ Oeleven/ petroleum/ petroleum hydrocarbons/ plant/ salt water/ sediment/ total hydrocarbons/ treatment
**Notes:** Assessment of the input and fate of petroleum hydrocarbons in Narragansett Bay from wastewater treatment plants. Sampled effluent from a large treatment plant as composite 6-da samples every other week for a year. Sampled surface water and sediments at four locations within the Bay. Analyzed all samples for total hydrocarbons and analyzed the fate of petroleum hydrocarbon input to the Bay.

**Vanderhorst, J. R., C. I. Gibson, L. J. Moore**, 1976. The role of dispersion in fuel oil bioassay. Bulletin of Environmental Contamination and Toxicology **15**:98-100.
**Keywords:** aromatic hydrocarbons/ bioassay/ dispersal/ experiment/ fuel oil/ hydrocarbons/ methods/ mixing/ No.2 fuel oil/ oil/ Onine/ petroleum/ salt water/ shrimp/ survival/ technical/ total hydrocarbons
**Notes:** An experiment demonstrating the significance of mechanical dispersion in petroleum bioassays. Coon stripe shrimp were subjected to a 24-hr bioassay employing five nominal quantities of No. 2 fuel oil, three methods of water delivery (subsurface delivery of water and no oil premixing, initial mixing of oil and

water prior to delivery at 1 cm above the surface, initial mixing of oil and water prior to delivery at 20 cm above the surface), and six replicates. Bioassay water was sampled and analyzed for total hydrocarbons at 1, 4, 6, and 24 hrs. Measured survival of shrimp and several water-soluble aromatics in the most 'dispersed' group.

**Vanderhorst, J. R., C. I. Gibson, L. J. Moore**, 1976. Toxicity of No. 2 fuel oil to coon stripe shrimp. Marine Pollution Bulletin **7**:106-108.
**Keywords:** bioassay/ concentration/ depth/ effects/ experiment/ flow-through/ fuel oil/ marine invertebrate/ No.2 fuel oil/ Ofour/ oil/ salt water/ shrimp/ survival/ toxicity
**Notes:** Assessment of the effects of oil-in-water dispersions of No. 2 fuel oil on coon stripe shrimp. A flow-through bioassay system was used to determine the 96 hr $LC_{50}$ of the fuel oil dispersion. Oil concentrations at various depths were monitored throughout the experiments.

**Vandermeulen, J. H., D. C. Gordon, Jr.**, 1976. Reentry of 5-year-old stranded Bunker C fuel oil from a low-energy beach into the water, sediments, and biota of Chedabucto Bay, Nova Scotia. Journal of the Fisheries Research Board of Canada **33**:2002-2010.
**Keywords:** algae/ aromatic hydrocarbons/ Arrow/ beach/ bivalve/ Bunker C/ degradation/ eelgrass/ evaluation/ fate/ fuel oil/ general effect/ hydrocarbons/ macroalgae/ marine invertebrate/ marine plant/ Nova Scotia/ Oeight/ oil/ salt water/ sampling/ sediment/ subtidal/ tanker/ time
**Notes:** An evaluation of the fate of Bunker C fuel oil 5 yrs after the grounding of the tanker *Arrow* in Chedabucto Bay, Nova Scotia. Established a 12 $m^2$ sampling grid from high tide to subtidal beyond the low tide line on a sheltered beach. Sampled water, sediment, eelgrass, and macroalgae. Analyzed all samples for aromatic hydrocarbons. Also conducted a beach inspection at 12 locations in the vicinity of the study site.

**Vandermeulen, J. H.**, 1977. The Chedabucto Bay spill -- *Arrow* 1970. Oceanus **20**:31-39.
**Keywords:** Arrow/ bivalve/ Bunker C/ cleaning/ degradation/ fuel oil/ general effect/ long-term/ marine invertebrate/ marine plant/ Oeight/ oil/ recovery/ salt water/ shoreline/ spill/ time
**Notes:** An assessment of the biological recovery following the spill of Bunker C fuel oil from the *Arrow* in 1970. Sections presented on natural cleaning processes on shorelines, recovery of fauna and flora, shoreline erosion, biological implications, aryl hydrocarbon hydroxylase, and short- and long-term concerns.

**Vandermeulen, J. H., D. E. Buckley, E. M. Levy, B. F. N. Long, P. McLaren, P. G. Wells**, 1979. Sediment penetration of *Amoco Cadiz* oil, potential for future release, and toxicity. Marine Pollution Bulletin **10**:222-227.
**Keywords:** algae/ Amoco Cadiz/ Bunker C/ crude oil/ evaluation/ France/ fuel oil/ general effect/ Kuwait/ Kuwait crude oil/ marine plant/ mousse/ Oeight/ oil/ release/ salt water/ sediment/ species/ tanker/ toxicity
**Notes:** An evaluation of the ability of oil from the tanker *Amoco Cadiz* to penetrate coastal sediments in Brittany, France. Authors discuss both sheen oils and mousse. An aqueous extract of freshly stranded oil was used in a 2-hr laboratory toxicity test (test tubes) with an algal species. Results of the toxicity test ($LC_{50s}$) were compared with those for Kuwait crude oil and Bunker C fuel oil.

**Vandermeulen, J. H.**, 1986. Altered grazing patterns in an experimental copepod-alga ecosystem exposed to naphthalene and Kuwait crude oil. Bulletin of Environmental Contamination and Toxicology **36**:260-266.
**Keywords:** algae/ bioassay/ concentration/ copepod/ crude oil/ dissolved/ ecosystem/ grazing/ Kuwait/ Kuwait crude oil/ marine invertebrate/ naphthalene/ Ofour/ oil/ predation/ salt water/ static
**Notes:** Assessment of the effect of naphthalene on the algal grazing patterns of a copepod. Naphthalene and Kuwait crude oil were dissolved in water to produce nominal concentrations of naphthalene of 0.1, 0.5, or 1.0 ppm. A static bioassay was used for 48 or 120 hrs of exposure. Measured grazing pressure at 24, 48, and 120 hrs.

**Vandermeulen, J. H., J. W. Thorpe, K. E. Hellenbrand**, 1994. Short-term weathering rates of buried oils in experimental sand columns over north-temperate temperature range. Bulletin of Environmental Contamination and Toxicology **53**:46-53.

**Keywords:** aliphatic hydrocarbons/ analysis/ beach/ Bunker C/ crude oil/ degradation/ experiment/ fuel oil/ hydrocarbons/ miscellaneous/ Oeleven/ oil/ petroleum/ rate/ salt water/ sand/ short-term/ temperature/ Venezuelan crude oil/ washing/ weathered
**Notes:** Three test oils (Venezuelan crude oil, Bunker C fuel oil, and a petroleum condensate) were mixed with beach sand and placed in mesh bags which were buried in experimental sand columns. Columns were set up to simulate periodic tidal washing. Environmental temperatures were either 5, 10, or 15 C. Experiment duration was 9-11 mo and mesh bags were sampled periodically (text description is confusing) for hydrocarbon analysis. Sand was analyzed for aliphatic hydrocarbons.

**Vandermeulen, J. H., J. G. Singh**, 1994. ARROW oil spill, 1970-90: persistence of 20-yr weathered Bunker C fuel oil. Canadian Journal of Fisheries and Aquatic Sciences **51**:845-855.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ Arrow/ Bunker C/ clam/ composition/ fuel oil/ hydrocarbons/ miscellaneous/ mussel/ Oeleven/ oil/ oil spill/ persistence/ salt water/ shoreline/ spill/ time/ weathered
**Notes:** A variety of types of residual Bunker C fuel oil were sampled from the shoreline of two sites in Chedabucto Bay, NS. Clams and mussels were also collected at one of the sites. All samples were analyzed for aliphatic and aromatic hydrocarbons, and asphaltines. Results were compared to the composition of stored reference Bunker C from the spill.

**Vandermeulen, J. H., C. W. Ross**, 1995. Oil spill response in freshwater assessment of the impact of cleanup as a management tool. Journal of Environmental Management **44**:297-308.
**Keywords:** effectiveness/ environment/ fresh water/ methods/ miscellaneous/ Oeleven/ oil/ oil spill/ petroleum/ review/ spill/ spill response
**Notes:** A review and assessment of methods used to respond to petroleum spills in freshwater environments. Emphasis is on determining the environmental consequences of the methods rather than their effectiveness.

**Vandermuelen, J. H., J. Hanrahan, T. Hemsworth**, 1980. Respiratory changes and stability of haemocyanin-$O_2$ binding capacity in the crab *Cancer irroratus* exposed to Kuwait crude oil in sea water. Marine Environmental Research **3**:161-170.
**Keywords:** bioassay/ crab/ crude oil/ effects/ evaluation/ hydrocarbons/ Kuwait/ Kuwait crude oil/ marine invertebrate/ movement/ Ofour/ oil/ petroleum hydrocarbons/ respiration/ salt water/ static/ uptake
**Notes:** Evaluation of the effect on mature crabs of exposure to an oil-in-water mixure of Kuwait crude oil. A static bioassay consisting of 2 hrs of exposure to 11 ppm aqueous phase Kuwait crude oil was performed. Measured respiration, movement of hydrocarbons into haemolymph, and hemocyanin-$O_2$ binding.

**Vangilder, L. D., T. J. Peterle**, 1980. South Louisiana crude oil and DDE in the diet of mallard hens: effects on reproduction and duckling survival. Bulletin of Environmental Contamination and Toxicology **25**:23-28.
**Keywords:** bird/ consumption/ crude oil/ DDE/ diet/ duckling/ effects/ Louisiana/ Louisiana crude oil/ mallard/ oil/ Oone/ reproduction/ South Louisiana crude oil/ survival
**Notes:** Effects on mallard reproduction and duckling survival following consumption of diets containing either South Louisiana crude oil or DDE.

**Vangilder, L. D., T. J. Peterle**, 1981. South Louisiana crude oil or DDE in the diet of mallard hens: effects on egg quality. Bulletin of Environmental Contamination and Toxicology **26**:328-336.
**Keywords:** bird/ consumption/ crude oil/ DDE/ diet/ effects/ eggs/ Louisiana/ Louisiana crude oil/ mallard/ oil/ Oone/ reproduction/ South Louisiana crude oil
**Notes:** Effects on mallard egg quality of consumption of diets containing either South Louisiana crude oil or DDE.

**Vangilder, L. D., T. J. Peterle**, 1983. Mallard egg quality: enhancement by low levels of petroleum and chlorinated hydrocarbons. Bulletin of Environmental Contamination and Toxicology **30**:17-23.
**Keywords:** bird/ combination/ concentration/ crude oil/ DDE/ effects/ eggs/ hydrocarbons/ Louisiana/ Louisiana crude oil/ mallard/ oil/ Oone/ petroleum/ reproduction/ South Louisiana crude oil

**Notes:** Effects on egg quality of mallards fed low concentrations of South Louisiana crude oil and DDE alone or in combination.

**Varadaraj, R., M. L. Robbins, J. Bock, S. Pace, and D. MacDonald** 1995. Dispersion and biodegradation of oil spills on water. Pages 101-106 *in* 1995 International Oil Spill Conference, API Publication 4620. American Petroleum Institute, Washington, D.C.
**Keywords:** Alaska/ biodegradation/ crude oil/ degradation/ dispersant/ evaluation/ experiment/ length/ microbes/ North Slope crude oil/ ODnine/ oil/ oil spill/ petroleum/ ratio/ salt water/ spill/ technical/ time
**Notes:** An evaluation of the relation between petroleum dispersion with chemical dispersants and microbial degradation. Used Alaska North Slope crude oil and a blend of dispersants Span 80 and Tween 80 in a parafinic solvent. Experiment had three levels of hydrophile-lipophile balance, ratio of dispersant to oil, and length of time of the experiment. Measured percent of oil dispersed, surface area of dispersed oil, and percent of oil degraded.

**Varanasi, U., D. J. Gmur**, 1981. Hydrocarbons and metabolites in English sole (*Parophrys vetulus*) exposed simultaneously to [$^{3}$H] benzo[*a*]pyrene and [$^{14}$C] naphthalene in oil-contaminated sediment. Aquatic Toxicology **1**:49-67.
**Keywords:** accumulation/ aromatic hydrocarbons/ benzo[a]pyrene/ bile/ biochemistry/ blood/ concentration/ crude oil/ fish/ gill/ hydrocarbons/ intestine/ liver/ metabolism/ metabolite/ muscle/ naphthalene/ oil/ Othree/ Prudhoe Bay/ Prudhoe Bay crude oil/ salt water/ sediment/ skin/ sole/ stomach
**Notes:** English sole exposed for 168 hrs to sediments containing [$^{3}$H] benzo[a]pyrene and [$^{14}$C] naphthalene in Prudhoe Bay crude oil. Accumulation and metabolism of hydrocarbons measured; sediment concentration, sediment associated water concentration, radioactive concentrations in gill, skin, muscle, blood, liver, bile, stomach, and intestine.

**Vargo, G. A., M. Hutchins, G. Almquist**, 1982. The effect of low, chronic levels of No. 2 fuel oil on natural phytoplankton assemblages in microcosms: 1. Species composition and seasonal succession. Marine Environmental Research **6**:245-264.
**Keywords:** abundance/ chlorophyll/ chronic/ community/ composition/ concentration/ effects/ experiment/ fuel oil/ index/ marine plant/ microcosm/ No.2 fuel oil/ nutrients/ oil/ Osix/ phytoplankton/ population/ salt water/ seasonal/ species/ time/ treatment
**Notes:** Large indoor microcosms stocked with natural phytoplankton assemblages were used to assess the effects of No. 2 fuel oil mechanically dispersed in sea water. Two experiments were performed; dispersions were added twice weekly for 5.5 mos in one experiment and for 4 mos in the other. Water was sampled weekly for phytoplankton counts, chlorophyll concentration; seasonal variation in abundance of single diatom species, groups of species, or species in a genera; species richness, and seasonal nutrient fluctuations. Water from Narragansett Bay was also collected weekly and assessed in comparison to the laboratory control and treatment microcosms. Also calculated a species similarity index for comparison among all experimental units.

**Vargo, S. L., P. L. Lutz, D. K. Odell, E. S. Van Vleet, and G. D. Bossart**. 1986. Effects of oil on marine turtles. U.S. Dept. of the Interior, Minerals Management Service, Washington, DC. **MMS 86-0070**. 12 pp.
**Keywords:** avoidance/ behavior/ biochemistry/ condition/ crude oil/ effects/ green turtle/ Louisiana/ Louisiana crude oil/ marine turtle/ mitigation/ oil/ OthreeR/ pathology/ physiology/ reptile/ review/ salt water/ South Louisiana crude oil/ turtle
**Notes:** Exposure of young loggerhead and green turtles to South Louisiana crude oil under experimental conditions, literature review, and examination of a few stranded turtles; behavior, avoidance of oil, physiology, biochemistry, pathology, suggested mitigation actions.

**Vasudevan, N., P. Rajaram**, 2001. Bioremediation of oil sludge-contaminated soil. Environment International **26**:409-411.
**Keywords:** bacteria/ bioremediation/ combination/ composition/ compost/ concentration/ degradation/ density/ experiment/ India/ microbes/ oil/ Oten/ petroleum/ refinery/ soil/ time
**Notes:** An experiment with enhanced bioremediation of refinery sludge. Sludge from a petroleum refinery in India was mixed with soil and enhancements in a variety of combinations (sterilized soil plus oil sludge, soil plus oil sludge, soil plus oil sludge and compost, soil plus sludge and bacteria addition, soil plus oil

sludge and bacteria and inorganic nutrient addition). The mixtures were incubated for 90 da and evaluated every 15 da. Determined the sludge composition and measured the petroleum concentration and density of bacteria.

**Vauk, G.**, 1984. Oil pollution dangers on the German coast. Marine Pollution Bulletin **15**:89-93.
**Keywords:** bird/ coast/ commentary/ effects/ Germany/ history/ North Sea/ oil/ oiled/ Oone/ pollution/ population/ rehabilitation/ salt water/ spill
**Notes:** Historical account and commentary of seabirds and oil pollution on the North Sea coast of Germany; covers 1960-83 and includes discussion on general ecological effects and oiled bird rehabilitation.

**Vazquez-Duhalt, R.**, 1989. Environmental impact of used motor oil. Science of the Total Environment **79**:1-23.
**Keywords:** biodegradation/ burning/ composition/ environment/ fate/ lubricating oil/ microbes/ miscellaneous/ motor oil/ Oeleven/ oil/ review/ soil/ toxicity/ used motor oil
**Notes:** A review of the global production, use, and environmental impact of lubricating oils as of the late 1980s. Sections on production, fate, composition of used motor oil, spillage into soil and water, burning of used oil, toxicity, and biodegradation.

**Vazquez, M. A., K. W. Allen, Y. M. Kattan**, 2000. Long-term effects of the 1991 Gulf War on the hydrocarbon levels in clams at selected areas of the Saudi Arabian Gulf coastline. Marine Pollution Bulletin **40**:440-448.
**Keywords:** Arabian Gulf/ aromatic hydrocarbons/ clam/ concentration/ effects/ Gulf of Oman/ hydrocarbons/ long-term/ marine invertebrate/ Ofour/ oil/ salt water/ saturated hydrocarbons/ Saudi Arabia/ war
**Notes:** The clam *Meretrix meretrix* was sampled at nine sites along the Gulf coastline of Saudi Arabia from 1981 to 1997. Samples were collected quarterly from 1981 to 1993 and then twice a year thereafter. Five of the sites were exposed to oil from the 1991 Gulf War. Clams were analyzed for saturated and aromatic hydrocarbons.

**Vermeer, K., R. Vermeer**, 1975. Oil threat to birds on the Canadian west coast. Canadian Field-Naturalist **89**:278-298.
**Keywords:** bird/ Canada/ coast/ concentration/ fresh water/ history/ oil/ oil spill/ Oone/ pipeline/ population/ salt water/ species/ spill/ survey
**Notes:** Survey and assessment of the threat to aquatic birds along the west coast of Canada from oil spills, especially from the impending completion of the Trans-Alaskan Pipeline; much detail on species concentrations and some historical information on world-wide oil spills.

**Vermeer, K., G. G. Anweiler**, 1975. Oil threat to aquatic birds along the Yukon coast. Wilson Bulletin **87**:467-480.
**Keywords:** bird/ coast/ development/ fresh water/ oil/ oil spill/ Oone/ population/ salt water/ species/ spill/ survey/ Yukon
**Notes:** Survey of aquatic birds along the Yukon coast in preparation for impending oil exploration; species accounts and statements of likely consequences of oil spills.

**Vermeer, K.**, 1976. Colonial auks and eiders as potential indicators of oil pollution. Marine Pollution Bulletin **7**:165-167.
**Keywords:** auks/ bird/ Canada/ effects/ eiders/ indicator/ oil/ Oone/ pollution/ population/ salt water/ species/ spill
**Notes:** Discussion of the seabird species to be of most use as indicators of the effects of oil pollution in Canadian waters.

**Verriopoulos, G., M. Moraitou-Apostolopoulou, A. Xatzispirou**, 1986. Evaluation of metabolic responses of *Artemia salina* to oil and oil dispersant as a potential indicator of toxicant stress. Bulletin of Environmental Contamination and Toxicology **36**:444-451.
**Keywords:** adult/ bioassay/ concentration/ crude oil/ dispersant/ evaluation/ indicator/ marine

invertebrate/ metabolism/ ODfour/ oil/ rate/ respiration/ salt water/ shrimp/ size/ static/ stress/ survival
**Notes:** Evaluation of the effect of Tunesian crude oil, Finasol-$OSR_2$ dispersant, and a mixture of the two on metabolism of adult brine shrimp. Shrimp were exposed to test materials for 96 hrs in a static bioassay. Crude oil was in the form of an oil-in-water dispersion; concentrations of oil, dispersant, or oil plus dispersant ranged from 0 to 800 ppm. Test solutions were evaluated as freshly mixed, 48 hrs old, and 96 hrs old, except for the oil plus dispersant, which was only tested as freshly mixed. Measured survival, respiration rates, and calculated $LD_{50s}$. Respiration rates of two size classes were also compared.

**Vignier, V., J. H. Vandermeulen, A. J. Fraser**, 1992. Growth and food conversion by Atlantic salmon parr during 40 days' exposure to crude oil. Transactions of the American Fisheries Society **121**:322-332.
**Keywords:** Atlantic/ Atlantic salmon/ biochemistry/ concentration/ crude oil/ feeding/ fish/ food/ fresh water/ growth/ Hibernia crude oil/ juvenile/ liver/ muscle/ oil/ Othree/ petroleum/ physiology/ rate/ salmon
**Notes:** Juvenile Atlantic salmon were exposed to two concentrations of water-accomodated Hibernia crude oil for up to 40 da. Measured petroleum concentrations in water, feeding rates, food conversion and growth, plus characteristics of physiology and biochemistry in muscle, gut, and liver.

**Vitaliano, J. J., R. N. Reid, A. B. Frame, D. B. Packer, L. Arlen, J. N. Sacco**, 2002. Comparison of benthic invertebrate assemblages at *Spartina alterniflora* marshes reestablished after an oil spill and existing marshes in the Arthur Kill (NY/NJ). Marine Pollution Bulletin **44**:1100-1108.
**Keywords:** benthic/ estuary/ fuel oil/ invertebrate/ marine invertebrate/ No.2 fuel oil/ Ofour/ oil/ oil spill/ oiled/ recovery/ remediation/ salt water/ Spartina/ spill
**Notes:** Six sites along the Arthur Kill were compared in an effort to determine recovery of invertebrates from a 1990 spill of No. 2 fuel oil. Two sites were oiled but not planted, two were oiled and planted, and two sites were established marshes that were only slightly affected by the spilled oil. Benthic invertebrates were sampled in 9/96 and 5/97, identified, and compared among sites.

**Vlasopoulos, N., F. A. Memon, D. Butler, R. Murphy**, 2006. Life cycle assessment of wastewater treatment technologies treating petroleum process waters. Science of the Total Environment **367**:58-70.
**Keywords:** combination/ life cycle/ methods/ oil/ oil field/ Onine/ petroleum/ pollution/ technical/ time/ treatment/ waste water/ water
**Notes:** Application of a life cycle assessement to determine the environmental impact of 20 technologies capable of treating waste water produced by oil and gas extraction operations over a 15 year time horizon. A decision support system was then used to identify combinations of methods that would produce water sufficiently clean for nine industrial and agricultural uses. Finally, a total of 618 suitable combinations were evaluated for their environmental impacts.

**Volkman, J. K., D. G. Holdsworth, G. P. Neill, H. J. Bavor, Jr.**, 1992. Identification of natural anthropogenic and petroleum hydrocarbons in aquatic sediments. Science of the Total Environment **112**:203-219.
**Keywords:** analysis/ Australia/ hydrocarbons/ methods/ Onine/ petroleum/ petroleum hydrocarbons/ salt water/ sediment/ sources/ technical
**Notes:** A detailed assessment of methods used to distinguish the sources of environmental hydrocarbons in sediments. The authors employ these methods on sediments collected from unpolluted and polluted sites along coastal Australia.

**Wade, T. L., J. G. Quinn**, 1980. Incorporation, distribution and fate of saturated petroleum hydrocarbons in sediments from a controlled marine ecosystem. Marine Environmental Research **3**:15-33.
**Keywords:** aliphatic hydrocarbons/ degradation/ distribution/ ecosystem/ fate/ flow-through/ fuel oil/ hydrocarbons/ mesocosm/ miscellaneous/ No.2 fuel oil/ Oeleven/ oil/ petroleum/ petroleum hydrocarbons/ salt water/ saturated hydrocarbons/ sediment/ time
**Notes:** Four indoor mesocosm water tanks were set up to mimic the dynamics of Narragansett Bay. Each tank contained sea water and sediment and operated in a flow-through mode. An oil-water dispersion of No. 2 fuel oil was added to three of the tanks twice weekly for 24 wk. Water and sediments were sampled periodically during the period of fuel oil addition and for about 9 wk beyond. Water and sediment were analyzed for aliphatic hydrocarbons.

**Wade, T. L., M. C. Kennicutt, II, J. M. Brooks**, 1989. Gulf of Mexico hydrocarbon seep communities: part III. Aromatic hydrocarbon concentrations in organisms, sediments and water. Marine Environmental Research **27**:19-30.
**Keywords:** aromatic hydrocarbons/ bivalve/ carbon/ clam/ community/ concentration/ crab/ fish/ Gulf of Mexico/ hydrocarbons/ isotope/ marine invertebrate/ Mexico/ microbes/ miscellaneous/ mussel/ Oeleven/ oil/ oil seep/ salt water/ scallop/ sediment/ shrimp/ snail
**Notes:** Organisms, sediment, and water were collected from the vicinity of a large natural oil seep in the northern Gulf of Mexico and analyzed for a subset of aromatic hydrocarbons. Also subjected the samples to a stable carbon isotope anslysis. Collected mussels, tube worms, snails, fish, crabs, scallops, clams, and shrimp.

**Wakeham, S. G.**, 1976. A comparative survey of petroleum hydrocarbons in lake sediments. Marine Pollution Bulletin **7**:206-211.
**Keywords:** aliphatic hydrocarbons/ composition/ fresh water/ hydrocarbons/ miscellaneous/ Oeleven/ petroleum/ petroleum hydrocarbons/ population/ sediment/ survey/ Washington
**Notes:** Sediment samples were collected from three lakes in the state of Washington; an urbanized lake, a lake with moderate population in the watershed, and a lake with few people in the watershed. Sediments were analyzed for aliphatic hydrocarbons and the results evaluated for their resemblance to the array of aliphatics found in petroleum.

**Wakeham, S. G.**, 1977. A characterization of the sources of petroleum hydrocarbons in Lake Washington. Journal of the Water Pollution Control Federation **49**:1680-1687.
**Keywords:** aliphatic hydrocarbons/ analysis/ creek/ fresh water/ hydrocarbons/ miscellaneous/ Oeleven/ particulate/ petroleum/ petroleum hydrocarbons/ river/ sampling/ sediment/ sources/ stormwater/ stream/ urban/ Washington
**Notes:** The source of hydrocarbons in the surface sediments of Lake Washington, WA were sought by sampling water from streams, urban stormwater, bridge stormwater, rainfall, and dry particulate deposition over a 15 mo period. A total of 45 river and creek, 50 stormwater, 13 rainfall, and six dust samples were collected. Samples were analyzed for aliphatic hydrocarbons and the results compared to the analysis of sediment hydrocarbons.

**Waldichuk, M.**, 1990. Sea otters and oil pollution. Marine Pollution Bulletin **21**:10-15.
**Keywords:** coast/ crude oil/ Exxon Valdez/ history/ mammal/ North America/ oil/ oil spill/ Otwo/ pollution/ population/ Prudhoe Bay crude oil/ rehabilitation/ salt water/ sea otter/ spill
**Notes:** A historical and status report on sea otters of the the west coast of North America with particular reference to the significance of oil spills, including the Exxon Valdez spill.

**Walker, A. H., J. H. Kucklick, J. Michel, D. K. Scholz, and T. Reilly** 1995. Chemical treating agents: response niches and research and development needs. Pages 211-217 *in* 1995 International Oil Spill Conference, API 4620. American Petroleum Institute, Washington, D.C.
**Keywords:** bioremediation/ burning/ chemical agent/ development/ dispersant/ evaluation/ miscellaneous/ Oeleven/ oil/ oil spill/ petroleum/ spill/ spill response
**Notes:** An evaluation of the worldwide use of chemical treating agents, excluding dispersants, burning agents, and bioremediation agents. Categorizes agents into classes, potential uses, use by oil type and weathering, use by spill response stage, and proposed research and development needs.

**Walker, D. A., P. J. Webber, E. F. Binnian, K. R. Everett, N. D. Lederer, E. A. Nordstrand, M. D. Walker**, 1987. Cumulative impacts of oil fields on northern Alaskan landscapes. Science **238**:757-761.
**Keywords:** Alaska/ development/ effects/ evaluation/ fresh water/ freshwater plant/ gravel/ miscellaneous/ Oeleven/ oil/ oil field/ Prudhoe Bay/ time/ vegetation
**Notes:** An evaluation of the physical and botanical effects of oil field development in the Prudhoe Bay oil fields using three 22 $km^2$ areas. Originally mapped in 1949, each area was re-mapped (aerial photos) on an annual basis from 1968 to 1983. Authors address the warming effect of gravel roads, gravel construction pads, and excavations; and the disturbance to natural vegetation.

**Walker, H. A., E. Lorda, S. B. Saila**, 1981. A comparison of the incidence of five pathological conditions in soft-shell clams, *Mya arenaria*, from environments with various pollution histories. Marine Environmental Research **5**:109-123.
**Keywords:** analysis/ bivalve/ Chesapeake/ clam/ condition/ environment/ evaluation/ history/ marine invertebrate/ Nova Scotia/ Ofour/ pathology/ pollution/ salt water/ shell/ statistics
**Notes:** Statistical evaluation of five pathological conditions found in soft shell clams collected from 17 sites between Nova Scotia and the Chesapeake Bay. Results of the analysis were related to the pollution history of the collection site.

**Walker, J. D., P. A. Seesman, T. L. Herbert, R. R. Colwell**, 1976. Petroleum hydrocarbons: degradation and growth potential of deep-sea sediment bacteria. Environmental Pollution **10**:89-99.
**Keywords:** assay/ bacteria/ concentration/ degradation/ growth/ hydrocarbons/ inorganic/ microbes/ nutrients/ oil/ organic/ Oten/ petroleum/ petroleum hydrocarbons/ salt water/ sediment/ static/ substrate
**Notes:** Assessed and compared the ability of coastal and deep-sea sediment bacteria to degrade petroleum hydrocarbons. Performed static laboratory assays for 7 wk periods. Measured concentrations of inorganic and organic compounds and microbes in water before autoclaving the water samples and measured inorganic nutrients after autoclaving and addition of sediment. Measured growth of sediment bacteria in oil salts and in autoclaved and non-autoclaved water after addition of a mixed hydrocarbon substrate.

**Walker, J. D., R. R. Colwell**, 1977. Effect of petroleum hydrocarbons in growth and activity of marine bacteria isolated from open ocean water. Developments in Industrial Microbiology **18**:655-660.
**Keywords:** activity/ bacteria/ Bunker C/ Caribbean/ condition/ crude oil/ depth/ experiment/ fuel oil/ glucose/ growth/ hydrocarbons/ Kuwait/ Kuwait crude oil/ Louisiana/ Louisiana crude oil/ microbes/ No.2 fuel oil/ oil/ Oten/ petroleum/ petroleum hydrocarbons/ population/ salt water/ sampling/ South Louisiana crude oil/ static
**Notes:** Microbes from surface and subsurface water samples collected in the Caribbean Sea were exposed to surface applications of South Louisiana crude oil or mixtures of hydrocarbons, or water-soluble fractions (WSF) of South Louisiana crude oil, Kuwait crude oil, No. 2 fuel oil, or Bunker C. Measured the growth of microbe populations during a 6 wk experiment (static) with surface applications and during a 6 da experiment with WSFs. Also compared the growth and glucose utilization of microbes from the two sampling depths under control conditions.

**Walker, J. D., R. R. Colwell**, 1977. Role of autochthonous bacteria in the removal of spilled oil from sediment. Environmental Pollution **12**:51-56.
**Keywords:** aromatic hydrocarbons/ bacteria/ Bunker C/ concentration/ creek/ crude oil/ degradation/ evaluation/ fuel oil/ hydrocarbons/ microbes/ oil/ oil spill/ Oten/ petroleum/ petroleum hydrocarbons/ salt water/ saturated hydrocarbons/ sediment/ spill/ weight
**Notes:** Evaluation of the degradation of petroleum in sediments of a tributary of Baltimore (MD) Harbor. Oil spills periodically affect the creek. Monthly samples of water and sediment were collected for 9 mos, during which there occurred spills of crude oil, fuel oil, and Bunker C oil. Hydrocarbons were analyzed by mass spectrometry and water-sediment mixtures were cultured for bacteria. Estimated degradation as percent decrease in the presence, by weight, of 12 classes of saturated and non-saturated hydrocarbons 1 mo after the spill increased the hydrocarbon concentrations in water and sediment.

**Walters, P., S. Khan, P. J. O'Brien, J. F. Payne, A. D. Rahimtula**, 1987. Effectiveness of a Prudhoe Bay crude oil and its aliphatic, aromatic and heterocyclic fractions in inducing mortality and aryl hydrocarbon hydroxylase in chick embryo in ovo. Archives of Toxicology **60**:454-459.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ bird/ chicken/ chicks/ crude oil/ effectiveness/ embryo/ metabolism/ nonhydrocarbon/ oil/ Oone/ physiology/ Prudhoe Bay/ Prudhoe Bay crude oil/ survival/ toxicity
**Notes:** Toxicity of the aliphatic, aromatic, and non-hydrocarbon fractions of Prudhoe Bay crude oil to chicken embryos; survival and physiological measures.

**Walton, D. G., W. R. Penrose, J. M. Green**, 1978. The petroleum-inducible mixed-function oxidase of cunner (*Tautogolabrus adspersus* Walbaum 1792): some characteristics relevant to hydrocarbon

monitoring. Journal of the Fisheries Research Board of Canada **35**:1547-1552.
**Keywords:** crude oil/ cunner/ dosed/ fish/ hydrocarbons/ liver/ mixed-function oxidase/ monitoring/ mussel/ oil/ Othree/ pollution/ salt water/ species/ tissue
**Notes:** Exposure of the cunner to crude oil in water (15 da), force-fed crude oil (one dose, followed for 1 wk), or force-fed mussel tissue containing crude oil (every 2 da for 2 wk). Measured hepatic aryl hydrocarbon hydroxylase in an effort to confirm its usefulness as a monitoring species for oil pollution.

**Walton, P., C. M. R. Turner, G. Austin, M. D. Burns, P. Monaghan**, 1997. Sub-lethal effects of an oil pollution incident on breeding kittiwakes (*Rissa tridactyla*). Marine Ecology Progress Series **155**:261-268.
**Keywords:** adult/ bird/ blood/ colony/ effects/ foraging/ kittiwake/ nest/ oil/ Oone/ pollution/ rate/ reproduction/ salt water/ Shetland/ sublethal/ survival/ tanker
**Notes:** Assessment of the breeding success of kittiwakes at the closest colony breeding site to the January, 1993 wreck of the 'Braer' oil tanker in Shetland. Measured breeding timing and performance, foraging behaviour, return rates and survival of adults, fidelity in nest site and mate, and several blood characteristics during the years 1990-95. All measures were not performed all years.

**Wang, R. T., J. A. C. Nicol**, 1977. Effects of fuel oil on sea catfish: feeding activity and cardiac responses. Bulletin of Environmental Contamination and Toxicology **18**:170-176.
**Keywords:** activity/ catfish/ concentration/ effects/ emulsion/ experiment/ feeding/ fish/ fuel oil/ heart/ No.2 fuel oil/ oil/ Othree/ pathology/ physiology/ salt water/ sea catfish/ survival
**Notes:** Sea catfish exposed to several concentrations of No. 2 fuel oil (oil-water emulsion) in laboratory experiments of 4 and 11 da duration. Activity, survival, feeding response, and cardiac function were measured; also some pathology.

**Wang, S. Y., J. L. Lum, M. G. Carls, S. D. Rice**, 1993. Relationship between growth and total nucleic acids in juvenile pink salmon, *Onchrhynchus gorbuscha*, fed crude oil contaminated food. Canadian Journal of Fisheries and Aquatic Sciences **50**:996-1001.
**Keywords:** concentration/ crude oil/ fish/ food/ growth/ juvenile/ North Slope/ North Slope crude oil/ nucleic acid/ oil/ Othree/ pink salmon/ salmon/ salt water
**Notes:** Exposure of juvenile pink salmon to North Slope crude oil in food for 6 wks. Measured nucleic acid concentrations and growth of fish to see if the former could be used to evaluate the latter.

**Wang, X., J. Zhang, X. Shi, C. Zhu, Y. An, S. Jun, R. Li, M. Zhu, S. Chen**, 2002. Determination of toxicokinetic parameters for bioconcentration of water-soluble fraction of petroleum hydrocarbon associated with No. 0 diesel in Changjiang Estuary and Jiaozhou Bay: model versus mesocosm experiments. Archives of Environmental Contamination and Toxicology **42**:272-279.
**Keywords:** biomass/ diesel/ elimination/ estuary/ experiment/ fuel oil/ growth/ hydrocarbons/ kinetic/ mesocosm/ model/ oil/ Onine/ parameters/ petroleum/ phytoplankton/ salt water/ technical/ uptake
**Notes:** Laboratory and mesocosm experiments were used to determine kinetic parameters for uptake and elimination of water-soluble hydrocarbons (No. 0 fuel oil) by phytoplankton, and the resultant growth in phytoplankton biomass.

**Wang, X., Y. An, J. Zhang, X. Shi, C. Zhu, R. Li, M. Zhu, S. Chen**, 2002. Contribution of biological processes to self-purification of water with respect to petroleum hydrocarbon associated with No. 0 diesel in Changjiang Estuary and Jiaozhou Bay, China. Hydrobiologia **469**:179-191.
**Keywords:** China/ coast/ degradation/ diesel/ diesel fuel/ estuary/ fuel oil/ hydrocarbons/ mesocosm/ model/ oil/ Onine/ petroleum/ petroleum hydrocarbons/ remediation/ salt water/ sediment/ suspended sediment/ technical
**Notes:** Mesocosms were situated in two estuaries in coastal China and contaminated with the water-soluble fraction of No. 0 fuel oil. Water was sampled periodically and relational values were calculated for natural degradation (chemical, physical, biological) of the hydrocarbons. Also performed a laboratory assessment of the sorption characteristics of suspended sediment. Results were used to create a model descriptive of the natural remediation process for this type of petroleum product in coast waters.

**Wang, X.-C., S. Sun, H.-Q. Ma, Y. Liu**, 2006. Sources and distribution of aliphatic and polyaromatic hydrocarbons in sediments of Jiaozhou Bay, Qingdao, China. Marine Pollution Bulletin **52**:129-138.

**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ carbon/ China/ distribution/ hydrocarbons/ miscellaneous/ nitrogen/ Oeleven/ organic/ organic carbon/ PAH/ salt water/ sediment/ sources
**Notes:** Surface sediments were sampled at 25 sites in and at the mouth of Jiaozhou Bay. Samples were analyzed for total organic carbon, total nitrogen, 21 n-alkanes, and 16 PAHs. Classified the sites according to the dominant source of hydrocarbons (petrogenic, pyrolitic, mixed).

**Wang, Z., M. Fingas**, 1996. Separation and characterization of petroleum hydrocarbons and surfactant in Orimulsion dispersion samples. Environmental Science and Technology **30**:3351-3361.
**Keywords:** hydrocarbons/ Onine/ Orimulsion/ petroleum/ petroleum hydrocarbons/ surfactant/ technical
**Notes:** Characterization of components of Orimulsion.

**Wang, Z., M. Fingas, S. Blenkinsopp, G. Sergy, M. Landriault, L. Sigouin, P. Lambert**, 1998. Study of the 25-year-old Nipisi oil spill: persistence of oil residues and comparisons between surface and subsurface sediments. Environmental Science and Technology **32**:2222-2232.
**Keywords:** Alberta/ analysis/ crude oil/ degradation/ fresh water/ hydrocarbons/ miscellaneous/ Oeleven/ oil/ oil spill/ persistence/ petroleum/ petroleum hydrocarbons/ pipeline/ ratio/ sediment/ soil/ spill/ weathered
**Notes:** Presentation of the chemical results of a 1995 follow-up study of three pipeline ruptures that occurred in northern Alberta during 1970-72. Soil samples were in three groups; reference, 0-4 cm, 10-40 cm, and 80-100 cm. Measured total solvent-extractable material, total petroleum hydrocarbons, total n-alkanes, diagnostic weathering ratios, and other results from a detailed GC/MS analysis.

**Wang, Z., M. Fingas, M. Landriault, L. Sigouin, S. Grenon, D. Zhang**, 1999. Source identification of an unknown spilled oil from Quebec (1998) by unique biomarkers and diagnostic ratios of "source-specific marker" compounds. Environmental Technology **20**:851-862.
**Keywords:** biomarker/ Canada/ chemical analysis/ distribution/ fingerprinting/ fresh water/ oil/ Onine/ PAH/ petroleum/ petroleum hydrocarbons/ ratio/ release/ sources/ spill/ technical
**Notes:** Forensic investigation into the release of an unknown oil from a factory fire in Quebec, Canada. Samples were collected of oil from the suspected source and the receiving river. Source identification involved hydrocarbon groups and oil type identification, distribution of petroleum alkylated PAH homologues, unique biomarker compounds, and stable carbon-isotopic ratios.

**Wang, Z., C. Yang, B. Hollebone, M. Fingas**, 2006. Forensic fingerprinting of diamondoids for correlation and differentiation of spilled oil and petroleum products. Environmental Science and Technology **40**:5636-5646.
**Keywords:** analysis/ crude oil/ distribution/ fingerprinting/ GC-MS/ oil/ Onine/ petroleum/ petroleum products/ refined oil/ technical
**Notes:** A discussion of the utility of using diamondoids (adamantanes and diamantanes) as identification markers for petroleum products. A GC-MS analytical method is described and the results of an analysis of the distributions of diamondoids in over 100 crude and refined oils are presented.

**Ward, D. M., R. M. Atlas, P. D. Boehm, J. A. Calder**, 1980. Microbial biodegradation and chemical evolution of oil from the Amoco spill. Ambio **9**:277-283.
**Keywords:** aerobic/ Amoco Cadiz/ anaerobic/ biodegradation/ coast/ combination/ composition/ degradation/ experiment/ France/ incubation/ microbes/ oil/ oiled/ Oten/ salt water/ sediment/ spill
**Notes:** Assessment of the role of microbial degradation in the removal of oil spilled by the wreck of the Amoco Cadiz off the coast of France in 1978. Sediment samples were collected from three oiled and two unoiled locations. Employed a combination of field collections and laboratory incubation experiments. Examined aerobic and anaerobic degradation potential. Reports the qualitative and quantitative changes in composition of the spilled oil during the first year after the spill.

**Wardrop, J. A., A. J. Butler, J. E. Johnson**, 1987. A field study of the toxicity of two oils and a dispersant to the mangrove *Avicennia marina*. Marine Biology **96** :151-156.
**Keywords:** adult/ Australia/ crude oil/ dispersant/ growth/ leaves/ mangrove/ marina/ marine plant/ ODsix/ oil/ reproduction/ salt water/ spill/ toxicity/ treatment
**Notes:** Adult mangroves in coastal Australia were sprayed with either crude oil (two kinds), chemical

dispersant, or crude oil plus dispersant (1:1) to the approximate height expected in an actual spill. Assessed leaf growth and damage during a 72-wk period after treatment. Monitored flower and fruit production for 157 wks after treatment.

**Warrick, G. D., T. T. Kato, M. V. Phillips, and H. J. Hill** 1997. Assessment of impacts and evaluation of restoration methods on areas affected by a well blowout, Naval Petroleum Reserve No. 1, California. Pages 53-66 *in* Effects of Oil on Wildlife. Bay Publishing Company, Monterey Bay, California.
**Keywords:** alkane/ bioremediation/ California/ crude oil/ effects/ evaluation/ fresh water/ general effect/ hydrocarbons/ invertebrate/ liver/ mammal/ methods/ Oeight/ oil/ PAH/ petroleum/ rat/ recovery/ restoration/ sampling/ soil/ sterane/ terpane/ vegetation
**Notes:** A broad spectrum description of the consequences of an oil well blowout at an arid grassland site in California. During the 12 mos after the blowout, the authors established sampling grids within areas that were subjected to natural recovery, bioremediation, surface modification, or served as an unaffected control. Collected soil, described vegetative cover, trapped small mammals, and made observations on presence of ants and beetles. Analyzed samples of crude oil, soil, and kangaroo rat livers for PAHs, alkanes, steranes, terpanes, or total 'extracted hydrocarbons'.

**Watt, I., T. Woodhouse, D. A. Jones**, 1993. Intertidal clean-up activities and natural regeneration on the Gulf coast of Saudi Arabia from 1991 to 1992 after the 1991 Gulf oil spill. Marine Pollution Bulletin **27**:325-331.
**Keywords:** abundance/ activity/ cleaning/ coast/ degradation/ epifauna/ Gulf oil spill/ infauna/ intertidal/ marine invertebrate/ oil/ oil spill/ Onine/ procedure/ salt water/ Saudi Arabia/ sediment/ spill/ technical/ temperature/ time/ weathered
**Notes:** From 3/91 to 2/92, five clean-up procedures were used at four locations on the Gulf coastline of Saudi Arabia. Biological response to clean-up or absence of clean-up (control) was measured with abundance of epifauna and infauna through 11/92. Also measured sediment temperature. Visual characteristics of each site are presented. Fig. 1 is missing some information.

**Webb, J. W., S. K. Alexander, J. K. Winters**, 1985. Effects of autumn application of oil on *Spartina alterniflora* in a Texas salt marsh. Environmental Pollution (Series A) **38**:321-337.
**Keywords:** aliphatic hydrocarbons/ Arabian crude oil/ aromatic hydrocarbons/ biomass/ crude oil/ density/ effects/ fuel oil/ hydrocarbons/ marine plant/ No.2 fuel oil/ No.6 fuel oil/ oil/ Osix/ plant/ regrowth/ salt marsh/ salt water/ sediment/ Spartina/ Texas/ time/ treatment/ vegetation
**Notes:** Plots of *Spartina alterniflora* were treated with one of four oils (Libyan and Arabian crude oil; No. 2 and No. 6 fuel oil) in the manner of sediment only, sediment and lower 30 cm of the vegetation, or sediment and all the vegetation. Plant density and biomass were measured after treatment at 3 wks, 5 mos, and 1yr; No. 2 fuel oil plots were also assessed after 2 yrs. Regeneration of new plants was evaluated at 5 mos. Sediments (at 4 mos and 1 yr) and parent oils were analyzed for aliphatic and aromatic hydrocarbons.

**Weber, D. D., D. J. Maynard, W. D. Gronlund, V. Konchin**, 1981. Avoidance reactions of migrating adult salmon to petroleum hydrocarbons. Canadian Journal of Fisheries and Aquatic Sciences **38**:779-781.
**Keywords:** adult/ aromatic hydrocarbons/ avoidance/ behavior/ concentration/ fish/ hydrocarbons/ monoaromatic/ numbers/ Othree/ Pacific/ petroleum/ petroleum hydrocarbons/ salmon/ salt water
**Notes:** Migrating Pacific salmon were offered a fish ladder spiked with a mixture of monoaromatic hydrocarbons and an alternate that was not treated. Numbers of fish using the two ladder were counted to determine if avoidance occurred; regression of concentrations and numbers of fish.

**Weiner, A., C. Berg, T. Gerlach, J. Grunblatt, K. Holbrook, M. Kuwada**, 1997. The *Exxon Valdez* oil spill: habitat protection as a restoration strategy. Restoration Ecology **5**:44-55.
**Keywords:** crude oil/ Exxon Valdez/ habitat/ habitat protection/ injury/ miscellaneous/ natural resource/ Oeleven/ oil/ oil spill/ procedure/ protection/ Prudhoe Bay crude oil/ recovery/ restoration/ salt water/ spill
**Notes:** Description of the habitat protection aspect of the Exxon Valdez oil spill restoration process. Procedures and rational for the acquisition of land parcels as compensation for the natural resource injuries caused by the spill.

**Weir, D. N., R. Y. McGowan, A. C. Kitchener, S. McOrist, B. Zonfrillo, M. Heubeck**, 1995. Iceland gulls from the 'Braer' disaster, Shetland 1993. British Birds **88**:15-25.
**Keywords:** bird/ gull/ necropsy/ oil/ oil spill/ Oone/ pathology/ salt water/ Shetland/ species/ spill/ United Kingdom
**Notes:** Necropsy results of 15 Iceland gulls that died during the 'Braer' oil spill in Shetland in 1993. The rare invasion of this species coincided with the oil spill. Necropsy results compared to those of other gull species.

**Weller, G., D. W. Norton**, 1977. Oil in the Arctic. 2. The Outer Continental Shelf Environmental Assessment Program. Interdisciplinary Science Review **2**:214-226.
**Keywords:** Arctic/ crude oil/ environment/ hazard/ miscellaneous/ Oeleven/ oil/ oil field/ petroleum/ pollution/ salt water
**Notes:** Environmental concerns about large-scale petroleum exploration and production in the Arctic began to be addressed by NOAA's Outer Continental Shelf Environmental Assessment Program (OCSEAP) in 1975. Authors present the background to the formation of the OCSEAP and discuss hazards to Arctic fauna, chemical baselines, the physical environment of the Arctic, hydrocarbon and metal pollution, and hazards for oil exploration and production.

**Wells, P. G., P. D. Keizer**, 1975. Effectiveness and toxicity of an oil dispersant in large outdoor salt water tanks. Marine Pollution Bulletin **6**:153-157.
**Keywords:** behavior/ bioassay/ crude oil/ dispersant/ effectiveness/ experiment/ marine invertebrate/ ODnine/ oil/ PAH/ ratio/ salt water/ sea urchin/ survival/ technical/ toxicity/ Venezuelan crude oil
**Notes:** Outdoor tanks were used in an assessment of the effectiveness of a chemical dispersant (Oilsperse 43) on Venezuelan crude oil. One tank received crude oil alone and the other tank received crude oil plus dispersant (1:1 ratio). Duration of the experiment was 31 da. Water was sampled and analyzed for PAHs at 0-2 hrs and 96-98 hrs. At 2, 7, 14, and 27 da water was collected for a 96 hr bioassay with sea urchins. Measured percentage of dead and moribund sea urchins and described their behavior. Determined crude oil 'budget' of each tank on da 32. Fig. 2 is confusing.

**Wells, P. G., J. B. Sprague**, 1976. Effects of crude oil on American lobster (*Homarus americanus*) larvae in the laboratory. Journal of the Fisheries Research Board of Canada **33**:1604-1614.
**Keywords:** behavior/ bioassay/ crude oil/ development/ effects/ growth/ larvae/ lobster/ marine invertebrate/ molt/ Ofour/ oil/ oiled/ procedure/ salt water/ sediment/ static/ survival/ time/ Venezuelan crude oil/ weathered
**Notes:** A laboratory assessment of the effects of a dispersion of Venezuelan crude oil on lobster larvae. Exposures ranged from 24 hrs through 30 da. A static bioassay procedure was employed with periodic replacement of the exposure solution in the 30 da exposures. Measured survival ($ET_{50s}$ and $LC_{50s}$), effect of moult on survival, development times, effects of aging (24 and 48 hrs) on the toxic effects of dispered oil solutions, and the response of post-larval lobsters to oiled sediment.

**Wells, P. G., G. W. Harris**, 1979. Dispersing effectiveness of some oil spill dispersants: tests with the 'Mackay apparatus' and Venezuelan Lago Medio crude oil. Spill Technology Newsletter **4** :232-241.
**Keywords:** Corexit 9527/ crude oil/ dispersant/ effectiveness/ fresh water/ ODnine/ oil/ oil spill/ petroleum/ salt water/ spill/ technical
**Notes:** An early report of effectiveness testing of five chemical dispersants (BP1100X, Corexit 8666, Corexit 9527, Drew O.S.E. 71, Oilsperse 43). Dispersants were ranked according to effectiveness in fresh and salt water.

**Wells, P. G., S. Abernethy, D. Mackay**, 1982. Study of oil-water partitioning of a chemical dispersant using an acute bioassay with marine crustaceans. Chemosphere **11**:1071-1086.
**Keywords:** acute/ adult/ bioassay/ combination/ concentration/ copepod/ Corexit 9527/ crustacean/ dispersant/ lethal/ marine invertebrate/ mineral oil/ ODnine/ oil/ procedure/ salt water/ shrimp/ static/ survival/ technical/ time
**Notes:** Static bioassays with larval brine shrimp (2 da) and larval and adult copepods (4 da) were employed to determine the oil-water partititioning of the toxic constituents of a chemical oil dispersant (Corexit 9527). Test organisms were exposed to various concentrations of a commercial mineral oil,

Corexit 9527, or combinations of median lethal concentrations of Corexit 9527 and mineral oil. Variations in the pre-mixing procedure were also evaluated. Measured survival, incapacitation, and the time to occurrence of both.

**Werner, M. D., V. D. Adams**, 1984. Consequences of oil pollution on the decomposition of vascular plant litter in freshwater lakes: Part 1 -- Decomposition rates and dissolved oxygen utilisation. Environmental Pollution (Series A) **34**:83-100.
**Keywords:** biomass/ consumption/ crude oil/ decomposition/ dissolved/ fresh water/ freshwater plant/ litter/ Louisiana/ microbes/ oil/ Oten/ oxygen/ petroleum/ plant/ pollution/ rate/ South Louisiana crude oil/ time/ vegetation
**Notes:** The effect of petroleum pollution on litter decomposition in Rocky Mountain (U.S.) lakes was evaluated. Mesh bags of two types of aquatic vegetation were dipped in either of two crude oils (S. Louisiana, Western Wyoming) and placed on the nearshore lake bottom of an acidic and an alkaline lake. Bags were sampled nine times during the 365 da period of study. Oxygen consumption of the decomposing vegetation and loss of biomass were measured.

**Wernersson, A.-S.**, 2003. Predicting petroleum phototoxicity. Ecotoxicology and Environmental Safety **54**:355-365.
**Keywords:** aromatic hydrocarbons/ bioassay/ crude oil/ daphnia/ fresh water/ freshwater invertebrate/ irradiance/ miscellaneous/ Oeleven/ oil/ PAH/ petroleum/ petroleum products/ phototoxicity/ refined oil/ toxicity
**Notes:** A total of 22 crude and refined oil products and 14 pure PAHs were used in laboratory bioassays with *Daphnia magna* to determine their phototoxicity. Crude oils or petroleum products were prepared as either water-accomodated fractions or petroleum-dissolved slurries. All petroleum crudes or refined products were analyzed for a suite of individual PAHs plus total aromatics. Toxicity was measured as the ability to immobilize the *Daphnia* after a 24 hr period of exposure with or without irradiation.

**Wertheimer, A. C., R. A. Heintz, J. F. Thedinga, J. M. Maselko, S. D. Rice**, 2001. Straying of adult pink salmon from their natal stream following embryonic exposure to weathered *Exxon Valdez* crude oil. Transactions of the American Fisheries Society **129**:989-1004.
**Keywords:** adult/ aromatic hydrocarbons/ crude oil/ eggs/ Exxon Valdez/ fish/ fry/ gravel/ hydrocarbons/ oil/ Othree/ PAH/ petroleum/ petroleum hydrocarbons/ pink salmon/ Prudhoe Bay/ Prudhoe Bay crude oil/ salmon/ salt water/ spawn/ stream/ substrate/ tissue/ weathered
**Notes:** Pink salmon eggs were exposed to either 0, 5, or 19 ppm of aqueous total PAHs from gravel substrate treated with artificially-aged Prudhoe Bay crude oil. Fry from each group were marked with coded wire tags and released from the natal stream. Adult salmon were captured upon return to the natal stream, and several streams and hatcheries were surveyed for returning adults (strays) up to 100 km away. Total petroleum hydrocarbons (sum of 44 PAHs) were measured in experimental gravel, water, and fish tissue.

**Weslawski, J. M., J. Wiktor, M. Zajaczkowski, G. Futsaeter, K. A. Moe**, 1997. Vulnerability assessment of Svalbard intertidal zone for oil spills. Estuarine and Coastal and Shelf Science **44**:33-41.
**Keywords:** bird/ coast/ intertidal/ mammal/ marine invertebrate/ marine plant/ miscellaneous/ Norway/ Oeleven/ oil/ oil spill/ salt water/ spill/ Svalbard/ vulnerability
**Notes:** A system for estimating the vulnerability of a coastline to oil spills. Physical and biological characteristics of the intertidal zone on the Svalbard archipelago (Norway) were ranked as principal, important, or secondary and used to produce physical and biological indices.

**West, R. L. and E. Snyder-Conn**. 1987. Effects of Prudhoe Bay reserve pit fluids on water quality and macroinvertebrates of Arctic tundra ponds. U.S. Fish and Wildlife Service, Washington, DC. Biological Report **87(7)**. 48 pp.
**Keywords:** aliphatic hydrocarbons/ Arctic/ aromatic hydrocarbons/ community/ diversity/ effects/ effluent/ hydrocarbons/ invertebrate/ macroinvertebrate/ marine invertebrate/ metals/ miscellaneous/ Oeleven/ oil/ oil field/ population/ Prudhoe Bay/ salt water/ tundra
**Notes:** Effluent in six drill site fluid reserve pits in the Prudhoe Bay oil fields were sampled in June 1983. In July, water in the same pits plus an adjacent and a distant natural pond downflow from each reserve

pit, and three control ponds, were sampled. Additionally, aquatic invertebrates were sampled from each reserve pit, adjacent and distant pond, and control pond in July. The water was chemically-characterized and analyzed for metals and selected aliphatic and aromatic hydrocarbons. Invertebrates were identified, counted, and diversity indices calculated.

**Westernhagen, H. von, V. Dethlefsen**, 1982. Effect of the surfactant Corexit 7664 on uptake of cadmium by organisms and biological matter in a closed circulated brackish-water system. Helgolander Meeresuntersuchungen **35**:1-12.
**Keywords:** accumulation/ bivalve/ combination/ concentration/ Corexit 7664/ digestive gland/ dispersant/ effects/ fish/ flounder/ growth/ juvenile/ liver/ marine invertebrate/ mussel/ ODthree/ salt water/ species/ surfactant/ survival/ tissue/ uptake
**Notes:** Effects on common mussels and juvenile flounder of experimental exposure to one concentration of Cd and Corexit 7664, singly or in combination, for 400 da. Accumulation of Cd was measured in digestive gland and soft tissue of mussels and liver of flounder; also survival of both species and growth of flounder.

**Whipple, W., Jr., J. V. Hunter**, 1979. Petroleum hydrocarbons in urban runoff. Water Research Bulletin **15**:1096-1105.
**Keywords:** fresh water/ hydrocarbons/ miscellaneous/ Oeleven/ PAH/ particulate/ petroleum/ petroleum hydrocarbons/ solubility/ stormwater/ urban
**Notes:** Sampled stormwater runoff during storm events at two sites in Philadelphia, PA and two sites in Trenton, NJ during 1974-76. Sampled 2-5 storm events at each site and measured the total hydrocarbon content as particulate and soluble portions. Selected PAHs were identified.

**White, D. H., K. A. King, N. C. Coon**, 1979. Effects of No. 2 fuel oil on hatchability of marine and estuarine bird eggs. Bulletin of Environmental Contamination and Toxicology **21**:7-10.
**Keywords:** bird/ effects/ egg shell/ eggs/ embryo/ estuarine/ fuel oil/ gull/ hatchability/ heron/ Louisiana/ No.2 fuel oil/ oil/ Oone/ salt water/ species/ tern
**Notes:** Effects on embryos of Louisiana herons, laughing gulls, and sandwich terns of eggshell applications of No. 2 fuel oil; field and laboratory portions of the study.

**White, F. N., J. L. Kinney**, 1974. Avian incubation. Science **186**:107-115.
**Keywords:** bird/ development/ embryo/ incubation/ insulation/ nest/ Oone/ temperature
**Notes:** A detailed discussion of how birds maintain the appropriate temperature for development of the embryo. Sections on attentiveness and environmental temperature, nest insulation and attentiveness, embryonic heat production, adjustments in attentiveness with environmental temperature, and sensory receptors and attentiveness.

**White, I. C., J. A. Nichols**, 1981. The cost of oil spills. Marine Pollution Bulletin **12**:363-367.
**Keywords:** cost/ environment/ evaluation/ miscellaneous/ Oeleven/ oil/ oil spill/ pollution/ spill/ tanker
**Notes:** An evaluation by two staff members of the International Tanker Owners Pollution Federation Ltd. of the monetary cost of oil spills. Authors examine the details of the nature of the spill, the clean-up response, and calculations of environmental damage.

**White, P. M., Jr., D. C. Wolf, G. J. Thoma, C. M. Reynolds**, 2006. Phytoremediation of alkylated polycyclic aromatic hydrocarbons in a crude oil-contaminated soil. Water Air and Soil Pollution **169**:207-220.
**Keywords:** aromatic/ aromatic hydrocarbon/ aromatic hydrocarbons/ bacteria/ bioremediation/ crude oil/ fertilizer/ freshwater plant/ fungi/ growth/ hopane/ hydrocarbons/ microbes/ oil/ Oten/ PAH/ petroleum/ petroleum hydrocarbons/ pollution/ remediation/ root/ soil/ time
**Notes:** Soil contaminated with crude oil (9,175 ppm) was used in a phytoremediation study involving an untreated control, a fescue-ryegrass mixture plus fertilizer, and a fescue-bermudagrass mixture plus fertilizer. Duration was 21 mos. Soils were sampled at 0, 6, 17, and 21 mos and analyzed for total petroleum hydrocarbons, hopane, and selected PAHs. Also measured total bacteria, total fungi, total PAH degraders, and root growth at 6, 17, and 21 mos.

**Whittaker, M., S. J. T. Pollard, T. E. Fallick**, 1995. Characterisation of refractory wastes at heavy oil-contaminated sites: a review of conventional and novel analytical methods. Environmental Technology **16**:1009-1033.
**Keywords:** analysis/ critique/ fresh water/ methods/ Onine/ petroleum/ petroleum products/ review/ soil/ technical/ weathered
**Notes:** Review and critique of analytical methods available for analysis of soil contaminanted with heavy petroleum products.

**Whittaker, M., S. J. T. Pollard**, 1997. A performance assessment of source correlation and weathering indices for petroleum hydrocarbons in the environment. Environmental Toxicology and Chemistry **16**:1149-1158.
**Keywords:** crude oil/ degradation/ environment/ hydrocarbons/ index/ Onine/ petroleum/ petroleum hydrocarbons/ rate/ ratio/ refined oil/ technical/ weathered
**Notes:** Petroleum source assessment and weathering indices; compound ratios, weathering rates.

**Whittaker, M., S. J. T. Pollard, G. Risden**, 1999. The fate of heavy oil wastes in soil microcosms II: a performance assessment of source correlation indices. Science of the Total Environment **226**:23-34.
**Keywords:** aromatic hydrocarbons/ crude oil/ evaluation/ fate/ fuel oil/ hydrocarbons/ microcosm/ No.6 fuel oil/ oil/ Onine/ petroleum/ saturated hydrocarbons/ soil/ sources/ technical
**Notes:** An evaluation of six petroleum source correlation indices employing a 9 mo microcosm study. A crude oil, a ballast oil, and No. 6 fuel oil were mixed with soil, incubated and sampled at 0, 2, 4, 8, 16, 32, 64, 128, and 256 days. Measured selected saturate and aromatic hydrocarbons and calculated the indicies.

**Wibbe, M. L., M. M. Blanke**, 1999. Aliphatic hydrocarbons in an oil-contaminated soil. Carbon economy during microbiological decontamination. Soil Sciences **6**:2-6.
**Keywords:** aliphatic hydrocarbons/ carbon/ degradation/ economy/ emulsion/ hydrocarbons/ indicator/ microbes/ nutrients/ Oten/ plant/ remediation/ respiration/ soil/ time
**Notes:** Description of the decontamination process used to reduce the aliphatic hydrocarbon content of 1,500 tons of soil from a former linoleum plant in German. A nutrient emulsion was added and the soil was aerated for 13 mos. Measured soil respiration as an indicator of carbon efflux.

**Wicksten, M. K.**, 1984. Survival of sea anemones in Bunker C fuel. Marine Pollution Bulletin **15**:28-33.
**Keywords:** behavior/ Bunker C/ marine invertebrate/ Ofour/ oil/ salt water/ sea anemone/ survival
**Notes:** Assessement of the effect of Bunker C oil on sea anemones. Applied Bunker C oil directly to 27 sea anemones; some applications were to the oral field, others simply coated the entire body. Exposure duration ranged from 1 min to 1 hr. Observed survival and behavioral responses of sea anemones.

**Widdows, J., P. Donkin, S. V. Evans**, 1987. Physiological responses of *Mytilus edulis* during chronic oil exposure and recovery. Marine Environmental Research **23**:15-32.
**Keywords:** aromatic hydrocarbons/ chronic/ concentration/ depuration/ diesel/ diesel fuel/ flow-through/ growth/ length/ marine invertebrate/ mesocosm/ mussel/ Ofour/ oil/ physiology/ recovery/ salt water/ shell/ weight
**Notes:** Assessment of the recovery of a mussel from chronic exposure to two concentrations of water-accomodated fractions of diesel oil. Employed flow-through mesocosms and exposed mussels for 8 mos followed by depuration ranged from 5 da to 55 da. Measured five physiological responses, shell length and growth characteristics, four weight measurements, concentrations of two- and three-ring aromatics, and calculated scope for growth.

**Wiens, J. A., R. G. Glenn, D. Heinemann**, 1984. Information needs and priorities for assessing the sensitivity of marine birds to oil spills. Biological Conservation **28**:21-49.
**Keywords:** bird/ effects/ foraging/ marine birds/ model/ oil/ oil spill/ Oone/ population/ reproduction/ salt water/ spill/ survival
**Notes:** Discussion of the problems associated with modelling the effects of oil spills on marine bird populations; prioritizes information needs and presents reasoning for each information need.

**Wiens, J. A.**, 1996. Oil, seabirds, and science. *The effects of the* Exxon Valdez *oil spill*. BioScience **46**:587-597.
**Keywords:** Alaska/ bird/ commentary/ crude oil/ effects/ evaluation/ Exxon Valdez/ habitat/ oil/ oil spill/ Oone/ population/ Prudhoe Bay crude oil/ reproduction/ salt water/ species/ spill/ toxicity
**Notes:** Overall evaluation of the results of scientific findings of the effects of the Exxon Valdez on bird species and a commentary on some of the effects of the spill on the scientific effort; direct toxicity, reproduction, population resiliency, and habitat.

**Wiens, J. A., T. O. Crist, R. H. Day, S. M. Murphy, G. D. Hayward**, 1996. Effects of the *Exxon Valdez* oil spill on marine bird communities in Prince William Sound, Alaska. Ecological Applications **6**:828-841.
**Keywords:** Alaska/ bird/ community/ crude oil/ effects/ evaluation/ Exxon Valdez/ marine birds/ multivariate/ oil/ oil spill/ Oone/ population/ Prince William Sound/ Prudhoe Bay crude oil/ salt water/ spill
**Notes:** Evaluation of the effects of the Exxon Valdez spill on marine bird communities of Prince William Sound, Alaska in 1989-91; use of multivariate analyses.

**Wiese, F. K., W. A. Montevecchi, G. K. Davoren, F. Huettmann, A. W. Diamond, J. Linke**, 2001. Seabirds at risk around offshore oil platforms in the North-west Atlantic. Marine Pollution Bulletin **42**:1285-1290.
**Keywords:** Atlantic/ bird/ injury/ monitoring/ offshore/ oil/ oil platform/ oil spill/ Oone/ risk/ salt water/ spill
**Notes:** Authors call for examination of the magnitude of bird losses at oil platforms, particularly in the northwest Atlantic. Documented losses from oil spills, impact injury, and incineration by gas flares merit more attention than they have received.

**Wiese, F. K., P. C. Ryan**, 2003. The extent of chronic marine oil pollution in southeastern Newfoundland waters assessed through beached bird surveys 1984-1999. Marine Pollution Bulletin **46**:1090-1101.
**Keywords:** beached bird survey/ bird/ chronic/ evaluation/ harvest/ Newfoundland/ oil/ Oone/ pollution/ salt water/ seasonal/ species/ survey/ time/ vulnerability
**Notes:** A very thorough evaluation of the results of 16 yrs (1984-1999) of beached bird surveys in southeastern Newfoundland. Considers factors such as weather, native bird harvests, ship traffic, seasonality, and oil vulnerability of species.

**Wiese, F. K., G. J. Robertson**, 2004. Assessing seabird mortality from chronic oil discharges at sea. Journal of Wildlife Management **68**:627-638.
**Keywords:** bird/ chronic/ discharges/ Grand Banks/ model/ Newfoundland/ oil/ Oone/ petroleum/ population/ region/ salt water
**Notes:** Authors present a model for estimating seabird losses due to chronic oil discharges at sea. The model has 'at-sea' and 'onshore' components and is applied to the Grand Banks region south of Newfoundland.

**Wiese, F. K., G. J. Robertson, A. J. Gaston**, 2005. Impacts of chronic marine oil pollution and the murre hunt in Newfoundland on thick-billed murre Uria lomvia populations in the eastern Canadian Arctic. Biological Conservation **116**:205-216.
**Keywords:** Arctic/ bird/ Canada/ chronic/ hunting/ model/ Newfoundland/ oil/ Oone/ petroleum/ pollution/ population/ salt water
**Notes:** Authors present a deterministic and stochastic population model that assesses the effects of losses from chronic oil pollution and annual subsistence hunting on populations of the thick-billed murre in the eastern Canadian Arctic.

**Wilhelm, S. M.**, 2001. Estimate of mercury emissions to the atmosphere from petroleum. Environmental Science and Technology **35**:4704-4710.
**Keywords:** crude oil/ estimate/ mercury/ miscellaneous/ Oeleven/ oil/ petroleum/ petroleum products/ refinery
**Notes:** An assessment of the amount of mercury escaping to the atmosphere every year from petroleum. Discusses mercury in crude oil and condensate and refined products, and estimates mercury emissions from refineries and utilization of petroleum products.

**Williams, J., C. Roderick, R. Alexander**, 2003. Sublethal effects of Orimulsion-400$^{R}$ on eggs and larvae of Atlantic herring (*Clupea harengus* L.). Environmental Toxicology and Chemistry **22**:3044-3048.
**Keywords:** bioassay/ concentration/ depth/ effects/ eggs/ fish/ herring/ larvae/ length/ Orimulsion/ Othree/ salt water/ static/ sublethal/ survival
**Notes:** Eggs of the Atlantic herring were exposed in a 24-hr static bioassay to varing concentrations of an oil-in-seawater dispersion of Orimulsion-400. Nominal concentrations of 0.1, 1, 10, 100, and 1,000 ppm were employed. Measured survival, larval and notocord length, yolk sac depth and length, head depth, and depth of myomeres adjacent to the pectoral buds.

**Williams, J. M., M. L. Tasker, I. C. Carter, A. Webb**, 1995. A method of assessing seabird vulnerability to surface pollutants. Ibis **137**:S147-S152.
**Keywords:** bird/ combination/ density/ index/ methods/ North Sea/ oil/ Oone/ population/ risk/ salt water/ vulnerability
**Notes:** Combination of an oil vulnerability index for seabirds with information on monthly site densities to produce 'potential risk' maps of the North Sea.

**Williams, T. M., R. A. Kastelein, R. W. Davis, J. A. Thomas**, 1988. The effects of oil contamination and cleaning on sea otters (*Enhydra lutris*). I. Thermoregulatory implications based on pelt studies. Canadian Journal of Zoology **66**:2776-2781.
**Keywords:** cleaning/ conductance/ Corexit 9527/ crude oil/ dispersant/ effects/ fur/ mammal/ ODtwo/ oil/ oiled/ sea otter/ weathered
**Notes:** Effect on thermal conductance of sea otter pelts of oiling (fresh or weathered crude oil, or a crude oil -- dispersant mixture) and subsequent cleaning.

**Williams, T. M.**, 1990. Evaluating the long term effects of crude oil exposure in sea otters: laboratory and field observations. Wildlife Journal **13**:42-48.
**Keywords:** blood/ condition/ crude oil/ effects/ Exxon Valdez/ habitat/ health/ long-term/ mammal/ oil/ oil spill/ oiled/ Otwo/ physiology/ Prince William Sound/ Prudhoe Bay crude oil/ reproduction/ salt water/ sea otter/ spill/ weight
**Notes:** Observations on the health of 12 oiled sea otters held in captivity for 12 months after the Exxon Valdez oil spill; long-term changes in coat condition, physiology, weight, blood, and reproductive status. Further comments on habitat conditions in the formerly oiled areas of Prince William sound.

**Williams, T. M., D. J. O'Connor, and S. W. Nielsen** 1995. The effects of oil on sea otters: histopathology, toxicology, and clinical history. Pages 3-22 *in* T. M. Williams, R. W. Davis, editors. Emergency Care and Rehabilitation of Oiled Sea Otters: A Guide for Oil Spills Involving Fur-Bearing Marine Mammals. University of Alaska Press, Fairbanks.
**Keywords:** Alaska/ crude oil/ effects/ Exxon Valdez/ mammal/ necropsy/ North Slope crude oil/ oil/ oil spill/ oiled/ organ/ Otwo/ pathology/ petroleum/ physiology/ rehabilitation/ salt water/ sea otter/ spill/ survey/ tissue/ toxicity/ otter
**Notes:** A reference chapter for assessing the effects of spilled petroleum on sea otters. The authors use published literature and information derived from sea otter surveys and rehabilitation efforts during the Exxon Valdez oil spill of 1989. Major chapter subheadings are (1) necropsy protocols and tissue collection, (2) mortality of oiled sea otters, (3) pathology and toxicology of individual organ systems, and (4) clinical, toxicological, and histopathologic profiles of oiled sea otters.

**Wilson, J. A., R. I. Carlson, D. M. Janz, R. L. Lochmiller, J. L. Schroder, N. T. Basta**, 2003. Ecotoxicological risks associated with land treatment of petrochemical wastes. III. Immune function and hematology of cotton rats. Journal of Toxicology and Environmental Health, Part A **66**:345-363.
**Keywords:** blood/ cotton rat/ immune response/ mammal/ Otwo/ petroleum waste/ rat/ remediation/ risk/ seasonal/ spleen
**Notes:** Cotton rats were collected from five petrochemical landfarms and five matched reference sites. Collections were made during summer and winter of two consecutive years (1998-00). Measured size of spleen and a set of blood characteristics and immunological parameters.

**Wilson, J. A., R. L. Lochmiller, D. M. Janz**, 2006. Population dynamics of cotton rats (*Sigmodon hispidus*) inhabiting abandoned petroleum landfarms in Oklahoma, USA. Ecotoxicology **15**:19-30.
**Keywords:** condition/ cotton rat/ fluoride/ land farming/ mammal/ metals/ Oklahoma/ organ/ Otwo/ PAH/ petroleum/ population/ rat/ remediation/ sex/ time/ weight
**Notes:** Five paired sites (reference and abandoned petrochemical landfarm). Contaminants (PAHs, metals, fluoride) were quantified at all sites (previous studies). Live trapping was used to evaluate cotton rats (weight, sex, reproductive condition, toe clipped, population estimation). Twelve rats were collected from each site during summer and winter for 2 years and the reproductive organs were examined.

**Wilson, K. W.**, 1976. Effects of oil dispersants on the developing embryos of marine fish. Marine Biology **36**:259-268.
**Keywords:** abnormalities/ concentration/ Corexit 7664/ development/ dispersant/ effects/ eggs/ embryo/ eye/ eye pigmentation/ fertilization/ fish/ hatching/ heart rate/ herring/ length/ ODthree/ oil/ petroleum/ plaice/ rate/ salt water/ sole/ sperm/ time
**Notes:** Exposure of eggs, sperm, and developing embyros of herring, plaice, and sole to varying concentrations of petroleum dispersants BP1002, Finasol ESK, and Corexit 7664. Measured effects on fertilization rate; heart-rate, length, and eye pigmentation during development; hatching rate, time to hatch, and larval abnormalities.

**Wilson, K. W.**, 1977. Acute toxicity of oil dispersants to marine fish larvae. Marine Biology **40**:65-74.
**Keywords:** acute/ age/ concentration/ development/ dispersant/ effects/ embryo/ fish/ haddock/ herring/ larvae/ lemon sole/ ODthree/ oil/ pilchard/ plaice/ salinity/ salt water/ sole/ starvation/ survival/ temperature/ toxicity
**Notes:** Exposure of the larvae of haddock, herring, lemon sole, pilchard, plaice, and sole to varying concentrations of six oil dispersants. Measured survival, effects of temperature, salinity, stage of embryo development, age of stock solution, and starvation; and an assessment of the most toxic component of the dispersants.

**Wilson, R. K., P. Tuomi, J. P. Schroeder, and T. Williams** 1990. Clinical treatment and rehabilitation of oiled sea otters. Pages 101-117 *in* T. M. Williams and R. W. Davis, editors. Sea Otter Rehabilitation Program: 1989 Exxon Valdez Oil Spill. International Wildlife Research.
**Keywords:** clinical treatment/ crude oil/ Exxon Valdez/ fur/ mammal/ oil/ oil spill/ oiled/ Otwo/ physiology/ procedure/ rehabilitation/ salt water/ sea otter/ spill/ treatment
**Notes:** Detailed description of the procedures and material used in the clinical treatment of sea otters admitted to rehabilitation centers following the Exxon Valdez oil spill.

**Wilson, R. K., C. R. McCormick, T. D. Williams, and P. A. Tuomi** 1990. Clinical treatment and rehabilitation of sea otters. Pages 326-334 *in* K. Bayha, J. Kormendy, editors. Sea Otter Symposium. Biological Report. U.S. Fish and Wildlife Service, Washington, DC.
**Keywords:** clinical treatment/ crude oil/ Exxon Valdez/ fur/ mammal/ oil/ oil spill/ oiled/ Otwo/ physiology/ procedure/ rehabilitation/ salt water/ sea otter/ spill/ treatment/ otter
**Notes:** Description of the clinical aspects of the rehabilitation procedure used to treat oiled sea otters at the Exxon Valdez oil spill.

**Winfrey, M. R., E. Beck, P. Boehm, D. M. Ward**, 1982. Impact of crude oil on sulphate reduction and methane production in sediments impacted by the Amoco Cadiz oil spill. Marine Environmental Research **7**:175-194.
**Keywords:** Amoco Cadiz/ beach/ benzene/ combination/ concentration/ crude oil/ depth/ estuary/ experiment/ habitat/ hydrocarbons/ metabolism/ microbes/ mousse/ oil/ oil spill/ oiled/ Oten/ reduction/ salt marsh/ salt water/ sampling/ saturated hydrocarbons/ sediment/ spill/ sulphate/ toluene/ unsaturated hydrocarbons/ weathered
**Notes:** Assessment of the effect of crude oil from the Amoco Cadiz spill on the function of sediment microbes. Sampled sediment from oiled and unoiled beach, estuary, and salt marsh habitat. Performed a combination of on-site measurements and experiments. Measured sulphate and methane concentrations at depth (on site), concentration of saturated and unsaturated hydrocarbons at sampling

sites, and effect of mousse, fresh oil, weathered oil, toluene, and benzene on sulphate reduction and metabolism.

**Winters, K., R. O'Donnell, J. C. Batterton, C. Van Baalen**, 1976. Water-soluble components of four fuel oils: chemical characterization and effects on growth of microalgae. Marine Biology **36**:269-276.
**Keywords:** chemical analysis/ concentration/ effects/ experiment/ fuel oil/ growth/ marine plant/ microalgae/ oil/ Osix/ salt water/ species
**Notes:** Assessment of the effects of four fuel oils (No. 2?) on growth of cultured microalgae; multiple experiments and chemical analyses. Water-soluble fractions (WSF) of the fuel oils were prepared in two concentrations and used with six species of microalgae. Single compounds (13) present in the WSF were used in four concentrations with three species of microalgae and two other compounds were used in five concentrations with three species of microalgae. WSF of all four fuel oils was analyzed in detail. Measured algal growth as generations/day.

**Winters, K., J. C. Batterton, C. Van Baalen**, 1977. Phenalen-1-one: occurrence in a fuel oil and toxicity to microalgae. Environmental Science and Technology **11**:270-272.
**Keywords:** concentration/ effects/ experiment/ fuel oil/ growth/ light/ marine plant/ microalgae/ No.2 fuel oil/ oil/ Osix/ salt water/ species/ toxicity
**Notes:** Assessment of the the effect of phenalen-1-one isolated from the water-soluble fraction of API fuel oil No. 2 on growth of microalgae. Six concentrations and a control were used on five species of microalgae and the results compared with the effects of seven other water-soluble compounds (previously reported) on one of the tested species. The experiment was performed under unfiltered white light and filtered (yellow) light. Growth was measured as generations/day.

**Witham, R.** 1978. Does a problem exist relative to small sea turtles and oil spills? Pages 630-632 *in* Conference on Assessment of Ecological Impacts of Oil Spills. American Institute of Biological Sciences.
**Keywords:** beach/ Florida/ green turtle/ oil/ oil spill/ OthreeR/ reptile/ salt water/ spill/ turtle/ vulnerability
**Notes:** A report of three (two dead) young green turtles found on the beaches of Florida with evidence of oil exposure. Discussion of the vulnerability of young sea turtles to oil spills.

**Wolfe, D. A., M. J. Hameedi, J. A. Galt, G. Watabayashi, J. Short, C. O'Claire, S. Rice, J. Michel, J. R. Payne, J. Braddock, S. Hanna, D. Sale**, 1994. The fate of the oil spilled from the *Exxon Valdez*. Environmental Science and Technology **28**:561A-568A.
**Keywords:** Alaska/ biodegradation/ bioremediation/ crude oil/ distribution/ evaporation/ Exxon Valdez/ fate/ Gulf of Alaska/ hydrocarbons/ mass balance/ miscellaneous/ Oeleven/ oil/ recovery/ salt water/ sediment/ shoreline/ spill/ subtidal/ time/ transport/ treatment/ water column
**Notes:** Authors present a mass balance description of the fate of the crude oil spilled by the *Exxon Valdez* in the Gulf of Alaska in 1989. Sections on transport and transformation of the oil slick, evaporation, distribution of hydrocarbons in the air, recovery or destruction of floating oil, dispersion and dissolution, photolysis and biodegradation in the water column, transformation of beached oil, recovery and disposal of beached oily wastes; shoreline treatment, bioremediation, and biodegradation; and transport of oil to subtidal sediments.

**Wolfe, J. L., R. J. Esher**, 1981. Effects of crude oil on swimming behavior and survival in the rice rat. Environmental Research **26**:486-489.
**Keywords:** behavior/ crude oil/ effects/ fresh water/ mammal/ oil/ Otwo/ rat/ rice rat/ salt water/ survival/ swimming/ Texas/ thermoregulation
**Notes:** Effects on swimming behavior and thermoregulation of rice rats exposed to water contaminated with Empire and South Texas crude oils.

**Wolfe, M. F., G. J. B. Schwartz, S. Singaram, E. E. Mielbrecht, R. S. Tjeerdema, M. L. Sowby**, 1998. Effects of salinity and temperature on the bioavailability of dispersed petroleum hydrocarbons to the golden-brown algae, *Isochrysis galbana*. Archives of Environmental Contamination and Toxicology **35**:268-273.
**Keywords:** algae/ concentration/ Corexit 9527/ crude oil/ dispersant/ effects/ hydrocarbons/ labelled/ marine plant/ metabolite/ naphthalene/ ODsix/ oil/ petroleum/ petroleum hydrocarbons/ Prudhoe Bay/

Prudhoe Bay crude oil/ salinity/ salt water/ temperature
**Notes:** Assessment of the influence of a dispersant (Corexit 9527) on the bioavailability of naphthalene to the golden-brown algae. In a laboratory study, algae were exposed to the water-accomodated fraction of Prudhoe Bay crude oil or a chemically dispersed oil mixture at two temperatures and two salinities; $^{14}C$ naphthalene was added to both solutions. Measured naphthalene concentrations in solutions, concentrations of parent and labelled naphthalene in brown algae, and two naphthalene metabolites in solution and in algae.

**Wolfe, M. F., G. J. B. Schwartz, S. Singaram, E. E. Mielbrecht, R. S. Tjeerdema, M. L. Sowby**, 1998. Influence of dispersants on the bioavailability of naphthalene from the water-accommodated fraction crude oil to the golden-brown algae, *Isochrysis galbana*. Archives of Environmental Contamination and Toxicology **35**:274-280.
**Keywords:** algae/ composition/ concentration/ Corexit 9527/ crude oil/ dispersant/ hydrocarbons/ labelled/ marine plant/ naphthalene/ ODsix/ oil/ petroleum/ petroleum hydrocarbons/ Prudhoe Bay/ Prudhoe Bay crude oil/ salt water/ uptake
**Notes:** Assessment of the influence of a dispersant (Corexit 9527) on the bioavailability of naphthalene to the golden-brown algae. In a laboratory study, algae were exposed to the water-accomodated fraction of Prudhoe Bay crude oil or a chemically dispersed oil mixture; $^{14}C$ naphthalene was added to both solutions. Measured concentrations of naphthalene and total petroleum hydrocarbons in solution, hydrocarbon composition of both solutions, and uptake of labelled naphthalene by algae.

**Wolfe, M. F., J. A. Schlosser, G. J. B. Schwartz, S. Singaram, E. E. Mielbrecht, R. S. Tjeerdema, M. L. Sowby**, 1998. Influence of dispersants on the bioavailability and trophic transfer of petroleum hydrocarbons to primary levels of a marine food chain. Aquatic Toxicology **42**:211-227.
**Keywords:** algae/ Corexit 9527/ crude oil/ depuration/ dispersant/ food/ food chain/ hydrocarbons/ marine invertebrate/ marine plant/ metabolite/ movement/ naphthalene/ ODfour/ oil/ petroleum/ petroleum hydrocarbons/ Prudhoe Bay/ Prudhoe Bay crude oil/ rotifer/ salt water/ species/ toxicity/ transfer/ trophic transfer/ uptake
**Notes:** Effect of a dispersant (Corexit 9527) on the bioavailability and trophic transfer of petroleum hydrocarbons of Prudhoe Bay crude oil. A species of algae and a species of rotifer were used to measure trophic movement of $^{14}C$-labelled naphthalene in the water-accomodated fraction of crude oil with or without dispersant present. Measured toxicity (96 hr) and hydrocarbon uptake and hydrocarbon and metabolite depuration (16 hr).

**Wolfe, M. F., G. J. B. Schwartz, S. Singaram, E. E. Mielbrecht, R. S. Tjeerdema, M. L. Sowby**, 1999. Influence of dispersants on the bioavailability and trophic transfer of phenanthrene to algae and rotifers. Aquatic Toxicology **48**:13-24.
**Keywords:** algae/ concentration/ Corexit 9527/ crude oil/ depuration/ dispersant/ labelled/ marine invertebrate/ marine plant/ metabolite/ ODfour/ oil/ phenanthrene/ Prudhoe Bay crude oil/ rotifer/ salt water/ trophic transfer/ uptake
**Notes:** Assessment of the effect of a dispersant (Corexit 9527) on the availablility, uptake, and trophic transfer of phenanthrene ($^{14}C$ labelled). The water-accomodated fraction of Prudhoe Bay crude oil was compared to the dispersed crude oil in a 24-hr uptake study with algae. The algae were then fed to rotifers (in the same aqueous exposure medium) during an 8-hr exposure and 8-hr depuration study. Measured uptake by algae, uptake and depuration by rotifers, concentrations of phenanthrene in water, and concentrations of phenanthrene and metabolites in algae and rotifers.

**Wolfe, M. F., G. J. B. Schwartz, S. Singaram, E. E. Mielbrecht, R. S. Tjeerdema, M. L. Sowby**, 2001. Influence of dispersants on the bioavailability and trophic transfer of petroleum hydrocarbons to larval topsmelt (*Atherinops affinis*). Aquatic Toxicology **52**:49-60.
**Keywords:** aromatic hydrocarbons/ Corexit 9527/ crude oil/ depuration/ dispersant/ evaluation/ fish/ flow-through/ food/ food chain/ hydrocarbons/ marine invertebrate/ marine plant/ metabolite/ naphthalene/ ODthree/ oil/ petroleum/ petroleum hydrocarbons/ Prudhoe Bay crude oil/ salt water/ transfer/ trophic transfer/ uptake
**Notes:** An evaluation of the influence of a chemical dispersant (Corexit 9527) on the uptake and depuration of $^{14}C$-labelled naphthalene by a larval fish from the water-accomodated fraction of Prudhoe

Bay crude oil and from chemically-dispersed crude oil. Used flow-through chambers and compared uptake from water only with uptake from water with a microalgae-rotifer food chain. Exposure and depuration periods were 12 hrs each. Measured naphthalene and metabolites and calculated bioaccumulation factors.

**Wolff, G. A., M. R. Preston, G. Harriman, S. J. Rowland**, 1993. Some preliminary observations after the wreck of the oil tanker *Braer* in Shetland. Marine Pollution Bulletin **26**:567-571.
**Keywords:** alkane/ aromatic hydrocarbons/ degradation/ fate/ grass/ hydrocarbons/ microbes/ miscellaneous/ Oeleven/ oil/ Shetland/ soil/ tanker
**Notes:** Samples of water, soil, grass, and spilled oil were collected in the vicinity of the grounded oil tanker *Braer* on mainland Shetland 5 da after the grounding. The oil was analyzed for alkanes and selected aromatic hydrocarbons.

**Wong, C. K., F. R. Engelhardt, J. R. Strickler**, 1981. Survival and fecundity of *Daphnia pulex* on exposure to particulate oil. Bulletin of Environmental Contamination and Toxicology **26**:606-612.
**Keywords:** activity/ concentration/ crude oil/ daphnia/ emulsion/ experiment/ fresh water/ freshwater invertebrate/ Norman Wells crude oil/ Ofive/ oil/ paraffin/ particulate/ recovery/ reproduction/ survival/ swimming/ weathered
**Notes:** Assessment of the effect of emulsified Norman Wells crude oil on *D. pulex*. Exposed daphnia to nominal concentrations of 1, 5, 10, 50, or 100 ppm crude oil, 24-hr weathered crude oil, or paraffin oil for 192 hrs: emulsions were renewed every 72 hrs. Measured survival and number of young produced. In a second experiment, daphnia were exposed for 30 hrs to either 50 or 100 ppm crude oil, then transferred to clean water for 192 hrs. Measured survival and swimming activity after exposure, after 48 hrs recovery, and after 192 hrs recovery. Also measured number of young produced during the 30 hr exposure period and compared to the end of 192 hrs recovery.

**Wong, C. K., J. R. Strickler, F. R. Engelhardt**, 1983. Feeding behavior of *Daphnia pulex* in crude oil dispersions. Bulletin of Environmental Contamination and Toxicology **31**:152-157.
**Keywords:** behavior/ concentration/ crude oil/ daphnia/ effects/ feeding/ fresh water/ freshwater invertebrate/ Norman Wells crude oil/ Ofive/ oil/ paraffin
**Notes:** Determination of the effects on feeding behavior of *Daphnia p.* to dispersions of Norman Wells crude oil and paraffin oil. Crude and paraffin oils were mechanically dispersed and allowed to stand for 1 hr before being used. Daphnia were exposed to 50 ppm nominal concentrations of either oil for 3 hrs. Measured 5 characteristics of feeding behavior at 1 hr intervals.

**Wong, C. S., F. A. Whitney, W. J. Cretney, K. Lee, F. McLaughlin**, 1984. An experimental marine ecosystem response to crude oil and Corexit 9527: part I -- fate of chemically dispersed crude oil. Marine Environmental Research **13**:247-263.
**Keywords:** alkane/ aromatic hydrocarbons/ biomass/ carbon/ composition/ concentration/ Corexit 9527/ crude oil/ dispersant/ ecosystem/ effects/ fate/ general effect/ labelled/ marine plant/ nitrogen/ nutrients/ ODeight/ oil/ organic carbon/ particulate/ Prudhoe Bay crude oil/ salinity/ salt water/ temperature/ time
**Notes:** Three controlled ecosystem enclosures located in nearshore waters were used to determine the effects of either Prudhoe Bay crude oil or crude oil plus Corexit 9527 dispersant. The crude oil was labelled with $^{14}C$ hexadecane. Samples of water and sedimented material were collected seven or eight times during the 24-da period of study. Measured changes in alkane composition, aromatic hydrocarbon concentration, concentration of $^{14}C$ hexadecane in particles, bacterial biomass, concentration of chloraphyll *a* in sedimented material, quantity of sedimented material, salinity, temperature, particulate organic carbon, nitrogen, and nutrients.

**Wood, M. A. and N. Heaphy** 1991. Rehabilitation of oiled seabirds and bald eagles following the *Exxon Valdez* oil spill. Pages 235-239 *in* 1991 International Oil Spill Conference, API Publication 4529. American Petroleum Institute, Washington, D.C.
**Keywords:** Alaska/ bald eagle/ bird/ Exxon Valdez/ miscellaneous/ Oeleven/ oil/ oil spill/ oiled/ rehabilitation/ salt water/ species/ spill
**Notes:** A description of the oiled bird rehabilitation efforts spanning a 6-mo period following the Exxon

Valdez oil spill. Over 1600 birds representing 71 species were brought to four rehabilitation centers. Authors discuss details of the effort.

**Woodall, D. W., R. P. Gambrell, N. N. Rabalais, R. D. Delaune**, 2001. Developing a method to track oil and gas produced water discharges in estuarine systems using salinity as a conservative tracer. Marine Pollution Bulletin **42**:1118-1127.
**Keywords:** discharges/ estuarine/ miscellaneous/ Oeleven/ oil/ oil field/ produced water/ salinity/ salt water
**Notes:** Authors describe a method employing salinity probes that tracks the spread of produced water from oil production wells. A canal and a semi-enclosed bay site were used to field test the method.

**Woodin, B. R., R. M. Smolowitz, J. J. Stegeman**, 1997. Induction of cytochrome P4501A in the intertidal fish *Anoplarchus purpurescens* by Prudhoe Bay crude oil and environmental induction in fish from Prince William Sound. Environmental Science and Technology **31**:1198-1205.
**Keywords:** crude oil/ effects/ experiment/ Exxon Valdez/ fish/ gill/ gonads/ intertidal/ intestine/ liver/ mesentery/ metabolism/ methods/ monooxygenase/ oil/ oil spill/ Othree/ Prince William Sound/ Prudhoe Bay/ Prudhoe Bay crude oil/ salt water/ sediment/ spill/ stomach/ tissue
**Notes:** Induction of cytochrome P4501A (CYP1A) in tissues of an intertidal fish by residual Prudhoe Bay crude oil 15 mos after the Exxon Valdez oil spill. Fish from field collections, caged fish experiments, and laboratory exposure experiments were used to assess the effects of oil remaining in sediments. Immunohistochemistry methods used on gill, liver, stomach, gastric cacae, intestine, mesentery, and gonad tissue.

**Woodward, D. F., P. M. Mehrle, Jr., W. L. Mauck**, 1981. Accumulation and sublethal effects of a Wyoming crude oil in cutthroat trout. Transactions of the American Fisheries Society **110**:437-445.
**Keywords:** accumulation/ analysis/ concentration/ crude oil/ cutthroat trout/ effects/ eye/ fin/ fish/ fresh water/ gill/ growth/ hydrocarbons/ juvenile/ muscle/ oil/ Othree/ pathology/ sublethal/ survival
**Notes:** Exposure of juvenile cutthroat trout exposed for 90 da to four concentrations of the water-soluble fraction of a Wyoming crude oil. Measured survival, growth, pathology of caudal fin, gill, and eye; also, hydrocarbon analysis of water and fish muscle.

**Woodward, D. F., R. G. Riley**, 1983. Petroleum hydrocarbon concentrations in a salmonid stream contaminated by oil field discharge water and effects on macrobenthos. Archives of Environmental Contamination and Toxicology **12**:327-334.
**Keywords:** benthic/ community/ concentration/ discharges/ diversity/ effects/ effluent/ evaluation/ fresh water/ freshwater invertebrate/ hydrocarbons/ index/ invertebrate/ metals/ naphthalene/ Ofive/ oil/ oil field/ petroleum/ petroleum hydrocarbons/ phenanthrene/ sampling/ saturated hydrocarbons/ sediment/ species/ species diversity/ stream/ waste water
**Notes:** Evaluation of the effects of oilfield waste water on a trout stream in Wyoming. Five sampling sites were located above, at (effluent), and at three locations below the water discharge. Water, sediment, and benthic invertebrates were collected at all sites except the discharge site, where only effluent water was sampled. Measured water chemistry, 19 saturated hydrocarbons, total naphthalene, total phenanthrenes, and concentrations of five metals, identified and counted invertebrates, and calculated an index of species diversity.

**Woodward, D. F., R. G. Riley, C. E. Smith**, 1983. Accumulation, sublethal effects, and safe concentration of a refined oil as evaluated with cutthroat trout. Archives of Environmental Contamination and Toxicology **12**:455-464.
**Keywords:** accumulation/ concentration/ cutthroat trout/ effects/ fin/ fish/ fresh water/ gill/ growth/ liver/ muscle/ oil/ Othree/ pathology/ refined oil/ refinery/ sublethal/ survival/ swimming
**Notes:** Exposure of cutthroat trout for 90 da to five concentrations of an unidentified refined oil seeping from a refinery site. Measured survival, growth, gill pathology, liver pathology, caudal fin erosion, caudal fin pathology, swimming performance, and muscle concentration.

**Woodward, D. F., R. G. Riley, M. G. Henry, J. S. Meyer, T. R. Garland**, 1985. Leaching of retorted oil shale: assessing the toxicity to Colorado squawfish, fathead minnows, and two food-chain organisms.

Transactions of the American Fisheries Society **114**:887-894.
**Keywords:** acute/ anion/ cations/ Colorado squawfish/ concentration/ daphnia/ fathead minnow/ fish/ food chain/ fresh water/ freshwater invertebrate/ growth/ larvae/ leachate/ mayfly/ metals/ neonate/ oil/ Othree/ reproduction/ species/ survival/ tissue/ toxicity
**Notes:** Exposure of Colorado squawfish, fathead minnows, a daphnia species, and a mayfly species for 30 da to varying concentrations of retorted shale leachate; also 96 hr acute toxicity tests for daphnia neonates and fathead minnow larvae. Measured survival, growth, reproduction of daphnia, anions and cations in leachate, and metals in fish tissue.

**Woodward, D. F., E. E. Little, L. M. Smith**, 1987. Toxicity of five shale oils to fish and aquatic invertebrates. Archives of Environmental Contamination and Toxicology **16**:239-246.
**Keywords:** behavior/ colony/ Colorado squawfish/ concentration/ cutthroat trout/ fathead minnow/ fish/ fresh water/ freshwater invertebrate/ invertebrate/ oil/ Othree/ shale oil/ survival/ toxicity
**Notes:** Exposure of three native fish and colonies of aquatic invertebrates on plate samplers to varying concentrations of water-soluble fractions of three crude shale oils and two refined shale oils. Measured survival of fish and invertebrates; and the predator success of Colorado squawfish and the prey success of fathead minnows.

**Woodward, D. F., E. Snyder-Conn, R. G. Riley, T. R. Garland**, 1988. Drilling fluids and the Arctic tundra of Alaska: assessing contamination of wetlands habitat and the toxicity to aquatic invertebrates and fish. Archives of Environmental Contamination and Toxicology **17**:683-697.
**Keywords:** Alaska/ Arctic/ aromatic hydrocarbons/ chemical characteristics/ chronic/ daphnia/ drilling fluids/ effluent/ experiment/ fish/ fresh water/ freshwater invertebrate/ fry/ growth/ habitat/ hydrocarbons/ invertebrate/ ions/ metals/ Ofive/ oil field/ reproduction/ sediment/ toxicity/ tundra/ wetland
**Notes:** Assessment of the toxicity of oilfield drilling fluids from five sites in the Arctic tundra of Alaska. Sampled a drilling fluid reserve pit, a near pond, and a distant pond at four drilling sites, and reserve pit and a near pond at the fifth site; also three control ponds. Sampled water and sediment and measured water quality characteristics, metal ions, and selected aromatic and paraffinic hydrocarbons. Performed 96 hr toxicity tests on Arctic grayling fry and 48 hr toxicity tests on *Daphnia magna*. Also performed a 42 da chronic test on daphnia wherein reproduction and growth were measured. Local *Daphnia middendorffiana* used for *in situ* whole effluent toxicity experiments.

**Wootton, T. A., C. R. Grau, T. E. Roudybush, M. E. Hahs, K. V. Hirsch**, 1979. Reproductive responses of quail to Bunker C oil fractions. Archives of Environmental Contamination and Toxicology **8**:457-463.
**Keywords:** bird/ Bunker C/ effects/ embryo/ fuel oil/ hatchability/ Japanese quail/ oil/ Oone/ quail/ reproduction/ solvent/ solvent extract/ toxicity
**Notes:** Effects of single doses of solvent extracts of Bunker C fuel oil on reproduction of Japanese quail. The purpose of the research was to identify the toxic fractions of Bunker C responsible for observed toxic effects.

**Wormald, A. P.**, 1976. Effects of a spill of marine diesel oil on the meiofauna of a sandy beach at Picnic Bay, Hong Kong. Environmental Pollution **11**:117-130.
**Keywords:** abundance/ beach/ carbon/ diesel/ effects/ harpacticoid/ intertidal/ long-term/ marine invertebrate/ meiofauna/ nematode/ nutrients/ Ofour/ oil/ organic/ organic carbon/ particle size/ recovery/ salt water/ sampling/ sandy beach/ sediment/ size/ spill
**Notes:** Report of the recovery of intertidal meiofauna of a Hong Kong sandy beach that was affected by an onshore spill of heavy marine diesel oil. Beach meiofauna (abundance of nematodes and harpacticoids) were monitored for 14 mos. Four sites were sampled for the immediate effects of the oil followed by long-term sampling at one site. Also evaluated particle size, moisture content, organic carbon, and nutrients in sediments.

**Wrabel, M. L., P. Peckol**, 2000. Effects of bioremediation on toxicity and chemical composition of No. 2 fuel oil: growth responses of the brown alga *Fucus vesiculosus*. Marine Pollution Bulletin **40**:135-139.
**Keywords:** algae/ biomass/ bioremediation/ composition/ concentration/ effects/ experiment/ Exxon Valdez/ fuel oil/ growth/ intertidal/ macroalgae/ marine plant/ No.2 fuel oil/ oil/ oil spill/ Osix/ salt water/ spill/ toxicity

**Notes:** The intertidal macroalgae *Fucus vusiculosus* was exposed to concentrations of No. 2 fuel oil ranging from 10 to 1,000 ppm for 1 da, then transferred to clean water for 2 more da; biomass was measure at the end of the experiment. Bioremediation effects were tested by exposing alga fronds for 6 da to either 100 ppm fuel oil, 100 ppm fuel oil + enrichment with N & P supplements similar to those used at the *Exxon Valdez* oil spill, autoclaved water with 100 ppm fuel oil and enrichment, and autoclaved water with enrichment only; measured algal biomass at the end the experiment.

**Wright, A. L., R. W. Weaver, J. W. Webb**, 1997. Oil bioremediation in salt marsh mesocosms as influenced by N and P fertilization, flooding, and season. Water, Air, and Soil Pollution **95**:179-191.
**Keywords:** bioremediation/ crude oil/ fertilization/ marine plant/ mesocosm/ microbes/ nitrogen/ oil/ Oten/ petroleum/ phosphorus/ salt marsh/ salt water/ seasonal/ Spartina
**Notes:** Crude oil bioremediation in salt marshes; salt water, fertilization.

**Wright, A. L., R. W. Weaver**, 2004. Fertilization and bioaugmentation for oil biodegradation in salt marsh mesocosms. Water Air and Soil Pollution **156**:229-240.
**Keywords:** Arabian Light crude oil/ biodegradation/ bioremediation/ community/ concentration/ condition/ crude oil/ effectiveness/ fertilization/ light/ mesocosm/ microbes/ oil/ oil spill/ Oten/ petroleum/ population/ salt marsh/ salt water/ spill/ weathered
**Notes:** Salt marsh mesocosms were established to test the effectiveness of oil spill bioremediation products. Arabian light crude oil was artificially weathered and applied to the surface of the mesocosms. Each mesocosm received an application of one of five bioremediation products, with or without supplemental N and P nutrient additions. One complete set of mesocosms were maintained in a constantly flooded condition (33 da) and another set was maintained on an alternately flooded-drained regime (41 da). Water samples were collected from the flooded mesocosms 9, 16, 22, and 29 da after oil application; nutrient concentrations were determined for all four collections and microbial populations (heterotroph and hydrocarbon degrading) were measured on days 16 and 29 only. The alternately flooded mesocosms were sampled after 16 and 31 da for nutrient concentrations and microbial populations. Remaining crude oil was quantitated at the end of each study; measured total crude oil and total petroleum hydrocarbon fractions remaining.

**Wu, R. S. S.**, 1981. Differences in the toxicities of an oil dispersant and a surface active agent to some marine animals, and their implications in the choice of species in toxicity testing. Marine Environmental Research **5**:157-163.
**Keywords:** assay/ barnacle/ bivalve/ diesel/ diesel fuel/ dispersant/ fish/ gastropod/ general effect/ marine invertebrate/ ODeight/ oil/ salt water/ shell/ shrimp/ species/ starfish/ survival/ toxicity/ urchin
**Notes:** Comparison of an oil dispersant (BP 1100X) with a surface active agent (Shell Herder) in a laboratory assay. Eighteen species of fish, tunicate, urchin, starfish, barnacle, shrimp, bivalve, and gastropod were exposed for 100 min to 1000 ppm of diesel oil combined with an equal amount of either the dispersant or surface active agent. Survival was determined after removal of test animals to clean water for 24 hrs.

**Wu, R. S. S., P. K. S. Lam, B. S. Zhou**, 1997. A settlement inhibition assay with a cyprid larvae of the barnacle *Balanus amphitrite*. Chemosphere **35**:1867-1874.
**Keywords:** assay/ barnacle/ behavior/ concentration/ diesel/ diesel fuel/ dispersant/ larvae/ marine invertebrate/ ODfour/ salt water
**Notes:** Exposure of cyprid larvae of the barnacle *Balanus amphitrite* to various concentrations of the three dispersants, Vecom B-1425, Norchem OSD-570, and Corexit 9905, and diesel fuel for 6 da. Measured percentage settlement of larvae on an experimental surface.

**Wu, R. S. S., P. K. S. Lam, B. S. Zhou**, 1997. Effects of two oil dispersants on phototaxis and swimming behaviour of barnacle larvae. Hydrobiologia **352**:9-16.
**Keywords:** barnacle/ behavior/ diesel/ diesel fuel/ dispersant/ effects/ larvae/ marine invertebrate/ nauplii/ ODfour/ oil/ phototaxis/ salt water/ static/ survival/ swimming/ toxicity
**Notes:** Exposure of stage II nauplii of barnacle *Balanus amphitrite* to various mixtures of two dispersants, Vecom B-1425 GL and Norchem OSD-570, and diesel fuel. Measured survival, phototaxis, and swimming behavior during 24 and 48 hr static toxicity tests.

**Xia, W-x., X-l. Zheng, J-c. Li, Z-w. Song, L. Zhou, H-f. Sun**, 2005. Degradation of crude oil by indigenous microorganisms supplemented with nutrients. Journal of Environmental Science **17**:659-661.
**Keywords:** ammonia/ ammonium/ bacteria/ biodegradation/ combination/ crude oil/ degradation/ hydrocarbons/ incubation/ microbes/ nitrate/ nutrients/ oil/ Oten/ petroleum/ petroleum hydrocarbons/ phosphate/ salt water/ water/ weathered
**Notes:** A study of biodegradation of crude oil in sea water supplemented with nutrients. Crude oil was artificially weathered and combined with four combinations of nitrate, phosphate, and ammonium nutrients. Laboratory incubation continued for nine weeks. Measured total petroleum hydrocarbons weekly and heterotrophic and petroleum-degrading bacteria at weeks 2, 4, 6, and 8.

**Xiong, Z.-T., H.-X. Hu, Y.-X. Wang, G.-H. Fu, Z.-Q. Tan, G.-A. Yan**, 1997. Comparative analyses of soil contaminant levels and plant species diversity at developing and disused oil well sites in Qianjiang oilfield, China. Bulletin of Environmental Contamination and Toxicology **58**:667-672.
**Keywords:** China/ crude oil/ diversity/ fresh water/ freshwater plant/ oil/ oil field/ oiled/ Oseven/ plant/ soil/ species/ species diversity
**Notes:** Plants growing on oiled soil at a Chinese oilfield.

**Xu, H., S. Lesage, S. Brown**, 1994. Petroporphyrins as chemical indicators of soil contamination by crude oil. Chemosphere **28**:1599-1609.
**Keywords:** analysis/ BTEX/ crude oil/ fingerprinting/ indicator/ oil/ Onine/ PAH/ soil/ technical/ TPH
**Notes:** Authors advocate the use of petroporphyrins for identification of crude oils and heavy residuals of refined crude. Soils contaminated by three crude oils are used to demonstrate the utility of this approach compared to the use of TPH profiles, BTEX analysis, and PAH analysis.

**Xu, R, N. L. A. Lau, K. L. Ng, J. P. Obbard**, 2004. Application of a slow-release fertilizer for oil bioremediation in beach sediment. Journal of Environmental Quality **33**:1210-1216.
**Keywords:** activity/ aliphatic hydrocarbons/ Arabian Light crude oil/ aromatic hydrocarbons/ beach/ bioremediation/ concentration/ crude oil/ fertilizer/ intertidal/ microbes/ microcosm/ nutrients/ oil/ Oten/ pore water/ salt water/ sediment/ Singapore
**Notes:** Sediments were placed in six microcosms located in the intertidal zone of a Singapore island. Arabian light crude oil was added to all batches of sediment and Osmocote added to three of the microcosms. Microcosms were sampled on days 0, 7, 15, 21, 28, 40, 56, 69, 77, and 105 of the 105-da study. Microbial activity was measured by determination of dehydrogenase activity, and the sediments were analyzed for several measures of aliphatic, aromatic, and total hydrocarbon presence. Pore water was also analyzed for concentration of nutrients.

**Xu, R., J. P. Obbard, E. T. C. Tay**, 2003. Optimization of slow-release fertilizer dosage for bioremediation of oil-contaminated beach sediment in a tropical environment. World Journal of Microbiology & Biotechnology **19**:719-725.
**Keywords:** activity/ Arabian Light crude oil/ beach/ bioremediation/ concentration/ crude oil/ degradation/ experiment/ fertilizer/ leachate/ microbes/ microcosm/ nutrients/ oil/ Oten/ salt water/ sediment/ weight
**Notes:** Beach sediment was mixed with Arabian light crude oil in concentrations of 0, 0.2, 0.8, 1.5, 2, and 4 % (dry weight) and used in a microcosm experiment. The slow release fertilizer Osmocote$^{TM}$ was used as a nutrient source. Duration of the experiment was 42 da and samples were collected on days 0, 2, 8, 14, 21, 28, 35, and 42. Measured metabolic activity (dehydrogenase activity), nutrients in leachate, n-alkanes, pristane, and phytane.

**Xu, R., J. P. Obbard**, 2004. Biodegradation of polycyclic aromatic hydrocarbons in oil-contaminated beach sediments treated with nutrient amendments. Journal of Environmental Quality **33**:861-867.
**Keywords:** activity/ analysis/ Arabian Light crude oil/ aromatic hydrocarbons/ beach/ biodegradation/ combination/ crude oil/ microbes/ nutrients/ oil/ Oten/ sediment/ time/ weathered
**Notes:** Sediment was mixed with Arabian light crude oil, weathered for 3 wks, and used in a 45-day test of the effects of three types of nutrient amendments on biodegradation of the crude oil. Amendments were soluble nutrients, Osmocote, Inipol, and combinations of the three. The treated sediment was sampled five times for hydrocarbon analysis and eight times for metabolic activity (dehydrogenase activity). Measured 22 two- to six-ring aromatic hydrocarbons.

**Yamada, M., H. Takada, K. Toyoda, A. Yoshida, A. Shibata, H. Nomura, M. Wada, M. Nishimura, K. Okamoto, K. Ohwada**, 2003. Study on the fate of petroleum-derived polycyclic aromatic hydrocarbons (PAHs) and the effect of chemical dispersant using an enclosed ecosystem, mesocosm. Marine Pollution Bulletin **47**:105-113.
**Keywords:** abundance/ aromatic hydrocarbons/ bacteria/ degradation/ dispersant/ ecosystem/ experiment/ fate/ hydrocarbons/ mesocosm/ microbes/ ODten/ oil/ PAH/ residual oil/ salt water/ sediment/ water column
**Notes:** Large indoor mesocosms containing sea water and the water-soluble fraction of heavy residual oil were used to determine the effect on degradation of a chemical oil dispersant. Mesocosms contained either no oil, high oil, low oil, or high oil plus dispersant (Taiho Self Mixing S-7). All tanks received nutrient additions prior to the oil addition. Experiment duration was 9 da. Water samples were collected from the water column and sediment from a sediment trap on a daily basis. Water and sediment were analyzed for 38 PAHs and abundance of bacteria was determined.

**Yamamoto, T., M. Nakaoka, T. Komatsu, H. Kawai, Marine Life Research Group of Takeno, K. Ohwada**, 2003. Impacts by heavy-oil spill from the Russian tanker *Nakhodka* on intertidal ecosystems: recovery of animal community. Marine Pollution Bulletin **47**:91-98.
**Keywords:** benthic/ community/ distribution/ ecosystem/ intertidal/ invertebrate/ Japan/ length/ limpet/ marine invertebrate/ Ofour/ population/ recovery/ salt water/ shell/ shoreline/ snail/ species/ spill/ tanker/ time
**Notes:** A spill of "heavy oil" from the tanker *Nakhodka* fouled shorlines of Japan. The authors monitored the recovery of benthic invertebrates along a 350 m length of shoreline with a series of 70 quadrats grouped into nine study areas. Samples were collected in May of 1998-2001. Invertebrates were identified and quantified. The size distribution of the two most common species (limpet and snail) was determined by measuring shell length.

**Yarbrough, J. D., J. R. Heitz, J. E. Chambers**, 1976. Physiological effects of crude oil exposure in the striped mullet, Mugil cephalus. Life Sciences **19**:755-760.
**Keywords:** biochemistry/ crude oil/ ecosystem/ effects/ Empire Mix crude oil/ estuarine/ fish/ gill/ liver/ mullet/ muscle/ oil/ Othree/ pathology/ salt water/ striped mullet/ weight
**Notes:** Exposure of striped mullet for 20 da to Empire Mix crude oil spilled on the surface of a simulated estuarine ecosystem. Measured body and liver weight; gill, liver, and muscle biochemistry; and some pathology.

**Yassaa, N., A. Cecinato**, 2005. Composition of torched crude oil organic particulate emitted by refinery and its similarity to atmospheric aerosol in the surrounding area. Chemosphere **60**:1660-1666.
**Keywords:** air/ aliphatic hydrocarbons/ aromatic hydrocarbons/ atmosphere/ composition/ crude oil/ miscellaneous/ Oeleven/ oil/ organic/ PAH/ particulate/ refinery
**Notes:** Air samples were collected from two refinery areas (torched gasses) and one area inside a nearby city in the interior of Algeria. Air samples were analyzed for n-alkanes, n-alkanoic and n-alkenoic acids, ketones, and 23 PAHs.

**Youssef, T., A. Ghanem**, 2002. Salt secretion and stomatal behaviour in *Avicennia marina* seedlings fumigated with the volatile fraction of light Arabian crude oil. Environmental Pollution **116**:215-223.
**Keywords:** Arabian crude oil/ Arabian Light crude oil/ aromatic hydrocarbons/ concentration/ crude oil/ hydrocarbons/ light/ mangrove/ marina/ marine plant/ oil/ Osix/ recovery/ salinity/ salt water/ seedling/ species/ toxicity
**Notes:** Propagules of a mangrove species were experimentally fumigated with the volatile fraction of Arabian light crude oil. Exposure was for 0, 3, or 6 hrs followed by a 1-hr transition period and then 48 hrs of recovery. Measured salt secretion at four salinities (10, 20, 30, 40 ppt) and stomatal behaviour at 20 ppt after 48 hrs of recovery. Also measured concentrations of volatile aromatic hydrocarbons in the crude oil.

**Youssef, T.**, 2002. Evidence for reduced post-spill recovery by the halophyte *Sporobolus iocladus* (Nees ex Trin.) Nees in oil-contaminated sediments. Marine Pollution Bulletin **44**:334-339.
**Keywords:** anthracene/ Arabian crude oil/ crude oil/ germination/ incubation/ light/ marine plant/

naphthalene/ oil/ Osix/ plant/ rate/ recovery/ salinity/ salt water/ sediment/ seed/ species
**Notes:** Determination of the effect of Light Arabian crude oil, naphthalene, and anthracene on the seed germination of a species of salt-tolerant plant. Seeds were collected from coastal Abu Dhabi and used in a 2 wk laboratory seed germination study that employed six water salinities (0-350 mM) . Measured or calculated accumulated germination rate, average incubation period, and germination 'velocity'.

**Yu, Q., W-Y. Zheng, Y. Weng, C.-G. Wang, R. Chen**, 2003. Response of antioxidase in viscera of *Pagrosuma major* larvae to water soluble fraction of hydrocarbons in No. 0 diesel oil. Journal of Environmental Science **15**:47-54.
**Keywords:** aromatic hydrocarbons/ bioassay/ biochemical/ China/ concentration/ diesel/ fish/ fuel oil/ hydrocarbons/ larvae/ oil/ Othree/ recovery/ salt water/ solubility/ species/ static/ viscera
**Notes:** Larvae of a commercial fish species were exposed to four concentrations of the water-soluble component of diesel oil (equivalent to No. 2 fuel oil) for 15 da in a static bioassay with water replacement every other day. This was followed with a 9-da recovery period for a subset of the larvae. Larvae were sampled on days 9 and 15 and four biochemical measurements were made.

**Zachleder, V., Z. Tukaj**, 1993. Effect of fuel oil and dispersant on cell cycle and macromolecular synthesis in the chlorococcal alga *Scenedesmus armatus*. Marine Biology **117**:347-353.
**Keywords:** biochemical/ cell/ chlorophyll/ condition/ dispersant/ DNA/ effects/ fuel oil/ light/ marine plant/ metabolism/ No.2 fuel oil/ ODsix/ oil/ protein/ ratio/ reproduction/ RNA/ salt water
**Notes:** Assessment of the effects of No. 2 fuel oil and a chemical dispersant on reproductive and biochemical processes of a chlorococcal alga. Algal cultures were exposed to either 100 ppm dispersant, 200 ppm dispersant, 100 ppm fuel oil, 100 ppm fuel oil plus 5 ppm dispersant, or 1000 ppm fuel oil plus 50 ppm dispersant. Monitored nuclear and cellular division in both light and dark conditions. Measured DNA, RNA, protein, chlorophyll *a* + *b* synthesis, starch synthesis, and ratio of chlorophyll *a* to *b*.

**Zanadri, E., M. C. Bicego, L. B. De Miranda, R. Weber**, 1999. Distribution and origin of hydrocarbons in water and sediment in Sao Sebastiao, SP, Brazil. Marine Pollution Bulletin **38**:261-267.
**Keywords:** aliphatic hydrocarbons/ aromatic hydrocarbons/ Brazil/ distribution/ hydrocarbons/ miscellaneous/ Oeleven/ origin/ petroleum hydrocarbons/ salt water/ sediment
**Notes:** Determined the distribution and origin of hydrocarbons in water and sediment near Sao Sebastiao Island, Brazil. Collected 20 samples of water and sediment in February 1994. Analyzed samples for aliphatic and aromatic hydrocarbons and compared results according to three site groupings within the sample collection.

**Zarba, M. A., O. S. Mohammad, V. C. Anderlini, P. Literathy, F. Shunbo**, 1985. Petroleum residues in surface sediments of Kuwait. Marine Pollution Bulletin **16**:209-211.
**Keywords:** Arabian Gulf/ aromatic hydrocarbons/ carbon/ concentration/ crude oil/ distribution/ hydrocarbons/ Kuwait/ Kuwait crude oil/ miscellaneous/ Oeleven/ offshore/ oil/ organic/ organic carbon/ petroleum/ sediment
**Notes:** A total of 66 surface sediment samples were collected from the offshore waters of Kuwait in the Arabian Gulf during 1979-80. Samples were analyzed for aromatic hydrocarbons and expressed as Kuwait crude oil equivalents. Sediment concentrations were then mapped. Also measured total organic carbon.

**Zengel, S. A., J. Michel**, 1996. Vegetation cutting as a clean-up method for salt and brackish marshes impacted by oil spills: a review and case history of the effects on plant recovery. Marine Pollution Bulletin **32**:876-885.
**Keywords:** crude oil/ Delaware/ Delaware River/ effects/ freshwater plant/ guidelines/ history/ marine plant/ miscellaneous/ Oeleven/ oil/ oil spill/ oiled/ plant/ procedure/ recovery/ remediation/ review/ river/ spill/ vegetation
**Notes:** Authors reviewed 22 operational and experimental situations where oiled vegetation was cut as part of the clean-up procedure. Details of actions and consequences are discussed. Also present a case study involving a crude oil spill in the Delaware river. Guidelines for cutting of oiled marsh vegetation are offered.

**Zhang, J. F., H. Shen, T. L. Xu, X. R. Wang, W. M. Li, Y. F. Gu**, 2003. Effects of long-term exposure of low-level diesel oil on the antioxidant defense system of fish. Bulletin of Environmental Contamination and Toxicology **71**:234-239.
**Keywords:** activity/ antioxidant/ bioassay/ biochemical/ concentration/ diesel/ experiment/ fish/ fresh water/ liver/ long-term/ oil/ Othree/ protein/ static/ time
**Notes:** The water-soluble fraction of No. 20 diesel oil was used in a static aquaria with gold fish. Concentrations were 0, 0.005, 0.01, 0.05, 0.1, 0.5, and 1 ppm and the duration of exposure was 40 da. At the end of the experiment the livers were analyzed for protein content, catalase activity, liver superoxide dismutase activity, reduced glutathione, se-dependent glutathione peroxidase, and glutathione S-transferase.

**Zhang, J. F., X. R. Wang, H. Y. Guo, J. C. Wu, Y. Q. Xue** , 2004. Effects of water-soluble fractions of diesel oil on the antioxidant defenses of the goldfish, *Carassius auratus*. Ecotoxicology and Environmental Safety **58**:110-116.
**Keywords:** antioxidant/ biochemical/ China/ depuration/ diesel fuel/ fish/ fresh water/ goldfish/ juvenile/ liver/ No.20 fuel oil/ Othree/ time
**Notes:** Juvenile goldfish were exposed to either 0.05 or 0.1 ppm of No. 20 diesel fuel for 2, 4, 7, 10, 15, 25, or 40 days. After 25 days, some of the fish were transferred to clean water for a 15-da depuration period. Fish livers were removed and analyzed for a suite of biochemical measures.

**Zhang, X. H., Z. S. Wang, M. Lu**, 1999. Control of ozonation for detoxification of petrochemicals in groundwater. Journal of Environmental Science and Health **A34**:1745-1752.
**Keywords:** carbon/ concentration/ evaluation/ fresh water/ ground water/ methods/ miscellaneous/ Oeleven/ petroleum hydrocarbons/ phenol/ toxicity
**Notes:** Evaluation of an ozonation method for removing petrochemicals from ground water. Applied increasing amounts of ozone to ground water and measured the resulting concentrations of phenols. Toxicity of untreated ground water, ozonated ground water, and ozonated ground water filtered through activated granular carbon was determined with the Ames test.

**Zhijie, F., Y. F. Zhang**, 1988. Levels and trends of oil pollution in the Bohai Sea. Marine Pollution Bulletin **19**:572-575.
**Keywords:** aromatic hydrocarbons/ distribution/ hydrocarbons/ kerosene/ miscellaneous/ Oeleven/ oil/ oil field/ pollution/ time/ trend
**Notes:** A total of 24 samples of surface water were collected from the Bohai Sea. At five of the stations, water was collected at 1m, 10 m, and bottom. Samples were analyzed for aromatic hydrocarbons and expressed as No. 20 kerosene. Results were compared to previous studies and interpreted as surface distribution, vertical distribution, and change over time. Results also were compared to oil pollution in surface waters at other global locations.

**Zhong, P., L. R. Kong, Z. F. Lin, G. M. Liu**, 2003. Photodegradation of diesel oil in aqueous solutions. Bulletin of Environmental Contamination and Toxicology **70**:1128-1135.
**Keywords:** concentration/ condition/ degradation/ diesel/ diesel fuel/ effects/ irradiance/ oil/ Onine/ photoenhanced/ technical/ waste water
**Notes:** A laboratory determination of the effect of differing reaction conditions on the Fenton reagent for degradation of diesel oil in wastewater. Evaluated the effects of irradiation wavelength, $H^2O^2$ concentration, direct photolysis and volatilization, $Fe^{2+}$ concentration, differing Fe valence, and addition of differing $Fe^{3+}$ complexing anions.

**Zhou, S., H. Heras, R. G. Ackman**, 1997. Role of adipocytes in the muscle tissue of Atlantic salmon (*Salmo salar*) in the uptake, release and retention of water-soluble fraction of crude oil hydrocarbons. Marine Biology **127**:545-553.
**Keywords:** adipocytes/ aromatic hydrocarbons/ Atlantic/ Atlantic salmon/ crude oil/ depuration/ fish/ hydrocarbons/ muscle/ oil/ Othree/ release/ salmon/ salt water/ tissue/ uptake
**Notes:** Uptake and depuration of WSF of crude oil by Atlantic salmon.

**Zinjarde, S. S., A. A. Pant**, 2002. Hydrocarbon degraders from tropical marine environments. Marine Pollution Bulletin **44**:118-121.
**Keywords:** aliphatic hydrocarbons/ bacteria/ crude oil/ degradation/ environment/ experiment/ marine environment/ microbes/ oil/ Oten/ salt water/ yeast
**Notes:** Bacteria and yeasts were isolated and identified from collections made in a coastal Indian harbor. Eleven bacteria and six yeasts were tested on three types of crude oil in a laboratory experiment. Most of the discussion is about the capability of the yeasts to degrade the aliphatic fraction of the crude oils.

**Zuberogoitia, I., J. A. Martinez, A. Iraeta, A. Azkona, J. Zabala, B. Jimenez, R. Merino, G. Gomez**, 2006. Short-term effects of the prestige oil spill on the peregrine falcon (*Falco peregrinus*). Marine Pollution Bulletin **52**:1176-1181.
**Keywords:** adult/ bird/ Bunker C/ coast/ concentration/ effects/ eggs/ fuel oil/ nest/ numbers/ oil/ oil spill/ Oone/ PAH/ population/ reproduction/ salt water/ short-term/ Spain/ spill
**Notes:** An assessment of the impact of the Prestige Bunker C fuel oil spill off the northwest coast of Spain on the peregrine falcon of Biscay province. The provincial population was monitored since 1997 and is reported for the first breeding year (2003) after the spill (November 2002). Data on numbers of breeding birds, adult turnover, reproductive success, and PAH concentrations in eggs from deserted nests are presented.

**Zurcher, F., M. Thuer**, 1978. Rapid weathering processes of fuel oil in natural waters: analyses and interpretations. Environmental Science and Technology **12**:838-843.
**Keywords:** alkane/ aromatic hydrocarbons/ composition/ degradation/ fresh water/ fuel oil/ hydrocarbons/ No.2 fuel oil/ oil/ Onine/ petroleum/ petroleum hydrocarbons/ technical/ weathered
**Notes:** An early investigation into the process of weathering by No. 2 fuel oil spilled on water. Authors analyzed (alkanes and aromatic hydrocarbons) the original fuel oil and oil in water over the first 24 hrs after the fuel oil was poured on the water. Petroleum of unknown composition from subsurface water was also sampled for comparison purposes. Results are presented in terms of dissolution, adsorption, dispersion and agglomeration of the petroleum hydrocarbons.