OFFSHORE OPERATORS COMMITTEE

February 29, 2016

Mr. Isaac Chen (6WQ-PP)
U.S. - EPA Region 6
1445 Ross Ave.
Dallas, Texas 75202-2733

Re: Offshore Operators Committee Recommended Permit Changes for 2017- GMG290000 Permit Renewal

Dear Mr. Chen:

The Offshore Operators Committee (OOC), Water Sub-Committee respectfully submits for your review and consideration the attached table of Recommended Permit Changes for the 2017-GMG290000 permit renewal. Additionally, we have included copies of the embedded files found in the table. These include copies of regulations, technical documents and/or other related information regarding each item.

OOC plans to contact you in the near future to coordinate and schedule a face to face to discuss the submittal. The purpose of this meeting would be to answer questions and provide any necessary clarifications that may be needed. Additionally, it will serve as a means to keep the lines of communication open for the permit renewal.

We appreciate the Agency's time and efforts on the permit renewal. If you have any questions or if additional information is needed, please contact me at (713) 624-7338 or shamm@wtoffshore.com. Additionally, you may contact James Durbin, C-K Associates, at (225) 755-1000 or james.durbin@c-ka.com .

Yours truly,

Steve Hamm
Chairman, Water Sub-committee
Offshore Operators Committee

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NPDES General Permit for New and Existing Sources and New Dischargers in the Offshore Subcategory of the Oil and Gas Extraction Point Source Category for the Western Portion of the Outer Continental Shelf of the Gulf of Mexico (GMG290000)

OOC GMG290000 2017 Permit Renewal – Recommended Changes/Comments List

General Note – all permit text is shown in quotations. All suggested revisions to the proposed permit text are shown in red and ~~strikethroughs~~ within OOC's comments.

Comment No.	Type/Category	Permit Section Ref.	Revised Permit Wording/Clarifications/Issue	Rationale
1	DMR	N/A	DMR Instructions	OOC is requesting DMR Instructions reference be added to the permit and Instructions to be posted on Region 6 Oil & Gas online web page as per previous two permit issuances in 2001 and 2007. Detailed instructions would eliminate multiple DMR errors and create more consistency and eliminate some of the (BSEE) inspector's questions during offshore inspections.
			Guidance and clarification of No Data Indicator Codes (NODI) listing and when to use.	Although NODI codes have been used on Region 4 DMRs for some time, not all operators have had experience with NODI codes until NetDMR was instituted. Since the system encompasses many different permit types, not all NODI codes are applicable to Region 6 DMRs. OOC requests guidance on which NODI codes are applicable and in what context they should be used to be added to either the permit or DMR Instructions.
			Correct DMR and NetDMR typos/inconsistencies	OOC is requesting that the DMRs be corrected to reflect the correct permit requirements for each parameter. OOC would like to work with EPA to address all the numerous typos and inconsistencies listed in the attachment below and as Appendix A, as well as others that have not been specifically listed. OOC can provide a more detailed list of these if necessary for clarity. Copy of NeTDMR Corrections.xlsx
		II.D.4	Edit Text accordingly: "DMRs shall be submitted according to the following schedule: a. All DMRs covering the first monitoring period (effective date of the permit to December 31, 2013) shall be submitted by no later than March 31, 2014. b. DMRs for subsequent monitoring periods shall be submitted quarterly no later than sixty ~~thirty~~ (~~63~~0) days following the end of the quarterly monitoring period. c. If the NetDMR system is unavailable for any reason during the 60-day period when DMRs are due, an extension of 60 days can be granted by the EPA Region 6 Enforcement Branch. This extension can be in the form of an e-mail or letter to the Oil and Gas Industry from Region 6 Enforcement Branch. ~~If for some reason the electronic submittal is not accepted, the permittee would be required to submit paper DMR.~~ The permittee has up to 60 days to submit ~~paper DMRs~~ a one page certified submittal of all outfalls that would have been covered as opposed to a full DMR (hard copy) submittal.	1. The OOC requests that EPA provide a 60 day submittal for Quarterly DMRs. Currently the permit allows for submittal of DMR's 30 days after the Quarter ends. There is a large amount of data that must go through QA/QC before the data can be inputted into NetDMR and once populated the Industry must review for correctness. There are multiple Companies and Consultants that have to submit between 2,500 and 4,000 DMRs a quarter. The extension of 60 days from 30 days will allow the industry to populate NetDMR with quality data. 2. The permit language allows for a 60 day paper DMR submittal if the system is unavailable, but since electronic submissions must be done as soon as the system is available, OOC requests language be added to the permit granting a minimum of a 60-day grace period for submitting electronic DMRs if the NetDMR system is out of service for any reason (e.g. due to maintenance, upgrades, malfunction, etc.). Rather than duplicate work by submitting both paper and electronic DMRs for a Semi-Annual/quarter where the system is unavailable, OOC is requesting that a Certification Letter be acceptable. The letter would contain the permit certification statement and a list of Permitted Feature numbers for which reporting is required for that Semi-annual/quarterly period. The postmark on the letter on or before the DMR due date) would demonstrate timely reporting was attempted while the system is down. The Certification Letter would be less burdensome for both the Oil and Gas Industry and EPA, and would also follow the Paper Reduction Act of 1995. OOC also requests that language be added to the permit addressing a government shutdown where there is the possibly of a longer period of system unavailability (longer than a system refresh or update) and requests a grace period of 60 days from the date the system is back up and functioning. The 60 day extension would begin from the end of the

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				reporting period.
2	Notice of Intent	I.A.2	Edit text as follows: ““Operator” - for the purpose of this permit and only in the context of discharges associated with oil and gas exploration, development, and production activities regulated by this permit, means any party that meets ~~either~~ one of the following three criteria:”	1. The use of “either” implies two qualifying criteria. Three definitions are listed; therefore, in this case, the term “operator” would be applicable should one of the criteria be met. 2. Additionally, OOC is requesting that mandatory limit sets be removed from the eNOI system and permittees be allowed to choose limit sets for the specific discharges that they are responsible for, and to allow for unique situations as well as avoid having to report on unused (but mandatory) limit sets. The eNOI system sets mandatory limit sets (defaults) that may or may not be under the control of the operator or another entity depending on agreements between the parties. Further, mandatory limit sets create a multitude of unnecessary “No Discharge” DMRs creating more work for permittees and filling in the NetDMR system. In some instances, coverage by both parties for the same limit sets may lead to redundant reporting.
3	Drilling Fluids – Prohibitions – Non aqueous Based Drilling Fluids - Exception	I.B.1.a.	Edit Text: “Exception: non aqueous base fluids may be used as a carrier fluid (transporter fluid), lubricity additive or pill in water based drilling fluids and discharged with those drilling fluids provided the discharge continues to meet the no free oil and 96-hour ~~LC50~~ LC_{50} toxicity limits, and a pill is removed prior to discharge”.	OOC is requesting this change to provide consistency with other sections of the permit.
4	Drilling Fluids – Limitations	I.B.1.b.	Edit Text: “Toxicity. Discharged drilling fluids shall meet both a daily minimum and a monthly average minimum 96-hour ~~LC50~~ LC_{50} of at least 30,000 ppm…”	OOC is requesting this change to provide consistency with other sections of the permit.
5	Limitations which apply to all drill cuttings –	I.B.2.b.	Edit Text: “Toxicity. Drill cuttings generated using drilling fluids with a daily minimum or a monthly average minimum 96-hour ~~LC50~~ LC_{50} of less than 30,000 ppm…”	OOC is requesting this change to provide consistency with other sections of the permit.
6	Discharge Limitations – Formation Oil	I.B.2.c.2.b	Revise and reword section as follows: “Formation Oil”. b) Once per week ~~during drilling~~ when generating and discharging cuttings using the Reverse Phase Extraction test method specified in Part I, Section D.12 of this permit or the gas chromatography/mass spectrometry method specified in Part I, Section D.11 of this permit.	OOC is requesting this change to provide consistency with other sections of the permit.
7	Crude Oil Standard	Appendix C, as referenced by I.D.11	Edit Text: “7.2.1 Crude Oil Reference- NIST ~~1582~~ 2779 Petroleum Crude Oil Standard Reference Material (U.S. Department of C~~c~~ommerce N~~n~~ational Institute of Standards and Technology, Gaithersburg, MD 20899). This oil will be used in the calibration procedures.” Sections 5.2.5.3, 7.2.5.4, and 7.2.5.5 will also need to be adjusted to reflect the appropriate amount of crude equivalent in NAF mud standards.	The National Institute of Standards and Technology has discontinued NIST 1582, the crude oil standard currently referenced in the permit. NIST 2779, Gulf of Mexico Crude Oil Standard is listed as an alternative crude oil standard for use; its target aromatics are similar to those of NIST 1582. Sections 5.2.5.3, 7.2.5.4, and 7.2.5.5 are used to build the calibration curve of the percent contamination of formation oil in NAF mud. The amounts of NIST 2779 crude to add for 0.5%, 1.0%, and 2.0% need to be adjusted to reflect a calibration curve comparable to the curve generated by using the amounts of NIST 1582 currently in the permit.
8	Produced Water	I.B.4.a	Edit Text:	OOC is requesting this change to provide clarity with the permit language and consistency with

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	- Limitations		"…..Critical dilution shall be determined using Table 1 in Appendix D of this permit and is based on the highest estimated monthly average discharge flow rate for the three months prior to the month in which the test sample is collected, discharge pipe diameter, and water depth between the discharge pipe and the bottom….."	language found Part I.B.4.b.3. See also comment No. 9.
9	Produced Water -Monitoring	I.B.4.b.3	Edit text: "….The highest estimated monthly average discharge flow rate recorded during that 12-month period will be the flow baseline for monitoring reduction purpose. During the reduced monitoring period, if the estimated monthly average discharge flow rate increase more than 20% of the flow baseline and there is an increase in the critical dilution most recently tested, an additional test is required for those discharges no later than the following quarter……"	OOC is requesting this change to provide clarity with the permit language and consistency with language found Part I.B.4.a. See also comment No. 8.
10	Miscellaneous Discharges of Seawater and Freshwater which have been chemically treated – Limitations	I.B.11.a	Edit Text: "…..Critical dilution shall be determined using Table 2 in Appendix D of this permit and is based on the highest estimated monthly average discharge flow rate, discharge pipe diameter, and water depth between the discharge pipe and the bottom….."	OOC is requesting this change to provide clarity with the permit language and consistency with language found Part I.B.11.b. See also comment No. 11.
11	Miscellaneous Discharges of Seawater and Freshwater which have been chemically treated – Monitoring Requirements	I.B.11.b	Edit text: "….The highest estimated monthly average discharge flow rate recorded during that 12-month period will be the flow baseline for monitoring reduction purpose. During the reduced monitoring period, if the estimated monthly average discharge flow rate increase more than 20% of the flow baseline and there is an increase in the critical dilution most recently tested, an additional test is required for those discharges no later than the following quarter……"	OOC is requesting this change to provide clarity with the permit language and consistency with language found Part I.B.11.a. See also comment No. 10
12	Miscellaneous Discharges	I.B.10	Add the following: "Mud, Cuttings, and Cement (including tracers) at the seafloor"	Being able to identify top of cement (TOC) behind a wellbore casing can sometimes be challenging given current (acoustic) cement evaluation logging technology. By being able to run tracers detectable by logging tools, the technical limits of acoustic logging tools are bypassed, thus allowing the operator another option that may more clearly identify TOC and ensure the cemented casing meets technical and HSE requirements for the well. The tracer in question would be a very small quantity (~ 1 mCi) of Sc-46 embedded in inert beads suspended in a gel (~1 cup by volume total), placed in the first 50 bbls of cement pumped (and so may extrude to sea floor for top hole casings). Sc-46 decays by beta emission (with detectable gamma), with a half-life of ~84 days (so effectively gone after 5 half-lives or 420 days). The beads will not float or disperse, rather we expect they will be encapsulated into the cement slurry as it solidifies (over 12-24 hours at the sea floor). Sc-46 beta emissions travel distance in water is estimated at 0.11 cm. The tenth thickness in concrete for the gamma emissions is 16 cm. Given these small distances, along with short half-life and cement encapsulation, we would not expect significant ecological risk from this tracer.
13	Excess fluids	I.B.10 & II.G	Edit text: "Excess Cement Slurry ~~[Note: Discharges of cement slurry used for testing cement handling equipment are not authorized.]"~~ Add to Miscellaneous Discharge List:	OOC recommends that discharges of cement used for testing and unused cement slurry be authorized by adding a new discharge under Miscellaneous Discharges: "Unused Cement Slurry".

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			"Unused Cement Slurry" Add to the Definitions in Part II.G: ""Unused Cement Slurry" means cement slurry used for testing of equipment or resulting from cement specification changes."	<u>Rationale:</u> Summarizing the details of OOCs submittals to EPA 7/15/11 and 12/15/11 related to this issue a) Equipment testing is critical to proper operation and maintenance of drilling systems. Without adequate testing, well control concerns (among others) can arise. Equipment that is not properly tested has the potential for a catastrophic environmental event. EPA must consider equipment testing/commissioning as "proper operation and maintenance" since if permittees do not test/commission equipment then a permittee cannot truly say that they are complying with this permit requirement. b) The discharge of such fluids would meet all monitoring and limitations of the permit for those fluid types, and since such fluids had not been "used" they would have a lower pollutant potential than the used fluids (which are authorized for discharge). c) Prior EPA determinations have been received which authorized such discharges (and the draft fact sheet does not now provide a substantive justification for now prohibiting such discharges). d) Authorizing discharge will avoid substantive safety risks for managing bulk fluids back to shore including lifting large, heavy containers at sea; transportation risks at sea and on-land and; tank/container cleaning associated with solidified cement (It is difficult to inhibit cement from setting up. Therefore, transport to shore is expected to be solidified blocks in their containers). Safety incidents have occurred during the removal of hardened cement from cutting boxes using jack hammers. One operator had two reported hand/finger injuries occur as a result of disposing the cement test mix from the commissioning of one cement unit on a new build drillship. This also consumes limited onshore disposal facility capacity for essentially benign materials. Finally, the transport of these materials involves environmental consequences including increased air emissions from marine and road transport. OOC presents here additional information on the discharge quantities to support approval of these discharges. The following are typical volumes of cement for the subject issue: 1. New drilling units (MODU or platform rig) commissioning/equipment testing: 100-200 bbls per ship. This is slurry used to test pumping functions and verify flow paths. Assuming 3-7 newly constructed drilling units per year enter the Gulf (1), this is equivalent to 600-1400 bbl/yr of slurry that may be discharged annually. 2. Out of the rigs that come to the GOM, some of those rigs/operators choose to do their commissioning before they enter the GOM and cement slurry from the test mix is not discharged in the GOM. The percentage of rigs that choose to go this route could be as high as 50%. 3. When cement slurry from a test mix cannot be discharged it must be caught in metal containers (i.e. cutting box, etc). The container must be sent in to shore to be disposed of before the cement slurry "sets up" or gets hard. Any time a liquid is transported it creates a greater risk of loss of primary containment. The lifts that must be made to move this container from the rig to a boat and then to the shore also introduce a higher risk for an accident or injury. This in turn puts more personnel in the line of fire and increases exposure rate versus discharging the cement slurry text mix while mixing it on the rig. 4. Other Discharges of Unused Cement Slurry o Repairs: when a cement system malfunctions or equipment must be upgraded or changed out for specific job, the existing cement must be removed, repairs made and testing conducted to ensure proper operation. There are two concerns in this case with a prohibition against the discharge: ▪ If the malfunction occurs during a cementing job, the existing cement must be washed out quickly (before it sets), the repair made, the testing performed and then new cement mixed. Discharge is the most effective means to support rapid repair since typically weight and space constraints

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				prevent holding empty containers offshore for such a contingency. This can involve potential well control issues if the cement system cannot be returned to service quickly. ▪ More generally, even if no cement job is in progress, the testing after repair is critical to assure all systems work as designed and provide cement that can comply with well design requirements. Estimated volumes are 5-100 bbls per event. OOC estimates this occurrence is rare on a per rig basis. Currently there are ~ 99 rigs working in the GOM (2). Assuming one event per year per rig this equates to ~500-10,000 bbls/year of slurry discharged. o Cement not meeting the specifications for a well job: 20-100 bbls. OOC expects this to also be a rare occurrence. Note- if this occurs when a well is in a productive interval, the cement must be washed out of the unit to prevent setting. Then a new batch needs to be quickly mixed to prevent well control issues. Discharge is the most effective means to support rapid response since typically weight and space constraints prevent holding empty containers offshore for such a contingency. This can involve potential well control issues if the cement system cannot be returned to service quickly. A review of BOEM data (3, 4) indicate > 100 wells per year are drilled in the Gulf. Assuming one event per well per year yields 2000-10,000 bbls/yr of slurry discharged. In summary, annual expected discharges of the proposed “Unused Cement Slurry” could be on the order of : Commissioning of new drilling units s= 600-1400 total bbls/year Repairs= 500-10,000 total bbls/year Off spec cement = 1000-10,000 total bbls/year Total= 2100 - 21,400 total bbl/year Compare this to a single well’s discharge of authorized Excess Cement Slurry (as authorized and defined in the permit): though highly variable depending on many factors, this is on the order of approximately 100-400 bbls (including pit cleanouts after a job). The majority of this is associated with riserless operations. Assuming 100 wells/year are drilled in the Gulf, this yields approximately 10,000-40,000 bbls of Excess Cement Slurry already authorized by the current permit (and continued for authorization in the proposed permit) for discharge. The volumes shown above for the proposed Unused Cement Slurry are of the same order of magnitude as existing authorized excess cement slurry discharges (and are probably significantly lower). Given this, and typical discharge at or near the surface with immediate dispersion into the water column, the environmental impacts are expected to be insignificant. Note: The values provided in the above are based on worst case scenarios. Numbers to date may be lower based on current MODU activity in the Gulf of Mexico. As an alternative, OOC recommends a joint industry study be performed to assess the overall environmental and safety impacts of this discharge.

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				References 1. Personal communication, Kuehn – Rigzone, 4/23/12. 2. Rigzone- Rig Report: Offshore Rig Fleet by Region http://www.rigzone.com/data/rig_report.asp?rpt=reg 3. http://www.boem.gov/uploadedFiles/BOEM/Newsroom/Offshore_Stats_and_Facts/Gulf_of_Mexico_Region/OCSDrilling.pdf http://www.gomr.boemre.gov/PDFs/2009/2009-016.pdf
14	Miscellaneous Discharges of Seawater and Freshwater which have been chemically treated	I.B.11	Revise and reword section as follows: Excess ~~sea~~water which permits the continuous operation of fire control and utility lift pumps, Excess ~~sea~~water from pressure maintenance and secondary recovery projects, Water released during training of personnel in fire protection, ~~Seaw~~Water used to pressure test piping and pipelines, Ballast water, Once through non-contact cooling water, ~~Seaw~~Water used as piping or equipment preservation fluids, and ~~Seaw~~Water used during Dual Gradient Drilling. Water includes both seawater and freshwater discharges.	OOC requests that a change be made to the Title and list for "Miscellaneous Discharges of Seawater and Freshwater which have been chemically Treated". This will be a word change from "Seawater" and "Freshwater" to "Water". This change will ensure that both "Seawater" and "Freshwater" are included in the chemically treated discharge list.
15	Miscellaneous Discharges of Seawater and Freshwater which have been chemically treated – Limitations	I.B.11.a	Add the following: "[Note: Discharges treated by bromide, chlorine, or hypochlorite or which contain only electrically generated forms of chlorine, hypochlorite, copper ions, iron ions, and aluminium ions are not required for toxicity tests.]"	OOC recommends revising the text to include copper, iron, and aluminium ions to account for the fact that not only is electric current used to generate active Chlorine from seawater, but also there are systems which use sacrificial anodes to generate other anti-biofouling ions (such as, iron, copper and aluminium). Examples of several systems are shown at: http://www.farwestcorrosion.com/fwst/marine/cathelco_anti_fouling_systems_for_lift_pumps.htm and http://www.blumeworldwideservices.com/ . OOC does not expect the discharge will have a toxic impact on the environment as these systems operate in the part per billion concentration range. It is also noted that these systems are in use in the marine industry. • During the 2012 permit renewal, EPA indicated they would reconsider exempting electrically generated ions during the next permit renewal. Comment 21 (c) : (c) OOC requested that the permit language be revised to add ions generated by electric current to the toxicity exclusion list. EPA Response: The OOC did not provide data to support its expectation of no toxic impact for discharges of electrically generated ions such as copper and aluminium. EPA will reconsider the request during the next permit renewal process if OOC provides toxicity test results which can demonstrate no reasonable potential for toxicity in the discharged quantity. Ref: Final permit decision and response to comments received on the draft reissued GMG290000 NPDES permit publicly noticed in the Federal Register on March 7, 2012. Date: September 28, 2012

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				OOC is submitting additional information to support no toxic impact from these systems. Data collected from electric current generated ion treated seawater discharges under current general permits GEG460000 and GMG290000 demonstrate no reasonable potential for toxicity at the critical dilution and should be excluded from the monitoring requirement. These data include electric current generated copper, iron and aluminium ions and are hereby submitted below and as Appendix B. Ion Toxicity.pdf
16	Miscellaneous Discharges of Seawater and Freshwater which have been chemically treated - Limitations	I.B.11.a	Delete language accordingly: "Treatment Chemicals. The concentration of treatment chemicals in discharged seawater or freshwater shall not exceed the most stringent of the following three constraints: 1) the maximum concentrations and any other conditions specified in the EPA product registration labeling if the chemical is an EPA registered product, or 2) the maximum manufacturer's recommended concentration. ~~3) 500 mg/l~~ "	OOC is requesting deletion of the requirement that concentrations of treatment chemicals no exceed 500 mg/L. The 500 mg/L limit was proposed in 1996 as part of a Best Available Technology for control of discharges of seawater or freshwater to which chemicals had been added based on Best Professional Judgement. OOC suggests that the 500 mg/L limit be deleted because the choice of a specific value of 500 mg/L limit is arbitrary, has no scientific basis, and is inconsistent with the approach used to regulate produced water discharges, in which operators have the latitude to select the most effective treatment chemicals provided that toxicity limits are met. We believe that the existing toxicity limit and the requirement that effluent concentrations not exceed manufacturers recommended concentrations effectively achieves the regulatory objective of preventing the discharge of toxic materials in toxic amounts.
17	Cooling Water Intake Structure Requirements – Application Information	I.B.12.a.2.i	Edit text: "As described below, operators of cooling water intake structures subject to Part I.B.~~11~~12may either conduct…"	Improper reference to section, the change corrects the reference.
18	Cooling Water Intake Structure Requirements – Monitoring Requirements	I.B.12.c.2.ii	Delete Section.12.c.2.ii : ~~ii. Entrainment monitoring/sampling. After commencement of operations, the operator must monitor for entrainment. The operator must collect samples to monitor entrainment rates (simple enumeration) for each species over a 24-hour period and no less than biweekly during the primary period of reproduction, larval recruitment, and peak abundance identified during the Source Water Baseline Biological Characterization Study. Representative species may be utilized for this monitoring consistent with their use in the Source Water Baseline Characterization Study. The operator must collect samples only when the cooling water intake structure is in operation. After 24 months of monitoring, the permittee may reduce the monitoring frequency to once per quarter for the remainder of the permit. New facilities may join the currently on-going EPA approved industry-wide entrainment study.~~	OOC requests the removal of entrainment monitoring/sampling requirement. 40 CFR 125.137 (iv).3 provides the Director the flexibility to reduce the frequency of monitoring following 24 months of bimonthly monitoring provided that "seasonal variations in species and the numbers of individuals that are impinged or entrained " can be detected.. The report on the 24 month industry entrainment study (1) documents that many important Gulf of Mexico species were not detected at all in the regions where new facilities are expected to be installed so that entrainment impacts on these species will be zero; (2) provided documentation on the seasonal dependence of species and number of eggs and larvae available for entrainment, and (3) concludes that anticipated entrainment will have an insignificant impact on fisheries in any season; OOC believes that the intent of 40 CFR 125.137 has effectively been met and that the requirement for ongoing entrainment monitoring can be removed. Our request is based on the results of the results of the recently completed Industry –wide Gulf of Mexico Cooling Water Intake Structure Entrainment Monitoring Study and reinforced by the quarterly entrainment monitoring reports recently submitted by individual operators. Industry believes that these results warrant removal of the entrainment monitoring/sampling because (a) the study showed that no meaningful impacts from entrainment are expected. (b) since no meaningful impact was found the seasonality of the impact is a moot point, (c) the SEAMAP database provides a continually-updated source of information that is functionally equivalent to permit-required monitoring for the purpose of estimating entrainment impacts. The final study reports are

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				attached below and as Appendix C. The following is a brief summary of key findings of the industry entrainment monitoring study: 1. Study results provide data for enumeration of entrainment losses by species and for total egg and larval losses as required by the Permit. 2. Estimated entrainment impacts on ichthyoplankton are insignificant. A. Entrainment monitoring/sampling is required during the primary period of reproduction, larval recruitment, and peak abundance for each species, specifically, identified as part of the Source Water Biological Baseline Characterization Study (SWBBCS); however, the SWBBCS found no evidence to suggest CWIS would impact selected species of socioeconomic and ecological importance. B. In this study, catches of SWBBCS selected species were too low to statistically model (all exhibited >90% zeroes across tows; some 100% zeroes). C. Thus, no meaningful impacts from entrainment on these species are expected to occur. D. Daily entrainment was extremely small compared to the corresponding daily reference abundances drifting past each facility; thus, no meaningful impacts are expected for any species. 3. Temporal and environmental influences on ichthyoplankton densities. A. While no impacts are expected to occur at any intake depth, the most prevalent influence was sampling depth, whereby densities declined exponentially with increasing depth. B. In general, the lowest densities occurred during the fall and greatest densities during the spring. 4. Using SEAMAP data to estimate entrainment loss. A. Ichthyoplankton densities also declined exponentially with total water column depth; all study sites were deeper than the shallower depths (about ≤ 200 m) where sharp increases in densities began in the shoreward direction. B. For each of the study sites and across months, forecasted densities based on SEAMAP data were consistently 1½ to 2 times greater than those observed during this study. C. No impacts are expected based on densities estimated from either dataset. D. Thus, SEAMAP data appear adequate for future estimates of impacts on the ichthyoplankton community. The results of recent quarterly on-platform entrainment monitoring studies conducted by two operators (attached below and as Appendix C) are fully consistent with the results of the Entrainment Monitoring Study. The concentrations of larvae of key socioeconomic and ecological important species were typically zero in these measurements. This is consistent with industry's views that (1) cooling water intake structures on offshore facilities present an insignificant risk to fisheries, (2) the quarterly monitoring requirement is providing no new useful information and (3) the requirement should be dropped entirely.

Comment No.	Type/Category	Permit Section Ref.	Revised Permit Wording/Clarifications/Issue	Rationale
				2014 - Entrainment_Monitori JSM Entrainment 3Q2015_Final.pdf JSM Entrainment Rpt 2Q14.pdf JSM Entrainment Rpt 3Q14.pdf JSM Entrainment Rpt 4Q14.pdf Revised JSM Entrainment Rpt 1Q15 Revised JSM Entrainment Rpt 2Q15 Lucius Q1 Sampling Results.pdf Lucius Q2 Sampling Results.pdf
19	Cooling Water Intake Structure Requirements – Monitoring Requirements	I.B.12.c.1.i and I.B.12.c.2.i and I.B.C.3.ii	Edit each section accordingly: <u>Section.12.c.1.i</u> New non-Fixed Facilities i. Visual or remote inspections. Beginning the coverage of this permit, the operator must conduct either visual inspections or use remote monitoring devices (e.g., remotely operated vehicles (ROV), subsea cameras, or other monitoring device) during the period the cooling water intake structure is in operation. The operator must conduct visual or remote inspections at least ~~monthly~~ quarterly to ensure that the required design and construction technologies are maintained and operated so they continue to function as designed. Visual or remote monitoring is not required when conditions such as storms, high seas, evacuation, or other factors make it unduly hazardous to personnel, the facility, or the equipment utilized. The operator must provide an explanation for any such failure to visually or remotely monitor with the subsequent DMR submittal. <u>Section.12.c.2.i</u> New Fixed Facilities that do not employ sea chests as intake structures i.Visual or remote inspections. Beginning the coverage of this permit, the operator must conduct either visual inspections or use remote monitoring devices (e.g., remotely operated vehicles (ROV), subsea cameras, or other monitoring device) during the period the cooling water intake structure is in operation. The operator must conduct visual or remote inspections at least ~~monthly~~ quarterly to ensure that the required design and construction technologies are maintained and operated so they continue to function as designed. Visual or remote monitoring is not required when conditions such as storms, high seas, evacuation, or other factors make it unduly hazardous to personnel, the facility, or the equipment utilized. The operator must provide an explanation for any such failure to visually or remotely monitor with the subsequent DMR submittal. <u>Section.12.c.3.i</u> New Fixed Facilities that employ sea chests as intake structures i.Visual or remote inspections. Beginning the coverage of this permit, the operator must conduct either visual inspections or use remote monitoring devices (e.g., remotely operated vehicles (ROV), subsea cameras, or other monitoring device) during the period the cooling water intake structure is in operation. The operator must conduct visual or remote inspections at	OOC is requesting visual or remote inspections be reduced to quarterly. A set of photos (attached below and as Appendix D) of intakes taken at a 6 month interval shows only limited blockage (i.e. minor growth) of intake screens, suggesting that a quarterly visual monitoring requirement would suffice to ensure intakes are not obscured by marine growth and that the required design and construction technologies are maintained and operated so that they continue function as designed. Based on information contained in the Interim Guidance For Performance-Based Reduction of NPDES Permit Monitoring Frequencies issued by EPA in April 1996, monitoring reductions based on facility performance should be considered during permit reissuance. Under this guidance, facilities can demonstrate this historical performance through both compliance and enforcement history and a demonstrated ability to consistently reduce pollutants in their discharge below the levels necessary to meet existing permit requirements. Despite the special focus of Section 316(b) on impacts of intake water, not discharges of effluent into water, the requirements are linked to the core elements of the NPDES permit program; therefore, the OOC believes the approach for determining degree of burden reduction available to facilities in this manner is sound and will not reduce the ability of EPA to determine non-compliance with permit requirements. Monitoring requirements are not considered effluent limitations under section 402(o) of the Clean Water Act, and therefore anti-backsliding prohibitions would not be triggered by reductions in monitoring frequencies. According to this guidance, the permitting authority may modify the permit solely to reduce monitoring requirements if sufficient resources are available. To determine eligibility for reductions, the permitting authority would calculate the 24-month composite average for each eligible parameter, in this case visual monitoring of marine growth (i.e., obscurity or blockage). The composite average is compared with the permit limit, and the information in Table 1 of the guidance document, which is based on the existing monitoring frequency, to determine the potential monitoring frequency reduction. As shown in the example photos provided, the 6-month growth rate demonstrates negligible variation (20% or less) in observable growth, satisfying the criteria for a reduction in baseline monitoring of once per month to not more than once per quarter. CWIS Images-1.pdf

<table>
<tr><th>Comment No.</th><th>Type/Category</th><th>Permit Section Ref.</th><th>Revised Permit Wording/Clarifications/Issue</th><th>Rationale</th></tr>
<tr><td></td><td></td><td></td><td>least ~~monthly~~ quarterly to ensure that the required design and construction technologies are maintained and operated so they continue to function as designed. Visual or remote monitoring is not required when conditions such as storms, high seas, evacuation, or other factors make it unduly hazardous to personnel, the facility, or the equipment utilized. The operator must provide an explanation for any such failure to visually or remotely monitor with the subsequent DMR submittal.</td><td></td></tr>
<tr><td>20</td><td>Cooling Water Intake Structure Requirements – Monitoring Requirements</td><td>I.B.12.c.1.ii and I.B.12.c.2.iii and I.B.c.3.ii</td><td>Edit each section accordingly:

<u>Section.12.c.1.ii</u>
New non-Fixed Facilities

ii. Velocity monitoring. The operator must monitor intake flow velocity across the intake screens to ensure the maximum intake flow velocity does not exceed 0.5 ft/s. The intake flow velocity shall be monitored ~~daily~~ quarterly if the most recently reported intake flow velocity is less than 0.30 ft/s; monthly if the most recently reported intake flow velocity is 0.30 to 0.38 ft/s; and daily if the most recently reported intake flow velocity exceeded 0.38 ft/s. If the permitee is monitoring daily, a downtime, up to two weeks, for periodic maintenance or repair is allowed and must be reported in the DMRs.

<u>Section.12.c.2.iii</u>
New Fixed Facilities that do not employ sea chests as intake structures

iii. Velocity monitoring. The operator must monitor intake flow velocity across the intake screens to ensure the maximum intake flow velocity does not exceed 0.5 ft/s. The intake flow velocity shall be monitored ~~daily~~ quarterly if the most recently reported intake flow velocity is less than 0.30 ft/s; monthly if the most recently reported intake flow velocity is 0.30 to 0.38 ft/s; and daily if the most recently reported intake flow velocity exceeded 0.38 ft/s. If the permitee is monitoring daily, a downtime, up to two weeks, for periodic maintenance or repair is allowed and must be reported in the DMRs.

<u>Section.12.c.3.ii</u>
New Fixed Facilities that employ sea chests as intake structures

ii. Velocity monitoring. The operator must monitor intake flow velocity across the intake screens to ensure the maximum intake flow velocity does not exceed 0.5 ft/s. The intake flow velocity shall be monitored ~~daily~~ quarterly if the most recently reported intake flow velocity is less than 0.30 ft/s; monthly if the most recently reported intake flow velocity is 0.30 to 0.38 ft/s; and daily if the most recently reported intake flow velocity exceeded 0.38 ft/s. If the permitee is monitoring daily, a downtime, up to two weeks, for periodic maintenance or repair is allowed and must be reported in the DMRs.</td><td>OOC is proposing a tiered approach to velocity monitoring versus the current daily monitoring requirement. Namely,

<table><tr><th>If the Most recent intake flow velocity</th><th>Then Monitoring Frequency Should be</th></tr><tr><td><0.300</td><td>Quarterly</td></tr><tr><td>0.300 – 0.38</td><td>Monthly</td></tr><tr><td>>0.384</td><td>Daily</td></tr></table>
Velocity monitoring consists of a demonstration requirement based on the facilities' proposed design and a compliance monitoring requirement that verifies the velocity limitation is being met. There is agreement with the purpose of inspection, but not the frequency.

The tiered velocity monitoring approach is based upon a statistical analysis of six separate CWIS operated in the GOM during 2015. The analysis is based on the rate-of-change in daily velocity monitoring data (attached below and as Appendix E). An ANOVA indicates no statistical difference in the rate of change in intake velocity among the five intakes ($P < 0.05$). The data are approximately normally distributed with a mean change in velocity equal to 0.0001 (ft/s)/day and a standard deviation equal to 0.0106 (ft/s)/day. Based on these data, there is a 95% probability that the mean velocity increase over any 30-day period will be less than 0.11 (ft/s)/day; and a 95% probability that the mean velocity increase over any 90-day period will be less than 0.20 (ft/s)/day. Therefore, 95% of all monthly intake velocity measurements will be less than 0.5 ft/s provided that the previous month's velocity measurement was less than 0.39 ft/s. Similarly, 95% of all quarterly velocity measurements will be less than 0.5 ft/s provided that the previous quarter's measurement was less than 0.30 ft/s.

We note this data makes sense relative to visual inspection information presented elsewhere- the rate of biogrowth on intakes is quite low and so the rate of change of intake velocity would also be expected to be quite low, hence allowing for reduced monitoring frequencies (using a tiered approach to ensure compliance with the 0.5 fps standard for any CWIS design).

Tiered Intake Velocity Monitoring Methodolog</td></tr>
<tr><td>21</td><td>Dispersants, Surfactants. and Detergents</td><td>I.C.3</td><td>Add paragraph space :

"…The restriction is imposed because detergents disperse and emulsify oil, thereby increasing toxicity and making the detection of a discharge of oil more difficult."
Insert new paragraph space</td><td>OOC believes these should be broken into two separate paragraphs.</td></tr>
</table>

APPENDICES

APPENDIX A

NeTDMR Inconsistences

Storet Code	Limit Set	Parameter	DMR	Permit	
85871	CW	Visual Frequency	Weekly	Monthly	
85868 R 85868 S 85868 T		Velocity Frequency	Instantaneous	Daily	
TQM3E	CT	Coeffecient of Variation	48 HR MN MO AV MN	DA MAX Not in permit	
TQM6B			48 HR MN MO AV MN	DA MAX Not in permit	
04239 T		Visuals - Untreated	See MD DMR		
22414 51726 TOP3E TOP6B TPP3E TPP6B TXP3E TXP6B TYP3E TYP6B	SS	Toxicity Reporting Units	Percentage	mg/L	
TLP3E TGP3E TOP3E TPP3E TYP3E TXP3E	HF	Mysid species name	None Shown	Mysidopsis bahia	(see TQP3E - mysid. Bahia) for consistency
			Americamysis bahia		
TOP6B TPP6B TXP6B		Menidia species name	Menidia menidia	Menidia berryllina	(see TLP6B - Menidia for consistency
TLP3E TGP3E TOP3E TPP3E TYP3E TXP3E	PR	Mysid species name	None Shown	Mysidopsis bahia	(see TQP3E - mysid. Bahia) for consistency
			Americamysis bahia		
TOP6B TPP6B TXP6B		Menidia species name	Menidia menidia	Menidia berryllina	(see TGP6B - Menidia for consistency
22414	MD	Whole effluent toxicity	percentage	mg/L	
51726		Critical Dilution	percentage	mg/L	
TLP3E TGP3E TOP3E TPP3E TYP3E TXP3E		Mysid species name	None Shown	Mysidopsis bahia	(see TQP3E - mysid. Bahia) for consistency
			Americamysis bahia		
TOP6B TPP6B TXP6B		Menidia species name	Menidia menidia	Menidia berryllina	(see TGP6B - Menidia for consistency

APPENDIX B

	Ion	Pipe Dia	Critical	Collection	*M. beryllina Survival*			*M. bahia Survival*			Copper Ion analysis	
Area & Block	**Treatment**	**(in)**	**Dilution (%)**	**Date**	**NOEC**	**LOEC**	**Pass/Fail**	**NOEC**	**LOEC**	**Pass/Fail**	**(mg/L)**	***Comment***
Mobile 904 AQ	Cu	6	1.48	06/09/14	5.92	>5.92	P	5.92	>5.92	P	0.5	Copper Ion treatment only EPA Region 4/7-Day NOEC testing
Mobile 904 AQ	Cu	6	1.48	08/04/14	5.92	>5.92	P	5.92	>5.92	P	0.99	Copper Ion treatment only EPA Region 4/7-Day NOEC testing
Mobile 904 AQ	Cu	6	1.48	10/27/14	5.92	>5.92	P	5.92	>5.92	P	Not measured	Copper Ion treatment only EPA Region 4/7-Day NOEC testing
Mobile 904 AQ	Cu	6	1.48	01/05/15	5.92	>5.92	P	5.92	>5.92	P	Not measured	Copper Ion treatment only EPA Region 4/7-Day NOEC testing
Mobile 904 AQ	Cu	6	1.48	07/13/15	5.92	>5.92	P	5.92	>5.92	P	Not measured	Copper Ion treatment only EPA Region 4/7-Day NOEC testing
Mobile 916 AP	Cu	2	0.29	01/13/14	1.16	>1.16	P	1.16	>1.16	P	Not measured	Copper Ion treatment only EPA Region 4/7-Day NOEC testing
Mobile 916 AP	Cu	2	0.29	04/07/14	1.16	>1.16	P	1.16	>1.16	P	Not measured	Copper Ion treatment only EPA Region 4/7-Day NOEC testing
Mobile 916 AP	Cu	2	0.29	06/17/14	1.16	>1.16	P	1.16	>1.16	P	Not measured	Copper Ion treatment only EPA Region 4/7-Day NOEC testing
Mobile 916 AP	Cu	2	0.29	07/14/14 07/28/14	1.16	>1.16	P	1.16	>1.16	P	BDL	Copper Ion treatment only EPA Region 4/7-Day NOEC testing
Mobile 916 AP	Cu	2	0.29	01/05/15	1.16	>1.16	P	1.16	>1.16	P	Not measured	Copper Ion treatment only EPA Region 4/7-Day NOEC testing
Mobile 916 AP	Cu	2	0.29	07/13/15	1.16	>1.16	P	1.16	>1.16	P	Not measured	Copper Ion treatment only EPA Region 4/7-Day NOEC testing
MP 142 C	Cu	3	12.4	12/25/13	49.6	>49.6	P	49.6	>49.6	P	Not measured	Copper Ion treatment only
MP 142 C	Cu	3	12.4	01/14/14	49.6	>49.6	P	49.6	>49.6	P	Not measured	Copper Ion treatment only
MP 144 A	Cu	3	12.4	12/25/13	24.8	>49.6	P	12.4	24.8	P	Not measured	Copper Ion treatment only
MP 144 A	Cu	3	12.4	01/14/14	49.6	>49.6	P	49.6	>49.6	P	Not measured	Copper Ion treatment only
MP 300 B	Cu	3	12.4	12/25/13	49.6	>49.6	P	49.6	>49.6	P	Not measured	Copper Ion treatment only
MP 300 B	Cu	3	12.4	01/14/14	49.6	>49.6	P	49.6	>49.6	P	Not measured	Copper Ion treatment only
MP 42 M	Cu	2	11.2	01/26/14	11.2	22.4	P	22.4	44.8	P	Not measured	Copper Ion treatment only
MP 42 M	Cu	2	11.2	04/15/14	44.8	>44.8	P	44.8	>44.8	P	Not measured	Copper Ion treatment only
MP 42 M	Cu	2	11.2	05/13/14	44.8	>44.8	P	44.8	>44.8	P	BDL	Copper Ion treatment only
MP 42 M	Cu	2	11.2	06/03/14	44.8	>44.8	P	44.8	>44.8	P	BDL	Copper Ion treatment only
MP 42 M	Cu	2	11.2	07/01/14	44.8	>44.8	P	44.8	>44.8	P	BDL	Copper Ion treatment only
MP 42 M	Cu	2	11.2	08/05/14	44.8	>44.8	P	44.8	>44.8	P	BDL	Copper Ion treatment only
MP 42 M	Cu	2	11.2	09/02/14	22.4	44.8	P	22.4	44.8	P	BDL	Copper Ion treatment only
MP 42 M	Cu	2	11.2	10/15/14	11.2	22.4	P	11.2	22.4	P	Not measured	Copper Ion treatment only
MP 42 M	Cu	2	11.2	11/12/14	44.8	>44.8	P	44.8	>44.8	P	Not measured	Copper Ion treatment only
MP 42 M	Cu	2	11.2	12/11/14	44.8	>44.8	P	44.8	>44.8	P	Not measured	Copper Ion treatment only
MP 42 M	Cu	2	11.2	01/06/15	11.2	22.4	P	11.2	22.4	P	Not measured	Copper Ion treatment only
MP 42 M	Cu	2	11.2	02/03/15	44.8	>44.8	P	44.8	>44.8	P	Not measured	Copper Ion treatment only
SMI 236 A	Cu	2	11.2	12/16/13	44.8	>44.8	P	44.8	>44.8	P	Not measured	Copper Ion treatment only
SMI 236 A	Cu	2	11.2	01/21/14	44.8	>44.8	P	44.8	>44.8	P	Not measured	Copper Ion treatment only
SMI 236 A	Cu	2	11.2	04/08/14	44.8	>44.8	P	44.8	>44.8	P	Not measured	Copper Ion treatment only
SMI 236 A	Cu	2	11.2	05/06/14	44.8	>44.8	P	44.8	>44.8	P	Not measured	Copper Ion treatment only
SMI 236 A	Cu	2	11.2	06/03/14	44.8	>44.8	P	44.8	>44.8	P	BDL	Copper Ion treatment only
SMI 236 A	Cu	2	11.2	07/08/14	44.8	44.8	P	22.4	44.8	P	BDL	Copper Ion treatment only
SMI 236 A	Cu	2	11.2	08/05/14	44.8	>44.8	P	44.8	>44.8	P	BDL	Copper Ion treatment only
SMI 236 A	Cu	2	11.2	11/25/14	11.2	22.4	P	22.4	44.8	P	BDL	Copper Ion treatment only
SMI 236 A	Cu	2	11.2	12/09/14	44.8	>44.8	P	44.8	44.8	P	Not measured	Copper Ion treatment only
SMI 236 A	Cu	2	11.2	01/06/15	44.8	>44.8	P	22.4	44.8	P	Not measured	Copper Ion treatment only
SMI 236 A	Cu	2	11.2	02/03/15	44.8	>44.8	P	22.4	44.8	P	Not measured	Copper Ion treatment only
SMI 236 A	Cu	2	11.2	03/03/15	44.8	>44.8	P	22.4	44.8	P	Not measured	Copper Ion treatment only
ST 151 P1	Cu	2	12.4	01/16/14	49.6	>49.6	P	49.6	>49.6	P	Not measured	Copper Ion treatment only
ST 37 J	Cu	>6	14	09/16/15	56	56	P	56	56	P	Not measured	Copper Ion treatment only
ST 52 A	Cu	2	12.4	01/15/14	49.6	>49.6	P	49.6	>49.6	P	Not measured	Copper Ion treatment only
ST 52 A	Cu	2	11.2	04/08/14	22.4	44.8	P	11.2	22.4	P	Not measured	Copper Ion treatment only
ST 52 A	Cu	2	11.2	07/10/14	44.8	>44.8	P	22.4	44.8	P	Not measured	Copper Ion treatment only
ST 52 A	Cu	2	11.2	10/16/14	44.8	>44.8	P	44.8	>44.8	P	Not measured	Copper Ion treatment only
ST 52 A	Cu	2	11.2	02/05/15	44.8	>44.8	P	44.8	>44.8	P	Not measured	Copper Ion treatment only
VK 900 A	Cu	3	12.4	01/22/14	49.6	>49.6	P	49.6	>49.6	P	Not measured	Copper Ion treatment only
WD 109 A	Cu	3	12.4	12/30/13	49.6	>49.6	P	49.6	>49.6	P	Not measured	Copper Ion treatment only
WD 109 A	Cu	3	12.4	01/22/14	49.6	>49.6	P	49.6	>49.6	P	Not measured	Copper Ion treatment only
GC 338 (Front Runner)	Cu & Al	16	20	01/16/14	80	>80	P	80	>80	P	Not measured	Copper and Aluminum Ions
GC 338 (Front Runner)	Cu & Al	16	20	02/13/14	80	>81	P	80	>80	P	Not measured	Copper and Aluminum Ions
GC 338 (Front Runner)	Cu & Al	16	20	03/06/14	80	>80	P	80	>80	P	Not measured	Copper and Aluminum Ions
GC 338 (Front Runner)	Cu & Al	16	20	04/24/14	80	>80	P	80	>80	P	Not measured	Copper and Aluminum Ions
GC 338 (Front Runner)	Cu & Al	16	20	05/20/14	80	>80	P	80	>80	P	Not measured	Copper and Aluminum Ions
GC 338 (Front Runner)	Cu & Al	16	20	06/10/14	80	>80	P	80	>80	P	Not measured	Copper and Aluminum Ions
GC 338 (Front Runner)	Cu & Al	16	20	07/08/14	80	>80	P	80	>80	P	Not measured	Copper and Aluminum Ions
GC 338 (Front Runner)	Cu & Al	16	20	08/13/14	80	>80	P	80	>80	P	Not measured	Copper and Aluminum Ions
GC 338 (Front Runner)	Cu & Al	16	20	09/18/14	80	>80	P	80	>80	P	Not measured	Copper and Aluminum Ions
GC 338 (Front Runner)	Cu & Al	16	20	10/28/14	80	>80	P	80	>80	P	Not measured	Copper and Aluminum Ions
GC 338 (Front Runner)	Cu & Al	16	20	11/05/14	80	>80	P	80	>80	P	Not measured	Copper and Aluminum Ions
GC 338 (Front Runner)	Cu & Al	16	20	12/09/14	80	>80	P	80	>80	P	Not measured	Copper and Aluminum Ions
MC 736 (Thunder Hawk)	Cu & Fe	14	20	01/15/14	80	>80	P	80	>80	P	Not measured	Copper and Iron Ions
MC 736 (Thunder Hawk)	Cu & Fe	14	20	02/13/14	80	>80	P	80	>80	P	Not measured	Copper and Iron Ions
MC 736 (Thunder Hawk)	Cu & Fe	14	20	03/06/14	80	>80	P	80	>80	P	Not measured	Copper and Iron Ions
MC 736 (Thunder Hawk)	Cu & Fe	14	20	04/24/14	80	>80	P	80	>80	P	Not measured	Copper and Iron Ions
MC 736 (Thunder Hawk)	Cu & Fe	14	20	05/20/14	80	>80	P	80	>80	P	Not measured	Copper and Iron Ions
MC 736 (Thunder Hawk)	Cu & Fe	14	20	06/10/14	80	>80	P	80	>80	P	Not measured	Copper and Iron Ions
MC 736 (Thunder Hawk)	Cu & Fe	14	20	07/08/14	80	>80	P	80	>80	P	Not measured	Copper and Iron Ions
MC 736 (Thunder Hawk)	Cu & Fe	14	20	08/11/14	80	>80	P	80	>80	P	Not measured	Copper and Iron Ions

MC 736 (Thunder Hawk)	Cu & Fe	14	20	09/11/14	80	>80	P	80	>80	P	Not measured	Copper and Iron Ions
MC 736 (Thunder Hawk)	Cu & Fe	14	20	10/09/14	80	>80	P	80	>80	P	Not measured	Copper and Iron Ions
MC 736 (Thunder Hawk)	Cu & Fe	14	20	11/06/14	80	>80	P	80	>80	P	Not measured	Copper and Iron Ions
MC 736 (Thunder Hawk)	Cu & Fe	14	20	12/03/14	80	>80	P	80	>80	P	Not measured	Copper and Iron Ions
AT618	Cu	5.9	23	10/28/14	92	>92	P	92	>92	P	Not measured	Copper Ion treatment only
AT618	Cu&Al	11.8	20	10/28/14	40	>80	P	80	>80	P	Not measured	Copper and Aluminum Ions
AT618	Cu&Al	17.7	14	10/28/14	56	>56	P	56	>56	P	Not measured	Copper and Aluminum Ions
AT618	Cu	5.9	23	11/07/14	92	>92	P	92	>92	P	Not measured	Copper Ion treatment only
AT618	Cu&Al	9.8	20	11/07/14	80	>80	P	80	>80	P	Not measured	Copper and Aluminum Ions
AT618	Cu&Al	17.7	14	11/07/14	64	>64	P	64	>64	P	Not measured	Copper and Aluminum Ions
GC610	Cu&Al	9.8	20	11/20/14	80	>80	P	80	>80	P	Not measured	Copper and Aluminum Ions
GC610	Cu	5.9	23	11/20/14	92	>92	P	92	>92	P	Not measured	Copper Ion treatment only
GC610	Cu	9.8	20	11/20/14	80	>80	P	80	>80	P	Not measured	Copper Ion treatment only
GC653	Cu	20	20	12/01/14	80	>80	P	80	>80	P	Not measured	Copper Ion treatment only
GC653	Cu	5.9	23	12/29/14	92	>92	P	92	>92	P	Not measured	Copper Ion treatment only
GC653	Cu&Al	9.8	20	12/29/14	80	>80	P	80	>80	P	Not measured	Copper and Aluminum Ions
GC610	Cu	9.8	20	01/28/15	80	>80	P	80	>80	P	Not measured	Copper Ion treatment only
GC610	Cu&Al	5.9	23	01/28/15	92	>92	P	92	>92	P	Not measured	Copper and Aluminum Ions
GG610	Cu	5.91	23	02/26/15	92	>92	P	92	>92	P	Not measured	Copper Ion treatment only
GC653	Cu&Al	11.81	20	02/26/15	80	>80	P	80	>80	P	Not measured	Copper and Aluminum Ions
GC653	Cu	4.5	23	03/25/15	92	>92	P	92	>92	P	Not measured	Copper Ion treatment only
GC653	Cu&Al	10	20	03/25/15	80	>80	P	80	>92	P	Not measured	Copper and Aluminum Ions
GC653	Cu	4.5	23	04/01/15	80	>80	P	92	>92	P	Not measured	Copper Ion treatment only
GC653	Cu&Al	10.7	20	04/01/15	80	>80	P	80	>80	P	Not measured	Copper and Aluminum Ions
GC653	Cu	11.8	20	04/01/15	80	>80	P	80	>80	P	Not measured	Copper Ion treatment only
GC609	Cu&Al	11.8	20	04/28/15	80	>80	P	80	>80	P	Not measured	Copper and Aluminum Ions
GC609	Cu&Al	17.7	24.6	04/28/15	98.4	>98.4	P	98.4	>98.4	P	Not measured	Copper and Aluminum Ions
GC609	Cu	11.8	20	04/28/15	80	>80	P	80	>80	P	Not measured	Copper Ion treatment only
GC609	Cu&Al	17.7	24.6	05/31/15	98.4	>98.4	P	98.4	>98.4	P	Not measured	Copper and Aluminum Ions
GC609	Cu	5.91	23	05/31/15	92	>92	P	92	>92	P	Not measured	Copper Ion treatment only
GC609	Cu&Al	9.84	20	05/31/15	80	>80	P	80	>80	P	Not measured	Copper and Aluminum Ions
GC609	Cu&Al	17.72	20	06/01/15	80	>80	P	80	>80	P	Not measured	Copper and Aluminum Ions
GC609	Cu&Al	17.7	24.6	06/01/15	98.4	>98.4	P	98.4	>98.4	P	Not measured	Copper and Aluminum Ions
GC609	Cu	5.91	23	06/01/15	92	>92	P	92	>92	P	Not measured	Copper Ion treatment only
GC609	Cu	6	23	07/01/15	92	>92	P	92	>92	P	Not measured	Copper Ion treatment only
GC609	Cu&Al	12	20	07/01/15	80	>80	P	80	>80	P	Not measured	Copper and Aluminum Ions
GC609	Cu&Al	12	20	07/01/15	80	>80	P	80	>80	P	Not measured	Copper and Aluminum Ions
GC609	Cu	5.91	23	08/05/15	92	>92	P	92	>92	P	Not measured	Copper Ion treatment only
GC609	Cu&Al	17.72	20	08/05/15	80	>80	P	80	>80	P	Not measured	Copper and Aluminum Ions
GC609	Cu&Al	17.72	20	08/05/15	80	>80	P	80	>80	P	Not measured	Copper and Aluminum Ions

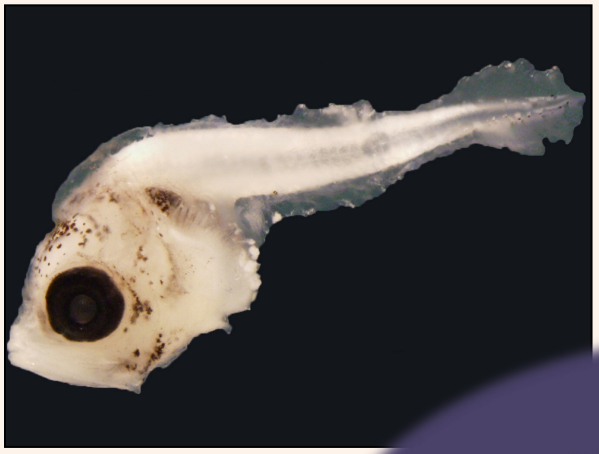
BDL- Below Detection limit (<0.01 mg/L)

APPENDIX C

Gulf Of Mexico
Cooling Water Intake Structure
Entrainment Monitoring Study

Final Report

March 2014



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EXECUTIVE SUMMARY

This report presents results of a joint industry Entrainment Monitoring Study (EMS) carried out to meet the study participant's requirements for entrainment monitoring under National Pollutant Discharge Elimination System (NPDES) permit GMG290000. An important issue related to the impacts of cooling water intake structures (CWIS) is entrainment of ichthyoplankton (fish eggs and larvae). Under the Clean Water Act Section 316(b) Phase III regulations, the NPDES permit for the Western and Central portions of the Gulf of Mexico requires operators of new facilities with CWIS taking in more than 2 million gallons of seawater per day with more than 25% of that used for cooling water to

- undertake source water biological baseline surveys;
- conduct frequent visual or remote inspections of CWIS; and
- for some facilities, conduct EMSs.

The permit provides operators with the choice of conducting individual site-specific studies to meet the requirements or participating in joint industry studies conducted under plans approved by the U.S. Environmental Protection Agency (USEPA).

The three objectives of the CWIS EMS were as follows:

1. Provide the data and analyses necessary to estimate ichthyoplankton densities around seawater intakes in order to meet permit requirements for enumeration of entrained organisms, quantify the magnitude of potential entrainment loss, and place this potential impact in proper ecological perspective;
2. Estimate the effects of depth, time of day, and seasonal variation (defined by sampling month) on ichthyoplankton densities to assist with the design of mitigation measures should they be needed and preclude unnecessary sampling during times when fish egg and larval densities may be low enough to surmise entrainment is nominal; and
3. Assess the usefulness of the SEAMAP database for the estimation of entrainment losses.

Four platforms (sampling sites) in the Gulf of Mexico were sampled during a 2-year period (23 January 2011 to 24 January 2013). During individual surveys, sampling at each study site consisted of vertically stratified ichthyoplankton collections taken from the ambient water column at dawn, midday, and dusk using a 1-m^2 multiple opening/closing net and environmental sensing system (MOCNESS). Each tow with the MOCNESS provided one plankton sample for each of three depth ranges: 0 to 100 m, 100 to 200 m, and 200 to 300 m. Fish eggs and larvae collected in these samples were counted and larvae were identified to the lowest practicable identification level.

Representatives of 164 fish families (and higher order taxa if family could not be determined) were taken in the MOCNESS collections. The family Myctophidae (lanternfishes) was the most abundant family with the 20,804 specimens accounting for 34% of the total collection of 60,376 fish larvae. The second and third most abundant families were Sternoptychidae (hatchetfishes) and Bregmacerotidae (codlets) represented by 7,713 and 4,508 specimens, respectively. Collectively, these three taxa comprised 55% of the total collection of ichthyoplankton. No adult fish were collected in any tow.

The three most important conclusions of the study were as follows:

1. The study successfully provided information to assist development of potential measures that could be taken if the need for mitigating the effects of entrainment is required. Ichthyoplankton densities in the 200 to 300 m depth range were only a fraction of those found at shallower depths, suggesting that site-specific sampling at structures with water intakes below 200 m may not be necessary.

2. The findings of this study suggest that SEAMAP data provide an adequate basis for estimating entrainment losses.

3. The observed sampling sites were over depths and distances offshore where ichthyoplankton densities were a small fraction of those observed closer to shore over the continental shelf. Relative to the daily ichthyoplankton abundances passing each site, this level of entrainment was not biologically significant. Commercially or recreationally important species were either not collected during 2 years of biweekly sampling or were collected so infrequently as to preclude robust estimates of their densities useful for modeling net impacts on the adult population. The entrainment of ichthyoplankton by CWIS will not have a noticeable or biologically significant impact.

TABLE OF CONTENTS

Page

LIST OF TABLES iii
LIST OF FIGURES iv
LIST OF PHOTOS v
LIST OF ACRONYMS AND ABBREVIATIONS vi
EXECUTIVE SUMMARY ES-1

1.0 INTRODUCTION 1
1.1 BACKGROUND 1
1.2 HISTORICAL ASSESSMENT APPROACHES 1
1.3 PURPOSE AND OBJECTIVES 2

2.0 METHODS 4
2.1 FIELD SAMPLING 4
2.1.1 Study Sites 4
2.1.2 Vessels and Navigation 4
2.1.3 Ichthyoplankton Sampling 6
2.2 LABORATORY ANALYSES 13
2.2.1 Ichthyoplankton Processing and Identification 13
2.2.2 Laboratory Quality Assurance 14
2.3 MODIFICATIONS TO THE SAMPLE DESIGN 14
2.3.1 Weather 14
2.3.2 Strike Incidents 15
2.4 SAMPLE ARCHIVAL 15
2.5 ANALYSIS AND ASSESSMENT METHODS 15
2.5.1 Estimation of Entrainment Loss 15
2.5.2 Cooling Water Intake Structure Analyses 16
2.5.3 Potential for using SEAMAP Data in Future Entrainment Studies 19

3.0 FIELD SAMPLING RESULTS AND DATA SUMMARIES 24
3.1 FIELD SAMPLING-CRUISES COMPLETED 24
3.2 DATA SUMMARIES 25

4.0 ANALYSIS AND ASSESSMENT RESULTS 28
4.1 COOLING WATER INTAKE STRUCTURE NET ANALYSIS 28
4.1.1 Myctophidae (Lanternfishes) 28
4.1.2 Sternoptychidae (Hatchetfishes) 35
4.1.3 Bregmacerotidae (Codlets) 35
4.1.4 Summary of Cooling Water Intake Structure Net Analysis Results 36
4.1.5 Total Larvae 39
4.1.6 Total Eggs 39
4.1.7 Assemblage Structure 39

TABLE OF CONTENTS
(CONTINUED)

Page

4.2 DATASET COMPARISONS....41
4.2.1 Block Approach – Analysis Results from the Datasets Modeled Together....44
4.2.2 Gradient Approach – Analysis Results from the Datasets Modeled Together....44
4.3 ENTRAINMENT LOSSES....46

5.0 SUMMARY OF SIGNIFICANT FINDINGS....48
5.1 COOLING WATER INTAKE STRUCTURES NET ANALYSIS....48
5.2 DATASET COMPARISONS....49
5.3 ENTRAINMENT LOSSES....49

6.0 LITERATURE CITED....51

APPENDICES....55
Appendix A: U.S. Environmental Protection Agency Permit Requirements....A-1
Appendix B: Incident Reports....B-1
Appendix C: Taxonomic Summaries....C-1
Appendix D: SEAMAP Fish Larvae and Egg Data Analysis Method....D-1
Appendix E: Summary of Total Eggs and Larvae Collected....E-1
Appendix F: Hydrographic Data Summaries....F-1
Appendix G: Family Representatives in the MOCNESS Collections....G-1

LIST OF TABLES

Table		Page
1	Facility names and lease block locations of samples collected	3
2	Incidents of striking submerged objects	15
3	MOCNESS tows conducted from January 2011 through January 2013	24
4	Number of MOCNESS tows by year, station, net, month, and time of day used in the CWIS Net Analysis	26
5	Number of tows used from the SEAMAP program and the CWIS monitoring study for the Block and Gradient Approaches to compare datasets with respect to total fish larvae and eggs	27
6	Results from the generalized linear mixed model for the Net Analysis of MOCNESS samples	30
7	Results for the prediction analysis from the generalized linear mixed models for the Block and Gradient Approaches to compare differences between SEAMAP and CWIS datasets with respect to total larvae and eggs	42
8	Water use and percent entrainment loss per day by facility	46

LIST OF FIGURES

Figure		Page
1	Study site locations relative to fishery zones from the LGL Ecological Research Associates, Inc. (2009) Source Water Biological Baseline Characterization Study.	5
2	Diagram of a multiple opening/closing net and environmental sensing system (MOCNESS)	6
3	Diagram of stepped-oblique towing pattern	7
4	Mean predictions of Myctophidae per cubic meter for levels of categorical variables used in the generalized linear mixed model for the Net Analysis	29
5	Mean predictions of total larvae per cubic meter for levels of categorical variables used in the generalized linear mixed model for the Net Analysis	31
6	Mean predictions of total eggs per cubic meter for levels of categorical variables used in the generalized linear mixed model for the Net Analysis	32
7	Mean predictions of Sternoptychidae per cubic meter for levels of categorical variables used in the generalized linear mixed model for the Net Analysis	33
8	Mean predictions of Bregmacerotidae per cubic meter for levels of categorical variables used in the generalized linear mixed model for the Net Analysis	34
9	Mean predictions of larval and egg densities by month output from the generalized linear mixed models and standardized to a common scale by conversion to z-scores (i.e., units of standard deviations relative to their respective means across months [indicated by the dashed line])	37
10	Nonmetric multidimensional scaling (NMDS) of samples (i.e., net-tow combinations) based on densities of larval fish families	38
11	Observed larval fish density by water depth based on SEAMAP data (circles) and CWIS data (squares)	40
12	Marginal mean responses of larval fish per cubic meter and eggs per cubic meter for each level of categorical variable used in the generalized linear mixed models for the Block and Gradient Approaches	43
13	Forecast accuracy for predictions of annual mean larval and egg densities at the four CWIS sites using models from the two approaches parameterized with SEAMAP data only	45

LIST OF PHOTOS

Photo		Page
1	Initiating a MOCNESS launch for a tow	8
2	Guiding the MOCNESS to enter water	8
3	Monitoring the progress of a MOCNESS tow at the computer control station	9
4	Computer screen display of tow information during a MOCNESS tow	9
5	MOCNESS at the sea surface after a successful tow	10
6	MOCNESS back on deck after tow	10
7	Rinsing net contents	11
8	Transferring sample from net cod ends into a 333-µm mesh sieve	11
9	Representative sample from a MOCNESS tow	12
10	Transferring net sample from sieve into sample containers	12
11	Samples in labeled sample containers	13

LIST OF ACRONYMS AND ABBREVIATIONS

AIC	Akaike Information Criterion
AC	Alaminos Canyon
CoC	chain of custody
CPUE	count per unit effort
CSA	CSA Ocean Sciences Inc.
CWIS	cooling water intake structures
EAM	Equivalent Adult Model
EMS	entrainment monitoring study
ETOH	ethanol
FHM	Fecundity Hindcasting Model
GB	Garden Banks
GLMM	generalized linear mixed model
GPS	global positioning system
IT	Information Theoretic
JIP	Joint Industry Project
LDWF	Louisiana Department of Wildlife and Fisheries
LGL	LGL Ecological Research Associates, Inc.
LNG	liquefied natural gas
LPIL	lowest practicable identification level
MARAD	Maritime Administration
MC	Mississippi Canyon
MOCNESS	multiple opening/closing net and environmental sensing system
NMDS	nonmetric multidimensional scaling
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
OOC	Offshore Operators Committee
QA	quality assurance
QAIC	quasi-likelihood Akaike Information Criterion
QC	quality control
SEAMAP	Southeast Area Monitoring and Assessment Program
SWBBCS	Source Water Biological Baseline Characterization Study
USCG	United States Coast Guard
USEPA	U.S. Environmental Protection Agency
VK	Viosca Knoll
ZSIOP	Sea Fisheries Institute, Plankton Sorting and Identification Center

1.0 INTRODUCTION

Under the Clean Water Act Section 316(b) Phase III regulations, the National Pollutant Discharge Elimination System (NPDES) permit for the Western and Central Portions of the Gulf of Mexico requires that operators of new facilities with cooling water intake structures (CWIS) taking in more than 2 million gallons of seawater per day with more than 25% of that used for cooling water to (1) undertake source water biological baseline surveys, (2) conduct frequent visual or remote inspections of CWIS, and (3) for some facilities, conduct entrainment monitoring studies (EMSs) (U.S. Environmental Protection Agency [USEPA], 2007). The permit provided operators with the choice of either doing individual site-specific studies to meet requirements 1 and 3, or to participate in joint industry studies, conducted under plans approved by the USEPA. "CWIS" will be used throughout this document to refer to facilities that would be included in the permit due to intake volume and purpose criteria. The current study was prepared as a Joint Industry Project (JIP) to meet the EMS requirements. Although the facilities at the four study sites have intakes, they are not subject to entrainment requirement because they do not meet the permit definition of a new facility. These facilities were chosen as surrogate sites to study entrainment of ichthyoplankton. Results and conclusions regarding this issue are intended to be representative of new facilities with regulated intakes. **Appendix A** lists the USEPA requirements for which this study was designed to address.

1.1 BACKGROUND

Entrainment of ichthyoplankton is the primary issue related to impacts from seawater intakes. A Source Water Biological Baseline Characterization Study (SWBBCS) was designed, approved by the USEPA, and conducted as a JIP under the auspices of the Offshore Operators Committee (OOC). In that study, LGL Ecological Research Associates, Inc. (LGL) divided the Gulf of Mexico into 15 regions believed to be relatively homogeneous from a biological standpoint (LGL Ecological Research Associates, Inc., 2009). Ichthyoplankton (fish eggs and larvae) densities were then estimated for each region based on data collected from the Gulf of Mexico for the past few decades by the Southeast Area Monitoring and Assessment Program (SEAMAP) conducted by the National Marine Fisheries Service (NMFS). Methods for assessment of ichthyoplankton entrainment impacts for offshore facilities are relatively recent, having been developed for proposed offshore liquefied natural gas (LNG) facilities (see **Section 1.2**; Gallaway et al., 2007). Applying these methods to the SEAMAP data and assuming likely development scenarios provided by industry, impacts were projected to be minimal (LGL Ecological Research Associates, Inc., 2009). The LGL (2009) study was approved as meeting the USEPA's SWBBCS requirements for the JIP participants on 8 October 2009.

A JIP was created to conduct an EMS to meet the monitoring requirements for companies participating in the study. This report presents the results of the joint industry entrainment monitoring study.

1.2 HISTORICAL ASSESSMENT APPROACHES

The issue of seawater intakes and their effects on the biological resources of the Gulf of Mexico gained prominence in early to mid-2000s in conjunction with LNG terminals proposed for construction in several areas of the central and western Gulf of Mexico. The primary issue associated with LNG terminal seawater intakes is their potential impacts on fishery stocks

resulting from the mortality of entrained eggs and larvae. NMFS developed a requirement that face velocities are limited to 0.5 ft/s to effectively mitigate the risk of impingement. Environmental assessments for proposed LNG facilities in Federal waters of the Gulf of Mexico were conducted by the U.S. Coast Guard (USCG) and the Maritime Administration (MARAD) (USCG and MARAD, 2003, 2004, 2005a,b,c, 2006a,b; TORP, 2006). The USCG and MARAD established strict analytical protocols for assessing the impact of seawater intake on key fish species of the region. The protocols included (1) the use of the SEAMAP database to estimate larval and egg densities in the vicinity of any proposed facility; (2) the use of forward-projecting Equivalent Adult Models (EAMs) to evaluate the expected levels of impacts from entrainment; and (3) the use of specific life-history parameters for assessing the individual fish species in question. Standardized protocols were developed so that the same set of techniques could be used for each of the multiple facilities that were being proposed.

The Electric Power Research Institute (2004, 2005) and Gallaway et al. (2007) noted that the use of EAMs was not always appropriate and proposed that Fecundity Hindcasting Models (FHMs) be used, especially given that they would be used in conjunction with the existing stock assessment models to estimate the impacts of entrainment on stocks and yield. Gallaway et al. (2007) also calculated ichthyoplankton densities by depth and used the depth of the facility and the intake volume as a basis for calculating entrainment losses. This approach was different than that used by the USCG/MARAD. The USCG/MARAD estimates of entrainment were based on the average density of ichthyoplankton within a rectangular polygon centered on a given site.

1.3 PURPOSE AND OBJECTIVES

The overarching goal of the current study was to enable subscribing companies to meet their sampling requirements for entrainment monitoring at fixed facilities with CWIS via the industry-wide study option provided by the USEPA. The average densities of fish eggs and larvae for each site were estimated based upon the 2-year EMS with biweekly sampling during 2011 and 2012 described herein. These data fulfill USEPA requirements for enumeration of entrained organisms with respect to the defined sampling timeline and frequency with field and laboratory protocols that allowed estimation of potential impacts from CWIS by providing the required inputs for the entrainment models mentioned above. The effects of season, time of day, and depth were estimated to facilitate the design of mitigation measures given that some time period-depth combinations exhibited lower ichthyoplankton densities.

The average densities estimated with data collected in the current study represent our best approximation of the true population densities at each of the four sampling sites listed in **Table 1**. This information presented an opportunity to assess the accuracy of SEAMAP data when used to estimate fish egg and larval densities to determine impacts from CWIS facilities. The SEAMAP data represents a long time series across many years, but with sampling mainly restricted to summer and fall seasons. As such, some differences between SEAMAP and CWIS were expected due to measurement error (i.e., measurement error = random sampling error + systematic bias). The magnitude and direction of these differences were assessed to determine whether current EMS requirements could still be achieved with SEAMAP data. If site-specific densities estimated with SEAMAP data were consistently equal to or greater than those from the CWIS data, then it is reasonable to assume that future impacts based only on SEAMAP data would not be biased low and most likely represent a worst case scenario. This finding would give confidence to decision makers that no impacts were occurring if the effects of entrainment were still found to be nominal even at high-end estimates of ichthyoplankton density.

Table 1. Facility names and lease block locations of samples collected.

Facility	Lease Block	Coordinates
Gunnison	Garden Banks 668 (GB668)	27°18.341 N; 93°32.384 W
Hoover-Diana	Alaminos Canyon 25 (AC25)	26°56.862 N; 94°42.313 W
Independence Hub	Mississippi Canyon 920 (MC920)	28°05.266 N; 87°59.152 W
Pompano	Viosca Knoll 989 (VK989)	28°59.656 N; 88°38.318 W

The three objectives of the CWIS EMS were as follows:

1. Provide the data and analyses necessary to estimate ichthyoplankton densities around seawater intakes in order to meet permit requirements for enumeration of entrained organisms, quantify the magnitude of potential entrainment loss, and place this potential impact in proper ecological perspective;
2. Estimate the effects of depth, time of day, and seasonal variation (defined by sampling month) on ichthyoplankton densities to assist with the design of mitigation measures and preclude unnecessary sampling during times when fish egg and larval densities may be low enough to surmise entrainment is nominal; and
3. Assess the usefulness of the SEAMAP database for the estimation of entrainment losses.

2.0 METHODS

2.1 FIELD SAMPLING

Four platforms (sampling sites) in the Gulf of Mexico were sampled during a 2-year period (23 January 2011 to 24 January 2013). Subject to weather constraints, 52 surveys at the four sampling sites were planned over the study period. Surveys were to be conducted at 2-week intervals, notwithstanding weather conditions that prevented sampling.

During individual surveys, sampling at each study site consisted of vertically stratified ichthyoplankton collections taken from the ambient water column at dawn, midday, and dusk. In addition, vertical profiles of temperature, conductivity (salinity), dissolved oxygen, chlorophyll, pressure, and transmissivity were collected to document water column conditions. Collection of the samples from the water column instead of from within cooling water systems made the results less dependent on the design of specific facilities and avoided damage to eggs or larvae, which could lead to underestimates of entrainment, due to mechanical stress due to passage through pumps. Sampling the ambient water column also facilitated measurement of egg and larval densities as a function of water depth. This information provides insight into the role of intake depth on entrainment of eggs and larvae.

2.1.1 Study Sites

Four existing facilities with cooling water intakes were chosen as sampling sites to be representative of the Gulf of Mexico ecosystem, contrasting mostly by longitude and depth (**Figure 1**). The selection of these sampling sites was guided by the results of the industry-wide SWBBCS (LGL Ecological Research Associates, Inc., 2009). This SWBBCS organized fishery data for the Gulf of Mexico into 15 geographic zones spanning five depth intervals (0 to 20 m, 20 to 60 m, 60 to 200 m, 200 to 1,000 m, and >1,000 m) and three longitudinal areas corresponding to the eastern, central, and western Gulf of Mexico. The zones were designated by a letter (E, C, and W) indicating their longitudinal area and a number designating the depth interval. Zones in the central and western Gulf of Mexico longitudinal areas are relevant to the NPDES permit (U.S. Environmental Protection Agency, 2007). An assessment conducted as part of the SWBBCS indicated that the central and western zones in depth intervals 200 to 1,000 m and >1,000 m (i.e., Zones C4, C5, W4, and W5) were the most likely locations for new facilities with regulated intakes. Based on information provided by operators, the four sampling sites were selected, one in each relevant zone. The coordinates and zone for each facility are presented in **Table 1**.

2.1.2 Vessels and Navigation

During the first year of sampling, surveys were conducted from the M/V *Will Bordelon*, a 110-ft (34-m) utility vessel, and during the second year, sampling was conducted from the M/V *Jim Bordelon*, another 110-ft (34-m) utility vessel. Each survey vessel was equipped with the necessary equipment to support the field effort along with requisite safety equipment and was continuously mobilized for the project. The vessel's onboard global positioning system (GPS) was used to navigate the vessel.

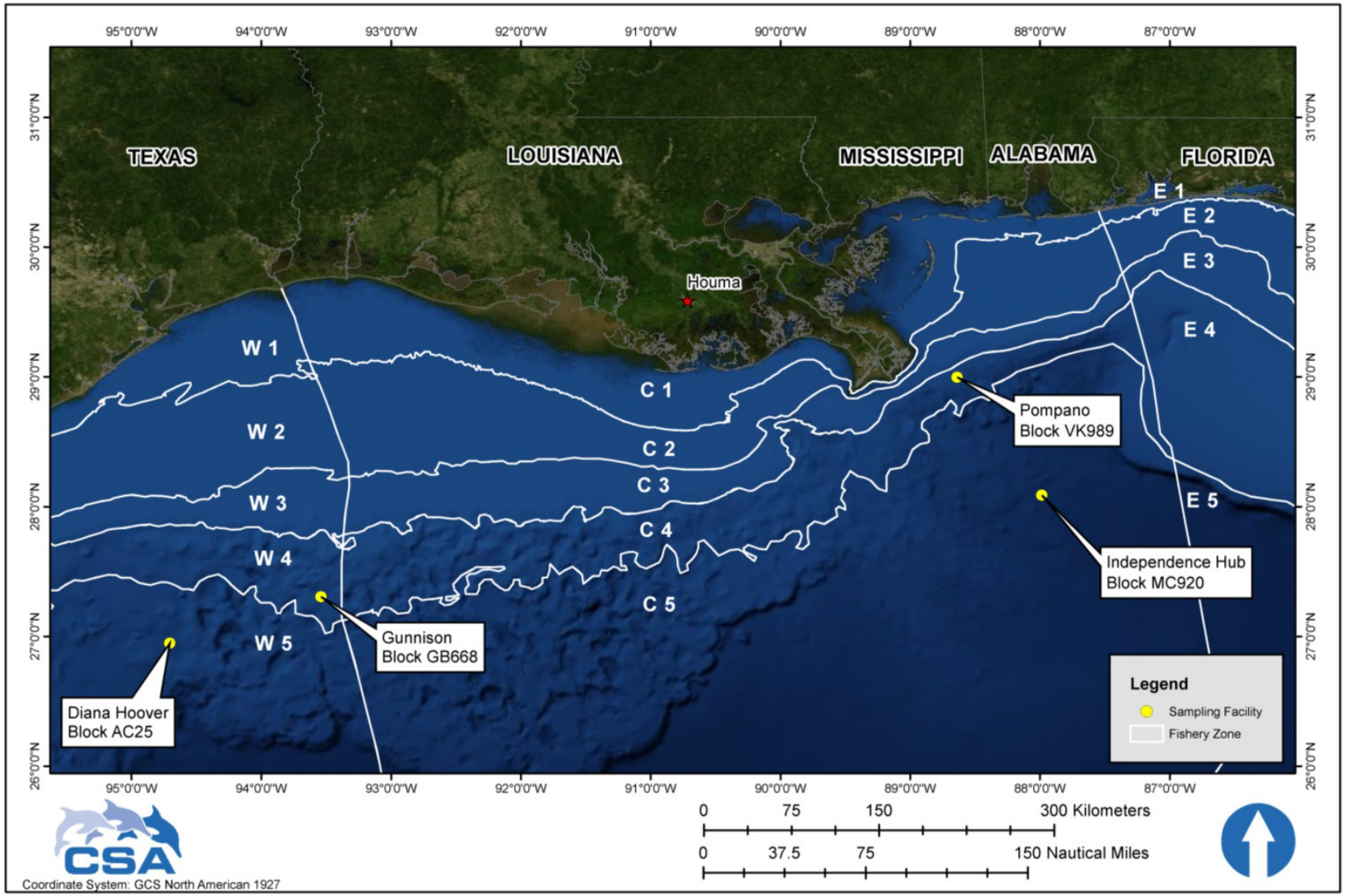


Figure 1. Study site locations relative to fishery zones from the LGL Ecological Research Associates, Inc. (2009) Source Water Biological Baseline Characterization Study.

2.1.3 Ichthyoplankton Sampling

2.1.3.1 Ichthyoplankton Net System

Ichthyoplankton samples were collected with a 1-m^2 multiple opening/closing net and environmental sensing system (MOCNESS) (**Figure 2**). The MOCNESS is a computer-controlled net system based on a Tucker trawl design that is able to collect plankton samples from specific depths in the water column on command from the surface. The MOCNESS consists of a rectangular frame with a series of 333-µm mesh size nets that can be opened and closed by a topside computer system and an *in situ* electronics package that measures environmental variables as well as net depth, volume filtered, and net frame angle with a real-time readout on the computer system.

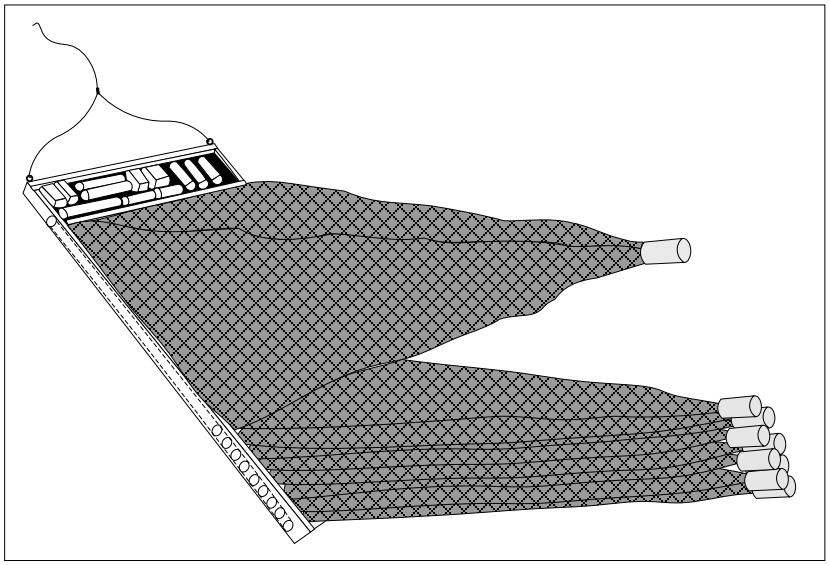


Figure 2. Diagram of a multiple opening/closing net and environmental sensing system (MOCNESS). MOCNESS nets have a 333-µm mesh size and a net mouth opening of 1 m^2.

During each MOCNESS cast, the operator on the vessel monitored and controlled the net system in real time. Depth of the nets, volume filtered, and water property parameters were monitored during each tow and net opening/closing was controlled from the surface. Measurements of selected water properties (temperature, conductivity [salinity], dissolved oxygen, chlorophyll, and transmissivity/turbidity) were made and recorded as the net system moved vertically through the water column.

2.1.3.2 Ichthyoplankton Tow Methodology

The original sampling design required that the start point of a tow be at least 500 m upcurrent of a facility and tows were made along a tangential towpath. After several incidents of striking underwater obstacles (see **Section 2.3.2**), start points and towpaths were modified. The modified start point was at least 500 m downcurrent of the facility, and the tow was conducted directly away from the platform. In addition, navigational software (HYPACK) was installed so that the tow operator could view the path of the tow in real time and advise the vessel bridge of needed course corrections to ensure that the tow continued in the proper directions. After making these changes, no further striking instances occurred.

Each MOCNESS tow was conducted in a stepped-oblique pattern similar to the pattern depicted in **Figure 3**. The system was lowered at a constant payout speed (approximately 30 m/min) from the water surface to the maximum sampling depth with the Archival Net open while the vessel was underway at 2 to 3 knots. At depth (approximately 300 m), the Archival Net was closed as the first ascending net was opened simultaneously. Subsequent openings/closures occurred at depths of 200 and 100 m. Thus, three nets were used during ascent sampling to divide the water column into thirds; Nets 1, 2, and 3 sampled plankton at depths of 200 to 300 m, 100 to 200 m, and 0 to 100 m, respectively.

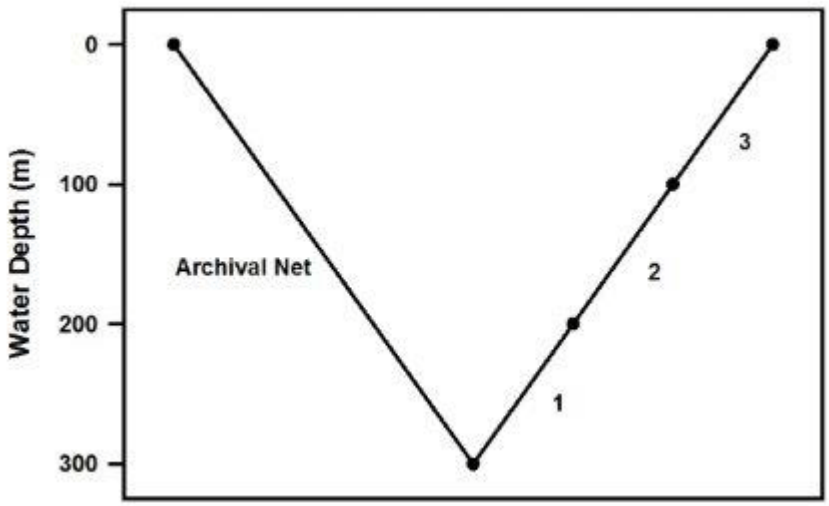


Figure 3. Diagram of stepped-oblique towing pattern. Numbers 1, 2, and 3 give reference to which MOCNESS net was open during each tow's ascent (retrieval); the Archival Net was open during the descent (deployment) to depth.

This tow pattern resulted in four samples per net cast. Only the samples from ascending Nets 1, 2, and 3 were analyzed. Contents from the descending Archival Net, which encompassed the entire water column as the net system was deployed to depth, were preserved and archived for future reference.

The sequence of a tow is presented in **Photos 1** to **6**. Upon retrieval to the survey vessel work deck, the outside of the net surfaces were carefully rinsed with seawater so that any plankton remaining on the net were washed down into the cod end (**Photo 7**). After rinsing, the cod end buckets of each net were removed and the contents transferred to appropriate sample containers (**Photos 8** to **11**).

Individual samples were fixed in the field for at least 12 hours in a 5% buffered formalin solution. After the samples were fixed, samples were transferred to 70% ethanol (ETOH). Sample jars were labeled on the outside, as appropriate, and inside in pencil with collection date and project-specific sample codes that reflect facility location, water depth, and time of day. After field sample processing was completed, all sample containers were checked to ensure proper labels were affixed and protected from damage and that all inner and outer label information was legible.

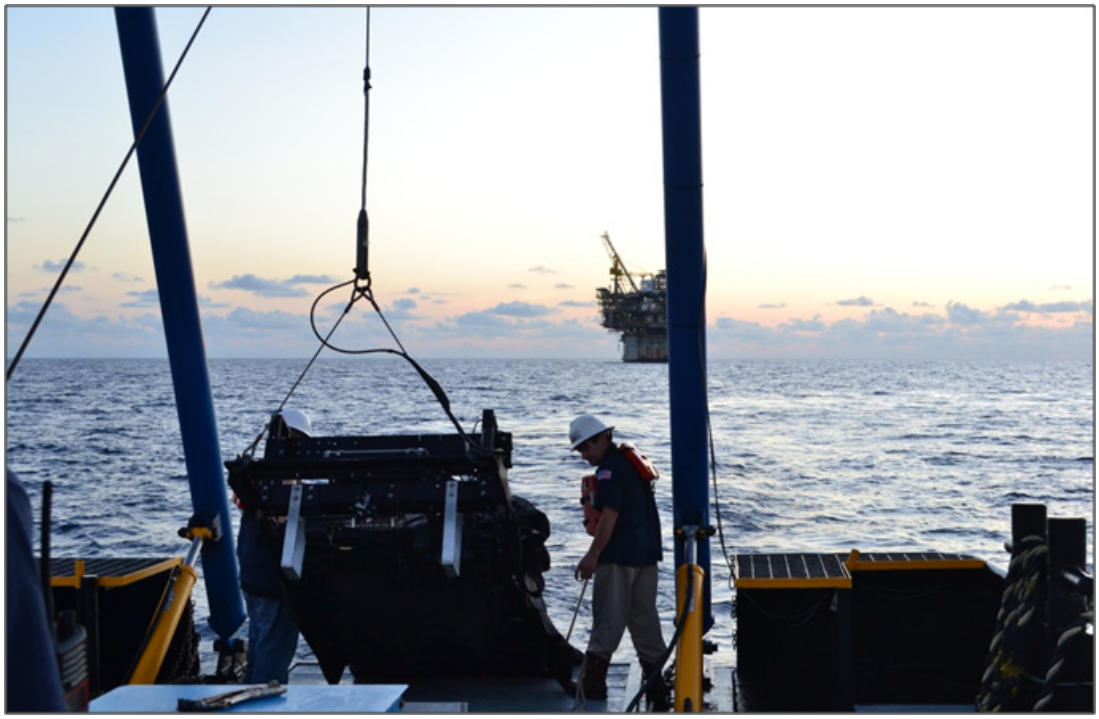


Photo 1. Initiating a MOCNESS launch for a tow.

Photo 2. Guiding the MOCNESS to enter water.

Photo 3. Monitoring the progress of a MOCNESS tow at the computer control station.

Photo 4. Computer screen display of tow information during a MOCNESS tow.

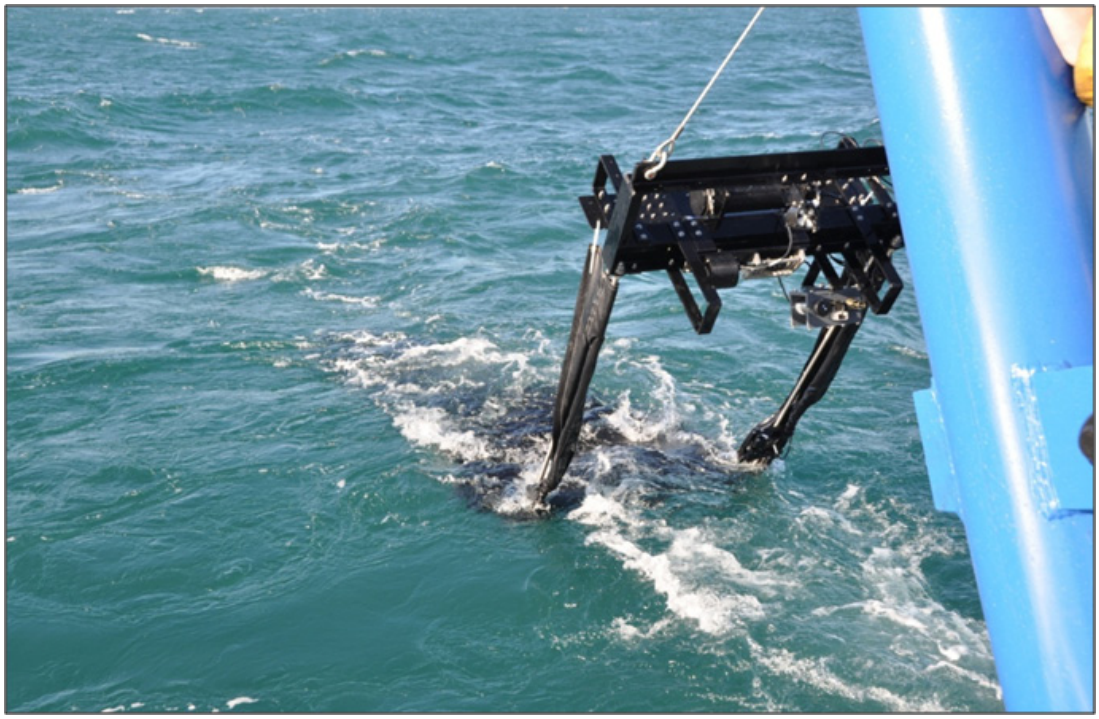


Photo 5. MOCNESS at the sea surface after a successful tow.

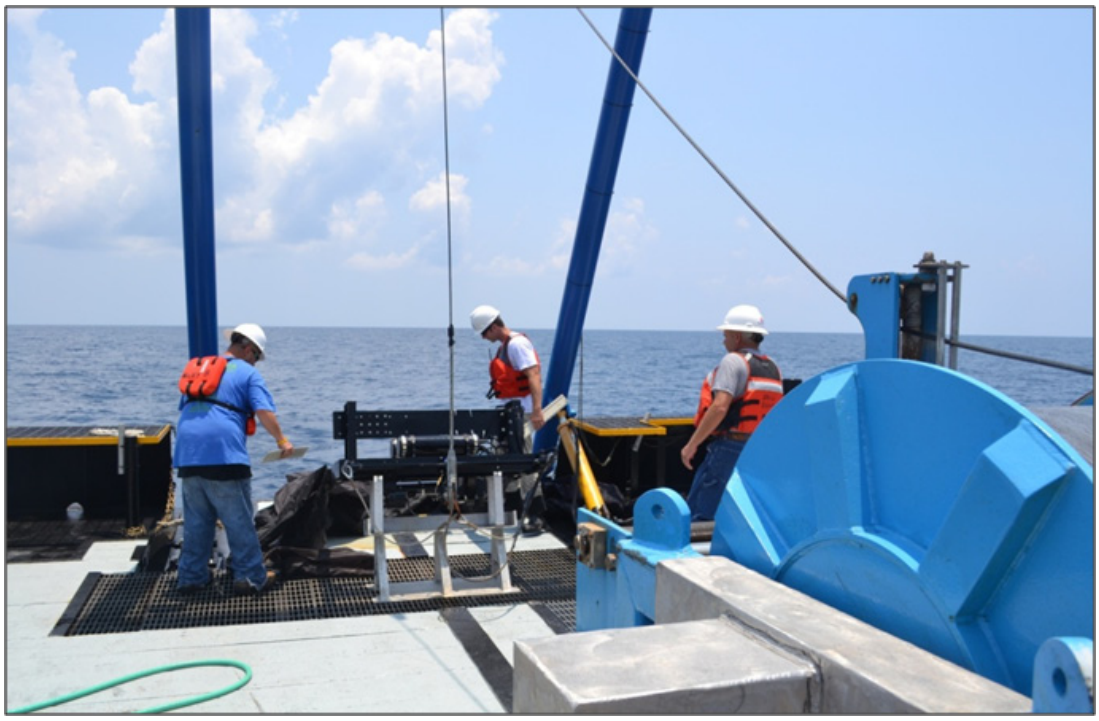


Photo 6. MOCNESS back on deck after tow.

Photo 7. Rinsing net contents.

Photo 8. Transferring sample from net cod ends into a 333-µm mesh sieve.

Photo 9. Representative sample from a MOCNESS tow.

Photo 10. Transferring net sample from sieve into sample containers.

Photo 11. Samples in labeled sample containers.

After completing plankton collection at a station, the nets were washed thoroughly with seawater. After completion of a survey, the nets were cleaned carefully with a brush and placed in a tank with freshwater and detergent. After a thorough rinse with freshwater, the nets were air dried and stored in a cool, dark place until used in the next survey.

Sample sets were assembled and organized in logical fashion to facilitate cataloging and inventory. Chain of custody (CoC) forms were prepared for transfer of samples to the laboratory. Sample sets were placed in coolers or plastic bins for transport to the laboratory. All sample containers were sealed and insulated from damage during transport. A project scientist drove each sample set directly to the laboratory.

2.2 LABORATORY ANALYSES

2.2.1 Ichthyoplankton Processing and Identification

Gulf Plankton Center LLC conducted the primary laboratory analysis under the direction of Dr. Talat Farooqui. Upon arrival at the laboratory, samples were examined to assess condition and logged in. CoC forms were completed and entered into a sample database. The count and listing of sample lots/sets for each survey that was logged in were compared against the field checklist/CoC to ensure that the sample tally was complete. The identity of each sample (e.g., location, date of collection, depth of tow) was checked and confirmed before samples were sorted. Ichthyoplankton samples were stored under appropriate conditions in a secure location in the laboratory.

Samples from Nets 1, 2, and 3 of each successful MOCNESS cast were analyzed to provide densities of fish eggs and larvae and identification of larval fish species. Samples from these nets were split according to the SEAMAP protocol by means of a Folsom plankton splitter.

Laboratory analysis began by sorting fish eggs, fish larvae, and juvenile and adult fish specimens from a sample. Fish eggs were counted and the ichthyoplankton, juvenile fish, and adult fish specimens were sorted into labeled vials and bottles, identified to the lowest practicable identification level (LPIL), and counted. Counts by taxa, identifications, and notes for each ichthyoplankton sample were entered into laboratory notebooks or datasheets. Upon completion of identifications and counts of each sample, the sorted samples were archived in a secure location in the laboratory.

Internal laboratory quality assurance/quality control (QA/QC) was conducted to ensure accurate sample processing and sorting. A total of 10% of samples were sorted twice from each cruise to ensure that rare species were not overlooked. If the error exceeded 5% in any sample, the entire lot was resorted. A competent specialist was consulted on any questionable species identification or life history stage. All data and associated sample logs were reviewed to ensure compliance with data quality objectives and calibration procedures. Data were reviewed for errors in transcription, input, and calculations by multiple knowledgeable project personnel.

2.2.2 Laboratory Quality Assurance

QA of the laboratory analyses was conducted under the directions of Dr. Michael Sherer at the Normandeau Laboratory in Falmouth, Massachusetts. Ten percent of the samples sorted at the primary laboratory were shipped to the QA laboratory. There, Dr. Sherer oversaw the re-identification of the sorted specimens. Differences in taxonomy were resolved between the primary and QA laboratories. In addition, 5% of the residual samples (i.e., the fraction of the original samples from which the specimens had been removed) were resorted to determine the sorting efficacy. Incorrect sorting exceeding 5% would result in the resorting of all samples.

2.3 MODIFICATIONS TO THE SAMPLE DESIGN

There were two primary factors that required adjustment of the sampling design: inclement weather and incidents of the MOCNESS striking submerged objects at the study locations.

2.3.1 Weather

Although the permit required sampling at 2-week intervals, it was recognized at the outset of the study that weather conditions would prevent sampling at some times during the 2-year study period. During discussions leading to USEPA approval of the study design, USEPA was advised that, because safety was an overriding concern in field operations, weather and sea state conditions would prevent collection of some samples are originally scheduled. USEPA and the study team agreed that additional samples would be collected on subsequent visits to make up for missed samples. This approach was adopted over the alternative of adding sampling cruises after the initial 2-year sampling period so that the study could be completed within the time frame prescribed in the permit. As a result of frequent weather interruptions, it was not possible to collect the originally envisioned number of samples during the sampling period. Extra samples were collected to the extent possible during favorable weather conditions resulting in collection of 80% of the originally planned number of samples.

2.3.2 Strike Incidents

During the course of the field program there were a total of three striking incidents during net tows (**Table 2**).

Table 2. Incidents of striking submerged objects.

Date	Time (h)	Study Site	Description
21 March 2011	1904	Hoover-Diana Platform Alaminos Canyon Block 25	During a dusk tow, the MOCNESS collided with an unknown object at a depth of 70 m below the water surface. Incident resulted in damage to the MOCNESS.
18 April 2011	1806	Independence Hub Mississippi Canyon Block 920	During a dusk tow, the survey vessel drifted within 100 to 150 m of the platform. Tow was aborted and the MOCNESS struck an unknown object at a 100 m depth during retrieval.
12 June 2011	1843	Hoover-Diana Platform Alaminos Canyon Block 25	During a dusk tow, a severe change in the angle of the MOCNESS was observed at 229 m. The damage to the net system indicated that a collision with an unknown object had occurred.

These three incidents were duly reported to the OOC project manager, Dr. Joseph P. Smith. The incident reports are presented in **Appendix B**. After three strike incidents, it was agreed between Dr. Smith and the CSA Ocean Sciences Inc. project manager that in order to ensure the safety of the vessel, crew, field survey team, and sampling equipment, the method of towing had to be changed. Based on the original sampling design, there was a 500-m buffer around each platform. Tows were made upcurrent of each platform along a tangential towpath. After the third striking incident, this pattern was changed; tows began downcurrent of each platform outside the buffer zone and proceeded away from the platform. After this change was implemented, no further striking instances occurred.

2.4 SAMPLE ARCHIVAL

All data and samples collected during this project will be maintained for a period of 5 years ending 31 January 2018.

2.5 ANALYSIS AND ASSESSMENT METHODS

2.5.1 Estimation of Entrainment Loss

The SWBBCS used SEAMAP data to estimate larval egg and fish densities within 15 biological zones that parsed the Gulf of Mexico into homogenous habitats. The impact modeling techniques used during the SWBBCS study relied on FHMs (see Gallaway et al. [2007] for a description of this approach) to convert egg and larval densities that were projected to be entrained into the number of spawning females it would take to produce them. This exercise facilitated estimation of how impacts would affect population trajectories and fisheries yield (LGL Ecological Research Associates, Inc., 2009). Impacts from entrainment loss based on the SEAMAP density estimates were projected to be nominal (LGL Ecological Research Associates, Inc., 2009).

Sampling from the current study (EMS) provided more localized data surrounding the four CWIS sites. An obvious question is whether the impacts based on these more representative data can still be considered nominal. The SWBBCS focused on species and species groups of socioeconomic importance. Most species designated as such in the Gulf of Mexico spawn near shore and were not represented in plankton samples of the outer biological zones within which the CWIS sites occurred. Of those that were, only a six had the life history parameters available from the literature that are required by the FHM to estimate spawning female equivalents. These species included anchovies (family Engraulidae), red snapper *Lutjanus campechanus*, yellowfin tuna *Thunnus albacores*, king mackerel *Scomberomorus cavalla*, Atlantic Spanish mackerel *S. maculatus*, and dolphinfish *Coryphaena hippurus*. Density estimates for these species were extremely low in the SEAMAP data used for the SWBBC study and even lower in the CWIS data with the exception of red snapper in Zone W5 (**Appendix C**). More importantly, the predominance of zero values (>90% of the samples for all six species) hindered more accurate and precise density estimates derived from the generalized linear modeling described in **Section 2.5.2**. As a result, it was deemed not worthwhile to repeat the life history modeling performed for the SWBBC study and to simply conclude that a similar modeling exercise would result in even lower entrainment impacts than were estimated in the SWBBC study.

In light of this finding of low ichthyoplankton densities, the significance of potential entrainment losses was estimated using the proportional water use approach described by Gallaway et al. (2007). In this approach, entrainment losses were compared to the population within a larger reference parcel of water, which was one half of the volume encompassed by a cylinder of water with a radius equivalent to 1 day's transport of water past the intake and a depth equivalent to that of the intake. Vuckovich and Crissman's (1986) reported drift rate of eddies across the continental slope in the western Gulf of Mexico was used as an estimate of 1 day's transport. The eddies drifted westward at an average speed of 5 km/d with a 95% confidence interval of 1 to 14 km/d. We used the lower confidence interval drift rate of 1 km/d to be conservative. It was assumed that water for most facilities would be drawn from the upper 60 m (approximately 200 ft) of the water column. Half the volume of a cylindrical reference parcel having these dimensions was 94,247,780 m^3.

2.5.2 Cooling Water Intake Structure Analyses

2.5.2.1 Application to Objective 1

Objective 1 was to provide the data and analyses necessary to estimate ichthyoplankton densities around seawater intakes to quantify the magnitude of potential entrainment loss and place this impact in a proper ecological perspective. The extent to which this perspective could be brought to bear on a loss estimate was partially a function of the estimate's accuracy and precision. The spatial-temporal sampling space usually varies with respect to habitat quality due to spatial heterogeneity in fixed topographical features such as water depth and time varying environmental influences such as temperature, salinity, and dissolved oxygen. In turn, most animal populations tend to be clustered in subareas during certain times with more favorable conditions. Field surveys are almost never balanced across the defined sampling space, which can lead to erroneous averages and/or inflated confidence intervals. For example, if more sampling effort happened to occur in ideal subareas at the right time due to sampling logistics or just random chance then density estimates intended to be representative of the larger defined sampling space would be biased high.

Statistical models were used during the CWIS Net Analysis to reduce the chance that unknown bias would degrade the accuracy of entrainment estimates. These models appropriately weighted each sample by its respective effort and effectively balanced effort across strata defined by the time, depth, and area variables to standardize all predictions to a common effort. This standardization/balancing removes bias in the patterns observed from the output, and the included environmental variables improved precision of these patterns to the extent they explained and removed variability in the data. These models were used to make the best use of the available data for estimating average ichthyoplankton densities.

2.5.2.2 Application to Objective 2

For Objective 2, it was of interest to determine how the ichthyoplankton community varied with depth, time of day, season (indexed by sampling month), and among the four sites. The results from the CWIS Net Analysis can be used to inform mitigation decisions concerning the depths and time periods to place the intake so as to minimize entrainment. Furthermore, identification of time periods of maximum density helps to define the "primary period of reproduction, larval recruitment, and peak abundance" as specified in the NPDES permit and to identify times when fish egg and larval densities may be low enough to surmise that entrainment is nominal and further sampling is uninformative.

2.5.2.3 Multivariate Responses

Each tow-net combination represented an experimental unit (i.e., an individual sample from the total sample size used for a given analysis) and both multivariate and univariate responses were available in the resulting dataset. Assemblage structure (the proportionate mix of species) is a multivariate response that was assessed with ordination analysis. This analysis reduces the dimensionality (i.e., the number of possible combinations in which densities can vary across species) to two or three dimensions that can be more easily interpreted with an x-y graph and interpreted as univariate responses.

Prior to the multivariate analysis, the dataset was modified to prevent bias from low abundance taxa and samples. Many larval fish were identified to taxonomic levels lower than family, but this resolution was inconsistent across species and magnified the number of zero observations in the database. Assessing communities at the family level has been shown to adequately (and sometimes more efficiently) represent ecological changes along gradients and from impacts (Hernandez et al., 2013). Parsing the individuals across lower taxon reduces the number of positive values for each taxonomic grouping and increases the number of zero observations for a given group. Using higher taxonomic levels pools these samples together and lowers the frequency of zeroes. Fewer zeroes allow for easier fitting of the observed data with statistical distributions and generate more robust results. Nearly all specimens were grouped by family, but a few specimens were identifiable only to higher levels; nevertheless, we refer to taxonomic groupings henceforth as "families."

For the statistical analysis, families occurring in fewer than 5% of the samples (again, a sample equals a tow-net combination) and samples having fewer than 10 individuals (42% of the samples but 4% of all individuals) were deleted (the resulting data matrix had 32 families collected across 1,425 samples). All counts and identification are preserved in the full dataset (**Appendices C** and **E**) to facilitate simple enumeration of entrainment as specified in the NPDES permit. Next, all samples were converted to catch per unit effort (CPUE = count/volume filtered) and 4th root transformed to prevent samples with larger abundances from dominating the ordination. This transformation on family level abundances is common in the ecological literature (e.g., Hernandez et al., 2013). Assemblage structure was analyzed using nonmetric

multidimensional scaling (NMDS), which is a nonparametric ordination technique based on ranks and is less sensitive to rare species than other ordination techniques (Shepard, 1962; Kruskal, 1964). This ordination was based on the Bray-Curtis Similarity matrix and performed with the statistical software PC-ORD (the "slow and thorough" autopilot setup was chosen; McCune and Mefford, 2006), which recommended two dimensions for the final solution.

The NMDS ordination is an indirect gradient analysis whereby continuous variables must be correlated with the station axes *post hoc* and can be overlaid on the ordination. Overlaying environmental variables with the station axis scores delineates how variability in assemblage structure correlated with these variables, which may indicate important environmental gradients to community dynamics. Likewise, the resulting plot allows visualization of the variability in assemblage structure across levels of each categorical variable (i.e., the distinctiveness of their respective larval communities).

2.5.2.4 Univariate Responses

The univariate responses (also called dependent variables) were statistically tested using a generalized linear mixed model (GLMM) to determine if the densities of total fish larvae, total fish eggs, and the three most abundant taxa differed across sampling depth, among other variables. In addition, we tested the two dimensions (Axes 1 and 2) from the ordination analysis as univariate responses; thus, there were seven univariate responses (five relating to individual densities and two relating to assemblage structure).

The egg and larval data were raw counts of individuals (some zero counts occurred) that were Poisson distributed and overdispersed, which is common for discrete data. In addition, the effort that produced each sample (i.e., the volume of water filtered) varied. Standardizing samples to a common level of effort creates the variable "catch per unit effort" (CPUE = individuals/m^3), which in the present study is used synonymously with the term density. The terms "catch" and "counts," when used alone, refer to a number of individuals that have not been standardized to a common effort. We clarified these terms because the data input and output from GLMM require their use. These data were modeled using GLMMs with discrete probability distributions to compute the likelihood of observing the counts that were collected. These types of GLMM have been a relatively new approach to analyzing count data (e.g., Terceiro, 2003; Minami et al., 2007; Arab et al., 2008; Shono, 2008; Dunn, 2009), and were applied to plankton data by Power and Moser (1999). Catch and effort for each sample enter the model separately, but the output is standardized for effort to yield density (or CPUE) estimates. This approach involved three steps:

1. Constructing a model with parameters of interest to predict the CPUE for all the observations;
2. Multiplying the predicted CPUE from Step 1 by the volume sampled (called an effort offset) to obtain the predicted (expected) number of individuals comparable to the observed counts; and
3. Computing the likelihood of the observed counts given the expected counts assuming some discrete distribution.

The discrete probability distributions used within the GLMMs correctly model data generated from the Poisson process of counting individuals and never generate negative values, which are impossible with count data. These models allow for zero counts (something lognormal distributions will not do) and Step 2 correctly weights each observation's contribution to the overall likelihood. The Poisson distribution is a one-parameter model for which the variance is equal to the mean. This distribution is ideal for situations where animal densities are uniformly

or randomly distributed. However, when animal population distributions are clustered (more common than not) the resulting variance will be larger than the mean, and the validity of hypothesis tests is compromised. Adding a second parameter to correctly model the variance fixes this problem. We chose to use the 2-parameter negative binomial regression model, which accounts for overdispersion and uses a global linear log link function to portray the predicted counts:

$$\log_e(\lambda_i) = \mu + x_i\beta \qquad (1)$$

where, λ_i = predicted count for the ith sample, μ = overall mean, x_i = the vector of explanatory variables, and β = their corresponding vector of coefficients.

Axis 1 and Axis 2 scores from the NMDS analysis (described in **Section 2.5.2.3**) were continuous and normally distributed. Therefore, the model for these univariate responses reduced to a mixed model ANOVA. All independent variables were parameterized with the GLIMMIX Procedure (approximation method = Laplace) in the SAS Version 9.2 statistical package (SAS Institute Inc., 2008) by maximizing the log likelihood.

Five categorical variables (also called factors) were included as fixed effects: year (2011 and 2012), month (January to December), time of day (dawn, noon, and dusk), site (AC25, GB668, VK989, and MC920), and net (Net 1: sampled 200 to 300 m depth range, Net 2: 100 to 200 m, and Net 3: 0 to 100 m). Multiple comparisons among levels of each fixed effect were controlled for family-wise error rate using Tukey's procedure.

While the variable net accounted for much of the variance along the depth gradient, there was some residual variance remaining due to varying physicochemical conditions across season and site. Therefore, the continuous variables (also called covariates), dissolved oxygen, salinity, and temperature were added as random effects with each month-station-net combination as the subject. These covariates were plotted against each other to visually inspect for co-linearity and prevent redundancy among independent variables.

Predicted average densities across factor levels were reported as marginal means. For instance, in a design with two factors, the marginal means for one factor are the means for that factor averaged across all levels of the other factor giving equal weight to each level of factor combinations. When covariates are included, the default is to estimate marginal means at their average values in the dataset. Estimating and reporting marginal means forces balance across unbalanced sampling designs and removes the confounding influence of environmental covariates so that the effects of any one factor can be interpreted in isolation. These means are standardized for effort in the model output, and thus, represent predicted density or CPUE (individuals/m^3).

2.5.3 Potential for using SEAMAP Data in Future Entrainment Studies

2.5.3.1 SEAMAP Data and Acquisition

The SEAMAP dataset provides information on larval densities by species, as well as egg densities for stations located throughout the Gulf of Mexico. SEAMAP data have been collected since 1982 and new data are collected in an ongoing program of sampling. The SEAMAP data constitute a unique resource for studying not only long-term trends in fishery status but also the responses of fisheries to future development activities, fishing, and natural events. The first step in analysis was to acquire the SEAMAP data from NMFS for comparison to site-specific

data. Initial processing of SEAMAP plankton samples was conducted at the Sea Fisheries Institute, Plankton Sorting and Identification Center (ZSIOP) in Szczecin, Poland and the Louisiana Department of Wildlife and Fisheries (LDWF) (Lyczkowski-Shultz et al., 2004). Vials of eggs and identified larvae, plankton displacement volumes, total egg counts, and counts and length measurements of identified larvae are sent to the SEAMAP Archive at the Florida Marine Research Institute in St. Petersburg, Florida. These data are entered into the SEAMAP database and specimens are cataloged, organized, and loaned to interested scientists. Data files containing specimen identifications and lengths are sent to the NMFS Mississippi Laboratories where these data are combined with field collection data and edited according to established SEAMAP editing routines.

A detailed description of methods for preparing the SEAMAP ichthyoplankton data (and the data gathered in this program) for assessment analysis is provided in **Appendix D**. These descriptions identify the three SEAMAP datasets (STATCARD, ICHSTRWK, and ICHSARWK) that are used together to estimate fish larvae and egg densities, and the relevant fields within each dataset. Here, we should also note that the SEAMAP database is more-or-less continually being updated (i.e., adding the next year's results, receipt of new laboratory analysis results from ZSIOP and LDWF, corrections of errors, etc.). Because the SEAMAP files are subject to updating, it is a best practice for any analysis based on these data to state the name and provenance of the data file that was used. The SEAMAP data file used in our analyses was acquired from David Hanisko, NMFS Pascagoula Laboratory. The file was an ACCESS database file dated 7 September 2010 and contained data from 18,398 ichthyoplankton sampling stations collected from 1982 to 2008. This dataset includes 217,930 ichthyoplankton identification records totaling 623,650 individuals.

The STATCARD dataset describes when and where sampling operations took place. The ICHSTRWK contains gear code information, volumes filtered, and all of the egg data, whereas the ICHSARWK dataset provides data about individual larval taxa including size information. As described in **Appendix D**, STATCARD and ICHSTRWK can be merged based upon three fields (cruise number, vessel, and station number). The sample number field is required to merge these data with the ICHSARWK dataset.

Most relevant for comparison with the CWIS baseline study were tows using a 60 cm Bongo net with 333-µm mesh. Data were restricted to only records using this gear protocol by way of filters on the following variables: Gear_ICD = '01' and Mesh_ICD = '03'. These were oblique tows sampling depths ranging from 0 to 200 m; tows over areas shallower than 200 m sampled the entire water column. The average volume filtered was 200 m^3 (range = 50 to 869 m^3); tows sampling less than 50 m^3 were deleted before analysis. For most tows, eggs and larvae were removed from the entire sample; however, for some only a fraction of the aliquot was removed. The variables EGGS_ALIQU and ALIQUOT indicated these fractions for eggs and larvae, respectively; from the SEAMAP documentation, the only valid values were 1/1, 1/2, 1/4, and 1/8. Records with any value other than these, including missing values, were deleted. Furthermore, records where NUM_EGGS was equal to 200 represent errors according to the SEAMAP documentation and were deleted for all analyses with egg density as the response variable.

2.5.3.2 Overview of the Analyses Comparing SEAMAP and CWIS Datasets

These analyses were designed to determine the extent to which the SEAMAP database could be used to assess entrainment losses of fish eggs and larvae for future CWIS installations. The use of the SEAMAP database is advantageous for this purpose because it is continually updated by an ongoing NMFS effort and readily allows future assessments to take into account temporal trends in Gulf of Mexico fishery conditions. The CWIS operations entrain a quantity of

larval fish and eggs, and the magnitude of these losses may differ from site to site. If the SEAMAP data can accurately estimate these losses then future sampling specific to each CWIS operation may not be necessary.

To this end, egg and larval density estimates from sampling conducted during 2011 and 2012 at each CWIS site (henceforth referred to as the CWIS dataset or just CWIS) were compared to estimates from SEAMAP data collected from 1982 to 2008 (data has been processed only through 2008). SEAMAP tows sample 0 to 200 m, and tows from the current CWIS study had to be made comparable. All samples from Net 1 (depth range 200 to 300 m) were dropped from the CWIS dataset, while counts and volumes filtered from Nets 2 and 3 were summed before the dataset comparison analyses. Thus, the experimental unit for these analyses was a distinct tow.

Statisticians use the term "predictions" to describe estimates generated by a model for the observations used to create the model (an example would be the CWIS Net analysis presented above). Estimates for observations not used during model creation are referred to as "forecasts." Both have application to the current study. First, we tested the null hypothesis that the two datasets rendered the same predicted responses using a GLMM created with data from both SEAMAP and CWIS datasets. The advantage of this analysis was that it took into account variability around the estimated averages from both datasets when testing whether differences were likely due to random chance (the null hypothesis) or systematic bias (the alternative hypothesis). The disadvantage is that CWIS data will not be available for comparison to SEAMAP data in the future if the latter is the only data source used to estimate entrainment.

The error likely to be incurred from using SEAMAP in lieu of localized sampling was estimated by forecasting the observed CWIS values from a GLMM created with SEAMAP data only. This exercise directly measured the extent to which conclusions would have been biased if the SEAMAP data were used instead.

For the two analyses just described, two data grouping approaches were used for these comparisons – the "Block Approach" and the "Gradient Approach." Thus, there were four sets of analyses for comparing datasets. Below we describe these approaches and rationale for how models for each were constructed.

2.5.3.3 Model Specification for the Block Approach

As mentioned, our dataset comparisons were of two approaches. For the Block Approach, a rectangle 30-min latitude tall by 90-min longitude wide was centered on each CWIS site, and all SEAMAP data that had been collected within this block were used to estimate average fish egg and larval densities for comparison with estimates from the CWIS dataset. This is the standard technique for grouping data around a facility site developed by the USCG and MARAD to estimate fish egg and larval entrainment losses associated with offshore LNG facilities (see USCG and MARAD, 2003, 2004, 2005a,b,c, 2006a,b; TORP, 2006; Gallaway et al., 2007). A criticism of this approach is that sometimes the defined blocks cut across pronounced changes in the larval fish community along depth and longitudinal (east/west) gradients (Gallaway et al., 2007). During the current study, this was especially true for the shallowest site, VK989.

One difficulty in comparing the SEAMAP and CWIS datasets was that samples were collected during different spans of years – 1982 to 2008 for SEAMAP and 2011 to 2012 for CWIS. One method of handling this discrepancy was to generalize estimates across years and months by modeling a random intercept with the Month×Year interaction nested within dataset as the subject. This random term was used in all models described below. Then the question being

answered becomes, "Do the estimates from the two datasets differ during an average year?", which is an Equal Dataset Hypothesis Comparison. The results from a model specified in this way are valid as long as no major shift in the responses occurred between the averages during each span of years.

For each Equal Dataset Hypothesis Comparison, there were four comparisons for each response (eggs and total larvae). For the Block Approach, there were comparisons for the prediction analysis and the forecast analysis. Similarly, for the Gradient Approach, there were comparisons for the prediction and forecast analyses.

For the Block Approach, possible fixed effects included a categorical variable designating Block (AC25, GB668, VK989, and MC920), another indicating Dataset (CWIS and SEAMAP), and a third variable representing their interaction. Responses were fish egg and total larval density, which were modeled as above in the CWIS Analysis with negative binomial regression. Block was always included, which resulted in three possible models: (1) Block, (2) Block + Dataset, and (3) Block + Dataset + Block×Dataset. Model 3 represents the "global" model in that it in includes all variables being tested. For this model, p-values from the Type III tests of fixed effects output by the GLMMs were used to assess the statistical significance ($\alpha = 0.05$) of these variables.

Finding no significance for the Dataset term would indicate that the differences between datasets could not be distinguished from random chance. We are aware that "absence of evidence is not evidence of absence." Nevertheless, this result would promote the argument for using SEAMAP data to estimate entrainment at future sites. Hence, localized sampling around CWIS may not be necessary; or at least it could be reduced to periodically spot check the SEAMAP estimates. Should the Dataset term be significant, the SEAMAP data may still be used to estimate future entrainment if differences were consistent across the CWIS sites, which would allow for estimation of a "corrective" multiplier or offset that could be applied to the SEAMAP data. Finding the Block×Dataset interaction term significant would preclude this corrective measure because the difference between the datasets would be subject to equivocal spatial variability. Finally, differences between datasets must be interpreted based on their biological ramifications in addition to statistical significance. In other words, the SEAMAP data may render estimates that are statistically greater than the CWIS estimates, but still not so great as to change a conclusion of no measurable impacts.

In addition to testing each term in the global model with p-values, the three Block models were compared using Akaike Information Criterion (AIC) values based on the Information Theoretic (IT) approach (Burnham and Anderson, 2002). The IT approach is more straightforward with respect to interpretation of results than classic hypothesis testing. The p-values rendered by the latter represent the percent of times the data would be randomly selected given the null hypothesis is true (i.e., no difference among treatments). If this probability is larger than the a priori level of α (typically set to 0.05), then differences among treatments are deemed not significant statistically. Further power analyses are required to move the interpretation beyond "failure to reject the null hypothesis" to the probability that the null would have been rejected had there been real differences of arbitrary levels. This approach is theoretically flawed and many statisticians and quantitative biologists strongly oppose the use of post hoc power analyses (Goodman and Berlin, 1994; Gerard et al., 1998; Anderson et al., 2001; Hoenig and Heisey, 2001; Burnham and Anderson, 2002). The IT approach directly estimates the probability of each hypothesis being true given the observed data and the suite of hypotheses being tested. Thus, the IT approach is more in keeping with the idea of multiple working hypotheses proffered by Chamberlin (1965) (Burnham and Anderson, 2002).

Weights were assigned to each model based upon their AIC values. These AIC values were modified to quasi-likelihood AIC (QAIC) values by first dividing the log-likelihood for each model by the variance inflation factor from the global model as recommended by Burnham and Anderson (2002) to account for over dispersion. Akaike weights for a given suite of models investigated sum to 1; the Akaike weight of a given model within that suite indicates the relative quality of the model compared to all others considered.

As mentioned, only SEAMAP data were used during creation of the forecast models, and thus the Dataset term was not needed. Only one model remained, which was specified with one fixed effect, Block, and one random intercept for which the Month×Year interaction was the subject.

2.5.3.4 Model Specification for the Gradient Approach

The original plan for the second approach to dataset comparisons was similar to the Block Approach, but was to group the datasets by the LGL (2009) biological zones, rather than the rectangular block drawn around each site. These 15 biological zones essentially bin the interaction of the depth and longitudinal gradients into coarse, albeit biologically significant polygons that help to homogenize variation in the larval community (Gallaway, 2007). However, during exploration of possible model specifications, we discovered these gradients could be modeled more efficiently as two separate random main effects (i.e., no interaction of the two) with greater resolution in their demarcations along each gradient. The continuous gradients Depth and Longitude were each binned into categorical variables (Depth bin size = 200 m; Longitude bin size = 1 degree) and each of these variables entered the model as a subject with a random intercept. Binning them into categorical variables rather than continuous variables yielded better statistical properties in the results (i.e., lower variance inflation factors, tighter confidence intervals for estimated means, and faster convergence). The resulting model had only one fixed effect, Dataset, which was compared to the null model (no fixed effects; only the random effects defining Depth and Longitude) with the Akaike weights (derived from their respective QAIC values) as described above in **Section 2.5.2.3**. Thus, the null model included no main effects and the three random intercepts for the subjects Month×Year interaction nested within dataset (same as the Block Approach), Depth, and Longitude. This model was used during the Forecasting from SEAMAP Analysis.

3.1 FIELD SAMPLING-CRUISES COMPLETED

From January 2011 through January 2013, 511 MOCNESS tows were conducted successfully during 39 surveys; 13 surveys were cancelled due to weather (**Table 3**).

Table 3. MOCNESS tows conducted from January 2011 through January 2013.

Survey	Date	Gunnison GB668 (W4)			Hoover-Diana AC25 (W5)			Independence Hub MC920 (C5)			Pompano VK989 (C4)		
		Dawn	Noon	Dusk	Dawn	Noon	Dusk	Dawn	Noon	Dusk	Dawn	Noon	Dusk
1	23-30 January 2011	1	1	1	1	1	1	1	1	1	1	1	1
2	Canceled – weather	--	--	--	--	--	--	--	--	--	--	--	--
3	19-26 February 2011	2	2	2	--	--	--	2	2	2	2	2	2
4	Canceled – weather	--	--	--	--	--	--	--	--	--	--	--	--
5	16-26 March 2011	2	1		3	3	1	2	2	2	--	--	2
6	Canceled – weather	--	--	--	--	--	--	--	--	--	--	--	--
7	17-20 April 2011	--	--	--	--	--	--	2	2	2	3	3	2
8	1-8 May 2011	3	3	3	3	3	3	--	--	--	2	--	--
9	17-20 May 2011	--	--	--	--	--	--	2	2	2	1	3	--
10	26-29 May 2011	--	--	--	--	--	--	1	1	1	1	1	3
11	9-18 June 2011	3	5	5	4	4	3	1	1	1	1	--	--
12	30 June-7 July 2011	1	1	1	1	1	3	1	1	1	1	2	2
13	15-19 July 2011	--	--	--	1	1	2	--	--	--	--	--	--
14	30 July-6 August 2011	2	2	2	1	1	1	2	2	2	2	2	2
15	13-21 August 2011	1	1	1	1	1	1	1	1	1	1	1	1
16	28-31 August 2011	--	--	--	--	--	--	1	1	1	1	1	1
17	14-20 September 2011	2	2	2	2	2	--	1	1	1	1	1	1
18	Canceled – weather	--	--	--	--	--	--	--	--	--	--	--	--
19	Canceled – weather	--	--	--	--	--	--	--	--	--	--	--	--
20	12-15 October 2011	--	--	--	--	--	--	3	3	3	3	3	3
21	Canceled – weather	--	--	--	--	--	--	--	--	--	--	--	--
22	Canceled – weather	--	--	--	--	--	--	--	--	--	--	--	--
23	30 November-2 December 2011	--	--	--	--	--	--	--	--	--	3	3	3
24	15-22 December 2011	--	--	--	--	--	--	2	2	1	1	1	1
25	5-9 January 2012	3	3	3	3	3	3	--	--	--	--	--	--
26	18-21 January 2012	--	--	--	--	--	--	--	--	--	2	2	2
27	Canceled – weather	--	--	--	--	--	--	--	--	--	--	--	--
28	15-18 February 2012	--	--	--	--	--	--	--	3	3	2	2	2
29	28 February-3 March 2012	--	--	--	2	3	3	--	--	--	--	--	--
30	15-18 March 2012	--	--	--	--	--	--	3	3	--	1	2	2
31	27 March-1 April 2012	1	--	--	1	1	--	--	--	--	--	--	--
32	10-13 April 2012	--	--	--	--	--	--	3	--	--	3	2	2
33	27-30 April 2012	--	--	--	--	--	--	2	3	3	1	1	--
34	8-12 May 2012	3	3	3	--	--	--	--	--	--	--	--	--
35	23-26 May 2012	--	--	--	--	--	--	3	3	3	2	2	3
36	6-11 June 2012	3	3	3	--	3	3	--	--	--	--	--	--
37	Canceled – weather	--	--	--	--	--	--	--	--	--	--	--	--
38	27 June-1 July 2012	1	--	--	2	1	3	--	--	--	--	--	--
39	11-18 July 2012	3	3	3	2	3	3	2	3	3	2	2	--
40	25 July-1 August 2012	3	3	4	--	--	--	3	3	3	3	2	2

Table 3. (Continued).

Survey	Date	Gunnison GB668 (W4)			Hoover-Diana AC25 (W5)			Independence Hub MC920 (C5)			Pompano VK989 (C4)		
		Dawn	Noon	Dusk	Dawn	Noon	Dusk	Dawn	Noon	Dusk	Dawn	Noon	Dusk
41	15-19 August 2012	2	--	--	2	3	3	--	--	--	--	--	--
42	Canceled – weather	--	--	--	--	--	--	--	--	--	--	--	--
43	5-7 September 2012	--	2	3	--	--	--	--	--	--	--	--	--
44	20-23 September 2012	--	--	--	--	--	--	3	3	3	3	3	3
45	2-6 October 2012	2	3	3	3	3	3	--	--	--	--	--	--
46	16-18 October 2012	--	--	--	--	--	--	--	--	--	3	3	--
47	30 October-4 November 2012	--	--	3 -	6	4	3	--	--	--	--	--	--
48	Canceled – weather	--	--	--	--	--	--	--	--	--	--	--	--
49	4-8 December 2012	--	--	--	--	--	--	--	--	--	1	2	--
50	Canceled – weather	--	--	--	--	--	--	--	--	--	--	--	--
51	Canceled – weather	--	--	--	--	--	--	--	--	--	--	--	--
52	18-26 January 2013	--	--	--	--	--	--	3	3	3	--	2	3

3.2 DATA SUMMARIES

Across 511 tows collected, a total of 1,533 net-tow samples were obtained; 1,485 of which were used for the Net Analysis (**Table 4**). For the Dataset Comparison Analysis, 498 tows were used (**Table 5**). Eighteen tows were deleted due to aberrant latitude/longitude values, five were deleted because of zero values for the variable "Volume Filtered," sixteen were deleted due to spurious values for one or more of the hydrographic variables used (temperature, salinity, and dissolved oxygen), and nine were deleted because the "Volume Filtered" was less than less than 50 m^3 (combined volume filtered for these nine tows was 199 m^3). Further, 15 samples were taken at site VK989 on 19 January 2013 and 27 samples were taken at the MC920 site on 24 January 2013. These were the only samples taken during 2013 giving poor representation of this year from one month at only two of the sites. To remedy this, these samples were treated as if they were taken at the respective sites in December 2012 as this was the nearest neighboring month and year in the dataset.

No adult fish were collected in any tow. A summary of the total eggs and larvae collected and volumes filtered (m^3) organized by platform, date, time of day, tow, and net is provided as **Appendix E**. Taxonomic summaries are provided in **Appendix C**. Hydrographic data (water temperature, conductivity [salinity], dissolved oxygen, chlorophyll, transmissivity/turbidity, and depth/pressure) were recorded as the net system moved vertically through the water column and were summarized as average values per net. Hydrographic data summaries of temperature, salinity, dissolved oxygen, and pressure (the variables used in the explanatory models) are shown by platform, tow, month, year, and time of day in **Appendix F**.

Overall, representatives of 164 families (and higher order taxa if family could not be determined) were taken in the MOCNESS collections (**Appendix G**). The family Myctophidae (lanternfishes) was the most abundant family with 20,804 specimens from 75 taxa accounting for 34% of the total collection of 60,376 fish larvae. The second and third most abundant families were Sternoptychidae (hatchetfishes) represented by 7,713 specimens from 18 taxa and Bregmacerotidae (codlets) represented by 4,508 specimens from 4 taxa. Collectively, these three families comprised 55% of the total collection.

Table 4. Number of MOCNESS tows by year, station, net, month, and time of day used in the CWIS Net Analysis.

Month	Time of Day	2011												2012												Total
		AC25			GB668			MC920			VK989			AC25			GB668			MC920			VK989			
		Net 1	Net 2	Net 3	Net 1	Net 2	Net 3	Net 1	Net 2	Net 3	Net 1	Net 2	Net 3	Net 1	Net 2	Net 3	Net 1	Net 2	Net 3	Net 1	Net 2	Net 3	Net 1	Net 2	Net 3	
1	Dawn	1	1	1	1	1	1	1	1	1	1	1	1	3	3	3	3	3	3				1	1	1	33
	Dusk	1	1	1	1	1	1	1	1	1	1	1	1	3	3	3	3	3	3	1	1	1	2	2	2	39
	Noon	1	1	1	1	1	1	1	1	1	1	1	1	3	3	3	3	3	3	1	1	1	2	2	2	39
2	Dawn				2	2	2	1	1	1	2	2	2										2	2	2	21
	Dusk				2	2	2	1	1	1	2	2	2							2	2	2	2	2	2	27
	Noon				2	2	2	2	2	2	2	2	2							2	2	2	2	2	2	30
3	Dawn	3	3	3	2	2	2	2	2	2				3	3	2	1	1	1	3	3	3	1	1	1	44
	Dusk	3	3	3	1	1	1	2	2	2				4	4	4				3	3	3	2	2	2	45
	Noon	1	1	1				2	2	2	2	1	1	3	3	3							2	2	2	28
4	Dawn							1	1	1	3	3	3							5	5	5	4	4	4	39
	Dusk							2	2	2	3	3	3							3	3	3	3	3	3	33
	Noon							2	2	2	2	2	2							3	3	3	2	2	2	27
5	Dawn	3	3	3	3	3	1	3	3	2	4	4	4				3	3	3	3	3	2	2	2	2	59
	Dusk	3	3	3	3	3	3	3	3	3	4	4	4				3	3	3	3	3	3	2	2	2	63
	Noon	3	3	3	3	3	3	3	3	3	3	3	3				3	3	3	3	3	3	3	3	3	63
6	Dawn	3	3	3	3	3	3	1	1	1	1	1	1	2	2	2	4	4	4							42
	Dusk	4	4	4	5	5	5	1	1	1				4	4	4	3	3	3							51
	Noon	4	4	4	4	4	4	1	1	1				6	6	6	3	3	3							54
7	Dawn	2	2	2	1	1	1	1	1	1	3	3	3	2	2	2	6	6	6	5	5	5	4	4	4	72
	Dusk	2	2	2	1	1	1	1	1	1	4	4	4	2	2	2	6	6	6	6	6	6	5	5	5	81
	Noon	5	5	5	1	1	1	1	1	1	4	4	4	3	3	3	7	7	7	6	6	6	2	2	2	87
8	Dawn	1	1	1	3	3	3	4	4	4	3	3	3	2	2	2	2	2	2							45
	Dusk	2	2	2	3	3	3	4	4	4	2	2	2	3	3	3										42
	Noon	2	2	2	3	3	3	3	3	3	2	2	2	3	3	3										39
9	Dawn	2	2	2	2	2	2	1	1	1	1	1	1							3	3	3	3	3	3	36
	Dusk	2	2	2	2	2	2	1	1	1	1	1	1				2	2	2	3	3	3	3	3	3	42
	Noon				2	2	2	1	1	1	1	1	1				3	3	3	2	2	2	3	3	3	36
10	Dawn							2	2	2	3	3	2	3	3	3	2	2	2				3	3	3	38
	Dusk							3	3	3	3	3	3	2	3	3	3	3	3				3	3	3	44
	Noon							3	3	3	3	3	3	3	3	3	6	6	6							45
11	Dawn													6	6	6										18
	Dusk													5	5	5										15
	Noon													3	3	3										9
12	Dawn							2	2	2	4	4	4							3	3	3	1	1	1	30
	Dusk							2	2	2	4	4	4							3	3	3	4	4	4	39
	Noon							1	1	1	4	4	4							2	2	2	3	3	3	30
Total		48	48	48	51	51	49	60	60	59	73	72	71	68	69	68	66	66	66	65	65	64	66	66	66	1,485

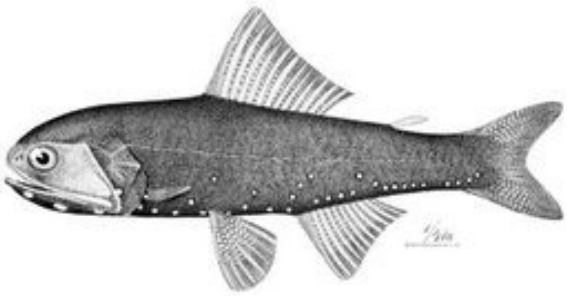
Table 5. Number of tows used from the SEAMAP program and the CWIS monitoring study for the Block and Gradient Approaches to compare datasets with respect to total fish larvae and eggs.

Dataset				
Response	Block	SEAMAP	CWIS	Total
Block Approach				
Total larvae	AC25	59	117	176
	GB668	16	117	133
	MC920	56	126	182
	VK989	173	138	311
	Total	304	498	802
Eggs	AC25	59	117	176
	GB668	16	117	133
	MC920	56	126	182
	VK989	168	138	306
	Total	299	498	797
Gradient Approach				
Total larvae		1,162	498	1,660
Eggs		948	498	1,446

4.1 COOLING WATER INTAKE STRUCTURE NET ANALYSIS

This chapter presents the Net Analysis for counts of the three most dominant taxa collected during the study as well as counts of total eggs and larvae. The dominant taxa were lanternfishes (Myctophidae), hatchetfishes (Sternoptychidae), and codlets (Bregmacerotidae). In addition, the results of the multivariate analysis of the ichthyoplankton assemblage structure are presented.

4.1.1 Myctophidae (Lanternfishes)



During the current study, lanternfishes were the most dominant taxa, comprising 34% of the total larvae specimens collected (20,804 out of 60,376; **Appendix G**). Lanternfishes are named for their conspicuous use of bioluminescence. Occurring in oceans worldwide, they are a deepsea family of small-bodied fishes represented by 246 species in 33 genera. The Gulf of Mexico myctophid assemblage appears to have a different structure compared to that in the Atlantic Ocean (Backus et al., 1977; Bangma and Haedrich, 2008; Ross et al., 2010). Alexander (1998) suggests that lanternfishes account for as much as 65% of all deepsea fish biomass. Global biomass is estimated to be on the order of 550 to 660 million metric tonnes, several times the entire world's fisheries catch. Based on older specimens collected with a Tucker trawl (1.59 mm mesh size) at stations near those used in this study, Ross et al. (2010) found lanternfishes to account for 38% of total catch. Annual differences were not pronounced in the CWIS data, but they were significantly more abundant at the westernmost sites than the easternmost sites, with site VK989 having the lowest density. Lanternfish abundance exhibited a similar seasonal trend to that of total larvae and total eggs by peaking during spring and decreasing into autumn. However, the spiked abundance in April suggests a more temporally compressed spawning period during spring (**Figure 4**, **Table 6**).

During the day, myctophids stratify in dense aggregations deep in the water column (e.g., >300 m). These aggregations are sufficiently dense to cause deep sound-scattering layers (e.g., Baird et al., 1974; McCartney, 1976). At night, they rise to surface waters presumably to feed on zooplankton. However, there is much variation among species within the family Myctophidae, and larval myctophids are non-migratory, spending day and night in near surface waters (Ahlstrom, 1959). The samples collected during this study corroborated these life history descriptions in that densities in the upper 100 m of the water column were on the order of 18 times higher than at deeper depths; furthermore, their density did not change significantly with time of day. Cha et al. (1994) found myctophids to be among the most abundant families in samples from MOCNESS tows offshore of the Florida Keys; 50% of individuals that were observed at depths <50 m.

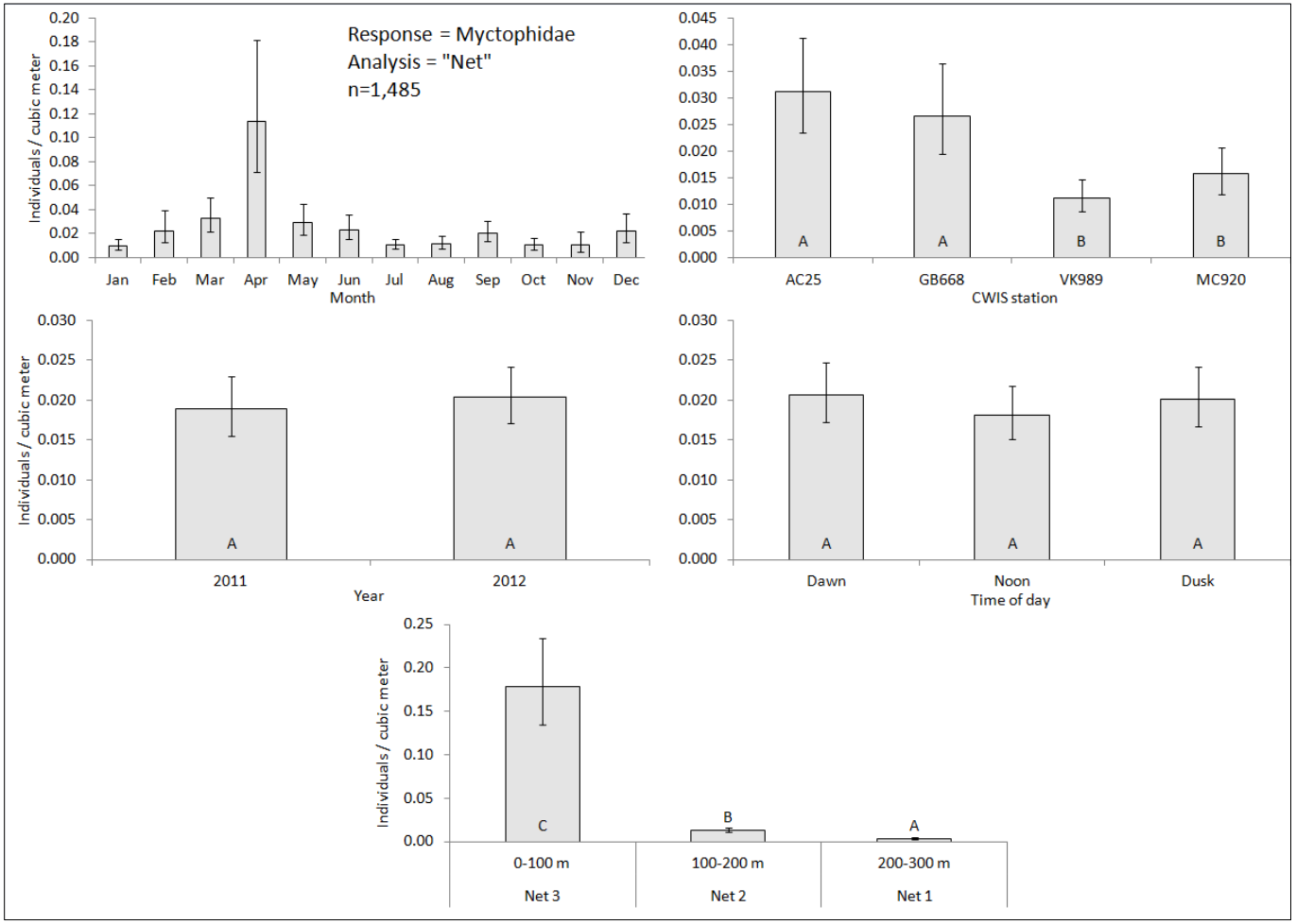


Figure 4. Mean predictions of Myctophidae per cubic meter for levels of categorical variables used in the generalized linear mixed model for the Net Analysis. Predictions are given as "marginal" means, defined as the average response in each level giving equal weight across all levels of other categorical variables and holding covariates constant at their averages observed during the study. Error bars reflect 95% prediction intervals. P-values for variables are given in **Table 6**. Columns with different letters are significantly different (α = 0.05). Significant differences among months are not indicated to avoid visual clutter; nevertheless, a seasonal trend was apparent with higher and lower values differing significantly in general and especially so for extreme values.

Table 6. Results from the generalized linear mixed model for the Net Analysis of MOCNESS samples. P-values are given for each categorical fixed effect (Term) along with the number of model parameters (k), and the variance inflation factor (VIF). For differences among levels of each categorical term, see corresponding figures for each response (**Figures 4** to **8**). Covariance terms represent random variance around environmental gradients across the Net-Station-Month cell combinations. The standard error (SE) is provided also.

Response	k	VIF	Term	P-value	Covariance Term	Estimate	SE
Total larvae	24	1.08	Year	0.6662	Oxygen	0.135	0.039
			Month	<0.0001	Salinity	0.041	0.022
			Time of Day	0.0262	Temperature	0.193	0.054
			Station	0.0016			
			Net	<0.0001			
Eggs	24	1.13	Year	<0.0001	Oxygen	0.140	0.041
			Month	<0.0001	Salinity	0.196	0.054
			Time of Day	0.0006	Temperature	0.010	0.026
			Station	0.0004			
			Net	<0.0001			
Myctophidae	24	1.19	Year	0.4222	Oxygen	0.446	0.160
			Month	<0.0001	Salinity	0.095	0.060
			Time of Day	0.2106	Temperature	0.747	0.228
			Station	<0.0001			
			Net	<0.0001			
Sternoptychidae	24	0.94	Year	0.0280	Oxygen	0.253	0.073
			Month	0.0546	Salinity	0.066	0.030
			Time of Day	0.0016	Temperature	0.265	0.075
			Station	0.0190			
			Net	<0.0001			
Bregmacerotidae	24	0.96	Year	<0.0001	Oxygen	0.638	0.359
			Month	0.1301	Salinity	0.613	0.225
			Time of Day	0.7011	Temperature	0.890	0.387
			Station	0.0432			
			Net	<0.0001			
NMDS Axis 1	24	0.18	Year	0.0005	Oxygen	0.003	0.002
			Month	0.4621	Salinity	0.000	-
			Time of Day	0.9716	Temperature	0.001	0.002
			Station	0.0842			
			Net	<0.0001			
NMDS Axis 2	24	0.17	Year	0.7477	Oxygen	0.000	-
			Month	0.0646	Salinity	0.000	-
			Time of Day	0.2257	Temperature	0.032	0.008
			Station	0.1682			
			Net	<0.0001			

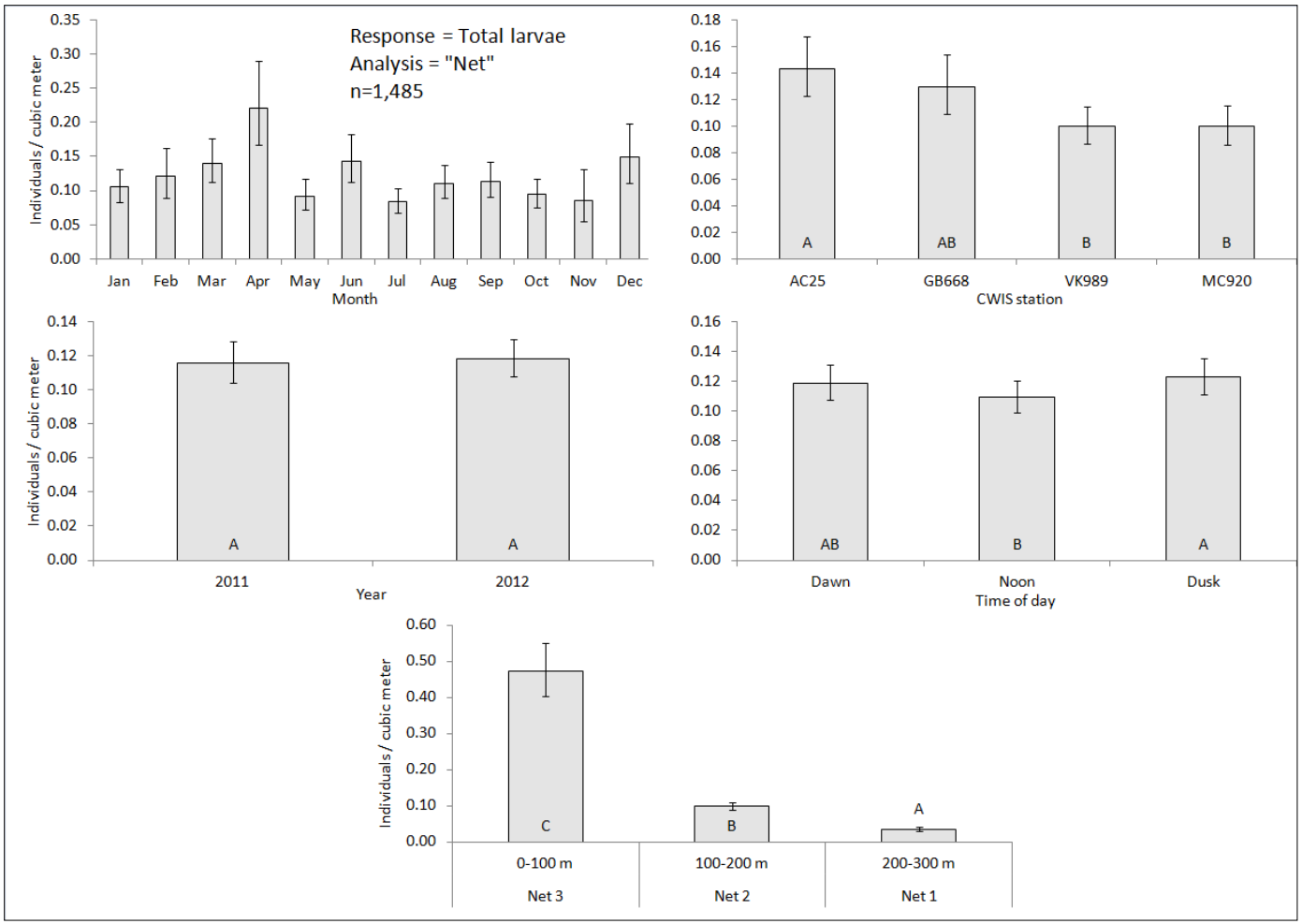


Figure 5. Mean predictions of total larvae per cubic meter for levels of categorical variables used in the generalized linear mixed model for the Net Analysis. Predictions are given as "marginal" means, defined as the average response in each level giving equal weight across all levels of other categorical variables and holding covariates constant at their averages observed during the study. Error bars reflect 95% prediction intervals. P-values for variables are given in **Table 6**. Columns with different letters are significantly different (α = 0.05). Significant differences among months are not indicated to avoid visual clutter; nevertheless, a seasonal trend was apparent with higher and lower values differing significantly in general and especially so for extreme values.

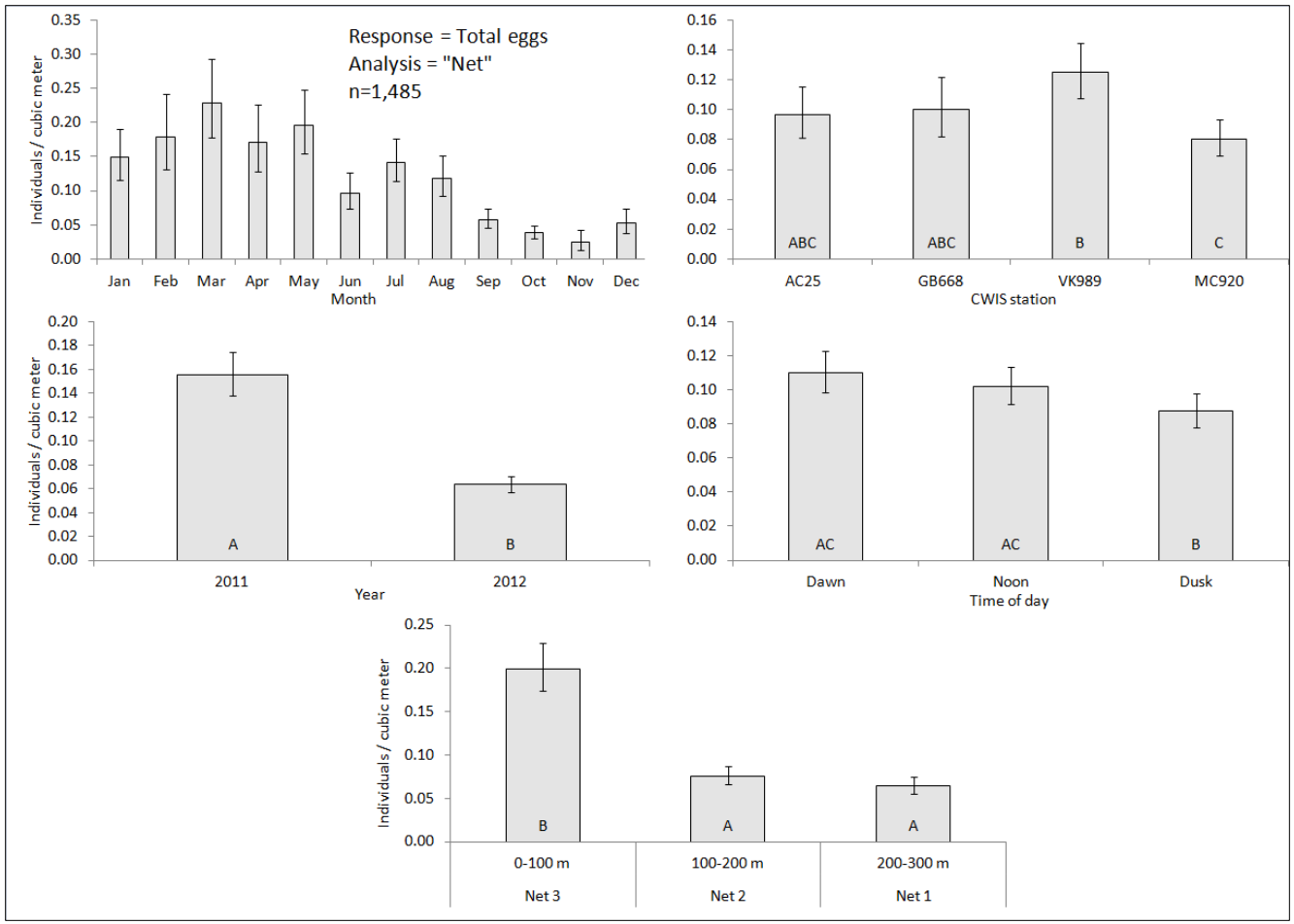


Figure 6. Mean predictions of total eggs per cubic meter for levels of categorical variables used in the generalized linear mixed model for the Net Analysis. Predictions are given as "marginal" means, defined as the average response in each level giving equal weight across all levels of other categorical variables and holding covariates constant at their averages observed during the study. Error bars reflect 95% prediction intervals. P-values for variables are given in **Table 6**. Columns with different letters are significantly different (α = 0.05). Significant differences among months are not indicated to avoid visual clutter; nevertheless, a seasonal trend was apparent with higher and lower values differing significantly in general and especially so for extreme values.

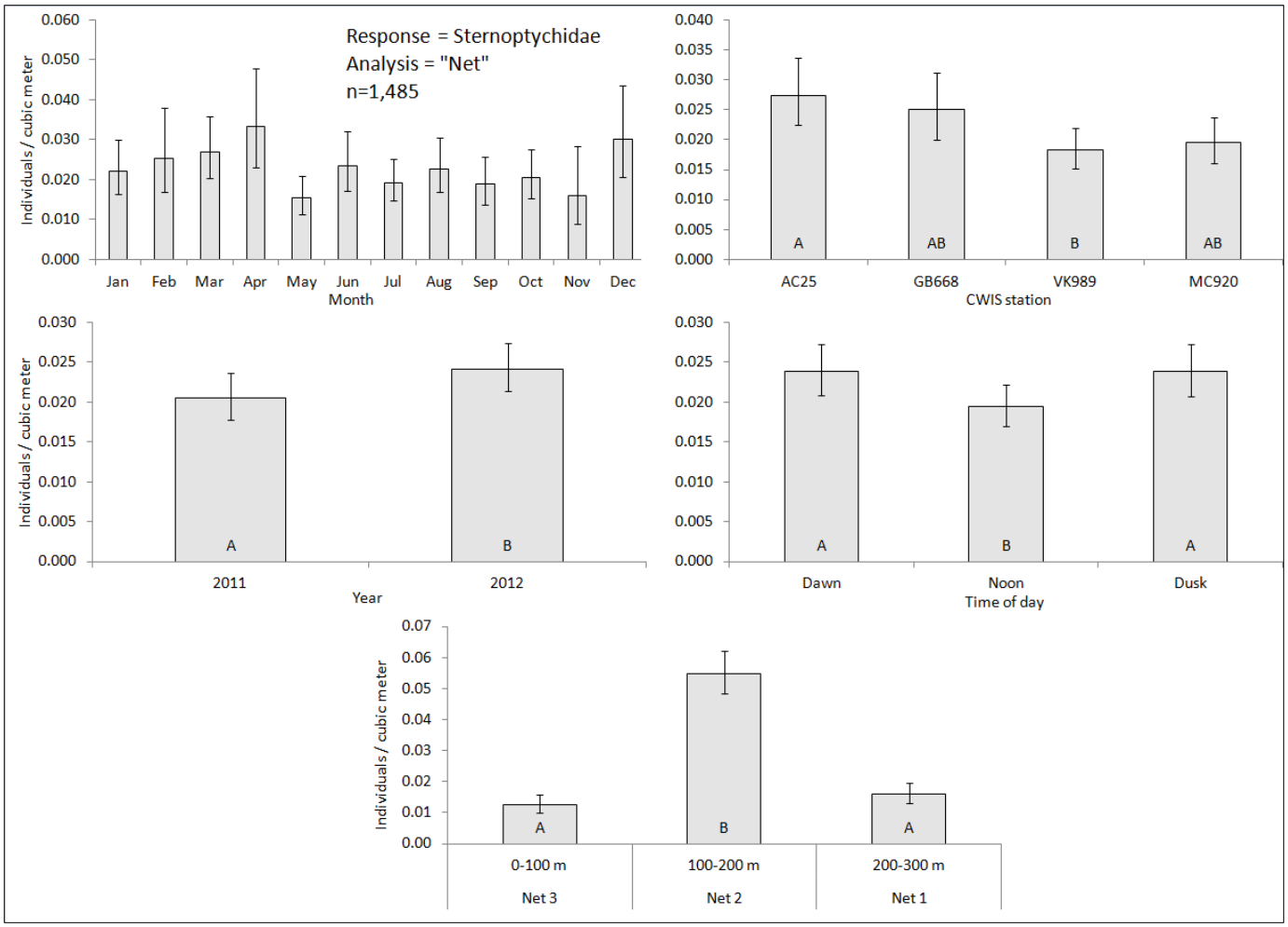


Figure 7. Mean predictions of Sternoptychidae per cubic meter for levels of categorical variables used in the generalized linear mixed model for the Net Analysis. Predictions are given as "marginal" means defined as the average response in each level giving equal weight across all levels of other categorical variables and holding covariates constant at their averages observed during the study. Error bars reflect 95% prediction intervals. P-values for variables are given in **Table 6**. Columns with different letters are significantly different (α = 0.05). Significant differences among months are not indicated to avoid visual clutter; nevertheless, a seasonal trend was apparent with higher and lower values differing significantly in general and especially so for extreme values.

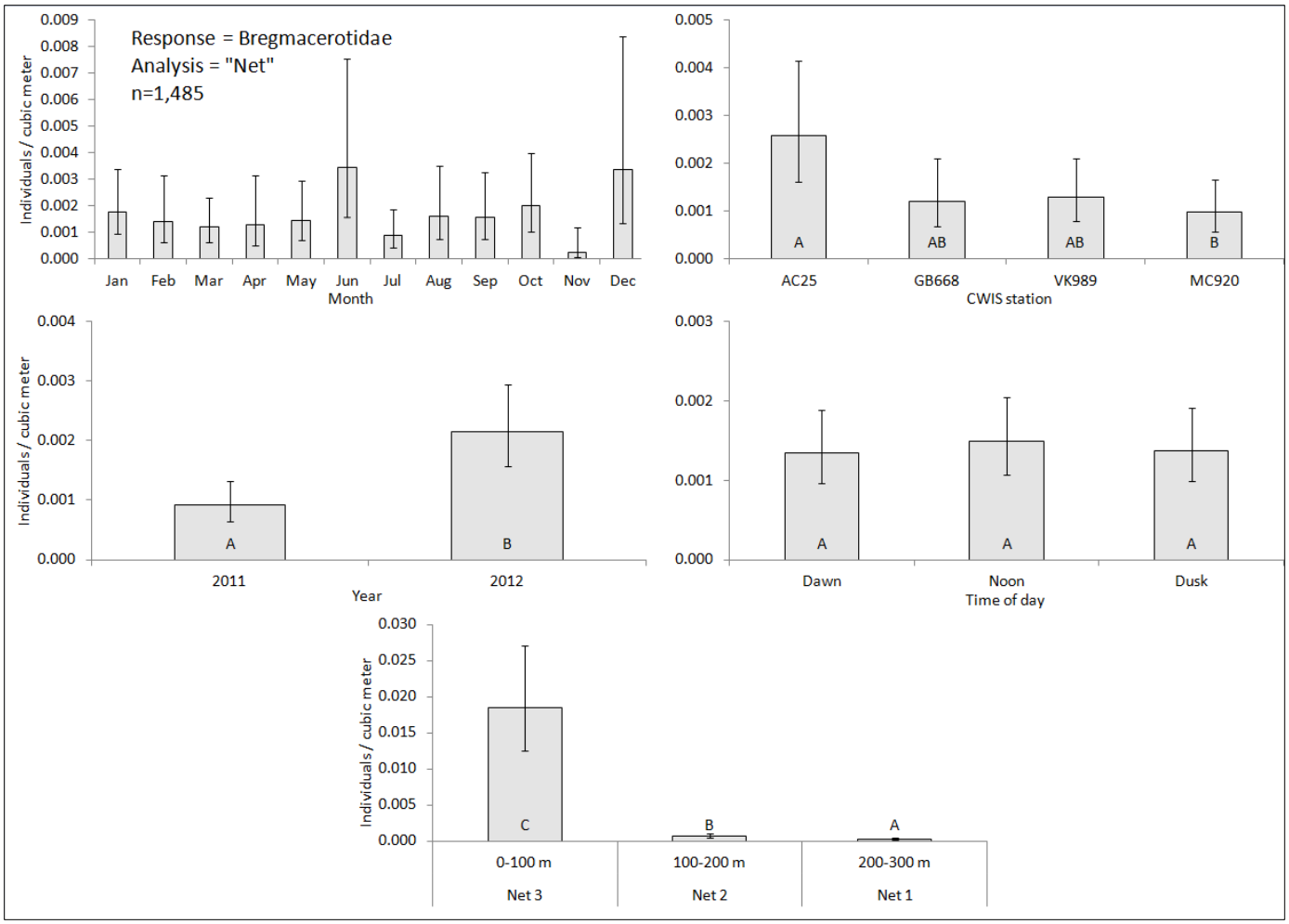
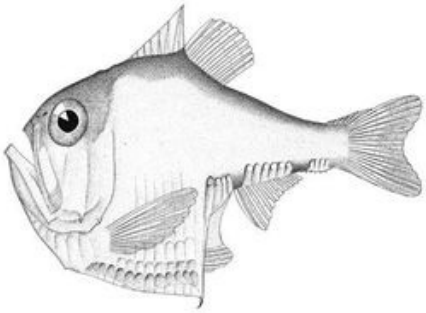


Figure 8. Mean predictions of Bregmacerotidae per cubic meter for levels of categorical variables used in the generalized linear mixed model for the Net Analysis. Predictions are given as "marginal" means defined as the average response in each level giving equal weight across all levels of other categorical variables and holding covariates constant at their averages observed during the study. Error bars reflect 95% prediction intervals. P-values for variables are given in **Table 6**. Columns with different letters are significantly different (α = 0.05). Significant differences among months are not indicated to avoid visual clutter; nevertheless, a seasonal trend was apparent with higher and lower values differing significantly in general and especially so for extreme values.

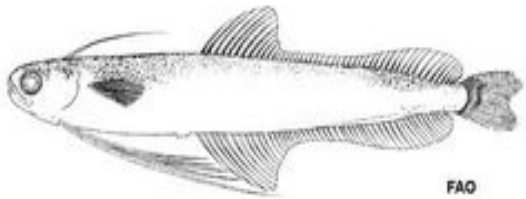
4.1.2 Sternoptychidae (Hatchetfishes)



The second most abundant family, Sternoptychidae (hatchetfishes), was represented by a total of 7,713 specimens, 13% of the total collection (**Appendix G**). This family is comprised of 73 species in 10 genera distributed worldwide. Hatchetfish use bioluminescent counter-illumination to camouflage their silhouette from predators below while feeding at night (Nelson, 2006). Hopkins and Baird (1985) studied the trophic ecology of the principle species of this family in the eastern Gulf of Mexico. Marked resource partitioning across time and space was found among the four species investigated. *Argyropelecus aculeatus* fed in the epipelagic zone (<200 m) at night, while *A. hemigymnus* foraged at deeper depths during late afternoon. The two other species, *Sternoptyx diaphana* and *S. pseudobscura* were found at much deeper depths (>500 m) and exhibited no clear diel feeding cycle.

Hatchetfish were found to be unique in their vertical distribution during this study. Unlike all other responses modeled, hatchetfish were markedly more abundant at depths of 100 to 200 m than at shallower or deeper depths (**Figure 7**, **Table 6**). Densities during the middle of the day were significantly lower than at dawn or dusk suggesting a diel cycle in their vertical migration. Densities of larval hatchetfish peaked in April and abated in autumn. Densities in 2012 were marginally, yet significantly, higher than those observed in 2011. As with total larvae, lanternfish, and codlet densities, hatchetfish were more numerous at the westernmost sites than at the easternmost sites.

4.1.3 Bregmacerotidae (Codlets)



The third most abundant family was Bregmacerotidae (codlets), accounting for 7% of all specimens (4,508 individuals; **Appendix G**). As with larval lanternfish densities, the results of this study corroborated Cha et al. (1994) who found codlets to be among the most numerically dominant families in MOCNESS tows of <50 m offshore of the Florida Keys (Cha et al., 1994).

In the current study, codlets exhibited a different seasonal pattern than the other ichthyoplankton. Instead of peaking during spring then tapering to lower densities during autumn, codlet densities were more consistent across all months except for distinct increases in June and December. This suggests that members of this family may spawn during all seasons (**Figure 8**). Namiki et al. (2007) found two species of codlets, *Bregmaceros atlanticus* and *B. cantori*, to exhibit greater larval densities during winter based on bongo net tows of <200 m off the central coast of Brazil. Given the range in lengths, a third species *Bregmaceros* sp. was suspected of spawning throughout the year.

Codlet densities in 2012 were more than double the densities found in 2011. As with the other larval fish responses, densities revealed an east-west trend, being the greatest in the westernmost site AC25. Codlet densities exhibited the common vertical distribution of decaying exponentially with depth.

4.1.4 Summary of Cooling Water Intake Structure Net Analysis Results

The univariate responses included in this analysis were catches for total fish larvae, total fish eggs, and the three families exhibiting greatest observed densities (Myctophidae, Sternoptychidae, and Bregmacerotidae). In addition, each of the two axes from the NMDS output (Axis 1 and Axis 2) were treated as univariate dependent variables. For each of the responses, the effects of the categorical variables year, month, time of day, station (i.e., site), and net were tested. The results of these tests are reported in this chapter and patterns are identified across the levels of these variables.

This study was successful in achieving Objective 2, which was to provide decision support for identifying and guiding potential mitigation measures for the effects of entrainment. The lowest ichthyoplankton densities were estimated to have been (1) in the central Gulf of Mexico, (2) over a water depth ≥400 m, (3) at least 200 m below the surface, (4) during November, and (5) around midday. This chapter further discusses each of these factors.

Annual fluctuation was statistically significant and substantial for total eggs (higher in 2011) and Bregmacerotidae (higher in 2012); the effect of year was small but significant for Sternoptychidae and Axis 1 scores from the NMDS (**Table 6**; **Figures 4** to **10**). Time of day had a significant effect on total larvae, total eggs, and Sternoptychidae, but differences among dawn, noon, and dusk samples were small relative to other factors. Assemblage structure of ichthyoplankton, as indexed by Axes 1 and 2, did not vary to a significant degree across sampling stations, while all five density responses changed significantly. Densities were greatest in at least one of the western sites (AC25 and GB668) for all responses except total eggs, suggesting a general trend in abundance of larval fish increasing from east to west. Total eggs had higher representation at the shallowest site VK989.

All seven univariate responses showed pronounced differences across the nets, which sampled three depth strata. Mean densities of total eggs, total larvae, Myctophidae, and Bregmacerotidae decreased markedly from the top stratum (Net 3, 0 to 100 m) to the middle stratum (Net 2, 200 to 300 m) then less so to the deepest stratum (Net 1, 200 to 300 m). Likewise, the two-dimensional representation of assemblage structure by Axes 1 and 2 from the NMDS ordination plot shows Net 3 samples to be more distinct from the deeper samples of Nets 1 and 2; Net 2 samples ordinated differently than Net 1 samples as well but to a lesser degree. Sternoptychidae was unique in that density was approximately four times greater in Net 2 than either the shallowest or deepest nets.

Total fish eggs and larvae as well as Myctophidae varied significantly across months indicating seasonal peaks and valleys in ichthyoplankton densities, which reflect spawning patterns of adults. Sternoptychidae had a p-value = 0.0545 (i.e., not significant at $\alpha = 0.05$), but the pattern was similar whereas Bregmacerotidae was less significant ($p = 0.1301$) with a dissimilar pattern across months. To generalize and clarify seasonal patterns, all density responses were rescaled to their standard normal deviates (z-scores) across months and plotted together (**Figure 9**). The rescaled values indicate how many standard deviations each month varied from the annual mean, which allows responses of different magnitudes to be compared directly. It appeared that the general trend for total eggs, total larvae, Myctophidae, and Sternoptychidae was to reach peak densities during spring (March and April), while Bregmacerotidae was more consistent except for dramatic spikes in density for June and December (**Figure 9**). All density responses appear to be low during the fall (October and November).

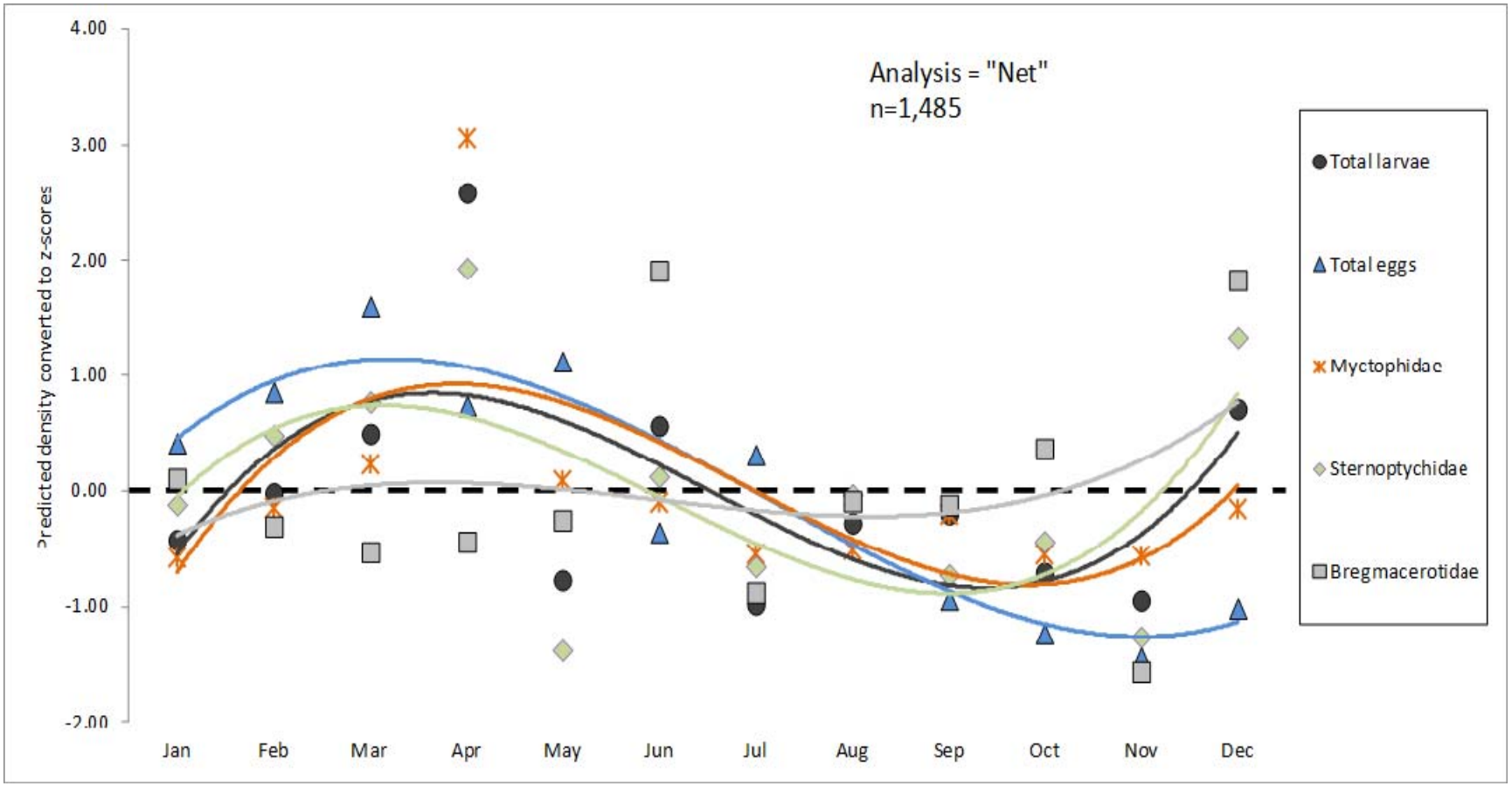


Figure 9. Mean predictions of larval and egg densities by month output from the generalized linear mixed models and standardized to a common scale by conversion to z-scores (i.e., units of standard deviations relative to their respective means across months [indicated by the dashed line]). Scores are based on "marginal" means defined as the average response in each level giving equal wp37p3737eight across all levels of other categorical variables and holding covariates constant at their averages observed during the study. All trend lines represent 3rd order polynomial least squares regression lines.

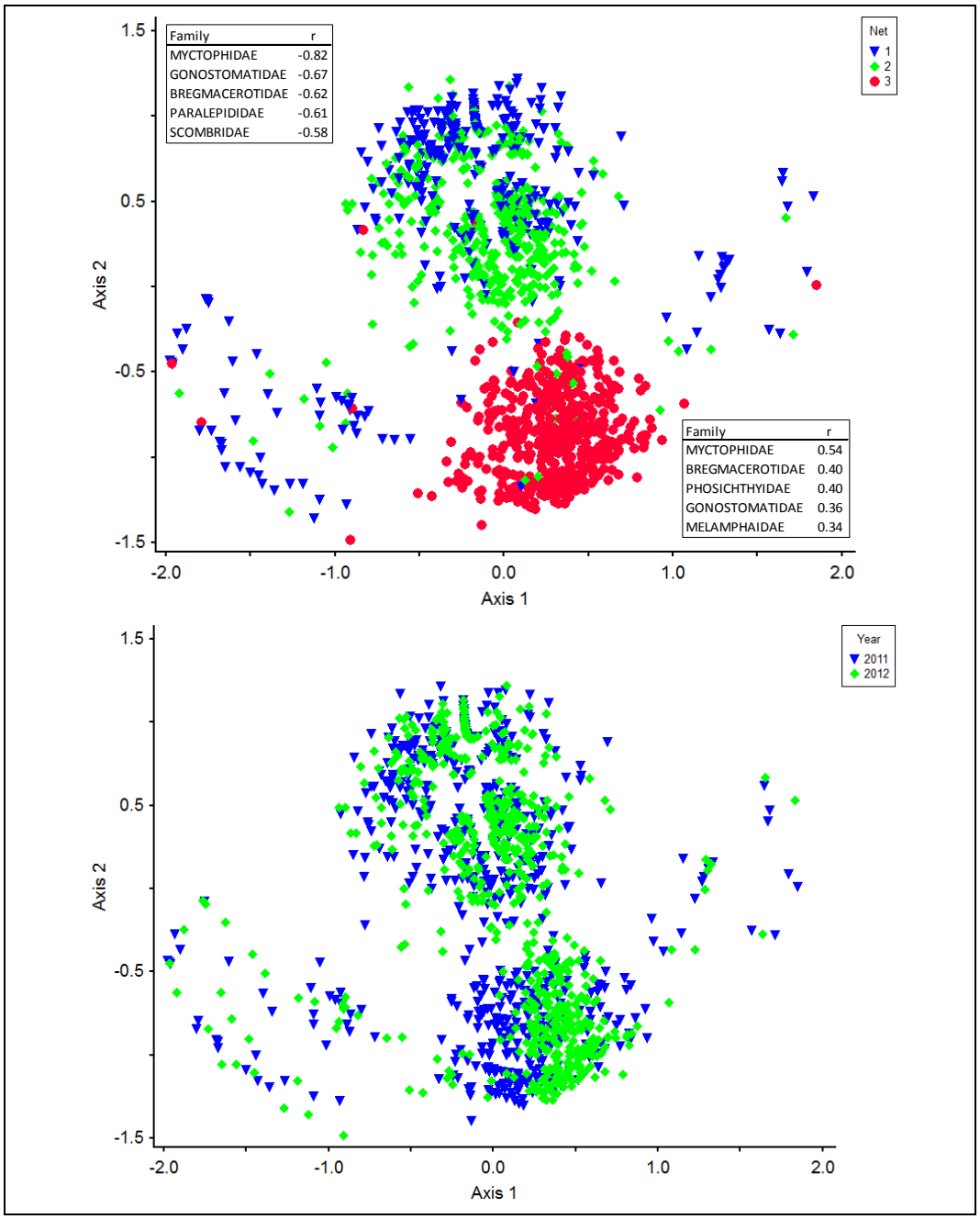


Figure 10. Nonmetric multidimensional scaling (NMDS) of samples (i.e., net-tow combinations) based on densities of larval fish families. Samples within each level of the categorical variable net (top panel) and year (bottom panel) are separated by colors and symbols. Using Axes 1 and 2 as responses in the generalized linear mixed model (see **Chapter 2.0**) only these two categorical variables showed significant differences (α = 0.05). All net levels differed along both axes; year differed only along Axis 1. The five families correlating the highest (r = Pearson's correlation coefficients) with each Axis are reported in tables overlaying the top panel.

4.1.5 Total Larvae

The abundance of total larvae at the continental slope study sites peaked in April and declined thereafter into autumn. The difference in abundance between 2011 and 2012 was small and not significant (**Figure 5**, **Table 6**). Larval abundance appeared higher at the westernmost sites (AC25 and GB668) than at the easternmost sites. Larval densities at VK989, the shallowest site with a depth of 393 m, were nearly identical to the density observed at MC920 where the depth was 2,515 m. Regardless, densities across all CWIS stations were a fraction of those observed from SEAMAP tows closer to shore (**Figure 11**). The trend in surface water larval density over increasing depth moving offshore appears to be an exponential decay. Whereas densities at dawn and dusk were higher than seen in the noon collections, the differences, albeit statistically significant, were slight (**Figure 5**). The most pronounced differences were related to depth of the sample net. Larval density in the upper 100 m of the water column was nearly five times higher than density observed at 100 to 200 m depth and approximately 16 times higher than larval densities at 200 to 300 m depth.

4.1.6 Total Eggs

Fish egg abundance exhibited a clear seasonal pattern peaking in March and declining to a minimum in November. Egg abundance was markedly higher in 2011 than in 2012 suggesting annual variability in egg production. Site VK989 was characterized by the highest mean egg density (0.12 eggs/m^3), and MC920 had the lowest (0.08 eggs/m^3). Changes due to time of day were statistically significant, but small. The most pronounced differences in egg density occurred among depths (**Figure 6**). Egg density in the upper 100 m of the water column was approximately two to three times higher than the deeper depths.

4.1.7 Assemblage Structure

An ichthyoplankton larvae sample is characterized by its assemblage structure (i.e., the number of species or taxa present and the number of individuals of each species or taxa). Understanding whether assemblage structure depends on factors such as the sample location or sample depth or the year, month, or time of day when samples were collected may be relevant in assessing the potential fishery impacts of cooling water intakes. Considering that representatives of 164 families were identified in the MOCNESS samples collected for this study, making an objective determination of whether sample-specific factors such as station, net, year, month, or time of day have a significant influence on assemblage structure is extremely difficult. NMDS is a numerical technique that transforms a multidimensional dataset (e.g., assemblage structure) into a smaller number of dimensions (e.g., two) so that the significance of the dependence of assemblage structure on sample-specific factors can be objectively tested. For this analysis, the complex assemblage structure data are transformed in values termed Axis 1 and Axis 2. These values can be used in the GLMM approach to test the correlation of assemblage structure with factors such as sample location, sample depth, year, month, or time of day.

Assemblage structure is a multivariate response or matrix where dimensions are equal to the number of species or taxa comprising it. The NMDS ordination converted this matrix into two dimensions to facilitate interpretation of how this response was influenced by the independent variables (factors) tested. The axis scores defining these dimensions represent two univariate indices of assemblage structure that capture predominate variation across samples. As such, changes in Axis 1 and Axis 2 were tested with the GLMM to estimate whether assemblage structure differed across levels of included factors.

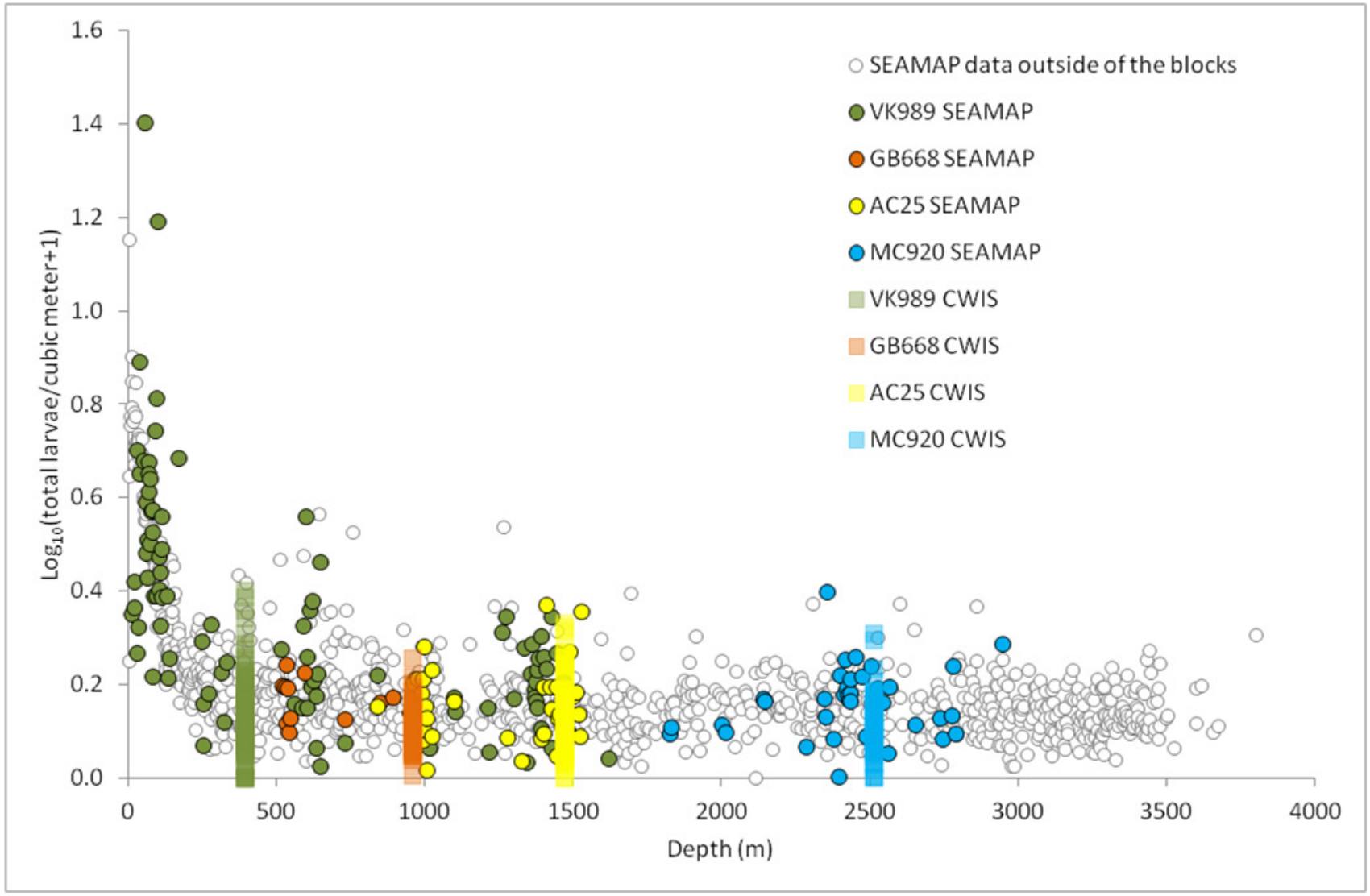


Figure 11. Observed larval fish density by water depth based on SEAMAP data (circles) and CWIS data (squares). Color-filled circles reflect SEAMAP observations within each of the United States Coast Guard Maritime Administration rectangles that are centered around the respective CWIS stations; empty circles reflect SEAMAP samples outside of these blocks.

The final NMDS two-dimensional ordination of samples (net-tow combinations) yielded a final stress value of 0.21 indicating a good representation of species dimensionality (according to McCune and Mefford, 2006) and therefore assemblage structure (**Figure 10**). Both axes (dimensions) exhibited p-values less than 0.001 based on comparing observed stress values with those derived from 1,000 Monte Carlo runs of randomized data A low p-value suggests that the patterns observed in the data to which the ordination was fitting could not be explained by random noise (at least not 99.9% of the time in the current case). Orthogonality ($1-r^2$) represents the degree to which the two axes are uncorrelated. Unlike other ordination techniques, NMDS axes are not always orthogonal, but should be (McCune and Mefford, 2006). McCune and Mefford (2006) recommend comparing distances among samples in ordination space versus their corresponding distances in the original, unreduced space as a diagnostic for how well the final axes represent the observed assemblage structure. Axes 1 and 2 in **Figure 10** were 93.3% orthogonal and explained 78% and 26% of the variance in the observed assemblage structure, respectively.

Significant differences in axis scores across factor levels were indicated for net and year only. Each net's samples ordinated differently along both axes; however, the majority of variability among nets, and therefore depth strata, was accounted for with Axis 2. Samples from the shallowest net (Net 3, 0 to 100 m) ordinated the lowest along Axis 2. Net 1 samples (200 to 300 m) ordinated the highest, and Net 2 samples (100 to 200 m) were in between, but more similar to Net 1 than to Net 3. The interpretation of these differences is that assemblage structure changed significantly along the vertical depth gradient, and this change became less dramatic with increasing depth. Myctophidae, Gonostomatidae, and Bregmacerotidae correlated the highest with Axis 2 and were inversely related. That is, their relative representation in the assemblage decreased with depth. Similarly, Sanvicente-Añorve et al. (1998) report these families to be among those having the greatest influence on assemblage structure of larval fish in the neritic (over the continental shelf) and oceanic (beyond the continental shelf) zones in the southern Gulf of Mexico. Similarly, Ross et al. (2010) found assemblage structure of older individuals collected with a Tucker Trawl to be fairly constant through time and across the Gulf of Mexico. As with the current study, they found that the primary gradient along which most change occurred was sampling depth.

Axis 1 explained less of the variation across all samples than Axis 2 but was the only axis for which significant differences occurred between years. Axis 1 most likely represents annual fluctuation in assemblage structure. Myctophidae, Bregmacerotidae, and Phosychthyidae were more represented in 2012 samples and positively correlated with Axis 1.

4.2 DATASET COMPARISONS

Two sample grouping approaches were used to compare the CWIS and SEAMAP datasets. The first approach compared site-specific CWIS fish egg and larval densities to those estimated using SEAMAP data restricted to corresponding blocks defined with the USCG-MARAD protocol (i.e., the Block Approach). The average SEAMAP estimates of larval fish densities significantly overestimated the observed, site-specific larval densities, especially at the shallowest site VK989 (**Table 7**, **Figure 12**). This difference is thought to be mainly an artifact of an observed onshore/offshore depth gradient as described by Gallaway et al. (2007). This gradient was evident for total larvae and SEAMAP samples within the USCG-MARAD block centered on site VK989, which clearly overlapped shallower areas with greater larval densities (**Figure 11**). Therefore, a second approach was developed that omitted SEAMAP samples from <350 m depth, yet used more of the SEAMAP dataset by removing the block restriction. Depth and longitudinal gradients were modeled directly (i.e., the Gradient Approach).

Table 7. Results for the prediction analysis from the generalized linear mixed models for the Block and Gradient Approaches to compare differences between SEAMAP and CWIS datasets with respect to total larvae and eggs. P-values are given for each categorical fixed effect (Term) along with the number of model parameters (k), and the variance inflation factor (VIF). Covariance terms represent random effects with estimates that account for how much the intercepts from each Month-Year-Dataset combination vary around the intercept common to all. The standard error (SE) is provided also.

Response	Model	Akaike Weight	k	VIF	Term	P-value	Covariance Term	Estimate	SE
Block Approach									
Total larvae	1	100%	10	0.77	Dataset	<0.0001	Month × Year (Dataset)	0.284	0.062
					Block	<0.0001			
					Dataset × Block	<0.0001			
	2	0%	7	0.76	Dataset	<0.0001	Month × Year (Dataset)	0.399	0.077
					Block	<0.0001			
	3	0%	6	0.77	Block	<0.0001	Month × Year (Dataset)	0.624	0.104
Eggs	1	98%	10	1.01	Dataset	0.8604	Month × Year (Dataset)	0.632	0.132
					Block	<0.0001			
					Dataset × Block	0.0004			
	2	1%	7	1.04	Dataset	0.2911	Month × Year (Dataset)	0.781	0.147
					Block	<0.0001			
	3	1%	6	1.04	Block	<0.0001	Month × Year (Dataset)	0.789	0.148
Gradient Approach									
Total larvae	1	100%	6	0.92	Dataset	<0.0001	Month × Year (Dataset)	0.113	0.021
							Depth bin	0.011	0.006
							Longitude bin	0.010	0.006
	2	0%	5	0.092	Null	-	Month × Year (Dataset)	0.144	0.026
							Depth bin	0.012	0.006
							Longitude bin	0.012	0.007
Eggs	1	65%	6	1.08	Dataset	0.0313	Month × Year (Dataset)	0.275	0.051
							Depth bin	0.026	0.022
							Longitude bin	0.093	0.044
	2	35%	5	1.44	Null	-	Month × Year (Dataset)	0.291	0.053
							Depth bin	0.104	0.019
							Longitude bin	0.020	0.049

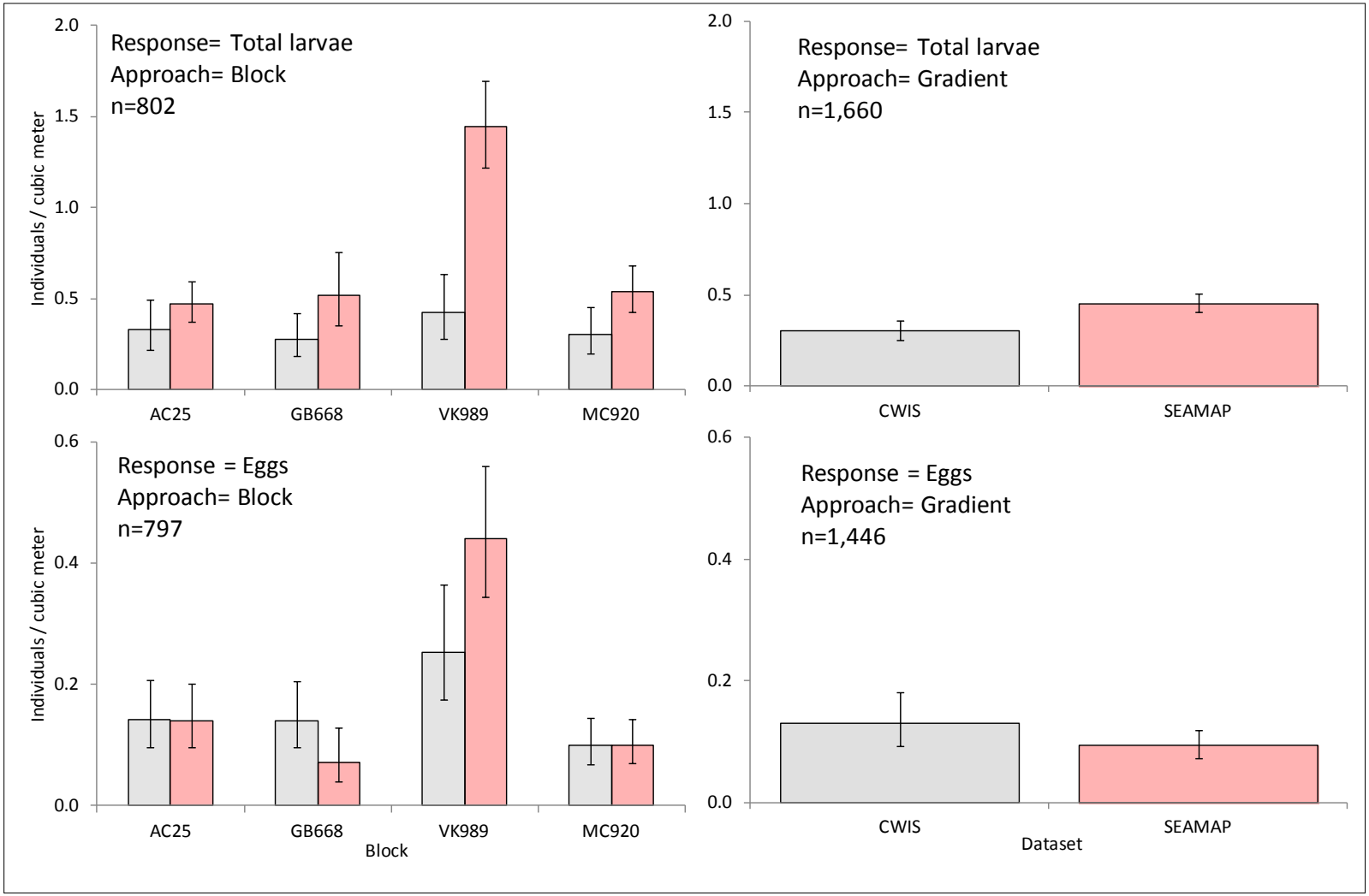


Figure 12. Marginal mean responses of larval fish per cubic meter and eggs per cubic meter for each level of categorical variable used in the generalized linear mixed models for the Block and Gradient Approaches. Gray columns represent CWIS data and pink columns represent SEAMAP data. Error bars reflect 95% prediction intervals. P-values for variables are given in **Table 7**. Responses were significantly different (α = 0.05) between datasets using both approaches except for eggs at Blocks AC25, GB668, and MC920.

4.2.1 Block Approach – Analysis Results from the Datasets Modeled Together

The analysis comparing SEAMAP and CWIS estimates of total larvae was based on 802 tow collections (304 SEAMAP tows and 498 CWIS tows taken at the four sites), whereas the analyses for eggs were based on 797 tows (**Table 5**). The results were somewhat equivocal. The best models describing dataset differences for both larvae and eggs received 100% and 98% of the Akaike weight, respectively, and included the interaction term "Block × Dataset" (**Table 7**). This finding means that the datasets were statistically different, but the magnitude and/or direction varied by Block.

For total larvae, the site-specific SEAMAP estimates of density were higher than the CWIS estimates across all sites, but the effect size varied (upper left panel of **Figure 12**). For site VK989, the SEAMAP estimate was more than three times higher than the CWIS estimate; for the other sites, SEAMAP estimates were approximately 50% to 100% higher than those for CWIS. While the differences between SEAMAP and CWIS total egg densities were less pronounced for three of the sites, the magnitude and direction of the discrepancies were inconsistent as well. The SEAMAP estimate was much higher than the CWIS estimate at site VK989, estimates were nearly identical at sites AC25 and MC920, and at site GB668, the direction reversed and the CWIS estimate was twice the SEAMAP estimate.

Forecasts of larval densities based on the Block Approach were higher than the observed CWIS values across all sites, but the magnitude of this bias was exaggerated at site VK989 (**Figure 13**). For egg densities, both magnitude and direction varied. It was concluded that the conventional Block Approach would generate less than optimal forecasts of local ichthyoplankton densities.

However, it is thought that the Block Approach was inappropriate because the defined blocks crossed over areas with substantial contrast in depth, yet treated all samples within these blocks as being homogenous with respect to environmental conditions and habitat features. For site VK989, the inclusion of SEAMAP samples from shallower waters caused the relationship between the databases to shift substantially.

4.2.2 Gradient Approach – Analysis Results from the Datasets Modeled Together

The gradient analysis for total larvae was based upon 1,660 tows; 1,162 from the SEAMAP dataset and 498 from the CWIS monitoring study (**Table 6**). The gradient analysis for eggs was based upon 1,446 samples; 948 from the SEAMAP dataset and 498 from the CWIS monitoring study. These results suggest the SEAMAP estimates of larval densities were significantly higher than the CWIS estimates by a multiplier of 1.5 (**Table 7**, upper right panel of **Figure 12**). For egg density, the CWIS estimate was 1.4 times higher than the SEAMAP estimate, although Akaike weight was only 65% for the model including the term Dataset (i.e., there was a 65% chance that the datasets differed).

Using the Gradient Approach reduced forecast error for larval fish densities, and while these forecasts were still biased high, the magnitude of the differences across sites and years was more consistent (**Figure 13**). The direction of bias was reversed for the prediction of egg densities. Overall, these results suggest the long term average SEAMAP estimates of total larval and egg densities can be used as estimates of site densities when longitude and depth gradients are modeled at greater resolutions. The consistent bias observed can be adjusted to balance with observed density estimates or inflated to assess worst case scenarios with respect to entrainment of ichthyoplankton.

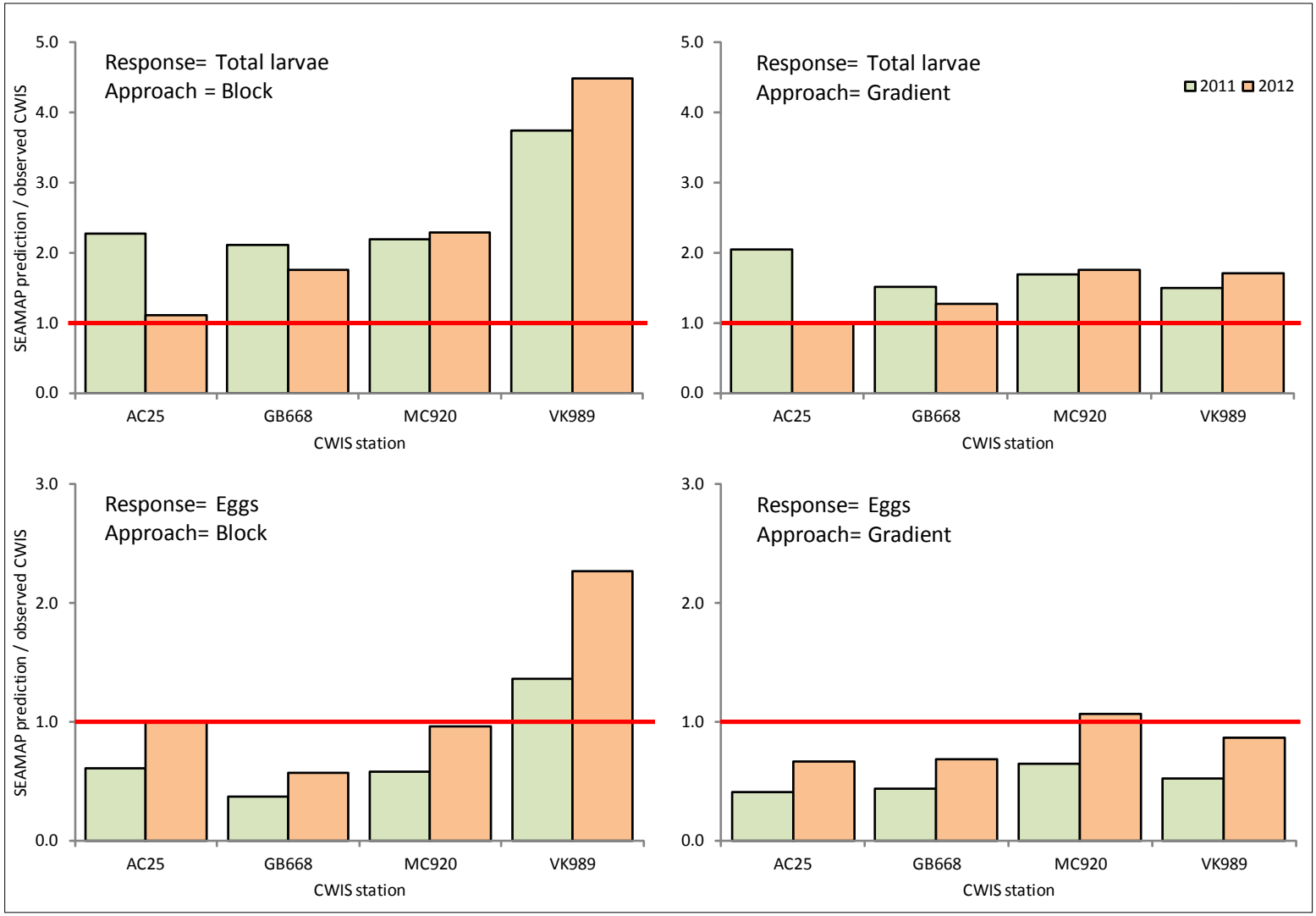


Figure 13. Forecast accuracy for predictions of annual mean larval and egg densities at the four CWIS sites using models from the two approaches parameterized with SEAMAP data only. The y-axis represents the ratio of the predicted annual mean to the observed mean at each station. The red line (ratio = 1.0) reflects perfect accuracy; for example, predicted total larvae density at Station AC25 was 2 times greater than the observed mean density in 2011, but accurate in 2012.

No adjustment for the larval densities would result in a conservative (i.e., worst case scenario) estimate of entrainment; an appropriate scalar would be required to equalize the SEAMAP estimates of egg densities with those observed (an average of 1.7 across station and years). An average scalar of 2.7 would make the SEAMAP egg density estimates as conservative as the total larval forecasts.

4.3 ENTRAINMENT LOSSES

Objective 1 was to provide data that allowed quantification of the magnitude of potential entrainment loss and place this potential impact in proper ecological perspective. The most relevant descriptors of this perspective were (1) the vastly reduced fish egg and larval densities compared to nearshore distributions, (2) the nominal fraction of the water used by CWIS facilities compared to the water mass typically moving past each site, and (3) the very small net effect this loss would have on the adult population.

Ichthyoplankton densities in the Gulf of Mexico decline exponentially with total depth as distance from the shoreline increases. The shallowest site is well beyond the inflection point of depth (approximately 200 m) where ichthyoplankton density reduces to a fraction of the nearshore densities (**Figure 11**). Surface layer densities over water depths >200 m are about one-sixth of those over depths <200 m.

The four monitoring sites examined in this study were located over the continental slope of the central and western Gulf of Mexico at depths ranging from 393 to 2,515 m (**Table 8**). Although these facilities are not subject to the entrainment monitoring requirement because of their construction dates, their estimated entrainment losses can be considered as representative surrogates for losses at regulated facilities. For Independence Hub, the facility with the largest water use (**Table 8**), the entrainment loss would be 0.15% (i.e., 15/10,000) of the population passing by the facility each day. For the Pompano facility, the losses would be 0.01% of the passing population. These percentages are relative to a reference parcel of water and are independent of density estimates (see **Section 2.5.1**).

Table 8. Water use and percent entrainment loss per day by facility. Each facility's daily water use was referenced to a standard volume (94,247,780 m^3; see **Section 2.5.1**) that passed the facility each day.

Facility	Lease Block	Zone	Depth (m)	Water use/day (m^3)	Percent of Reference Volume Lost
Pompano	VK989	C4	393	10,978	0.01
Independence Hub	MC920	C5	2,515	140,817	0.15
Gunnison	GB668	W4	960	20,063	0.02
Hoover-Diana	AC25	W5	1,471	79,494	0.08

As mentioned under the results for the Net Analysis, density responses in the deepest stratum (200 to 300 m) were less than one-third of the surface layer for codlets and lanternfishes. For hatchetfish, the density of the deepest stratum was less than one-third the middle layer. For total larvae, the fraction drops to one-thirteenth, and for myctophids one-fiftieth. When combined, these factors causing reductions in ichthyoplankton densities become multiplicative. For instance, entrainment by an intake below 200 m at the Independence Hub site could be approximately 6% of the density expected from a site over the continental shelf with a 50-m deep intake over a depth of less than 200 m. This comparison assumes water usage and

movement past the two facilities are equal; both sites would entrain a fraction of the passing population from the reference parcel of water as defined earlier.

Statistical models like those generated during the Net Analysis would be useful for estimating densities to input into impact assessment models for species of interest. Equivalent Adult Models (EAMs) and Fecundity Hindcasting Models (FHMs) apply mortality and stage duration schedules across early life stages to convert losses of eggs and larvae into adult equivalents. However, none of these species occurred frequently enough to facilitate robust estimates of density.

Assemblages were dominated by deepsea families, mainly lanternfishes, hatchetfishes, and codlets. High profile species of recreational and commercial important species were not well-represented in the slope collections. For example, mackerels and tunas (Scombridae) were the most abundant family of recreational and commercial species and were represented by 2,231 out of the 60,376 specimens or about 4% of the total collection. Sea basses (Serranidae) and snappers (Lutjanidae) were the next most abundant of these species with a total of 340 and 246 specimens, respectively; together they accounted for less than 1% of all specimens. Dolphinfish (Coryphaenidae) were represented by 48 specimens, and only two swordfish (Xiphiidae) larvae were collected. Most of the entrainment losses involve species whose life histories are poorly known.

It is worth noting that based on output from FHMs applied to species of interest during the SWBBCS entrainment impacts were miniscule. Densities for these species from samples taken during this study were found to be either zero or lower those used for the SWBBCS, with the exception of red snapper in Zone W5. Moreover, the estimated impacts were so small that the positive bias in density estimates made from the SEAMAP data when compared to the CWIS samples from this study was nowhere near the error that would have to occur before impacts began to be marginally detrimental to the affected species. As a result, the differences between densities measured in this study and those estimated from SEAMAP data using the Gradient Approach are small enough that they have no practically significant effect on the usefulness and validity of impact estimates made with SEAMAP data.

5.0 SUMMARY OF SIGNIFICANT FINDINGS

During 2011 and 2012, a CWIS EMS was conducted at four sampling sites in the Gulf of Mexico. Two sites were located off eastern Louisiana at water depths of 393 and 2,515 m (eastern sites); and two sites were located offshore Texas at water depths of 960 and 1,471 m (western sites). Ichthyoplankton samples were collected using a MOCNESS that sampled three depth ranges during each tow: 0 to 100 m, 100 to 200 m, and 200 to 300 m. Tows were conducted at dawn, noon, and dusk. It was the intention to sample biweekly during 2011 and 2012, however, inclement weather precluded some sampling. In all, 498 tows comprising 1,485 depth-specific samples were viable for analyses.

Using the CWIS EMS data only, the responses for total larvae, eggs, the three most abundant families, and an index of assemblage structure (i.e., the proportionate mix of families) were tested for differences across levels of five effects: year, month, time of day, station, and sample depth. This analysis was referred to as the "CWIS Net Analysis" as the experimental unit was each net-tow combination. In a separate "Dataset Comparison," larval fish and egg density estimates from the current study were compared to those made with data collected during the routine plankton monitoring program (SEAMAP) conducted by NMFS. Finally, impacts from "Entrainment Losses" were assessed by placing the magnitude of losses in reference to ichthyoplankton abundance for the immediate vicinity. The significant findings from these analyses are outlined in this chapter.

5.1 COOLING WATER INTAKE STRUCTURES NET ANALYSIS

- The three most abundant larval fish families across the entire study were Myctophidae (lanternfishes), Sternoptychidae (hatchetfishes), and Bregmacerotidae (codlets).

- Pronounced differences across years only occurred for eggs and codlets; eggs were greater in 2011, while codlets were greater in 2012.

- Month had a significant effect on the density responses. All taxa exhibited greater densities during March and April except for codlets, which peaked in June; all responses were lower in October and November.

- Differences across time of day, though occasionally statistically significant, were nominal for all responses.

- The effect of station revealed a general east-west trend in ichthyoplankton densities. Western stations, tended to have greater density responses for all except eggs, which was greatest at the shallowest, eastern site.

- The most pronounced patterns from the effects investigated during the study were changes in densities and assemblage structure across sample depths. For the larvae of all taxa except hatchetfish larvae, densities were several times greater in the shallowest range (0 to 100 m); hatchetfishes were concentrated more in the mid-range (100 to 200 m). Assemblage structure differed markedly across depth ranges with samples from the shallowest range being more distinct in their observed species composition.

5.2 DATASET COMPARISONS

- The USCG and MARAD established strict analytical protocols for assessing the impact of seawater intake on key fish species in a region. This approach called for the estimation of larval fish and egg densities based on SEAMAP data arbitrarily restricted to a defined rectangular polygon (referred to as a block) centered on the site in question. This approach was found to be inadequate for this study because blocks can cut across depth and longitudinal gradients along which pronounced changes in the larval fish community occur. This resulted in inconsistent differences between estimates based on the SEAMAP data versus CWIS data across the sampling stations.

- A better approach that does not use arbitrary polygons but instead statistically models the depth and longitudinal gradients to estimate fish larval and egg densities is presented in this report. While the SEAMAP estimates still differed from the site-specific CWIS estimates using this new approach, these differences were less pronounced and more consistent.

- Forecasts of total fish larvae densities based on SEAMAP data would typically be biased high to represent a worst case scenario with respect to impacts from CWIS. Using the Gradient Approach, the mean ratio of SEAMAP to CWIS was 1.6:1 ranging across stations and years from 1.0:1 to 2.0:1; using the Block Approach, the mean ratio was 2.5:1 ranging from 1.1:1 to 4.5:1.

- Forecasts of total fish egg densities based on SEAMAP data would typically be biased low. Using the Gradient Approach, the mean ratio of SEAMAP to CWIS was 0.7:1 ranging across stations and years from 0.4:1 to 1.1:1; using the Block Approach, this mean ratio was 1.0:1 ranging from 0.4:1 to 2.5:1. The scalar needed to equalize the mean for SEAMAP with that of CWIS was then 1.7; a scalar of 2.7 would cause the SEAMAP mean to be an overestimate by the same magnitude as it was for the total fish larvae response.

- Based on these findings, the SEAMAP dataset provides an adequate basis for the estimation of entrainment of ichthyoplankton.

5.3 ENTRAINMENT LOSSES

- Ichthyoplankton densities in the Gulf of Mexico declined exponentially with total water depth as distance from the shoreline increased. The shallowest site examined in this study was well beyond the inflection point of depth (approximately 200 m) where ichthyoplankton density was reduced to a fraction of the nearshore densities. Surface layer densities over water depths greater than 200 m are approximately one-sixth of those over depths less than 200 m. The four monitoring sites were located over the continental slope of the central and western Gulf of Mexico at water depths ranging from 393 to 2,515 m.

- Entrainment loss for each site was compared to ichthyoplankton abundance within a larger reference parcel of water. The reference parcel was one half of the volume encompassed by a cylinder with a radius equivalent to one day's transport of water past the intake and a depth equivalent to that of the intake. Even with a worst case scenario transport velocity, water usage by the facilities would cause only 0.01% to 0.15% of this reference abundance to be entrained.

- Fish egg and larvae densities at the deepest depth range sampled (200 to 300 m) was found to be a fraction of the densities at shallower depths. Thus, placing water intakes below 200 m would substantially reduce entrainment and possibly eliminate the need for site-specific sampling.

- Most of the entrainment losses involved species whose life histories are poorly known. Larval fish assemblages were dominated by deepsea families, mainly lanternfishes, hatchetfishes, and codlets. High profile species of recreational and commercial importance were not well represented in the slope collections.

- Based on output from FHMs applied to species of interest during the SWBBCS, entrainment impacts were projected to be miniscule. Densities for these species from samples taken during this study were found to be either lower than those used for the SWBBCS or zero. Moreover, the estimated impacts were so small that the positive bias in density estimates made from the SEAMAP data when compared to the CWIS samples from this study was nowhere near the error that would have to occur before impacts began to be marginally detrimental to the affected species.

6.0 LITERATURE CITED

Ahlstrom, E.H. 1959. Vertical distribution of pelagic fish eggs and larvae off California and Baja California. U.S. Fish and Wildlife Service, Fishery Bulletin 60:107-146.

Anderson, D.R., W.A. Link, D.H. Johnson, and K.P. Burnham. 2001. Suggestions for presenting results of data analyses. Journal of Wildlife Management 65:373-378.

Alexander, H.P. 1998. Lanternfishes, pp. 127-128. In: J.R. Paxton and W.N. Eschmeyer (ed.), Encyclopedia of Fishes. Academic Press, San Diego, CA.

Arab, A., M.L. Wildhaber, C.K. Wikle, and C.N. Gentry. 2008. Zero-inflated modeling of fish catch per unit area resulting from multiple gears: application to channel catfish and shovelnose sturgeon in the Missouri River. North American Journal of Fisheries Management 28:1,044-1,058.

Backus, R.H., J.E. Craddock, R.L. Haedrich, and B.H. Robison. 1977. Atlantic mesopelagic zoogeography. In: Fishes of the Western North Atlantic. Sears Foundation for Marine Research 1:266-287.

Baird, R.C., D.F. Wilson, R.C. Beckett, and T.L. Hopkins. 1974. *Diaphus taaningi* Norman, the principal component of a shallow sound-scattering layer in the Cariaco Trench, Venezuela. Journal of Marine Research 32:301-312.

Bangma, J.L. and R.L. Haedrich. 2008. Distinctiveness of the mesopelagic fish fauna of the Gulf of Mexico. Deep Sea Research Part II 55(24-26):2,594-2,596.

Burnham, K.P. and D. R. Anderson. 2002. Model selection and multimodel inference: a practical information-theoretic approach. Springer-Verlag, New York, NY. 488 pp.

Cha, S.S., M.F. McGowan, and W.J. Richards. 1994. Vertical distribution of fish larvae off the Florida Keys, 26 May-5 June 1989. Bulletin of Marine Science 54(3):828-842.

Chamberlin, T.C. 1965. The method of multiple working hypotheses. Science 148:754-759. (Original work published in 1890).

Dunn, M.R. 2009. Review and stock assessment of black cardinalfish (*Epigonus telescopes*) on the east coast North Island, New Zealand. New Zealand Fisheries Assessment Report 2009/39. 55 pp.

Electric Power Research Institute, Inc. 2004. Extrapolating Impingement and Entrainment Losses to Equivalent Adults and Production Foregone. Final Technical Report. Palo Alto, CA.

Electric Power Research Institute, Inc. 2005. Parameter Development for Equivalent Adult and Production Foregone Models. Final Technical Report. Palo Alto, CA.

Gallaway, B.J., W.J. Gazey, J.G. Cole, and R.G. Fechhelm. 2007. Estimation of Potential Impacts from Offshore Liquefied Natural Gas Terminals on Red Snapper and Red Drum Fisheries of the Gulf of Mexico: An Alternative Approach. Transactions of the American Fisheries Society 136:655-677.

Gerard, P.D., D.R. Smith, and G. Weerakkody. 1998. Limits of retrospective power analysis. Journal of Wildlife Management 62(2):801-807.

Goodman, S.N. and J.A. Berlin. 1994. The Use of Predicted Confidence Intervals When Interpreting Results. Annals of Internal Medicine 121(3):200-206.

Hernandez, F.J., Jr., L. Carassou, W.M. Graham, and S.P. Powers. 2013. Evaluation of the taxonomic sufficiency approach for ichthyoplankton community analysis. Marine Ecology Progress Series 491:77-90.

Hoenig, J.M. and D.M. Heisey. 2001. The abuse of power: the pervasive fallacy of power calculations for data analysis. The American Statistician 55(1):19-24.

Hopkins, T.L. and R.C. Baird. 1985. Feeding ecology of four hatchetfishes (Sternoptychidae) in the eastern Gulf of Mexico. Bulletin of Marine Science 36(2):260-277.

Kruskal, J.B. 1964. Multidimensional scaling by optimizing goodness of fit to a nonmetric hypothesis. Psychometrika 29(1):1-27.

LGL Ecological Research Associates, Inc. 2009. Gulf of Mexico Cooling Water Intake Structure: Source Water Biological Baseline Characterization Study. Report to the Offshore Operators Committee, Environmental Sciences Subcommittee, Houston, TX. 142 pp. + app.

Lyczkowski-Shultz, J., D.S. Hanisko, and G.W. Ingram, Jr. 2004. The potential for incorporating a larval index of abundance for stock assessment of red snapper, *Lutjanus campechanus*. NOAA, NMFS, Report SEDAR7-DW-14. 10 pp.

McCartney, B.S. 1976. Comparison of the acoustic and biological sampling of the sonic scattering layers: R.R.S. 'Discovery' SOND Cruise, 1965. Journal of the Marine Biological Association of the United Kingdom 56(1):161-178.

McCune, B. and M.J. Mefford. 2006. Multivariate analysis of ecological data, version 5.31. MjM Software, Gleneden Beach, OR.

Minami, M., C.E. Lennert-Cody, W. Gao, and M. Román-Verdesoto. 2007. Modeling shark bycatch: The zero-inflated negative binomial regression model with smoothing. Fisheries Research 84(2):210-221.

Namiki, C., A.C. Teixeira Bonecker, and M. Salustiano de Castro. 2007. Occurrence and abundance of three larval codlet species (Bregmacerotidae, Teleostei) in the Southwest Atlantic Ocean (12-22°S). Journal of Applied Ichthyology 23(2):136-141.

Nelson, J.S. 2006. Fishes of the World. John Wiley and Sons, Inc., New York, NY. 601 pp.

Power, J.H. and E.B. Moser. 1999. Linear model analysis of net catch data using the negative binomial distribution. Canadian Journal of Fisheries and Aquatic Sciences 56(2):191-200.

Ross, S.W., A.M. Quattrini, A.Y. Roa-Varón, and J.P. McClain. 2010. Species composition and distributions of mesopelagic fishes over the slope of the north-central Gulf of Mexico. Deep Sea Research Part II 57(21-23):1,926-1,956.

SAS Institute Inc. 2008. SAS Online Doc, Version 9.2. Cary, NC.

Sanvicente-Añorve, L., C. Flores-Coto, and L. Sánchez-Velasco. 1998. Spatial and seasonal patterns of larval fish assemblages in the southern Gulf of Mexico. Bulletin of Marine Science 62(1):17-30.

Shepard, R.N. 1962. The analysis of proximities: multidimensional scaling with an unknown distance function, I and II. Psychometrika 27(2):125-139 and 219-246.

Shono, H. 2008. Application of the Tweedie distribution to zero-catch data in CPUE analysis. Fisheries Research 93(1-2):154-162.

Terceiro, M. 2003. The statistical properties of recreational catch rate data for some fish stocks of the northeast U.S. coast. Fishery Bulletin 101(3):653-672.

TORP. 2006. Bienville Offshore Energy Terminal, Topic Report 3: Biological resources. TORP Terminal LP. Houston, TX. Docket No. USCG-2006-24644. May 2006. Available at: http://dms.dot.gov.

U.S. Coast Guard and Maritime Administration. 2003. Final Environmental Impact Statement for the El Paso Energy Bridge Gulf of Mexico LLC Deepwater Port License Application. Docket No. USCG-2003-14294. November 2003. Available at: http://dms.dot.gov.

U.S. Coast Guard and Maritime Administration. 2004. Final Environmental Impact Statement for the Gulf Landing LLC Deepwater Port License Application. Appendix G (prepared by E^2M): Ichthyoplankton assessment model methodology and results. Docket No. USCG-2004-16860. November 2004. Available at: http://dms.dot.gov.

U.S. Coast Guard and Maritime Administration. 2005a. Appendix G (revised) to the Gulf Landing Final Environmental Impact Statement for the Gulf Landing LLC Deepwater Port License Application. Docket No. USCG-2004-16860-89. February 2005. Available at: http://dms.dot.gov.

U.S. Coast Guard and Maritime Administration. 2005b. Draft Environmental Impact Statement for the Pearl Crossing LLC Project and the Pearl Crossing LLC Pipeline Project. Docket No. USCG-2004-18474. February 2005. Available at: http://dms.dot.gov.

U.S. Coast Guard and Maritime Administration. 2005c. USCG Staff Internal Communication, January 21, 2005. Pending errata to the Gulf Landing Final EIS (USCG and MARAD 2004) presenting the content changes in Appendix G.

U.S. Coast Guard and Maritime Administration. 2006a. Final Environmental Impact Statement for the Compass Port LLC Deepwater Port License Application. Docket No. USCG-2004-17659. March 2006. Available at: http://dms.dot.gov.

U.S. Coast Guard and Maritime Administration. 2006b. Final Environmental Impact Statement for the Main Pass Energy Hub™ Deepwater Port License Application. Docket No. USCG-2004-17696. March 2006. Available at: http://dms.dot.gov.

U.S. Environmental Protection Agency. 2007. [FRL-8323-5] Notice of Final NPDES General Permit; Final NPDES General Permit for New and Existing Sources and New Dischargers in the Offshore Subcategory of the Oil and Gas Extraction Category for the Western Portion of the Outer Continental Shelf of the Gulf of Mexico (GMG290000). Federal Register 72(109):31,575-31,578. June 7, 2007. Effective date October 1, 2007. Available at: http://epa.gov/region6/water/npdes/genpermt/index.htm.

Vuckovich, F.M. and B.W. Crissman. 1986. Aspects of warm rings in the Gulf of Mexico. Journal of Geophysical Research: Oceans 91(C2):2,645-2,660.

APPENDICES

APPENDIX A

U.S. Environmental Protection Agency Permit Requirements

Table A-1. Permit requirements summation of the Entrainment Monitoring Study relative to the eight requirements by the U.S. Environmental Protection Agency (USEPA) (2007).

Requirement	Comment
Any industry-wide study conducted to meet the entrainment monitoring requirements in Section B.12 must be commenced within 2 years after the effective date of this permit or the installation of a new facility subject to the cooling water intake structure (CWIS) requirements of Part I.B.12, whichever is later. The industry-wide study must be completed 3 years after its commencement.	• Permit effective 10/1/2007 • USEPA approved Source Water Biological Baseline Characterization Study (SWBBCS) Plan 6/28/2008 • Contract for Baseline Study 8/25/2008 • USEPA approved SWBBCS Report 10/5/2009 • Industry presented Entrainment Monitoring Study (EMS) Plan to USEPA 10/14/2009 • USEPA approved EMS Plan 1/20/2010 • Contract with CSA Ocean Sciences Inc. executed 4/1/10 • Deepwater Horizon 4/10/2010 • Sampling initiated January 2011 • Final report of CWIS EMS submitted to USEPA December 2013
Beginning 2 years after the effective date of the permit or after commencement of operations, whichever is later, the operator must monitor for entrainment. The operator must collect samples to monitor entrainment rates (simple enumeration) for each species over a 24-hour period and no less than biweekly during the primary period of reproduction, larval recruitment, and peak abundance identified during the SWBBCS. Representative species may be utilized for this monitoring consistent with their use in the SWBBCS. The operator must collect samples only when the CWIS is in operation. After 24 months of monitoring, the permittee may request from USEPA a reduced monitoring frequency for the remainder of the permit.	• Permit effective 10/1/2007 • USEPA approved EMS Plan 1/20/2010 • Biweekly sampling initiated January 2011 • Combined with intake flow rates, tabulated densities provided the basis for enumerating entrained species • Ichthyoplankton densities were found to be greatest during the spring (March and April) and least during the fall (September to November) • Densities may be estimated from Southeast Area Monitoring and Assessment Program (SEAMAP) data based on an improved statistical model described in the report. This model directly models gradients along depth and longitude ranges, as opposed to the U.S. Coast Guard (USCG)/Maritime Administration (MARAD) polygon approach. Based on these results, SEAMAP can be used to estimate entrainment of ichthyoplankton, and the need for site-specific sampling is unnecessary
Alternatively, operators may comply with these requirements through participation in a USEPA approved industry-wide study. That study may include a smaller, statistically representative number of facilities. See also Section B.12.a of this permit. Any industry-wide study conducted to meet the entrainment monitoring requirements in Section B.12 must be commenced within 2 years after the effective date of this permit and must be completed and submitted to EPA Region 6 three years after the effective date.	• Permit effective 10/1/2007 • USEPA approved Baseline Study Plan to collect information necessary for design of entrainment study 6/28/2008 • USEPA approved Baseline Study Report 10/5/2009 • Industry presented EMS Plan to USEPA 10/14/2009 • USEPA approved an industry plan for a study of four Gulf of Mexico sites 1/20/2010 • Start of the sampling 1/10/2011 after being delayed by the Deepwater Horizon spill • Field sampling for the study completed 1/10/2013 • Final report of CWIS EMS submitted to USEPA December 2013

Table A-1. (Continued).

Requirement	Comment
A list of species (or relevant taxa) for all life stages and their relative abundance in the vicinity of the cooling water intake structure.	• The EMS reports larval densities by taxa and biological zone in **Appendix E** • The study goes beyond the requirement to enumerate representative taxa by providing densities for all identified taxa
Identification of the taxa and life stages that would be most susceptible to impingement and entrainment. Taxa evaluated should include the forage base as well as those most important to commercial and recreational fisheries.	• The densities of fish larvae identified to the lowest practicable identification level were reported in a table sorted from most to least numerous • Furthermore, densities of total larvae and the three most abundant families were statistically modeled to improve accuracy and precision for the most likely affected taxonomic groups
Identification and evaluation of the primary period of reproduction, larval recruitment, and period of peak abundance for relevant taxa.	• Ichthyoplankton densities were found to be greatest during the spring (March and April) and least during the fall (September to November)
Identification of all threatened, endangered, and other protected species that might be susceptible to impingement and entrainment at CWIS.	• These species were either absent during the 2 years of biweekly sampling or were collected so infrequently so as to preclude robust estimation with statistical models

APPENDIX B

Incident Reports

CSA INCIDENT/ACCIDENT NOTIFICATION FORM **Directions for filling out form**

Email within 24 hrs to – Lynwood Powell, CSA Stuart Office – lpowell@conshelf.com

Originators Reference No: ***OOC 2285/Task 4***		
Date of Incident: March 21st, 2011	**Time:** 19:04 h	**Exact Location**: Diana Hoover AC25 Block 26° 57.080N 94°40.998W Point where MOCNESS came up **Location of the incident/Project Group**
Name of Person(s) involved: ***N/A***		
Employing Company: ***CSA international***		
Type of Incident: ***Equipment damaged (MOCNESS 1)***		
Initial Potential Consequence: ***Mooring anchor buoys around Platform***		
Description of Incident:	Incident happened at Diana Hoover AC Block 25 on 3-21-2011 at 19:04 h. As the system was brought back to the surface during our regular Dusk Sampling Series we hit something in 170 m of water (Based on computer depth profile data). Stopped operations and assessed the situation before continuing bringing MOCNESS to the surface. After a few minutes it was agreed that was safe to keep retrieving the system and Josh Bolles (CSA) at the Winch was asked to bring system to the surface. Once it reached the surface noticed the MOCNESS was upside down. Immediately after was positioned on board the deck of the Will Bordelon and inspected for damage. Visibly one of its support legs was bent inward where the impact may have occurred. The bracket holding the Temp, Transmissivity and Fluorometer sensors was also bent a little bit, but no damaged to any of the sensors. Replaced damaged part.	

Provide details of the incident including:

- ***Incident occurred 19:04 h on March 21st, 2011.***
- ***order of events:MOCNESS in the water, reached sampling max depth of 300 m (according to computer data) closed net 0 and started retrieving MOC from this depth. Closed net 1 at 207 m and continued bringing net to the surface. At 170 m hit something bringing winch to an abrupt stop. Assessed situation and after a few minutes was decided that was safe to continue bringing system up. MOCNESS at the surface visibly upside down. Net 2 closed and Net 3 tripped (never opened during ascend). System out of the water and on board the Will Bordelon. On deck began inspection - noticed a visible bent on one of the support legs. Also, a bit of damaged (bent) on the bracket of the housing of theTemp, Transmissivity, Fluorometer sensors. Proceeded to replace leg support and moved to new location. Gunnison***
- ***Ernesto Calix, Josh Bolles (CSA); Phil Odegaards (Captain), James Akins (Captain); David Elliot(Deck hand) & Don Jackson (Engineer) (Will Bordelon)***
- ***E. Calix (Project Scientist); J. Bolles (Scientist)***
- ***any relevant information available at the time of reporting: Suspected Pressure Sensor on MOCNESS to be faulty and very likely net deeper than depth registered on computer.***
- ***medical/emergency response details: N/A***
- ***any other important information: Weather conditions during towing marginal with 15 to 20 kt winds and 4 to 5 ft seas with occasional 6 ft.***

Immediate Action:	Immediate remedial action and actions to prevent reoccurrence or escalation
In this section provide only immediate remedial actions (corrective) and actions TO PREVENT REOCCURRENCE. Do not include medical response into this section	
Remedial Actions: ***Provide long term remedial actions (if identified at the stage of reporting). For the incidents requiring further investigation do not include remedial actions. Those will have to be reported as a part of a final investigation report***	

Name: R. Ernesto Calix **Title: Project Scientist 2** **Date: 3-30-2011**

Signature:

CSA INCIDENT/ACCIDENT NOTIFICATION FORM

Email within 24 hrs to – Lynwood Powell, CSA Stuart Office – lpowell@conshelf.com

Originators Reference No: 2285-OOC		
Date of Incident: April 18, 2011	**Time:** 18:06 h	**Exact Location**: ~100 -150 m S of 28° 05.266N; 87° 59.152W **Location of the incident/Project Group** Independence Hub/OOC
Name of Person(s) involved: N/A		
Employing Company: N/A		
Type of Incident: Damaged Equipment (MOCNESS)		
Initial Potential Consequence: Boat drifted too close to platform during our Dusk Sampling Series at Independence Hub.		

Description of Incident: On April 18th, 2011 at 18:06 h ten minutes into our Dusk Tow Series at Independence Hub MC920) 28° 05.266 N/-87°59.152W the boat drifted and entered within the 500 m buffer zone. When I observed that the vessel was too close to the platform (~100 to150 m), I called Josh Bolles (CSA) over the radio at the winch and ordered him to abort the tow and bring the net up from its 263 m actual depth immediately. The boat continued with its initial speed of 1.5 to 2.0 knots and NW heading, passing approximately 100 to 150 m from the platform on the south side. After several minutes into its retrieval, the MOCNESS system struck something at a 100 m depth (based on MOCNESS computer data and profile), bringing its ascend to a sudden stop. I immediately asked the Captain of the Will Bordelon (Cedric Scott) to stop the vessel to assess the situation before continuing retrieving the system. Once it was determined that it was safe to keep bringing the system up, the MOCNESS was retrieved to the surface. Only Net 0 had been opened, and all sensors were functioning and recording data all the way to the surface - even the damaged ones. At the surface, the damage to the MOCNESS was assessed. The two leg supports were visibly bent inward, the flowmeter dangling with broken bracket, and the step motor suspended in the air detached from its support end. The damaged parts were replaced, and we continued with scheduled dusk sampling series.

- Weather conditions: 5 to 10 k winds, 1 kt current and 3 ft swell.
- CSA personnel – Ernesto Calix (Project Scientist) Josh Bolles (Technician)
- Will Bordelon personnel – Cedric Scott (Captain); David Elliot (deck hand); Stefan Plaisance (deck hand)
- Cause of the incident – Nothing obvious that may have caused the ship to get that close to the platform.
- No medical/emergency required.

Immediate Action: Keep crew more alert of surroundings during each tow. Steer away from the platform if starting to enter the 500-m buffer zone

Remedial Actions:

1. The Captain will meet with the on board CSA representative to complete a full JSA (Job Safety Analysis) for the project.
2. BMI will host a safety and policy meeting on the vessel and prior to the next cruise date to verify everyone's understanding of the rules and protocols.
3. CSA will install its Hypack computer navigation system on an onboard computer, and a separate GPS will be interfaced to the navigation computer. A real-time display will be provided on the bridge for the Captain and for the CSA Field Lead. The real-time display will show a 500-m buffer zone around each platform and the location of the vessel relative to the buffer zone.
4. Captain will plot a vessel course to remain at least 500 m from any structure, and the Captain will utilize the proximity warning feature from the vessel's radar units to assure this distance.

Name: R. Ernesto Calix Title: Project Scientist Date: April 21, 2011

Signature:

INCIDENT/ACCIDENT NOTIFICATION FORM

Email within 24 hrs to – Lynwood Powell, CSA Stuart Office – lpowell@conshelf.com

Originators Reference No: 2285-OOC		
Date of Incident: June 12, 2011	**Time:** 18:43 h	**Location**: Diana Hoover - AC25 Block 1st Dusk Tow Start 26°55.8455 N; 94°41.8747 W End 26°57.0708 N; 94°41.3641 W **Location of the incident/Project Group** Diana Hoover
Name of Person(s) involved: N/A		
Employing Company: N/A		
Type of Incident: Damaged Equipment (MOCNESS)		
Initial Potential Consequence: None observed.		
Description of Incident: The incident occurred at Diana Hoover (AC Block 25) on June 12, 2011 at ~18:43 h as the system was brought back from the 299-m maximum depth mark during the first regular dusk sampling tow. Net 0 had been closed at the maximum depth, and Net 1 was opened and fishing. As the net was being towed, a severe change in the angle of the net was observed on computer screen at 229 m (based on computer depth data profile). The angle of the net went from the 33-35° to 89° in a split second then returned to 35° where it remained for the duration of the tow. Immediately after making this observation, Ernesto Calix (Field Team Leader, who was monitoring the computer screen) radioed Josh Bolles (Field Team Operations, who was operating the winch) and asked if Josh had observed anything unusual at the winch or cable. Josh responded that he had not observed anything unusual. Based on that assessment, the tow was continued, and the net system was fished per the sampling protocol to the surface. When the net system arrived at the surface, damage was clearly evident. One leg support was bent inward, and two nets were ripped at the distal end. One cod end was missing and the other cod end was dangling from the remains of one of the ripped nets. During the tow, the vessel was at least 643 meters from the platform, maintaining the required buffer distance of 500m. The speed of the boat was about 2.5 knots at a heading of 45°N. The tow took four minutes longer to complete because cable was paid out slower at the beginning. The MOCNESS was repaired, but the remainder of the day's sampling was cancelled because the sampling window for the dusk period had passed. The underwater unit was changed out with the spare because it was not known how the incident affected its calibration. The unit will need to be returned to the manufacturer for recalibration. Samples for the tow were discarded.		
Will Bordelon - Cedric Scott (Captain); Phil Odegaards (Captain), Nick Breaux(Deck hand); Brent marcel (Engineer); Jeromie Smith (Deck hand) CSA - Ernesto Calix (Field Team Lead, Project Scientist); Josh Bolles (Operations Technician) No medical incidents to report Recalibrate underwater unit on MOCNESS will be required		
Immediate Action: Adopt a radial tow pattern directed away from the three platforms that have anchor chains emanating from the platform. These platforms are Diana Hoover, Gunnison, and Independence Hub. Maintain all safety measures currently in place including Hypack system and radar alert to insure the vessel does not encroach within the 500 m buffer during a tow.		
Remedial Actions: Investigate the incident to determine potential causes of the incident and additional remedial actions that are required to avoid additional incidents.		

Name: R. Ernesto Calix Title: Project Scientist Date: June 29, 2011

Signature: _____

APPENDIX C

Taxonomic Summaries

Table C-1. Observed arithmetic mean count per unit effort (CPUE) for larval fish (individuals/m^3) identified to the lowest possible taxonomic level in the SEAMAP (1982 to 2008) and CWIS (2011 to 2012) databases for each biological zone (CWIS station identifiers are given in the left column for each zone). Taxon highlighted with red boxes indicate commercially important species that were converted to spawning female equivalents as per Gallaway et al. (2007) during the SWBBCS (LGL Ecological Research Associates, Inc., 2009), which used SEAMAP data (1982 to 2004) only. Blank cells indicate that the taxon was not observed in the SEAMAP database or CWIS tows.

Order	Common Names	Taxon	W4		W5		C4		C5	
			GB668	SEAMAP	AC25	SEAMAP	VK989	SEAMAP	MC920	SEAMAP
AMPHIOXIFORMES	Lancelets									
	Lancelets	Branchiostomatidae								<0.00005
ELOPIFORMES	Tarpons and ladyfishes									
	Ladyfishes	Elopidae			<0.00005		0.0001	0.0001		<0.00005
	Ladyfish	*Elops saurus*			<0.00005					
	Tarpon	*Megalops atlanticus*			<0.00005		<0.00005			
ALBULIFORMES	Bonefishes									
	Bonefishes	Albulidae								<0.00005
	Bonefish	*Albula vulpes*			<0.00005					
	Halosaurs	Notacanthoidei								<0.00005
ANGUILLIFORMES	Eels									
	Freshwater eels	Anguilliformes		0.0012	<0.00005	0.0004	0.0022	0.0062	0.0004	0.0002
	Freshwater eels	Anguillidae								<0.00005
	Spaghetti eels	Moringuidae		0.0001	0.0001	<0.00005	<0.00005	0.0006		0.0001
	Spaghetti eels	*Neoconger* sp.					<0.00005			
	Ridged eel	*Neoconger mucronatus*					0.0002			
	False Moray eels	Chlopsidae							0.0001	
	Moray eels	Muraenidae	0.0004	0.0002	0.0005	<0.00005	0.0010	0.0002	0.0003	0.0001
	Moray eels	*Gymnothorax* sp.				<0.00005				
	Snake eels and worm eels	Ophichthidae	0.0001	0.0019	0.0004	0.0005	0.0004	0.0044		0.0003
	Key worm eel	*Ahlia egmontis*						<0.00005		
	Academy eel	*Apterichtus ansp*						<0.00005		<0.00005
	Blotched snake eel	*Callechelys muraena*				<0.00005		<0.00005		<0.00005
	Indifferent eel	*Ethadophis akkistikos*						<0.00005		
	Snake eels	*Letharchus aliculatus*								<0.00005
	Worm eels	*Myrichthys* sp.								<0.00005
	Worm eels	Myrophinae						0.0001		<0.00005
	Worm eels	*Myrophis* sp.			<0.00005					
	Snake eels	*Ophichthini* sp.	<0.00005		<0.00005		0.0001		<0.00005	
	Tusky eel	*Aplatophis chauliodus*		0.0001		<0.00005		<0.00005		<0.00005

Table C-1. (Continued).

Order	Common Names	Taxon	W4		W5		C4		C5	
			GB668	SEAMAP	AC25	SEAMAP	VK989	SEAMAP	MC920	SEAMAP
	Snake eels	*Ophichthus* sp.	0.0001	0.0001	0.0002	<0.00005	0.0001		<0.00005	<0.00005
	Margined snake eel	*Ophichthus cruentifer*			<0.00005		<0.00005			
	Shrimp eel	*Ophichthus gomesii*		0.0005	<0.00005	0.0001	0.0001	0.0007		<0.00005
	Blackpored eel	*Ophichthus melanoporus*						<0.00005		
	Palespotted eel	*Ophichthus puncticeps*						<0.00005		<0.00005
	King snake eel	*Ophichthus rex*		0.0001				<0.00005		<0.00005
	Antillean snake eel	*Ophichthus spinicauda*		<0.00005						
	Short-maned sand eel	*Phaenomonas longissimus*						<0.00005		
	Worm eels	*Pseudomyrophis* sp.		<0.00005				<0.00005		<0.00005
	Diminutive worm eel	*Pseudomyrophis fugesae*				<0.00005		0.0001		<0.00005
	Snake eel	*Pseudomyrophis nimius*						<0.00005		
	Pike-conger eels	Muraenesocidae		0.0001		<0.00005		<0.00005	<0.00005	<0.00005
	Snipe eels	Nemichthyidae		<0.00005	<0.00005	0.0001		0.0001		<0.00005
	Conger eels and garden eels	Congridae	0.0009	0.0028	0.0012	0.0016	0.0029	0.0055	0.0004	0.0010
	Bandtooth conger	*Ariosoma balearicum*			<0.00005			<0.00005		<0.00005
	Conger eels	*Ariosoma selenops*					<0.00005			
	Garden eels	*Heteroconger* sp.					0.0001			
	Speckled worm-eel	*Myrophis punctatus*		0.0003		0.0002		0.0010		0.0002
	Conger eels	*Rhynchoconger* sp.						<0.00005		
	Cutthroat eels	Synaphobranchidae		0.0001		0.0002		<0.00005	<0.00005	<0.00005
	Arrowtooth eels	Ilyiophinae		<0.00005		<0.00005		<0.00005		<0.00005
	Arrowtooth eels and mustard eels	Ilyophinae						<0.00005		
	Cutthroat eels	*Ilyophis* sp.		<0.00005						
	Conger eels	*Conger* sp.	<0.00005							
	Arrowtooth eels	*Dysomma* sp.			<0.00005					
	Arrowtooth eels	*Dysommina* sp.				0.0001		<0.00005		<0.00005
	Shortbelly eel	*Dysomma anguillare*	0.0002		0.0002	<0.00005	0.0001		<0.00005	<0.00005
	Duckbill eels	Nettastomatidae	0.0009	0.0010	0.0014	0.0009	0.0020	0.0023	0.0004	0.0005
	Duckbill eels	*Hoplunnis* sp.								<0.00005
	Spotted pike-conger	*Hoplunnis tenuis*			<0.00005					
	Duckbill eels	*Nettastoma* sp.	0.0001		<0.00005		0.0001		<0.00005	
	Duckbill eels	*Nettastoma melanurum*					<0.00005			<0.00005
	Duckbill eels	*Saurenchelys* sp.					0.0001			
	Longface eel	*Saurenchelys cognita*					0.0001			

Table C-1. (Continued).

Order	Common Names	Taxon	W4		W5		C4		C5	
			GB668	SEAMAP	AC25	SEAMAP	VK989	SEAMAP	MC920	SEAMAP
SACCOPHARYNGIFORMES	Gulper eels									
	Swallower eels and gulper eels	Saccopharyngidae	<0.00005							
CLUPEIFORMES	Herrings and anchovies									
	Herrings	Clupeiformes	0.0001	0.0001	0.0001	0.0001	0.0003	0.0020	0.0002	0.0001
	Anchovies	Engraulidae	0.0005	0.0142	0.0006	0.0105	0.0008	0.0584	0.0002	0.0033
	Anchovies	*Anchoa* sp.	0.0003	0.0006	0.0003		0.0005	0.0016	0.0001	
	Broad-striped anchovy	*Anchoa hepsetus*	0.0001				0.0009			
	Longnose anchovy	*Anchoa nasuta*	<0.00005							
	Silver anchovy	*Engraulis eurystole*	0.0003	0.0001	0.0006	<0.00005	0.0016	<0.00005	0.0003	
	Herrings, pilchards, sardines	Clupeidae	0.0001	0.0001	<0.00005	<0.00005	0.0001	0.0048	0.0002	0.0001
	Menhadens	*Brevoortia* sp.		<0.00005			0.0003	0.0086		0.0014
	Gulf menhaden	*Brevoortia patronus*					0.0179			
	Atlantic menhaden	*Brevoortia tyrannus*								<0.00005
	Herrings	*Etrumeus* sp.						<0.00005		
	Round herring	*Etrumeus teres*		<0.00005		0.0001	0.0001	0.0005	<0.00005	0.0001
	Scaled herring	*Harengula jaguana*		0.0025		0.0002	<0.00005	0.0006	0.0001	0.0001
	Thread herrings	*Opisthonema* sp.					0.0001			
	Atlantic thread herring	*Opisthonema oglinum*	0.0002	0.0011	0.0002		0.0326	0.0023	0.0004	0.0001
	Spanish sardine	*Sardinella aurita*		0.0001				0.0003		0.0007
	Brazilian sardinella	*Sardinella brasiliensis*					0.0001			
	Minnows and carps	*Elopichthys* sp.	<0.00005							
ARGENTINIFORMES	Argentines, deepsea smelts, and spookfishes									
	Argentines, deepsea smelts, and spookfishes	Argentinoidei	0.0004	0.0001	0.0002	0.0001	0.0001	0.0001	0.0002	0.0001
	Argentines	Argentinidae	0.0002	0.0004	0.0002	0.0003	0.0003	0.0003	0.0002	0.0004
	Argentines	*Argentina* sp.					<0.00005			<0.00005
	Greater argentine	*Argentina silus*			<0.00005					
	Deepsea smelts	Microstomatidae	<0.00005		0.0001		0.0001			
	Deepsea smelts	*Microstoma* sp.		<0.00005		<0.00005				<0.00005
	Deepsea smelts	*Microstoma microstoma*	0.0001			<0.00005	0.0001		<0.00005	<0.00005
	Spookfishes	Opisthoproctidae	<0.00005		0.0001		<0.00005			
	Spookfishes	*Bathylychnops* sp.			<0.00005		0.0001			
	Brownsnout spookfish	*Dolichopteryx longipes*			0.0001		<0.00005		<0.00005	
	Deepsea smelts	Bathylagidae	0.0002	0.0007	0.0002	0.0011	0.0003	0.0009	0.0001	0.0013
	Deepsea smelts	Bathylaginae	0.0004		0.0002		0.0008		0.0004	

Table C-1. (Continued).

Order	Common Names	Taxon	W4		W5		C4		C5	
			GB668	SEAMAP	AC25	SEAMAP	VK989	SEAMAP	MC920	SEAMAP
	Deepsea smelts	*Bathylagoides* sp.			<0.00005		0.0001		<0.00005	
	Deepsea smelts	*Bathylagus* sp.	0.0001	0.0002	0.0003	0.0002	0.0001	0.0002	0.0001	0.0002
	Grey's deepsea smelt	*Bathylagichthys greyae*	<0.00005				<0.00005			
	Goiter blacksmelt	*Bathylagus euryops*	0.0001		0.0001		0.0001		0.0001	
	Deepsea smelts	*Bathylagus longirostris*								<0.00005
	Longsnout blacksmelt	*Dolicholagus longirostris*	0.0012		0.0014		0.0014		0.0018	
	Bigscale deepsea smelt	*Melanolagus bericoides*	0.0001		<0.00005		0.0001		0.0002	
	Barreleyes	Opisthoproctidae								
	Barreleyes	*Dolichopteryx* sp.					<0.00005			
SALMONIFORMES	Salmons and smelts									
	Smelts	Salmoniformes		0.0006		0.0010		0.0004		0.0009
STOMIIFORMES	Dragonfishes, bristlemouths, hatchetfishes, and viperfishes									
	Dragonfishes	Stomiiformes	0.0001	0.0001	0.0004			<0.00005	<0.00005	<0.00005
	Bristlemouths	Gonostomatidae	0.0189	0.0315	0.0133	0.0349	0.0171	0.0475	0.0175	0.0313
	Bristlemouths	*Bonapartia* sp.						<0.00005		<0.00005
	Bristlemouths	*Bonapartia pedaliota*			<0.00005	0.0001	<0.00005			0.0003
	Bristlemouths	*Cyclothone* sp.	0.0006	0.0160	0.0006	0.0252	0.0006	0.0124	0.0021	0.0216
	Benttooth bristlemouth	*Cyclothone acclinidens*	0.0001		<0.00005					
	Bristlemouths	*Diplophos* sp.		<0.00005				<0.00005		
	Bristlemouths	*Diplophos taenia*		0.0001	0.0001	0.0001	<0.00005	<0.00005	<0.00005	<0.00005
	Bristlemouths	*Gonostoma* sp.	0.0001	0.0013	0.0007	0.0027	0.0001	0.0010	<0.00005	0.0012
	Atlantic fangjaw	*Gonostoma atlanticum*	0.0005	<0.00005	0.0003	<0.00005	0.0005	<0.00005	0.0009	<0.00005
	Spark anglemouth	*Gonostoma bathyphilum*							<0.00005	
	Elongated bristlemouth	*Gonostoma elongatum*	0.0001		<0.00005		0.0001		0.0001	0.0001
	Lightfishes	*Margrethia* sp.	0.0001	<0.00005	<0.00005		<0.00005	<0.00005		<0.00005
	Bighead portholefish	*Margrethia obtusirostra*	0.0001	<0.00005	0.0002	0.0001	<0.00005	0.0001	<0.00005	<0.00005
	Lightfishes	*Sigmops* sp.			<0.00005		0.0002		<0.00005	
	Hatchetfishes	Sternoptychidae	0.0287	0.0078	0.0310	0.0114	0.0274	0.0070	0.0238	0.0080
	Hatchetfishes	*Argyropelecus* sp.	0.0013	0.0001	0.0014	<0.00005	0.0017	0.0001	0.0012	<0.00005
	Lovely hatchetfish	*Argyropelecus aculeatus*						<0.00005	<0.00005	<0.00005
	Pacific hatchetfish	*Argyropelecus affinis*	0.0002		0.0004		0.0001		0.0002	
	Hatchetfishes	*Argyropelecus amabilis*								<0.00005
	Half-naked hatchetfish	*Argyropelecus hemigymnus*			<0.00005		0.0001		0.0002	<0.00005
	Sladen's hatchetfish	*Argyropelecus sladeni*			0.0001		0.0003		0.0002	
	Hatchetfishes	*Maurolicus* sp.								<0.00005

Table C-1. (Continued).

Order	Common Names	Taxon	W4		W5		C4		C5	
			GB668	SEAMAP	AC25	SEAMAP	VK989	SEAMAP	MC920	SEAMAP
	Hatchetfishes	*Polyipnus laternatus*							<0.00005	
	Hatchetfishes	*Polyipnus* sp.	0.0003		0.0002		0.0007		0.0007	<0.00005
	Round hatchetfish	*Polyipnus polli*					0.0001		0.0001	
	Hatchetfishes	*Sternoptyx* sp.	0.0009	0.0003	0.0008	0.0005	0.0008	0.0004	0.0015	0.0009
	Highlight hatchetfish	*Sternoptyx pseudobscura*							<0.00005	
	Hatchetfishes	Maurolicinae	0.0001		0.0004		0.0003		0.0002	
	Hatchetfishes	*Argyripnus* sp.					0.0001			<0.00005
	Hatchetfishes	*Argyripnus atlanticus*					0.0001			<0.00005
	Atlantic pearlside	*Maurolicus weitzmani*	0.0006		0.0003		0.0007		0.0006	
	Hatchetfishes	*Valenciennellus* sp.	0.0001		0.0002		<0.00005		0.0001	<0.00005
	Hatchetfishes	*Valenciennellus tripunctulatus*	0.0032	<0.00005	0.0032	<0.00005	0.0037	<0.00005	0.0034	0.0001
	Lightfishes	Phosichthyidae	0.0039	<0.00005	0.0043		0.0025	0.0001	0.0028	<0.00005
	Lightfishes	*Ichthyococcus* sp.								<0.00005
	Lightfish	*Ichthyococcus ovatus*	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005		<0.00005
	Lightfishes	*Pollichthys* sp.	0.0001			<0.00005				
	Stareye lightfish	*Pollichthys mauli*	<0.00005	0.0002		0.0002	<0.00005	0.0005		0.0009
	Lightfishes	*Vinciguerria* sp.	0.0033	0.0042	0.0023	0.0056	0.0024	0.0038	0.0035	0.0054
	Lightfishes	*Woodsia* sp.				<0.00005				<0.00005
	Slender Lightfish	*Vinciguerria attenuata*	0.0001	0.0028	0.0002	0.0032	0.0001	0.0018	0.0003	0.0026
	Oceanic lightfish	*Vinciguerria nimbaria*	0.0002	0.0017	0.0001	0.0018	0.0003	0.0018	0.0003	0.0033
	Power's deepwater bristlemouth fish	*Vinciguerria poweriae*	0.0012	0.0003	0.0012	0.0008	0.0010	0.0004	0.0006	0.0005
	Lighfishes	*Yarella blackfordi*								<0.00005
	Bigeye lightfish	*Woodsia nonsuchae*	0.0001				<0.00005		0.0003	
	Viperfishes	Chauliodontidae	0.0006	0.0001	0.0006	0.0002	0.0015	0.0002	0.0012	0.0003
	Dana viperfish	*Chauliodus danae*	0.0001	0.0008	0.0003	0.0006	0.0005	0.0003	0.0004	0.0004
	Sloane's viperfish	*Chauliodus sloani*	0.0001	0.0002	0.0001	0.0001	0.0001	0.0003	<0.00005	0.0002
	Viperfishes, dragonfishes, snaggletooths, loosejaws	Stomiidae	<0.00005	0.0001		0.0001	0.0001	0.0001	0.0004	0.0003
	Dragonfish	*Bathophilus* sp.			0.0001	<0.00005	<0.00005		0.0001	<0.00005
	Highfin dragonfish	*Bathophilus flemingi*	<0.00005						<0.00005	
	Scaleless dragonfish	*Bathophilus nigerrimus*								<0.00005
	Viperfishes	*Chauliodus* sp.	0.0003	0.0002	0.0001	0.0005	0.0003	0.0002	0.0004	0.0003
	Dragonfishes	Melanostominae		0.0003		0.0003		0.0004		0.0004
	Dragonfishes	*Eustomias* sp.	0.0002		<0.00005	0.0001	0.0001		0.0001	0.0001
	Dragonfishes	*Leptostomias* sp.			<0.00005					
	Boafish, dragonfish	*Stomias* sp.		<0.00005	0.0001		<0.00005	<0.00005	0.0001	<0.00005

Table C-1. (Continued).

Order	Common Names	Taxon	W4		W5		C4		C5	
			GB668	SEAMAP	AC25	SEAMAP	VK989	SEAMAP	MC920	SEAMAP
	Boa dragonfish	*Stomias boa*								<0.00005
	Boafish, dragonfish	*Stomias ferox*							<0.00005	
	Loosejaws	Malacosteinae	<0.00005		<0.00005	0.0001		<0.00005		0.0001
	Dragonfish	*Aristostomias* sp.			<0.00005		<0.00005			
	Stareaters and snaggletooths	Astronesthinae	0.0002	0.0001	<0.00005	0.0001	0.0001	<0.00005	0.0001	0.0001
	Stareaters and snaggletooths	*Astronesthes* sp.	0.0002		<0.00005		0.0001		0.0002	
	Loosejaws	*Photonectes* sp.	0.0001							
	Loosejaws	*Photostomias* sp.			<0.00005		<0.00005			<0.00005
	Loosejaws	*Photostomias guernei*								<0.00005
	Black dragonfishes	Idiacanthinae		<0.00005		<0.00005				<0.00005
	Dragonfishes	Melanostomiidae	0.0002	0.0001	0.0001	0.0001	0.0004	0.0001	0.0004	0.0003
	Dragonfishes	*Melanostomias* sp.	<0.00005	0.0001	0.0001	0.0001	<0.00005	0.0001	0.0001	0.0002
	Black dragonfishes	Idiacanthidae				<0.00005				<0.00005
	Ribbon sawtail fish	*Idiacanthus fasciola*	0.0001		<0.00005	<0.00005	<0.00005			<0.00005
AULOPIFORMES	Flagfins, greeneyes, pearleyes, lizardishes, barracudinas, daggertooths, and lancetfishes									
	Flagfins	Aulopidae					<0.00005	<0.00005		
	Flagfins	*Aulopus* sp.	<0.00005	<0.00005	0.0001	<0.00005	0.0002	<0.00005	<0.00005	<0.00005
	Flagfin	*Aulopus nanae*			<0.00005		0.0001		0.0001	
	Lizardfishes	Synodontidae	<0.00005	0.0113	0.0005	0.0045	0.0002	0.0206	0.0001	0.0020
	Lizardfishes	*Saurida* sp.			0.0018					
	Largescale lizardfish	*Saurida brasiliensis*			0.0049		0.0001		0.0002	
	Lizardfishes	*Synodus* sp.	0.0001		0.0009		0.0001		<0.00005	
	Inshore lizardfish	*Synodus foetens*	0.0002	0.0001	0.0003			0.0001	0.0001	<0.00005
	Diamond lizardfish	*Synodus synodus*	<0.00005							
	Snakefish	*Trachinocephalus myops*					0.0001		0.0003	
	Waryfishes	Notosudidae				<0.00005		<0.00005		<0.00005
	Waryfishes	*Ahliesaurus berryi*	0.0001							
	Greeneyes	Chlorophthalmidae	0.0002	0.0001	0.0005	<0.00005	<0.00005	0.0001	0.0001	0.0001
	Greeneyes	*Chlorophthalmus* sp.	0.0001		<0.00005		<0.00005		<0.00005	
	Shortnose greeneye	*Chlorophthalmus agassizi*	0.0004	0.0004	0.0002	<0.00005	0.0001	0.0002	0.0002	0.0002
	Longnose greeneye	*Parasudis truculenta*	0.0002		0.0001				0.0001	
	Blind lizardfishes	Ipnopidae			0.0001					
	Tripodfishes	*Bathypterois* sp.								<0.00005
	Marion's spiderfish	*Bathytyphlops marionae*					<0.00005			

Table C-1. (Continued).

Order	Common Names	Taxon	W4		W5		C4		C5	
			GB668	SEAMAP	AC25	SEAMAP	VK989	SEAMAP	MC920	SEAMAP
	Waryfishes	Notosudidae	<0.00005			0.0001		<0.00005	<0.00005	<0.00005
	Lancetfishes	*Scopelosaurus* sp.	<0.00005	<0.00005	<0.00005		<0.00005		<0.00005	
	Maul's waryfish	*Scopelosaurus mauli*				<0.00005	<0.00005		<0.00005	
	Grinners, lizardfishes	*Scopelosaurus smithii*			<0.00005			<0.00005		
	Lancetfishes	Alepisauridae		0.0001	<0.00005	0.0002		<0.00005		<0.00005
	Lancetfishes	*Alepisaurus* sp.		<0.00005	<0.00005	<0.00005		<0.00005		<0.00005
	Long-snouted lancetfish	*Alepisaurus ferox*	<0.00005				<0.00005			
	Omosudid	*Omosudis* sp.		0.0001						
	Omosudid	*Omosudis lowei*	0.0001				<0.00005			<0.00005
	Sabertooth fishes	Evermannellidae		0.0002		0.0008	<0.00005	0.0002	<0.00005	0.0006
	Atlantic sabretooth	*Coccorella atlantica*					<0.00005			
	Lancetfishes	*Evermannella* sp.	0.0001				0.0001		<0.00005	<0.00005
	Balbo sabretooth	*Evermannella balbo*	0.0001				<0.00005		0.0001	
	Indian sabretooth	*Evermannella melanoderma*	<0.00005						<0.00005	
	Undistinguished sabretooth	*Odontostomops normalops*							<0.00005	
	Barracudinas	Paralepididae	0.0058	0.0072	0.0063	0.0092	0.0065	0.0080	0.0050	0.0076
	White barracudina, spotted barracudina	*Arctozenus risso*								<0.00005
	Barracudinas	*Lestidiops* sp.	0.0001		0.0001		0.0001	<0.00005	0.0001	<0.00005
	Barracudinas	*Lestidium* sp.			0.0003		<0.00005		0.0001	<0.00005
	Barracudinas	*Lestrolepis* sp.	0.0004		0.0003		0.0014		0.0001	
	Barracudinas	*Macroparalepis* sp.	0.0001		<0.00005		0.0001		0.0001	
	Barracudinas	*Paralepis* sp.	<0.00005				<0.00005	<0.00005	<0.00005	<0.00005
	Barracudinas	*Stemonosudis* sp.								<0.00005
	Barracudinas	*Sudis* sp.	0.0001	0.0001	0.0001	0.0005	0.0001	0.0001	0.0001	0.0004
	Barracudinas	*Uncisudis* sp.	0.0001		<0.00005				<0.00005	
	Barracudinas	*Lestidiops affinis*	<0.00005		0.0001		0.0002		0.0001	
	Pacific barrcudina	*Lestidiops jayakari*			0.0001		<0.00005			
	Barracudinas	*Lestidiops mirabilis*			<0.00005					
	Atlantic barracudina	*Lestidium atlanticum*	0.0001	<0.00005	0.0003	<0.00005	0.0001	0.0001	0.0002	<0.00005
	Barracudinas	*Lestrolepis intermedia*	0.0001		0.0004		0.0002		0.0002	
	Barracudinas	*Macroparalepis affinis*	<0.00005		<0.00005		<0.00005			
	Duckbill barracudina	*Paralepis atlantica*								<0.00005
	Barracudinas	*Paralepis brevirostris*	<0.00005							
	Barracudinas	*Stemonosudis bullisi*					<0.00005			
	Rothschild's barrcudina	*Stemonosudis rothschildi*					<0.00005			

Table C-1. (Continued).

Order	Common Names	Taxon	W4		W5		C4		C5	
			GB668	SEAMAP	AC25	SEAMAP	VK989	SEAMAP	MC920	SEAMAP
	Barracudinas	*Sudis atrox*	0.0005		0.0003		0.0001		0.0001	
	Barracudinas	*Sudis hyalina*	0.0001	0.0001	0.0001	0.0001	0.0002	0.0001	0.0002	0.0001
	Barracudinas	*Uncisudis advena*					<0.00005		0.0001	
	Barracudinas	*Uncisudis quadrimaculata*	<0.00005						<0.00005	
	Pearleyes	Scopelarchidae	0.0003	0.0019	0.0012	0.0032	0.0002	0.0023	0.0003	0.0029
	Pearleyes	*Scopelarchus* sp.	0.0002		0.0005		0.0003	<0.00005	0.0003	<0.00005
	Zugmayer's pearleye	*Benthalbella infans*							<0.00005	<0.00005
	Pearlside	*Maurolicus muelleri*		0.0095		0.0057		0.0141		0.0075
	Dana pearleye	*Scopelarchoides danae*							<0.00005	
	Short fin pearleye	*Scopelarchus analis*	0.0003		0.0003		0.0002		0.0002	
	Staring pearleye	*Scopelarchus guentheri*	0.0001		<0.00005				<0.00005	<0.00005
	Bigfin pearleye	*Scopelarchus michaelsarsi*					<0.00005			
	Bathysaurids	Bathysauridae			<0.00005				<0.00005	
	Bathysaurus	*Bathysaurus* sp.	0.0001		<0.00005		<0.00005			
	Highfin lizardfish	*Bathysaurus mollis*	0.0003		0.0001				<0.00005	
	Telescopefishes	Giganturidae								<0.00005
	Telescopefishes	*Gigantura* sp.					<0.00005			
	Telescopefish	*Gigantura indica*	<0.00005							<0.00005
MYCTOPHIFORMES	Lanternfishes									
	Lanternfishes	Myctophiformes		0.0003		0.0002		0.0003		0.0003
	Lanternfishes	Damaged Myctophidae	<0.00005		0.0005				0.0004	
	Lanternfishes	Myctophidae	0.0780	0.0516	0.0818	0.0523	0.0737	0.0439	0.0949	0.0508
	Lanternfishes	*Benthosema* sp.		0.0100	<0.00005	0.0155	0.0001	0.0083	0.0004	0.0134
	Lanternfishes	*Centrobranchus* sp.	0.0001			0.0001	<0.00005	0.0001	0.0001	0.0001
	Lanternfishes	*Ceratoscopelus* sp.	0.0043	0.0026	0.0016	0.0047	0.0024	0.0036	0.0038	0.0065
	Lanternfishes	*Diogenichthys* sp.	0.0001	<0.00005		0.0001		0.0001		0.0001
	Lanternfishes	*Gonichthys* sp.						<0.00005		0.0001
	Lanternfishes	*Hygophum* sp.	0.0023	0.0162	0.0018	0.0165	0.0055	0.0122	0.0040	0.0276
	Lanternfishes	*Myctophum* sp.	0.0049	0.0071	0.0037	0.0072	0.0062	0.0080	0.0033	0.0188
	Lanternfishes	*Symbolophorus* sp.		0.0001		0.0002		<0.00005		<0.00005
	Lanternfishes	*Bolinichthys* sp.		<0.00005		<0.00005		<0.00005		<0.00005
	Lanternfishes	*Ceratoscopelus* sp.	0.0043	0.0026	0.0016	0.0047	0.0024	0.0036	0.0038	0.0065
	Lanternfishes	*Diaphus* sp.	0.0054	0.0377	0.0059	0.0315	0.0097	0.0522	0.0052	0.0530
	Lanternfishes	*Lampadena* sp.	0.0007	0.0002	0.0007	0.0003	0.0003	0.0003	0.0004	0.0002
	Lanternfishes	*Lampadena urophaos atlantica*					<0.00005			

Table C-1. (Continued).

Order	Common Names	Taxon	W4		W5		C4		C5	
			GB668	SEAMAP	AC25	SEAMAP	VK989	SEAMAP	MC920	SEAMAP
	Lanternfishes	*Lampanyctus* sp.	0.0010	0.0043	0.0018	0.0051	0.0018	0.0039	0.0021	0.0062
	Lanternfishes	*Lepidophanes* sp.			<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.0001
	Lanternfishes	*Lobianchia* sp.		0.0001	<0.00005	0.0002	<0.00005	0.0001		0.0002
	Lanternfishes	*Myctophum* sp.	0.0049	0.0071	0.0037	0.0072	0.0062	0.0080	0.0033	0.0188
	Lanternfishes	*Nannobrachium* sp.			0.0001		0.0003		0.0001	
	Lanternfishes	*Notolychnus* sp.				0.0001	<0.00005	0.0001	<0.00005	<0.00005
	Lanternfishes	*Notoscopelus* sp.	0.0001	<0.00005	0.0004	<0.00005	<0.00005	<0.00005	0.0005	0.0001
	Lanternfishes	*Taaningichthys* sp.				<0.00005				<0.00005
	Glacier lanternfish	*Benthosema glaciale*						<0.00005		<0.00005
	Smallfin lanternfish	*Benthosema suborbitale*	0.0036	0.0003	0.0026	0.0008	0.0042	0.0007	0.0035	0.0012
	Roundnose lanternfish	*Centrobranchus nigroocellatus*	0.0004	0.0003	0.0004	0.0005	0.0003	0.0005	0.0003	0.0009
	Longfin lanternfish	*Diogenichthys atlanticus*	0.0044	0.0063	0.0033	0.0085	0.0048	0.0044	0.0038	0.0082
	Electric lanternfish	*Electrona risso*							0.0002	
	Coccoâ's lanternfish	*Gonichthys cocco*	0.0001	0.0002	<0.00005	0.0004	0.0001	0.0002	<0.00005	0.0007
	Benoit's lanternfish	*Hygophum benoiti*			<0.00005		0.0001		<0.00005	<0.00005
	Bermuda lanternfish	*Hygophum hygomii*				0.0009				0.0002
	Bermuda lanternfish	*Hygophum hygomii*					<0.00005			
	Large-finned lanterfish	*Hygophum macrochir*							<0.00005	<0.00005
	Reinhardt's lanternfish	*Hygophum reinhardtii*	0.0006	0.0014	0.0005	0.0024	0.0006	0.0008	0.0005	0.0021
	Taning's lanternfish	*Hygophum taaningi*			<0.00005	<0.00005	<0.00005			<0.00005
	Metallic lanternfish	*Myctophum affine*	<0.00005		0.0003	0.0001	<0.00005	0.0012	0.0001	0.0004
	Prickly lanternfish	*Myctophum asperum*	0.0001		0.0001	<0.00005	0.0001	<0.00005	0.0001	<0.00005
	Pearly lanternfish	*Myctophum nitidulum*	0.0001	0.0001	0.0001	<0.00005		0.0001	0.0001	<0.00005
	Bluntsnout lanternfish	*Myctophum obtusirostre*							<0.00005	<0.00005
	Spotted lanternfish	*Myctophum punctatum*								<0.00005
	Wisner's lanternfish	*Myctophum selenops*			<0.00005		<0.00005	<0.00005	<0.00005	<0.00005
	Lanternfishes	*Symbolophorus rufinus*	0.0001		<0.00005		<0.00005		<0.00005	
	Large-scale lanternfish	*Symbolophorus veranyi*				<0.00005				
	Spurcheek lanternfish	*Bolinichthys photothorax*		<0.00005				<0.00005		<0.00005
	Madeira lanternfish	*Ceratoscopelus maderensis*		0.0005		0.0006		0.0004	<0.00005	0.0009
	Warming's lanternfish	*Ceratoscopelus warmingii*	<0.00005	0.0001		0.0001	0.0003	<0.00005	0.0006	0.0001
	Lanternfishes	*Diaphus* sp.	0.0054	0.0377	0.0059	0.0315	0.0097	0.0522	0.0052	0.0530
	Short-headed lanternfish	*Diaphus brachycephalus*								<0.00005
	Lanternfishes	*Diaphus dumerili*		<0.00005		<0.00005		0.0001		0.0002
	Fragile lanternfish	*Diaphus fragilis*								<0.00005

Table C-1. (Continued).

Order	Common Names	Taxon	W4		W5		C4		C5	
			GB668	SEAMAP	AC25	SEAMAP	VK989	SEAMAP	MC920	SEAMAP
	Garman's lanternfish	*Diaphus garmani*								<0.00005
	Soft lanternfish	*Diaphus mollis*		<0.00005		<0.00005	<0.00005			<0.00005
	Transparent lanternfish	*Diaphus perspicillatus*								<0.00005
	Problematic lanternfish	*Diaphus problematicus*				<0.00005				<0.00005
	White-spotted lanternfish	*Diaphus rafinesquei*			<0.00005		0.0001			
	Lanternfishes	*Diaphus subtilis*								<0.00005
	Slopewater lanternfish	*Diaphus taaningi*		<0.00005				0.0001		
	Taaning's lanternfish	*Diaphus termophilus*		<0.00005						
	Sunbeam lampfish	*Lampadena urophaos*	0.0001				<0.00005		<0.00005	
	Winged lanternfish	*Lampanyctus alatus*		0.0001			0.0001			<0.00005
	Lanternfishes	*Lampanyctus cuprarius*								<0.00005
	Noble lampfish	*Lampanyctus nobilis*	<0.00005		0.0001		<0.00005			<0.00005
	Pygmy lanternfish	*Lampanyctus pusillus*					<0.00005			<0.00005
	Lanternfishes	*Lepidophanes gaussi*			0.0001				<0.00005	<0.00005
	Gunther's lanternfish	*Lepidophanes guentheri*			0.0001	0.0001		<0.00005	<0.00005	0.0001
	Dofleini's lanternfish	*Lobianchia dofleini*								<0.00005
	Cocco's lanternfish	*Lobianchia gemellarii*					0.0001			<0.00005
	Dusky lanternfish	*Nannobrachium atrum*			0.0001		0.0001			
	Lanternfishes	*Nannobrachium lineatum*					<0.00005			
	Lanternfishes	*Notolychnus resplendens*					<0.00005			
	Topside lampfish	*Notolychnus valdiviae*	0.0009	0.0102	0.0007	0.0131	0.0006	0.0055	0.0008	0.0088
	Lobisomem	*Notoscopelus caudispinosus*			0.0004		<0.00005		0.0001	
	Patchwork lampfish	*Notoscopelus resplendens*	0.0001	0.0005	0.0001	0.0006	<0.00005	0.0005	0.0001	0.0007
	Waistcoat lanternfish	*Taaningichthys minimus*			<0.00005					<0.00005
LAMPRIDIFORMES	Opahs									
	Tapertail	*Radiicephalus elongatus*	<0.00005		<0.00005				0.0001	
GADIFORMES	Cods, codlets, ratails, and hakes									
	Muraenolepidids	Gadiformes		0.0002	<0.00005	0.0001	0.0002	0.0011	0.0005	0.0003
	Codfishes, haddocks and allies	Gadidae				<0.00005	<0.00005	0.0002	0.0002	0.0001
	Fourbeard rockling	*Enchelyopus cimbrius*								<0.00005
	Codlets	Bregmacerotidae		0.0047		0.0008	<0.00005	0.0011		0.0011
	Codlets	*Bregmaceros* sp.	0.0005	0.0592	0.0014	0.0212	0.0008	0.0564	0.0010	0.0153
	Antenna codlet	*Bregmaceros atlanticus*	0.0075		0.0072		0.0042		0.0045	
	Striped codlet	*Bregmaceros cantori*	0.0049		0.0446		0.0186		0.0039	
	Stellate codlet	*Bregmaceros houdei*							<0.00005	

Table C-1. (Continued).

Order	Common Names	Taxon	W4		W5		C4		C5	
			GB668	SEAMAP	AC25	SEAMAP	VK989	SEAMAP	MC920	SEAMAP
	Grenadiers, bathygadids, rattails, whiptails	Bathygadidae	0.0003		<0.00005		0.0002		0.0002	
	Rattails and grenadiers	Macrouridae	<0.00005	0.0001	0.0001	0.0002	0.0002	0.0002	0.0002	0.0002
	Rattails and grenadiers	*Coryphaenoides* sp.	0.0001		<0.00005		0.0001		0.0002	
	Rattails and grenadiers	*Coryphaenoides* sp.							<0.00005	
	Western Atlantic grenadier	*Nezumia atlantica*			<0.00005					
	Morid eels and morays	Moridae	0.0012	0.0001	<0.00005		0.0001	0.0001		0.0001
	Beardless codling	*Gadella imberbis*					<0.00005		0.0001	
	Hakeling	*Physiculus fulvus*	0.0001		<0.00005				<0.00005	
	Hakes	Merlucciidae	<0.00005				0.0001			
	Hakes	Steindachneriinae					<0.00005			
	Codlets	*Merluccius* sp.						<0.00005		
	Luminous hake	*Steindachneria argentea*					0.0001	<0.00005		
	Phycid hakes	Phycidae	<0.00005		0.0002		<0.00005		<0.00005	
	Codlets	*Urophycis* sp.	<0.00005	<0.00005		<0.00005	<0.00005	0.0003	0.0001	0.0001
	Longfin hake	*Urophycis chesteri*	<0.00005				<0.00005		<0.00005	
	Red hake	*Urophycis chuss*					<0.00005			
	Southern codling	*Urophycis floridana*			<0.00005					
	Spotted codling	*Urophycis regia*		<0.00005		<0.00005	<0.00005	<0.00005		
OPHIDIIFORMES	Cusk-eels and brotulids									
	Cusk-eels and brotulids	Ophidiiformes		<0.00005		<0.00005		<0.00005		
	Livebearing brotulas	Bythitidae								<0.00005
	Brotulas	Bythitinae						<0.00005		
	Cusk-eels	Ophidiidae	0.0001	0.0015	0.0003	0.0006	0.0002	0.0044	0.0002	0.0007
	Brotulids	Brotulidae								<0.00005
	Brotulids	*Brotula* sp.	<0.00005		0.0001		<0.00005	0.0004		<0.00005
	Bearded brotula	*Brotula barbata*	0.0001		<0.00005		0.0002		<0.00005	
	Aphyonids	*Lepophidium* sp.	0.0001		0.0003		0.0004		0.0002	
	Blackrim cusk-eel	*Lepophidium profundorum*			<0.00005		<0.00005			
	Barred cusk-eel	*Lepophidium staurophor*	<0.00005		0.0001		0.0001		0.0001	
	Aphyonids	*Ophidion* sp.	0.0002		0.0004		0.0001		0.0002	
	Blotched cusk-eel	*Ophidion grayi*	<0.00005							
	Letter opener	*Ophidion nocomis*					<0.00005			
	Colonial cusk-eel	*Ophidion robinsi*					<0.00005			
	Pearlfishes	Carapidae	0.0001	<0.00005	<0.00005	<0.00005	0.0001	0.0002	0.0001	0.0001
	Pearlfish	*Carapus* sp.		0.0001		<0.00005		<0.00005		<0.00005

Table C-1. (Continued).

Order	Common Names	Taxon	W4		W5		C4		C5	
			GB668	SEAMAP	AC25	SEAMAP	VK989	SEAMAP	MC920	SEAMAP
	Pearlfish	*Carapus bermudensis*		0.0001				0.0002		0.0001
	Chain pearlfish	*Echiodon dawsoni*	0.0001		0.0001		<0.00005		0.0001	
	Pearlfish	*Snyderidia canina*	<0.00005		<0.00005		0.0001		0.0002	
LOPHIIFORMES	Anglerfishes									
	Goosefishes and monkfishes	Lophiiformes		0.0001				0.0001		<0.00005
	Goosefishes and monkfishes	Lophiidae			<0.00005		<0.00005			
	Anglerfishes	*Lophiodes* sp.			<0.00005					
	American angler	*Lophius americanus*				<0.00005				<0.00005
	Blackfin goosefish	*Lophius gastrophysus*							<0.00005	
	Frogfishes	Antennariidae	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005		<0.00005
	Singlespot frogfish	*Antennarius radiosus*	<0.00005	<0.00005						<0.00005
	Sargassumfish	*Histrio histrio*	0.0019		0.0008	<0.00005	0.0012		0.0013	<0.00005
	Batfishes	Ogcocephalidae			<0.00005					
	Pancake batfish	*Halieutichthys aculeatus*			<0.00005		<0.00005			
	Seadevils, devilfishes, deepsea Anglerfishes	Ceratioidei	0.0001	0.0012		0.0007	<0.00005	0.0013	0.0001	0.0010
	Fanfins	Caulophrynidae	<0.00005		0.0001		0.0001	<0.00005		
	Fanfins	*Caulophryne* sp.	0.0001		<0.00005				<0.00005	
	Fanfin angler	*Caulophryne jordani*	0.0001		<0.00005		0.0001		<0.00005	
	Seadevils	Ceratiidae	0.0001	<0.00005	0.0001	<0.00005	0.0001	0.0001	0.0001	0.0001
	Triplewart seadevil	*Cryptopsaras couesii*			<0.00005					<0.00005
	Footballfishes	*Himantolophus* sp.		<0.00005						
	Deepsea anglerfishes	*Neoceratias spinifer*	<0.00005		<0.00005					
	Netdevils	Linophrynidae	0.0001		<0.00005		<0.00005			
	Netdevils	*Linophryne* sp.	0.0001				0.0001			
	Deepsea anglers	*Linophryne arborifera*	0.0001		0.0001		<0.00005		<0.00005	
	Soft leafvent angler	*Edriolychnus schmidti*	0.0001				0.0001		0.0001	
	Netdevils	*Oreophryne apagon*							<0.00005	
	Dreamers	Oneirodidae							<0.00005	
	Dreamers	*Dolopichthys* sp.				<0.00005				
	Whalehead dreamer	*Lophodolus acanthognathus*			<0.00005					
ATHERINIFORMES	Silversides									
	New World silversides	Atheriniformes								<0.00005
	New World silversides	Atherinidae					<0.00005	0.0002		
	Silversides	Atherinopsidae					<0.00005			
	Mullets	Mugilidae	0.0001	0.0002	<0.00005	0.0001	<0.00005	0.0013	<0.00005	0.0003

Table C-1. (Continued).

Order	Common Names	Taxon	W4		W5		C4		C5	
			GB668	SEAMAP	AC25	SEAMAP	VK989	SEAMAP	MC920	SEAMAP
	Mullets	*Mugil* sp.	0.0002	0.0003	0.0001	0.0020	0.0001	0.0015	<0.00005	0.0003
	Striped mullet	*Mugil cephalus*	0.0001		0.0008		0.0007		0.0008	0.0003
	White mullet	*Mugil curema*	0.0009		0.0010	0.0001	0.0001	0.0001	<0.00005	0.0001
BELONIFORMES	Flyingfishes, halfbeaks, and needlefishes									
	Flyingfishes	Beloniformes				<0.00005				
	Flyingfishes	Exocoetidae	<0.00005	0.0002		0.0004		0.0007	<0.00005	0.0006
	Flyingfishes	*Exocoetus* sp.			0.0001				<0.00005	
	Flyingfishes	*Cheilopogon* sp.	<0.00005							
	Tropical two-wing flyingfish	*Exocoetus volitans*			<0.00005				<0.00005	
	Halfbeaks	Hemiramphidae		<0.00005		<0.00005				<0.00005
	Halfbeaks	*Hemiramphus* sp.						<0.00005		
	False halfbeak	*Oxyporhamphus micropterus similis*	0.0001						<0.00005	
	Needlefishes	Belonidae		<0.00005		<0.00005				<0.00005
	Tinselfishes	Grammicolepididae							<0.00005	
	Atlantic saury	*Scomberesox saurus*				<0.00005				<0.00005
LAMPRIDIFORMES	Opahs, tube-eyes, and ribbonfishes									
	Opahs, Tube-eyes and ribbonfishes	Lampridiformes						<0.00005		<0.00005
	Opahs	Lampridae					<0.00005			
	Opahs	*Lampris* sp.								<0.00005
	Opahs	*Lampris guttatus*							<0.00005	<0.00005
	Ribbonfishes	Trachipteridae				<0.00005		<0.00005	<0.00005	<0.00005
	Ribbonfishes	*Trachipterus* sp.								<0.00005
BERYCIFORMES	Squirrelfishes and soldierfishes									
	Squirrelfishes and soldierfishes	Beryciformes				<0.00005		<0.00005	<0.00005	<0.00005
	Fangtooth fishes	Anoplogasteridae								<0.00005
	Shorthorn fangtooth	*Anoplogaster brachycera*							<0.00005	
	Alfonsinos	Berycidae	<0.00005							
	Alfonsinos	*Beryx* sp.			<0.00005					
	Black discfish	*Diretmichthys parini*					<0.00005		<0.00005	
	Spinyfin	*Diretmus argenteus*	<0.00005		<0.00005		<0.00005			
	Squirrelfishes and soldierfishes	Holocentridae		0.0001		<0.00005		0.0001		0.0001
	Squirrelfishes	*Holocentrus* sp.						<0.00005		0.0001
	Blackbar soldierfish	*Myripristis jacobus*							0.0001	
	Squirrelfishes	*Sargocentron* sp.							<0.00005	
	Dusky squirrelfish	*Sargocentron vexillarium*							<0.00005	

Table C-1. (Continued).

Order	Common Names	Taxon	W4		W5		C4		C5	
			GB668	SEAMAP	AC25	SEAMAP	VK989	SEAMAP	MC920	SEAMAP
GASTEROSTEIFORMES	Tubesnouts									
	Tubesnouts	Gasterosteiformes					<0.00005			
	Trumpetfish	*Aulostomus maculatus*					<0.00005			
STEPHANOBERYCIFORMES	Bigscale fishes and ridgeheads									
	Bigscale fishes and ridgeheads	Melamphaidae	<0.00005	0.0011	0.0004	0.0014	0.0001	0.0012	0.0001	0.0017
	Bigscale fishes and ridgeheads	*Melamphaes* sp.	0.0014	0.0001	0.0013		0.0017	<0.00005	0.0012	<0.00005
	Highsnout melamphid	*Melamphaes lugubris*	0.0001		<0.00005				0.0001	
	Ridgehead	*Melamphaes simus*	0.0003	0.0009	0.0005	0.0004	0.0001	0.0006	0.0002	0.0005
	Shoulderspine bigscale	*Melamphaes suborbitalis*		<0.00005				<0.00005		<0.00005
	Bigscale fishes and ridgeheads	*Poromitra* sp.		<0.00005						<0.00005
	Bigscale fishes and ridgeheads	*Poromitra megalops*				<0.00005				
	Bigscale fishes and ridgeheads	*Scopeloberyx* sp.	0.0002		<0.00005	<0.00005	0.0001	<0.00005	0.0002	<0.00005
	Bigscale fishes and ridgeheads	*Scopeloberyx opisthopterus*			<0.00005					
	Longjaw bigscale	*Scopeloberyx robustus*	<0.00005	<0.00005	0.0001	<0.00005		<0.00005		<0.00005
	Bigscale fishes and ridgeheads	*Scopelogadus* sp.		<0.00005	<0.00005	<0.00005		<0.00005		0.0001
	Bigscale fishes and ridgeheads	*Scopelogadus mizolepis*						<0.00005		
	Red velvet whalefish	Barbourisiidae							<0.00005	
	Hairyfishes and mirapinnids	Mirapinnidae	<0.00005		0.0001		<0.00005		<0.00005	
	Ribbonbearers and tapetails	Eutaeniophorinae								<0.00005
	Hairyfishes and mirapinnids	*Parataeniophorus gulosus*								<0.00005
POLYMIXIIFORMES	Beardfishes									
	Beardfishes	Polymixiidae				<0.00005		<0.00005		<0.00005
	Beardfishes	*Polymixia* sp.			0.0001				0.0001	
	Beardfish	*Polymixia lowei*	0.0004	<0.00005	0.0007	<0.00005	0.0003		0.0001	<0.00005
	Stout beardfish	*Polymixia nobilis*								<0.00005
	Beardfishes	*Polymixia towel*	0.0001							
ZEIFORMES	Boarfishes									
	Deepbody boarfish	*Antigonia capros*	0.0001		0.0001				<0.00005	
	Diamond dories	Grammicolepididae								
	Spotted tinselfish	*Xenolepidichthys dalgleishi*							0.0002	
	Buckler dory	*Zenopsis conchifera*					<0.00005			
SYNGNATHIFORMES	Pipefishes, seahorses, cornetfishes, and trumpetfishes									
	Snipefishes	Macrorhamphosidae						<0.00005		<0.00005
	Snipefish	*Macrorhamphosus* sp.				<0.00005		<0.00005		<0.00005
	Longspine snipefish	*Macrorhamphosus scolopax*	0.0002		0.0001		0.0003			

Table C-1. (Continued).

Order	Common Names	Taxon	W4		W5		C4		C5	
			GB668	SEAMAP	AC25	SEAMAP	VK989	SEAMAP	MC920	SEAMAP
	Cornetfishes	Fistulariidae				<0.00005	0.0001	<0.00005		<0.00005
	Cornetfish	*Fistularia* sp.		<0.00005						
	Pipefishes and seahorses	Syngnathiformes		<0.00005		<0.00005				
	Pipefishes and seahorses	Syngnathidae					<0.00005	<0.00005	0.0005	<0.00005
	Pipefishes	*Syngnathus* sp.			0.0001	<0.00005		<0.00005		<0.00005
	Gulf pipefish	*Syngnathus scovelli*							<0.00005	
DACTYLOPTERIFORMES	Gurnards									
	Flying gurnard	*Dactylopterus volitans*		<0.00005	<0.00005	<0.00005			<0.00005	<0.00005
SCORPAENIFORMES	Scorpionfishes									
	Scorpionfishes	Scorpaeniformes		0.0001		<0.00005		0.0002		0.0001
	Scorpionfishes	Scorpaenidae	0.0001	0.0010	0.0004	0.0002	0.0003	0.0039	0.0004	0.0007
	Scorpionfishes	*Pontinus* sp.	<0.00005				<0.00005		<0.00005	
	Midwater scorpionfish	*Ectreposepobastes imus*							<0.00005	
	Blackbelly rosefish	*Helicolenus dactylopterus*					<0.00005			
	Highfin scorpionfish	*Pontinus rathbuni*					0.0001		0.0001	
	Scorpionfishes	*Scorpaena* sp.	0.0005		0.0024		0.0010		0.0005	
	Smooth-cheek scorpionfish	*Scorpaena isthmensis*							<0.00005	
	Searobins	Triglidae		0.0003		0.0002		0.0005		0.0002
	Armored searobins	*Peristedion* sp.		<0.00005						<0.00005
	Searobins	*Prionotus* sp.		0.0001		0.0002		0.0001	0.0001	0.0001
	Armored searobins	Peristediidae								<0.00005
	Poachers	Agonidae		0.0002		0.0001		<0.00005		<0.00005
	Lumpfishes	Cyclopteridae						0.0001		
PERCIFORMES	Perch-like fishes									
	Glassfishes	Perciformes	0.0005	0.0012	0.0003	0.0003	0.0008	0.0016	0.0007	0.0006
	Boneyfishes	Percoidei		0.0003		0.0002		0.0005		0.0003
	Acropomatids	Acropomatidae	0.0001	0.0010	0.0001	0.0003	<0.00005	0.0004		0.0002
	Acropomatids	*Synagrops* sp.	0.0001	0.0002	0.0001	0.0002	0.0001	0.0004	<0.00005	0.0001
	Blackmouth bass	*Synagrops bellus*	<0.00005		<0.00005		<0.00005		<0.00005	
	Keelcheek bass	*Synagrops spinosus*	0.0002		0.0004		0.0001		0.0001	
	Slopefishes	*Symphysanodon* sp.						<0.00005		<0.00005
	Oceanic basslets	Howellidae					<0.00005		<0.00005	
	Oceanic basslets	*Howella* sp.	0.0005	0.0018	0.0003	0.0015	0.0003	0.0008	0.0003	0.0017
	Pelagic basslet	*Howella brodiei*	0.0002		<0.00005		<0.00005		0.0001	
	Sea basses	Serranidae	0.0002	0.0009	0.0005	0.0014	0.0005	0.0039	0.0004	0.0019

Table C-1. (Continued).

Order	Common Names	Taxon	W4		W5		C4		C5	
			GB668	SEAMAP	AC25	SEAMAP	VK989	SEAMAP	MC920	SEAMAP
	Sea basses	Anthiinae								<0.00005
	Sea basses	*Centropristis* sp.		0.0005		0.0004		0.0003		0.0001
	Black sea bass	*Centropristis striata*	0.0001		0.0001			<0.00005		
	Sea basses	*Diplectrum* sp.		0.0007	<0.00005	0.0005		0.0004		0.0001
	Apricot bass	*Plectranthias garrupellus*					<0.00005		<0.00005	
	Roughtongue bass	*Pronotogrammus* sp.				<0.00005				<0.00005
	Streamer bass	*Pronotogrammus aurerobens*				<0.00005		<0.00005		<0.00005
	Roughtongue bass	*Pronotogrammus martinicensis*		0.0001	0.0001	0.0001	<0.00005		0.0001	<0.00005
	Pygmy sea bass	*Serraniculus* sp.			<0.00005					
	Pygmy sea bass	*Serraniculus pumilio*		<0.00005				0.0001		<0.00005
	Sea basses	*Serranus* sp.	0.0002	0.0006	0.0011	0.0014	0.0006	0.0005	0.0005	0.0006
	Saddle bass	*Serranus notospilus*	0.0001							
	Harlequin bass	*Serranus tigrinus*	0.0001		0.0003		0.0001		<0.00005	
	Basslets	Grammatidae								
	Basslets	*Lipogramma* sp.	<0.00005							
	Groupers	Epinephelinae		0.0001		<0.00005		0.0002		0.0001
	Groupers	Epinephelini								
	Groupers	*Epinephelus* sp.		<0.00005	<0.00005	<0.00005	<0.00005		<0.00005	0.0001
	Cave bass	*Liopropoma* sp.	0.0002		0.0003		0.0001		0.0001	<0.00005
	Eyestripe bass	*Liopropoma aberrans*			<0.00005				<0.00005	
	Groupers	*Mycteroperca* sp.	<0.00005		0.0001		<0.00005	<0.00005	<0.00005	<0.00005
	Gag	*Mycteroperca microlepis*			<0.00005					
	Soapfishes	Grammistinae		<0.00005		<0.00005		0.0002		0.0001
	Soapfishes	Grammistini		0.0001		0.0001		0.0001		0.0001
	Soapfishes	*Pseudogramma* sp.								<0.00005
	Reef bass	*Pseudogramma gregoryi*	0.0001				0.0001		0.0002	<0.00005
	Bladefin bass	*Jeboehlkia gladifer*					<0.00005			
	Sea basses	*Anthias* sp.	0.0001	0.0005	0.0007	0.0004	<0.00005	0.0009	<0.00005	0.0005
	Yellowfin bass	*Anthias nicholsi*	0.0001	0.0003	0.0002	0.0001	0.0001	0.0003		0.0004
	Swallowtail bass	*Anthias woodsi*	<0.00005		<0.00005		<0.00005		<0.00005	
	Sea basses	*Hemanthias* sp.		0.0001	<0.00005	0.0001		0.0002		0.0002
	Streamer bass	*Hemanthias aureorubens*				<0.00005		<0.00005		<0.00005
	Longtail bass	*Hemanthias leptus*		0.0001				<0.00005	<0.00005	<0.00005
	Red barbier	*Hemanthias vivanus*	<0.00005	0.0001	<0.00005	0.0001		0.0003	<0.00005	0.0001
	Soapfishes	*Rypticus* sp.						<0.00005		<0.00005

Table C-1. (Continued).

Order	Common Names	Taxon	W4		W5		C4		C5	
			GB668	SEAMAP	AC25	SEAMAP	VK989	SEAMAP	MC920	SEAMAP
	Bigeyes	Priacanthidae		0.0001		0.0002		0.0002	0.0001	0.0001
	Bigeyes	*Heteropriacanthus* sp.	<0.00005							
	Bigeyes	*Priacanthus* sp.	<0.00005		<0.00005				<0.00005	
	Atlantic bigeye	*Priacanthus arenatus*							0.0001	<0.00005
	Short bigeye	*Pristigenys alta*	0.0001		<0.00005		0.0001		0.0001	
	Boarfishes	Caproidae		<0.00005						<0.00005
	Boarfishes	*Antigonia* sp.				<0.00005		0.0001		<0.00005
	Cardinalfishes	Apogonidae	0.0001	0.0003	<0.00005	0.0003		0.0003	<0.00005	0.0003
	Cardinalfishes	*Apogon* sp.	<0.00005	0.0001	0.0002	0.0001	<0.00005	0.0001	0.0001	0.0001
	Bridle cardinalfish	*Apogon aurolineatus*	<0.00005						<0.00005	
	Whitestar cardinalfish	*Apogon lachneri*					<0.00005			
	Bluefish	*Pomatomus saltatrix*	<0.00005		<0.00005	0.0001		0.0001		<0.00005
	Epigonids	Epigonidae	0.0001	0.0002	<0.00005	0.0001	<0.00005	0.0002	0.0001	0.0001
	Deepwater cardinalfishes	*Epigonus* sp.				<0.00005	<0.00005			<0.00005
	Deepwater cardinalfishes	*Sphyraenops* sp.	0.0001		0.0002		<0.00005		<0.00005	
	Triplespine deepwater cardinalfish	*Sphyraenops bairdianus*	0.0007	<0.00005	0.0014		0.0002		0.0002	<0.00005
	Tilefishes	Malacanthidae	0.0001	0.0003	<0.00005	0.0001	<0.00005	0.0003	<0.00005	0.0001
	Tilefishes	*Caulolatilus* sp.			0.0001		<0.00005		0.0002	
	Anchor tilefish	*Caulolatilus intermedius*	<0.00005		<0.00005					
	Blueline tilefish	*Caulolatilus microps*			<0.00005					
	Great northern tilefish	*Lopholatilus chamaeleonticeps*	<0.00005				<0.00005		<0.00005	
	Sand tilefish	*Malacanthus plumieri*								<0.00005
	Gnomefishes	Scombropidae	0.0001							
	Remoras	Echeneidae			0.0001	<0.00005		<0.00005		<0.00005
	Remoras	*Echeneis* sp.			<0.00005				<0.00005	
	Jacks	Carangidae	0.0007	0.0009	0.0005	0.0016	0.0011	0.0037	0.0003	0.0023
	African pompano	*Alectis ciliaris*			<0.00005					
	Jacks	*Caranx* sp.	0.0012	0.0008	0.0017	0.0031	0.0015	0.0029	0.0009	0.0014
	Yellow jack	*Caranx bartholomaei*							<0.00005	
	Blue runner	*Caranx crysos*	0.0023	0.0013	0.0016	0.0001	0.0008	0.0012	0.0048	0.0005
	Crevalle jack	*Caranx hippos*	0.0005	0.0001	0.0008		0.0003		0.0002	
	Horse-eye jack	*Caranx latus*	0.0001		0.0001		<0.00005		0.0002	
	Bar jack	*Caranx ruber*	<0.00005				0.0001		<0.00005	
	Atlantic bumper	*Chloroscombrus chrysurus*		0.0014		<0.00005	0.0004	0.0039	0.0001	<0.00005
	Scad	*Decapterus* sp.	0.0003		0.0001		0.0002	<0.00005	0.0002	<0.00005

Table C-1. (Continued).

Order	Common Names	Taxon	W4		W5		C4		C5	
			GB668	SEAMAP	AC25	SEAMAP	VK989	SEAMAP	MC920	SEAMAP
	Mackerel scad	*Decapterus macarellus*							0.0002	
	Round scad	*Decapterus punctatus*	0.0001	0.0001	0.0001	0.0002	0.0010	0.0009	0.0007	0.0006
	Rainbow runner	*Elagatis bipinnulata*	0.0002	0.0002	<0.00005	0.0003	0.0001	0.0008		0.0003
	Bluntnose jack	*Hemicaranx* sp.			<0.00005					
	Bluntnose jack	*Hemicaranx amblyrhynchus*	0.0003	<0.00005	<0.00005		<0.00005			
	Leatherjacket	*Oligoplites saurus*							<0.00005	<0.00005
	White trevally	*Pseudocaranx dentex*	0.0008		0.0003		0.0001		0.0004	
	Lookdown/moonfish	*Selene* sp.	<0.00005	0.0001	0.0002		0.0036	0.0001	0.0001	<0.00005
	Atlantic moonfish	*Selene setapinnis*	0.0001		0.0003		0.0005	0.0001	0.0002	
	Lookdown	*Selene vomer*	0.0003	0.0004	0.0002	<0.00005	0.0010	0.0019		<0.00005
	Bigeye scad	*Selar crumenophthalmus*	0.0004	0.0024	0.0004	0.0006	0.0001	0.0016	0.0001	0.0002
	Amberjacks	*Seriola* sp.	0.0012	<0.00005	0.0002	0.0001		0.0002	0.0001	0.0002
	Greater amberjack	*Seriola dumerili*	0.0002		0.0001				<0.00005	
	Lesser amberjack	*Seriola fasciata*							<0.00005	
	Almaco jack	*Seriola rivoliana*			<0.00005					
	Banded rudderfish	*Seriola zonata*	<0.00005		<0.00005				<0.00005	
	Pompano/permit	*Trachinotus* sp.								<0.00005
	Rough scad	*Trachurus* sp.	0.0001							
	Rough scad	*Trachurus lathami*	0.0002	0.0003	0.0009	0.0001	0.0009	0.0002	<0.00005	0.0005
	Cobia	*Rachycentron canadum*	<0.00005				0.0001	<0.00005		<0.00005
	Dolphinfishes	Coryphaenidae	<0.00005		<0.00005		0.0001	0.0001	0.0001	<0.00005
	Dolphinfishes	*Coryphaena* sp.	<0.00005	0.0001	<0.00005	0.0001	0.0001	0.0001	0.0002	0.0003
	Pompano dolphinfish	*Coryphaena equiselis*	<0.00005		<0.00005		0.0001		<0.00005	<0.00005
	Common dolphinfish	*Coryphaena hippurus*	<0.00005	<0.00005	0.0001	0.0001	<0.00005	0.0001	0.0002	0.0002
	Pomfrets	Bramidae		0.0001		<0.00005		0.0002	<0.00005	0.0003
	Pomfrets	*Brama* sp.	0.0001				0.0001			
	Atlantic pomfret	*Brama brama*							<0.00005	
	Lowfin prompret	*Brama dussumieri*	0.0002		0.0001		0.0002		0.0001	
	Tropical pomfret	*Eumegistus brevorti*			<0.00005					
	Rough pomfret	*Taractes asper*	<0.00005						<0.00005	
	Big-scale pomfret	*Taractichthys longipinnis*					<0.00005			
	Atlantic fanfish	*Pterycombus brama*							<0.00005	
	Rover	*Emmelichthys* sp.					<0.00005			
	Manefishes	*Caristius* sp.	<0.00005							
	Manefishes	*Caristius maderensis*							0.0001	

Table C-1. (Continued).

Order	Common Names	Taxon	W4		W5		C4		C5	
			GB668	SEAMAP	AC25	SEAMAP	VK989	SEAMAP	MC920	SEAMAP
	Slope bass	*Symphysanodon berryi*	<0.00005						0.0001	
	Snappers	Lutjanidae	0.0001	0.0012	0.0002	0.0005		0.0011	0.0001	0.0001
	Queen snapper	*Etelis oculatus*	<0.00005							
	Snappers	*Lutjanus* sp.	0.0004	0.0003	0.0006	0.0001	0.0008	0.0003	0.0007	<0.00005
	Mutton snapper	*Lutjanus analis*	0.0001		0.0001		<0.00005	<0.00005		
	Red snapper	*Lutjanus campechanus*	0.0003	0.0001	0.0001		0.0003	0.0002	0.0002	<0.00005
	Gray snapper	*Lutjanus griseus*		0.0001				<0.00005		
	Lane snapper	*Lutjanus synagris*	<0.00005						<0.00005	
	Yellowtail snapper	*Ocyurus chrysurus*					<0.00005			
	Wenchman	*Pristipomoides* sp.	0.0001		0.0001		<0.00005		0.0001	
	Wenchman	*Pristipomoides aquilonaris*	0.0003	0.0025	0.0006	0.0004		0.0010	0.0001	0.0001
	Vermilion snapper	*Rhomboplites aurorubens*	0.0001	0.0001	<0.00005	<0.00005		0.0003		0.0001
	Tripletails	Lobotidae						<0.00005		
	Tripletail	*Lobotes surinamensis*		0.0001	<0.00005			<0.00005		<0.00005
	Mojarras	Gerreidae		0.0003		0.0001		0.0003		<0.00005
	Mojarras	*Eucinostomus* sp.	<0.00005		<0.00005					
	Mottled mojarra	*Eucinostomus lefroyi*	<0.00005							
	Grunts	Haemulidae				<0.00005			<0.00005	<0.00005
	Grunts	*Haemulon* sp.								<0.00005
	White grunt	*Haemulon plumierii*								<0.00005
	Pigfish	*Orthopristis chrysopterus*						<0.00005		<0.00005
	Porgies	Sparidae	0.0001	0.0001	<0.00005	0.0001	<0.00005	0.0004		0.0001
	Pinfish	*Lagodon rhomboides*		<0.00005			<0.00005		<0.00005	
	Red porgy	*Pagrus pagrus*								<0.00005
	Atlantic threadfin	*Polydactylus octonemus*		<0.00005				<0.00005		
	Drums and croakers	Sciaenidae		0.0002		0.0003	<0.00005	0.0004		<0.00005
	Drums and croakers	*Cynoscion* sp.						<0.00005		<0.00005
	Sand weakfish	*Cynoscion arenarius*		<0.00005			0.0002	0.0007		<0.00005
	Spotted weakfish	*Cynoscion nebulosus*				<0.00005				
	Silver seatrout	*Cynoscion nothus*						0.0001		<0.00005
	Squeteague	*Cynoscion regalis*					<0.00005	<0.00005		<0.00005
	Banded drum	*Larimus fasciatus*				<0.00005	<0.00005	0.0001		<0.00005
	Spot	*Leiostomus xanthurus*					0.0005	0.0003		<0.00005
	Kingfishes	*Menticirrhus* sp.		0.0004		<0.00005		0.0001		<0.00005
	Northern kingfish	*Menticirrhus saxatilis*					<0.00005			

Table C-1. (Continued).

Order	Common Names	Taxon	W4		W5		C4		C5	
			GB668	SEAMAP	AC25	SEAMAP	VK989	SEAMAP	MC920	SEAMAP
	Atlantic croaker	*Micropogonias* sp.					<0.00005			
	Atlantic croaker	*Micropogonias undulatus*				<0.00005	0.0012	0.0004		<0.00005
	Red drum	*Sciaenops ocellatus*		0.0005			<0.00005	0.0003		
	Star drum	*Stellifer lanceolatus*		0.0005		<0.00005				
	Goatfishes	Mullidae		0.0002		0.0007	<0.00005	0.0004	<0.00005	0.0008
	Yellow goatfish	*Mulloidichthys martinicus*			<0.00005					
	Spotted goatfish	*Pseudupeneus maculatus*							<0.00005	
	Dwarf goatfish	*Upeneus parvus*			0.0003					
	Seachubs	Kyphosidae	<0.00005							<0.00005
	Seachubs	*Kyphosus* sp.		0.0001		<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
	Bermuda chub	*Kyphosus sectatrix*							<0.00005	
	Spadefishes	Ephippidae					<0.00005		<0.00005	
	Atlantic spadefish	*Chaetodipterus faber*		0.0001				0.0001		<0.00005
	Butterflyfishes	Chaetodontidae						<0.00005		0.0001
	Foureye butterflyfish	*Chaetodon capistratus*							<0.00005	
	Angelfishes	Pomacanthidae						<0.00005	<0.00005	0.0001
	Cherubfish	*Centropyge* sp.								<0.00005
	Cherubfish	*Centropyge argi*		<0.00005					0.0001	<0.00005
	Angelfish	*Holacanthus* sp.	0.0001						<0.00005	
	Blue angelfish	*Holacanthus bermudensis*							<0.00005	
	Queen angelfish	*Holacanthus ciliaris*							<0.00005	
	Angelfishes	*Pomacanthus* sp.							<0.00005	
	Gray angelfish	*Pomacanthus arcuatus*			<0.00005					
	French angelfish	*Pomacanthus paru*							<0.00005	
	Hawkfishes	Cirrhitidae						<0.00005		<0.00005
	Damselfishes	Pomacentridae		0.0001		0.0001	<0.00005	0.0001	<0.00005	0.0004
	Jawfishes	Opistognathidae		0.0001		0.0001		<0.00005		<0.00005
	Jawfishes	*Opistognathus* sp.			<0.00005					
	Wrasses	Labridae	0.0002	0.0005	0.0001	0.0001	0.0028	0.0072	0.0018	0.0033
	Red hogfish	*Decodon puellaris*	0.0001		0.0002		0.0001		<0.00005	
	Hogfish	*Lachnolaimus maximus*							<0.00005	
	Bluehead	*Thalassoma bifasciatum*	<0.00005		<0.00005				0.0001	<0.00005
	Razorfishes	*Xyrichtys* sp.			<0.00005				<0.00005	0.0001
	Rosy razorfish	*Xyrichtys martinicensis*					<0.00005		0.0001	
	Pearly razorfish	*Xyrichtys novacula*							<0.00005	

Table C-1. (Continued).

Order	Common Names	Taxon	W4		W5		C4		C5	
			GB668	SEAMAP	AC25	SEAMAP	VK989	SEAMAP	MC920	SEAMAP
	Parrotfishes	Scaridae		0.0010	<0.00005	0.0003	<0.00005	0.0033	0.0001	0.0028
	Parrotfishes	*Sparisoma* sp.	0.0001	0.0001	0.0001	0.0007	0.0002	0.0001	0.0009	0.0010
	Greenblotch parrotfish	*Sparisoma atomarium*	<0.00005						0.0001	
	Bucktooth parrotfish	*Sparisoma radians*			<0.00005				0.0001	
	Swallowers	Chiasmodontidae	<0.00005	0.0001		0.0004	<0.00005	0.0001	0.0001	0.0003
	Black swallower	*Chiasmodon niger*	0.0002		0.0001		0.0003		0.0006	
	Sandlances	*Ammodytes* sp.								<0.00005
	Stargazers	Uranoscopidae		0.0002		0.0002		0.0003	<0.00005	0.0003
	Duckbills	Percophidae			<0.00005		<0.00005			
	Duckbills	*Bembrops* sp.	0.0004	0.0002	0.0003	0.0001	0.0006	0.0007	0.0003	0.0002
	Duckbill flathead	*Bembrops anatirostris*	0.0003		<0.00005		0.0003		0.0001	<0.00005
	Blennies	Blennioidei								<0.00005
	Triplefins	Tripterygiidae								<0.00005
	Combtooth blennies	Blenniidae				<0.00005	<0.00005	0.0004	<0.00005	<0.00005
	Combtooth blennies	Hypsoblennius sp.					<0.00005			
	Feather blenny	*Hypsoblennius hentzi*						0.0001		
	Tessellated blenny	*Hypsoblennius invemar*					<0.00005			
	Freckled blenny	*Hypsoblennius ionthas*					<0.00005			
	Combtooth blennies	*Hypleurochilus* sp.					<0.00005			
	Crested blenny	*Hypleurochilus geminatus*						<0.00005		
	Featherduster blenny	*Hypleurochilus multifilis*					<0.00005			
	Molly miller	*Scartella cristata*					<0.00005			
	Weed blennies	Labrisomidae								<0.00005
	Clingfishes	Gobiesocidae		<0.00005				<0.00005		<0.00005
	Skilletfish	*Gobiesox strumosus*					<0.00005			
	Dragonets	Callionymidae	0.0003	0.0004	<0.00005	0.0001	<0.00005	0.0008	0.0007	0.0004
	Dragonets	*Callionymus* sp.		0.0001		<0.00005		0.0001	<0.00005	0.0002
	Spotted dragonet	*Diplogrammus pauciradiatus*	<0.00005				<0.00005		0.0001	
	Dragonets	*Foetorepus* sp.	<0.00005				<0.00005		0.0004	
	Lancer dragonet	*Paradiplogrammus bairdi*	0.0003		0.0001		0.0001		0.0002	
	Gobies	Gobioidei		<0.00005						<0.00005
	Gobies	Gobiidae	0.0089	0.0492	0.0380	0.0081	0.0085	0.0387	0.0028	0.0049
	Gobies	*Bathygobius* sp.			0.0001					
	Notchtongue goby	*Bathygobius curacao*								<0.00005
	Frillfin goby	*Bathygobius soporator*	0.0002							

Table C-1. (Continued).

Order	Common Names	Taxon	W4		W5		C4		C5	
			GB668	SEAMAP	AC25	SEAMAP	VK989	SEAMAP	MC920	SEAMAP
	Darter goby	*Ctenogobius beleosoma*	0.0001						<0.00005	
	Twoscale goby	*Gobiosoma longipala*			<0.00005					
	Gobies	*Microgobius* sp.	0.0001				<0.00005		<0.00005	
	Gobies	*Priolepis* sp.	0.0007							
	Sleepers	Eleotridae	0.0012		0.0017					
	Emerald sleeper	*Erotelis smaragdus*	0.0001		<0.00005					
	Wormfishes	Microdesmidae		0.0021		0.0005	<0.00005	0.0012		0.0001
	Lancetail wormfish	*Microdesmus lanceolatus*	0.0003		0.0006		0.0001			
	Pink wormfish	*Microdesmus longipinnis*	0.0001				0.0001			
	Wormfishes	*Microdesmus* sp.	0.0007		0.0009		0.0008	<0.00005	0.0002	
	Dartfishes	*Ptereleotris* sp.	<0.00005				<0.00005			
	Louvar	Luvaridae								<0.00005
	Louvar	*Luvarus imperialis*								<0.00005
	Surgeonfishes	Acanthuridae						<0.00005		0.0001
	Surgeonfishes	*Acanthurus* sp.		<0.00005	<0.00005		<0.00005	0.0001	0.0001	0.0005
	Doctorfish	*Acanthurus chirurgus*							0.0001	
	Blue tang	*Acanthurus coeruleus*							<0.00005	
	Barracudas	Sphyraenidae	0.0001	<0.00005	<0.00005	<0.00005	<0.00005		<0.00005	<0.00005
	Barracudas	*Sphyraena* sp.	<0.00005	0.0005	0.0001	0.0001	<0.00005	0.0005	<0.00005	0.0002
	Great barracuda	*Sphyraena barracuda*			0.0001				0.0001	
	Northern sennet	*Sphyraena borealis*	<0.00005					<0.00005	0.0001	
	Guachanche barracuda	*Sphyraena guachancho*					<0.00005			
	Southern sennet	*Sphyraena picudilla*			<0.00005					
	Tunas and mackerels	Scombroidei	<0.00005			<0.00005		<0.00005		<0.00005
	Longfine escolar	*Scombrolabrax heterolepis*	<0.00005	0.0001	<0.00005	0.0001	<0.00005	0.0001	<0.00005	0.0001
	Snake mackerels	Gempylidae	0.0010	0.0001	0.0008	0.0001	0.0009	0.0001	0.0007	0.0001
	Striped escolar	*Diplospinus multistriatus*	0.0018	0.0018	0.0013	0.0026	0.0011	0.0010	0.0018	0.0020
	Domine	*Epinnula magistralis*		<0.00005				<0.00005		<0.00005
	Snake mackerels	*Gempylus* sp.	0.0002		0.0001	<0.00005	0.0001		0.0004	
	Snake mackerel	*Gempylus serpens*	0.0001	0.0001	0.0001	0.0004	<0.00005	0.0002	0.0001	0.0004
	Snake mackerels	*Nealotus* sp.								<0.00005
	Black snake mackerel	*Nealotus tripes*	0.0001	0.0001	<0.00005		<0.00005	<0.00005	0.0001	<0.00005
	Snake mackerels	*Neoepinnula* sp.						<0.00005		
	American sackfish	*Neoepinnula americana*		0.0001	<0.00005			0.0001		<0.00005
	Snake mackerels	*Nesiarchus* sp.								<0.00005

Table C-1. (Continued).

Order	Common Names	Taxon	W4		W5		C4		C5	
			GB668	SEAMAP	AC25	SEAMAP	VK989	SEAMAP	MC920	SEAMAP
	Black gemfish	*Nesiarchus nasutus*	0.0003	0.0001		0.0001		0.0002	0.0001	0.0003
	Oilfish	*Ruvettus pretiosus*		<0.00005						
	Cutlassfishes	Trichiuridae	0.0001		0.0001	<0.00005	0.0011	0.0001	0.0003	0.0001
	Cutlassfishes	*Benthodesmus* sp.			<0.00005			<0.00005		<0.00005
	Slender frostfish	*Benthodesmus tenuis*			<0.00005		0.0001	<0.00005		<0.00005
	Cutlassfishes	*Lepidopus* sp.			<0.00005				<0.00005	
	Crested scabbardfish	*Lepidopus altifrons*	0.0001				0.0001		<0.00005	
	Silver scabbarfish	*Lepidopus caudatus*		0.0001				0.0002		0.0001
	Cutlassfishes	*Trichiurus* sp.	<0.00005		0.0001		0.0002		<0.00005	<0.00005
	Atlantic cutlassfish	*Trichiurus lepturus*		0.0002	<0.00005	0.0001	0.0004	0.0021	0.0001	0.0002
	Tunas and mackerels	Scombridae	0.0035	0.0076	0.0032	0.0016	0.0049	0.0028	0.0053	0.0008
	Chub mackerels	*Scomber* sp.							<0.00005	
	Atlantic chub mackerel	*Scomber colias*					<0.00005			<0.00005
	Chub mackerel	*Scomber japonicus*								<0.00005
	Atlantic mackerel	*Scomber scombrus*				<0.00005				0.0001
	Mackerels	*Scomberomorus* sp.	<0.00005	<0.00005	<0.00005		0.0001		<0.00005	0.0001
	Bullet tunas	*Auxis* sp.	0.0003	0.0021	0.0004	0.0006	0.0018	0.0039	0.0011	0.0015
	Bullet tuna	*Auxis rochei*			<0.00005					
	Frigate tuna	*Auxis thazard*	<0.00005		0.0001					
	Little tunny	*Euthynnus* sp.		<0.00005	<0.00005	<0.00005	0.0001		0.0001	<0.00005
	Little tunny	*Euthynnus alletteratus*	0.0004	0.0020	0.0006	0.0008	0.0028	0.0026	0.0016	0.0004
	Skipjack tuna	*Katsuwonus* sp.			0.0001				0.0002	
	Skipjack tuna	*Katsuwonus pelamis*	0.0012	0.0017	0.0009	0.0017	0.0007	0.0011	0.0009	0.0016
	Tunas	*Thunnus* sp.	0.0048	0.0054	0.0024	0.0034	0.0007	0.0034	0.0028	0.0023
	Albacore	*Thunnus alalunga*					<0.00005			
	Yellowfin tuna	*Thunnus albacares*	<0.00005				0.0001			<0.00005
	Blackfin tuna	*Thunnus atlanticus*		0.0011	0.0001	0.0004	<0.00005	0.0004	0.0001	0.0002
	Bigeye tuna	*Thunnus obesus*			<0.00005					
	Atlantic bluefin tuna	*Thunnus thynnus*	0.0003	0.0014	0.0001	0.0006	<0.00005	0.0008		0.0013
	Wahoo	*Acanthocybium solandri*	0.0001	0.0001		0.0001	<0.00005	0.0001	0.0001	<0.00005
	King mackerel	*Scomberomorus cavalla*	0.0010	0.0003	0.0001	0.0001	0.0021	0.0004	0.0035	<0.00005
	Atlantic Spanish mackerel	*Scomberomorus maculatus*		<0.00005			0.0002	0.0001		0.0001
	Cero	*Scomberomorus regalis*								<0.00005
	Billfishes	Istiophoridae		0.0001				<0.00005		<0.00005
	Sailfishes	*Istiophorus* sp.								<0.00005

Table C-1. (Continued).

Order	Common Names	Taxon	W4		W5		C4		C5	
			GB668	SEAMAP	AC25	SEAMAP	VK989	SEAMAP	MC920	SEAMAP
	Sailfish	*Istiophorus platypterus*	<0.00005	0.0001		<0.00005			<0.00005	<0.00005
	Blue marlin	*Makaira nigricans*								<0.00005
	Swordfish	*Xiphias gladius*			<0.00005				<0.00005	<0.00005
	Squaretails	Tetragonuridae				<0.00005				<0.00005
	Squaretails	*Tetragonurus* sp.				<0.00005				<0.00005
	Bigeye squaretail	*Tetragonurus atlanticus*	<0.00005			<0.00005				<0.00005
	Driftfishes	Nomeidae	<0.00005	<0.00005	<0.00005		0.0001		<0.00005	
	Cigarfishes	*Cubiceps* sp.	0.0001	0.0022	0.0001	0.0027		0.0049	0.0002	0.0063
	Bigeye cigarfish	*Cubiceps pauciradiatus*	0.0035	0.0003	0.0016	0.0002	0.0060	0.0003	0.0056	0.0008
	Man-of-war fish	*Nomeus* sp.	<0.00005						<0.00005	
	Driftfishes	*Psenes* sp.	0.0001	0.0002	<0.00005	0.0002		0.0003	0.0001	0.0006
	Freckled driftfish	*Psenes cyanophrys*	<0.00005				<0.00005		<0.00005	<0.00005
	Silver driftfish	*Psenes maculatus*					<0.00005			<0.00005
	Bluefin driftfish	*Psenes pellucidus*			0.0002					
	Driftfish	*Ariomma* sp.	0.0007	0.0003	0.0003	0.0001	0.0002	0.0011	0.0004	0.0005
	Brown driftfish	*Ariomma melanum*	0.0003		0.0002		0.0002		0.0002	
	Spotted driftfish	*Ariomma regulus*		<0.00005			<0.00005			<0.00005
	Butterfishes	Stromateidae	0.0009	0.0006	0.0003	0.0004	0.0003	0.0008	0.0006	0.0004
	Butterfishes	Stromateoidei	0.0003		0.0001		0.0004	0.0001	0.0025	<0.00005
	Butterfishes	*Peprilus* sp.	0.0001	<0.00005			<0.00005	0.0002	<0.00005	<0.00005
	American harvestfish	*Peprilus alepidotus*					0.0001		<0.00005	
	Gulf butterfish	*Peprilus burti*		0.0001		0.0001	0.0002	0.0009		<0.00005
	American harvestfish	*Peprilus paru*		<0.00005				0.0001		
PLEURONECTIFORMES	Flatfishes									
	Spiny flatfishes	Pleuronectiformes		0.0001		0.0001		0.0003		<0.00005
	Windowpane	Scophthalmidae							<0.00005	
	Sand flounders	Paralichthyidae		0.0002	0.0001	<0.00005		0.0002		<0.00005
	Sand flounders	*Citharichthys* sp.	0.0003	0.0015	0.0016	0.0007	0.0012	0.0038	0.0004	0.0006
	Gulf Stream flounder	*Citharichthys arctifrons*	0.0001				<0.00005	<0.00005		
	Horned whiff	*Citharichthys cornutus*	0.0001	0.0001	<0.00005	<0.00005	<0.00005	0.0001	0.0003	0.0001
	Anglefin whiff	*Citharichthys gymnorhinus*		0.0001	0.0001		0.0001	0.0001	0.0001	0.0001
	Bay whiff	*Citharichthys spilopterus*	0.0004	0.0001	0.0017	0.0003	0.0005	0.0007	0.0004	0.0001
	Flounder	*Cyclopsetta* sp.		0.0001		0.0001		0.0002		<0.00005
	Spotfin flounder	*Cyclopsetta fimbriata*	0.0001	<0.00005	0.0003		0.0001		0.0001	<0.00005
	American soles	*Etropus* sp.		0.0001	<0.00005	0.0001	<0.00005	0.0005		0.0001

Table C-1. (Continued).

Order	Common Names	Taxon	W4		W5		C4		C5	
			GB668	SEAMAP	AC25	SEAMAP	VK989	SEAMAP	MC920	SEAMAP
	Fringed flounder	*Etropus crossotus*			0.0002	<0.00005	0.0001	0.0005		0.0001
	Smallmouth flounder	*Etropus microstomus*					<0.00005			<0.00005
	American soles	*Paralichthys* sp.								<0.00005
	American soles	*Syacium* sp.		0.0046		0.0005		0.0058	<0.00005	0.0004
	Shoal flounder	*Syacium gunteri*	<0.00005					<0.00005		
	Dusky flounder	*Syacium papillosum*	0.0012	0.0044	0.0055	0.0007	0.0010	0.0016	0.0016	0.0003
	Lefteye flounders	Bothidae	0.0002	0.0070	0.0004	0.0030	0.0008	0.0050	0.0009	0.0012
	Lefteye flounders	*Bothus* sp.	0.0009	0.0020	0.0010	0.0011	0.0015	0.0021	0.0009	0.0015
	Eyed flounder	*Bothus ocellatus*	0.0007		0.0005		0.0004	0.0001	0.0012	0.0001
	Lefteye flounders	*Chascanopsetta* sp.			0.0001					
	Pelican flounder	*Chascanopsetta lugubris*	0.0002		0.0006		0.0004		0.0002	
	Lefteye flounders	*Engyophrys* sp.				<0.00005				
	American spiny flounder	*Engyophrys senta*	0.0008	0.0012	0.0011	0.0004	0.0001	0.0002	<0.00005	0.0001
	Lefteye flounders	*Monolene* sp.		0.0001				0.0001		<0.00005
	Deepwater flounder	*Monolene sessilicauda*	0.0001		0.0007		0.0004		<0.00005	
	Lefteye flounders	*Trichopsetta* sp.	0.0001	0.0001	0.0001	<0.00005	<0.00005	<0.00005		<0.00005
	Sash flounder	*Trichopsetta ventralis*	0.0016		0.0009	<0.00005	0.0004	0.0001	0.0003	<0.00005
	Righteye flounders	Pleuronectidae		<0.00005				<0.00005	<0.00005	<0.00005
	Righteye flounders	*Microstomus microstomus*	0.0001		<0.00005		<0.00005			
	Righteye flounders	Poecilopsettidae					<0.00005			
	Deepwater dab	*Poecilopsetta* sp.		0.0001	<0.00005					<0.00005
	Deepwater dab	*Poecilopsetta beanii*	<0.00005		<0.00005					
	American soles	Achiridae		<0.00005						
	Soles	Soleidae								<0.00005
	Tonguefishes	Cynoglossidae		0.0007		0.0001	0.0001	0.0005		<0.00005
	Tonguefishes	*Symphurus* sp.	0.0002	0.0057	0.0006	0.0009	0.0008	0.0121	0.0002	0.0008
	Offshore tonguefish	*Symphurus civitatium*	0.0003		0.0003		0.0007		0.0001	
	Spottedfin toungefish	*Symphurus diomedianus*			<0.00005		0.0001		<0.00005	
	Deepwater tonguefish	*Symphurus piger*	0.0002		0.0003		0.0008		0.0001	
	Blackcheek tonguefish	*Symphurus plagiusa*	<0.00005	0.0003	0.0001	0.0003	<0.00005	0.0002	0.0001	0.0001
	Northern tonguefish	*Symphurus pusillus*							<0.00005	
TETRAODONTIFORMES	Puffers, triggerfishes, filefishes, and porcupinefishes									
	Spikefishes	Triacanthodidae				<0.00005		<0.00005	<0.00005	<0.00005
	Triggerfishes	Balistidae		<0.00005		<0.00005		<0.00005		<0.00005
	Triggerfishes	*Balistes* sp.	<0.00005		<0.00005					

Table C-1. (Continued).

Order	Common Names	Taxon	W4		W5		C4		C5	
			GB668	SEAMAP	AC25	SEAMAP	VK989	SEAMAP	MC920	SEAMAP
	Grey triggerfish	*Balistes capriscus*	0.0001	0.0001	<0.00005	<0.00005		0.0001	<0.00005	<0.00005
	Robust boxfishes	*Canthidermis* sp.	0.0001							
	Spotted ocean triggerfish	*Canthidermis maculatus*								<0.00005
	Ocean triggerfish	*Canthidermis sufflamen*	<0.00005					<0.00005		<0.00005
	Sargassum triggerfish	*Xanthichthys ringens*	<0.00005						0.0001	<0.00005
	Filefishes	Monacanthidae		<0.00005		<0.00005		0.0001	<0.00005	0.0001
	Orange filefish	*Aluterus schoepfi*								<0.00005
	Scrawled filefish	*Aluterus scriptus*								<0.00005
	Filefishes	*Cantherhines* sp.								<0.00005
	Orangespotted filefish	*Cantherhines pullus*						<0.00005		
	Filefishes	*Monacanthus* sp.							<0.00005	<0.00005
	Fringed filefish	*Monacanthus ciliatus*						<0.00005		<0.00005
	Filefishes	*Monacanthus hispidus*								<0.00005
	Filefishes	*Stephanolepis* sp.						<0.00005		
	Planehead filefish	*Stephanolepis hispida*								0.0001
	Puffers	Tetraodontidae	0.0001	0.0003	<0.00005	0.0003		0.0003		0.0002
	Puffers	*Canthigaster* sp.	0.0001		<0.00005		<0.00005		<0.00005	
	Caribbean sharpnose puffer	*Canthigaster rostrata*			<0.00005		<0.00005		<0.00005	
	Puffers	*Lagocephalus* sp.	0.0001							
	Smooth puffer	*Lagocephalus laevigatus*			<0.00005					
	Puffers	*Sphoeroides* sp.	0.0001	0.0002	0.0001	0.0001	0.0001	0.0003	0.0001	0.0001
	Northern puffer	*Sphoeroides maculatus*	0.0002		0.0003		0.0001		<0.00005	<0.00005
	Least puffer	*Sphoeroides parvus*								<0.00005
	Porcupinefishes	Diodontidae	<0.00005			<0.00005				<0.00005
	Porcupinefishes	*Diodon* sp.				<0.00005				
	Spot-fin porcupinefish	*Diodon hystrix*			<0.00005					
UNKNOWN	Unknown fish	Unidentified fish	<0.00005	0.0222		0.0211	0.0010	0.0358	0.0004	0.0273

APPENDIX D

SEAMAP Fish Larvae and Egg Data Analysis Method

Description of Methods for Analyzing SEAMAP Fish Larvae and Egg Data

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Updated: December 17, 2004

Data Tables

Three SEAMAP data tables are used together to analyze fish larvae and egg catch rates:

- STATCARD. This data table contains when and where sampling operations take place. Fields relevant to these analyses include (note underscores "_" in field names have been replace by periods "."):

  1. CRUISE.NO
  2. VESSEL
  3. P.STA.NO
  4. S.LATD
  5. S.LATM
  6. S.LOND
  7. S.LONM
  8. S.STA.NO
  9. MO.DAY.YR

- ICHSTRWK. This data table contains information on the plankton samples taken at each station. It contains all of the egg data. Fields relevant to these analyses are listed below.

  1. CRUISE.NO
  2. VESSEL
  3. P.STA.NO
  4. SAMPLE.NO
  5. GEAR.CODE
  6. MESH.CODE
  7. VOL.FILT
  8. NO.EGGS
  9. EGGS.ALIQU

- ICHSARWK. This is the individual taxa data table. It contains information on each individual fish larvae taxa collected in each sample. Relevant fields are listed below.

  1. CRUISE.NO
  2. VESSEL

3. P.STA.NO
4. SAMPLE.NO
5. SAMP.STAT
6. TAXONOMIC
7. BIOCODE
8. MEAS
9. NOT.MEAS
10. ALIQUOT

Merging Data Tables

The STATCARD and ICHSTRWK data tables can be merged based on 3 fields, CRUISE.NO,VESSEL, and P.STA.NO. To further merge the resulting set with the ICHSAR set, the SAMPLE.NO field must be included in the merge key.

Analysis Steps

The STATCARD data table, with its station time and place information is the core data table for these analyses. The data table is read into a database file (R data.frame), where the station latitude and longitude values are converted to decimal degrees, and the sample date is used to create variables for sampling month and year. Next, the ICHSTRWK data table is read into a database file (R data.frame), and restricted to records with GEAR.CODE equal to 1 and MESH.CODE equal to 3, which represent the .333m mesh, 60 cm Bongo net. At this time we also convert the value for VOL.FILT from -9 to NA, to adjust for differences in handling of missing data. The NO.EGGS variable is also adjusted by the size of the EGGS.ALIQU variable, multiplying subsampled aliquots by the appropriate value to set them equal to 1/1 aliquots.

Analysis Constraints. There are no year or month restrictions placed on the station data. Stations were restricted to a rectangle which consisted of 3 30 minute blocks, the one containing the project and one block each east and west of the project block. The blocks were patterned after those created by David Hanisko of NMFS, which attempt to center the principle SEAMAP stations on the blocks. The rectangle is described by the -93.75 and -92.25 degree longitude lines making the vertical sides, and the 28.75 and 29.25 degree latitude lines making the horizontal sides. All stations that were outside of the rectangle were eliminated.

Data Table joins. At this point the station and ichstr data tables were merged using the fields CRUISE.NO, VESSEL, and P.STA.NO as the merge key.

Egg CPUE. Number of eggs per cubic meter of water filtered (Egg.cpue) are calculated for each sample in the combined station-ichstr dataset where the VOL.FILT variable is greater than zero. The mean Egg.cpue and 2 standard errors are then calculated to produce the mean value with upper and lower confidence intervals. Where the NO.EGGS variable is equal to zero and the EGG.ALIQU variable is not one of the valid values, the record is changed to NA. Also, where the NO.EGGS equals 200 this is a sampling protocol error and the value should be changed to NA, (personal communications from David Hanisko, 11/04).

Preparing the Fish Larvae data table. The ICHSARWK data table is read into a database file (R data.frame), and is restricted to records containing a SAMP.STAT (sample status) value of either 1 or 2 (the only values valid for quantative analysis and summaries, David Hanisko, NMFS, pers. comm.). The variables MEAS and NOT.MEAS are adjusted to zero values where the value in the record is -9, then they are added together to create the total count variable, which is then adjusted by the ALIQUOT variable

factor to represent a whole sample. This database table is then merged with the station-ichstr data table using the four variables, CRUISE.NO, VESSEL, P.STA.NO, and SAMPLE.NO as the merge key.

Fish Larvae Summary Values. Total fish larvae catch for each sample is aggregated, and divided by the sample VOL.FILT variable to create the sample catch per cubic meter of water filtered (Fish.cpue). Then the mean Fish.cpue and 2 standard errors are calculated to produce the mean value with upper and lower confidence intervals, both by month of sampling, and for the overall period.

Fish Larvae Individual Taxa Catch Rates. Calculating the catch per cubic meter of water filtered for each taxa caught at anytime in the included samples requires construction of a matrix with one record for each taxa for each sampling record (total size of matrix will be number stations X number of taxa). This data table is then merged with the data table created above (station-ichstr-ichsar, which represents taxa actually caught at each sampling station), and all records with missing values are set to a value of zero. The catch rate per cubic meter of water filtered (Taxa.cpue) can now be calculated for each taxa for each station. These data can be summarized to produce the mean cpue for each taxa along with standard errors, so that upper and lower confidence intervals can be provided.

APPENDIX E

Summary of Total Eggs and Larvae Collected

Table E-1. Fish egg and larvae collection summary.

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
MC920	1/24/2011	Dawn	1	1	200	39	1
MC920	1/24/2011	Dawn	1	2	222	58	31
MC920	1/24/2011	Dawn	1	3	325	57	26
MC920	1/24/2011	Noon	2	1	216	24	2
MC920	1/24/2011	Noon	2	2	229	28	2
MC920	1/24/2011	Noon	2	3	241	52	33
MC920	1/24/2011	Dusk	3	1	262	29	1
MC920	1/24/2011	Dusk	3	2	249	22	5
MC920	1/24/2011	Dusk	3	3	281	7	0
VK989	1/26/2011	Dawn	4	1	239	74	1
VK989	1/26/2011	Dawn	4	2	193	154	3
VK989	1/26/2011	Dawn	4	3	246	131	59
VK989	1/26/2011	Noon	5	1	295	45	0
VK989	1/26/2011	Noon	5	2	316	156	14
VK989	1/26/2011	Noon	5	3	250	161	64
VK989	1/26/2011	Dusk	6	1	314	97	2
VK989	1/26/2011	Dusk	6	2	248	115	6
VK989	1/26/2011	Dusk	6	3	300	152	68
AC25	1/28/2011	Dawn	7	1	285	166	1
AC25	1/28/2011	Dawn	7	2	203	76	28
AC25	1/28/2011	Dawn	7	3	253	137	35
AC25	1/28/2011	Noon	8	1	208	94	3
AC25	1/28/2011	Noon	8	2	137	78	13
AC25	1/28/2011	Noon	8	3	155	141	30
AC25	1/28/2011	Dusk	9	1	258	163	4
AC25	1/28/2011	Dusk	9	2	151	77	28
AC25	1/28/2011	Dusk	9	3	184	242	35
GB668	1/29/2011	Dawn	10	1	193	43	1
GB668	1/29/2011	Dawn	10	2	194	22	20
GB668	1/29/2011	Dawn	10	3	149	38	40
GB668	1/29/2011	Noon	11	1	244	206	3
GB668	1/29/2011	Noon	11	2	206	119	9
GB668	1/29/2011	Noon	11	3	219	58	32

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
GB668	1/29/2011	Dusk	12	1	260	117	4
GB668	1/29/2011	Dusk	12	2	230	31	7
GB668	1/29/2011	Dusk	12	3	205	213	58
MC920	2/21/2011	Dawn	13	1	217	45	2
MC920	2/21/2011	Dawn	13	2	221	23	6
MC920	2/21/2011	Dawn	13	3	197	49	64
MC920	2/21/2011	Dawn	14	1	207	11	0
MC920	2/21/2011	Dawn	14	2	258	8	14
MC920	2/21/2011	Dawn	14	3	212	61	94
MC920	2/21/2011	Noon	15	1	239	14	0
MC920	2/21/2011	Noon	15	2	255	16	9
MC920	2/21/2011	Noon	15	3	241	14	13
MC920	2/21/2011	Noon	16	1	259	29	0
MC920	2/21/2011	Noon	16	2	278	18	22
MC920	2/21/2011	Noon	16	3	255	46	60
MC920	2/21/2011	Dusk	17	1	356	22	2
MC920	2/21/2011	Dusk	17	2	294	10	14
MC920	2/21/2011	Dusk	17	3	279	48	158
MC920	2/21/2011	Dusk	18	1	471	20	7
MC920	2/21/2011	Dusk	18	2	329	15	14
MC920	2/21/2011	Dusk	18	3	318	52	250
VK989	2/22/2011	Dawn	19	1	234	7	2
VK989	2/22/2011	Dawn	19	2	300	14	7
VK989	2/22/2011	Dawn	19	3	244	90	234
VK989	2/22/2011	Dawn	20	1	289	7	2
VK989	2/22/2011	Dawn	20	2	277	16	5
VK989	2/22/2011	Dawn	20	3	396	176	165
VK989	2/22/2011	Noon	21	1	291	8	3
VK989	2/22/2011	Noon	21	2	276	7	9
VK989	2/22/2011	Noon	21	3	277	151	84
VK989	2/22/2011	Noon	22	1	317	8	4
VK989	2/22/2011	Noon	22	2	326	9	9
VK989	2/22/2011	Noon	22	3	302	179	90
VK989	2/22/2011	Dusk	23	1	308	9	2

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
VK989	2/22/2011	Dusk	23	2	298	9	6
VK989	2/22/2011	Dusk	23	3	270	213	142
VK989	2/22/2011	Dusk	24	1	325	1	6
VK989	2/22/2011	Dusk	24	2	310	24	6
VK989	2/22/2011	Dusk	24	3	268	62	241
GB668	2/25/2011	Dawn	25	1	273	16	0
GB668	2/25/2011	Dawn	25	2	262	10	13
GB668	2/25/2011	Dawn	25	3	232	157	90
GB668	2/25/2011	Dawn	26	1	289	36	1
GB668	2/25/2011	Dawn	26	2	274	13	11
GB668	2/25/2011	Dawn	26	3	263	187	80
GB668	2/25/2011	Noon	27	1	247	16	6
GB668	2/25/2011	Noon	27	2	255	13	12
GB668	2/25/2011	Noon	27	3	194	92	80
GB668	2/25/2011	Noon	28	1	283	10	6
GB668	2/25/2011	Noon	28	2	255	19	9
GB668	2/25/2011	Noon	28	3	248	100	95
GB668	2/25/2011	Dusk	29	1	177	8	1
GB668	2/25/2011	Dusk	29	2	156	4	10
GB668	2/25/2011	Dusk	29	3	242	96	67
GB668	2/25/2011	Dusk	30	1	204	6	4
GB668	2/25/2011	Dusk	30	2	224	22	16
GB668	2/25/2011	Dusk	30	3	224	91	81
AC25	3/21/2011	Dawn	31	1	284	10	9
AC25	3/21/2011	Dawn	31	2	230	16	10
AC25	3/21/2011	Dawn	31	3	304	43	112
AC25	3/21/2011	Dawn	32	1	280	16	6
AC25	3/21/2011	Dawn	32	2	348	16	6
AC25	3/21/2011	Dawn	32	3	456	92	116
AC25	3/21/2011	Dawn	33	1	405	13	12
AC25	3/21/2011	Dawn	33	2	468	19	12
AC25	3/21/2011	Dawn	33	3	454	84	88
AC25	3/21/2011	Noon	34	1	443	13	14
AC25	3/21/2011	Noon	34	2	468	8	9

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
AC25	3/21/2011	Noon	34	3	393	84	77
AC25	3/21/2011	Noon	35	1	524	121	10
AC25	3/21/2011	Noon	35	2	448	22	13
AC25	3/21/2011	Noon	35	3	388	100	158
AC25	3/21/2011	Noon	36	1	430	24	9
AC25	3/21/2011	Noon	36	2	399	10	14
AC25	3/21/2011	Noon	36	3	440	96	107
AC25	3/21/2011	Dusk	37	1	558	15	20
AC25	3/21/2011	Dusk	37	2	517	25	10
AC25	3/21/2011	Dusk	37	3	415	82	72
GB668	3/22/2011	Dawn	39	1	264	9	9
GB668	3/22/2011	Dawn	39	2	328	22	3
GB668	3/22/2011	Dawn	39	3	271	31	77
GB668	3/22/2011	Dawn	40	1	292	16	15
GB668	3/22/2011	Dawn	40	2	305	25	9
GB668	3/22/2011	Dawn	40	3	227	65	65
GB668	3/22/2011	Noon	41	1	333	8	12
GB668	3/22/2011	Noon	41	2	288	13	4
GB668	3/22/2011	Noon	41	3	257	33	58
VK989	3/24/2011	Dusk	44	1	106	13	2
VK989	3/24/2011	Dusk	44	2	114	14	12
VK989	3/24/2011	Dusk	44	3	125	191	103
VK989	3/24/2011	Dusk	45	1	88	30	5
VK989	3/24/2011	Dusk	45	2	38	14	17
VK989	3/24/2011	Dusk	45	3	2.1	59	174
MC920	3/25/2011	Dawn	46	1	56	19	12
MC920	3/25/2011	Dawn	46	2	52	11	6
MC920	3/25/2011	Dawn	46	3	101	67	72
MC920	3/25/2011	Dawn	47	1	142	2	1
MC920	3/25/2011	Dawn	47	2	98	35	5
MC920	3/25/2011	Dawn	47	3	95	9	19
MC920	3/25/2011	Noon	48	1	345	37	5
MC920	3/25/2011	Noon	48	2	317	21	20
MC920	3/25/2011	Noon	48	3	328	93	66

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
MC920	3/25/2011	Noon	49	1	344	30	7
MC920	3/25/2011	Noon	49	2	304	38	41
MC920	3/25/2011	Noon	49	3	234	97	62
MC920	3/25/2011	Dusk	50	1	101	18	5
MC920	3/25/2011	Dusk	50	2	97	13	17
MC920	3/25/2011	Dusk	50	3	82	78	49
MC920	3/25/2011	Dusk	51	1	138	27	7
MC920	3/25/2011	Dusk	51	2	144	35	22
MC920	3/25/2011	Dusk	51	3	267	46	61
MC920	4/18/2011	Dawn	52	1	82	9	6
MC920	4/18/2011	Dawn	52	2	77	7	14
MC920	4/18/2011	Dawn	52	3	0	50	169
MC920	4/18/2011	Dawn	53	1	17	50	16
MC920	4/18/2011	Dawn	53	2	15	97	8
MC920	4/18/2011	Dawn	53	3	155	63	101
MC920	4/18/2011	Noon	54	1	245	11	5
MC920	4/18/2011	Noon	54	2	214	11	14
MC920	4/18/2011	Noon	54	3	163	29	104
MC920	4/18/2011	Noon	55	1	269	16	2
MC920	4/18/2011	Noon	55	2	242	19	13
MC920	4/18/2011	Noon	55	3	158	57	149
MC920	4/18/2011	Dusk	57	1	406	12	8
MC920	4/18/2011	Dusk	57	2	347	14	25
MC920	4/18/2011	Dusk	57	3	281	29	124
MC920	4/18/2011	Dusk	58	1	196	29	7
MC920	4/18/2011	Dusk	58	2	142	9	14
MC920	4/18/2011	Dusk	58	3	192	20	132
VK989	4/19/2011	Dawn	59	1	80	15	1
VK989	4/19/2011	Dawn	59	2	716	24	22
VK989	4/19/2011	Dawn	59	3	95	23	180
VK989	4/19/2011	Dawn	60	1	138	10	0
VK989	4/19/2011	Dawn	60	2	135	24	14
VK989	4/19/2011	Dawn	60	3	193	33	254
VK989	4/19/2011	Dawn	61	1	213	18	2

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
VK989	4/19/2011	Dawn	61	2	199	98	12
VK989	4/19/2011	Dawn	61	3	293	148	208
VK989	4/19/2011	Noon	62	1	194	18	4
VK989	4/19/2011	Noon	62	2	154	21	37
VK989	4/19/2011	Noon	62	3	112	46	89
VK989	4/19/2011	Noon	63	1	317	60	3
VK989	4/19/2011	Noon	63	2	250	82	44
VK989	4/19/2011	Noon	63	3	219	77	143
VK989	4/19/2011	Noon	64	1	165	11	0
VK989	4/19/2011	Noon	64	2	169	52	51
VK989	4/19/2011	Noon	64	3	242	20	104
VK989	4/19/2011	Dusk	65	1	285	28	3
VK989	4/19/2011	Dusk	65	2	249	17	28
VK989	4/19/2011	Dusk	65	3	163	18	117
VK989	4/19/2011	Dusk	66	1	241	20	5
VK989	4/19/2011	Dusk	66	2	231	21	32
VK989	4/19/2011	Dusk	66	3	171	23	145
VK989	5/3/2011	Dawn	67	1	124	15	2
VK989	5/3/2011	Dawn	67	2	110	17	37
VK989	5/3/2011	Dawn	67	3	60	200	212
VK989	5/3/2011	Dawn	68	1	59	29	2
VK989	5/3/2011	Dawn	68	2	104	17	25
VK989	5/3/2011	Dawn	68	3	125	280	172
GB668	5/6/2011	Dawn	69	1	521	17	7
GB668	5/6/2011	Dawn	69	2	250	24	4
GB668	5/6/2011	Dawn	69	3	0	28	35
GB668	5/6/2011	Dawn	70	1	130	16	2
GB668	5/6/2011	Dawn	70	2	113	29	21
GB668	5/6/2011	Dawn	70	3	125	93	43
GB668	5/6/2011	Dawn	71	1	66	18	6
GB668	5/6/2011	Dawn	71	2	65	23	15
GB668	5/6/2011	Dawn	71	3	47	122	58
GB668	5/6/2011	Noon	72	1	121	17	8
GB668	5/6/2011	Noon	72	2	84	12	17

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
GB668	5/6/2011	Noon	72	3	143	102	84
GB668	5/6/2011	Noon	73	1	116	14	3
GB668	5/6/2011	Noon	73	2	148	20	26
GB668	5/6/2011	Noon	73	3	257	121	53
GB668	5/6/2011	Noon	74	1	143	15	2
GB668	5/6/2011	Noon	74	2	162	27	13
GB668	5/6/2011	Noon	74	3	255	149	45
GB668	5/6/2011	Dusk	75	1	142	46	9
GB668	5/6/2011	Dusk	75	2	119	37	14
GB668	5/6/2011	Dusk	75	3	227	106	46
GB668	5/6/2011	Dusk	76	1	127	4	5
GB668	5/6/2011	Dusk	76	2	156	13	13
GB668	5/6/2011	Dusk	76	3	266	37	48
GB668	5/6/2011	Dusk	77	1	135	17	10
GB668	5/6/2011	Dusk	77	2	219	22	16
GB668	5/6/2011	Dusk	77	3	314	77	49
AC25	5/7/2011	Dawn	78	1	292	16	2
AC25	5/7/2011	Dawn	78	2	300	10	6
AC25	5/7/2011	Dawn	78	3	247	28	29
AC25	5/7/2011	Dawn	79	1	512	77	5
AC25	5/7/2011	Dawn	79	2	346	51	11
AC25	5/7/2011	Dawn	79	3	308	91	55
AC25	5/7/2011	Dawn	80	1	268	31	7
AC25	5/7/2011	Dawn	80	2	177	32	13
AC25	5/7/2011	Dawn	80	3	105	133	34
AC25	5/7/2011	Noon	81	1	94	20	0
AC25	5/7/2011	Noon	81	2	130	24	4
AC25	5/7/2011	Noon	81	3	205	113	31
AC25	5/7/2011	Noon	82	1	74	29	1
AC25	5/7/2011	Noon	82	2	124	25	6
AC25	5/7/2011	Noon	82	3	200	199	32
AC25	5/7/2011	Noon	83	1	87	34	0
AC25	5/7/2011	Noon	83	2	150	16	16
AC25	5/7/2011	Noon	83	3	235	147	39

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
AC25	5/7/2011	Dusk	84	1	161	30	1
AC25	5/7/2011	Dusk	84	2	400	21	15
AC25	5/7/2011	Dusk	84	3	64	129	28
AC25	5/7/2011	Dusk	85	1	193	45	1
AC25	5/7/2011	Dusk	85	2	167	47	10
AC25	5/7/2011	Dusk	85	3	293	200	54
AC25	5/7/2011	Dusk	86	1	177	57	8
AC25	5/7/2011	Dusk	86	2	172	25	11
AC25	5/7/2011	Dusk	86	3	287	47	74
MC920	5/18/2011	Dawn	88	1	148	15	4
MC920	5/18/2011	Dawn	88	2	98	18	25
MC920	5/18/2011	Dawn	88	3	101	26	59
MC920	5/18/2011	Dawn	89	1	128	141	7
MC920	5/18/2011	Dawn	89	2	90	42	27
MC920	5/18/2011	Dawn	89	3	26	39	64
MC920	5/18/2011	Noon	90	1	223	26	5
MC920	5/18/2011	Noon	90	2	189	19	22
MC920	5/18/2011	Noon	90	3	156	11	76
MC920	5/18/2011	Noon	91	1	235	22	4
MC920	5/18/2011	Noon	91	2	190	6	25
MC920	5/18/2011	Noon	91	3	195	26	90
MC920	5/18/2011	Dusk	92	1	283	12	9
MC920	5/18/2011	Dusk	92	2	220	11	23
MC920	5/18/2011	Dusk	92	3	156	13	80
MC920	5/18/2011	Dusk	93	1	238	24	4
MC920	5/18/2011	Dusk	93	2	258	10	20
MC920	5/18/2011	Dusk	93	3	156	16	88
VK989	5/19/2011	Dawn	94	1	98	21	3
VK989	5/19/2011	Dawn	94	2	169	23	2
VK989	5/19/2011	Dawn	94	3	224	210	126
VK989	5/19/2011	Noon	95	1	226	97	2
VK989	5/19/2011	Noon	95	2	311	122	7
VK989	5/19/2011	Noon	95	3	280	280	196
VK989	5/19/2011	Noon	96	1	338	24	1

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
VK989	5/19/2011	Noon	96	2	331	79	2
VK989	5/19/2011	Noon	96	3	244	220	179
VK989	5/19/2011	Noon	97	1	100	88	1
VK989	5/19/2011	Noon	97	2	140	23	6
VK989	5/19/2011	Noon	97	3	129	159	116
MC920	5/27/2011	Dawn	100	1	479	21	4
MC920	5/27/2011	Dawn	100	2	332	21	18
MC920	5/27/2011	Dawn	100	3	526	112	163
MC920	5/27/2011	Noon	101	1	342	15	6
MC920	5/27/2011	Noon	101	2	284	21	10
MC920	5/27/2011	Noon	101	3	290	68	101
MC920	5/27/2011	Dusk	102	1	463	31	5
MC920	5/27/2011	Dusk	102	2	339	18	25
MC920	5/27/2011	Dusk	102	3	319	33	98
VK989	5/28/2011	Dawn	103	1	86	10	2
VK989	5/28/2011	Dawn	103	2	141	33	7
VK989	5/28/2011	Dawn	103	3	267	220	619
VK989	5/28/2011	Noon	104	1	318	63	3
VK989	5/28/2011	Noon	104	2	245	47	4
VK989	5/28/2011	Noon	104	3	184	205	180
VK989	5/28/2011	Dusk	105	1	160	18	5
VK989	5/28/2011	Dusk	105	2	264	7	11
VK989	5/28/2011	Dusk	105	3	334	86	318
VK989	5/28/2011	Dusk	106	1	232	106	9
VK989	5/28/2011	Dusk	106	2	212	35	9
VK989	5/28/2011	Dusk	106	3	361	117	216
VK989	5/28/2011	Dusk	107	1	171	22	16
VK989	5/28/2011	Dusk	107	2	184	14	8
VK989	5/28/2011	Dusk	107	3	174	73	247
AC25	6/11/2011	Dawn	109	1	210	36	7
AC25	6/11/2011	Dawn	109	2	281	16	18
AC25	6/11/2011	Dawn	109	3	220	100	72
AC25	6/11/2011	Dawn	110	1	386	25	2
AC25	6/11/2011	Dawn	110	2	287	33	35

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
AC25	6/11/2011	Dawn	110	3	198	56	185
AC25	6/11/2011	Dawn	111	1	264	20	2
AC25	6/11/2011	Dawn	111	2	197	56	49
AC25	6/11/2011	Dawn	111	3	109	18	98
AC25	6/11/2011	Noon	112	1	387	65	3
AC25	6/11/2011	Noon	112	2	225	30	51
AC25	6/11/2011	Noon	112	3	137	12	118
AC25	6/11/2011	Noon	113	1	326	44	8
AC25	6/11/2011	Noon	113	2	289	6	22
AC25	6/11/2011	Noon	113	3	165	2	94
AC25	6/11/2011	Noon	114	1	352	14	3
AC25	6/11/2011	Noon	114	2	236	19	32
AC25	6/11/2011	Noon	114	3	199	39	120
AC25	6/11/2011	Dusk	115	1	183	42	4
AC25	6/11/2011	Dusk	115	2	208	46	27
AC25	6/11/2011	Dusk	115	3	281	7	80
AC25	6/11/2011	Dusk	116	1	175	40	5
AC25	6/11/2011	Dusk	116	2	232	11	24
AC25	6/11/2011	Dusk	116	3	202	3	87
AC25	6/11/2011	Dusk	117	1	166	39	0
AC25	6/11/2011	Dusk	117	2	189	23	20
AC25	6/11/2011	Dusk	117	3	188	11	111
AC25	6/12/2011	Dawn	118	1	241	23	7
AC25	6/12/2011	Dawn	118	2	166	14	14
AC25	6/12/2011	Dawn	118	3	67	75	176
AC25	6/12/2011	Noon	119	1	376	18	3
AC25	6/12/2011	Noon	119	2	294	13	35
AC25	6/12/2011	Noon	119	3	246	12	217
GB668	6/13/2011	Dawn	121	1	158	102	2
GB668	6/13/2011	Dawn	121	2	137	8	8
GB668	6/13/2011	Dawn	121	3	106	9	34
GB668	6/13/2011	Dawn	122	1	138	17	5
GB668	6/13/2011	Dawn	122	2	97	4	16
GB668	6/13/2011	Dawn	122	3	109	26	102

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
GB668	6/13/2011	Dawn	123	1	113	15	5
GB668	6/13/2011	Dawn	123	2	98	5	11
GB668	6/13/2011	Dawn	123	3	101	11	42
GB668	6/13/2011	Noon	124	1	116	16	4
GB668	6/13/2011	Noon	124	2	81	1	10
GB668	6/13/2011	Noon	124	3	115	5	47
GB668	6/13/2011	Noon	125	1	115	30	9
GB668	6/13/2011	Noon	125	2	112	8	13
GB668	6/13/2011	Noon	125	3	114	31	72
GB668	6/13/2011	Noon	126	1	127	10	3
GB668	6/13/2011	Noon	126	2	117	6	19
GB668	6/13/2011	Noon	126	3	112	19	46
GB668	6/13/2011	Dusk	127	1	147	27	10
GB668	6/13/2011	Dusk	127	2	115	9	12
GB668	6/13/2011	Dusk	127	3	101	9	63
GB668	6/13/2011	Dusk	128	1	179	23	6
GB668	6/13/2011	Dusk	128	2	155	62	19
GB668	6/13/2011	Dusk	128	3	110	5	66
GB668	6/13/2011	Dusk	129	1	119	20	6
GB668	6/13/2011	Dusk	129	2	104	13	16
GB668	6/13/2011	Dusk	129	3	121	10	54
GB668	6/14/2011	Noon	130	1	121	12	7
GB668	6/14/2011	Noon	130	2	108	6	18
GB668	6/14/2011	Noon	130	3	85	9	67
GB668	6/14/2011	Noon	131	1	131	16	6
GB668	6/14/2011	Noon	131	2	118	42	112
GB668	6/14/2011	Noon	131	3	105	9	69
GB668	6/14/2011	Dusk	132	1	106	18	4
GB668	6/14/2011	Dusk	132	2	124	21	5
GB668	6/14/2011	Dusk	132	3	419	7	79
GB668	6/14/2011	Dusk	133	1	125	16	8
GB668	6/14/2011	Dusk	133	2	133	5	10
GB668	6/14/2011	Dusk	133	3	123	15	60
MC920	6/16/2011	Dawn	134	1	105	14	0

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
MC920	6/16/2011	Dawn	134	2	82	5	15
MC920	6/16/2011	Dawn	134	3	100	9	86
MC920	6/16/2011	Noon	135	1	93	24	73
MC920	6/16/2011	Noon	135	2	130	11	11
MC920	6/16/2011	Noon	135	3	114	11	5
MC920	6/16/2011	Dusk	136	1	119	28	3
MC920	6/16/2011	Dusk	136	2	127	10	13
MC920	6/16/2011	Dusk	136	3	135	22	71
VK989	6/17/2011	Dawn	137	1	147	19	8
VK989	6/17/2011	Dawn	137	2	102	45	11
VK989	6/17/2011	Dawn	137	3	106	210	260
VK989	7/1/2011	Dawn	138	1	137	8	1
VK989	7/1/2011	Dawn	138	2	137	7	11
VK989	7/1/2011	Dawn	138	3	128	210	92
VK989	7/1/2011	Noon	139	1	134	27	1
VK989	7/1/2011	Noon	139	2	161	104	8
VK989	7/1/2011	Noon	139	3	138	171	52
VK989	7/1/2011	Noon	140	1	144	8	1
VK989	7/1/2011	Noon	140	2	163	17	8
VK989	7/1/2011	Noon	140	3	145	210	71
VK989	7/1/2011	Dusk	141	1	167	39	4
VK989	7/1/2011	Dusk	141	2	131	53	14
VK989	7/1/2011	Dusk	141	3	143	186	88
VK989	7/1/2011	Dusk	142	1	142	23	5
VK989	7/1/2011	Dusk	142	2	149	50	7
VK989	7/1/2011	Dusk	142	3	151	39	109
MC920	7/2/2011	Dawn	143	1	257	16	2
MC920	7/2/2011	Dawn	143	2	229	122	20
MC920	7/2/2011	Dawn	143	3	150	213	150
MC920	7/2/2011	Noon	144	1	190	16	3
MC920	7/2/2011	Noon	144	2	194	27	12
MC920	7/2/2011	Noon	144	3	219	39	427
MC920	7/2/2011	Dusk	145	1	171	9	4
MC920	7/2/2011	Dusk	145	2	225	10	19

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
MC920	7/2/2011	Dusk	145	3	204	19	424
GB668	7/4/2011	Dawn	146	1	182	21	6
GB668	7/4/2011	Dawn	146	2	176	7	19
GB668	7/4/2011	Dawn	146	3	128	210	99
GB668	7/4/2011	Noon	147	1	180	35	3
GB668	7/4/2011	Noon	147	2	159	25	28
GB668	7/4/2011	Noon	147	3	208	30	169
GB668	7/4/2011	Dusk	148	1	144	5	8
GB668	7/4/2011	Dusk	148	2	170	5	18
GB668	7/4/2011	Dusk	148	3	157	6	118
AC25	7/5/2011	Dawn	149	1	191	9	9
AC25	7/5/2011	Dawn	149	2	205	3	38
AC25	7/5/2011	Dawn	149	3	142	13	117
AC25	7/5/2011	Noon	150	1	144	47	1
AC25	7/5/2011	Noon	150	2	200	17	29
AC25	7/5/2011	Noon	150	3	196	20	141
AC25	7/5/2011	Dusk	151	1	148	23	2
AC25	7/5/2011	Dusk	151	2	161	5	21
AC25	7/5/2011	Dusk	151	3	192	20	219
AC25	7/5/2011	Dusk	152	1	139	8	6
AC25	7/5/2011	Dusk	152	2	171	2	25
AC25	7/5/2011	Dusk	152	3	197	9	224
AC25	7/5/2011	Dusk	153	1	142	22	6
AC25	7/5/2011	Dusk	153	2	177	7	28
AC25	7/5/2011	Dusk	153	3	180	15	151
AC25	7/17/2011	Dawn	154	1	216	31	8
AC25	7/17/2011	Dawn	154	2	224	12	17
AC25	7/17/2011	Dawn	154	3	169	21	100
AC25	7/17/2011	Noon	156	1	137	30	7
AC25	7/17/2011	Noon	156	2	171	28	31
AC25	7/17/2011	Noon	156	3	191	26	94
AC25	7/15/2011	Dusk	157	1	146	16	4
AC25	7/15/2011	Dusk	157	2	136	19	18
AC25	7/15/2011	Dusk	157	3	180	15	93

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
AC25	7/17/2011	Dusk	158	1	145	20	8
AC25	7/17/2011	Dusk	158	2	161	7	21
AC25	7/17/2011	Dusk	158	3	173	9	137
VK989	7/31/2011	Dawn	160	1	157	25	6
VK989	7/31/2011	Dawn	160	2	147	12	0
VK989	7/31/2011	Dawn	160	3	153	134	83
VK989	7/31/2011	Dawn	161	1	186	30	2
VK989	7/31/2011	Dawn	161	2	151	16	7
VK989	7/31/2011	Dawn	161	3	125	210	106
VK989	7/31/2011	Noon	162	1	154	12	0
VK989	7/31/2011	Noon	162	2	159	23	6
VK989	7/31/2011	Noon	162	3	176	64	36
VK989	7/31/2011	Noon	163	1	139	23	3
VK989	7/31/2011	Noon	163	2	150	23	5
VK989	7/31/2011	Noon	163	3	155	39	23
VK989	7/31/2011	Dusk	164	1	174	23	8
VK989	7/31/2011	Dusk	164	2	174	10	5
VK989	7/31/2011	Dusk	164	3	170	38	49
VK989	7/31/2011	Dusk	165	1	196	22	4
VK989	7/31/2011	Dusk	165	2	195	23	15
VK989	7/31/2011	Dusk	165	3	171	43	85
MC920	8/1/2011	Dawn	166	1	165	18	1
MC920	8/1/2011	Dawn	166	2	152	7	4
MC920	8/1/2011	Dawn	166	3	138	83	62
MC920	8/1/2011	Dawn	167	1	217	62	3
MC920	8/1/2011	Dawn	167	2	211	34	21
MC920	8/1/2011	Dawn	167	3	143	122	69
MC920	8/1/2011	Noon	168	1	129	20	2
MC920	8/1/2011	Noon	168	2	141	48	6
MC920	8/1/2011	Noon	168	3	171	88	61
MC920	8/1/2011	Noon	169	1	126	20	0
MC920	8/1/2011	Noon	169	2	168	80	11
MC920	8/1/2011	Noon	169	3	170	120	88
MC920	8/1/2011	Dusk	170	1	163	24	0

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
MC920	8/1/2011	Dusk	170	2	168	19	9
MC920	8/1/2011	Dusk	170	3	196	12	53
MC920	8/1/2011	Dusk	171	1	155	20	6
MC920	8/1/2011	Dusk	171	2	219	31	18
MC920	8/1/2011	Dusk	171	3	222	15	192
GB668	8/3/2011	Dawn	172	1	149	5	3
GB668	8/3/2011	Dawn	172	2	166	9	23
GB668	8/3/2011	Dawn	172	3	148	23	74
GB668	8/3/2011	Dawn	173	1	175	17	3
GB668	8/3/2011	Dawn	173	2	169	27	20
GB668	8/3/2011	Dawn	173	3	189	73	91
GB668	8/3/2011	Noon	174	1	122	6	1
GB668	8/3/2011	Noon	174	2	170	7	14
GB668	8/3/2011	Noon	174	3	187	94	113
GB668	8/3/2011	Noon	175	1	139	25	7
GB668	8/3/2011	Noon	175	2	180	10	32
GB668	8/3/2011	Noon	175	3	202	15	96
GB668	8/3/2011	Dusk	176	1	147	12	4
GB668	8/3/2011	Dusk	176	2	169	0	24
GB668	8/3/2011	Dusk	176	3	207	20	95
GB668	8/3/2011	Dusk	177	1	171	19	6
GB668	8/3/2011	Dusk	177	2	156	23	13
GB668	8/3/2011	Dusk	177	3	206	12	103
AC25	8/4/2011	Dawn	178	1	194	61	6
AC25	8/4/2011	Dawn	178	2	198	40	11
AC25	8/4/2011	Dawn	178	3	155	210	64
AC25	8/4/2011	Noon	179	1	139	47	3
AC25	8/4/2011	Noon	179	2	161	21	15
AC25	8/4/2011	Noon	179	3	176	18	53
AC25	8/4/2011	Dusk	180	1	142	35	8
AC25	8/4/2011	Dusk	180	2	156	16	15
AC25	8/4/2011	Dusk	180	3	166	12	80
AC25	8/15/2011	Dawn	181	1	162	6	3
AC25	8/15/2011	Dawn	181	2	154	20	8

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
AC25	8/15/2011	Dawn	181	3	175	5	54
AC25	8/16/2011	Noon	182	1	168	28	4
AC25	8/16/2011	Noon	182	2	174	18	17
AC25	8/16/2011	Noon	182	3	190	9	111
AC25	8/16/2011	Dusk	183	1	159	15	4
AC25	8/16/2011	Dusk	183	2	167	5	15
AC25	8/16/2011	Dusk	183	3	149	7	97
GB668	8/17/2011	Dawn	184	1	156	14	5
GB668	8/17/2011	Dawn	184	2	204	16	18
GB668	8/17/2011	Dawn	184	3	146	9	89
GB668	8/17/2011	Noon	185	1	178	26	11
GB668	8/17/2011	Noon	185	2	116	0	0
GB668	8/17/2011	Noon	185	3	139	16	106
GB668	8/17/2011	Dusk	186	1	205	37	8
GB668	8/17/2011	Dusk	186	2	203	4	38
GB668	8/17/2011	Dusk	186	3	194	19	107
MC920	8/19/2011	Dawn	187	1	134	14	2
MC920	8/19/2011	Dawn	187	2	173	11	2
MC920	8/19/2011	Dawn	187	3	174	82	76
MC920	8/19/2011	Noon	188	1	175	81	38
MC920	8/19/2011	Noon	188	2	203	57	2
MC920	8/19/2011	Noon	188	3	105	2	1
MC920	8/19/2011	Dusk	189	1	242	29	4
MC920	8/19/2011	Dusk	189	2	237	19	21
MC920	8/19/2011	Dusk	189	3	157	14	63
VK989	8/20/2011	Noon	191	1	248	30	3
VK989	8/20/2011	Noon	191	2	251	67	5
VK989	8/20/2011	Noon	191	3	174	90	118
VK989	8/20/2011	Dusk	192	1	160	21	3
VK989	8/20/2011	Dusk	192	2	161	32	13
VK989	8/20/2011	Dusk	192	3	159	69	67
VK989	8/29/2011	Dawn	193	1	141	15	3
VK989	8/29/2011	Dawn	193	2	103	7	13
VK989	8/29/2011	Dawn	193	3	150	210	126

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
VK989	8/29/2011	Dawn	194	1	152	14	3
VK989	8/29/2011	Dawn	194	2	136	10	18
VK989	8/29/2011	Dawn	194	3	158	210	194
VK989	8/29/2011	Noon	195	1	140	14	1
VK989	8/29/2011	Noon	195	2	138	17	11
VK989	8/29/2011	Noon	195	3	168	131	140
VK989	8/29/2011	Dusk	196	1	164	5	4
VK989	8/29/2011	Dusk	196	2	141	5	13
VK989	8/29/2011	Dusk	196	3	147	174	249
MC920	8/30/2011	Dawn	197	1	136	12	2
MC920	8/30/2011	Dawn	197	2	108	3	5
MC920	8/30/2011	Dawn	197	3	88	35	35
MC920	8/30/2011	Noon	198	1	163	10	3
MC920	8/30/2011	Noon	198	2	172	5	11
MC920	8/30/2011	Noon	198	3	152	24	76
MC920	8/30/2011	Dusk	199	1	157	12	5
MC920	8/30/2011	Dusk	199	2	157	6	12
MC920	8/30/2011	Dusk	199	3	168	3	111
VK989	9/15/2011	Dawn	201	1	540	28	5
VK989	9/15/2011	Dawn	201	2	239	8	5
VK989	9/15/2011	Dawn	201	3	146	52	63
VK989	9/15/2011	Noon	202	1	520	44	5
VK989	9/15/2011	Noon	202	2	232	33	29
VK989	9/15/2011	Noon	202	3	168	71	114
VK989	9/15/2011	Dusk	203	1	190	23	1
VK989	9/15/2011	Dusk	203	2	179	23	13
VK989	9/15/2011	Dusk	203	3	138	29	67
MC920	9/16/2011	Dawn	204	1	185	4	6
MC920	9/16/2011	Dawn	204	2	117	1	6
MC920	9/16/2011	Dawn	204	3	104	18	58
MC920	9/16/2011	Noon	205	1	142	12	2
MC920	9/16/2011	Noon	205	2	146	25	14
MC920	9/16/2011	Noon	205	3	110	7	19
MC920	9/16/2011	Dusk	206	1	134	11	0

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
MC920	9/16/2011	Dusk	206	2	124	3	12
MC920	9/16/2011	Dusk	206	3	126	19	62
GB668	9/18/2011	Dawn	207	1	233	11	4
GB668	9/18/2011	Dawn	207	2	220	12	27
GB668	9/18/2011	Dawn	207	3	145	4	41
GB668	9/18/2011	Dawn	208	1	192	9	6
GB668	9/18/2011	Dawn	208	2	146	5	18
GB668	9/18/2011	Dawn	208	3	134	3	88
GB668	9/18/2011	Noon	209	1	179	25	4
GB668	9/18/2011	Noon	209	2	145	17	19
GB668	9/18/2011	Noon	209	3	118	8	52
GB668	9/18/2011	Noon	210	1	187	18	10
GB668	9/18/2011	Noon	210	2	174	21	28
GB668	9/18/2011	Noon	210	3	113	23	48
GB668	9/18/2011	Dusk	211	1	244	26	3
GB668	9/18/2011	Dusk	211	2	202	30	22
GB668	9/18/2011	Dusk	211	3	131	10	58
GB668	9/18/2011	Dusk	212	1	258	14	9
GB668	9/18/2011	Dusk	212	2	211	9	27
GB668	9/18/2011	Dusk	212	3	130	6	91
AC25	9/19/2011	Dawn	213	1	184	10	8
AC25	9/19/2011	Dawn	213	2	181	82	30
AC25	9/19/2011	Dawn	213	3	110	60	53
AC25	9/19/2011	Dawn	214	1	146	10	4
AC25	9/19/2011	Dawn	214	2	110	86	28
AC25	9/19/2011	Dawn	214	3	113	44	56
AC25	9/19/2011	Noon	215	1	129	21	2
AC25	9/19/2011	Noon	215	2	109	80	15
AC25	9/19/2011	Noon	215	3	118	41	58
AC25	9/19/2011	Noon	216	1	195	11	111
AC25	9/19/2011	Noon	216	2	164	17	11
AC25	9/19/2011	Noon	216	3	133	75	2
MC920	10/13/2011	Dawn	217	1	204	14	4
MC920	10/13/2011	Dawn	217	2	169	8	15

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
MC920	10/13/2011	Dawn	217	3	134	16	40
MC920	10/13/2011	Dawn	218	1	155	6	5
MC920	10/13/2011	Dawn	218	2	133	19	7
MC920	10/13/2011	Dawn	218	3	111	47	108
MC920	10/13/2011	Dawn	219	1	171	2	4
MC920	10/13/2011	Dawn	219	2	139	8	3
MC920	10/13/2011	Dawn	219	3	102	3	124
MC920	10/13/2011	Noon	220	1	154	11	2
MC920	10/13/2011	Noon	220	2	129	8	6
MC920	10/13/2011	Noon	220	3	130	8	127
MC920	10/13/2011	Noon	221	1	133	3	4
MC920	10/13/2011	Noon	221	2	139	3	11
MC920	10/13/2011	Noon	221	3	142	3	105
MC920	10/13/2011	Noon	222	1	163	5	1
MC920	10/13/2011	Noon	222	2	166	7	6
MC920	10/13/2011	Noon	222	3	138	5	106
MC920	10/13/2011	Dusk	223	1	150	12	1
MC920	10/13/2011	Dusk	223	2	124	6	10
MC920	10/13/2011	Dusk	223	3	156	6	80
MC920	10/13/2011	Dusk	224	1	148	4	3
MC920	10/13/2011	Dusk	224	2	138	3	4
MC920	10/13/2011	Dusk	224	3	144	11	102
MC920	10/13/2011	Dusk	225	1	150	7	2
MC920	10/13/2011	Dusk	225	2	135	8	10
MC920	10/13/2011	Dusk	225	3	145	4	97
VK989	10/14/2011	Dawn	226	1	112	4	0
VK989	10/14/2011	Dawn	226	2	76	26	7
VK989	10/14/2011	Dawn	226	3	100	118	93
VK989	10/14/2011	Dawn	227	1	119	13	2
VK989	10/14/2011	Dawn	227	2	120	14	10
VK989	10/14/2011	Dawn	227	3	94	65	76
VK989	10/14/2011	Dawn	228	1	128	16	6
VK989	10/14/2011	Dawn	228	2	118	15	17
VK989	10/14/2011	Dawn	228	3	1	87	108

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
VK989	10/14/2011	Noon	229	1	178	13	4
VK989	10/14/2011	Noon	229	2	123	9	3
VK989	10/14/2011	Noon	229	3	126	42	68
VK989	10/14/2011	Noon	230	1	163	11	5
VK989	10/14/2011	Noon	230	2	126	20	9
VK989	10/14/2011	Noon	230	3	113	92	86
VK989	10/14/2011	Noon	231	1	134	11	5
VK989	10/14/2011	Noon	231	2	100	8	8
VK989	10/14/2011	Noon	231	3	102	68	91
VK989	10/14/2011	Dusk	232	1	138	7	8
VK989	10/14/2011	Dusk	232	2	109	10	12
VK989	10/14/2011	Dusk	232	3	137	57	110
VK989	10/14/2011	Dusk	233	1	148	7	4
VK989	10/14/2011	Dusk	233	2	133	16	14
VK989	10/14/2011	Dusk	233	3	169	76	80
VK989	10/14/2011	Dusk	234	1	162	11	5
VK989	10/14/2011	Dusk	234	2	167	11	13
VK989	10/14/2011	Dusk	234	3	133	75	90
VK989	12/1/2011	Dawn	235	1	115	8	7
VK989	12/1/2011	Dawn	235	2	105	11	12
VK989	12/1/2011	Dawn	235	3	115	46	80
VK989	12/1/2011	Dawn	236	1	123	6	3
VK989	12/1/2011	Dawn	236	2	99	10	18
VK989	12/1/2011	Dawn	236	3	92	37	107
VK989	12/1/2011	Dawn	237	1	124	14	7
VK989	12/1/2011	Dawn	237	2	123	7	10
VK989	12/1/2011	Dawn	237	3	117	49	113
VK989	12/1/2011	Noon	238	1	132	8	12
VK989	12/1/2011	Noon	238	2	117	4	11
VK989	12/1/2011	Noon	238	3	126	34	134
VK989	12/1/2011	Noon	239	1	120	10	8
VK989	12/1/2011	Noon	239	2	108	5	10
VK989	12/1/2011	Noon	239	3	115	29	108
VK989	12/1/2011	Noon	240	1	118	9	7

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
VK989	12/1/2011	Noon	240	2	108	11	15
VK989	12/1/2011	Noon	240	3	117	38	135
VK989	12/1/2011	Dusk	241	1	105	6	1
VK989	12/1/2011	Dusk	241	2	107	8	8
VK989	12/1/2011	Dusk	241	3	122	26	231
VK989	12/1/2011	Dusk	242	1	128	10	9
VK989	12/1/2011	Dusk	242	2	111	10	12
VK989	12/1/2011	Dusk	242	3	97	27	143
VK989	12/1/2011	Dusk	243	1	108	10	10
VK989	12/1/2011	Dusk	243	2	89	2	20
VK989	12/1/2011	Dusk	243	3	110	25	223
VK989	12/16/2011	Dawn	244	1	208	7	4
VK989	12/16/2011	Dawn	244	2	240	12	12
VK989	12/16/2011	Dawn	244	3	305	30	69
VK989	12/16/2011	Noon	245	1	304	22	10
VK989	12/16/2011	Noon	245	2	376	11	27
VK989	12/16/2011	Noon	245	3	367	24	7
VK989	12/16/2011	Dusk	246	1	236	13	9
VK989	12/16/2011	Dusk	246	2	261	16	29
VK989	12/16/2011	Dusk	246	3	279	19	68
MC920	12/17/2011	Dawn	247	1	264	7	5
MC920	12/17/2011	Dawn	247	2	309	6	24
MC920	12/17/2011	Dawn	247	3	281	16	112
MC920	12/17/2011	Dawn	248	1	251	12	3
MC920	12/17/2011	Dawn	248	2	268	1	21
MC920	12/17/2011	Dawn	248	3	286	4	84
MC920	12/17/2011	Noon	249	1	227	14	0
MC920	12/17/2011	Noon	249	2	263	5	30
MC920	12/17/2011	Noon	249	3	282	10	88
MC920	12/17/2011	Noon	250	1	266	10	5
MC920	12/17/2011	Noon	250	2	297	10	23
MC920	12/17/2011	Noon	250	3	315	14	108
MC920	12/17/2011	Dusk	251	1	280	5	7
MC920	12/17/2011	Dusk	251	2	262	4	25

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
MC920	12/17/2011	Dusk	251	3	287	14	82
AC25	1/7/2012	Dawn	252	1	165	1	9
AC25	1/7/2012	Dawn	252	2	106	4	16
AC25	1/7/2012	Dawn	252	3	126	12	56
AC25	1/7/2012	Dawn	253	1	128	6	6
AC25	1/7/2012	Dawn	253	2	148	5	17
AC25	1/7/2012	Dawn	253	3	133	25	55
AC25	1/7/2012	Dawn	254	1	134	3	5
AC25	1/7/2012	Dawn	254	2	131	7	14
AC25	1/7/2012	Dawn	254	3	150	16	46
AC25	1/7/2012	Noon	255	1	125	16	5
AC25	1/7/2012	Noon	255	2	118	11	23
AC25	1/7/2012	Noon	255	3	132	7	69
AC25	1/7/2012	Noon	256	1	153	15	12
AC25	1/7/2012	Noon	256	2	146	20	18
AC25	1/7/2012	Noon	256	3	120	16	35
AC25	1/7/2012	Noon	257	1	143	15	3
AC25	1/7/2012	Noon	257	2	156	20	15
AC25	1/7/2012	Noon	257	3	125	13	52
AC25	1/7/2012	Dusk	258	1	138	6	3
AC25	1/7/2012	Dusk	258	2	147	14	24
AC25	1/7/2012	Dusk	258	3	115	9	63
AC25	1/7/2012	Dusk	259	1	123	5	6
AC25	1/7/2012	Dusk	259	2	110	6	16
AC25	1/7/2012	Dusk	259	3	123	16	51
AC25	1/7/2012	Dusk	260	1	145	9	7
AC25	1/7/2012	Dusk	260	2	120	8	43
AC25	1/7/2012	Dusk	260	3	129	3	50
GB668	1/8/2012	Dawn	261	1	183	16	4
GB668	1/8/2012	Dawn	261	2	158	10	40
GB668	1/8/2012	Dawn	261	3	141	19	56
GB668	1/8/2012	Dawn	262	1	166	14	0
GB668	1/8/2012	Dawn	262	2	161	22	34
GB668	1/8/2012	Dawn	262	3	113	21	51

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
GB668	1/8/2012	Dawn	263	1	191	16	4
GB668	1/8/2012	Dawn	263	2	139	12	29
GB668	1/8/2012	Dawn	263	3	178	21	72
GB668	1/8/2012	Noon	264	1	168	15	3
GB668	1/8/2012	Noon	264	2	168	18	30
GB668	1/8/2012	Noon	264	3	121	8	60
GB668	1/8/2012	Noon	265	1	199	13	3
GB668	1/8/2012	Noon	265	2	175	13	29
GB668	1/8/2012	Noon	265	3	135	11	82
GB668	1/8/2012	Noon	266	1	192	6	7
GB668	1/8/2012	Noon	266	2	172	5	29
GB668	1/8/2012	Noon	266	3	146	6	76
GB668	1/8/2012	Dusk	267	1	136	12	2
GB668	1/8/2012	Dusk	267	2	148	4	40
GB668	1/8/2012	Dusk	267	3	121	16	66
GB668	1/8/2012	Dusk	268	1	147	3	5
GB668	1/8/2012	Dusk	268	2	144	3	24
GB668	1/8/2012	Dusk	268	3	134	12	75
GB668	1/8/2012	Dusk	269	1	142	22	3
GB668	1/8/2012	Dusk	269	2	161	8	48
GB668	1/8/2012	Dusk	269	3	135	15	81
VK989	1/19/2012	Dawn	270	1	277	19	15
VK989	1/19/2012	Dawn	270	2	173	4	24
VK989	1/19/2012	Dawn	270	3	180	17	64
VK989	1/19/2012	Dawn	271	1	241	13	19
VK989	1/19/2012	Dawn	271	2	168	15	23
VK989	1/19/2012	Dawn	271	3	143	15	51
VK989	1/19/2012	Noon	272	1	224	6	15
VK989	1/19/2012	Noon	272	2	234	12	33
VK989	1/19/2012	Noon	272	3	229	108	102
VK989	1/19/2012	Noon	273	1	219	0	0
VK989	1/19/2012	Noon	273	2	227	0	1
VK989	1/19/2012	Noon	273	3	195	11	7
VK989	1/19/2012	Dusk	275	1	220	6	10

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
VK989	1/19/2012	Dusk	275	2	147	13	28
VK989	1/19/2012	Dusk	275	3	155	22	57
VK989	1/19/2012	Dusk	276	1	205	8	12
VK989	1/19/2012	Dusk	276	2	192	8	42
VK989	1/19/2012	Dusk	276	3	176	32	87
VK989	2/16/2012	Dawn	277	1	210	3	6
VK989	2/16/2012	Dawn	277	2	180	6	20
VK989	2/16/2012	Dawn	277	3	151	78	162
VK989	2/16/2012	Dawn	278	1	157	4	1
VK989	2/16/2012	Dawn	278	2	148	6	11
VK989	2/16/2012	Dawn	278	3	159	84	97
VK989	2/16/2012	Noon	279	1	211	12	1
VK989	2/16/2012	Noon	279	2	214	8	13
VK989	2/16/2012	Noon	279	3	193	99	142
VK989	2/16/2012	Noon	280	1	191	7	4
VK989	2/16/2012	Noon	280	2	158	18	15
VK989	2/16/2012	Noon	280	3	150	62	122
VK989	2/16/2012	Dusk	281	1	179	6	2
VK989	2/16/2012	Dusk	281	2	205	3	12
VK989	2/16/2012	Dusk	281	3	223	48	87
VK989	2/16/2012	Dusk	282	1	211	14	3
VK989	2/16/2012	Dusk	282	2	157	4	21
VK989	2/16/2012	Dusk	282	3	169	24	55
MC920	2/17/2012	Noon	285	1	204	20	5
MC920	2/17/2012	Noon	285	2	175	23	26
MC920	2/17/2012	Noon	285	3	133	172	0
MC920	2/17/2012	Noon	286	1	174	13	5
MC920	2/17/2012	Noon	286	2	177	13	17
MC920	2/17/2012	Noon	286	3	141	52	57
MC920	1/17/2012	Noon	287	1	161	17	7
MC920	1/17/2012	Noon	287	2	165	19	11
MC920	1/17/2012	Noon	287	3	111	52	57
MC920	2/17/2012	Dusk	288	1	177	23	26
MC920	2/17/2012	Dusk	288	2	98	21	4

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
MC920	2/17/2012	Dusk	288	3	86	15	27
MC920	2/17/2012	Dusk	289	1	170	38	22
MC920	2/17/2012	Dusk	289	2	102	23	3
MC920	2/17/2012	Dusk	289	3	95	18	28
MC920	1/17/2012	Dusk	290	1	188	21	4
MC920	1/17/2012	Dusk	290	2	148	12	14
MC920	1/17/2012	Dusk	290	3	131	31	51
AC25	3/1/2012	Dawn	291	1	173	30	2
AC25	3/1/2012	Dawn	291	2	122	22	13
AC25	3/1/2012	Dawn	291	3	109	93	100
AC25	3/1/2012	Dawn	293	1	156	41	3
AC25	3/1/2012	Dawn	293	2	134	30	26
AC25	3/1/2012	Dawn	293	3	110	80	107
AC25	3/1/2012	Noon	294	1	180	14	7
AC25	3/1/2012	Noon	294	2	140	21	20
AC25	3/1/2012	Noon	294	3	123	29	127
AC25	3/1/2012	Noon	295	1	124	37	20
AC25	3/1/2012	Noon	295	2	114	93	120
AC25	3/1/2012	Noon	295	3	124	173	109
AC25	3/1/2012	Noon	296	1	130	20	28
AC25	3/1/2012	Noon	296	2	109	1	3
AC25	3/1/2012	Noon	296	3	117	95	116
AC25	3/1/2012	Dusk	297	1	127	24	21
AC25	3/1/2012	Dusk	297	2	99	72	77
AC25	3/1/2012	Dusk	297	3	99	15	4
AC25	3/1/2012	Dusk	298	1	133	11	1
AC25	3/1/2012	Dusk	298	2	95	105	12
AC25	3/1/2012	Dusk	298	3	108	34	80
AC25	3/1/2012	Dusk	299	1	124	68	4
AC25	3/1/2012	Dusk	299	2	99	30	13
AC25	3/1/2012	Dusk	299	3	104	56	103
VK989	3/16/2012	Dawn	300	1	139	8	5
VK989	3/16/2012	Dawn	300	2	116	23	9
VK989	3/16/2012	Dawn	300	3	153	53	89

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
VK989	3/16/2012	Noon	301	1	136	18	7
VK989	3/16/2012	Noon	301	2	103	8	15
VK989	3/16/2012	Noon	301	3	141	43	89
VK989	3/16/2012	Noon	302	1	142	11	6
VK989	3/16/2012	Noon	302	2	108	25	21
VK989	3/16/2012	Noon	302	3	133	81	92
VK989	3/16/2012	Dusk	303	1	168	15	3
VK989	3/16/2012	Dusk	303	2	97	15	20
VK989	3/16/2012	Dusk	303	3	140	41	118
VK989	3/16/2012	Dusk	304	1	141	8	3
VK989	3/16/2012	Dusk	304	2	122	15	17
VK989	3/16/2012	Dusk	304	3	138	28	115
MC920	3/17/2012	Dawn	305	1	245	18	11
MC920	3/17/2012	Dawn	305	2	181	15	19
MC920	3/17/2012	Dawn	305	3	175	25	126
MC920	3/17/2012	Dawn	306	1	229	22	6
MC920	3/17/2012	Dawn	306	2	223	22	20
MC920	3/17/2012	Dawn	306	3	172	10	112
MC920	3/17/2012	Dawn	307	1	271	17	9
MC920	3/17/2012	Dawn	307	2	229	16	22
MC920	3/17/2012	Dawn	307	3	187	29	144
MC920	3/17/2012	Noon	308	1	189	27	10
MC920	3/17/2012	Noon	308	2	210	11	24
MC920	3/17/2012	Noon	308	3	166	72	109
MC920	3/17/2012	Noon	309	1	196	15	9
MC920	3/17/2012	Noon	309	2	202	7	26
MC920	3/17/2012	Noon	309	3	192	50	89
MC920	3/17/2012	Noon	310	1	182	23	8
MC920	3/17/2012	Noon	310	2	183	16	26
MC920	3/17/2012	Noon	310	3	168	31	131
AC25	3/29/2012	Dawn	311	1	190	21	10
AC25	3/29/2012	Dawn	311	2	206	7	21
AC25	3/29/2012	Dawn	311	3	16	23	215
AC25	3/29/2012	Noon	312	1	258	28	7

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
AC25	3/29/2012	Noon	312	2	195	9	22
AC25	3/29/2012	Noon	312	3	146	18	102
GB668	3/30/2012	Dawn	313	1	189	22	8
GB668	3/30/2012	Dawn	313	2	166	4	26
GB668	3/30/2012	Dawn	313	3	142	38	68
VK989	4/11/2012	Dawn	314	1	190	8	1
VK989	4/11/2012	Dawn	314	2	213	11	63
VK989	4/11/2012	Dawn	314	3	273	210	158
VK989	4/11/2012	Dawn	315	1	261	87	421
VK989	4/11/2012	Dawn	315	2	239	5	12
VK989	4/11/2012	Dawn	315	3	214	19	58
VK989	4/11/2012	Dawn	316	1	171	34	41
VK989	4/11/2012	Dawn	316	2	196	14	51
VK989	4/11/2012	Dawn	316	3	195	210	159
VK989	4/11/2012	Noon	317	1	198	11	1
VK989	4/11/2012	Noon	317	2	197	25	83
VK989	4/11/2012	Noon	317	3	204	212	72
VK989	4/11/2012	Noon	318	1	242	26	3
VK989	4/11/2012	Noon	318	2	177	38	29
VK989	4/11/2012	Noon	318	3	199	201	36
VK989	4/11/2012	Dusk	319	1	234	20	56
VK989	4/11/2012	Dusk	319	2	199	51	56
VK989	4/11/2012	Dusk	319	3	164	210	95
VK989	4/11/2012	Dusk	320	1	200	9	12
VK989	4/11/2012	Dusk	320	2	176	21	52
VK989	4/11/2012	Dusk	320	3	132	208	83
MC920	4/12/2012	Dawn	321	1	240	22	86
MC920	4/12/2012	Dawn	322	1	187	0	19
MC920	4/12/2012	Dawn	322	2	216	12	28
MC920	4/12/2012	Dawn	322	3	220	59	106
MC920	4/12/2012	Dawn	323	1	207	12	11
MC920	4/12/2012	Dawn	323	2	127	12	15
MC920	4/12/2012	Dawn	323	3	147	22	77
MC920	4/28/2012	Dawn	324	1	167	15	21

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
MC920	4/28/2012	Dawn	324	2	146	16	8
MC920	4/28/2012	Dawn	324	3	141	70	34
MC920	4/28/2012	Dawn	325	1	187	10	6
MC920	4/28/2012	Dawn	325	2	141	17	27
MC920	4/28/2012	Dawn	325	3	128	48	38
MC920	4/28/2012	Noon	326	1	146	0	6
MC920	4/28/2012	Noon	326	2	100	8	27
MC920	4/28/2012	Noon	326	3	120	29	32
MC920	4/28/2012	Noon	327	1	196	26	7
MC920	4/28/2012	Noon	327	2	138	19	35
MC920	4/28/2012	Noon	327	3	145	41	38
MC920	4/28/2012	Noon	328	1	180	26	6
MC920	4/28/2012	Noon	328	2	142	8	16
MC920	4/28/2012	Noon	328	3	133	34	49
MC920	4/28/2012	Dusk	329	1	175	15	13
MC920	4/28/2012	Dusk	329	2	135	15	34
MC920	4/28/2012	Dusk	329	3	131	36	43
MC920	4/28/2012	Dusk	330	1	172	22	5
MC920	4/28/2012	Dusk	330	2	169	9	40
MC920	4/28/2012	Dusk	330	3	150	21	58
MC920	4/28/2012	Dusk	331	1	177	18	13
MC920	4/28/2012	Dusk	331	2	201	7	59
MC920	4/28/2012	Dusk	331	3	168	32	108
VK989	4/29/2012	Dawn	332	1	129	5	3
VK989	4/29/2012	Dawn	332	2	97	4	27
VK989	4/29/2012	Dawn	332	3	158	86	108
VK989	4/29/2012	Noon	333	1	142	4	3
VK989	4/29/2012	Noon	333	2	97	24	19
VK989	4/29/2012	Noon	333	3	113	75	39
GB668	5/10/2012	Dawn	334	1	244	16	9
GB668	5/10/2012	Dawn	334	2	192	11	21
GB668	5/10/2012	Dawn	334	3	163	12	91
GB668	5/10/2012	Dawn	335	1	220	17	4
GB668	5/10/2012	Dawn	335	2	198	9	8

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
GB668	5/10/2012	Dawn	335	3	178	51	97
GB668	5/10/2012	Dawn	336	1	212	21	9
GB668	5/10/2012	Dawn	336	2	219	17	21
GB668	5/10/2012	Dawn	336	3	141	27	85
GB668	5/10/2012	Noon	337	1	218	20	8
GB668	5/10/2012	Noon	337	2	221	8	22
GB668	5/10/2012	Noon	337	3	171	37	68
GB668	5/10/2012	Noon	338	1	230	13	7
GB668	5/10/2012	Noon	338	2	213	0	12
GB668	5/10/2012	Noon	338	3	156	22	64
GB668	5/10/2012	Noon	339	1	209	36	8
GB668	5/10/2012	Noon	339	2	180	5	13
GB668	5/10/2012	Noon	339	3	131	28	67
GB668	5/10/2012	Dusk	340	1	181	19	1
GB668	5/10/2012	Dusk	340	2	188	31	9
GB668	5/10/2012	Dusk	340	3	148	29	82
GB668	5/10/2012	Dusk	341	1	174	14	4
GB668	5/10/2012	Dusk	341	2	154	6	8
GB668	5/10/2012	Dusk	341	3	144	60	93
GB668	5/10/2012	Dusk	342	1	165	245	25
GB668	5/10/2012	Dusk	342	2	159	81	58
GB668	5/10/2012	Dusk	342	3	150	25	21
VK989	5/24/2012	Dawn	343	1	244	4	14
VK989	5/24/2012	Dawn	343	2	236	0	6
VK989	5/24/2012	Dawn	343	3	271	210	172
VK989	5/24/2012	Dawn	344	1	322	7	17
VK989	5/24/2012	Dawn	344	2	318	23	16
VK989	5/24/2012	Dawn	344	3	349	102	262
VK989	5/24/2012	Noon	345	1	268	7	3
VK989	5/24/2012	Noon	345	2	282	8	4
VK989	5/24/2012	Noon	345	3	328	12	408
VK989	5/24/2012	Dusk	347	1	248	10	7
VK989	5/24/2012	Dusk	347	2	254	12	7
VK989	5/24/2012	Dusk	347	3	290	210	362

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
VK989	5/24/2012	Dusk	348	1	235	13	6
VK989	5/24/2012	Dusk	348	2	254	13	8
VK989	5/24/2012	Dusk	348	3	205	266	308
VK989	5/24/2012	Dusk	349	1	207	4	4
VK989	5/24/2012	Dusk	349	2	228	28	5
VK989	5/24/2012	Dusk	349	3	196	210	336
MC920	5/25/2012	Dawn	350	1	222	16	6
MC920	5/25/2012	Dawn	350	2	268	17	43
MC920	5/25/2012	Dawn	350	3	215	51	118
MC920	5/25/2012	Dawn	351	1	252	1	4
MC920	5/25/2012	Dawn	351	2	218	6	1
MC920	5/25/2012	Dawn	351	3	155	52	108
MC920	5/25/2012	Dawn	352	1	251	9	11
MC920	5/25/2012	Dawn	352	2	221	13	23
MC920	5/25/2012	Dawn	352	3	137	83	67
MC920	5/25/2012	Noon	353	1	215	19	9
MC920	5/25/2012	Noon	353	2	157	16	15
MC920	5/25/2012	Noon	353	3	142	10	66
MC920	5/25/2012	Noon	354	1	326	9	6
MC920	5/25/2012	Noon	354	2	259	19	26
MC920	5/25/2012	Noon	354	3	158	21	100
MC920	5/25/2012	Noon	355	1	295	17	7
MC920	5/25/2012	Noon	355	2	240	27	37
MC920	5/25/2012	Noon	355	3	141	21	143
MC920	5/25/2012	Dusk	356	1	270	27	7
MC920	5/25/2012	Dusk	356	2	191	12	20
MC920	5/25/2012	Dusk	356	3	157	21	90
MC920	5/25/2012	Dusk	357	1	279	0	4
MC920	5/25/2012	Dusk	357	2	220	17	14
MC920	5/25/2012	Dusk	357	3	143	17	120
MC920	5/25/2012	Dusk	358	1	190	16	6
MC920	5/25/2012	Dusk	358	2	170	13	26
MC920	5/25/2012	Dusk	358	3	175	19	120
GB668	6/8/2012	Dawn	359	1	177	1	3

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
GB668	6/8/2012	Dawn	359	2	128	5	16
GB668	6/8/2012	Dawn	359	3	128	35	139
GB668	6/8/2012	Dawn	360	1	161	18	1
GB668	6/8/2012	Dawn	360	2	134	9	14
GB668	6/8/2012	Dawn	360	3	109	0	86
GB668	6/8/2012	Dawn	361	1	178	3	2
GB668	6/8/2012	Dawn	361	2	171	5	19
GB668	6/8/2012	Dawn	361	3	106	15	71
GB668	6/8/2012	Noon	362	1	181	1	2
GB668	6/8/2012	Noon	362	2	109	2	11
GB668	6/8/2012	Noon	362	3	165	14	86
GB668	6/8/2012	Noon	363	1	168	18	1
GB668	6/8/2012	Noon	363	2	112	10	12
GB668	6/8/2012	Noon	363	3	162	24	102
GB668	6/8/2012	Noon	364	1	189	3	2
GB668	6/8/2012	Noon	364	2	226	3	26
GB668	6/8/2012	Noon	364	3	275	24	69
GB668	6/8/2012	Dusk	365	1	210	8	113
GB668	6/8/2012	Dusk	365	2	131	3	9
GB668	6/8/2012	Dusk	365	3	159	17	113
GB668	6/8/2012	Dusk	366	1	158	0	0
GB668	6/8/2012	Dusk	366	2	150	9	18
GB668	6/8/2012	Dusk	366	3	208	26	182
GB668	6/8/2012	Dusk	367	1	164	3	5
GB668	6/8/2012	Dusk	367	2	156	9	15
GB668	6/8/2012	Dusk	367	3	211	31	163
AC25	6/9/2012	Noon	368	1	173	10	7
AC25	6/9/2012	Noon	368	2	157	1	13
AC25	6/9/2012	Noon	368	3	131	14	219
AC25	6/9/2012	Noon	369	1	179	7	6
AC25	6/9/2012	Noon	369	2	186	13	7
AC25	6/9/2012	Noon	369	3	184	41	300
AC25	6/9/2012	Noon	370	1	168	1	3
AC25	6/9/2012	Noon	370	2	155	2	14

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
AC25	6/9/2012	Noon	370	3	157	12	242
AC25	6/9/2012	Dusk	371	1	197	8	3
AC25	6/9/2012	Dusk	371	2	209	12	18
AC25	6/9/2012	Dusk	371	3	168	14	271
AC25	6/9/2012	Dusk	372	1	179	1	4
AC25	6/9/2012	Dusk	372	2	184	1	0
AC25	6/9/2012	Dusk	372	3	164	10	223
AC25	6/9/2012	Dusk	373	1	173	3	5
AC25	6/9/2012	Dusk	373	2	191	1	20
AC25	6/9/2012	Dusk	373	3	180	19	178
AC25	6/29/2012	Dawn	374	1	212	7	10
AC25	6/29/2012	Dawn	374	2	151	5	30
AC25	6/29/2012	Dawn	374	3	160	45	92
AC25	6/29/2012	Dawn	375	1	195	1	10
AC25	6/29/2012	Dawn	375	2	186	0	30
AC25	6/29/2012	Dawn	375	3	159	26	104
AC25	6/29/2012	Noon	376	1	189	8	7
AC25	6/29/2012	Noon	376	2	179	18	38
AC25	6/29/2012	Noon	376	3	183	227	93
AC25	6/29/2012	Dusk	377	1	207	6	6
AC25	6/29/2012	Dusk	377	2	174	4	26
AC25	6/29/2012	Dusk	377	3	129	12	44
AC25	6/29/2012	Dusk	378	1	271	9	10
AC25	6/29/2012	Dusk	378	2	233	15	79
AC25	6/29/2012	Dusk	378	3	150	1	17
AC25	6/29/2012	Dusk	379	1	130	0	4
AC25	6/29/2012	Dusk	379	2	162	3	29
AC25	6/29/2012	Dusk	379	3	151	2	57
GB668	6/30/2012	Dawn	380	1	163	6	3
GB668	6/30/2012	Dawn	380	2	115	4	12
GB668	6/30/2012	Dawn	380	3	128	18	60
AC25	7/13/2012	Dawn	382	1	227	8	3
AC25	7/13/2012	Dawn	382	2	174	49	18
AC25	7/13/2012	Dawn	382	3	224	210	156

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
AC25	7/13/2012	Dawn	383	1	214	4	3
AC25	7/13/2012	Dawn	383	2	224	94	11
AC25	7/13/2012	Dawn	383	3	254	125	348
AC25	7/13/2012	Noon	384	1	159	2	1
AC25	7/13/2012	Noon	384	2	173	4	25
AC25	7/13/2012	Noon	384	3	134	10	215
AC25	7/13/2012	Noon	385	1	157	4	7
AC25	7/13/2012	Noon	385	2	144	7	9
AC25	7/13/2012	Noon	385	3	140	8	235
AC25	7/13/2012	Noon	386	1	151	5	14
AC25	7/13/2012	Noon	386	2	110	9	259
AC25	7/13/2012	Noon	386	3	136	9	19
AC25	7/13/2012	Dusk	387	1	148	1	2
AC25	7/13/2012	Dusk	387	2	161	5	17
AC25	7/13/2012	Dusk	387	3	197	19	399
AC25	7/13/2012	Dusk	388	1	132	1	1
AC25	7/13/2012	Dusk	388	2	187	5	25
AC25	7/13/2012	Dusk	388	3	186	6	396
AC25	7/13/2012	Dusk	389	1	170	3	3
AC25	7/13/2012	Dusk	389	2	168	5	27
AC25	7/13/2012	Dusk	389	3	198	3	297
GB668	7/14/2012	Dawn	390	1	159	4	2
GB668	7/14/2012	Dawn	390	2	165	78	14
GB668	7/14/2012	Dawn	390	3	190	210	57
GB668	7/14/2012	Dawn	391	1	252	18	2
GB668	7/14/2012	Dawn	391	2	232	11	22
GB668	7/14/2012	Dawn	391	3	187	195	54
GB668	7/14/2012	Dawn	392	1	214	27	5
GB668	7/14/2012	Dawn	392	2	204	17	21
GB668	7/14/2012	Dawn	392	3	209	163	78
GB668	7/14/2012	Noon	393	1	147	1	1
GB668	7/14/2012	Noon	393	2	176	2	23
GB668	7/14/2012	Noon	393	3	169	25	77
GB668	7/14/2012	Noon	394	1	142	5	3

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
GB668	7/14/2012	Noon	394	2	169	160	18
GB668	7/14/2012	Noon	394	3	208	80	76
GB668	7/14/2012	Noon	395	1	189	10	2
GB668	7/14/2012	Noon	395	2	222	200	32
GB668	7/14/2012	Noon	395	3	193	46	89
GB668	7/14/2012	Dusk	396	1	176	2	6
GB668	7/14/2012	Dusk	396	2	195	0	9
GB668	7/14/2012	Dusk	396	3	198	12	122
GB668	7/14/2012	Dusk	397	1	276	25	9
GB668	7/14/2012	Dusk	397	2	213	124	16
GB668	7/14/2012	Dusk	397	3	154	16	64
GB668	7/14/2012	Dusk	398	1	212	1	7
GB668	7/14/2012	Dusk	398	2	163	36	15
GB668	7/14/2012	Dusk	398	3	167	16	82
MC920	7/16/2012	Dawn	399	1	145	2	2
MC920	7/16/2012	Dawn	399	2	138	8	16
MC920	7/16/2012	Dawn	399	3	150	12	116
MC920	7/16/2012	Dawn	400	1	161	8	3
MC920	7/16/2012	Dawn	400	2	138	8	24
MC920	7/16/2012	Dawn	400	3	157	10	134
MC920	7/16/2012	Noon	401	1	183	2	3
MC920	7/16/2012	Noon	401	2	155	3	27
MC920	7/16/2012	Noon	401	3	170	0	81
MC920	7/16/2012	Noon	402	1	160	2	2
MC920	7/16/2012	Noon	402	2	170	0	23
MC920	7/16/2012	Noon	402	3	159	2	77
MC920	7/16/2012	Noon	403	1	163	7	6
MC920	7/16/2012	Noon	403	2	173	6	26
MC920	7/16/2012	Noon	403	3	158	1	92
MC920	7/16/2012	Dusk	404	1	158	6	9
MC920	7/16/2012	Dusk	404	2	148	4	11
MC920	7/16/2012	Dusk	404	3	160	4	82
MC920	7/16/2012	Dusk	405	1	159	9	11
MC920	7/16/2012	Dusk	405	2	122	4	18

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
MC920	7/16/2012	Dusk	405	3	148	14	88
MC920	7/16/2012	Dusk	406	1	174	0	12
MC920	7/16/2012	Dusk	406	2	170	1	25
MC920	7/16/2012	Dusk	406	3	149	39	104
VK989	7/17/2012	Dawn	407	1	189	2	3
VK989	7/17/2012	Dawn	407	2	196	2	6
VK989	7/17/2012	Dawn	407	3	145	82	191
VK989	7/17/2012	Dawn	408	1	187	8	1
VK989	7/17/2012	Dawn	408	2	217	6	5
VK989	7/17/2012	Dawn	408	3	182	196	159
VK989	7/17/2012	Noon	409	1	156	9	1
VK989	7/17/2012	Noon	409	2	179	44	9
VK989	7/17/2012	Noon	409	3	171	45	116
VK989	7/17/2012	Noon	410	1	196	3	2
VK989	7/17/2012	Noon	410	2	220	2	18
VK989	7/17/2012	Noon	410	3	191	199	179
GB668	7/27/2012	Dusk	411	1	168	8	7
GB668	7/27/2012	Dusk	411	2	163	63	12
GB668	7/27/2012	Dusk	411	3	200	11	100
GB668	7/27/2012	Dusk	412	1	165	0	4
GB668	7/27/2012	Dusk	412	2	187	0	16
GB668	7/27/2012	Dusk	412	3	163	1	111
GB668	7/28/2012	Dawn	413	1	221	6	8
GB668	7/28/2012	Dawn	413	2	223	4	22
GB668	7/28/2012	Dawn	413	3	208	13	138
GB668	7/28/2012	Dawn	414	1	297	2	9
GB668	7/28/2012	Dawn	414	2	223	1	19
GB668	7/28/2012	Dawn	414	3	157	13	116
GB668	7/28/2012	Dawn	415	1	240	5	2
GB668	7/28/2012	Dawn	415	2	170	16	27
GB668	7/28/2012	Dawn	415	3	147	15	145
GB668	7/28/2012	Noon	416	1	171	0	0
GB668	7/28/2012	Noon	416	2	134	0	0
GB668	7/28/2012	Noon	416	3	167	6	79

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
GB668	7/28/2012	Noon	417	1	174	26	3
GB668	7/28/2012	Noon	417	2	131	14	12
GB668	7/28/2012	Noon	417	3	187	21	95
GB668	7/28/2012	Noon	418	1	183	0	5
GB668	7/28/2012	Noon	418	2	126	1	26
GB668	7/28/2012	Noon	418	3	160	11	115
GB668	7/28/2012	Dusk	419	1	184	6	1
GB668	7/28/2012	Dusk	419	2	167	4	12
GB668	7/28/2012	Dusk	419	3	189	23	146
GB668	7/28/2012	Dusk	420	1	181	5	1
GB668	7/28/2012	Dusk	420	2	178	5	13
GB668	7/28/2012	Dusk	420	3	205	17	120
MC920	7/30/2012	Dawn	421	1	135	2	1
MC920	7/30/2012	Dawn	421	2	138	1	10
MC920	7/30/2012	Dawn	421	3	153	39	55
MC920	7/30/2012	Dawn	422	1	176	3	6
MC920	7/30/2012	Dawn	422	2	180	0	14
MC920	7/30/2012	Dawn	422	3	209	17	75
MC920	7/30/2012	Dawn	424	1	159	0	3
MC920	7/30/2012	Dawn	424	2	134	4	4
MC920	7/30/2012	Dawn	424	3	161	17	90
MC920	7/30/2012	Noon	425	1	189	7	13
MC920	7/30/2012	Noon	425	3	252	7	89
MC920	7/30/2012	Noon	426	1	170	2	4
MC920	7/30/2012	Noon	426	2	181	2	17
MC920	7/30/2012	Noon	426	3	208	4	66
MC920	7/30/2012	Noon	427	1	232	5	4
MC920	7/30/2012	Noon	427	2	248	12	12
MC920	7/30/2012	Noon	427	3	219	6	85
MC920	7/30/2012	Dusk	428	1	183	7	2
MC920	7/30/2012	Dusk	428	2	163	0	7
MC920	7/30/2012	Dusk	428	3	189	7	50
MC920	7/30/2012	Dusk	429	1	215	11	1
MC920	7/30/2012	Dusk	429	2	196	0	8

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
MC920	7/30/2012	Dusk	429	3	194	5	56
MC920	7/30/2012	Dusk	430	1	245	8	2
MC920	7/30/2012	Dusk	430	2	216	1	11
MC920	7/30/2012	Dusk	430	3	199	12	81
VK989	7/31/2012	Dawn	431	1	0	8	6
VK989	7/31/2012	Dawn	431	2	0	4	6
VK989	7/31/2012	Dawn	431	3	0	69	109
VK989	7/31/2012	Dawn	432	1	258	0	7
VK989	7/31/2012	Dawn	432	2	238	32	7
VK989	7/31/2012	Dawn	432	3	217	138	132
VK989	7/31/2012	Dawn	433	1	213	9	3
VK989	7/31/2012	Dawn	433	2	224	17	7
VK989	7/31/2012	Dawn	433	3	197	130	119
VK989	7/31/2012	Noon	434	1	198	9	1
VK989	7/31/2012	Noon	434	2	203	11	6
VK989	7/31/2012	Noon	434	3	203	27	249
VK989	7/31/2012	Noon	436	1	274	5	4
VK989	7/31/2012	Noon	436	2	164	6	8
VK989	7/31/2012	Noon	436	3	190	21	150
VK989	7/31/2012	Dusk	438	1	237	0	4
VK989	7/31/2012	Dusk	438	2	187	0	9
VK989	7/31/2012	Dusk	438	3	180	29	184
VK989	7/31/2012	Dusk	439	1	269	7	2
VK989	7/31/2012	Dusk	439	2	147	4	1
VK989	7/31/2012	Dusk	439	3	195	7	185
AC25	8/17/2012	Dawn	440	1	192	3	6
AC25	8/17/2012	Dawn	440	2	196	2	28
AC25	8/17/2012	Dawn	440	3	171	69	143
AC25	8/17/2012	Dawn	441	1	221	4	5
AC25	8/17/2012	Dawn	441	2	231	11	26
AC25	8/17/2012	Dawn	441	3	160	18	113
AC25	8/17/2012	Noon	442	1	177	15	3
AC25	8/17/2012	Noon	442	2	182	16	32
AC25	8/17/2012	Noon	442	3	156	20	128

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
AC25	8/17/2012	Noon	443	1	149	8	2
AC25	8/17/2012	Noon	443	2	163	18	28
AC25	8/17/2012	Noon	443	3	102	8	102
AC25	8/17/2012	Noon	444	1	181	16	3
AC25	8/17/2012	Noon	444	2	161	18	22
AC25	8/17/2012	Noon	444	3	162	61	114
AC25	8/17/2012	Dusk	445	1	144	10	1
AC25	8/17/2012	Dusk	445	2	131	1	7
AC25	8/17/2012	Dusk	445	3	147	22	116
AC25	8/17/2012	Dusk	446	1	181	2	10
AC25	8/17/2012	Dusk	446	2	183	6	22
AC25	8/17/2012	Dusk	446	3	162	6	99
AC25	8/17/2012	Dusk	447	1	131	0	3
AC25	8/17/2012	Dusk	447	2	138	2	15
AC25	8/17/2012	Dusk	447	3	159	7	154
GB668	8/18/2012	Dawn	448	1	175	4	12
GB668	8/18/2012	Dawn	448	2	134	11	46
GB668	8/18/2012	Dawn	448	3	186	19	21
GB668	8/18/2012	Dawn	449	1	208	2	6
GB668	8/18/2012	Dawn	449	2	186	1	11
GB668	8/18/2012	Dawn	449	3	161	19	84
GB668	9/6/2012	Noon	451	1	127	17	5
GB668	9/6/2012	Noon	451	2	132	3	18
GB668	9/6/2012	Noon	451	3	151	23	62
GB668	9/6/2012	Noon	452	1	161	4	8
GB668	9/6/2012	Noon	452	2	135	0	16
GB668	9/6/2012	Noon	452	3	163	5	63
GB668	9/6/2012	Dusk	453	1	136	1	16
GB668	9/6/2012	Dusk	453	2	166	0	45
GB668	9/6/2012	Dusk	453	3	163	4	6
GB668	9/6/2012	Dusk	454	1	154	5	4
GB668	9/6/2012	Dusk	454	2	164	9	21
GB668	9/6/2012	Dusk	454	3	147	4	68
GB668	9/6/2012	Dusk	455	1	139	0	1

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
GB668	9/6/2012	Dusk	455	2	155	0	18
GB668	9/6/2012	Dusk	455	3	168	4	78
VK989	9/21/2012	Dawn	456	1	60	1	10
VK989	9/21/2012	Dawn	456	2	192	2	7
VK989	9/21/2012	Dawn	456	3	162	7	48
VK989	9/21/2012	Dawn	457	1	225	2	7
VK989	9/21/2012	Dawn	457	2	174	1	9
VK989	9/21/2012	Dawn	457	3	174	17	82
VK989	9/21/2012	Dawn	458	1	151	1	9
VK989	9/21/2012	Dawn	458	2	215	7	15
VK989	9/21/2012	Dawn	458	3	186	20	82
VK989	9/21/2012	Noon	459	1	166	2	6
VK989	9/21/2012	Noon	459	2	183	5	11
VK989	9/21/2012	Noon	459	3	180	12	84
VK989	9/21/2012	Noon	460	1	162	2	6
VK989	9/21/2012	Noon	460	2	159	4	6
VK989	9/21/2012	Noon	460	3	150	13	79
VK989	9/21/2012	Noon	461	1	174	3	3
VK989	9/21/2012	Noon	461	2	124	1	7
VK989	9/21/2012	Noon	461	3	149	6	77
VK989	9/21/2012	Dusk	463	1	167	6	3
VK989	9/21/2012	Dusk	463	2	193	3	5
VK989	9/21/2012	Dusk	463	3	163	13	70
VK989	9/21/2012	Dusk	464	1	90	3	5
VK989	9/21/2012	Dusk	464	2	196	6	6
VK989	9/21/2012	Dusk	464	3	167	15	76
VK989	9/21/2012	Dusk	465	1	202	0	8
VK989	9/21/2012	Dusk	465	2	170	0	2
VK989	9/21/2012	Dusk	465	3	168	8	67
MC920	9/22/2012	Dawn	466	1	171	0	5
MC920	9/22/2012	Dawn	466	2	154	0	16
MC920	9/22/2012	Dawn	466	3	151	7	69
MC920	9/22/2012	Dawn	467	1	180	1	3
MC920	9/22/2012	Dawn	467	2	163	5	9

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
MC920	9/22/2012	Dawn	467	3	164	10	98
MC920	9/22/2012	Dawn	468	1	153	1	4
MC920	9/22/2012	Dawn	468	2	153	1	12
MC920	9/22/2012	Dawn	468	3	162	12	97
MC920	9/22/2012	Noon	469	1	98	1	2
MC920	9/22/2012	Noon	469	2	189	1	6
MC920	9/22/2012	Noon	469	3	174	13	82
MC920	9/22/2012	Noon	470	1	165	1	4
MC920	9/22/2012	Noon	470	2	147	2	14
MC920	9/22/2012	Noon	470	3	164	7	49
MC920	9/22/2012	Noon	471	1	151	0	3
MC920	9/22/2012	Noon	471	2	184	1	12
MC920	9/22/2012	Noon	471	3	172	10	58
MC920	9/22/2012	Dusk	472	1	150	3	1
MC920	9/22/2012	Dusk	472	2	154	0	9
MC920	9/22/2012	Dusk	472	3	139	5	54
MC920	9/22/2012	Dusk	473	1	141	3	1
MC920	9/22/2012	Dusk	473	2	152	1	6
MC920	9/22/2012	Dusk	473	3	138	4	48
MC920	9/22/2012	Dusk	474	1	163	2	8
MC920	9/22/2012	Dusk	474	2	151	0	9
MC920	9/22/2012	Dusk	474	3	142	3	42
AC25	10/4/2012	Dawn	475	1	268	2	5
AC25	10/4/2012	Dawn	475	2	170	1	16
AC25	10/4/2012	Dawn	475	3	204	2	94
AC25	10/4/2012	Dawn	476	1	181	4	3
AC25	10/4/2012	Dawn	476	2	159	0	10
AC25	10/4/2012	Dawn	476	3	212	2	112
AC25	10/4/2012	Dawn	477	1	198	3	5
AC25	10/4/2012	Dawn	477	2	158	0	15
AC25	10/4/2012	Dawn	477	3	183	1	90
AC25	10/4/2012	Noon	478	1	179	1	9
AC25	10/4/2012	Noon	478	2	152	0	22
AC25	10/4/2012	Noon	478	3	174	2	85

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
AC25	10/4/2012	Noon	479	1	151	3	4
AC25	10/4/2012	Noon	479	2	157	1	19
AC25	10/4/2012	Noon	479	3	164	2	85
AC25	10/4/2012	Noon	480	1	37	0	3
AC25	10/4/2012	Noon	480	2	174	1	12
AC25	10/4/2012	Noon	480	3	194	6	80
AC25	10/4/2012	Dusk	481	1	173	1	3
AC25	10/4/2012	Dusk	481	2	172	0	16
AC25	10/4/2012	Dusk	481	3	173	6	90
AC25	10/4/2012	Dusk	482	1	177	3	9
AC25	10/4/2012	Dusk	482	2	187	3	77
AC25	10/4/2012	Dusk	482	3	165	3	77
AC25	10/4/2012	Dusk	483	1	168	1	7
AC25	10/4/2012	Dusk	483	2	173	0	17
AC25	10/4/2012	Dusk	483	3	156	6	85
GB668	10/5/2012	Dawn	484	1	174	0	2
GB668	10/5/2012	Dawn	484	2	150	0	11
GB668	10/5/2012	Dawn	484	3	167	4	91
GB668	10/5/2012	Dawn	486	1	152	2	5
GB668	10/5/2012	Dawn	486	2	129	0	12
GB668	10/5/2012	Dawn	486	3	138	5	55
GB668	10/5/2012	Noon	487	1	137	2	4
GB668	10/5/2012	Noon	487	2	137	0	14
GB668	10/5/2012	Noon	487	3	154	8	68
GB668	10/5/2012	Noon	488	1	149	0	5
GB668	10/5/2012	Noon	488	2	141	1	10
GB668	10/5/2012	Noon	488	3	147	13	66
GB668	10/5/2012	Noon	489	1	174	2	2
GB668	10/5/2012	Noon	489	2	156	0	14
GB668	10/5/2012	Noon	489	3	160	9	44
GB668	10/5/2012	Dusk	490	1	135	4	3
GB668	10/5/2012	Dusk	490	2	141	0	7
GB668	10/5/2012	Dusk	490	3	152	5	69
GB668	10/5/2012	Dusk	491	1	141	3	8

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
GB668	10/5/2012	Dusk	491	2	141	1	12
GB668	10/5/2012	Dusk	491	3	164	14	64
GB668	10/5/2012	Dusk	492	1	156	1	6
GB668	10/5/2012	Dusk	492	2	141	0	3
GB668	10/5/2012	Dusk	492	3	160	14	69
VK989	10/17/2012	Dawn	494	1	71	1	5
VK989	10/17/2012	Dawn	494	2	142	2	5
VK989	10/17/2012	Dawn	494	3	160	9	75
VK989	10/17/2012	Dawn	495	1	143	3	2
VK989	10/17/2012	Dawn	495	2	176	2	11
VK989	10/17/2012	Dawn	495	3	178	12	66
VK989	10/17/2012	Dawn	496	1	146	4	2
VK989	10/17/2012	Dawn	496	2	154	2	10
VK989	10/17/2012	Dawn	496	3	162	45	77
VK989	10/17/2012	Noon	497	1	170	1	3
VK989	10/17/2012	Noon	497	2	151	10	20
VK989	10/17/2012	Noon	497	3	167	5	87
VK989	10/17/2012	Noon	498	1	198	3	3
VK989	10/17/2012	Noon	498	2	198	6	19
VK989	10/17/2012	Noon	498	3	179	5	99
VK989	10/17/2012	Noon	499	1	200	1	10
VK989	10/17/2012	Noon	499	2	194	8	19
VK989	10/17/2012	Noon	499	3	187	7	83
GB668	10/31/2012	Dusk	500	1	135	2	4
GB668	10/31/2012	Dusk	500	2	132	1	8
GB668	10/31/2012	Dusk	500	3	150	2	45
GB668	10/31/2012	Dusk	501	1	159	2	4
GB668	10/31/2012	Dusk	501	2	161	0	17
GB668	10/31/2012	Dusk	501	3	189	12	66
GB668	10/31/2012	Dusk	502	1	171	2	4
GB668	10/31/2012	Dusk	502	2	157	0	9
GB668	10/31/2012	Dusk	502	3	206	18	47
AC25	11/1/2012	Dawn	503	1	144	1	7
AC25	11/1/2012	Dawn	503	2	144	0	18

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
AC25	11/1/2012	Dawn	503	3	169	1	241
AC25	11/1/2012	Dawn	504	1	150	2	8
AC25	11/1/2012	Dawn	504	2	171	2	22
AC25	11/1/2012	Dawn	504	3	173	4	189
AC25	11/1/2012	Dawn	505	1	159	0	5
AC25	11/1/2012	Dawn	505	2	164	1	14
AC25	11/1/2012	Dawn	505	3	171	11	182
AC25	11/1/2012	Noon	506	1	160	4	7
AC25	11/1/2012	Noon	506	2	155	0	13
AC25	11/1/2012	Noon	506	3	171	2	167
AC25	11/1/2012	Noon	508	1	154	0	2
AC25	11/1/2012	Noon	508	2	148	1	19
AC25	11/1/2012	Noon	508	3	170	6	128
AC25	11/1/2012	Dusk	509	1	163	0	5
AC25	11/1/2012	Dusk	509	2	146	1	14
AC25	11/1/2012	Dusk	509	3	152	0	121
AC25	11/1/2012	Dusk	510	1	173	1	5
AC25	11/1/2012	Dusk	510	2	170	7	16
AC25	11/1/2012	Dusk	510	3	164	3	142
AC25	11/1/2012	Dusk	512	1	151	2	6
AC25	11/1/2012	Dusk	512	2	151	1	18
AC25	11/1/2012	Dusk	512	3	154	2	57
AC25	11/2/2012	Dawn	513	1	166	3	8
AC25	11/2/2012	Dawn	513	2	152	2	16
AC25	11/2/2012	Dawn	513	3	153	3	193
AC25	11/2/2012	Dawn	514	1	148	0	5
AC25	11/2/2012	Dawn	514	2	141	2	15
AC25	11/2/2012	Dawn	514	3	173	10	129
AC25	11/2/2012	Dawn	515	1	145	1	3
AC25	11/2/2012	Dawn	515	2	141	1	26
AC25	11/2/2012	Dawn	515	3	174	20	119
AC25	11/2/2012	Noon	517	1	172	3	4
AC25	11/2/2012	Noon	517	2	174	13	7
AC25	11/2/2012	Noon	517	3	192	5	167

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
AC25	11/2/2012	Noon	518	1	152	0	7
AC25	11/2/2012	Noon	518	2	180	3	30
AC25	11/2/2012	Noon	518	3	164	4	95
VK989	1/19/2013	Noon	525	1	152	3	4
VK989	1/19/2013	Noon	525	2	137	2	4
VK989	1/19/2013	Noon	525	3	138	26	5
VK989	1/19/2013	Noon	526	1	141	4	9
VK989	1/19/2013	Noon	526	2	119	33	50
VK989	1/19/2013	Noon	526	3	155	38	53
VK989	1/19/2013	Dusk	527	1	127	1	9
VK989	1/19/2013	Dusk	527	2	129	14	51
VK989	1/19/2013	Dusk	527	3	190	83	76
VK989	1/19/2013	Dusk	529	1	159	9	16
VK989	1/19/2013	Dusk	529	2	163	20	42
VK989	1/19/2013	Dusk	529	3	192	69	92
VK989	1/19/2013	Dusk	530	1	152	7	10
VK989	1/19/2013	Dusk	530	2	175	4	13
VK989	1/19/2013	Dusk	530	3	204	39	63
MC920	1/24/2013	Dawn	531	1	173	9	9
MC920	1/24/2013	Dawn	531	2	161	2	32
MC920	1/24/2013	Dawn	531	3	178	9	59
MC920	1/24/2013	Dawn	532	1	141	1	7
MC920	1/24/2013	Dawn	532	2	150	3	23
MC920	1/24/2013	Dawn	532	3	163	9	25
MC920	1/24/2013	Dawn	533	1	175	7	43
MC920	1/24/2013	Dawn	533	2	159	4	21
MC920	1/24/2013	Dawn	533	3	172	11	54
MC920	1/24/2013	Noon	534	1	194	1	4
MC920	1/24/2013	Noon	534	2	182	8	25
MC920	1/24/2013	Noon	534	3	182	4	89
MC920	1/24/2013	Noon	535	1	155	4	3
MC920	1/24/2013	Noon	535	2	162	5	18
MC920	1/24/2013	Noon	535	3	172	12	65
MC920	1/24/2013	Noon	536	1	187	0	2

Table E-1. (Continued).

Station	Sampling Date	Time of Day	Tow	Net	Volume Filtered (m^3)	Number of Eggs	Number of Larvae
MC920	1/24/2013	Noon	536	2	187	3	29
MC920	1/24/2013	Noon	536	3	183	5	73
MC920	1/24/2013	Dusk	537	1	163	2	6
MC920	1/24/2013	Dusk	537	2	182	4	27
MC920	1/24/2013	Dusk	537	3	188	9	60
MC920	1/24/2013	Dusk	538	1	150	2	7
MC920	1/24/2013	Dusk	538	2	171	3	39
MC920	1/24/2013	Dusk	538	3	165	6	61
MC920	1/24/2013	Dusk	539	1	172	1	6
MC920	1/24/2013	Dusk	539	2	171	3	35
MC920	1/24/2013	Dusk	539	3	173	3	52

APPENDIX F

Hydrographic Data Summaries

Table F-1. Hydrographic data summaries.

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
AC25	7	1	1	2011	Dawn	285	2.54	135.38	36.1	17.49
AC25	7	2	1	2011	Dawn	203	1.61	252.19	35.66	13.31
AC25	7	3	1	2011	Dawn	253	1.73	153.61	36.19	17.26
AC25	8	1	1	2011	Noon	208	1.62	245.63	35.68	13.49
AC25	8	2	1	2011	Noon	137	1.82	144.31	36.21	17.6
AC25	8	3	1	2011	Noon	155	3.21	40.44	36.27	20.41
AC25	9	1	1	2011	Dusk	258	1.58	259.28	35.63	13.16
AC25	9	2	1	2011	Dusk	151	1.86	145.63	36.19	17.41
AC25	9	3	1	2011	Dusk	184	3.2	40.34	35.93	20.43
GB668	10	1	1	2011	Dawn	193	1.62	256.42	35.64	13.24
GB668	10	2	1	2011	Dawn	194	1.89	145.84	36.28	18.17
GB668	10	3	1	2011	Dawn	149	3.01	37.93	35.84	21.26
GB668	11	1	1	2011	Noon	244	1.65	251.03	35.69	13.53
GB668	11	2	1	2011	Noon	206	1.87	153.94	36.25	17.8
GB668	11	3	1	2011	Noon	219	3.12	45.73	35.14	21.14
GB668	12	1	1	2011	Dusk	260	1.65	252.55	35.67	13.39
GB668	12	2	1	2011	Dusk	230	1.82	156.2	36.23	17.61
GB668	12	3	1	2011	Dusk	205	3.07	44.21	34.65	21.33
MC920	1	1	1	2011	Dawn	200	1.85	246.23	35.93	15.07
MC920	1	2	1	2011	Dawn	222	2.39	141.77	36.4	19.09
MC920	1	3	1	2011	Dawn	325	3.05	32.04	36.06	20.84
MC920	2	1	1	2011	Noon	216	1.81	258	35.88	14.72
MC920	2	2	1	2011	Noon	229	2.15	159.25	36.33	18.19
MC920	2	3	1	2011	Noon	241	3.28	39.53	33.38	20.22
MC920	3	1	1	2011	Dusk	262	1.85	257.56	35.9	14.9
MC920	3	2	1	2011	Dusk	249	2.22	149	36.38	18.58
MC920	3	3	1	2011	Dusk	281	3.17	36.21	35.6	20.68
VK989	4	1	1	2011	Dawn	239	1.72	251.67	35.53	12.51
VK989	4	2	1	2011	Dawn	193	1.85	151.69	36.12	16.44
VK989	4	3	1	2011	Dawn	246	3.06	42.5	36.13	19.61
VK989	5	1	1	2011	Noon	295	1.73	248	35.57	12.74

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
VK989	5	2	1	2011	Noon	316	1.89	157.24	36.1	16.21
VK989	5	3	1	2011	Noon	250	3.03	46.99	35.38	19.52
VK989	6	1	1	2011	Dusk	314	1.72	249.66	35.53	12.52
VK989	6	2	1	2011	Dusk	248	1.88	156.32	36.1	16.22
VK989	6	3	1	2011	Dusk	300	3.05	47.4	36.2	19.61
AC25	31	1	3	2011	Dawn	284	3.54	110.58	35.96	15.98
AC25	31	2	3	2011	Dawn	230	2.49	251.72	35.23	9.89
AC25	31	3	3	2011	Dawn	304	2.58	148.34	35.75	13.72
AC25	34	1	3	2011	Noon	443	2.49	243.39	35.23	9.87
AC25	34	2	3	2011	Noon	468	2.56	155.9	35.68	13.18
AC25	34	3	3	2011	Noon	393	4.2	39.34	35.85	19.79
AC25	37	1	3	2011	Dusk	558	2.49	247.32	35.23	9.83
AC25	37	2	3	2011	Dusk	517	2.56	156.85	35.7	13.34
AC25	37	3	3	2011	Dusk	415	4.14	46.05	36.08	19.91
GB668	25	1	2	2011	Dawn	273	1.64	247.2	35.69	13.51
GB668	25	2	2	2011	Dawn	262	1.89	151.42	36.23	17.41
GB668	25	3	2	2011	Dawn	232	3.1	44.31	35.7	20.3
GB668	27	1	2	2011	Noon	247	1.67	246.92	35.72	13.67
GB668	27	2	2	2011	Noon	255	1.96	153.46	36.22	17.33
GB668	27	3	2	2011	Noon	194	3.23	43.43	35.59	20.36
GB668	29	1	2	2011	Dusk	177	1.62	254.08	35.66	13.31
GB668	29	2	2	2011	Dusk	156	1.91	144.43	36.24	17.66
GB668	29	3	2	2011	Dusk	242	3.21	39.1	35.79	20.4
MC920	15	1	2	2011	Noon	239	1.88	249.21	35.71	13.73
MC920	15	2	2	2011	Noon	255	2.42	153.08	36.2	17.45
MC920	15	3	2	2011	Noon	241	3.19	41.71	34.42	20.2
MC920	17	1	2	2011	Dusk	356	1.91	252.07	35.67	13.43
MC920	17	2	2	2011	Dusk	294	2.17	155.01	36.21	17.26
MC920	17	3	2	2011	Dusk	279	3.24	49.06	36.03	19.9
VK989	19	1	2	2011	Dawn	234	1.77	247.29	35.61	12.98
VK989	19	2	2	2011	Dawn	300	1.99	154.9	36.09	16.47
VK989	19	3	2	2011	Dawn	244	3.23	46.58	35.89	19.36

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
VK989	21	1	2	2011	Noon	291	1.79	246.24	35.58	12.8
VK989	21	2	2	2011	Noon	276	1.91	154.52	36.08	16.36
VK989	21	3	2	2011	Noon	277	3.23	46.13	36.16	19.43
VK989	23	1	2	2011	Dusk	308	1.74	246.95	35.59	12.86
VK989	23	2	2	2011	Dusk	298	2.02	153.49	36.07	16.35
VK989	23	3	2	2011	Dusk	270	3.27	46.34	36.29	19.61
AC25	32	1	3	2011	Dawn	280	2.49	248.46	35.24	10.01
AC25	32	2	3	2011	Dawn	348	2.58	152.89	35.73	13.55
AC25	32	3	3	2011	Dawn	456	4.24	39.63	35.94	20.23
AC25	35	1	3	2011	Noon	524	2.48	250.62	35.27	10.24
AC25	35	2	3	2011	Noon	448	2.58	160.07	35.74	13.64
AC25	35	3	3	2011	Noon	388	4.28	41.4	35.78	20.1
AC25	84	1	5	2011	Dusk	161	2.57	250.24	35.35	11.29
AC25	84	2	5	2011	Dusk	400	3.46	114.98	36.05	17.36
AC25	84	3	5	2011	Dusk	64	4.98	16.49	36.38	24.92
GB668	26	1	2	2011	Dawn	289	1.66	249.41	35.68	13.42
GB668	26	2	2	2011	Dawn	274	1.94	151.13	36.22	17.39
GB668	26	3	2	2011	Dawn	263	3.19	44.76	36.06	20.33
GB668	28	1	2	2011	Noon	283	1.66	246.78	35.71	13.61
GB668	28	2	2	2011	Noon	255	1.95	152.02	36.22	17.34
GB668	28	3	2	2011	Noon	248	3.22	39.31	35.62	20.41
GB668	30	1	2	2011	Dusk	204	1.64	250.97	35.67	13.37
GB668	30	2	2	2011	Dusk	224	1.9	150.98	36.21	17.36
GB668	30	3	2	2011	Dusk	224	3.16	42.45	35.93	20.35
MC920	14	1	2	2011	Dawn	207	1.84	248.54	35.74	13.89
MC920	14	2	2	2011	Dawn	258	2.4	148.24	36.21	17.54
MC920	14	3	2	2011	Dawn	212	3.29	42.83	34.62	20.13
MC920	16	1	2	2011	Noon	259	1.89	248.27	35.72	13.73
MC920	16	2	2	2011	Noon	278	2.42	153.06	36.2	17.39
MC920	16	3	2	2011	Noon	255	3.2	46.95	35.69	19.98
MC920	18	1	2	2011	Dusk	471	1.9	255.65	35.64	13.22
MC920	18	2	2	2011	Dusk	329	2.15	157.05	36.2	17.15

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
MC920	18	3	2	2011	Dusk	318	3.2	47.25	35.98	20.01
VK989	20	1	2	2011	Dawn	289	1.78	250.77	35.6	12.92
VK989	20	2	2	2011	Dawn	277	2.01	156.02	36.08	16.44
VK989	20	3	2	2011	Dawn	396	3.28	45.35	35.03	19.39
VK989	22	1	2	2011	Noon	317	1.78	246.75	35.54	12.56
VK989	22	2	2	2011	Noon	326	1.94	154.03	36.08	16.34
VK989	22	3	2	2011	Noon	302	3.26	47.28	36.06	19.4
VK989	24	1	2	2011	Dusk	325	1.79	247.46	35.6	12.93
VK989	24	2	2	2011	Dusk	310	2.01	155.38	36.06	16.31
VK989	24	3	2	2011	Dusk	268	3.25	46.47	36.35	19.59
AC25	33	1	3	2011	Dawn	405	2.49	251.31	35.23	9.88
AC25	33	2	3	2011	Dawn	468	2.49	209.3	35.37	11.05
AC25	33	3	3	2011	Dawn	454	2.57	158.44	35.69	13.29
AC25	36	1	3	2011	Noon	430	2.48	246.54	35.26	10.09
AC25	36	2	3	2011	Noon	399	2.57	155.45	35.73	13.52
AC25	36	3	3	2011	Noon	440	4.14	46.54	35.74	19.8
AC25	85	1	5	2011	Dusk	193	2.57	249.25	35.34	11.24
AC25	85	2	5	2011	Dusk	167	2.7	147.37	35.86	14.81
AC25	85	3	5	2011	Dusk	293	4.63	47.14	36.02	22.41
GB668	39	1	3	2011	Dawn	264	2.53	247.34	35.3	10.53
GB668	39	2	3	2011	Dawn	328	2.64	155.07	35.76	13.82
GB668	39	3	3	2011	Dawn	271	4.24	46.34	36.25	19.44
GB668	41	1	3	2011	Noon	333	2.54	247.83	35.24	10.02
GB668	41	2	3	2011	Noon	288	2.64	146.97	35.76	13.83
GB668	41	3	3	2011	Noon	257	4.22	39.98	35.66	19.15
GB668	75	1	5	2011	Dusk	142	2.65	249.55	35.76	14.06
GB668	75	2	5	2011	Dusk	119	3.33	147.58	36.3	18.53
GB668	75	3	5	2011	Dusk	227	5.01	42.67	36.22	23.53
MC920	46	1	3	2011	Dawn	56	3.02	253.82	35.83	14.5
MC920	46	2	3	2011	Dawn	52	3.73	144.91	36.27	18.12
MC920	46	3	3	2011	Dawn	101	4.98	46.35	36.36	21.68
MC920	48	1	3	2011	Noon	345	3.03	247.44	35.83	14.43

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
MC920	48	2	3	2011	Noon	317	3.72	153.17	36.29	17.85
MC920	48	3	3	2011	Noon	328	4.8	48.97	35.84	21.89
MC920	50	1	3	2011	Dusk	101	3.03	250.98	35.82	14.41
MC920	50	2	3	2011	Dusk	97	3.69	142.14	36.38	18.45
MC920	50	3	3	2011	Dusk	82	4.52	40.29	35.84	22.99
VK989	44	1	3	2011	Dusk	106	2.83	245.84	35.71	13.69
VK989	44	2	3	2011	Dusk	114	3.41	154.87	36.13	17.06
VK989	44	3	3	2011	Dusk	125	5.07	51.14	35.56	20.18
VK989	59	1	4	2011	Dawn	80	2.81	251.77	35.46	12.15
VK989	59	2	4	2011	Dawn	716	3.28	143.54	36.09	16.52
VK989	59	3	4	2011	Dawn	95	4.84	38.48	33.9	21.78
VK989	62	1	4	2011	Noon	194	2.81	250.15	35.46	12.14
VK989	62	2	4	2011	Noon	154	3.23	151.78	36.03	15.98
VK989	62	3	4	2011	Noon	112	4.64	47.85	36.34	21.26
AC25	78	1	5	2011	Dawn	292	2.55	247.81	35.34	11.15
AC25	78	2	5	2011	Dawn	300	2.65	156.33	35.81	14.42
AC25	78	3	5	2011	Dawn	247	4.47	49.44	35.6	21.36
AC25	81	1	5	2011	Noon	94	2.6	253.28	35.33	11.18
AC25	81	2	5	2011	Noon	130	2.72	149.3	35.85	14.72
AC25	81	3	5	2011	Noon	205	4.63	48.36	36.29	22.13
AC25	86	1	5	2011	Dusk	177	2.56	252.17	35.34	11.19
AC25	86	2	5	2011	Dusk	172	2.68	148.94	35.85	14.77
AC25	86	3	5	2011	Dusk	287	4.73	44.35	35.9	22.73
GB668	40	1	3	2011	Dawn	292	2.53	252.29	35.28	10.4
GB668	40	2	3	2011	Dawn	305	2.65	151.89	35.79	14.02
GB668	40	3	3	2011	Dawn	227	4.35	41.03	36.32	19.59
GB668	72	1	5	2011	Noon	121	2.65	254.82	35.73	13.86
GB668	72	2	5	2011	Noon	84	3.45	152.04	36.24	18.16
GB668	72	3	5	2011	Noon	143	5.01	40.61	36.54	23.69
GB668	76	1	5	2011	Dusk	127	2.65	250.91	35.77	14.14
GB668	76	2	5	2011	Dusk	156	2.74	196	36.07	16.24
GB668	76	3	5	2011	Dusk	266	3.38	146.49	36.32	18.67

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
MC920	47	1	3	2011	Dawn	142	3.03	249.18	35.83	14.49
MC920	47	2	3	2011	Dawn	98	3.79	142.91	36.26	18.13
MC920	47	3	3	2011	Dawn	95	5.02	42.16	36.36	21.88
MC920	49	1	3	2011	Noon	344	3.01	245.41	35.82	14.37
MC920	49	2	3	2011	Noon	304	3.67	150.13	36.3	17.88
MC920	49	3	3	2011	Noon	234	4.86	47.52	36.37	21.84
MC920	51	1	3	2011	Dusk	138	3.02	251.29	35.82	14.42
MC920	51	2	3	2011	Dusk	144	3.35	150.85	36.36	18.09
MC920	51	3	3	2011	Dusk	267	4.52	40.58	36.38	23.19
VK989	45	1	3	2011	Dusk	88	2.91	245.28	35.72	13.8
VK989	45	2	3	2011	Dusk	38	3.55	150.25	36.16	17.32
VK989	45	3	3	2011	Dusk	2.1	5.05	46.34	36.04	20.43
VK989	60	1	4	2011	Dawn	138	2.82	248.86	35.49	12.34
VK989	60	2	4	2011	Dawn	135	3.21	152.37	36.06	16.19
VK989	60	3	4	2011	Dawn	193	4.81	44.65	35.78	21.5
VK989	63	1	4	2011	Noon	317	2.83	250.49	35.48	12.25
VK989	63	2	4	2011	Noon	250	3.2	155.61	36.02	15.87
VK989	63	3	4	2011	Noon	219	4.72	45.92	35.98	21.54
AC25	79	1	5	2011	Dawn	512	2.58	255.05	35.3	10.89
AC25	79	2	5	2011	Dawn	346	2.67	157.21	35.78	14.23
AC25	79	3	5	2011	Dawn	308	4.6	50.77	35.66	21.55
AC25	82	1	5	2011	Noon	74	2.59	251.28	35.33	11.23
AC25	82	2	5	2011	Noon	124	2.72	148.54	35.87	14.89
AC25	82	3	5	2011	Noon	200	4.62	47.2	36.06	22.01
AC25	115	1	6	2011	Dusk	183	4.93	250.07	35.5	12.32
AC25	115	2	6	2011	Dusk	208	5.23	146.91	36.06	16.34
AC25	115	3	6	2011	Dusk	281	6.15	47.49	36.1	24.35
GB668	69	1	5	2011	Dawn	521	2.71	230.74	35.89	14.9
GB668	69	2	5	2011	Dawn	250	3.62	141.86	36.29	18.72
GB668	73	1	5	2011	Noon	116	2.66	248.99	35.75	14.02
GB668	73	2	5	2011	Noon	148	3.65	141.65	36.27	18.64
GB668	73	3	5	2011	Noon	257	4.96	37.66	34.91	23.73

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
GB668	77	1	5	2011	Dusk	135	2.65	252.26	35.76	14.11
GB668	77	2	5	2011	Dusk	219	3.5	145.96	36.31	18.8
GB668	77	3	5	2011	Dusk	314	5.01	42.23	36.52	23.58
MC920	52	1	4	2011	Dawn	82	2.92	306.82	35.49	12.29
MC920	52	2	4	2011	Dawn	77	2.94	258.96	35.64	13.32
MC920	57	1	4	2011	Dusk	406	2.98	247.39	35.71	13.71
MC920	57	2	4	2011	Dusk	347	3.41	154.66	36.1	16.11
MC920	57	3	4	2011	Dusk	281	4.39	51.09	36.3	21.09
VK989	61	1	4	2011	Dawn	213	2.81	249.4	35.47	12.19
VK989	61	2	4	2011	Dawn	199	3.22	151.05	36.07	16.22
VK989	61	3	4	2011	Dawn	293	4.79	46.78	35.97	21.46
VK989	64	1	4	2011	Noon	165	2.82	252.31	35.46	12.15
VK989	64	2	4	2011	Noon	169	3.22	150.56	36.05	16.07
VK989	64	3	4	2011	Noon	242	4.76	43.28	35.93	21.74
VK989	65	1	4	2011	Dusk	285	2.82	251.31	35.48	12.25
VK989	65	2	4	2011	Dusk	249	3.19	152.49	36.04	16.01
VK989	65	3	4	2011	Dusk	163	4.73	48.65	36.34	21.44
AC25	80	1	5	2011	Dawn	268	2.59	251.72	35.33	11.12
AC25	80	2	5	2011	Dawn	177	2.68	155.97	35.79	14.33
AC25	80	3	5	2011	Dawn	105	4.53	47.56	36.12	21.7
AC25	83	1	5	2011	Noon	87	2.58	251.02	35.33	11.15
AC25	83	2	5	2011	Noon	150	2.72	149.43	35.87	14.82
AC25	83	3	5	2011	Noon	235	4.59	49.2	36.32	21.87
AC25	116	1	6	2011	Dusk	175	4.89	251.34	35.5	12.35
AC25	116	2	6	2011	Dusk	232	4.52	141.33	36.1	16.74
AC25	116	3	6	2011	Dusk	202	6.16	42.23	36.36	24.85
GB668	70	1	5	2011	Dawn	130	2.67	252.77	35.75	14.01
GB668	70	2	5	2011	Dawn	113	3.41	152.89	36.25	18.25
GB668	70	3	5	2011	Dawn	125	4.97	49.68	36.53	23.35
GB668	74	1	5	2011	Noon	143	2.66	250.16	35.74	13.97
GB668	74	2	5	2011	Noon	162	3.61	144.31	36.26	18.51
GB668	74	3	5	2011	Noon	255	5.03	41.59	36.55	23.68

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
GB668	124	1	6	2011	Noon	116	5.12	253.8	35.77	14.23
GB668	124	2	6	2011	Noon	81	5.92	143.69	36.27	18.59
GB668	124	3	6	2011	Noon	115	6.8	41.33	36.54	25.58
GB668	127	1	6	2011	Dusk	147	5.12	249.6	35.78	14.26
GB668	127	2	6	2011	Dusk	115	5.9	149.37	36.29	18.6
GB668	127	3	6	2011	Dusk	101	6.99	47.01	35.82	25.01
MC920	53	1	4	2011	Dawn	17	2.95	250.48	35.66	13.45
MC920	53	2	4	2011	Dawn	15	3.46	148.46	36.07	15.94
MC920	53	3	4	2011	Dawn	155	4.58	30.95	35.67	22.29
MC920	55	1	4	2011	Noon	269	2.99	248.81	35.69	13.6
MC920	55	2	4	2011	Noon	242	3.43	145.83	36.12	16.25
MC920	55	3	4	2011	Noon	158	4.51	37.14	34.42	21.82
VK989	66	1	4	2011	Dusk	241	2.82	249.2	35.5	12.41
VK989	66	2	4	2011	Dusk	231	3.22	152.07	36.06	16.16
VK989	66	3	4	2011	Dusk	171	4.71	48.98	35.79	21.42
VK989	67	1	5	2011	Dawn	124	2.81	251.16	35.37	11.6
VK989	67	2	5	2011	Dawn	110	3.17	140.86	35.92	15.42
VK989	67	3	5	2011	Dawn	60	4.56	38.68	36.14	21.88
VK989	95	1	5	2011	Noon	226	5.26	257.58	35.42	11.88
VK989	95	2	5	2011	Noon	311	5.2	148.6	36	15.6
VK989	95	3	5	2011	Noon	280	6.23	50.27	36.23	22
AC25	109	1	6	2011	Dawn	210	4.99	249.21	35.48	12.23
AC25	109	2	6	2011	Dawn	281	4.52	153.67	36.03	16.04
AC25	109	3	6	2011	Dawn	220	5.95	49.86	36.48	24.31
AC25	112	1	6	2011	Noon	387	4.88	245.4	35.52	12.42
AC25	112	2	6	2011	Noon	225	4.44	149.98	36.03	16.13
AC25	112	3	6	2011	Noon	137	5.8	47.58	36.43	24.49
AC25	117	1	6	2011	Dusk	166	4.82	250.25	35.51	12.38
AC25	117	2	6	2011	Dusk	189	4.49	146.18	36.08	16.5
AC25	117	3	6	2011	Dusk	188	6.05	48.29	36.2	24.13
GB668	71	1	5	2011	Dawn	66	2.66	251.59	35.74	13.97
GB668	71	2	5	2011	Dawn	65	3.49	149.81	36.25	18.37

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
GB668	71	3	5	2011	Dawn	47	5	46.22	36.24	23.49
GB668	125	1	6	2011	Noon	115	5.11	249.14	35.8	14.39
GB668	125	2	6	2011	Noon	112	5.99	144.05	36.29	18.62
GB668	125	3	6	2011	Noon	114	6.82	46.11	36.56	25.17
GB668	128	1	6	2011	Dusk	179	5.13	250.09	35.78	14.19
GB668	128	2	6	2011	Dusk	155	5.85	152.03	36.29	18.52
GB668	128	3	6	2011	Dusk	110	7.04	46	36.06	25.12
MC920	88	1	5	2011	Dawn	148	5.09	256.34	35.74	13.95
MC920	88	2	5	2011	Dawn	98	5.03	148.59	36.27	18.01
MC920	88	3	5	2011	Dawn	101	6.34	46.23	36.34	23.07
MC920	90	1	5	2011	Noon	223	4.92	248.44	35.77	14.12
MC920	90	2	5	2011	Noon	189	5.03	143.92	36.27	17.92
MC920	90	3	5	2011	Noon	156	6.59	42.72	36.44	23.12
MC920	92	1	5	2011	Dusk	283	4.96	249.18	35.78	14.17
MC920	92	2	5	2011	Dusk	220	4.95	152.47	36.24	17.68
MC920	92	3	5	2011	Dusk	156	6.47	46.19	36.39	23.1
VK989	68	1	5	2011	Dawn	59	2.81	251.29	35.36	11.54
VK989	68	2	5	2011	Dawn	104	3.12	147.3	35.87	15.07
VK989	68	3	5	2011	Dawn	125	4.58	37.48	35.62	22.01
VK989	96	1	5	2011	Noon	338	5.23	244.11	35.46	12.1
VK989	96	2	5	2011	Noon	331	5.13	153.33	35.91	15.01
VK989	96	3	5	2011	Noon	244	6.03	47.46	36.07	22.19
VK989	105	1	5	2011	Dusk	160	5.25	250.47	35.59	12.98
VK989	105	2	5	2011	Dusk	264	5.14	149.29	36.14	16.53
VK989	105	3	5	2011	Dusk	334	6	47.08	35.82	22.63
AC25	113	1	6	2011	Noon	326	4.96	249.05	35.51	12.36
AC25	113	2	6	2011	Noon	289	4.49	151.82	36.03	16
AC25	113	3	6	2011	Noon	165	5.84	49.69	36.42	24.21
AC25	120	1	6	2011	Dusk	387	5.38	254.44	35.48	12.16
AC25	120	2	6	2011	Dusk	330	5.23	150.63	36.04	16.31
AC25	120	3	6	2011	Dusk	192	7.16	48.15	36.23	24.12
AC25	151	1	7	2011	Dusk	148	5.17	249.94	35.84	14.66

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
AC25	151	2	7	2011	Dusk	161	5.78	147.68	36.37	19.32
AC25	151	3	7	2011	Dusk	192	7.16	44.49	35.82	25.6
GB668	121	1	6	2011	Dawn	158	5.18	247.28	35.82	14.54
GB668	121	2	6	2011	Dawn	137	5.96	146.35	36.28	18.51
GB668	121	3	6	2011	Dawn	106	7.06	43.2	36.51	25.22
GB668	126	1	6	2011	Noon	127	5.12	253.4	35.78	14.26
GB668	126	2	6	2011	Noon	117	5.98	144.47	36.29	18.66
GB668	126	3	6	2011	Noon	112	6.89	45.47	36.56	25.22
GB668	129	1	6	2011	Dusk	119	5.12	251.01	35.77	14.19
GB668	129	2	6	2011	Dusk	104	5.94	146.75	36.31	18.8
GB668	129	3	6	2011	Dusk	121	7.15	48.78	36.53	24.87
MC920	89	1	5	2011	Dawn	128	4.98	249.86	35.77	14.15
MC920	89	2	5	2011	Dawn	90	4.85	153.05	36.25	17.75
MC920	89	3	5	2011	Dawn	26	6.33	46.17	35.88	22.95
MC920	91	1	5	2011	Noon	235	5.1	249.17	35.76	14.06
MC920	91	2	5	2011	Noon	190	5.1	146.84	36.25	17.78
MC920	91	3	5	2011	Noon	195	6.58	44.37	36.44	23.07
MC920	93	1	5	2011	Dusk	238	5.04	249.85	35.78	14.14
MC920	93	2	5	2011	Dusk	258	4.9	150.99	36.25	17.77
MC920	93	3	5	2011	Dusk	156	6.39	50.87	36.41	22.73
VK989	94	1	5	2011	Dawn	98	5.26	248.91	35.51	12.52
VK989	94	2	5	2011	Dawn	169	5.2	151.08	36.07	16.03
VK989	94	3	5	2011	Dawn	224	5.99	46.71	36.19	22.25
VK989	97	1	5	2011	Noon	100	5.25	250.41	35.45	12.06
VK989	97	2	5	2011	Noon	140	5.13	149.76	35.97	15.49
VK989	97	3	5	2011	Noon	129	5.93	44.39	35.56	22.36
VK989	106	1	5	2011	Dusk	232	5.28	255.53	35.58	12.89
VK989	106	2	5	2011	Dusk	212	5.15	149.52	36.11	16.37
VK989	106	3	5	2011	Dusk	361	6.06	45.18	35.87	22.99
AC25	111	1	6	2011	Dawn	264	4.83	246.75	35.51	12.39
AC25	111	2	6	2011	Dawn	197	4.46	153.3	36.04	16.16
AC25	111	3	6	2011	Dawn	109	5.84	47.93	36.44	24.37

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
AC25	114	1	6	2011	Noon	352	4.91	249.32	35.5	12.27
AC25	114	2	6	2011	Noon	236	4.49	150.18	36.03	16.07
AC25	114	3	6	2011	Noon	199	5.98	47.14	36.08	24.49
AC25	152	1	7	2011	Dusk	139	5.17	251.45	35.84	14.67
AC25	152	2	7	2011	Dusk	171	5.76	149.3	36.36	19.26
AC25	152	3	7	2011	Dusk	197	7.18	46.38	36.16	25.5
GB668	122	1	6	2011	Dawn	138	5.19	252.82	35.79	14.32
GB668	122	2	6	2011	Dawn	97	6.1	143.22	36.29	18.65
GB668	122	3	6	2011	Dawn	109	7.03	42.05	36.18	25.26
GB668	130	1	6	2011	Noon	121	5.16	250.6	35.76	14.11
GB668	130	2	6	2011	Noon	108	5.68	145.32	36.32	18.92
GB668	130	3	6	2011	Noon	85	7.19	45.67	36.06	24.94
GB668	132	1	6	2011	Dusk	106	5.15	251.53	35.74	14
GB668	132	2	6	2011	Dusk	124	5.78	145.87	36.32	19.03
GB668	132	3	6	2011	Dusk	419	7.2	46.36	36.52	25.17
MC920	100	1	5	2011	Dawn	479	5.53	265.81	35.71	13.76
MC920	100	2	5	2011	Dawn	332	5.32	154.84	36.21	16.81
MC920	100	3	5	2011	Dawn	526	5.43	46.11	36.4	23.35
MC920	101	1	5	2011	Noon	342	5.52	251.37	35.7	13.67
MC920	101	2	5	2011	Noon	284	5.26	157.81	36.12	16.28
MC920	101	3	5	2011	Noon	290	5.4	49.8	36.45	23.25
MC920	102	1	5	2011	Dusk	463	5.51	253.29	35.68	13.56
MC920	102	2	5	2011	Dusk	339	5.36	155.02	36.13	16.35
MC920	102	3	5	2011	Dusk	319	5.5	47.66	36.45	23.58
VK989	103	1	5	2011	Dawn	86	5.21	256.19	35.54	12.65
VK989	103	2	5	2011	Dawn	141	5.04	150.29	36.07	16.11
VK989	103	3	5	2011	Dawn	267	6.09	44.42	35.99	22.8
VK989	104	1	5	2011	Noon	318	5.19	252.58	35.56	12.76
VK989	104	2	5	2011	Noon	245	4.98	155.93	36.06	16.07
VK989	104	3	5	2011	Noon	184	6.03	48.17	35.87	22.62
VK989	107	1	5	2011	Dusk	171	5.1	254.96	35.58	12.9
VK989	107	2	5	2011	Dusk	184	5	147.09	36.13	16.58

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
VK989	107	3	5	2011	Dusk	174	5.87	47.88	36.15	22.73
AC25	118	1	6	2011	Dawn	241	4.86	248.37	35.49	12.24
AC25	118	2	6	2011	Dawn	166	4.45	150.54	36	15.92
AC25	118	3	6	2011	Dawn	67	5.6	45.18	36.26	24.31
AC25	119	1	6	2011	Noon	376	4.89	253.01	35.49	12.2
AC25	119	2	6	2011	Noon	294	4.55	151.09	36.05	16.23
AC25	119	3	6	2011	Noon	246	5.88	50.54	36.31	23.7
AC25	153	1	7	2011	Dusk	142	5.16	250.48	35.85	14.69
AC25	153	2	7	2011	Dusk	177	5.87	146.04	36.37	19.43
AC25	153	3	7	2011	Dusk	180	7.18	44.43	35.97	25.57
GB668	123	1	6	2011	Dawn	113	5.1	253.92	35.78	14.27
GB668	123	2	6	2011	Dawn	98	5.99	144.11	36.28	18.65
GB668	123	3	6	2011	Dawn	101	6.93	45.76	35.98	24.97
GB668	131	1	6	2011	Noon	131	5.16	251.54	35.75	14.08
GB668	131	2	6	2011	Noon	118	5.64	147.14	36.31	18.88
GB668	131	3	6	2011	Noon	105	7.2	48.83	36.51	24.8
GB668	133	1	6	2011	Dusk	125	5.15	252.65	35.75	14.02
GB668	133	2	6	2011	Dusk	133	5.77	148.15	36.32	19.01
GB668	133	3	6	2011	Dusk	123	7.23	48.94	36.19	24.95
MC920	134	1	6	2011	Dawn	105	5.82	253.08	35.36	11.48
MC920	134	2	6	2011	Dawn	82	5.51	144.42	35.97	15.61
MC920	134	3	6	2011	Dawn	100	6.74	43.25	35.78	23.69
MC920	135	1	6	2011	Noon	93	5.83	251.39	35.38	11.66
MC920	135	2	6	2011	Noon	130	5.53	148.24	35.95	15.4
MC920	135	3	6	2011	Noon	114	6.51	41.77	35.87	24.23
MC920	136	1	6	2011	Dusk	119	5.8	249.4	35.41	11.81
MC920	136	2	6	2011	Dusk	127	5.54	146.07	35.96	15.39
MC920	136	3	6	2011	Dusk	135	6.31	49.3	36.26	23.43
VK989	137	1	6	2011	Dawn	147	5.74	257.16	35.48	12.29
VK989	137	2	6	2011	Dawn	102	5.78	143.62	36.06	15.97
VK989	137	3	6	2011	Dawn	106	6.44	47.89	36.1	22.7
VK989	139	1	7	2011	Noon	134	5.78	247.23	35.54	12.7

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
VK989	139	2	7	2011	Noon	161	5.35	149.06	36.05	16
VK989	139	3	7	2011	Noon	138	6.61	47.96	35.83	23.07
VK989	141	1	7	2011	Dusk	167	5.84	258.3	35.5	12.43
VK989	141	2	7	2011	Dusk	131	5.36	148.55	36.07	16.25
VK989	141	3	7	2011	Dusk	143	6.78	46.62	35.94	23.59
AC25	149	1	7	2011	Dawn	191	5.15	248.23	35.87	14.83
AC25	149	2	7	2011	Dawn	205	5.79	150	36.37	19.38
AC25	149	3	7	2011	Dawn	142	7.16	47.47	35.97	25.21
AC25	150	1	7	2011	Noon	144	5.18	251.64	35.87	14.86
AC25	150	2	7	2011	Noon	200	5.96	149.16	36.39	19.63
AC25	150	3	7	2011	Noon	196	7.22	48.77	36.11	25.17
AC25	157	1	7	2011	Dusk	146	5.24	252.23	35.71	13.79
AC25	157	2	7	2011	Dusk	136	6	149.09	36.35	18.96
AC25	157	3	7	2011	Dusk	180	6.93	45.47	36.13	25.99
GB668	146	1	7	2011	Dawn	182	5.33	249.29	35.6	13
GB668	146	2	7	2011	Dawn	176	5.18	150.9	36.07	16.47
GB668	146	3	7	2011	Dawn	128	6.98	47.05	35.78	24.96
GB668	147	1	7	2011	Noon	180	5.32	248.85	35.61	13.1
GB668	147	2	7	2011	Noon	159	5.22	146.84	36.11	16.82
GB668	147	3	7	2011	Noon	208	7.12	46.25	35.59	25.16
GB668	148	1	7	2011	Dusk	144	5.28	249.89	35.63	13.17
GB668	148	2	7	2011	Dusk	170	5.23	149.11	36.09	16.67
GB668	148	3	7	2011	Dusk	157	6.97	47.95	35.67	25.12
MC920	143	1	7	2011	Dawn	257	5.55	249.78	35.8	14.28
MC920	143	2	7	2011	Dawn	229	5.6	154.11	36.25	17.76
MC920	143	3	7	2011	Dawn	150	7.06	50.9	35.87	24.88
MC920	144	1	7	2011	Noon	190	5.92	252.15	35.75	13.97
MC920	144	2	7	2011	Noon	194	5.89	152.18	36.29	17.89
MC920	144	3	7	2011	Noon	219	7.08	47.73	36.08	25.55
MC920	145	1	7	2011	Dusk	171	5.88	248.35	35.79	14.27
MC920	145	2	7	2011	Dusk	225	6.05	149.37	36.27	18.1
MC920	145	3	7	2011	Dusk	204	6.95	43.75	36.11	26.66

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
VK989	138	1	7	2011	Dawn	137	5.8	249.43	35.52	12.55
VK989	138	2	7	2011	Dawn	137	5.34	148.13	36.05	16.04
VK989	138	3	7	2011	Dawn	128	6.7	44.48	35.43	23.63
VK989	140	1	7	2011	Noon	144	5.79	248.11	35.55	12.71
VK989	140	2	7	2011	Noon	163	5.34	148.75	36.06	16.11
VK989	140	3	7	2011	Noon	145	6.63	47.96	35.51	23.12
VK989	142	1	7	2011	Dusk	142	5.77	250.64	35.55	12.74
VK989	142	2	7	2011	Dusk	149	5.36	149.57	36.08	16.26
VK989	142	3	7	2011	Dusk	151	6.74	46.62	35.72	23.65
AC25	154	1	7	2011	Dawn	216	5.21	248.4	35.73	13.88
AC25	154	2	7	2011	Dawn	224	5.83	153.17	36.35	18.77
AC25	154	3	7	2011	Dawn	169	6.96	49.22	36.48	25.55
AC25	156	1	7	2011	Noon	137	5.19	249.14	35.74	14
AC25	156	2	7	2011	Noon	171	5.99	149.3	36.35	18.88
AC25	156	3	7	2011	Noon	191	6.88	43.98	36.4	26.04
AC25	158	1	7	2011	Dusk	145	5.24	252.06	35.71	13.8
AC25	158	2	7	2011	Dusk	161	6.06	146.21	36.34	19.05
AC25	158	3	7	2011	Dusk	173	6.94	44.96	36.02	26.12
GB668	172	1	8	2011	Dawn	149	5.17	251.16	35.76	14.1
GB668	172	2	8	2011	Dawn	166	5.78	150.14	36.31	18.95
GB668	172	3	8	2011	Dawn	148	6.73	41.07	36.52	27.33
GB668	174	1	8	2011	Noon	122	5.17	250.32	35.75	14.06
GB668	174	2	8	2011	Noon	170	5.85	148.11	36.32	19.07
GB668	174	3	8	2011	Noon	187	6.96	46.22	36.49	26.84
GB668	176	1	8	2011	Dusk	147	5.18	250.41	35.78	14.27
GB668	176	2	8	2011	Dusk	169	5.93	147.97	36.35	19.22
GB668	176	3	8	2011	Dusk	207	6.86	41.91	36.51	27.14
MC920	166	1	8	2011	Dawn	165	5.88	251.11	35.58	12.96
MC920	166	2	8	2011	Dawn	152	5.64	149.69	36.16	16.78
MC920	166	3	8	2011	Dawn	138	6.43	38.28	36.28	26.66
MC920	168	1	8	2011	Noon	129	5.91	247.45	35.54	12.73
MC920	168	2	8	2011	Noon	141	5.66	142.89	36.15	16.75

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
MC920	168	3	8	2011	Noon	171	6.44	42.4	36.26	26.12
MC920	170	1	8	2011	Dusk	163	5.89	246.92	35.57	12.86
MC920	170	2	8	2011	Dusk	168	5.67	146.94	36.17	16.87
MC920	170	3	8	2011	Dusk	196	6.41	43.3	35.67	26.14
VK989	160	1	7	2011	Dawn	157	5.81	252.19	35.62	13.19
VK989	160	2	7	2011	Dawn	147	5.66	153.93	36.15	16.75
VK989	160	3	7	2011	Dawn	153	6.39	45.85	34.85	25.8
VK989	162	1	7	2011	Noon	154	5.81	250.4	35.62	13.21
VK989	162	2	7	2011	Noon	159	5.67	147.29	36.18	16.92
VK989	162	3	7	2011	Noon	176	6.36	45.35	35.2	25.51
VK989	164	1	7	2011	Dusk	174	5.85	250.96	35.62	13.2
VK989	164	2	7	2011	Dusk	174	5.76	148.69	36.19	17.07
VK989	164	3	7	2011	Dusk	170	6.45	42.73	35.11	25.89
AC25	178	1	8	2011	Dawn	194	5.33	248.3	35.67	13.45
AC25	178	2	8	2011	Dawn	198	5.61	153.03	36.23	17.79
AC25	178	3	8	2011	Dawn	155	6.93	43.66	36.43	26.88
AC25	179	1	8	2011	Noon	139	5.32	247.14	35.69	13.64
AC25	179	2	8	2011	Noon	161	5.62	149.39	36.28	18.22
AC25	179	3	8	2011	Noon	176	6.85	45.8	36.46	26.57
AC25	180	1	8	2011	Dusk	142	5.39	243.58	35.73	13.92
AC25	180	2	8	2011	Dusk	156	5.59	150.17	36.26	18.08
AC25	180	3	8	2011	Dusk	166	6.79	46.75	36.44	26.71
GB668	173	1	8	2011	Dawn	175	5.15	248.59	35.78	14.24
GB668	173	2	8	2011	Dawn	169	5.75	152.3	36.31	18.87
GB668	173	3	8	2011	Dawn	189	6.87	46.37	36.51	26.79
GB668	175	1	8	2011	Noon	139	5.15	247.82	35.77	14.21
GB668	175	2	8	2011	Noon	180	5.78	150.17	36.32	18.99
GB668	175	3	8	2011	Noon	202	6.97	45.52	36.5	26.77
GB668	177	1	8	2011	Dusk	171	5.17	247.17	35.81	14.49
GB668	177	2	8	2011	Dusk	156	6.01	143.77	36.37	19.44
GB668	177	3	8	2011	Dusk	206	6.88	43.95	36.39	27.04
MC920	167	1	8	2011	Dawn	217	5.88	251.41	35.57	12.88

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
MC920	167	2	8	2011	Dawn	211	5.72	155.09	36.14	16.65
MC920	167	3	8	2011	Dawn	143	6.4	41.86	36.3	26.26
MC920	169	1	8	2011	Noon	126	5.9	253.38	35.52	12.61
MC920	169	2	8	2011	Noon	168	5.68	149.11	36.12	16.56
MC920	169	3	8	2011	Noon	170	6.46	40.74	35.97	26.29
MC920	171	1	8	2011	Dusk	155	5.9	247.44	35.56	12.82
MC920	171	2	8	2011	Dusk	219	5.69	148.86	36.16	16.79
MC920	171	3	8	2011	Dusk	222	6.5	43.01	35.83	26.22
VK989	161	1	7	2011	Dawn	186	5.78	248.55	35.64	13.31
VK989	161	2	7	2011	Dawn	151	5.68	153.47	36.16	16.81
VK989	161	3	7	2011	Dawn	125	6.42	44.56	35.32	26.11
VK989	163	1	7	2011	Noon	139	5.78	248.17	35.64	13.32
VK989	163	2	7	2011	Noon	150	5.67	146.71	36.18	16.93
VK989	163	3	7	2011	Noon	155	6.42	43.68	35.01	25.77
VK989	165	1	7	2011	Dusk	196	5.86	252.68	35.62	13.2
VK989	165	2	7	2011	Dusk	195	5.78	149.98	36.19	17.1
VK989	165	3	7	2011	Dusk	171	6.4	42.02	35.36	25.89
AC25	182	1	8	2011	Noon	168	5.71	249.42	35.88	14.9
AC25	182	2	8	2011	Noon	174	6.13	151.99	36.35	19.12
AC25	182	3	8	2011	Noon	190	6.98	46.66	36.5	26.81
AC25	183	1	8	2011	Dusk	159	5.69	251.73	35.85	14.69
AC25	183	2	8	2011	Dusk	167	6.25	150.62	36.35	19.33
AC25	183	3	8	2011	Dusk	149	6.88	42.64	36.32	27.2
GB668	184	1	8	2011	Dawn	156	5.26	250.02	35.71	13.81
GB668	184	2	8	2011	Dawn	204	5.66	150.89	36.27	18.5
GB668	184	3	8	2011	Dawn	146	6.75	42.41	36.38	27.38
GB668	185	1	8	2011	Noon	178	5.29	244.46	35.76	14.05
GB668	185	2	8	2011	Noon	116	5.75	153.95	36.27	18.56
GB668	185	3	8	2011	Noon	139	6.97	46	36.05	27.03
GB668	186	1	8	2011	Dusk	205	5.28	250.77	35.71	13.72
GB668	186	2	8	2011	Dusk	203	5.75	152.66	36.29	18.67
GB668	186	3	8	2011	Dusk	194	6.88	45.73	36.36	27.4

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
MC920	187	1	8	2011	Dawn	134	5.74	248.05	35.59	13.05
MC920	187	2	8	2011	Dawn	173	5.71	151.48	36.15	16.65
MC920	187	3	8	2011	Dawn	174	6.11	46.06	35.58	25.41
MC920	188	1	8	2011	Noon	175	5.76	256.13	35.56	12.81
MC920	188	2	8	2011	Noon	203	5.71	163.84	36.08	16.17
MC920	188	3	8	2011	Noon	105	6.04	46.72	35.01	25.13
MC920	189	1	8	2011	Dusk	242	5.72	246.16	35.6	13.05
MC920	189	2	8	2011	Dusk	237	5.71	158.59	36.12	16.46
MC920	189	3	8	2011	Dusk	157	6.04	44.18	34.4	25.61
VK989	190	1	8	2011	Dawn	138	5.87	245.63	35.59	13.05
VK989	190	2	8	2011	Dawn	116	5.55	150.02	36.11	16.49
VK989	190	3	8	2011	Dawn	134	5.97	83.61	36.28	19.57
VK989	191	1	8	2011	Noon	248	5.9	244.33	35.62	13.17
VK989	191	2	8	2011	Noon	251	5.72	155.47	36.1	16.32
VK989	191	3	8	2011	Noon	174	6.23	45.47	34.98	25.07
VK989	192	1	8	2011	Dusk	160	5.9	252.24	35.64	13.31
VK989	192	2	8	2011	Dusk	161	5.63	147.88	36.14	16.61
VK989	192	3	8	2011	Dusk	159	6.34	47.81	35.75	24.62
VK989	193	1	8	2011	Dawn	141	5.9	251.14	35.51	12.55
VK989	193	2	8	2011	Dawn	103	5.55	136.3	36.15	16.92
VK989	193	3	8	2011	Dawn	150	6.23	35.94	34.35	25.79
AC25	213	1	9	2011	Dawn	184	5.2	249.25	35.95	15.36
AC25	213	2	9	2011	Dawn	181	6.26	150.37	36.41	19.99
AC25	213	3	9	2011	Dawn	110	6.76	45.3	36.57	27.64
AC25	215	1	9	2011	Noon	129	5.31	252.26	35.96	15.46
AC25	215	2	9	2011	Noon	109	6.33	145.97	36.42	20.25
AC25	215	3	9	2011	Noon	118	6.61	41.46	36.03	28.12
AC25	258	1	1	2012	Dusk	138	5.39	246.45	35.61	13.11
AC25	258	2	1	2012	Dusk	147	5.24	147.9	36.15	16.92
AC25	258	3	1	2012	Dusk	115	7.34	49.43	36.5	22.01
GB668	207	1	9	2011	Dawn	233	5.43	249.12	35.9	15
GB668	207	2	9	2011	Dawn	220	6.07	152.38	36.36	19.47

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
GB668	207	3	9	2011	Dawn	145	6.86	44.86	36.25	27.18
GB668	209	1	9	2011	Noon	179	5.37	247.44	35.87	14.85
GB668	209	2	9	2011	Noon	145	6.01	149.81	36.35	19.43
GB668	209	3	9	2011	Noon	118	6.89	44.45	36.48	27.16
GB668	211	1	9	2011	Dusk	244	5.41	247.31	35.89	14.89
GB668	211	2	9	2011	Dusk	202	6.01	151.67	36.35	19.36
GB668	211	3	9	2011	Dusk	131	6.92	46.92	36.26	27.19
MC920	197	1	8	2011	Dawn	136	5.81	251.27	35.66	13.47
MC920	197	2	8	2011	Dawn	108	5.75	140.49	36.25	17.69
MC920	197	3	8	2011	Dawn	88	6.04	36.02	34.58	27.16
MC920	198	1	8	2011	Noon	163	5.81	249.54	35.68	13.55
MC920	198	2	8	2011	Noon	172	5.73	148.65	36.24	17.51
MC920	198	3	8	2011	Noon	152	6.27	44.73	35.41	26.08
MC920	199	1	8	2011	Dusk	157	5.8	246.65	35.72	13.85
MC920	199	2	8	2011	Dusk	157	5.66	145.09	36.26	17.65
MC920	199	3	8	2011	Dusk	168	6.18	46.08	35.65	26.06
VK989	194	1	8	2011	Dawn	152	5.89	250.37	35.53	12.62
VK989	194	2	8	2011	Dawn	136	5.58	143.75	36.12	16.53
VK989	194	3	8	2011	Dawn	158	6.19	42.66	35.03	24.98
VK989	195	1	8	2011	Noon	140	5.92	248.64	35.53	12.61
VK989	195	2	8	2011	Noon	138	5.64	146.33	36.09	16.35
VK989	195	3	8	2011	Noon	168	6.28	46.54	35.62	24.33
VK989	196	1	8	2011	Dusk	164	6.04	298.6	35.33	11.17
VK989	196	2	8	2011	Dusk	141	5.93	251.97	35.52	12.53
VK989	196	3	8	2011	Dusk	147	5.61	144.64	36.09	16.37
AC25	214	1	9	2011	Dawn	146	5.23	253.36	35.93	15.25
AC25	214	2	9	2011	Dawn	110	6.41	140.36	36.43	20.49
AC25	214	3	9	2011	Dawn	113	6.68	43.15	36.58	27.87
AC25	216	1	9	2011	Noon	195	5.35	248.35	36	15.67
AC25	216	2	9	2011	Noon	164	6.35	146.46	36.43	20.19
AC25	216	3	9	2011	Noon	133	6.64	44.63	36.6	27.76
AC25	259	1	1	2012	Dusk	123	5.41	248.48	35.6	13.07

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
AC25	259	2	1	2012	Dusk	110	5.23	147.11	36.16	17.05
AC25	259	3	1	2012	Dusk	123	7.34	47.02	36.49	22.01
GB668	208	1	9	2011	Dawn	192	5.43	247.93	35.88	14.92
GB668	208	2	9	2011	Dawn	146	6.09	149.44	36.37	19.61
GB668	208	3	9	2011	Dawn	134	6.87	45.19	36.53	26.97
GB668	210	1	9	2011	Noon	187	5.4	251.96	35.84	14.64
GB668	210	2	9	2011	Noon	174	6.01	151.22	36.35	19.42
GB668	210	3	9	2011	Noon	113	6.94	47.01	36.53	27.02
GB668	212	1	9	2011	Dusk	258	5.41	247.9	35.88	14.84
GB668	212	2	9	2011	Dusk	211	6.08	150.63	36.35	19.47
GB668	212	3	9	2011	Dusk	130	6.9	47.12	36.53	27.2
MC920	204	1	9	2011	Dawn	185	5.57	259.33	35.74	13.93
MC920	204	2	9	2011	Dawn	117	5.8	146.23	36.29	17.95
MC920	204	3	9	2011	Dawn	104	6.47	43.41	35.56	25.77
MC920	205	1	9	2011	Noon	142	5.79	247.54	35.77	14.15
MC920	205	2	9	2011	Noon	146	5.97	148.73	36.3	17.94
MC920	205	3	9	2011	Noon	110	6.42	42.63	35.44	25.71
MC920	206	1	9	2011	Dusk	134	5.79	251.25	35.76	14.1
MC920	206	2	9	2011	Dusk	124	6.19	143.83	36.32	18.32
MC920	206	3	9	2011	Dusk	126	6.35	46.41	35.68	25.49
VK989	201	1	9	2011	Dawn	540	5.87	256.15	35.46	12.11
VK989	201	2	9	2011	Dawn	239	5.59	155.36	36.06	16.16
VK989	201	3	9	2011	Dawn	146	6.45	43.58	34.99	24.36
VK989	202	1	9	2011	Noon	520	5.85	251.53	35.45	12.01
VK989	202	2	9	2011	Noon	232	5.64	153.29	36.09	16.19
VK989	202	3	9	2011	Noon	168	6.26	50.85	35.74	23.67
VK989	203	1	9	2011	Dusk	190	5.85	249.31	35.41	11.82
VK989	203	2	9	2011	Dusk	179	5.72	153.14	36.01	15.7
VK989	203	3	9	2011	Dusk	138	6.27	48.39	35.58	23.76
AC25	252	1	1	2012	Dawn	165	5.22	245.1	35.6	13.02
AC25	252	2	1	2012	Dawn	106	5.23	141.93	36.17	17.09
AC25	252	3	1	2012	Dawn	126	7.19	48.97	36.52	21.95

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
AC25	255	1	1	2012	Noon	125	5.23	249.76	35.6	13.03
AC25	255	2	1	2012	Noon	118	5.28	148.52	36.14	16.99
AC25	255	3	1	2012	Noon	132	7.36	47.09	36.53	22.06
AC25	260	1	1	2012	Dusk	145	5.41	251.48	35.6	13.02
AC25	260	2	1	2012	Dusk	120	5.24	146.6	36.17	17.09
AC25	260	3	1	2012	Dusk	129	7.35	46.56	36.5	22.05
GB668	261	1	1	2012	Dawn	183	5.67	246.78	35.65	13.37
GB668	261	2	1	2012	Dawn	158	5.45	148.49	36.23	17.56
GB668	261	3	1	2012	Dawn	141	7.38	48.08	36.46	21.98
GB668	264	1	1	2012	Noon	168	5.7	248.51	35.66	13.47
GB668	264	2	1	2012	Noon	168	5.5	150.57	36.2	17.33
GB668	264	3	1	2012	Noon	121	7.46	48.47	36.46	21.99
GB668	267	1	1	2012	Dusk	136	5.72	254.68	35.6	13.1
GB668	267	2	1	2012	Dusk	148	5.46	151.46	36.21	17.31
GB668	267	3	1	2012	Dusk	121	7.41	48.48	36.44	21.94
MC920	217	1	10	2011	Dawn	204	6.04	248.52	35.74	13.92
MC920	217	2	10	2011	Dawn	169	6.11	147.82	36.27	17.21
MC920	217	3	10	2011	Dawn	134	5.95	43.11	36.27	24.75
MC920	220	1	10	2011	Noon	154	6.07	250.24	35.68	13.6
MC920	220	2	10	2011	Noon	129	6.11	143.7	36.27	17.24
MC920	220	3	10	2011	Noon	130	5.97	45.24	36.31	24.6
MC920	223	1	10	2011	Dusk	150	6.09	253.62	35.69	13.69
MC920	223	2	10	2011	Dusk	124	6.11	145.68	36.24	17.01
MC920	223	3	10	2011	Dusk	156	6.11	44.9	36.3	25.07
VK989	226	1	10	2011	Dawn	112	5.7	249.38	35.43	11.97
VK989	226	2	10	2011	Dawn	76	5.4	147.14	36.04	16.25
VK989	226	3	10	2011	Dawn	100	6.11	47.6	35.22	24.29
VK989	229	1	10	2011	Noon	178	5.71	252.3	35.42	11.87
VK989	229	2	10	2011	Noon	123	5.35	144.06	36.04	16.23
VK989	229	3	10	2011	Noon	126	6.11	42.07	35.01	25
VK989	232	1	10	2011	Dusk	138	5.73	253.06	35.4	11.74
VK989	232	2	10	2011	Dusk	109	5.39	144.22	36.09	16.58

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
VK989	232	3	10	2011	Dusk	137	6.16	47.81	35.08	24.93
AC25	253	1	1	2012	Dawn	128	5.19	247.17	35.61	13.06
AC25	253	2	1	2012	Dawn	148	5.27	154.34	36.1	16.6
AC25	253	3	1	2012	Dawn	133	7.22	51.17	36.54	21.95
AC25	256	1	1	2012	Noon	153	5.22	249.22	35.6	12.99
AC25	256	2	1	2012	Noon	146	5.29	146.31	36.16	17.14
AC25	256	3	1	2012	Noon	120	7.38	45.98	36.53	22.09
AC25	297	1	3	2012	Dusk	127	5.28	254.29	35.63	13.26
AC25	297	2	3	2012	Dusk	99	5.13	145.47	36.24	17.8
AC25	297	3	3	2012	Dusk	99	7.64	45.17	36.36	21.45
GB668	262	1	1	2012	Dawn	166	5.64	245.28	35.68	13.56
GB668	262	2	1	2012	Dawn	161	5.43	150.08	36.24	17.54
GB668	262	3	1	2012	Dawn	113	7.36	48.32	36.46	21.97
GB668	265	1	1	2012	Noon	199	5.7	253.24	35.65	13.38
GB668	265	2	1	2012	Noon	175	5.51	151.77	36.2	17.31
GB668	265	3	1	2012	Noon	135	7.47	45.83	36.45	21.97
GB668	268	1	1	2012	Dusk	147	5.72	253.84	35.61	13.13
GB668	268	2	1	2012	Dusk	144	5.43	148.04	36.23	17.52
GB668	268	3	1	2012	Dusk	134	7.42	46.07	36.44	21.95
MC920	218	1	10	2011	Dawn	155	6.04	252.49	35.71	13.77
MC920	218	2	10	2011	Dawn	133	6.1	144.76	36.29	17.41
MC920	218	3	10	2011	Dawn	111	6.05	41.02	36.25	24.94
MC920	221	1	10	2011	Noon	133	6.07	248.84	35.67	13.58
MC920	221	2	10	2011	Noon	139	6.12	144.19	36.27	17.23
MC920	221	3	10	2011	Noon	142	6.03	47.1	36.31	24.64
MC920	224	1	10	2011	Dusk	148	6.09	253.2	35.69	13.65
MC920	224	2	10	2011	Dusk	138	6.1	146.48	36.22	16.93
MC920	224	3	10	2011	Dusk	144	6.1	44.66	36.29	25.11
VK989	227	1	10	2011	Dawn	119	5.7	251.72	35.43	11.98
VK989	227	2	10	2011	Dawn	120	5.4	149.04	36.03	16.15
VK989	227	3	10	2011	Dawn	94	6.07	45.62	35.04	24.42
VK989	230	1	10	2011	Noon	163	5.71	256.34	35.43	11.89

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
VK989	230	2	10	2011	Noon	126	5.38	148.88	36.04	16.12
VK989	230	3	10	2011	Noon	113	6.09	46.01	35.13	24.71
VK989	233	1	10	2011	Dusk	148	5.72	253.7	35.41	11.81
VK989	233	2	10	2011	Dusk	133	5.4	146.82	36.04	16.19
VK989	233	3	10	2011	Dusk	169	6.13	49.38	35.39	24.92
AC25	254	1	1	2012	Dawn	134	5.18	246.62	35.61	13.06
AC25	254	2	1	2012	Dawn	131	5.24	148.43	36.15	16.98
AC25	254	3	1	2012	Dawn	150	7.3	50.57	36.55	22.03
AC25	257	1	1	2012	Noon	143	5.27	248.29	35.6	13
AC25	257	2	1	2012	Noon	156	5.3	152.73	36.12	16.8
AC25	257	3	1	2012	Noon	125	7.42	47	36.52	22.1
AC25	298	1	3	2012	Dusk	133	5.27	250.91	35.64	13.29
AC25	298	2	3	2012	Dusk	95	5.14	145.84	36.24	17.79
AC25	298	3	3	2012	Dusk	108	7.63	47.78	36.36	21.42
GB668	263	1	1	2012	Dawn	191	5.64	249.15	35.67	13.46
GB668	263	2	1	2012	Dawn	139	5.42	149.81	36.23	17.48
GB668	263	3	1	2012	Dawn	178	7.38	49.25	36.46	21.97
GB668	266	1	1	2012	Noon	192	5.7	251.08	35.66	13.44
GB668	266	2	1	2012	Noon	172	5.48	151.67	36.21	17.34
GB668	266	3	1	2012	Noon	146	7.47	48.13	36.45	21.96
GB668	269	1	1	2012	Dusk	142	5.71	248.85	35.65	13.38
GB668	269	2	1	2012	Dusk	161	5.46	150.29	36.22	17.39
GB668	269	3	1	2012	Dusk	135	7.38	45.58	36.43	21.93
MC920	219	1	10	2011	Dawn	171	6.07	247.8	35.72	13.85
MC920	219	2	10	2011	Dawn	139	6.08	144.73	36.27	17.34
MC920	219	3	10	2011	Dawn	102	6.11	36.72	36.19	25.47
MC920	222	1	10	2011	Noon	163	6.07	251.72	35.67	13.55
MC920	222	2	10	2011	Noon	166	6.13	147.02	36.25	17.09
MC920	222	3	10	2011	Noon	138	6.03	46.99	36.12	24.64
MC920	225	1	10	2011	Dusk	150	6.09	252.03	35.7	13.74
MC920	225	2	10	2011	Dusk	135	6.1	144.31	36.25	17.11
MC920	225	3	10	2011	Dusk	145	6.11	44.41	36.14	25.1

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
VK989	228	1	10	2011	Dawn	128	5.7	248.53	35.44	12.03
VK989	228	2	10	2011	Dawn	118	5.41	145.76	36.05	16.33
VK989	228	3	10	2011	Dawn	1	6.05	50.73	35.46	24.49
VK989	231	1	10	2011	Noon	134	5.67	250.79	35.47	12.19
VK989	231	2	10	2011	Noon	100	5.38	142.2	36.09	16.56
VK989	231	3	10	2011	Noon	102	6.05	43.41	34.97	24.93
VK989	234	1	10	2011	Dusk	162	5.71	252.24	35.42	11.88
VK989	234	2	10	2011	Dusk	167	5.4	148.05	36.05	16.25
VK989	234	3	10	2011	Dusk	133	6.14	44.82	35.24	25.24
AC25	291	1	3	2012	Dawn	173	5.34	256.1	35.61	13.1
AC25	291	2	3	2012	Dawn	122	5.15	149.22	36.21	17.54
AC25	291	3	3	2012	Dawn	109	7.6	45.82	36.37	21.43
AC25	294	1	3	2012	Noon	180	5.24	248.49	35.69	13.59
AC25	294	2	3	2012	Noon	140	5.23	146.92	36.23	17.78
AC25	294	3	3	2012	Noon	123	7.62	45.79	36.37	21.4
AC25	299	1	3	2012	Dusk	124	5.32	254.13	35.62	13.13
AC25	299	2	3	2012	Dusk	99	5.23	143.16	36.25	18
AC25	299	3	3	2012	Dusk	104	7.65	46.8	36.35	21.43
GB668	313	1	3	2012	Dawn	189	5.54	253.18	35.65	13.36
GB668	313	2	3	2012	Dawn	166	5.13	153.77	36.19	17.16
GB668	313	3	3	2012	Dawn	142	7.05	47.37	36.41	22.4
GB668	337	1	5	2012	Noon	218	4.96	248.93	35.74	13.92
GB668	337	2	5	2012	Noon	221	4.96	151.82	36.27	17.94
GB668	337	3	5	2012	Noon	171	6.88	49.33	36.29	23.38
GB668	340	1	5	2012	Dusk	181	4.96	251.38	35.71	13.72
GB668	340	2	5	2012	Dusk	188	4.9	153.63	36.25	17.75
GB668	340	3	5	2012	Dusk	148	6.83	47.5	36.29	23.43
MC920	247	1	12	2011	Dawn	264	5.68	252.43	35.68	13.53
MC920	247	2	12	2011	Dawn	309	5.51	151.13	36.28	17.69
MC920	247	3	12	2011	Dawn	281	6.93	46.95	36.41	23.42
MC920	249	1	12	2011	Noon	227	5.68	249.19	35.69	13.64
MC920	249	2	12	2011	Noon	263	5.57	153.49	36.25	17.63

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
MC920	249	3	12	2011	Noon	282	6.94	54.24	36.39	23.16
MC920	251	1	12	2011	Dusk	280	5.64	251.46	35.68	13.54
MC920	251	2	12	2011	Dusk	262	5.54	154.51	36.24	17.5
MC920	251	3	12	2011	Dusk	287	6.93	51.16	36.4	23.3
VK989	235	1	12	2011	Dawn	115	5.58	251.97	35.71	13.8
VK989	235	2	12	2011	Dawn	105	5.33	145.01	36.24	17.52
VK989	235	3	12	2011	Dawn	115	6.65	42.22	36.03	22.74
VK989	238	1	12	2011	Noon	132	5.62	252.04	35.76	14.06
VK989	238	2	12	2011	Noon	117	5.69	148.56	36.28	17.74
VK989	238	3	12	2011	Noon	126	6.74	48.73	36.11	22.77
VK989	241	1	12	2011	Dusk	105	5.63	250.15	35.76	14.13
VK989	241	2	12	2011	Dusk	107	5.79	148.75	36.29	17.69
VK989	241	3	12	2011	Dusk	122	6.81	45.89	36.07	22.85
AC25	293	1	3	2012	Dawn	156	5.29	246.48	35.65	13.37
AC25	293	2	3	2012	Dawn	134	5.23	145.11	36.23	17.77
AC25	293	3	3	2012	Dawn	110	7.62	45.87	36.37	21.41
AC25	295	1	3	2012	Noon	124	5.24	249.25	35.68	13.59
AC25	295	2	3	2012	Noon	114	5.18	144.95	36.25	17.88
AC25	295	3	3	2012	Noon	124	7.62	45.24	36.36	21.46
AC25	371	1	6	2012	Dusk	197	5.25	249.9	35.77	14.09
AC25	371	2	6	2012	Dusk	209	5.46	147.49	36.3	18.33
AC25	371	3	6	2012	Dusk	168	6.55	50.05	35.84	23.94
GB668	334	1	5	2012	Dawn	244	4.96	252.23	35.73	13.83
GB668	334	2	5	2012	Dawn	192	5.01	152.06	36.29	18.17
GB668	334	3	5	2012	Dawn	163	6.83	47.93	36.31	23.41
GB668	338	1	5	2012	Noon	230	4.96	250.01	35.73	13.85
GB668	338	2	5	2012	Noon	213	4.99	153.32	36.25	17.84
GB668	338	3	5	2012	Noon	156	6.89	48.54	36.3	23.42
GB668	341	1	5	2012	Dusk	174	4.96	250.92	35.72	13.75
GB668	341	2	5	2012	Dusk	154	4.93	149.04	36.27	18.01
GB668	341	3	5	2012	Dusk	144	6.85	47.5	36.28	23.5
MC920	248	1	12	2011	Dawn	251	5.68	247.2	35.72	13.78

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
MC920	248	2	12	2011	Dawn	268	5.48	150.78	36.28	17.77
MC920	248	3	12	2011	Dawn	286	6.77	59.14	36.41	22.98
MC920	250	1	12	2011	Noon	266	5.66	250.24	35.69	13.61
MC920	250	2	12	2011	Noon	297	5.55	153.09	36.26	17.64
MC920	250	3	12	2011	Noon	315	7.03	51.66	36.39	23.42
MC920	288	1	2	2012	Dusk	177	5.75	248.77	35.68	13.54
MC920	288	2	2	2012	Dusk	98	5.56	147.38	36.22	17.29
MC920	288	3	2	2012	Dusk	86	7.12	52.28	36.36	21.76
VK989	236	1	12	2011	Dawn	123	5.61	252.23	35.72	13.87
VK989	236	2	12	2011	Dawn	99	5.48	143.43	36.26	17.78
VK989	236	3	12	2011	Dawn	92	6.8	39.67	36.11	22.88
VK989	239	1	12	2011	Noon	120	5.64	252.01	35.76	14.07
VK989	239	2	12	2011	Noon	108	5.67	148.5	36.28	17.74
VK989	239	3	12	2011	Noon	115	6.76	49.9	36.1	22.77
VK989	242	1	12	2011	Dusk	128	5.62	252.43	35.76	14.07
VK989	242	2	12	2011	Dusk	111	5.81	148.42	36.32	17.87
VK989	242	3	12	2011	Dusk	97	6.78	49	36.1	22.8
AC25	296	1	3	2012	Noon	130	5.27	251.5	35.66	13.45
AC25	296	2	3	2012	Noon	109	5.16	146.28	36.25	17.9
AC25	296	3	3	2012	Noon	117	7.61	48.82	36.36	21.41
AC25	311	1	3	2012	Dawn	190	5.57	249.74	35.68	13.52
AC25	311	2	3	2012	Dawn	206	5.75	152.06	36.24	17.77
AC25	311	3	3	2012	Dawn	16	7.62	49.55	36.39	21.69
AC25	372	1	6	2012	Dusk	179	5.22	250.08	35.77	14.13
AC25	372	2	6	2012	Dusk	184	5.45	147.85	36.3	18.31
AC25	372	3	6	2012	Dusk	164	6.55	51.1	35.82	23.84
GB668	335	1	5	2012	Dawn	220	4.94	248.55	35.76	14.02
GB668	335	2	5	2012	Dawn	198	4.85	157.09	36.27	17.86
GB668	335	3	5	2012	Dawn	178	6.86	51.4	36.32	23.23
GB668	339	1	5	2012	Noon	209	4.96	249.52	35.74	13.93
GB668	339	2	5	2012	Noon	180	4.98	150.47	36.27	17.97
GB668	339	3	5	2012	Noon	131	6.89	50.23	36.31	23.3

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
GB668	342	1	5	2012	Dusk	165	4.96	249.98	35.71	13.74
GB668	342	2	5	2012	Dusk	159	4.88	148.02	36.29	18.13
GB668	342	3	5	2012	Dusk	150	6.85	51.45	36.32	23.28
MC920	285	1	2	2012	Noon	204	5.65	252.77	35.64	13.27
MC920	285	2	2	2012	Noon	175	5.55	146.32	36.25	17.4
MC920	285	3	2	2012	Noon	133	6.93	50.15	36.37	21.63
MC920	289	1	2	2012	Dusk	170	5.72	252.54	35.65	13.38
MC920	289	2	2	2012	Dusk	102	5.53	149.78	36.2	17.17
MC920	289	3	2	2012	Dusk	95	7.14	48.91	36.35	21.79
MC920	305	1	3	2012	Dawn	245	5.67	250	35.79	14.22
MC920	305	2	3	2012	Dawn	181	5.56	150.74	36.34	18.26
MC920	305	3	3	2012	Dawn	175	7.22	52.91	36.3	22.52
VK989	237	1	12	2011	Dawn	124	5.59	251.75	35.73	13.92
VK989	237	2	12	2011	Dawn	123	5.49	145.78	36.26	17.75
VK989	237	3	12	2011	Dawn	117	6.78	43.2	36.12	22.87
VK989	240	1	12	2011	Noon	118	5.63	253.14	35.74	13.99
VK989	240	2	12	2011	Noon	108	5.69	148.38	36.28	17.8
VK989	240	3	12	2011	Noon	117	6.81	48.91	36.1	22.85
VK989	243	1	12	2011	Dusk	108	5.63	253.28	35.75	14.05
VK989	243	2	12	2011	Dusk	89	5.77	144.57	36.32	18.02
VK989	243	3	12	2011	Dusk	110	6.81	46.95	36.07	22.84
AC25	312	1	3	2012	Noon	258	5.55	253.65	35.66	13.38
AC25	312	2	3	2012	Noon	195	5.72	151.79	36.24	17.78
AC25	312	3	3	2012	Noon	146	7.63	42.67	36.38	21.93
AC25	373	1	6	2012	Dusk	173	5.22	247.71	35.78	14.17
AC25	373	2	6	2012	Dusk	191	5.42	148.52	36.3	18.27
AC25	373	3	6	2012	Dusk	180	6.52	50.51	35.81	23.93
AC25	374	1	6	2012	Dawn	212	5.33	255.09	35.77	14.15
AC25	374	2	6	2012	Dawn	151	6.03	145.64	36.36	19.66
AC25	374	3	6	2012	Dawn	160	7.08	48.4	36.5	26.51
GB668	336	1	5	2012	Dawn	212	4.94	247.59	35.77	14.11
GB668	336	2	5	2012	Dawn	219	4.95	152.45	36.29	18.14

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
GB668	336	3	5	2012	Dawn	141	6.84	47.42	36.28	23.48
GB668	362	1	6	2012	Noon	181	5.45	253.81	35.67	13.47
GB668	362	2	6	2012	Noon	109	5.5	141.09	36.27	18.3
GB668	362	3	6	2012	Noon	165	7.13	46.08	35.75	24.43
GB668	365	1	6	2012	Dusk	210	5.47	252.51	35.62	13.15
GB668	365	2	6	2012	Dusk	131	5.35	147.77	36.24	17.96
GB668	365	3	6	2012	Dusk	159	7.18	46.93	35.77	24.53
MC920	286	1	2	2012	Noon	174	5.69	252.25	35.65	13.4
MC920	286	2	2	2012	Noon	177	5.58	145.88	36.25	17.48
MC920	286	3	2	2012	Noon	141	7.31	45.45	36.35	21.84
MC920	290	1	1	2012	Dusk	188	5.7	256.59	35.63	13.26
MC920	290	2	1	2012	Dusk	148	5.55	149.4	36.22	17.26
MC920	290	3	1	2012	Dusk	131	7.38	45.6	36.35	21.92
MC920	306	1	3	2012	Dawn	229	5.72	249.77	35.8	14.28
MC920	306	2	3	2012	Dawn	223	5.61	151.57	36.33	18.31
MC920	306	3	3	2012	Dawn	172	7.32	46.77	36.25	22.69
VK989	244	1	12	2011	Dawn	208	5.63	253.62	35.65	13.38
VK989	244	2	12	2011	Dawn	240	5.46	148.22	36.18	16.95
VK989	244	3	12	2011	Dawn	305	6.89	49.38	36.29	21.91
VK989	245	1	12	2011	Noon	304	5.64	249.49	35.68	13.49
VK989	245	2	12	2011	Noon	376	5.57	153.62	36.18	16.8
VK989	245	3	12	2011	Noon	367	6.84	51.61	36.29	21.72
VK989	246	1	12	2011	Dusk	236	5.66	247.09	35.66	13.38
VK989	246	2	12	2011	Dusk	261	5.54	153.43	36.17	16.77
VK989	246	3	12	2011	Dusk	279	6.82	48.62	36.3	21.87
AC25	368	1	6	2012	Noon	173	5.36	253.22	35.74	13.95
AC25	368	2	6	2012	Noon	157	5.49	145.41	36.29	18.29
AC25	368	3	6	2012	Noon	131	6.57	45.57	35.75	24.35
AC25	375	1	6	2012	Dawn	195	5.32	252.68	35.79	14.28
AC25	375	2	6	2012	Dawn	186	5.94	151.35	36.35	19.39
AC25	375	3	6	2012	Dawn	159	7.14	51.61	36.49	26.17
AC25	377	1	6	2012	Dusk	207	5.31	251.76	35.82	14.48

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
AC25	377	2	6	2012	Dusk	174	5.86	151.36	36.34	19.34
AC25	377	3	6	2012	Dusk	129	6.92	43.94	36.49	26.92
GB668	359	1	6	2012	Dawn	177	5.47	251.11	35.65	13.33
GB668	359	2	6	2012	Dawn	128	5.44	143.32	36.25	18.03
GB668	359	3	6	2012	Dawn	128	7.06	39.3	35.48	25.18
GB668	363	1	6	2012	Noon	168	5.45	252.9	35.66	13.46
GB668	363	2	6	2012	Noon	112	5.42	142.61	36.26	18.18
GB668	363	3	6	2012	Noon	162	7.16	47.41	35.81	24.37
GB668	366	1	6	2012	Dusk	158	5.47	254.45	35.61	13.08
GB668	366	2	6	2012	Dusk	150	5.42	146.37	36.26	18.06
GB668	366	3	6	2012	Dusk	208	7.2	46.44	35.71	24.58
MC920	287	1	1	2012	Noon	161	5.72	250.62	35.67	13.53
MC920	287	2	1	2012	Noon	165	5.6	149.24	36.23	17.26
MC920	287	3	1	2012	Noon	111	7.13	45.99	36.36	21.76
MC920	307	1	3	2012	Dawn	271	5.72	253.58	35.77	14.08
MC920	307	2	3	2012	Dawn	229	5.63	155.56	36.32	18.12
MC920	307	3	3	2012	Dawn	187	7.33	47.79	36.26	22.59
MC920	329	1	4	2012	Dusk	175	5.44	255.65	36.2	16.66
MC920	329	2	4	2012	Dusk	135	5.69	146.45	36.48	20.39
MC920	329	3	4	2012	Dusk	131	6.68	47.01	36.26	22.93
VK989	272	1	1	2012	Noon	224	5.57	245.47	35.79	14.25
VK989	272	2	1	2012	Noon	234	5.43	152.59	36.29	17.98
VK989	272	3	1	2012	Noon	229	7.3	49.72	36.3	21.83
VK989	275	1	1	2012	Dusk	220	5.55	254.73	35.76	14.06
VK989	275	2	1	2012	Dusk	147	5.41	149.02	36.28	17.81
VK989	275	3	1	2012	Dusk	155	7.48	49.82	36.3	21.84
AC25	369	1	6	2012	Noon	179	5.31	250.72	35.76	14.07
AC25	369	2	6	2012	Noon	186	5.52	146.02	36.29	18.36
AC25	369	3	6	2012	Noon	184	6.6	46.91	35.79	24.28
AC25	378	1	6	2012	Dusk	271	5.31	251.17	35.82	14.44
AC25	378	2	6	2012	Dusk	233	5.91	151.37	36.33	19.31
AC25	378	3	6	2012	Dusk	150	7.29	89.9	36.41	23.39

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
AC25	382	1	7	2012	Dawn	227	5.34	249.49	35.75	13.99
AC25	382	2	7	2012	Dawn	174	5.58	146.11	36.36	19.54
AC25	382	3	7	2012	Dawn	224	6.76	51.56	36.13	26.27
GB668	360	1	6	2012	Dawn	161	5.46	252.1	35.66	13.44
GB668	360	2	6	2012	Dawn	134	5.42	145.63	36.24	17.93
GB668	360	3	6	2012	Dawn	109	7.06	44.96	35.52	24.71
GB668	364	1	6	2012	Noon	189	5.45	254.62	35.65	13.38
GB668	364	2	6	2012	Noon	226	5.38	148.78	36.25	17.84
GB668	364	3	6	2012	Noon	275	7.14	50.01	35.85	24.3
GB668	367	1	6	2012	Dusk	164	5.47	254.71	35.6	13.05
GB668	367	2	6	2012	Dusk	156	5.43	144.88	36.26	18.14
GB668	367	3	6	2012	Dusk	211	7.22	48.24	35.76	24.38
MC920	308	1	3	2012	Noon	189	5.65	254.33	35.76	14.05
MC920	308	2	3	2012	Noon	210	5.64	151.72	36.3	18.19
MC920	308	3	3	2012	Noon	166	7.5	55.55	36.26	21.98
MC920	321	1	4	2012	Dawn	240	6.01	255.54	36.09	16.08
MC920	321	2	4	2012	Dawn	188	6.28	146.77	36.45	20.3
MC920	321	3	4	2012	Dawn	196	7.5	50.1	36.25	23.04
MC920	330	1	4	2012	Dusk	172	5.52	253.28	36.25	16.92
MC920	330	2	4	2012	Dusk	169	5.63	152.06	36.5	20.3
MC920	330	3	4	2012	Dusk	150	6.68	50.28	36.27	22.85
VK989	271	1	1	2012	Dawn	241	5.56	256.23	35.79	14.26
VK989	271	2	1	2012	Dawn	168	5.5	145.22	36.32	18.61
VK989	271	3	1	2012	Dawn	143	7.47	45.51	36.3	21.84
VK989	273	1	1	2012	Noon	219	5.54	247.61	35.78	14.18
VK989	273	2	1	2012	Noon	227	5.51	151.02	36.29	18.08
VK989	273	3	1	2012	Noon	195	7.5	47.4	36.3	21.83
VK989	276	1	1	2012	Dusk	205	5.56	249.86	35.77	14.12
VK989	276	2	1	2012	Dusk	192	5.42	148.38	36.29	17.93
VK989	276	3	1	2012	Dusk	176	7.49	47.37	36.3	21.84
AC25	370	1	6	2012	Noon	168	5.29	253.36	35.75	13.98
AC25	370	2	6	2012	Noon	155	5.5	144.91	36.3	18.42

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
AC25	370	3	6	2012	Noon	157	6.62	46.62	35.84	24.24
AC25	379	1	6	2012	Dusk	130	5.28	245.99	35.83	14.62
AC25	379	2	6	2012	Dusk	162	6.1	144.35	36.35	19.79
AC25	379	3	6	2012	Dusk	151	6.97	45.33	36.49	26.87
AC25	383	1	7	2012	Dawn	214	5.35	254.29	35.72	13.81
AC25	383	2	7	2012	Dawn	224	5.34	153.53	36.31	18.79
AC25	383	3	7	2012	Dawn	254	6.61	52.66	35.92	26.02
GB668	361	1	6	2012	Dawn	178	5.46	251.05	35.66	13.43
GB668	361	2	6	2012	Dawn	171	5.42	148.74	36.24	17.93
GB668	361	3	6	2012	Dawn	106	7.07	45.03	35.58	24.65
GB668	393	1	7	2012	Noon	147	5.88	251.79	35.54	12.72
GB668	393	2	7	2012	Noon	176	5.38	147.33	36.14	16.98
GB668	393	3	7	2012	Noon	169	6.89	47.16	36.2	25.18
GB668	396	1	7	2012	Dusk	176	5.84	249.06	35.59	13.02
GB668	396	2	7	2012	Dusk	195	5.43	149.19	36.17	17.19
GB668	396	3	7	2012	Dusk	198	7.05	50.51	36.25	24.95
MC920	309	1	3	2012	Noon	196	5.52	248.54	35.8	14.3
MC920	309	2	3	2012	Noon	202	5.62	147.65	36.36	18.61
MC920	309	3	3	2012	Noon	192	7.53	50.34	36.24	22.21
MC920	322	1	4	2012	Dawn	187	5.99	257.51	36.08	15.98
MC920	322	2	4	2012	Dawn	216	6.21	150.36	36.47	20.14
MC920	322	3	4	2012	Dawn	220	7.51	48.63	36.25	23.13
MC920	331	1	4	2012	Dusk	177	5.48	254.67	36.22	16.72
MC920	331	2	4	2012	Dusk	201	5.64	149.46	36.5	20.4
MC920	331	3	4	2012	Dusk	168	6.68	47.63	36.26	22.85
VK989	277	1	2	2012	Dawn	210	5.56	252.61	35.5	12.4
VK989	277	2	2	2012	Dawn	180	5.46	153.3	36.13	16.55
VK989	277	3	2	2012	Dawn	151	7.2	48	35.49	20.96
VK989	279	1	2	2012	Noon	211	5.59	250.58	35.49	12.33
VK989	279	2	2	2012	Noon	214	5.52	148.77	36.15	16.65
VK989	279	3	2	2012	Noon	193	7.27	49.69	36.26	21.26
VK989	281	1	2	2012	Dusk	179	5.57	248.69	35.53	12.55

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
VK989	281	2	2	2012	Dusk	205	5.47	148.23	36.14	16.62
VK989	281	3	2	2012	Dusk	223	7.24	47.36	36.48	21.68
AC25	376	1	6	2012	Noon	189	5.3	251.9	35.83	14.54
AC25	376	2	6	2012	Noon	179	5.78	152.23	36.35	19.24
AC25	376	3	6	2012	Noon	183	7.16	54.16	36.48	25.8
AC25	387	1	7	2012	Dusk	148	5.36	252.24	35.76	14.12
AC25	387	2	7	2012	Dusk	161	5.6	148.14	36.32	19.23
AC25	387	3	7	2012	Dusk	197	6.53	47.8	35.65	25.5
AC25	440	1	8	2012	Dawn	192	5.57	254.15	35.61	13.04
AC25	440	2	8	2012	Dawn	196	5.24	157.14	36.15	16.78
AC25	440	3	8	2012	Dawn	171	6.66	51.88	36.07	25.62
GB668	380	1	6	2012	Dawn	163	5.84	255.18	35.51	12.49
GB668	380	2	6	2012	Dawn	115	5.49	148.05	36.03	16.16
GB668	380	3	6	2012	Dawn	128	6.98	49.19	35.99	24.34
GB668	394	1	7	2012	Noon	142	5.88	253.67	35.54	12.69
GB668	394	2	7	2012	Noon	169	5.37	152.04	36.12	16.78
GB668	394	3	7	2012	Noon	208	6.85	51.78	36.26	24.82
GB668	397	1	7	2012	Dusk	276	5.85	249.03	35.59	12.96
GB668	397	2	7	2012	Dusk	213	5.48	154.36	36.14	16.95
GB668	397	3	7	2012	Dusk	154	7.01	46.52	36.21	25.37
MC920	310	1	3	2012	Noon	182	5.6	248.52	35.81	14.32
MC920	310	2	3	2012	Noon	183	5.61	146.61	36.36	18.63
MC920	310	3	3	2012	Noon	168	7.57	51.56	36.26	22.14
MC920	323	1	4	2012	Dawn	207	6.02	254.05	36.11	16.17
MC920	323	2	4	2012	Dawn	127	6.22	148.22	36.47	20.27
MC920	323	3	4	2012	Dawn	147	7.5	45.14	36.25	23.09
MC920	356	1	5	2012	Dusk	270	5.22	253.38	35.55	12.66
MC920	356	2	5	2012	Dusk	191	5.11	150.93	36.08	16.35
MC920	356	3	5	2012	Dusk	157	6.51	44.55	36.14	23.23
VK989	278	1	2	2012	Dawn	157	5.54	247.27	35.53	12.62
VK989	278	2	2	2012	Dawn	148	5.44	142.59	36.2	17.17
VK989	278	3	2	2012	Dawn	159	7.28	43.89	36.13	21.18

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
VK989	280	1	2	2012	Noon	191	5.6	252.83	35.49	12.29
VK989	280	2	2	2012	Noon	158	5.5	146.27	36.17	16.84
VK989	280	3	2	2012	Noon	150	7.36	44.15	35.97	21.29
VK989	282	1	2	2012	Dusk	211	5.6	255.26	35.46	12.15
VK989	282	2	2	2012	Dusk	157	5.45	149.07	36.11	16.44
VK989	282	3	2	2012	Dusk	169	7.11	47.15	36.47	21.58
AC25	384	1	7	2012	Noon	159	5.31	250.47	35.77	14.21
AC25	384	2	7	2012	Noon	173	5.33	150.19	36.3	18.94
AC25	384	3	7	2012	Noon	134	6.66	52.49	35.79	25.13
AC25	388	1	7	2012	Dusk	132	5.35	249.34	35.77	14.21
AC25	388	2	7	2012	Dusk	187	5.74	146.1	36.32	19.48
AC25	388	3	7	2012	Dusk	186	6.48	47.44	35.7	25.79
AC25	441	1	8	2012	Dawn	221	5.59	254.02	35.61	13.04
AC25	441	2	8	2012	Dawn	231	5.27	157.43	36.15	16.84
AC25	441	3	8	2012	Dawn	160	6.69	53.92	36.11	25.32
GB668	390	1	7	2012	Dawn	159	5.85	252.99	35.57	12.91
GB668	390	2	7	2012	Dawn	165	5.44	143.79	36.15	17.27
GB668	390	3	7	2012	Dawn	190	6.98	44.16	36.19	25.49
GB668	395	1	7	2012	Noon	189	5.86	249.7	35.57	12.87
GB668	395	2	7	2012	Noon	222	5.41	149.04	36.15	17.03
GB668	395	3	7	2012	Noon	193	7.02	49.27	36.23	25.06
GB668	398	1	7	2012	Dusk	212	5.87	253.05	35.58	12.91
GB668	398	2	7	2012	Dusk	163	5.46	146.91	36.15	17.21
GB668	398	3	7	2012	Dusk	167	7.03	45.38	36.21	25.49
MC920	324	1	4	2012	Dawn	167	5.64	256.25	36.24	16.76
MC920	324	2	4	2012	Dawn	146	5.62	146.07	36.48	20
MC920	324	3	4	2012	Dawn	141	6.64	46.19	36.27	22.92
MC920	326	1	4	2012	Noon	146	5.64	253.58	36.27	16.97
MC920	326	2	4	2012	Noon	100	5.75	143.69	36.45	20.23
MC920	326	3	4	2012	Noon	120	6.68	46.06	36.26	23.04
MC920	357	1	5	2012	Dusk	279	5.17	248.55	35.58	12.89
MC920	357	2	5	2012	Dusk	220	5.05	152.08	36.09	16.37

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
MC920	357	3	5	2012	Dusk	143	6.4	46.81	36.16	23.2
VK989	300	1	3	2012	Dawn	139	5.67	252.55	35.68	13.54
VK989	300	2	3	2012	Dawn	116	5.44	142.7	36.3	17.91
VK989	300	3	3	2012	Dawn	153	7.2	44.77	36.35	22.3
VK989	301	1	3	2012	Noon	136	5.69	253.86	35.68	13.54
VK989	301	2	3	2012	Noon	103	5.45	141.89	36.3	17.71
VK989	301	3	3	2012	Noon	141	7.14	49.84	36.39	22.07
VK989	303	1	3	2012	Dusk	168	5.71	255.01	35.61	13.1
VK989	303	2	3	2012	Dusk	97	5.48	141.51	36.3	17.78
VK989	303	3	3	2012	Dusk	140	7.29	48.26	36.37	22.23
AC25	385	1	7	2012	Noon	157	5.33	253.93	35.76	14.14
AC25	385	2	7	2012	Noon	144	5.41	146.15	36.3	19.12
AC25	385	3	7	2012	Noon	140	6.68	50.05	35.65	25.15
AC25	389	1	7	2012	Dusk	170	5.36	252.3	35.75	14.04
AC25	389	2	7	2012	Dusk	168	5.7	146.86	36.32	19.39
AC25	389	3	7	2012	Dusk	198	6.5	52.13	35.88	25.52
AC25	475	1	10	2012	Dawn	268	5.52	273.63	35.52	12.45
AC25	475	2	10	2012	Dawn	170	5.23	219.08	35.84	14.52
AC25	475	3	10	2012	Dawn	204	5.25	147.65	36.32	18.18
GB668	391	1	7	2012	Dawn	252	5.79	252.86	35.57	12.84
GB668	391	2	7	2012	Dawn	232	5.4	155.09	36.13	16.74
GB668	391	3	7	2012	Dawn	187	6.92	48.2	36.23	25
GB668	411	1	7	2012	Dusk	168	5.76	256.07	35.62	13.13
GB668	411	2	7	2012	Dusk	163	5.29	148.46	36.27	17.68
GB668	411	3	7	2012	Dusk	200	6.54	51.02	36.3	25.07
GB668	416	1	7	2012	Noon	171	5.68	253.25	35.71	13.73
GB668	416	2	7	2012	Noon	134	5.31	144.48	36.27	17.78
GB668	416	3	7	2012	Noon	167	6.76	53.14	36.09	24.8
MC920	325	1	4	2012	Dawn	187	5.67	255.25	36.25	16.84
MC920	325	2	4	2012	Dawn	141	5.66	146.16	36.47	19.95
MC920	325	3	4	2012	Dawn	128	6.65	45.78	36.27	22.96
MC920	327	1	4	2012	Noon	196	5.66	256.43	36.28	17

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
MC920	327	2	4	2012	Noon	138	5.76	147.18	36.45	20.12
MC920	327	3	4	2012	Noon	145	6.66	46.39	36.27	23.04
MC920	358	1	5	2012	Dusk	190	5.21	251.22	35.58	12.89
MC920	358	2	5	2012	Dusk	170	5.08	150.41	36.1	16.36
MC920	358	3	5	2012	Dusk	175	6.41	48.26	36.17	23.04
VK989	302	1	3	2012	Noon	142	5.67	251.58	35.68	13.57
VK989	302	2	3	2012	Noon	108	5.48	143.66	36.29	17.65
VK989	302	3	3	2012	Noon	133	7.17	45.98	36.38	22.16
VK989	304	1	3	2012	Dusk	141	5.71	251.13	35.63	13.27
VK989	304	2	3	2012	Dusk	122	5.48	143.2	36.3	17.78
VK989	304	3	3	2012	Dusk	138	7.32	47.67	36.36	22.32
VK989	314	1	4	2012	Dawn	190	5.68	248.93	35.71	13.72
VK989	314	2	4	2012	Dawn	213	5.64	147.69	36.3	18.06
VK989	314	3	4	2012	Dawn	273	6.6	102.7	36.46	20.85
AC25	445	1	8	2012	Dusk	144	5.6	250.73	35.61	13.07
AC25	445	2	8	2012	Dusk	131	5.26	146.06	36.22	17.39
AC25	445	3	8	2012	Dusk	147	6.68	46.12	35.93	26.22
AC25	476	1	10	2012	Dawn	181	5.43	250.72	35.64	13.27
AC25	476	2	10	2012	Dawn	159	5.25	146.85	36.32	18.26
AC25	476	3	10	2012	Dawn	212	6.43	53.12	36.36	26.03
GB668	392	1	7	2012	Dawn	214	5.8	254.73	35.55	12.75
GB668	392	2	7	2012	Dawn	204	5.46	146.54	36.15	17.1
GB668	392	3	7	2012	Dawn	209	7.02	45.9	36.22	24.95
GB668	412	1	7	2012	Dusk	165	5.75	256.1	35.64	13.29
GB668	412	2	7	2012	Dusk	187	5.28	146.48	36.27	17.69
GB668	412	3	7	2012	Dusk	163	6.51	50.78	36.27	25.19
GB668	417	1	7	2012	Noon	174	5.7	258.78	35.69	13.58
GB668	417	2	7	2012	Noon	131	5.32	150.57	36.24	17.46
GB668	417	3	7	2012	Noon	187	6.69	50.41	35.93	25.23
MC920	328	1	4	2012	Noon	180	5.64	252.5	36.29	17.09
MC920	328	2	4	2012	Noon	142	5.74	145.37	36.46	20.22
MC920	328	3	4	2012	Noon	133	6.66	46.32	36.27	23.03

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
MC920	350	1	5	2012	Dawn	222	5.17	250.71	35.57	12.78
MC920	350	2	5	2012	Dawn	268	5.05	152.49	36.12	16.41
MC920	350	3	5	2012	Dawn	215	6.38	50.33	36.09	22.72
MC920	404	1	7	2012	Dusk	158	5.9	253.73	35.84	14.66
MC920	404	2	7	2012	Dusk	148	5.51	145.81	36.37	19.42
MC920	404	3	7	2012	Dusk	160	6.58	48.55	36.3	27.2
VK989	315	1	4	2012	Dawn	261	5.68	252.67	35.7	13.67
VK989	315	2	4	2012	Dawn	239	5.59	149.92	36.28	17.93
VK989	315	3	4	2012	Dawn	214	7.27	48.94	36.31	22.91
VK989	317	1	4	2012	Noon	198	5.69	247.61	35.65	13.4
VK989	317	2	4	2012	Noon	197	5.64	148.21	36.27	17.91
VK989	317	3	4	2012	Noon	204	7.29	46.71	36.3	23.13
VK989	319	1	4	2012	Dusk	234	5.69	251.09	35.69	13.6
VK989	319	2	4	2012	Dusk	199	5.59	151.55	36.25	17.6
VK989	319	3	4	2012	Dusk	164	7.3	48.3	36.26	23.13
AC25	442	1	8	2012	Noon	177	5.59	253.37	35.61	13.03
AC25	442	2	8	2012	Noon	182	5.27	150.47	36.2	17.22
AC25	442	3	8	2012	Noon	156	6.73	50.49	36.08	25.86
AC25	446	1	8	2012	Dusk	181	5.6	251.66	35.61	13.06
AC25	446	2	8	2012	Dusk	183	5.27	150.09	36.21	17.23
AC25	446	3	8	2012	Dusk	162	6.68	50.07	36.02	25.83
AC25	477	1	10	2012	Dawn	198	5.41	253.53	35.64	13.26
AC25	477	2	10	2012	Dawn	158	5.24	149.07	36.3	18.08
AC25	477	3	10	2012	Dawn	183	6.4	52.48	36.36	26.1
GB668	413	1	7	2012	Dawn	221	5.71	252.61	35.66	13.38
GB668	413	2	7	2012	Dawn	223	5.31	152.9	36.23	17.47
GB668	413	3	7	2012	Dawn	208	6.5	49.55	36.15	25.37
GB668	418	1	7	2012	Noon	183	5.68	257.45	35.71	13.67
GB668	418	2	7	2012	Noon	126	5.32	144.51	36.26	17.74
GB668	418	3	7	2012	Noon	160	6.82	50.79	36.04	25.17
GB668	419	1	7	2012	Dusk	184	5.78	258.65	35.67	13.45
GB668	419	2	7	2012	Dusk	167	5.39	147.58	36.26	17.62

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
GB668	419	3	7	2012	Dusk	189	6.8	47.61	35.94	25.22
MC920	351	1	5	2012	Dawn	252	5.19	251.02	35.57	12.81
MC920	351	2	5	2012	Dawn	218	5.04	152.33	36.1	16.32
MC920	351	3	5	2012	Dawn	155	6.31	49.13	36.08	22.69
MC920	353	1	5	2012	Noon	215	5.21	250.66	35.56	12.79
MC920	353	2	5	2012	Noon	157	5.11	145.23	36.18	17
MC920	353	3	5	2012	Noon	142	6.51	47.08	36.1	22.96
MC920	405	1	7	2012	Dusk	159	5.85	254.46	35.84	14.69
MC920	405	2	7	2012	Dusk	122	5.48	141.76	36.4	19.72
MC920	405	3	7	2012	Dusk	148	6.6	45.62	36.26	27.34
VK989	316	1	4	2012	Dawn	171	5.66	248	35.72	13.81
VK989	316	2	4	2012	Dawn	196	5.54	145.55	36.3	18.06
VK989	316	3	4	2012	Dawn	195	7.23	49.25	36.31	22.9
VK989	318	1	4	2012	Noon	242	5.69	251.8	35.64	13.28
VK989	318	2	4	2012	Noon	177	5.65	147.25	36.26	17.85
VK989	318	3	4	2012	Noon	199	7.3	47.18	36.29	23.11
VK989	320	1	4	2012	Dusk	200	5.69	252.81	35.7	13.64
VK989	320	2	4	2012	Dusk	176	5.68	149.56	36.25	17.79
VK989	320	3	4	2012	Dusk	132	7.34	44.28	36.28	23.39
AC25	443	1	8	2012	Noon	149	5.57	250.39	35.62	13.14
AC25	443	2	8	2012	Noon	163	5.31	146.52	36.22	17.56
AC25	443	3	8	2012	Noon	102	6.82	80.81	36.44	22.16
AC25	447	1	8	2012	Dusk	131	5.6	253.98	35.6	13.02
AC25	447	2	8	2012	Dusk	138	5.26	147.2	36.22	17.37
AC25	447	3	8	2012	Dusk	159	6.71	50.01	36.06	25.88
AC25	503	1	11	2012	Dawn	144	5.25	250.8	35.73	13.86
AC25	503	2	11	2012	Dawn	144	5.05	147.11	36.3	18.2
AC25	503	3	11	2012	Dawn	169	6.44	49.42	36.45	25.62
GB668	414	1	7	2012	Dawn	297	5.71	251.22	35.68	13.47
GB668	414	2	7	2012	Dawn	223	5.29	155.18	36.22	17.42
GB668	414	3	7	2012	Dawn	157	6.46	51.43	36.13	25.06
GB668	420	1	7	2012	Dusk	181	5.76	255.79	35.67	13.5

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
GB668	420	2	7	2012	Dusk	178	5.34	143.85	36.29	17.82
GB668	420	3	7	2012	Dusk	205	6.71	47.26	35.91	25.23
GB668	451	1	9	2012	Noon	127	5.5	248.92	35.7	13.62
GB668	451	2	9	2012	Noon	132	5.47	142.12	36.3	18.41
GB668	451	3	9	2012	Noon	151	6.54	44.01	36.23	26.98
MC920	352	1	5	2012	Dawn	251	5.19	247.56	35.56	12.75
MC920	352	2	5	2012	Dawn	221	5.05	153.45	36.09	16.28
MC920	354	1	5	2012	Noon	326	5.22	255.19	35.57	12.77
MC920	354	2	5	2012	Noon	259	5.12	153.55	36.13	16.61
MC920	354	3	5	2012	Noon	158	6.43	50.91	36.15	22.73
MC920	406	1	7	2012	Dusk	174	5.75	248.32	35.89	14.98
MC920	406	2	7	2012	Dusk	170	5.51	140.48	36.42	19.78
MC920	406	3	7	2012	Dusk	149	6.56	49.24	36.29	27.06
VK989	332	1	4	2012	Dawn	129	4.95	252.45	35.56	12.8
VK989	332	2	4	2012	Dawn	97	4.98	139.63	36.29	17.92
VK989	332	3	4	2012	Dawn	158	6.48	49.63	36.29	22.62
VK989	333	1	4	2012	Noon	142	4.96	250.03	35.55	12.72
VK989	333	2	4	2012	Noon	97	4.99	142.56	36.22	17.45
VK989	333	3	4	2012	Noon	113	6.5	46.49	36.2	22.63
VK989	347	1	5	2012	Dusk	248	5.12	249.54	35.56	12.7
VK989	347	2	5	2012	Dusk	254	5.1	152.32	36.05	15.91
VK989	347	3	5	2012	Dusk	290	5.84	52.06	35.95	22.01
AC25	444	1	8	2012	Noon	181	5.57	249.69	35.63	13.18
AC25	444	2	8	2012	Noon	161	5.28	149.51	36.21	17.38
AC25	444	3	8	2012	Noon	162	6.73	48.42	35.99	26.07
AC25	481	1	10	2012	Dusk	173	5.38	252.97	35.68	13.51
AC25	481	2	10	2012	Dusk	172	5.28	151.52	36.31	18.15
AC25	481	3	10	2012	Dusk	173	6.39	49.57	36.39	26.28
AC25	504	1	11	2012	Dawn	150	5.25	252.24	35.71	13.74
AC25	504	2	11	2012	Dawn	171	5.06	149.18	36.29	18.12
AC25	504	3	11	2012	Dawn	173	6.45	49.22	36.45	25.63
GB668	415	1	7	2012	Dawn	240	5.71	254.3	35.67	13.43

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
GB668	415	2	7	2012	Dawn	170	5.27	148.25	36.26	17.81
GB668	415	3	7	2012	Dawn	147	6.56	46.6	36.09	25.68
GB668	452	1	9	2012	Noon	161	5.49	251.7	35.68	13.52
GB668	452	2	9	2012	Noon	135	5.43	143.14	36.32	18.43
GB668	452	3	9	2012	Noon	163	6.57	47.93	36.24	26.7
GB668	453	1	9	2012	Dusk	136	5.48	253.71	35.66	13.38
GB668	453	2	9	2012	Dusk	166	5.39	152.54	36.28	18.02
GB668	453	3	9	2012	Dusk	163	6.55	49.13	36.27	26.5
MC920	355	1	5	2012	Noon	295	5.23	250.19	35.57	12.8
MC920	355	2	5	2012	Noon	240	5.1	152.63	36.11	16.46
MC920	355	3	5	2012	Noon	141	6.49	47.11	36.11	23.16
MC920	399	1	7	2012	Dawn	145	5.91	249.11	35.86	14.79
MC920	399	2	7	2012	Dawn	138	5.7	146.51	36.35	19.31
MC920	399	3	7	2012	Dawn	150	6.7	48.61	36.11	26.82
MC920	428	1	7	2012	Dusk	183	5.77	255.77	35.72	13.75
MC920	428	2	7	2012	Dusk	163	5.38	146.98	36.29	18.23
MC920	428	3	7	2012	Dusk	189	6.93	48.49	36.13	25.54
VK989	343	1	5	2012	Dawn	244	5.1	248.57	35.58	12.84
VK989	343	2	5	2012	Dawn	236	5.01	150.13	36.12	16.51
VK989	343	3	5	2012	Dawn	271	5.92	50.96	36.16	22.59
VK989	345	1	5	2012	Noon	268	5.08	253.11	35.55	12.66
VK989	345	2	5	2012	Noon	282	5.05	152.2	36.07	16.12
VK989	345	3	5	2012	Noon	328	5.93	52.3	36.11	22.11
VK989	348	1	5	2012	Dusk	235	5.14	252.23	35.56	12.76
VK989	348	2	5	2012	Dusk	254	5.12	152.32	36.06	15.95
VK989	348	3	5	2012	Dusk	205	5.94	48.74	35.66	22.33
AC25	478	1	10	2012	Noon	179	5.38	252.14	35.67	13.45
AC25	478	2	10	2012	Noon	152	5.29	148.85	36.33	18.23
AC25	478	3	10	2012	Noon	174	6.38	51.03	36.38	26.27
AC25	482	1	10	2012	Dusk	177	5.81	301.5	35.4	11.64
AC25	482	2	10	2012	Dusk	187	5.39	253.05	35.68	13.49
AC25	482	3	10	2012	Dusk	165	5.29	150.92	36.32	18.23

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
AC25	505	1	11	2012	Dawn	159	5.25	252.25	35.71	13.75
AC25	505	2	11	2012	Dawn	164	5.03	148.81	36.3	18.13
AC25	505	3	11	2012	Dawn	171	6.39	49.45	36.45	25.58
GB668	448	1	8	2012	Dawn	175	5.57	249.06	35.6	12.97
GB668	448	2	8	2012	Dawn	134	5.2	147.38	36.18	16.99
GB668	448	3	8	2012	Dawn	186	6.5	49.78	36.18	25.19
GB668	454	1	9	2012	Dusk	154	5.51	247.67	35.7	13.63
GB668	454	2	9	2012	Dusk	164	5.34	144.86	36.33	18.44
GB668	454	3	9	2012	Dusk	147	6.55	47.99	36.26	26.7
GB668	487	1	10	2012	Noon	137	5.48	251.94	35.59	12.94
GB668	487	2	10	2012	Noon	137	5.27	147.31	36.19	16.97
GB668	487	3	10	2012	Noon	154	6.23	49.39	36.31	24.48
MC920	400	1	7	2012	Dawn	161	5.93	249.97	35.86	14.75
MC920	400	2	7	2012	Dawn	138	5.6	146.53	36.35	19.28
MC920	400	3	7	2012	Dawn	157	6.68	53.23	36.15	26.57
MC920	401	1	7	2012	Noon	183	5.95	245.33	35.88	14.86
MC920	401	2	7	2012	Noon	155	5.64	149.74	36.34	19.06
MC920	401	3	7	2012	Noon	170	6.57	49.71	36.21	26.76
MC920	429	1	7	2012	Dusk	215	5.77	255.03	35.72	13.78
MC920	429	2	7	2012	Dusk	196	5.38	149.43	36.27	18.08
MC920	429	3	7	2012	Dusk	194	6.9	49.27	36.14	25.5
VK989	344	1	5	2012	Dawn	322	5.09	250.92	35.56	12.7
VK989	344	2	5	2012	Dawn	318	5.01	150.29	36.12	16.47
VK989	344	3	5	2012	Dawn	349	5.98	50.43	35.72	22.44
VK989	346	1	5	2012	Noon	227	5.07	248.82	35.56	12.76
VK989	346	2	5	2012	Noon	242	5.05	149.2	36.09	16.31
VK989	346	3	5	2012	Noon	256	5.91	51.4	36.08	22.12
VK989	349	1	5	2012	Dusk	207	5.12	252.17	35.57	12.81
VK989	349	2	5	2012	Dusk	228	5.12	148.12	36.09	16.17
VK989	349	3	5	2012	Dusk	196	6.01	47.63	35.45	22.5
AC25	479	1	10	2012	Noon	151	5.37	248.99	35.68	13.55
AC25	479	2	10	2012	Noon	157	5.26	148.36	36.33	18.24

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
AC25	479	3	10	2012	Noon	164	6.39	52.66	36.37	26.15
AC25	483	1	10	2012	Dusk	168	5.39	253.66	35.66	13.4
AC25	483	2	10	2012	Dusk	173	5.31	147.96	36.34	18.43
AC25	483	3	10	2012	Dusk	156	6.4	48.25	36.38	26.46
AC25	513	1	11	2012	Dawn	166	5.24	252.71	35.72	13.75
AC25	513	2	11	2012	Dawn	152	5.04	147.93	36.3	18.16
AC25	513	3	11	2012	Dawn	153	6.41	47.75	36.45	25.54
GB668	449	1	8	2012	Dawn	208	5.61	251.14	35.59	12.93
GB668	449	2	8	2012	Dawn	186	5.29	147.42	36.18	17.01
GB668	449	3	8	2012	Dawn	161	6.65	47.04	36.16	25.52
GB668	455	1	9	2012	Dusk	139	5.51	250.05	35.69	13.59
GB668	455	2	9	2012	Dusk	155	5.36	147.02	36.31	18.28
GB668	455	3	9	2012	Dusk	168	6.57	48.28	36.27	26.69
GB668	488	1	10	2012	Noon	149	5.49	252.24	35.59	12.95
GB668	488	2	10	2012	Noon	141	5.27	145.9	36.21	17.08
GB668	488	3	10	2012	Noon	147	6.2	49.8	36.31	24.4
MC920	402	1	7	2012	Noon	160	6.01	253.35	35.84	14.64
MC920	402	2	7	2012	Noon	170	5.48	149.4	36.36	19.21
MC920	402	3	7	2012	Noon	159	6.6	49.74	36.28	26.95
MC920	421	1	7	2012	Dawn	135	5.7	254.83	35.73	13.89
MC920	421	2	7	2012	Dawn	138	5.34	145.9	36.3	18.31
MC920	421	3	7	2012	Dawn	153	6.87	50.18	36.14	25.11
MC920	430	1	7	2012	Dusk	245	5.8	254.59	35.71	13.69
MC920	430	2	7	2012	Dusk	216	5.32	146.6	36.29	18.12
MC920	430	3	7	2012	Dusk	199	6.9	53.99	36.17	25.06
VK989	407	1	7	2012	Dawn	189	5.66	253.59	35.62	13.16
VK989	407	2	7	2012	Dawn	196	5.66	146.23	36.21	17.16
VK989	407	3	7	2012	Dawn	145	6.25	82.27	36.45	21.47
VK989	409	1	7	2012	Noon	156	5.64	252.72	35.67	13.51
VK989	409	2	7	2012	Noon	179	5.8	150.7	36.22	17.07
VK989	409	3	7	2012	Noon	171	6.61	48.58	36.25	24.96
VK989	438	1	7	2012	Dusk	237	5.48	251.16	35.77	14.06

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
VK989	438	2	7	2012	Dusk	187	5.58	150.54	36.23	17.16
VK989	438	3	7	2012	Dusk	180	6.56	51.01	35.95	25
AC25	480	1	10	2012	Noon	37	5.47	265.59	35.58	12.86
AC25	480	2	10	2012	Noon	174	5.18	212.92	35.93	15.17
AC25	480	3	10	2012	Noon	194	5.27	152.6	36.31	18.06
AC25	509	1	11	2012	Dusk	163	5.26	249.38	35.71	13.71
AC25	509	2	11	2012	Dusk	146	5.05	147.59	36.3	18.19
AC25	509	3	11	2012	Dusk	152	6.42	48.47	36.45	25.57
AC25	514	1	11	2012	Dawn	148	5.23	253.19	35.71	13.72
AC25	514	2	11	2012	Dawn	141	5.03	148.56	36.3	18.11
AC25	514	3	11	2012	Dawn	173	6.43	50.37	36.45	25.41
GB668	484	1	10	2012	Dawn	174	5.47	252.81	35.61	13.05
GB668	484	2	10	2012	Dawn	150	5.28	148.8	36.2	17
GB668	484	3	10	2012	Dawn	167	6.25	50.07	36.32	24.61
GB668	489	1	10	2012	Noon	174	5.5	254.51	35.57	12.82
GB668	489	2	10	2012	Noon	156	5.23	148.95	36.18	16.93
GB668	489	3	10	2012	Noon	160	6.27	48.45	36.31	24.58
GB668	490	1	10	2012	Dusk	135	5.45	251.12	35.6	13.02
GB668	490	2	10	2012	Dusk	141	5.21	146.71	36.2	17.11
GB668	490	3	10	2012	Dusk	152	6.32	49.35	36.32	24.43
MC920	403	1	7	2012	Noon	163	5.99	249.76	35.86	14.71
MC920	403	2	7	2012	Noon	173	5.54	145.77	36.38	19.45
MC920	403	3	7	2012	Noon	158	6.62	50.19	36.28	26.91
MC920	422	1	7	2012	Dawn	176	5.66	256.42	35.75	14.04
MC920	422	2	7	2012	Dawn	180	5.27	150.97	36.29	18.11
MC920	422	3	7	2012	Dawn	209	6.77	47.94	36.11	25.28
MC920	472	1	9	2012	Dusk	150	5.69	251.24	35.78	14.16
MC920	472	2	9	2012	Dusk	154	5.5	148.82	36.36	18.15
MC920	472	3	9	2012	Dusk	139	6.31	48.88	36.19	25.72
VK989	408	1	7	2012	Dawn	187	5.63	250.03	35.64	13.3
VK989	408	2	7	2012	Dawn	217	5.67	149.12	36.19	17.01
VK989	408	3	7	2012	Dawn	182	6.59	48.5	36.27	25.15

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
VK989	410	1	7	2012	Noon	196	5.64	249.4	35.69	13.63
VK989	410	2	7	2012	Noon	220	5.79	150.77	36.23	17.12
VK989	410	3	7	2012	Noon	191	6.54	51.09	36.28	24.86
VK989	439	1	7	2012	Dusk	269	5.6	254.83	35.74	13.87
VK989	439	2	7	2012	Dusk	147	5.57	150.18	36.23	17.2
VK989	439	3	7	2012	Dusk	195	6.68	52.94	36.02	25.1
AC25	506	1	11	2012	Noon	160	5.26	253.51	35.7	13.66
AC25	506	2	11	2012	Noon	155	5.05	148.03	36.3	18.13
AC25	506	3	11	2012	Noon	171	6.46	49.64	36.45	25.54
AC25	510	1	11	2012	Dusk	173	5.27	251.19	35.7	13.66
AC25	510	2	11	2012	Dusk	170	5.05	149.09	36.3	18.14
AC25	510	3	11	2012	Dusk	164	6.44	49	36.45	25.52
AC25	515	1	11	2012	Dawn	145	5.23	251.15	35.72	13.8
AC25	515	2	11	2012	Dawn	141	5.16	197.1	36.04	15.84
AC25	515	3	11	2012	Dawn	174	5.04	145.15	36.32	18.33
GB668	486	1	10	2012	Dawn	152	5.45	251.47	35.63	13.21
GB668	486	2	10	2012	Dawn	129	5.26	143.92	36.22	17.16
GB668	486	3	10	2012	Dawn	138	6.33	49.83	36.31	24.68
GB668	491	1	10	2012	Dusk	141	5.45	249.27	35.61	13.08
GB668	491	2	10	2012	Dusk	141	5.2	147.24	36.21	17.18
GB668	491	3	10	2012	Dusk	164	6.28	49.04	36.31	24.55
MC920	424	1	7	2012	Dawn	159	5.66	255.15	35.75	14
MC920	424	2	7	2012	Dawn	134	5.33	144.47	36.32	18.47
MC920	424	3	7	2012	Dawn	161	6.8	43.38	36.05	25.83
MC920	425	1	7	2012	Noon	189	5.71	253.11	35.74	13.87
MC920	425	2	7	2012	Noon	231	5.3	151.88	36.29	18.07
MC920	425	3	7	2012	Noon	252	6.89	54.4	36.2	24.44
MC920	473	1	9	2012	Dusk	141	5.7	252.82	35.77	14.09
MC920	473	2	9	2012	Dusk	152	5.5	147.75	36.38	18.25
MC920	473	3	9	2012	Dusk	138	6.34	50.81	36.19	25.51
VK989	434	1	7	2012	Noon	198	5.41	254.18	35.75	13.92
VK989	434	2	7	2012	Noon	203	5.54	155.74	36.15	16.64

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
VK989	434	3	7	2012	Noon	203	6.5	49.34	35.84	25.43
VK989	463	1	9	2012	Dusk	167	5.65	248.25	35.88	14.73
VK989	463	2	9	2012	Dusk	193	5.49	150.49	36.34	18.03
VK989	463	3	9	2012	Dusk	163	6.4	50.09	36.14	25.06
AC25	507	1	11	2012	Noon	144	5.43	299.3	35.5	12.22
AC25	507	2	11	2012	Noon	131	5.26	248.31	35.72	13.78
AC25	507	3	11	2012	Noon	151	5.04	145.15	36.32	18.33
AC25	508	1	11	2012	Noon	154	5.26	253.36	35.7	13.63
AC25	508	2	11	2012	Noon	148	5.04	148.06	36.31	18.2
AC25	508	3	11	2012	Noon	170	6.46	49.08	36.38	25.61
AC25	512	1	11	2012	Dusk	151	5.26	250.78	35.72	13.74
AC25	512	2	11	2012	Dusk	151	5.06	150.57	36.29	18.03
AC25	512	3	11	2012	Dusk	154	6.38	49.71	36.45	25.45
GB668	492	1	10	2012	Dusk	156	5.48	253.18	35.59	12.95
GB668	492	2	10	2012	Dusk	141	5.19	148.44	36.2	17.1
GB668	492	3	10	2012	Dusk	160	6.27	50.56	36.32	24.36
MC920	426	1	7	2012	Noon	170	5.72	253.64	35.75	13.96
MC920	426	2	7	2012	Noon	181	5.34	146.5	36.31	18.35
MC920	426	3	7	2012	Noon	208	6.9	47.33	36.14	25.38
MC920	466	1	9	2012	Dawn	171	5.69	249.5	35.75	13.97
MC920	466	2	9	2012	Dawn	154	5.46	146.41	36.39	18.32
MC920	466	3	9	2012	Dawn	151	6.25	47.16	36.18	25.76
MC920	474	1	9	2012	Dusk	163	5.7	253.87	35.75	13.93
MC920	474	2	9	2012	Dusk	151	5.49	150.39	36.35	18.03
MC920	474	3	9	2012	Dusk	142	6.3	50.43	36.18	25.61
VK989	432	1	7	2012	Dawn	258	5.46	252.72	35.78	14.09
VK989	432	2	7	2012	Dawn	238	5.41	153.23	36.14	16.57
VK989	432	3	7	2012	Dawn	217	6.48	52.41	36.02	25.15
VK989	435	1	7	2012	Noon	275	5.47	298	35.67	13.4
VK989	435	2	7	2012	Noon	141	5.41	247.37	35.78	14.09
VK989	435	3	7	2012	Noon	173	5.7	184.63	36	15.5
VK989	436	1	7	2012	Noon	274	5.41	254.42	35.75	13.92

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
VK989	436	2	7	2012	Noon	164	5.55	148.16	36.23	17.2
VK989	436	3	7	2012	Noon	190	6.59	47.81	35.77	25.45
VK989	464	1	9	2012	Dusk	90	5.61	268.54	35.78	14.1
VK989	464	2	9	2012	Dusk	196	5.7	222.02	35.98	15.36
VK989	464	3	9	2012	Dusk	167	5.49	150.58	36.35	18.06
AC25	517	1	11	2012	Noon	172	5.24	250.9	35.71	13.71
AC25	517	2	11	2012	Noon	174	5.03	150.88	36.29	17.98
AC25	517	3	11	2012	Noon	192	6.45	50.69	36.45	25.48
GB668	500	1	10	2012	Dusk	135	5.61	253.73	35.39	11.56
GB668	500	2	10	2012	Dusk	132	5.14	146.38	36.18	17.13
GB668	500	3	10	2012	Dusk	150	6.32	50.36	36.4	24.05
MC920	427	1	7	2012	Noon	232	5.75	256.43	35.73	13.85
MC920	427	2	7	2012	Noon	248	5.3	153.25	36.29	18.02
MC920	427	3	7	2012	Noon	219	6.82	52.42	36.19	24.86
MC920	467	1	9	2012	Dawn	180	5.7	249.72	35.76	14.01
MC920	467	2	9	2012	Dawn	163	5.48	147.19	36.39	18.27
MC920	467	3	9	2012	Dawn	164	6.26	48.08	36.19	25.71
MC920	537	1	12	2012	Dusk	163	5.6	249.83	36.01	15.55
MC920	537	2	12	2012	Dusk	182	5.84	149.08	36.36	19.83
MC920	537	3	12	2012	Dusk	188	7.45	48.72	36.25	21.83
VK989	433	1	7	2012	Dawn	213	5.47	253.67	35.75	13.95
VK989	433	2	7	2012	Dawn	224	5.42	153.79	36.14	16.6
VK989	433	3	7	2012	Dawn	197	6.45	54.84	36.12	24.88
VK989	459	1	9	2012	Noon	166	5.62	248.47	35.85	14.54
VK989	459	2	9	2012	Noon	183	5.47	148.53	36.36	18.18
VK989	459	3	9	2012	Noon	180	6.49	49.26	36.14	25.19
VK989	465	1	9	2012	Dusk	202	5.65	249.71	35.86	14.64
VK989	465	2	9	2012	Dusk	170	5.5	149.79	36.35	18.12
VK989	465	3	9	2012	Dusk	168	6.43	47.92	36.13	25.3
AC25	518	1	11	2012	Noon	152	5.23	250.82	35.72	13.76
AC25	518	2	11	2012	Noon	180	5.04	150.71	36.3	18.1
AC25	518	3	11	2012	Noon	164	6.48	49.7	36.44	25.61

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
GB668	501	1	10	2012	Dusk	159	5.61	252.79	35.39	11.57
GB668	501	2	10	2012	Dusk	161	5.15	148.04	36.17	17.01
GB668	501	3	10	2012	Dusk	189	6.38	50.33	36.4	24.15
MC920	468	1	9	2012	Dawn	153	5.7	250.56	35.76	14
MC920	468	2	9	2012	Dawn	153	5.48	146.65	36.38	18.26
MC920	468	3	9	2012	Dawn	162	6.29	46.99	36.17	25.82
MC920	469	1	9	2012	Noon	98	5.74	273.53	35.68	13.51
MC920	469	2	9	2012	Noon	189	5.65	222.55	35.91	14.96
MC920	469	3	9	2012	Noon	174	5.57	150.23	36.37	18.02
MC920	538	1	12	2012	Dusk	150	5.61	255.54	35.97	15.34
MC920	538	2	12	2012	Dusk	171	5.85	149.67	36.36	19.82
VK989	456	1	9	2012	Dawn	60	5.56	266.3	35.77	14.04
VK989	456	2	9	2012	Dawn	192	5.7	213.47	36.05	15.81
VK989	456	3	9	2012	Dawn	162	5.48	148.66	36.38	18.28
VK989	460	1	9	2012	Noon	162	5.62	251.93	35.84	14.54
VK989	460	2	9	2012	Noon	159	5.47	147.08	36.36	18.27
VK989	460	3	9	2012	Noon	150	6.49	48.03	36.13	25.3
VK989	527	1	12	2012	Dusk	127	5.45	258.69	35.67	13.47
VK989	527	2	12	2012	Dusk	129	5.16	149.21	36.26	17.62
VK989	527	3	12	2012	Dusk	190	7.38	54.31	35.88	21.14
GB668	502	1	10	2012	Dusk	171	5.6	250.33	35.41	11.69
GB668	502	2	10	2012	Dusk	157	5.15	148.21	36.17	17.02
GB668	502	3	10	2012	Dusk	206	6.37	50.53	36.4	24.13
MC920	470	1	9	2012	Noon	165	5.7	249.31	35.8	14.28
MC920	470	2	9	2012	Noon	147	5.55	148.72	36.37	18.07
MC920	470	3	9	2012	Noon	164	6.29	50.37	36.17	25.58
MC920	531	1	12	2012	Dawn	173	5.59	249.49	36.01	15.61
MC920	531	2	12	2012	Dawn	161	6	145.71	36.35	19.89
MC920	531	3	12	2012	Dawn	178	7.45	48.7	36.24	21.7
MC920	539	1	12	2012	Dusk	172	5.61	252.09	35.99	15.43
MC920	539	2	12	2012	Dusk	171	5.89	145.73	36.37	20.02
MC920	539	3	12	2012	Dusk	173	7.45	48.83	36.25	21.83

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
VK989	457	1	9	2012	Dawn	225	5.61	254.29	35.83	14.43
VK989	457	2	9	2012	Dawn	174	5.46	147.92	36.37	18.28
VK989	457	3	9	2012	Dawn	174	6.46	50	36.14	25.1
VK989	461	1	9	2012	Noon	174	5.61	249.9	35.85	14.54
VK989	461	2	9	2012	Noon	124	5.45	145.91	36.36	18.27
VK989	461	3	9	2012	Noon	149	6.45	49.25	36.13	25.23
VK989	529	1	12	2012	Dusk	159	5.45	260.84	35.68	13.5
VK989	529	2	12	2012	Dusk	163	5.19	154.74	36.23	17.43
VK989	529	3	12	2012	Dusk	192	6.23	101.1	36.14	20.09
MC920	471	1	9	2012	Noon	151	5.7	253.63	35.79	14.2
MC920	471	2	9	2012	Noon	184	5.56	155.36	36.33	17.82
MC920	471	3	9	2012	Noon	172	6.27	48.48	36.16	25.78
MC920	532	1	12	2012	Dawn	141	5.6	251.84	35.99	15.5
MC920	532	2	12	2012	Dawn	150	5.93	146.4	36.35	19.82
MC920	532	3	12	2012	Dawn	163	7.46	48.74	36.25	21.71
VK989	458	1	9	2012	Dawn	151	5.49	289.06	35.66	13.35
VK989	458	2	9	2012	Dawn	215	5.66	238.53	35.92	14.98
VK989	458	3	9	2012	Dawn	186	5.46	148.23	36.37	18.22
VK989	497	1	10	2012	Noon	170	5.65	250.37	35.65	13.33
VK989	497	2	10	2012	Noon	151	5.47	147.66	36.24	17.21
VK989	497	3	10	2012	Noon	167	6.29	49.82	36.02	25.08
VK989	530	1	12	2012	Dusk	152	5.46	258.02	35.69	13.58
VK989	530	2	12	2012	Dusk	175	5.17	149.85	36.27	17.67
VK989	530	3	12	2012	Dusk	204	7.44	54.3	35.92	21.22
MC920	533	1	12	2012	Dawn	175	5.6	251.17	35.99	15.47
MC920	533	2	12	2012	Dawn	159	5.81	148.86	36.36	19.69
MC920	533	3	12	2012	Dawn	172	7.46	51	36.24	21.7
MC920	534	1	12	2012	Noon	194	5.61	251.58	35.98	15.35
MC920	534	2	12	2012	Noon	182	5.89	146.89	36.35	19.68
MC920	534	3	12	2012	Noon	182	7.46	49.63	36.25	21.76
VK989	494	1	10	2012	Dawn	71	5.64	275.54	35.5	12.37
VK989	494	2	10	2012	Dawn	142	5.64	222.56	35.77	14.11

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
VK989	494	3	10	2012	Dawn	160	5.46	148.21	36.24	17.23
VK989	498	1	10	2012	Noon	198	5.64	251.16	35.65	13.29
VK989	498	2	10	2012	Noon	198	5.47	150.23	36.22	17.11
VK989	498	3	10	2012	Noon	179	6.25	50.83	36	25.01
MC920	535	1	12	2012	Noon	155	5.6	249.98	36	15.5
MC920	535	2	12	2012	Noon	162	5.88	148.37	36.35	19.68
MC920	535	3	12	2012	Noon	172	7.46	50.48	36.25	21.77
VK989	495	1	10	2012	Dawn	143	5.67	299.1	35.43	11.85
VK989	495	2	10	2012	Dawn	176	5.63	247.6	35.65	13.32
VK989	495	3	10	2012	Dawn	178	5.48	151.45	36.23	17.09
VK989	499	1	10	2012	Noon	200	5.64	251.64	35.65	13.31
VK989	499	2	10	2012	Noon	194	5.45	150.29	36.23	17.14
VK989	499	3	10	2012	Noon	187	6.23	52.04	36.02	24.85
MC920	536	1	12	2012	Noon	187	5.61	250.88	36	15.52
MC920	536	2	12	2012	Noon	187	5.82	151.2	36.36	19.56
MC920	536	3	12	2012	Noon	183	7.46	51.44	36.25	21.76
VK989	496	1	10	2012	Dawn	146	5.64	251.18	35.64	13.27
VK989	496	2	10	2012	Dawn	154	5.48	147.79	36.24	17.26
VK989	496	3	10	2012	Dawn	162	6.22	49.43	36	24.96
VK989	522	1	12	2012	Noon	144	5.58	255.08	36.04	15.81
VK989	522	2	12	2012	Noon	116	5.65	196.8	36.37	17.96
VK989	522	3	12	2012	Noon	119	5.43	143.69	36.41	20.04
VK989	525	1	12	2012	Noon	152	5.46	250.13	35.68	13.51
VK989	525	2	12	2012	Noon	137	5.19	152.01	36.27	17.7
VK989	525	3	12	2012	Noon	138	7.25	48.78	35.88	21.3
VK989	521	1	12	2012	Dawn	159	5.6	253.33	36.07	16.01
VK989	521	2	12	2012	Dawn	152	5.41	148.12	36.44	19.99
VK989	521	3	12	2012	Dawn	135	6.86	50.9	35.96	22.38
VK989	523	1	12	2012	Noon	125	5.56	250.69	36.05	15.88
VK989	523	2	12	2012	Noon	110	5.42	144.79	36.42	19.98
VK989	523	3	12	2012	Noon	144	6.81	48.44	35.91	22.33
VK989	526	1	12	2012	Noon	141	5.47	260.53	35.64	13.27

Table F-1. (Continued).

Station	Tow	Net	Month	Year	Time of Day	Volume Filtered (m^3)	Oxygen (ml/L)	Pressure (m)	Salinity (ppt)	Temperature (°C)
VK989	526	2	12	2012	Noon	119	5.2	153.21	36.23	17.5
VK989	526	3	12	2012	Noon	155	7.26	48.49	35.91	21.37
MC920	54	1	4	2011	Noon	245	2.99	250	35.68	13.52
MC920	54	2	4	2011	Noon	214	3.45	149.86	36.11	16.17
MC920	54	3	4	2011	Noon	163	4.38	43.53	35.16	21.38
MC920	58	1	4	2011	Dusk	196	2.99	245.36	35.69	13.63
MC920	58	2	4	2011	Dusk	142	3.4	141.94	36.15	16.52
MC920	58	3	4	2011	Dusk	192	4.52	35.21	32.8	21.96

APPENDIX G

Family Representatives in the MOCNESS Collections

Table G-1. Raw number of individuals by cooling water intake structures (CWIS) station and family listed in order of descending abundance. The raw count of eggs is given first. Taxonomic levels other than family included superclass, order, and suborder (shaded in grey).

Taxon	Common Name	AC25	GB668	VK989	MC920	Total	Percent of Total	X if Used in the NMDS
Eggs		7,189	6,289	14,932	5,647	34,057		
Myctophidae	Lanternfishes	4,777	4,307	5,848	5,872	20,804	34	X
Sternoptychidae	Hatchetfishes and allies	2,059	1,715	2,079	1,860	7,713	13	X
Bregmacerotidae	Codlets	2,345	523	1,200	440	4,508	7	X
Gonostomatidae	Lightfishes and bristlemouths	651	785	926	875	3,237	5	X
Clupeidae	Herrings, pilchards, sardines	12	22	2,583	43	2,660	4	X
Gobiidae	Gobies, gudgeons, sleepers	1,689	388	433	133	2,643	4	X
Scombridae	Bonitos, mackerels, tunas	381	462	690	721	2,254	4	X
Carangidae	Jacks and trevallies	333	366	591	408	1,698	3	X
Phosichthyidae	Lightfishes	370	361	347	368	1,446	2	X
Paralepididae	Barracudinas	355	289	466	281	1,391	2	X
Paralichthyidae	Large-tooth flounders	508	146	216	228	1,098	2	X
Nomeidae	Driftfishes	87	155	309	289	840	1	X
Bothidae	Lefteye flounders	243	182	203	161	789	1	X
Bathylagidae	Deepsea smelts	132	118	171	147	568	1	X
Melamphaidae	Bigscale fishes and ridgeheads	161	134	102	130	527	1	X
Gempylidae	Snake mackerels and gemfishes	106	137	110	144	497	1	X
Engraulidae	Anchovies	93	49	198	37	377	1	X
Chauliodontidae	Viperfishes	56	46	151	117	370	1	X
Serranidae	Groupers and sea basses	155	48	83	70	356	1	X
Congridae	Conger eels and garden eels	56	38	158	24	276	0	X
Labridae	Wrasses	15	12	150	97	274	0	X
Scorpaenidae	Scorpionfishes, rockfishes, stonefishes	123	21	70	49	263	0	X
Lutjanidae	Emperors and snappers	78	59	59	55	251	0	X
Nettastomatidae	Duckbills	62	40	118	18	238	0	X
Antennariidae	Frogfishes and shallow anglerfishes	34	78	65	60	237	0	X
Cynoglossidae	Tonguefishes and tongue soles	60	23	122	30	235	0	X
Mugilidae	Mullets	84	50	47	44	225	0	X
Scopelarchidae	Pearleyes	98	40	44	40	222	0	X
Stomiidae	Viperfishes, dragonfishes, snaggletooths, loosejaws	28	41	46	74	189	0	X
Ophidiidae	Brotulas, cusk eels and allies	55	23	49	36	163	0	X
Epigonidae	Epigonids	73	36	18	12	139	0	X
Muraenidae	Moray eels	24	18	52	14	108	0	X
Synodontidae	Lizardfishes, Bombay duck	370	12	28	35	445	1	
Microdesmidae	Wormfishes	63	43	49	8	163	0	

Table G-1. (Continued).

Taxon	Common Name	AC25	GB668	VK989	MC920	Total	Percent of Total	X if Used in the NMDS
Eggs		7,189	6,289	14,932	5,647	34,057		
Stromateoidei	Butterfishes	5	10	22	107	144	0	
Trichiuridae	Cutlassfishes	15	5	93	22	135	0	
Anguilliformes	Freshwater eels	3		110	19	132	0	
Eleotridae	Sleeperfishes	76	52			128	0	
Perciformes	Glassfishes	16	21	44	46	127	0	
Stromateidae	Butterfishes	14	37	34	30	115	0	
Ariommatidae	Ariommatids	23	41	22	27	113	0	
Percophidae	Duckbills	15	30	49	17	111	0	
Callionymidae	Dragonets	6	26	10	64	106	0	
Sciaenidae	Drums and croakers			105		105	0	
Chlorophthalmidae	Greeneyes	35	31	5	19	90	0	
Osteichthyes	Bony fishes		2	54	24	80	0	
Howellidae	Oceanic basslets	13	27	17	21	78	0	
Polymixiidae	Beardfishes	35	17	14	11	77	0	
Scaridae	Parrotfishes	7	6	10	52	75	0	
Ophichthidae	Snake eels and worm eels	31	7	32	3	73	0	
Microstomatidae bathylagidae	Deepsea smelts	12	18	7	33	70	0	
Moridae	Morid eels, morays	3	48	5	8	64	0	
Acropomatidae	Acropomatids	27	14	10	10	61	0	
Chiasmodontidae	Swallowers	4	9	18	28	59	0	
Tetraodontidae	Pufferfishes, toados	22	17	8	9	56	0	
Argentinidae	Herring smelts	9	8	17	17	51	0	
Lestidae		28	3	7	12	50	0	
Coryphaenidae	Dolphins	8	4	13	23	48	0	
Macrouridae	Rattails, grenadiers	6	4	18	17	45	0	
Synaphobranchidae	Cutthroat eels	9	7	5	23	44	0	
Clupeiformes	Herrings, anchovies, sardines	7	6	18	12	43	0	
Gadiformes	Muraenolepidids	2		16	22	40	0	
Carapidae	Pearlfishes	6	8	9	16	39	0	
Bramidae	Pomfrets	6	9	13	9	37	0	
Linophrynidae	Netdevils	7	12	9	8	36	0	
Malacanthidae	Tilefishes	10	5	4	11	30	0	
Microstomatidae	Deepsea smelts	9	7	11	3	30	0	
Bathygadidae	Grenadiers, bathygadids, rattails, whiptails	1	12	8	7	28	0	
Caulophrynidae	Fanfins	11	5	6	4	26	0	
Priacanthidae	Bigeyes and catalufas	3	5	4	14	26	0	
Aulopidae	Aulopids	4	1	13	7	25	0	
Bathysauridae	Bathysaurids	8	12	2	3	25	0	

Table G-1. (Continued).

Taxon	Common Name	AC25	GB668	VK989	MC920	Total	Percent of Total	X if Used in the NMDS
Eggs		7,189	6,289	14,932	5,647	34,057		
Centriscidae	Razorfishes and shrimpfishes	5	6	14		25	0	
Sphyraenidae	Barracudas	9	4	4	8	25	0	
Moringuidae	Spaghetti eels	5		19		24	0	
Evermannellidae	Sabertooth fishes		5	8	10	23	0	
Apogonidae	Cardinalfishes	8	6	2	6	22	0	
Ceratiidae	Seadevils	8	3	5	6	22	0	
Gadidae	Codfishes, haddocks and allies	1	2	6	13	22	0	
Notosudidae	Waryfishes	2	9	3	7	21	0	
Opisthoproctidae	Barreleyes and spookfishes	7	1	8	4	20	0	
Stomiiformes	Lightfishes and dragonfishes	17	2		1	20	0	
Mullidae	Goatfishes	13	1	2	1	17	0	
Pomacanthidae	Angelfishes	1	2		13	16	0	
Acanthuridae	Surgeonfishes and tangs	1		3	11	15	0	
Balistidae	Triggerfishes	2	7		5	14	0	
Exocoetidae	Flyingfishes	5	2		5	12	0	
Bleniidae	Blennies			10	1	11	0	
Merluciidae	Hakes		1	10		11	0	
Phycidae	Phycid hakes	7	1	1	1	10	0	
Ceratioidei	Deepsea anglerfishes		4	1	4	9	0	
Sparidae	Breams and porgies	1	3	4	1	9	0	
Stomiatoidei	Lightfishes and allies		3		6	9	0	
Caproidae	Boarfishes	5	2		1	8	0	
Grammicolepididae	Tinselfishes				8	8	0	
Mirapinnidae	Hairyfishes	4	1	1	2	8	0	
Diretmidae	Spinyfins	2	1	3	1	7	0	
Holocentridae	Squirrelfishes and soldierfishes				7	7	0	
Pleuronectidae	Righteye flounders	3	1	1	1	6	0	
Alepisauridae	Lancetfishes	3	1	1		5	0	
Dussmieriidae	Herrings and sardines			4	1	5	0	
Echeneidae	Remoras	4			1	5	0	
Elopidae	Tenpounders and ladyfishes	2		3		5	0	
Kyphosidae	Sea chubs		1	1	3	5	0	
Ogcocephalidae	Batfishes	4		1		5	0	
Radiicephalidae	Inkfishes	1	1		3	5	0	
Scombrolabracidae	Scombrolabracids	2	1	1	1	5	0	
Caristiidae	Manefishes		1		3	4	0	
Gerreidae	Mojarras and silver biddies	2	2			4	0	
Hemiramphidae	Halfbeaks	1	2		1	4	0	

Table G-1. (Continued).

Taxon	Common Name	AC25	GB668	VK989	MC920	Total	Percent of Total	X if Used in the NMDS
Eggs		7,189	6,289	14,932	5,647	34,057		
Ipnopidae	Ipnopids, tripodfishes	3		1		4	0	
Lampridiidae	Opahs			1	3	4	0	
Lophiidae	Goosefishes and monkfishes	2		1	1	4	0	
Rachycentridae	Cobia, black kingfish		1	3		4	0	
Sygnathidae	Pipefishes and seahorses	3			1	4	0	
Dactylopteridae	Helmet gurnards and flying gurnards	1			2	3	0	
Fistulariidae	Cornetfishes			3		3	0	
Nettastomatidae	Duckbill eels	1			2	3	0	
Omosudidae	Omosudids		2	1		3	0	
Pomatomidae	Bluefish, tailors	2	1			3	0	
Triglidae	Gurnards and sea robins				3	3	0	
Berycidae	Alfoncinos	1	1			2	0	
Ephippidae	Spadefishes			1	1	2	0	
Giganturidae	Telescopefishes		1	1		2	0	
Congridae	Conger eels		2			2	0	
Haemulidae	Grunts				2	2	0	
Istiophoridae	Billfishes		1		1	2	0	
Megalopidae	Tarpons	1		1		2	0	
Monacanthidae	Filefishes and leatherjackets				2	2	0	
Neoceratiidae	Needlebeard angler	1	1			2	0	
Pomacentridae	Anemonefishes and damselfishes			1	1	2	0	
Scombropidae	Gnomefishes		2			2	0	
Steindachneriidae	Steindachneriids			2		2	0	
Trachipteridae	Ribbonfishes				2	2	0	
Xenocongridae	False moray eels				2	2	0	
Xiphiidae	Swordfishes	1			1	2	0	
Albulidae	Bonefishes	1				1	0	
Alepocephalidae	Slickheads		1			1	0	
Anoplogastridae	Fangtooths				1	1	0	
Atherinidae	Grunions, silversides, topsmelts			1		1	0	
Atherinopsidae	Neotropical silversides			1		1	0	
Aulopiformes	Aulopids				1	1	0	
Aulostomidae	Trumpetfishes			1		1	0	
Barbourisiidae	Red velvet whalefish				1	1	0	
Beryciformes	Squirrelfishes, soldierfishes				1	1	0	
Chaetodontidae	Butterflyfishes				1	1	0	
Chlopsidae	False moray eels				1	1	0	
Cyprinidae	Carps and minnows		1			1	0	

Table G-1. (Continued).

Taxon	Common Name	AC25	GB668	VK989	MC920	Total	Percent of Total	X if Used in the NMDS
Eggs		7,189	6,289	14,932	5,647	34,057		
Emmelichthyidae	Rovers			1		1	0	
Gasterosteiformes	Sand eels			1		1	0	
Gobiesocidae	Clingfishes			1		1	0	
Muraenesocidae	Pike eels				1	1	0	
Nemichthyidae	Snipe eels	1				1	0	
Oneirodidae	Dreamers				1	1	0	
Opistognathidae	Jawfishes	1				1	0	
Pempheridae	Sweepers				1	1	0	
Saccopharyngoidae	Swallowers and gulpers		1			1	0	
Scombroidei	Jacks, tunas, mackerels		1			1	0	
Scophthalmidae	Turbots				1	1	0	
Sebastidae	Rockfishes, rockcods, thornyheads			1		1	0	
Stylephoridae	Tube-eye			1		1	0	
Tetragonuridae	Squaretails		1			1	0	
Triacanthodidae	Spikefishes				1	1	0	
Uranoscopidae	Stargazers				1	1	0	
Zeidae	Dories			1		1	0	
Total		**16,376**	**11,386**	**18,764**	**13,850**	**60,376**	**100**	**56,596**
Taxon richness		**111**	**112**	**116**	**127**	**165**		**32**

AC = Aliminos Canyon; GB = Garden Banks; VK = Viosca Knoll; MC = Mississippi Canyon; NMDS = nonmetric multidimensional scaling.

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July 23, 2015 **Sent Via Email**

Chevron USA
100 Northpark Blvd.
Houston, TX 70433
Attn: Jim Floyd

Re: Third Quarter 2015 Entrainment Monitoring Report for the Chevron Jack and St. Malo Floating Production Unit
CK Project No. 10726

Dear Mr. Floyd:

CK Associates (CK) is providing this letter report to Chevron USA (Chevron) to summarize the findings of the third quarter 2015 entrainment monitoring event for intake water collected from the cooling water intake structure (CWIS) aboard the Jack and St. Malo (JSM) floating production unit (FPU). The JSM FPU is a new fixed facility, for which construction was commenced after July 17, 2006. Therefore, quarterly entrainment monitoring is required for the JSM FPU CWIS in accordance with section 12.c.2.ii of the *NPDES General Permit for New and Existing Sources and New Dischargers in the Offshore Subcategory of the Oil and Gas Extraction Point Source Category for the Western Portion of the Outer Continental Shelf of the Gulf of Mexico (GMG290000)* (general permit), effective October 1, 2012.

Sample Collection

Entrainment samples were collected by Chevron personnel from a slip stream of the cooling water system. The slip stream begins downstream of the CWIS intake screens and upstream of the facility heat exchanger(s). The slip stream is passed through an entrainment monitoring device (EMD) consisting of a closed conduit with a 330 micrometer screen in line with the flow after which the stream is returned to the JSM cooling water system downstream of the facility heat exchanger(s).

The sampling process began at 13:00 on July 4, 2015 and lasted until 07:00 July 5, 2015. The EMD was operated continuously during the sampling period at a flow rate of 11.0 gallons per minute resulting in an entrainment sample volume of 12,000 gallons. Sample collection data are summarized in Table 1. Upon sampling termination, the screen was removed from the EMD and washed of entrained particles into sample jars containing 10% buffered formalin. The sample jars were packed in an ice chest and shipped to CK for processing and species identification by a fisheries biologist. See attachments A and B for a copy of the field data sheet and chain of custody documentation respectively.

Sample Results

Samples were analyzed for the presence of eggs and larvae from yellowfin tuna, and red snapper. These species were identified in the FPU's general permit application as representative commercial and recreational species of concern because eggs and larvae of these species are considered to be most likely to be entrained in the JSM CWIS.

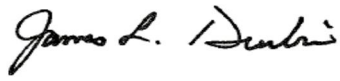
Zero yellowfin tuna eggs/larvae and zero red snapper eggs/larvae were identified during sample analysis. When normalized to the total facility flow, this entrainment rate amounts to zero eggs/larvae per cubic meter and zero species of concern entrained per day. A summary of the entrained species of concern is included in Table 2. Entrained organisms that were not listed as species of concern, but that were found in the entrainment samples included chaetognatha, copepods, amphipods, Lucifer faxoni. Additionally, three scaridae larvae was observed, although the species was unable to be identified. None of these organisms should be included as part of the discharge monitoring report submittal because they do not represent important commercial and recreational species of concern.

Conclusions

Zero organisms of important commercial and recreational species of concern were identified in entrainment samples collected from the JSM FPU during its third calendar quarter of entrainment monitoring. Based on the analysis of the entrainment monitoring samples, engineering controls installed at the JSM FPU CWIS have successfully minimized the potential for environmental, socioeconomic, and ecological damage due to entrainment in the facility CWIS.

If you have any questions or comments regarding this report, please do not hesitate to contact me at (255) 755-1000 or via email at James.Durbin@c-ka.com .

Sincerely yours,
CK Associates



James L. Durbin
Senior Environmental Scientist

Attachments: As referenced

Table 1
Sample Collection Data Summary by Quarter

Quarter	Year	Start Date and Time	Stop Date and Time	Flow Rate (gal/min)	Sample Volume (MG)	Collection Method
3	2015	7/4/15 1300	7/5/15 0700	11.0 (est)	0.012	Composite

Table 2
Entrainment Summary by Quarter

Quarter	Year	Species/Family	Total Collected	Sample Volume (MG)	Total # Entrained[1]
1	2015	*Thunnus albacares* (yellowfin tuna)	0	0.016	0
1	2015	*Lutjanus campechanus*(red snapper)	0	0.016	0
2	2015	*Thunnus albacares* (yellowfin tuna)	0	0.016	0
2	2015	*Lutjanus campechanus*(red snapper)	0	0.016	0
3	2015	*Thunnus albacares* (yellowfin tuna)	0	0.012	0
3	2015	*Lutjanus campechanus*(red snapper)	0	0.012	0
Total	**2015**	***Thunnus albacares* (yellowfin tuna)**	**0**	**N/A**	**0**
Total	**2015**	***Lutjanus campechanus*(red snapper)**	**0**	**N/A**	**0**

[1] Projected number of organisms entrained per quarter based on an average cooling water flow equal to 26.8 MGD for a 91-day quarter.

ATTACHMENT A
DATA SHEET FOR SAMPLE EVENT

Attachment A - Example Data Sheet
Cooling Water Intake Structure Entrainment Sampling and Monitoring Procedures
Chevron North America Exploration and Production Company Deepwater
Jack St. Malo Platform

Collection Date	7/4 - 7/5/15
Project Number	
Names of Personnel Collecting Samples	John Berry, Isaac Newman
Sample Collection Flow Rate	11 gal/min
Sample Event Start Time and Date	1 pm 7/4/15
Sample Event End Time and Date	7 Am 7/5/15
Weather Conditions during each cycle	Calm
Number of Sample Jars Filled	4
Sample Collection Method	every 6 hours for 24 total hours
Other Notes Relevant to Sampling Event	

ATTACHMENT B
CHAIN-OF-CUSTODY FOR SAMPLE EVENT

C-K ASSOCIATES • LLC
ENVIRONMENTAL & ENGINEERING CONSULTANTS

CHAIN OF CUSTODY AND ANALYTICAL REQUEST RECORD

Page____ of____

CLIENT: Chevron N.A. Jack St. Malo **P.O. NUMBER:** N/A **SAMPLED BY:** Isaac Newman

PROJECT NO.: **LABORATORY*:** CK Associates **DATE:** 7/8/15

SAMPLE IDENTIFICATION	DATE	TIME	MATRIX	NO. OF CONTAINERS	PRESERVATIVE	ANALYSES AND INSTRUCTIONS
Sample #1	7/8/15	7/4/15 @ 1300	Sea-Water	1 of 4	10% formain	Provide information on species composition, abundance, and size of entrained organisms
Sample #2	7/8/15	7/4/15 @ 1900	Sea-Water	2 of 4	10% formain	
Sample #3	7/8/15	7/5/15 @ 0100	Sea-Water	3 of 4	10% formain	
Sample #4	7/8/15	7/5/15 @ 0700	Sea-Water	4 of 4	10% formain	
		Dates and times written on sample containers				~~Lab ID JM15070801~~ CKZ 7.8.15
						Lab ID JSM15070801

Relinquished by:	(Name)	Date	Time	Received by:	(Name)	Date	Time
	Clint Ward	7-8-15	8:00		Kasten Despaux	7/8/15	1047
	(Signature)	Date	Time		(Signature)	Date	Time
		7-8-15	8:00			7/8/15	1047
Relinquished by:	(Name) Kasten Despaux	Date	Time	Received by ~~Laboratory~~:	(Name) Jenifer Thibodaux	Date	Time
		7-8-15	11:18			7/8/15	11:18
	(Signature)	Date	Time		(Signature)	Date	Time
		7-8-15	11:18			7/8/15	11:18

Method of Shipment:	Condition of Samples upon receipt at laboratory:	Temperature upon receipt
HotShot		

Jenifer Thibodaux 7/8/15 13:58 Robert Waddell 7-8-15 1358

Please send results and invoice to the attention of _____ in our ☐ Baton Rouge, ☐ Lake Charles, ☐ Shreveport, ☐ Houston Office

WHITE COPY TO ACCOMPANY SAMPLE • RETAIN YELLOW COPY FOR FILES • RETAIN PINK COPY FOR FIELD SUPERVISOR

CK-100

ATTACHMENT C
FIELD OBSERVATIONS DURING SAMPLING

Subject: JSM Entrainment Sample-Attachment A

From: Rodrigue, Clay W. (wrod) [mailto:WROD@chevron.com]
Sent: Thursday, July 09, 2015 3:56 PM
To: Kunjappy, Raj
Subject: RE: JSM Entrainment Sample-Attachment A

Raj, Speaking with John Berry.

1. No obstructions in the meter or the hoses.
2. The assembly has no devices that require calibration, the flow meter is a replaceable type and is functioning now.
3. See above.
4. Both gentlemen report that the screen was intact during the collection procedure.
5. No incident or situation occurred that would that draw any attention to the lowered count. Pumps stayed online with no shut-ins or swaps.

Both indicated a light coating of the material was noted. Let me know if you feel another sample is needed.

From: Kunjappy, Raj
Sent: Thursday, July 09, 2015 3:03 PM
To: Rodrigue, Clay W. (wrod)
Cc: Floyd, Jim
Subject: RE: JSM Entrainment Sample-Attachment A

If we can evaluate the sample procedure and ensure none of the following occurred:

(1) possible flow meter obstruction due to aquatic vegetation or other debris on the propeller
(2) malfunctioning or damaged flow meters;
(3) any equipment used that requires calibration and is not properly calibrated;
(4) damaged (torn) screening found after a sample is collected;
(5) any incident or situation which may result in the collection of unreliable data;

I am leaning towards having the lab analyze if we can confirm the above.

Thank you,
Raj Kunjappy
HES Specialist- Water/NPDES

Gulf of Mexico Business Unit
Chevron North America Exploration and Production Company
(a Chevron U.S.A. Inc division)
100 Northpark Boulevard (COV114/122B)
Covington, LA 70433
O: 985-773-7283
C: 985-377-6991
raj.kunjappy@chevron.com

From: Rodrigue, Clay W. (wrod)
Sent: Thursday, July 09, 2015 2:50 PM

To: Kunjappy, Raj
Subject: RE: JSM Entrainment Sample-Attachment A

Raj, I just spoke with Isaac and he commented that he noticed little was caught in the sample he recovered. Also spoke with John separately and he noted the same. Neither felt the necessity to include it in the note section, though they both said it was just out of the ordinary.

From: Kunjappy, Raj
Sent: Thursday, July 09, 2015 2:05 PM
To: Rodrigue, Clay W. (wrod)
Subject: JSM Entrainment Sample-Attachment A

Clay,
Do you have a document referred to as "Attachment A" that was filled out? If you do, could you send it to me? See the second page of the attachment.

Thank you,
Raj Kunjappy
HES Specialist- Water/NPDES

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July 9, 2014 **Sent Via Email**

Chevron USA
17000 Katy Freeway
Houston, TX 77094
Attn: Ms. Kathy Dahl

Re: Second Quarter 2014 Entrainment Monitoring Report for the Chevron Jack and St. Malo Floating Production Unit
CK Project No. 10726

Dear Ms. Dahl:

CK Associates (CK) is providing this letter report to Chevron USA (Chevron) to summarize the findings of the second quarter 2014 entrainment monitoring event for intake water collected from the cooling water intake structure (CWIS) aboard the Jack and St. Malo (JSM) floating production unit (FPU). The JSM FPU is a new fixed facility, for which construction was commenced after July 17, 2006. Therefore, quarterly entrainment monitoring is required for the JSM FPU CWIS in accordance with section 12.c.2.ii of the *NPDES General Permit for New and Existing Sources and New Dischargers in the Offshore Subcategory of the Oil and Gas Extraction Point Source Category for the Western Portion of the Outer Continental Shelf of the Gulf of Mexico (GMG290000)* (general permit).

Sample Collection

Entrainment samples were collected by Chevron personnel from a slip stream of the cooling water system. The slip stream begins downstream of the CWIS intake screens and upstream of the facility heat exchanger(s). The slip stream is passed through an entrainment monitoring device (EMD) consisting of a closed conduit with a 330 micrometer screen in line with the flow after which the stream is returned to the JSM cooling water system downstream of the facility heat exchanger(s).

The sampling process began at 14:15 on June 27, 2014 and lasted until 14:15 on June 28, 2014. The EMD was operated continuously during the sampling period at a flow rate of 13.2 gallons per minute resulting in an entrainment sample volume of 19,000 gallons. Sample collection data are summarized in Table 1. Upon sampling termination, the screen was removed from the EMD and washed of entrained particles into sample jars containing 10% buffered formalin. The sample jars were packed in an ice chest and shipped to CK for processing and species identification by a fisheries biologist.

Sample Results

Samples were analyzed for the presence of eggs and larvae from yellowfin tuna, and red snapper. These species were identified in the FPU's general permit application as representative commercial and recreational species of concern because eggs and larvae of these species are considered to be most likely to be entrained in the JSM CWIS.

Zero yellowfin tuna eggs/larvae and zero red snapper eggs/larvae were identified during sample analysis. When normalized to the total facility flow, this entrainment rate accounts to zero eggs/larvae per cubic meter and approximately zero species of concern entrained per day. A summary of the entrained species of concern is included in Table 2. Entrained organisms that were not listed as species of concern, but that were found in the entrainment samples included copepods, decapods, chaetognatha, and various phytoplankton. These organisms should not be included as part of the discharge monitoring report submittal because they do not represent species of commercial, recreational, or forage concern.

Conclusions

Based on the analysis of the entrainment monitoring samples, engineering controls installed at the JSM FPU CWIS have successfully minimized the potential for environmental damage due to entrainment in the facility CWIS.

If you have any questions or comments regarding this report, please do not hesitate to contact me at (255) 755-1000 or via email at Chad.Cristina@C-KA.com.

Sincerely yours,
CK Associates

Chad Cristina Ph.D., P.E

Chad M. Cristina Ph.D., P.E.
Senior Environmental Engineer

Attachments: As referenced

Table 1
Sample Collection Data Summary by Quarter

Quarter	Year	Start Date and Time	Stop Date and Time	Flow Rate (gal/min)	Sample Volume (MG)	Collection Method
2	2014	6/27/2014 14:15	6/28/2014 14:25	13.2	0.019	24-hr Continuous

Table 2
Entrainment Summary by Quarter

Quarter	Year	Species/Family	Total Collected	Sample Volume (MG)	Total # Entrained[1]
2	2014	*Thunnus albacares*(yellowfin tuna)	0	0.019	0
2	2014	*Lutjanus campechanus*(red snapper)	0	0.019	0
2	2014	Total	0	0.019	0

[1] Projected number of organisms entrained per quarter based on an average cooling water flow equal to 26.8 MGD for a 91-day quarter

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September 18, 2014 **Sent Via Email**

Chevron USA
17000 Katy Freeway
Houston, TX 77094
Attn: Ms. Kathy Dahl

Re: Third Quarter 2014 Entrainment Monitoring Report for the Chevron Jack and St. Malo Floating Production Unit
CK Project No. 10726

Dear Ms. Dahl:

CK Associates (CK) is providing this letter report to Chevron USA (Chevron) to summarize the findings of the third quarter 2014 entrainment monitoring event for intake water collected from the cooling water intake structure (CWIS) aboard the Jack and St. Malo (JSM) floating production unit (FPU). The JSM FPU is a new fixed facility, for which construction was commenced after July 17, 2006. Therefore, quarterly entrainment monitoring is required for the JSM FPU CWIS in accordance with section 12.c.2.ii of the *NPDES General Permit for New and Existing Sources and New Dischargers in the Offshore Subcategory of the Oil and Gas Extraction Point Source Category for the Western Portion of the Outer Continental Shelf of the Gulf of Mexico (GMG290000)* (general permit).

Sample Collection

Entrainment samples were collected by Chevron personnel from a slip stream of the cooling water system. The slip stream begins downstream of the CWIS intake screens and upstream of the facility heat exchanger(s). The slip stream is passed through an entrainment monitoring device (EMD) consisting of a closed conduit with a 330 micrometer screen in line with the flow after which the stream is returned to the JSM cooling water system downstream of the facility heat exchanger(s).

The sampling process began at 03:00 on August 4, 2014 and lasted until 03:00 on August 5, 2014. The EMD was operated continuously during the sampling period at a flow rate of 13.2 gallons per minute resulting in an entrainment sample volume of 19,000 gallons. Sample collection data are summarized in Table 1. Upon sampling termination, the screen was removed from the EMD and washed of entrained particles into sample jars containing 10% buffered formalin. The sample jars were packed in an ice chest and shipped to CK for processing and species identification by a fisheries biologist.

Sample Results

Samples were analyzed for the presence of eggs and larvae from yellowfin tuna, and red snapper. These species were identified in the FPU's general permit application as representative commercial and recreational species of concern because eggs and larvae of these species are considered to be most likely to be entrained in the JSM CWIS.

Zero yellowfin tuna eggs/larvae and zero red snapper eggs/larvae were identified during sample analysis. When normalized to the total facility flow, this entrainment rate accounts to zero eggs/larvae per cubic meter and approximately zero species of concern entrained per day. A summary of the entrained species of concern is included in Table 2. Entrained organisms that were not listed as species of concern, but that were found in the entrainment samples included copepods, decapods, chaetognatha, and various phytoplankton. These organisms should not be included as part of the discharge monitoring report submittal because they do not represent species of commercial, recreational, or forage concern.

Conclusions

Based on the analysis of the entrainment monitoring samples, engineering controls installed at the JSM FPU CWIS have successfully minimized the potential for environmental damage due to entrainment in the facility CWIS.

If you have any questions or comments regarding this report, please do not hesitate to contact me at (255) 755-1000 or via email at Chad.Cristina@C-KA.com.

Sincerely yours,
CK Associates

Chad Cristina Ph.D., P.E

Chad M. Cristina Ph.D., P.E.
Senior Environmental Engineer

Attachments: As referenced

Table 1
Sample Collection Data Summary by Quarter

Quarter	Year	Start Date and Time	Stop Date and Time	Flow Rate (gal/min)	Sample Volume (MG)	Collection Method
3	2014	8/4/2014 03:00	8/5/2014 03:00	13.2	0.019	24-hr Continuous

Table 2
Entrainment Summary by Quarter

Quarter	Year	Species/Family	Total Collected	Sample Volume (MG)	Total # Entrained[1]
3	2014	*Thunnus albacares*(yellowfin tuna)	0	0.019	0
3	2014	*Lutjanus campechanus*(red snapper)	0	0.019	0
3	2014	Total	0	0.019	0

[1] Projected number of organisms entrained per quarter based on an average cooling water flow equal to 26.8 MGD for a 91-day quarter.

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FAX (318) 798-0478

December 29, 2014 **Sent Via Email**

Chevron USA
17000 Katy Freeway
Houston, TX 77094
Attn: Ms. Kathy Dahl

Re: Fourth Quarter 2014 Entrainment Monitoring Report for the Chevron Jack and St. Malo Floating Production Unit
CK Project No. 10726

Dear Ms. Dahl:

CK Associates (CK) is providing this letter report to Chevron USA (Chevron) to summarize the findings of the fourth quarter 2014 entrainment monitoring event for intake water collected from the cooling water intake structure (CWIS) aboard the Jack and St. Malo (JSM) floating production unit (FPU). The JSM FPU is a new fixed facility, for which construction was commenced after July 17, 2006. Therefore, quarterly entrainment monitoring is required for the JSM FPU CWIS in accordance with section 12.c.2.ii of the *NPDES General Permit for New and Existing Sources and New Dischargers in the Offshore Subcategory of the Oil and Gas Extraction Point Source Category for the Western Portion of the Outer Continental Shelf of the Gulf of Mexico (GMG290000)* (general permit).

Sample Collection

Entrainment samples were collected by Chevron personnel from a slip stream of the cooling water system. The slip stream begins downstream of the CWIS intake screens and upstream of the facility heat exchanger(s). The slip stream is passed through an entrainment monitoring device (EMD) consisting of a closed conduit with a 330 micrometer screen in line with the flow after which the stream is returned to the JSM cooling water system downstream of the facility heat exchanger(s).

The sampling process began at 03:00 on August 4, 2014 and lasted until 03:00 on August 5, 2014. The EMD was operated continuously during the sampling period at a flow rate of 13 gallons per minute resulting in an entrainment sample volume of 19,000 gallons. Sample collection data are summarized in Table 1. Upon sampling termination, the screen was removed from the EMD and washed of entrained particles into sample jars containing 10% buffered formalin. The sample jars were packed in an ice chest and shipped to CK for processing and species identification by a fisheries biologist.

Sample Results

Samples were analyzed for the presence of eggs and larvae from yellowfin tuna, and red snapper. These species were identified in the FPU's general permit application as representative commercial and recreational species of concern because eggs and larvae of these species are considered to be most likely to be entrained in the JSM CWIS.

Zero yellowfin tuna eggs/larvae and zero red snapper eggs/larvae were identified during sample analysis. When normalized to the total facility flow, this entrainment rate amounts to zero eggs/larvae per cubic meter and zero species of concern entrained per day. A summary of the entrained species of concern is included in Table 2. Entrained organisms that were not listed as species of concern, but that were found in the entrainment samples included polychaets, pteropods, copepods, chaetognaths, amphipods, and five fish species. None of these organisms should not be included as part of the discharge monitoring report submittal because they do not represent species of commercial, recreational, or forage concern.

Conclusions

Zero organisms of commercial, recreational, or forage concern were identified in entrainment samples collected from the JSM FPU during its first three calendar quarters of entrainment monitoring. Based on the analysis of the entrainment monitoring samples, engineering controls installed at the JSM FPU CWIS have successfully minimized the potential for environmental damage due to entrainment in the facility CWIS.

If you have any questions or comments regarding this report, please do not hesitate to contact me at (255) 755-1000 or via email at Chad.Cristina@C-KA.com.

Sincerely yours,
CK Associates

Chad Cristina Ph.D., P.E

Chad M. Cristina Ph.D., P.E.
Senior Environmental Engineer

Attachments: As referenced

Table 1
Sample Collection Data Summary by Quarter

Quarter	Year	Start Date and Time	Stop Date and Time	Flow Rate (gal/min)	Sample Volume (MG)	Collection Method
4	2014	11/24/2014 0300	11/25/2014 0300	13.2 (est)	0.019	24-hr Continuous

Table 2
Entrainment Summary by Quarter

Quarter	Year	Species/Family	Total Collected	Sample Volume (MG)	Total # Entrained[1]
2	2014	*Thunnus albacares* (yellowfin tuna)	0	0.019	0
2	2014	*Lutjanus campechanus*(red snapper)	0	0.019	0
3	2014	*Thunnus albacares* (yellowfin tuna)	0	0.019	0
3	2014	*Lutjanus campechanus*(red snapper)	0	0.019	0
4	2014	*Thunnus albacares* (yellowfin tuna)	0	0.019	0
4	2014	*Lutjanus campechanus*(red snapper)	0	0.019	0
Total	**2014**	***Thunnus albacares* (yellowfin tuna)**	**0**		**0**
Total	**2014**	***Lutjanus campechanus*(red snapper)**	**0**		**0**

[1] Projected number of organisms entrained per quarter based on an average cooling water flow equal to 26.8 MGD for a 91-day quarter.

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July 23, 2015 **Sent Via Email**

Chevron USA
17000 Katy Freeway
Houston, TX 77094
Attn: Ms. Kathy Dahl

Re: Revised First Quarter 2015 Entrainment Monitoring Report for the Chevron Jack and St. Malo Floating Production Unit
CK Project No. 10726

Dear Ms. Dahl:

CK Associates (CK) is providing this letter report to Chevron USA (Chevron) to summarize the findings of the first quarter 2015 entrainment monitoring event for intake water collected from the cooling water intake structure (CWIS) aboard the Jack and St. Malo (JSM) floating production unit (FPU). The JSM FPU is a new fixed facility, for which construction was commenced after July 17, 2006. Therefore, quarterly entrainment monitoring is required for the JSM FPU CWIS in accordance with section 12.c.2.ii of the *NPDES General Permit for New and Existing Sources and New Dischargers in the Offshore Subcategory of the Oil and Gas Extraction Point Source Category for the Western Portion of the Outer Continental Shelf of the Gulf of Mexico (GMG290000)* (general permit).

Sample Collection

Entrainment samples were collected by Chevron personnel from a slip stream of the cooling water system. The slip stream begins downstream of the CWIS intake screens and upstream of the facility heat exchanger(s). The slip stream is passed through an entrainment monitoring device (EMD) consisting of a closed conduit with a 330 micrometer screen in line with the flow after which the stream is returned to the JSM cooling water system downstream of the facility heat exchanger(s).

The sampling process began at 15:00 on January 18, 2015 and lasted until 11:00 on January 19, 2015. The EMD was operated continuously during the sampling period at a flow rate of 13.2 gallons per minute resulting in an entrainment sample volume of 16,000 gallons. Sample collection data are summarized in Table 1. Upon sampling termination, the screen was removed from the EMD and washed of entrained particles into sample jars containing 10% buffered formalin. The sample jars were packed in an ice chest and shipped to CK for processing and species identification by a fisheries biologist.

Sample Results

Samples were analyzed for the presence of eggs and larvae from yellowfin tuna, and red snapper. These species were identified in the FPU's general permit application as representative commercial and recreational species of concern because eggs and larvae of these species are considered to be most likely to be entrained in the JSM CWIS.

Zero yellowfin tuna eggs/larvae and zero red snapper eggs/larvae were identified during sample analysis. When normalized to the total facility flow, this entrainment rate amounts to zero eggs/larvae per cubic meter and zero species of concern entrained per day. A summary of the entrained species of concern is included in Table 2. Entrained organisms that were not listed as species of concern, but that were found in the entrainment samples included polychaets, pteropods, copepods, chaetognaths, amphipods, ctenophores and two fish species. None of these organisms should be included as part of the discharge monitoring report submittal because they do not represent species of commercial, recreational, or forage concern.

Conclusions

Zero organisms of commercial, recreational, or forage concern were identified in entrainment samples collected from the JSM FPU during its first calendar quarter of entrainment monitoring. Based on the analysis of the entrainment monitoring samples, engineering controls installed at the JSM FPU CWIS have successfully minimized the potential for environmental damage due to entrainment in the facility CWIS.

If you have any questions or comments regarding this report, please do not hesitate to contact me at (255) 755-1000 or via email at Chad.Cristina@C-KA.com.

Sincerely yours,
CK Associates

Chad Cristina Ph.D., P.E

Chad M. Cristina Ph.D., P.E.
Senior Environmental Engineer

Attachments: As referenced

Table 1
Sample Collection Data Summary by Quarter

Quarter	Year	Start Date and Time	Stop Date and Time	Flow Rate (gal/min)	Sample Volume (MG)	Collection Method
1	2015	1/18/2015 1500	1/19/2015 1100	13.2 (est)	0.016	Composite

Table 2
Entrainment Summary by Quarter

Quarter	Year	Species/Family	Total Collected	Sample Volume (MG)	Total # Entrained[1]
1	2015	*Thunnus albacares* (yellowfin tuna)	0	0.016	0
1	2015	*Lutjanus campechanus*(red snapper)	0	0.016	0
Total	**2014**	***Thunnus albacares* (yellowfin tuna)**	**0**		**0**
Total	**2014**	***Lutjanus campechanus*(red snapper)**	**0**		**0**

[1] Projected number of organisms entrained per quarter based on an average cooling water flow equal to 26.8 MGD for a 91-day quarter.

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July 23, 2015 **Sent Via Email**

Chevron USA
100 Northpark Blvd.
Houston, TX 70433
Attn: Jim Floyd

Re: Revised Second Quarter 2015 Entrainment Monitoring Report for the Chevron Jack and St. Malo Floating Production Unit
CK Project No. 10726

Dear Ms. Dahl:

CK Associates (CK) is providing this letter report to Chevron USA (Chevron) to summarize the findings of the second quarter 2015 entrainment monitoring event for intake water collected from the cooling water intake structure (CWIS) aboard the Jack and St. Malo (JSM) floating production unit (FPU). The JSM FPU is a new fixed facility, for which construction was commenced after July 17, 2006. Therefore, quarterly entrainment monitoring is required for the JSM FPU CWIS in accordance with section 12.c.2.ii of the *NPDES General Permit for New and Existing Sources and New Dischargers in the Offshore Subcategory of the Oil and Gas Extraction Point Source Category for the Western Portion of the Outer Continental Shelf of the Gulf of Mexico (GMG290000)* (general permit).

Sample Collection

Entrainment samples were collected by Chevron personnel from a slip stream of the cooling water system. The slip stream begins downstream of the CWIS intake screens and upstream of the facility heat exchanger(s). The slip stream is passed through an entrainment monitoring device (EMD) consisting of a closed conduit with a 330 micrometer screen in line with the flow after which the stream is returned to the JSM cooling water system downstream of the facility heat exchanger(s).

The sampling process began at 03:00 on April 6, 2015 and lasted until 21:00 that evening. The EMD was operated continuously during the sampling period at a flow rate of 13.2 gallons per minute resulting in an entrainment sample volume of 16,000 gallons. Sample collection data are summarized in Table 1. Upon sampling termination, the screen was removed from the EMD and washed of entrained particles into sample jars containing 10% buffered formalin. The sample jars were packed in an ice chest and shipped to CK for processing and species identification by a fisheries biologist.

Sample Results

Samples were analyzed for the presence of eggs and larvae from yellowfin tuna, and red snapper. These species were identified in the FPU's general permit application as representative commercial and recreational species of concern because eggs and larvae of these species are considered to be most likely to be entrained in the JSM CWIS.

Zero yellowfin tuna eggs/larvae and zero red snapper eggs/larvae were identified during sample analysis. When normalized to the total facility flow, this entrainment rate amounts to zero eggs/larvae per cubic meter and zero species of concern entrained per day. A summary of the entrained species of concern is included in Table 2. Entrained organisms that were not listed as species of concern, but that were found in the entrainment samples included copepods, pteropods, amphipods, chaetognaths, ctenophores. Additionally, one damaged fish larva was observed, although the species was unable to be identified. None of these organisms should be included as part of the discharge monitoring report submittal because they do not represent species of commercial, recreational, or forage concern.

Conclusions

Zero organisms of commercial, recreational, or forage concern were identified in entrainment samples collected from the JSM FPU during its first calendar quarter of entrainment monitoring. Based on the analysis of the entrainment monitoring samples, engineering controls installed at the JSM FPU CWIS have successfully minimized the potential for environmental damage due to entrainment in the facility CWIS.

If you have any questions or comments regarding this report, please do not hesitate to contact me at (255) 755-1000 or via email at Chad.Cristina@C-KA.com.

Sincerely yours,
CK Associates

Chad Cristina Ph.D., P.E

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Attachments: As referenced

Table 1
Sample Collection Data Summary by Quarter

Quarter	Year	Start Date and Time	Stop Date and Time	Flow Rate (gal/min)	Sample Volume (MG)	Collection Method
2	2015	4/6/15 0300	4/6/15 2100	13.2 (est)	0.016	Composite

Table 2
Entrainment Summary by Quarter

Quarter	Year	Species/Family	Total Collected	Sample Volume (MG)	Total # Entrained[1]
1	2015	*Thunnus albacares* (yellowfin tuna)	0	0.016	0
1	2015	*Lutjanus campechanus*(red snapper)	0	0.016	0
2	2015	*Thunnus albacares* (yellowfin tuna)	0	0.016	0
2	2015	*Lutjanus campechanus*(red snapper)	0	0.016	0
Total	**2015**	***Thunnus albacares* (yellowfin tuna)**	**0**	**N/A**	**0**
Total	**2015**	***Lutjanus campechanus*(red snapper)**	**0**	**N/A**	**0**

[1] Projected number of organisms entrained per quarter based on an average cooling water flow equal to 26.8 MGD for a 91-day quarter.

Memorandum

Environmental Resources Management

CityCentre Four
840 West Sam Houston
Parkway North, Suite 600
Houston, Texas 77024-3920
T: 281-600-1000
F: 281-520-4625

To: Ms. Sofia Lamon, Ms. Ellen Thomson

Company: Anadarko

From: Kurtis Schlicht, Bill Stephens, Emily Lantz

Date: 10 April 2015

Subject: Quarter 1 (January-March) 2015 Entrainment Sampling Results

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The Environmental Protection Agency (EPA) regulates discharges from exploration, development, and production facilities located in and discharging to federal waters of the Gulf of Mexico offshore of Louisiana and Texas under National Pollutant Discharge Elimination System (NPDES) General Permit number GMG 290000 (General Permit). The General Permit provides authorization to discharge wastewater and storm water in the western outer continental shelf (OCS) regions of the Gulf of Mexico with conditions that the permittee agrees to a variety of effluent limitations, monitoring, reporting, and cooling water intake structure (CWIS) requirements.

Samples were collected from the Lucius Truss Spar (Lucius) in accordance with the General Permit quarterly entrainment sampling requirements for Quarter 1 2015 (Q1 2015). A description of the sampling procedures and analytical results of the Q1 2015 event are presented in the following paragraphs

Procedure

ERM staff travelled to Lucius under Anadarko supervision on March 9, 2015. Sampling began at 00:00 on the morning of March 10, 2015. Samples were collected every six hours (06:00, 12:00, 18:00) until four 25 m^3 entrainment sample volumes were collected representing a 24-hour sample period. Samples remained in the possession of the sample team during the transport to shore.

Once onshore, entrainment samples were shipped within 24 hours to Ecological Associates, Inc. (EAI), with chain-of-custody documentation included in the shipment. Samples were processed by EAI during a 45-60 day period.

In the laboratory, EAI technicians separated debris or material from aquatic organisms and sorted the organisms by life-stage to the lowest possible taxonomic level.

Sampling Results

A total of 2,597 organisms were present in the 100m^3 of water sampled. Of these organisms, 21 were fish and shellfish (also known as "Target" organisms, per EAI nomenclature): 2 fish larvae and 19 fish eggs. Table 1 below indicates the types, numbers, and lifestages of the fish within the March 10, 2015 sample. Table 2 below indicates the types, numbers, and lifestages of the non-fish species within the March 10, 2015 sample.

Table 1. Laboratory Analysis of Ichthyoplankton Samples Collected During Event 1 on March 10, 2015 at the Anadarko Lucius Truss Spar Platform: Target Organisms.

Taxa	**CRI/Non-CRI Invertebrates**	**Lifestage**	**Sample 1**	**Sample 2**	**Sample 3**	**Sample 4**	**Total**
		Collection time	**00:00**	**06:00**	**12:00**	**18:00**	
Fish							
Aulostomus maculatus		Post Yolk-Sac Larvae		1			1
Unidentified fish - damaged		Post Yolk-Sac Larvae				1	1
Fish total				**1**		**1**	**2**
Fish Eggs							
Unidentified eggs - No embryos		Egg	3	3	1	12	19
Fish Eggs Total			**3**	**3**	**1**	**12**	**19**
Total Combined			**3**	**4**	**1**	**13**	**21**

*CRI = Commercially or Recreationally Important Decapod Crustaceans. None present in samples.

Table 2. Laboratory Analysis of Ichthyoplankton Samples Collected During Event 1 on March 10, 2015 at the Anadarko Lucius Truss Spar Platform: Non-target Organisms.

Taxa	CRI/Non-CRI Invertebrates	Lifestage	Sample 1	Sample 2	Sample 3	Sample 4	Total
		Collection time	**00:00**	**06:00**	**12:00**	**18:00**	
Crustaceans							
Amphipoda	Non-CRI	Other			1	1	2
Portunus sp.	Non-CRI	Megalops				1	1
Decapod shrimp	Non-CRI	Other	6	10	18	35	69
Crustacean Total			**6**	**10**	**19**	**37**	**72**
Decapods							
Pleocyemata	Non-CRI	Megalops			1	2	3
Pleocyemata	Non-CRI	Zoea			7		7
Decapods Total					**8**	**2**	**10**
Ostracods							
Ostracoda	Non-CRI	Other	87	149	182	187	605
Ostracods Total			**87**	**149**	**182**	**187**	**605**
Polychaetes							
Polychaeta	Non-CRI	Other	3	1	3	1	8
Polychaete Total			**3**	**1**	**3**	**1**	**8**
Arthropods							
Copepoda	Non-CRI	Other	244	380	533	705	1,862
Arthropod Total			**244**	**380**	**533**	**705**	**1,862**
Chaetognatha							
Chaetognatha	Non-CRI	Other	2	5	8	4	19
Chaetognatha Total			**2**	**5**	**8**	**4**	**19**
Total Combined			**342**	**545**	**753**	**936**	**2576**

Memorandum

Environmental Resources Management

CityCentre Four
840 West Sam Houston
Parkway North, Suite 600
Houston, Texas 77024-3920

T: 281-600-1000
F: 281-520-4625

To: Ms. Sofia Lamon, Ms. Ellen Thomson

Company: Anadarko

From: Kurtis Schlicht, Bill Stephens, Emily Lantz

Date: 17 August 2015

Subject: Quarter 2 (April-June) 2015 Entrainment Sampling Results

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The Environmental Protection Agency (EPA) regulates discharges from exploration, development, and production facilities located in and discharging to federal waters of the Gulf of Mexico offshore of Louisiana and Texas under National Pollutant Discharge Elimination System (NPDES) General Permit number GMG 290000 (General Permit). The General Permit provides authorization to discharge wastewater and storm water in the western outer continental shelf (OCS) regions of the Gulf of Mexico with conditions that the permittee agrees to a variety of effluent limitations, monitoring, reporting, and cooling water intake structure (CWIS) requirements.

Samples were collected from the Lucius Truss Spar (Lucius) in accordance with the General Permit quarterly entrainment sampling requirements for Quarter 2 2015 (Q2 2015). A description of the sampling procedures and analytical results of the Q2 2015 event are presented in the following paragraphs

Procedure

ERM staff travelled to Lucius under Anadarko supervision on June 01, 2015. Sampling began at 00:00 on the morning of June 02, 2015. Samples were collected every six hours (06:00, 12:00, 18:00) until four 25 m^3 entrainment sample volumes were collected representing a 24-hour sample period. Samples remained in the possession of the sample team during the transport to shore.

Once onshore, entrainment samples were shipped within 24 hours to Ecological Associates, Inc. (EAI), with chain-of-custody documentation included in the shipment. Samples were processed by EAI during a 45-60 day period.

In the laboratory, EAI technicians separated debris or material from aquatic organisms and sorted the organisms by life-stage to the lowest possible taxonomic level.

Sampling Results

A total of 120 "Target" (per EAI nomenclature) fish or shellfish organisms were present in the 100m^3 of water sampled: 2 fish larvae and 118 fish eggs. Table 1 below indicates the types, numbers, and lifestages of the fish within the June 02, 2015 sample.

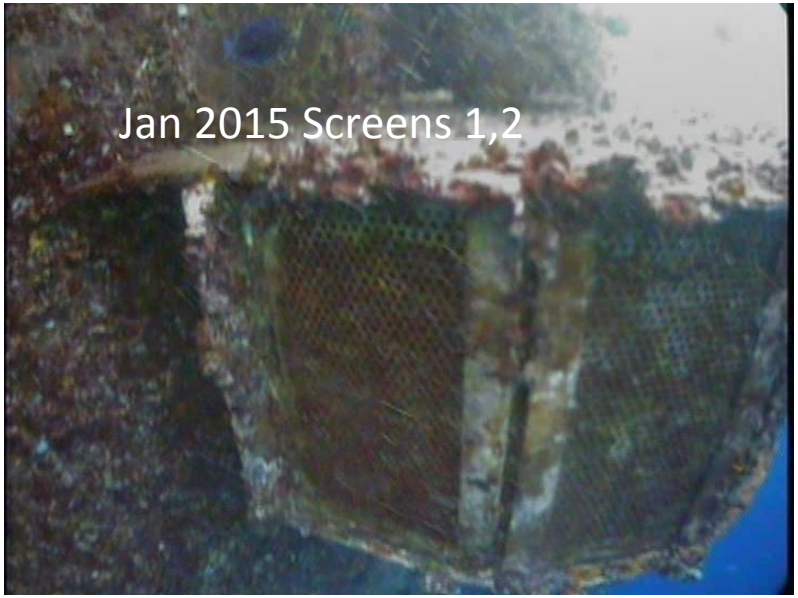
Table 1. Laboratory Analysis of Ichthyoplankton Samples Collected During Event 1 on June 02, 2015 at the Anadarko Lucius Truss Spar Platform: Target Organisms.

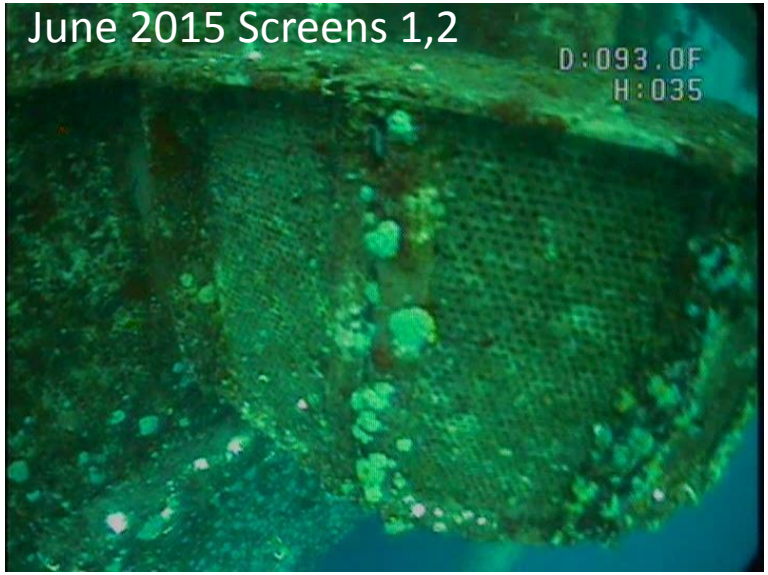
Taxa	**CRI/Non-CRI Invertebrates**	**Lifestage**	**Sample 1**	**Sample 2**	**Sample 3**	**Sample 4**	**Total**
		Collection time	**00:00**	**06:00**	**12:00**	**18:00**	
Fish							
Carangidae		Post Yolk-Sac Larvae	1	0	0	0	1
Unidentified fish - damaged		Post Yolk-Sac Larvae	1	0	0	0	1
Fish total			**2**	**0**	**0**	**0**	**2**
Fish Eggs							
Unidentified eggs - No embryos		Egg	0	115	3	0	118
Fish Eggs Total			**0**	**115**	**3**	**0**	**118**
Total Combined			**2**	**115**	**3**	**0**	**120**

*CRI = Commercially or Recreationally Important Decapod Crustaceans. None present in samples.

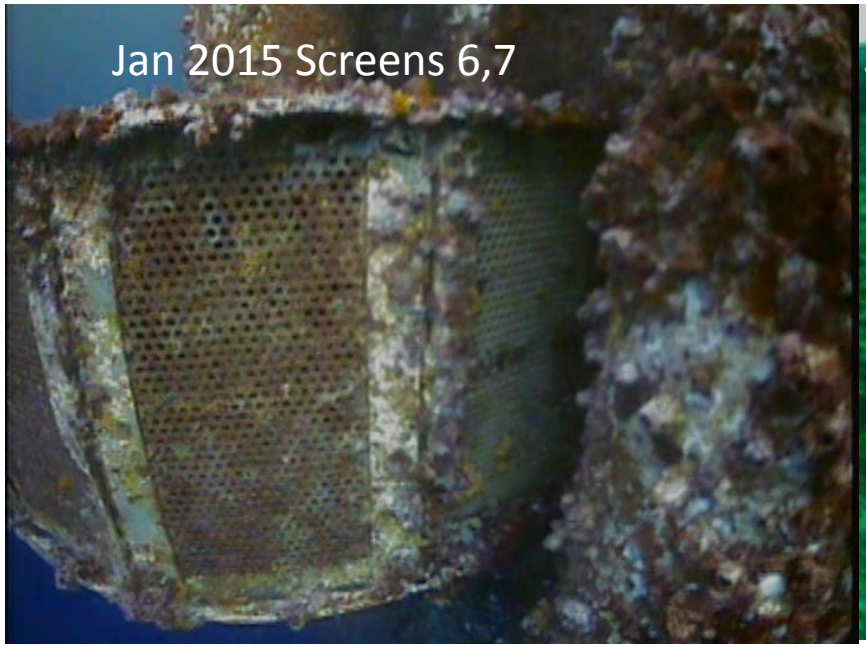
APPENDIX D

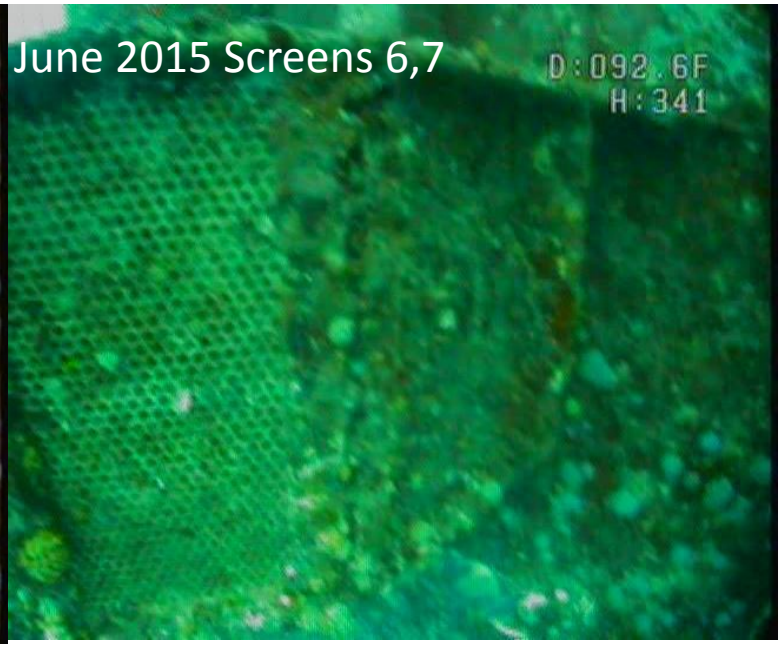
CWIS Images #1



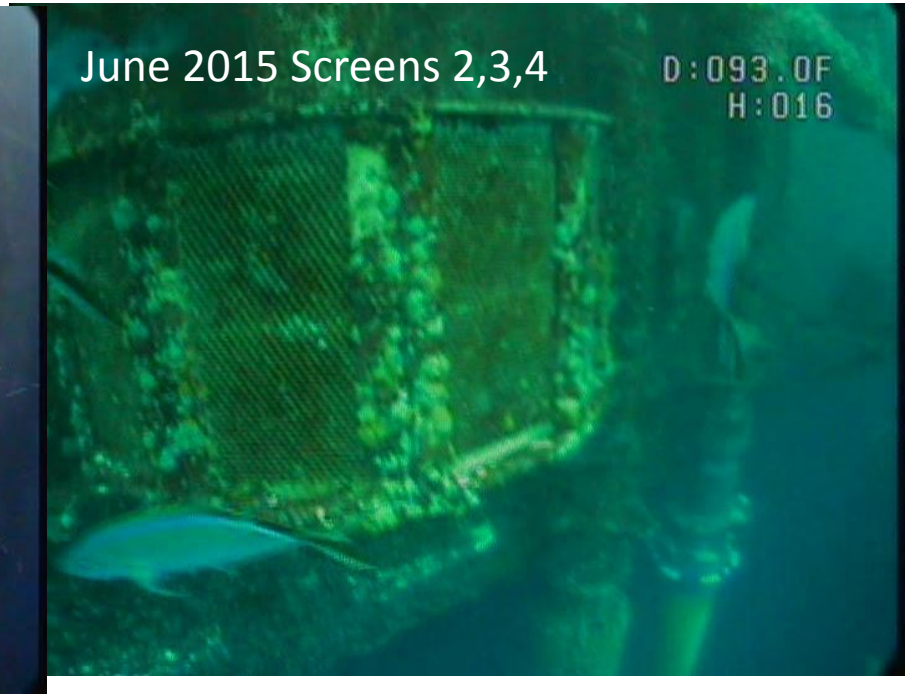


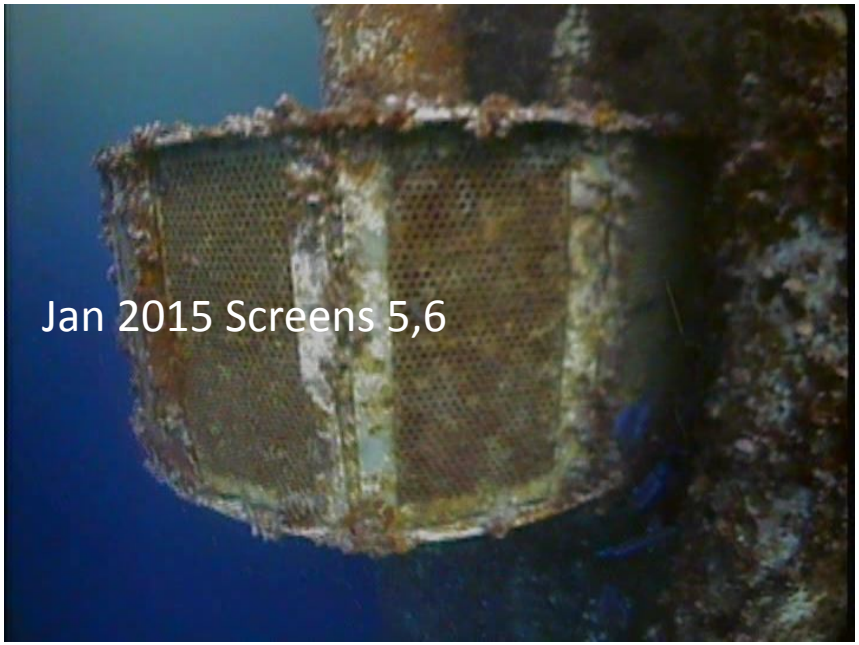
CWIS Images#2



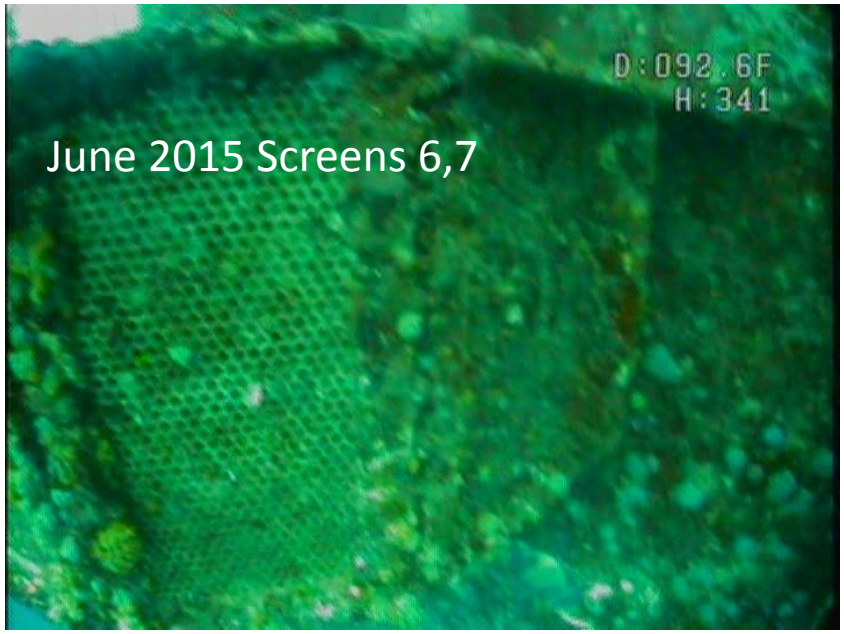


CWIS Images #3




Jan 2015 Screens 5,6

Operator 3 #4


D:092.6F
H:341
June 2015 Screens 6,7

Jan 2015 Screens 3,4

June 2015 Screens 4,5
D:093.6F
H:350

APPENDIX E

Tiered Intake Velocity Monitoring Methodology Justification

The Offshore Operators Committee (OOC) commissioned CK Associates (CK) to evaluate if the velocity monitoring frequency, proscribed for CWIS (intakes) by GMG290000, could be reduced from daily to a lesser frequency while remaining protective of species subject to impingement mortality (IM).

CK evaluated one year of data (2015) from six separate CWIS, located in the GOM, for analysis. The intake velocity data are presented on Figure 1. The data presented in Figure 1 show a range of intake velocities measured throughout the year with a minimum velocity equal to 0.02 ft/s, a maximum intake velocity equal to 0.45 ft/s and a mean intake velocity equal to 0.172 ft/s (excluding days of zero intake flow). Gaps in the plots indicate days for which the intake was not operating. Each of the six CWIS maintained intake velocities below the 0.5 ft/s regulatory threshold (zero exceedances) during the calendar year. There is no general trend of increasing velocity for the intakes as a whole. Intake velocities tend to increase and decrease randomly due to fluctuating cooling water needs rather than an accumulation of biomass blocking the screens.

The daily intake velocities were converted to rates-of-change in intake velocity for this analysis. The results are presented as an individual value plot on Figure 2 and represent 1,290 individual velocity monitoring events. Two criteria were used to create the rate-of-change results. Missing data are omitted for purposes of the analysis (not assumed to be zero); any rate-of-change requires two consecutive non-zero velocity measurements. This analysis resulted in 1,290 data points upon which the remainder of the analysis is based. The data show a minimum rate-of-change in intake velocity equal to -0.14 (ft/s)/day, a mean of 0.00 (ft/s)/day, and a maximum of 0.20 (ft/s)/day.

An ANOVA was used to determine if any individual intake differed statistically from the others based on rates-of-change. Interval plots for each intake can be found on Figure 3. No statistically significant differences in rates-of-change were identified for any intake ($P < 0.05$). Individual comparison plots using Tukey's Method can be found on Figure 4.

The rate-of-change data were combined for all subsequent analyses because they do not differ statistically. The combined data set is plotted as a histogram with a normal distribution overlain on Figure 5. The data are approximately normal. However, the spread of the data is less than would be expected of a perfectly normal distribution. Therefore, the normal distribution will provide conservative estimates of mean rates-of-change throughout the remainder of the analysis.

As shown on Figure 5, the mean rate-of-change in intake velocity for the combined data set is equal to 0.00004651 (ft/s)/day with a standard deviation equal to 0.01073 (ft/s)/day. These values were used to calculate the upper 95th percentile value for mean velocity increase over 1 day, 30 days, and 90 days. The results can be found in Table 1. Based on this analysis, a given intake will exhibit an increase in velocity equal to 0.115 ft/s or less during any 30-day period at the 95% confidence level. A given intake will exhibit an increase in velocity equal to 0.200 ft/s or less during any 90-day period at the 95% confidence level.

Table 1: Velocity increase for intakes as a function of days between velocity monitoring events.

Interval Between Consecutive Velocity Monitoring Events (days)	Upper 95% Confidence Interval for Daily Average Velocity Increase (ft/s)/day	Upper 95% Confidence Interval for Velocity Increase during the Interval (ft/s)
1	0.021	0.021
30	0.00384	0.115
90	0.00222	0.200

The information found in Table 1 was used to develop a tiered velocity monitoring frequency that is equally protective of species that are susceptible to IM as the current daily velocity monitoring requirement proscribed in the GMG290000.

Table 2: Tiered intake velocity monitoring frequency based on most-recent intake velocity monitoring data.

If the most recently reported intake velocity was: (ft/s)	Interval between most recent velocity monitoring event, and next monitoring event (days)	95% Velocity at the end of the interval	Proposed Permit Monitoring Frequency
<0.300	90	<0.300 + <0.200 = <0.500	Quarterly
0.300 – 0.384	30	<0.384 + <0.115 = <0.500	Monthly
>0.384	1	<0.500	Daily

The following points summarize the arguments in support of the tiered intake velocity monitoring frequency approach:

- Of the six intakes included in this evaluation, zero exceeded the 0.5 ft/s intake velocity threshold during 2015 (Figure 1);
- Intake velocity does not monotonically increase over time (Figure 1);
- There is no statistically significant difference in rate-of-change for intake velocity across the six intakes included in the study ($P < 0.05$). Therefore a general approach to all intakes, as opposed to a site-specific monitoring methodology, is appropriate (Figures 2 – 5); and
- The tiered approach presented in Table 2 ensures that intake velocity measurements will be made prior to exceeding the 0.5 ft/s regulatory threshold. Therefore, the tiered velocity monitoring frequency is equally protective of species susceptible to IM as is the current daily intake velocity monitoring requirement proscribed in the GMG290000.

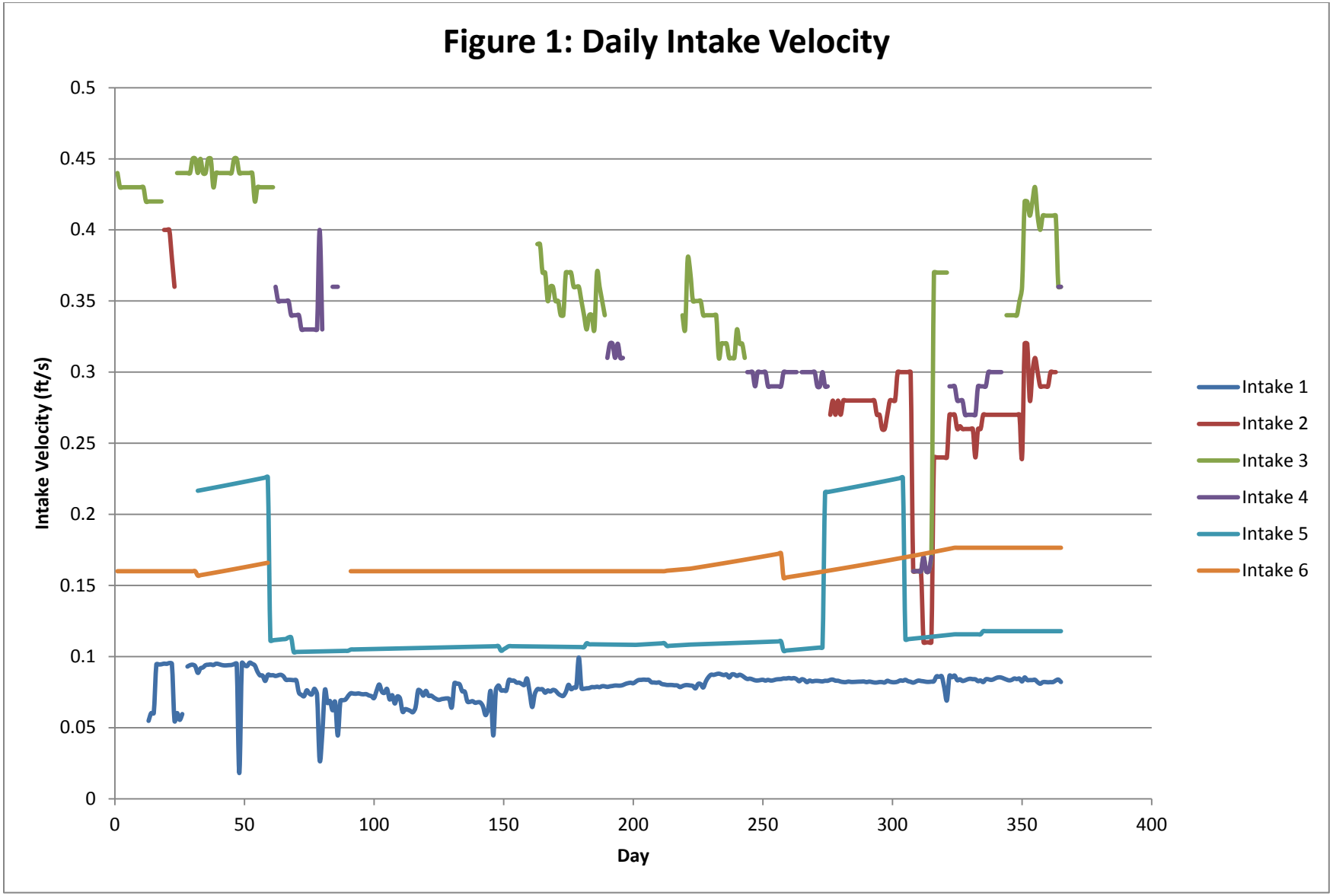


Figure 1: Daily Intake Velocity
Intake Velocity (ft/s)
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
50
100
150
200
250
300
350
400
Day
Intake 1
Intake 2
Intake 3
Intake 4
Intake 5
Intake 6

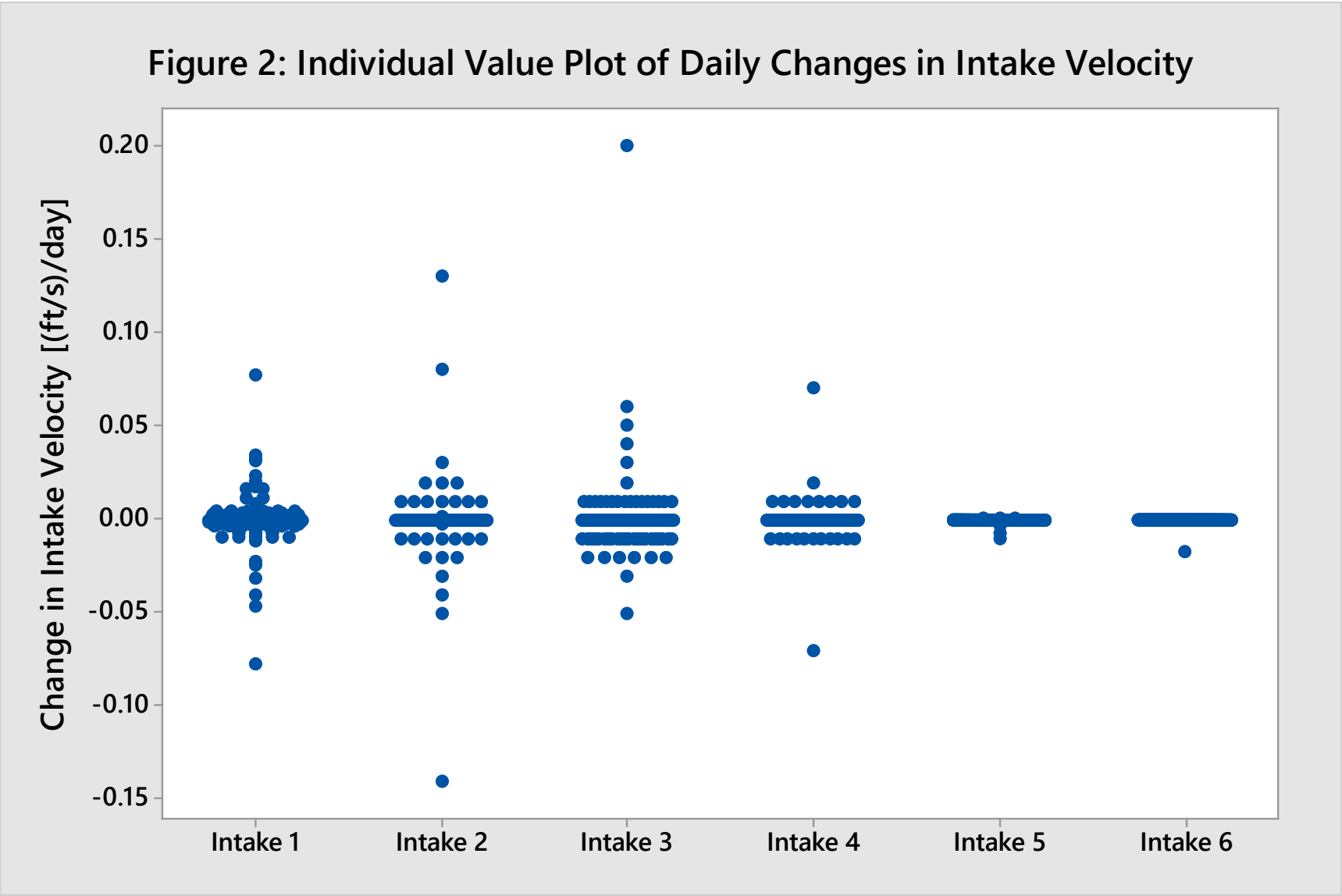
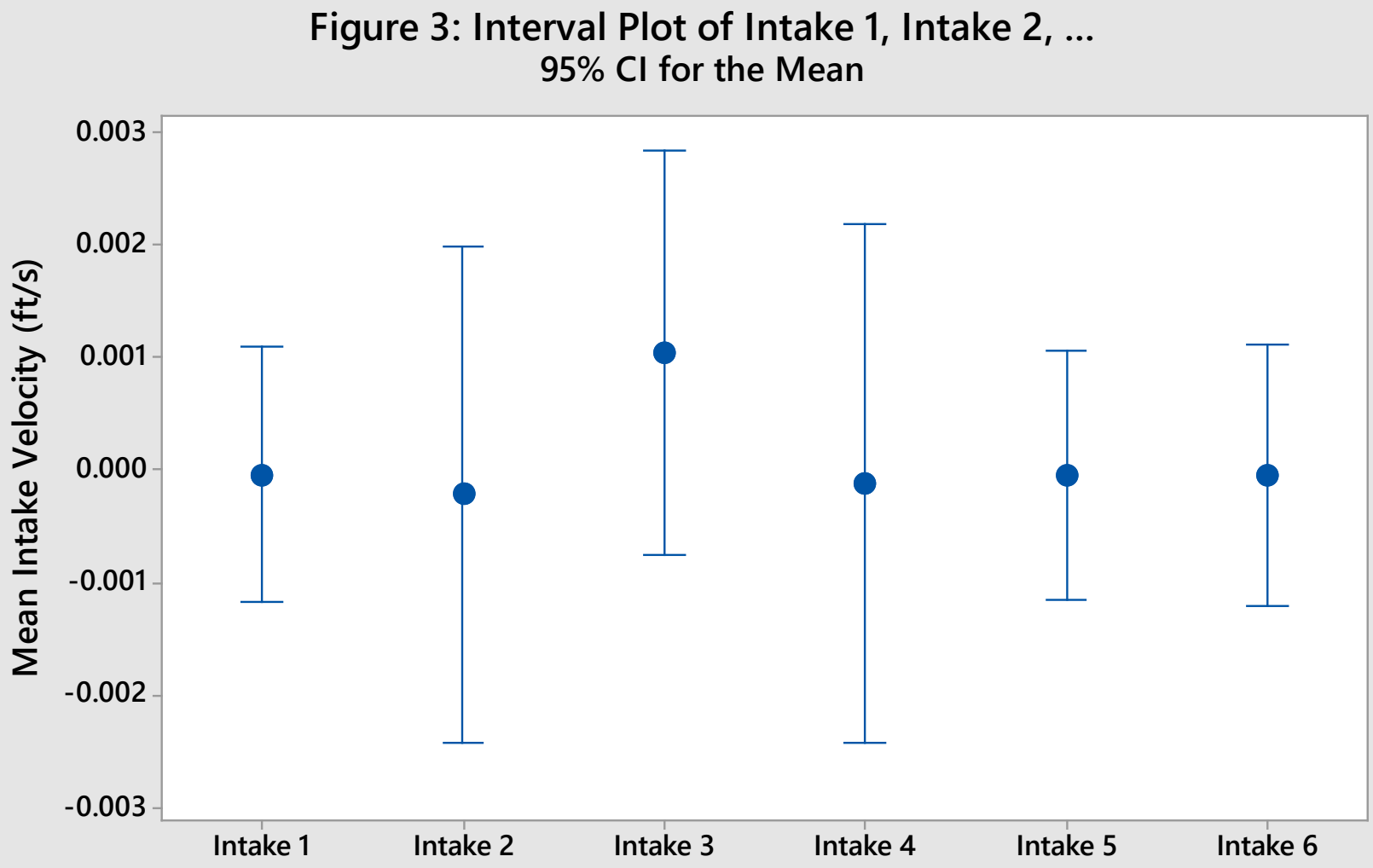
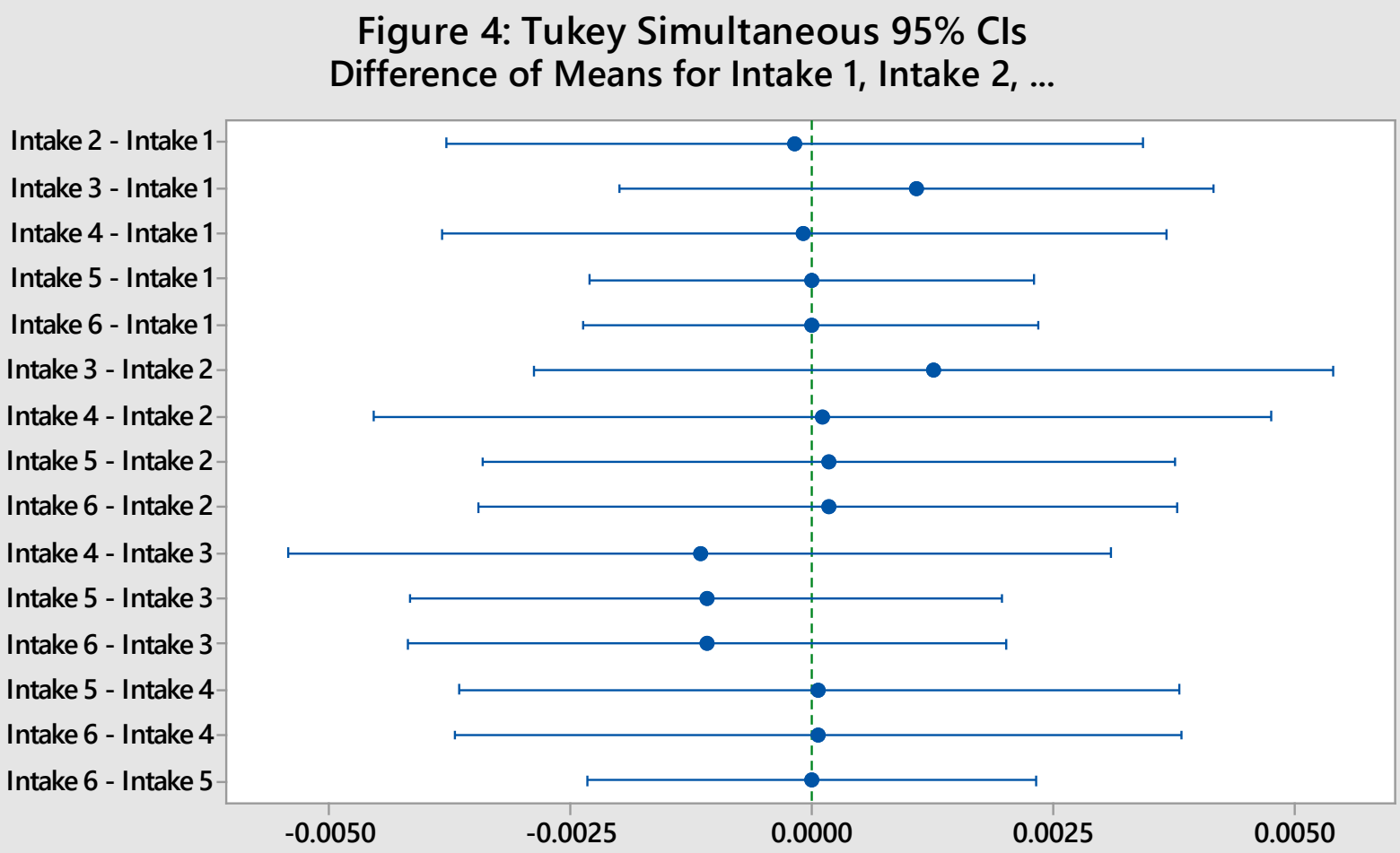


Figure 2: Individual Value Plot of Daily Changes in Intake Velocity
Change in Intake Velocity [(ft/s)/day]
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
-0.15
Intake 1
Intake 2
Intake 3
Intake 4
Intake 5
Intake 6



The pooled standard deviation is used to calculate the intervals.



If an interval does not contain zero, the corresponding means are significantly different.

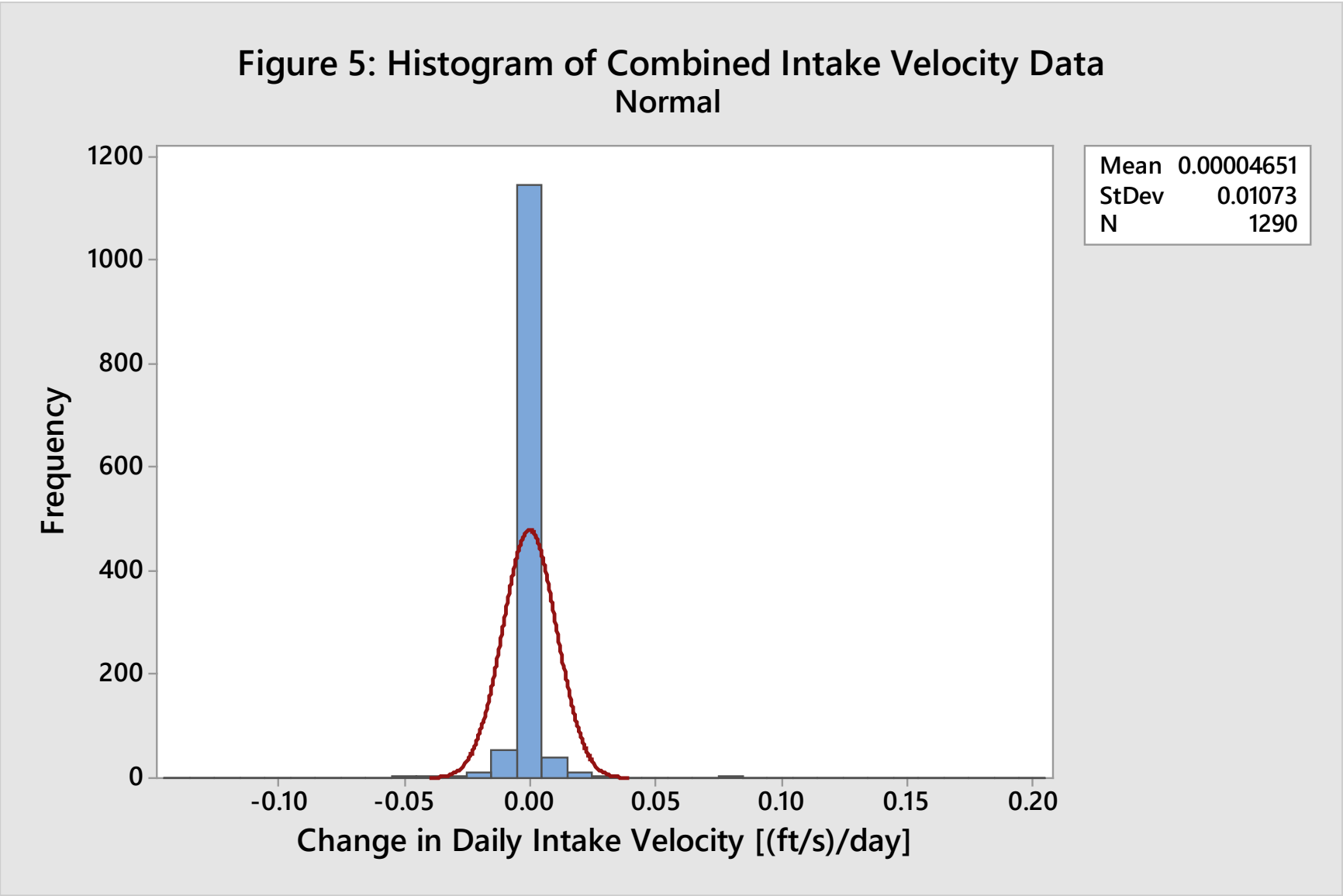


Figure 5: Histogram of Combined Intake Velocity Data
Normal
Mean 0.00004651
StDev 0.01073
N 1290
Frequency
1200
1000
800
600
400
200
0
-0.10
-0.05
0.00
0.05
0.10
0.15
0.20
Change in Daily Intake Velocity [(ft/s)/day]