http://tragerwaterreport.files.wordpress.com/2010/05/san_francisco_bay_aerial_view-and-golden-gate-bridge.jpg

Appears to show upwelling and outflow of turbid water.

Directions on how to print notes from PowerPoint presentation:

http://answers.yahoo.com/question/index?qid=20081209120035AARdGie

PowerPoint XP/2003: File pulldown menu --> Send To --> Microsoft Word
PowerPoint 2007: round Office pulldown menu -> Publish --> Create Handouts in Microsoft Office Word

All versions are the same from here on: select "Notes Next to Slides." Hit okay. Word launches and your computer just does its own thing. At the end, your Word document still has a column of slide miniatures and a column of notes, but it's a table, so if you don't want the slides, you can delete the column of slide miniatures (all at once - not one-by-one) and format the remaining text column the way you want.

http://geology.com/topographic-physical-map/california.shtml
Satellite map of the San Francisco Bay Area of Northern California - *from the U.S. Geological Survey*.

The Bay Delta by the Numbers
- Largest estuary on the west coast of the Americas with ~800 species flora & fauna.
- The watershed comprises 40% of CA's surface area (153,000 km^2).
- Most of the rain and snow falls in California on just 5-15 days/year.
- 75% of the precipitation occurs in N. CA while 80% of the demand exists in S. CA.
- 50% of CA's runoff flows toward the Delta.
- The federal Central Valley Project (CVP) and the State Water Project (SWP) draw water from the Bay Delta and constitute the backbone of CA's water supply infrastructure.
- Up to 65% of the freshwater flowing to the Delta is diverted to consumptive uses (~7.5 million acre feet, MAF).
- The snow-capped Sierra Nevada serves as CA's best water storage "reservoir" because it slowly releases ~15 MAF during the warm spring and summer seasons.
- 60% of CA's "developed" water supply originating as Sierra snowpack could diminish by 80% by the year 2100 due to climate change.
- Net use of "developed water": 62% agriculture; 16% municipal; 22% environmental.
- Drinking water for 27 million people.
- Irrigation water for 3 million acres of farmland that produces 50% of the USA's fruits & vegetables, 20% of the Nation's milk, and a $27 billion agricultural sector (2% of CA's economy).
- The Regional Water Board (Central Valley) has listed the waters of the Delta as impaired for heavy metals, pesticides, and invasive species per CWA §303(d).
- 90 native and introduced species of fish occur in the Delta; populations of all the native fish are in decline; several are federally-listed as T or E.
- The islands of the W. Delta have subsided by up to ~25 feet due to conversion to farming and peat oxidation; levees vulnerable to collapse.
- The San Joaquin Valley floor has subsided by up to ~30 feet due to groundwater overdraft, and this represents a permanent loss of aquifer storage capacity.
- In 2012, EPA Region 9 issued a 7-point Bay Delta Action Plan focused on improving water quality and restoring aquatic resources.

Snowpack and Water Supply
- The snowpack in the Sierra Nevada provides a natural form of water storage, and healthy mountain forests and meadows help ensure the quality and reliability of this water supply.
- The snow-capped Sierra Nevada constitutes California's "largest and most important water storage reservoir."
- More than 60 percent of California's developed water supply originates in the Sierra Nevada serving end users throughout the State.
- Historically, this snowpack has released about 15 million acre-feet slowly over the warming spring and summer months…
- Up to 50 percent of the flow into the Sacramento San Joaquin Delta comes from the Sierra.
- According to some climate change scenarios, the Sierra snow pack could diminish by as much as 80% by the end of this century…Uh oh!

http://www.sierranevada.ca.gov/our-region/sierra-water-supply-connection

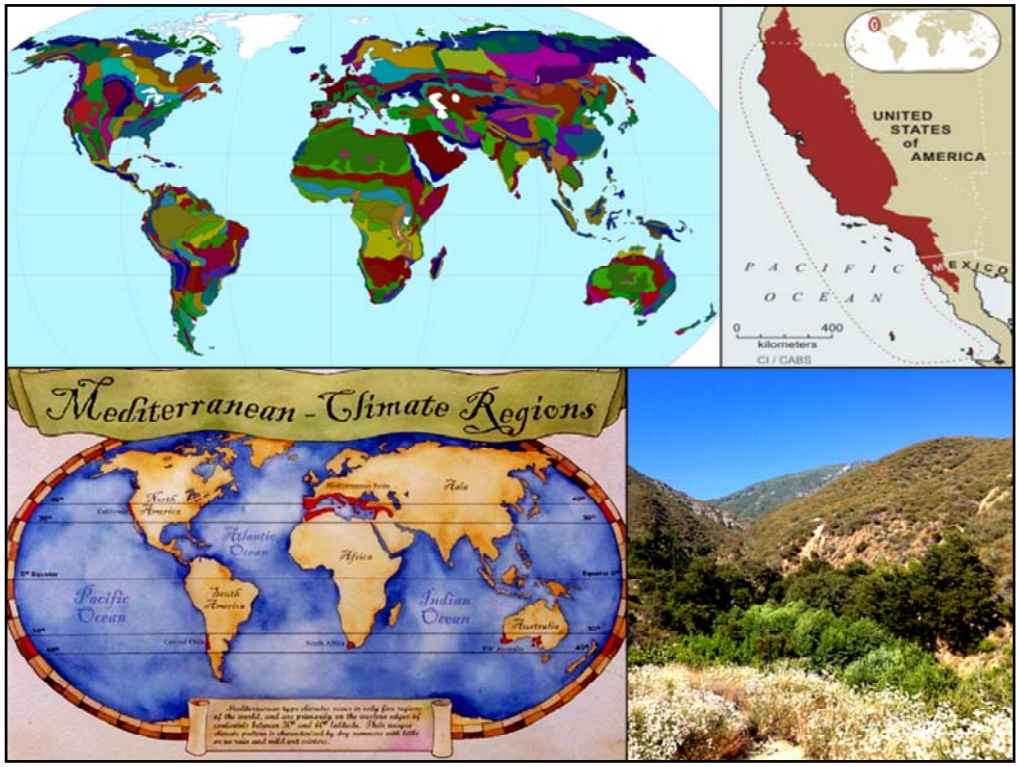
http://www.acwa.com/content/climate-change/californias-water-climate-change
The snow capped Sierra Nevada comprises California's "largest and most important water storage reservoir."
According to some climate change scenarios, the Sierra snow pack could diminish by as much as 80% by the end of this century, vastly reducing the state's water storage capacity and creating a major challenge for our water supply system in coming decades.

http://resources.ca.gov/climate_adaptation/docs/Statewide_Adaptation_Strategy_-_Chapter_7_-_Water_Management.pdf
Historically, this snowpack has released about 15 million acre-feet slowly over the warming spring and summer months…

http://markosun.wordpress.com/2013/01/08/images-from-space/

http://www.water.ca.gov/waterconditions/

http://www.sierranevada.ca.gov/our-region/docs/sierrabookletfinal.pdf



Map of mediterranean climate regions Rundel and Pompelli

http://www.californiachaparral.org/shrublandecosystems.html

CHAPARRAL

A special plant community dominated by woody, drought-hardy shrubs, shaped by a Mediterranean -type climate (summer drought, winter rain) and infrequent wildfire. Where chaparral is found: California, southern Oregon, northern Baja California, and a few unique places in Arizona (although the Arizona version is subject to summer monsoons).

http://johndonoghue.wordpress.com/2012/07/04/revisiting-the-north-etiwanda-preserve/

North Etiwanda Preserve – San Gabriel Mountains

Other similar, Mediterranean-type shrublands

1. Central Chile - called Matorral 2. South Africa - called Fynbos (fain-boos)
3. Western Australia - Kwongan 4. Mediterranean Region - Maquis

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2712077/

http://www.unep-wcmc.org/wdpa

Bailey's Ecoregions map of the World

http://www.californiachaparral.com/awheresthechaparral.html

http://www.dfg.ca.gov/biogeodata/atlas/pdf/Clim_12b_web.pdf

http://www.conservation.org/where/priority_areas/hotspots/north_central_america/California-Floristic-Province/Pages/default.aspx

http://www.laspilitas.com/easy/easyclimate.htm

Climate of California

http://www.wrcc.dri.edu/narratives/CALIFORNIA.htm

Global Mediterranean Action Network

http://www.mediterraneanaction.net/ma_v2/about_biome/ca_mex_baja.jsp

http://www.mediterraneanaction.net/ma_v2/hope/strategies_california.jsp

Fast Facts

- California / Baja California is the second smallest Mediterranean climate region, with 4% of the biome's total land area.
- The region covers only 1% of the United States, but it is home to almost 10% of the country's population (TNC Analysis, In Prep).
- This region supports 4,300 plant species, 35% of which are found nowhere else in the world (Cowling, 1996).
- The area's population is nearly double that of any other region.

http://kueda.net/blog/2008/07/30/question-why-does-california-have-a-mediterranean-climate/

The equator receives more direct sunlight than other parts of the planet, which causes the air there to heat up and rise. The planet is spinning on its axis, so when air rises, it gets delfected north or south. The rising air loses pressure, cools, and expands, losing the water vapor it gained at the equator in the form of equatorial rain. High up in the atmosphere, this dry, expanding air spreads out in all directions and falls back to Earth, and the air moving north and south falling around the 30th latitudes. In falling, the this dry air increases in pressure and heat again. Dry, warm air, falling around 30°, right where the Earth's major deserts are … not a coincidence.

SO. Mediterranean climates occur on the poleward borders of these 30° desert zones. Basically, when I said the equator receives the most sunlight, what I meant was the region of the Earth that receives the most perpendicular sunlight, which oscilates between the tropics as the tilted planet revolves around the sun. So in the northern summer, the region of falling, warm air shifts north as the region w/ the most perpendicular insolation approaches the Tropic of Cancer. This pushes the hot dry weather up in to the Bay Area and beyond. In the winter the opposite happens, and we get cooler temperatures and rain.

http://www.a-state-of-change.com/Paleoart.html

http://carnivoraforum.com/search/118/?c=3&mid=3323712&month=1&year=2012

Pleistocene (1.8 million to ~10,000 years ago): The Bay Area before the Bay: Ancient bison and Western horse.

Sabertooth cats (*Smilodon*) lived "in California" during the Pleistocene (1.8 million to ~10,000 years ago):
Named the State Fossil by the California Legislature.
http://www.ucmp.berkeley.edu/quaternary/ple.html

http://www.sciencedirect.com/science/article/pii/0033589489900896

Chief Estanislao at the Stanislaus County Court House

http://rhhr.files.wordpress.com/2010/07/estanislao-at-ch.jpg

A member and leader of the Lakisamni tribe of the Yokut people of northern California. He was notorious for leading bands of armed Amerindians in revolt against the Mexican government and Mission establishments.

http://en.wikipedia.org/wiki/Estanislao

Yokuts polychrome bottleneck baskets. c.1910
http://genequintanabaskets.com/

Sierra Miwok basket

http://hearstmuseum.berkeley.edu/exhibitions/ncc/gallery_4_4_27.html

Indian Grinding Rock State Park, near Pine Grove, California

http://www.pinterest.com/pin/201676889534724799/

http://www.tpl.org/our-work/land-and-water/northern-sierra-nevada/foothills

Detailed map of the State of California, depicting the various Linguistic Regions of the California Indian Tribes.

Look at the location of the Bay Delta in context with the entire State of California.

1877 map showing the distribution of tribes.

This large, colorful and historically important map was compiled under the direction of J.W. Powell. The map appeard in Volume III - *Contributions to North American Ethnology* of Steven Powers' report. Powers is considered California's first Ethnologist.

This map is a detailed examination of the Indian tribes throughout the state. The extensive legend provides the key to the coloring of the tribes, which identifies nineteen Linguistic Stocks. There is good detail of the existing railroads between Ft. Yuma and the Los Angeles area, and up the central valley to Sacramento and north to end at Shasta. This map was drawn by H. Lindenkohl.

http://www.raremaps.com/gallery/detail/24886?view=print

http://sfnhs.com/2013/08/16/ancient-places-sept-19-2013/

http://www.allwalls.net/coyote-hills-regional-park-california/

http://www.oaklandhistory.com/files/hindians.html

http://bayradical.blogspot.com/2007_11_01_archive.html

http://bayradical.blogspot.com/2007/11/shellmound.html

http://www.sacredland.org/new-sacred-site-reports-feature-native-american-celtic-christian-sites/

http://wn.com/shellmound#/images

http://protectglencove.org/about/historical-accounts/

Sogorea Te or *Ssogoréate* was a large village and gathering/ceremonial ground utilized by dozens of tribes who lived near and around the San Francisco Bay Area, including the Carquin or Karkin [Ohlone], Huchiun-Aguasto [Ohlone], Suisun/Patwin [Southern Wintun], Bay Miwok, Coast Miwok, Yokuts, and Wappo. For over 3500 years, indigenous people gathered at Sogorea Te or Glen Cove, a large, shallow natural cove at the narrowest portion of the Carquinez Strait, ideal for making land crossings.

http://www.ci.emeryville.ca.us/index.aspx?NID=730

Photo showing excavation of the Shellmound in 1926.

http://www.sacredland.org/shellmounds-of-the-bay-area/

Emeryville Shellmound

The Emeryville shellmound, north of Oakland, is perhaps the most publicized example of how these burial grounds fared as the Bay Area developed. Associated with the Ohlone people, it was one of the largest shellmounds in the region. In 1876, the site was partially leveled for an amusement park; when the park closed in 1924, archaeologists excavated more than 700 indigenous graves. The site was then razed to build an industrial plant that occupied the site until the late 1990s, when the city demolished the buildings and started cleaning up the toxic soil left behind.

During that process, hundreds of human remains were found, some of which were reburied while others were taken to landfills or incinerated as part of the cleanup. Activists attended city council meetings to ask that the site be cleaned and allowed to remain open space and a place to honor ancestors. Construction continued, however, and was protested by groups like Indian People Organizing for Change, which now organizes the annual shellmound prayer walk.

http://en.wikipedia.org/wiki/Coyote_Hills_Regional_Park

Coyote Hills Regional Park is a regional park encompassing nearly 978 acres of land and administered by the East Bay Regional Park District. The park, which was dedicated to public use in 1967, is located in Fremont, California, on the southeast shore of the San Francisco Bay. The Coyote Hills themselves are a small range of hills at the edge of the bay. There are a number of archaeological sites within the park, preserving evidence of habitation by Native Americans of the Ohlone group of tribes, including shellmounds. Access to these sites is not allowed for casual visitors, but they can be visited by arrangement.

Bay Delta by the Numbers

- Largest estuary on the west coast of the Americas with ~800 species flora & fauna.
- The watershed comprises 40% of CA's surface area (153,000 km^2).
- 50% of CA's runoff flows toward the Delta
- Most rain/snow falls on 5-15 days/year (75% in NorCal); 80% demand in SoCal.

http://deltacouncil.ca.gov/sites/default/files/documents/files/CH_01_2013.pdf (see page 11)

The Delta and Suisun Marsh support more than 55 fish species and more than 750 plant and wildlife species. Of these, approximately 100 wildlife species, 140 plant species, and 13 taxonomic units of fish are considered special-status species and are afforded some form of legal or regulatory protection (CNDDB 2010, USFWS 2010, CNPS 2010).

Aquafornia Exclusive: Why the Delta matters to every Californian: http://aquafornia.com/archives/588.

PPIC Envisioning Delta Futures (page 41): http://www.ppic.org/content/pubs/report/R_207JLR.pdf

https://watershed.ucdavis.edu/pdf/Madani-Lund_Delta_Conflict_A.pdf

http://pubs.usgs.gov/fs/2000/fs00500/pdf/fs00500.pdf

Monsen et al.: Effects of Flow Diversions on Water and Habitat Quality
http://www.science.calwater.ca.gov/pdf/iep_sag/Effects_of_Flow_Diversions_on_Water_and_Habitat_Quality_Monsen_et_al.pdf

http://resources.ca.gov/climate_adaptation/docs/Statewide_Adaptation_Strategy_-_Chapter_7_-_Water_Management.pdf

75 percent of California's available water supply originates in the northern third of the state (north of Sacramento), mainly from water stored in the Sierra Nevada snowpack. At the same time, 80 percent of the demand occurs in the southern two-thirds of the state.

http://californiawaterblog.com/2011/05/05/water%e2%80%94who-uses-how-much/
On the who-uses-how-much debate, any standard should be net usage of water within the interconnected network of California. All other comparisons simply muddy the waters…When you account based on net water use—meaning water that is lost to evapotranspiration or salt sinks and not returned to rivers or groundwater for alternative uses—this translates to 62% agricultural, 16% urban and 22% environmental.

http://www.sfgate.com/opinion/article/Away-go-our-dollars-down-the-delta-drains-5132228.php

…personal water use is a drop in the bucket. Statewide, domestic consumption is only about 8 percent of the total versus 75 percent for agriculture and 17 percent for business and landscaping. As for water pumped out of the delta, only about one-quarter goes to Southern California, while three-quarters go to agribusiness in the Central Valley. Instead of building the Delta Drains, use the money to buy out Westlands, about $9 billion at current land prices. This would be cheaper and have the added benefit of saving 1 million acre-feet a year (average) now going to Westlands, leaving that water for other farmers and urban users.

Richard Walker is professor emeritus of geography at UC Berkeley and the author of "The Conquest of Bread: 150 Years of California Agribusiness" (2004) and "The Atlas of California" (2013), among his many writings on the Golden State.

Bay Delta by the Numbers

- Sierra snowpack melts into 15 MAF/year of freshwater; 60% of which is captured in reservoirs ~ 30% of CA's water supply.
- 1.5-2 MAF groundwater overdraft.
- 60% of CA's "developed" water supply from Sierra could diminish by 80% (2100).
- Up to 65% of the freshwater flowing to the Delta is diverted (up to ~7.5 MAF).

Aquafornia Exclusive: Why the Delta matters to every Californian:
http://aquafornia.com/archives/588.

PPIC Envisioning Delta Futures (page 41): http://www.ppic.org/content/pubs/report/R_207JLR.pdf

https://watershed.ucdavis.edu/pdf/Madani-Lund_Delta_Conflict_A.pdf

http://pubs.usgs.gov/fs/2000/fs00500/pdf/fs00500.pdf

Monsen et al.: Effects of Flow Diversions on Water and Habitat Quality
http://www.science.calwater.ca.gov/pdf/iep_sag/Effects_of_Flow_Diversions_on_Water_and_Habitat_Quality_Monsen_et_al.pdf

An acre-foot of water is about 326,000 gallons.
http://www.colusa-sun-herald.com/articles/million-11633-water-reservoir.html

http://www.sfgate.com/news/article/California-drought-Sierra-Nevada-snowpack-hits-a-6164391.php
"…snow makes up 60 percent of the water that is captured in California's reservoirs when it melts in the spring and 30 percent of the state's overall water supply during a normal year."

"The new Sustainable Groundwater Management Act (SGMA) seems likely to increase demands for water diversions from the Delta to the south to partially compensate for the roughly 1.5-2 maf/year that is currently supplied by groundwater overdraft. " see page 15 of the following ISB document.
http://deltacouncil.ca.gov/docs/final-delta-isb-comments-partially-recirculated-draft-environmental-impact-reportsupplemental

Bay Delta by the Numbers

- Net use: 62% Ag., 16% urban, 22% env. (drinking water for 27 million people).
- Irrigation water for 3 million acres of farmland ($27 billion agricultural sector).
- 50% of the USA's fruits & vegetables and 20% of the Nation's milk.
- Western Delta subsided by up to ~25 feet; SJ Valley subsided by up to ~30 feet.

Aquafornia Exclusive: Why the Delta matters to every Californian:
http://aquafornia.com/archives/588.
http://www.watereducation.org/photo-gallery/california-water-basics

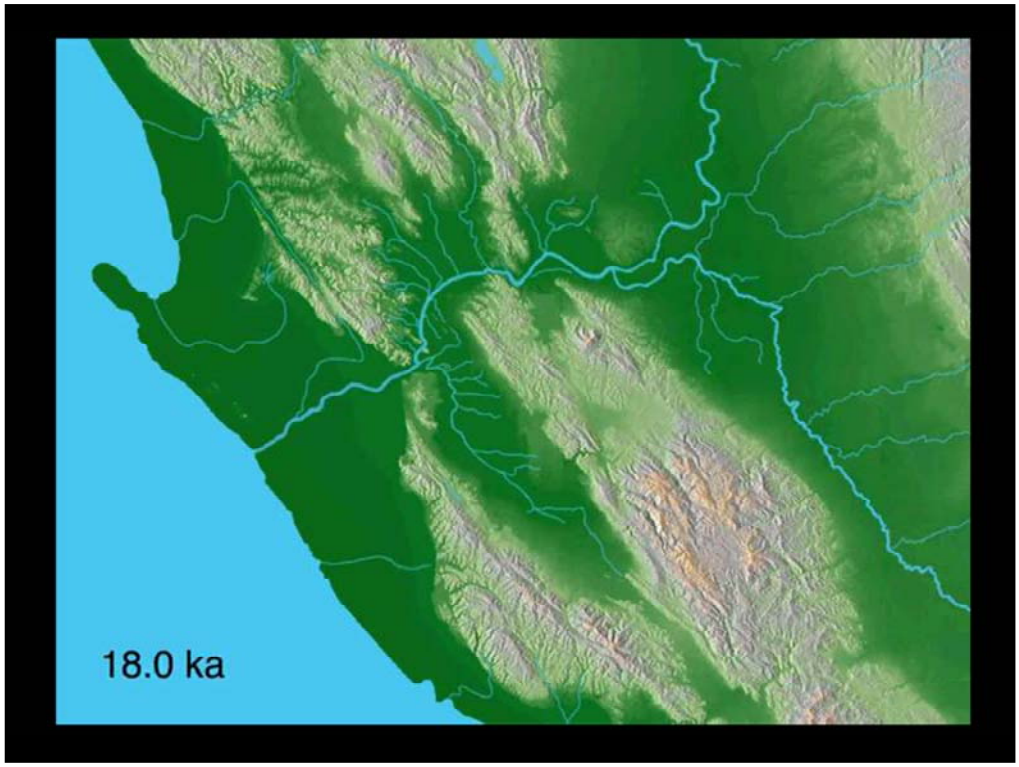
PPIC Envisioning Delta Futures (page 41):
http://www.ppic.org/content/pubs/report/R_207JLR.pdf

https://watershed.ucdavis.edu/pdf/Madani-Lund_Delta_Conflict_A.pdf

http://pubs.usgs.gov/fs/2000/fs00500/pdf/fs00500.pdf

Monsen et al.: Effects of Flow Diversions on Water and Habitat Quality

http://www.science.calwater.ca.gov/pdf/iep_sag/Effects_of_Flow_Diversions_on_Water_and_Habitat_Quality_Monsen_et_al.pdf



http://iceagebayarea.wordpress.com/

Back before the San Francisco Bay was a bay, it was a verdant green plain, with a single river gushing through it to the sea. The Pacific coastline extended out 12-15 miles further than it does today. This area was once home to mammoths, camels, wolves, bears, lions, giant sloths, and antelope.

http://pubs.usgs.gov/fs/2007/3015/fs2007-3015.pdf

Age Terms

The age of a stratigraphic unit or the time of a geologic event may be expressed in years before present (before A.D. 1950). The "North American Stratigraphic Code" (North American Commission on Stratigraphic Nomenclature, 2005) recommends abbreviations for ages in SI (International System of Units) prefixes coupled with "a" for annum: ka for kilo-annum, 10^3 years; Ma for mega-annum, 10^6 years; and Ga for giga-annum, 10^9 years. Duration of time should be expressed in millions of years (m.y.). For example, deposition began at 85 Ma and continued for 2 m.y.

http://www.sfgate.com/bayarea/article/Portals-of-the-past-where-mammoths-roamed-4704196.php#page-1

In 1983, workers building the foundation for the Pansini Building, on the south side of Pacific a few yards east of Columbus, found fossilized bones in dark clay soil, 15 feet below street level. Peter Rodda found the remains of three Columbian mammoths and one giant bison. It was the biggest discovery of Pleistocene-era mammals in the city's history, only the fourth overall, and the first since the early 20th century. The enormous beasts dated from the Rancholabrean age, named after the famous La Brea tar pits near Los Angeles. The Rancholabrean age started 240,000 years ago and ended 11,000 years ago, when almost all of the so-called megafauna became extinct for reasons that are still unclear. Most species died out in just 1,500 years.

http://www.education.savingthebay.org/wp-content/guides/The-Formation-of-San-Francisco-Bay.pdf

The familiar San Francisco Bay formation is young on a geologic time scale—just 10,000 or so years old.

A million years ago, there were rolling grasslands in the region where today lies the San Francisco Bay.

An enormous inland sea called Corcoran Lake covered what is now the Central Valley.

About 560,000 years ago, as the earth's huge tectonic plates slowly shifted, the land sank and the southern end of Lake Corcoran rose. Water spilled over the western edge, and the lake drained completely. This action carved out what we know today as the Carquinez Strait and began to shape the basin that would become San Francisco Bay.

Twenty thousand years ago, the Pacific coastline was 27 miles west of the Golden Gate, with coastal hills whose tops are now the Farallon Islands. The world was in the last ice age. With much of Earth's water frozen in glaciers, the sea level was much lower than it is today and more land was exposed. Today's San Francisco Bay was a series of broad, dry valleys within the Coast Ranges.

As the ice age ended about 10,000 years ago, the glaciers began to melt and the Sacramento and San Joaquin rivers carried huge flows of water and sediment down from the Sierra Nevada Mountains. Sea levels began to rise, and water entered the Coast Ranges through the Golden Gate.

San Francisco Bay too form when seawater began covering the broad, dry valleys at the rate of about one inch per year (a rapid fill in a geologic time frame). On the gentle slopes of the South Bay, the seawater advanced southward by several inches each day.

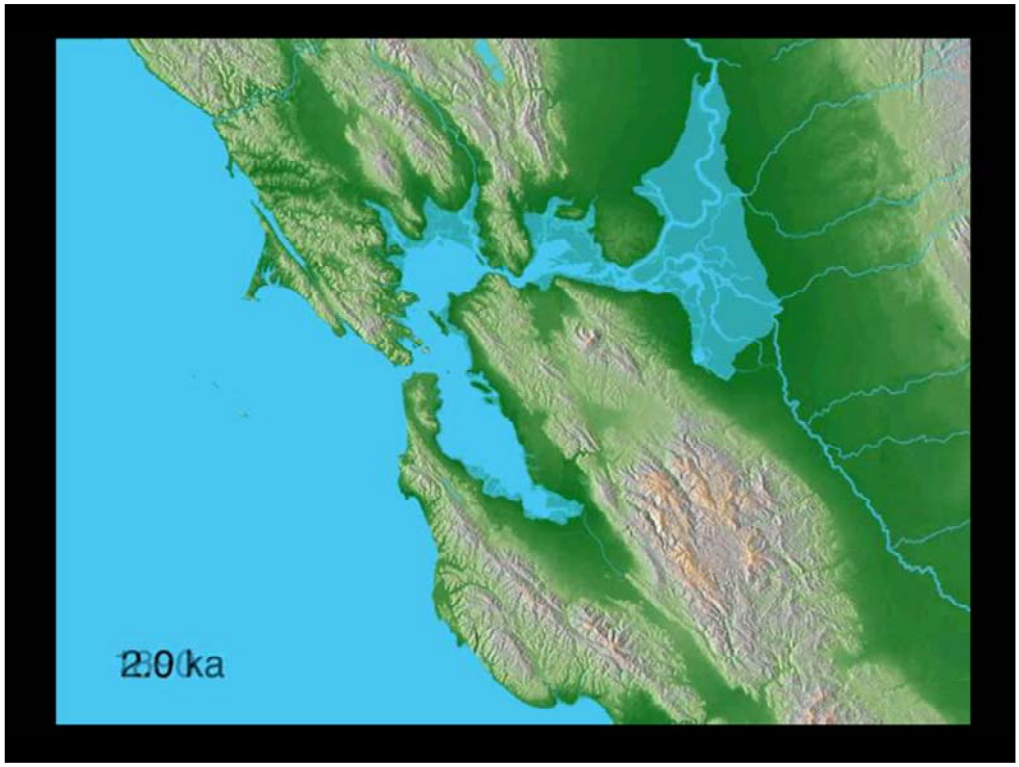
After a few thousand years, the rate of rising sea levels began to slow. Sediments from area rivers (the San Joaquin and the Sacramento in the north and Alameda Creek in the south) began to accumulate along the shallow shores of the new bay, creating marshes and mudflats that supported plant and animal life.

Image: http://www.geog.ucsb.edu/~joel/g148_f09/lecture_notes/central_valley/california_tulefog_sm.jpg

http://www.fws.gov/cno/refuges/sanjoaquin/SanJoaquinRiverNWR-EnvironmentalAssessment.pdf

Schoenherr (1992) provides a broad overview of the soils and geology of California's Central Valley:

"The Central Valley is a huge basin filled with sediments. The deepest parts of the gravels and sands are marine sediments that have accumulated since the late Jurassic—145 million years ago. The sea retreated from the Central Valley at about the same time that the southern Coast Ranges were uplifted, and during the long history of accumulation of marine sediments in the valley, the basement rock continued to subside. During most of the Pleistocene the area was occupied by shallow brackish and freshwater lakes. During the last 5 million years, sediments accumulated as alluvial deposits washed out of the mountains. These deposits are only a few thousand feet deep over most of the valley floor."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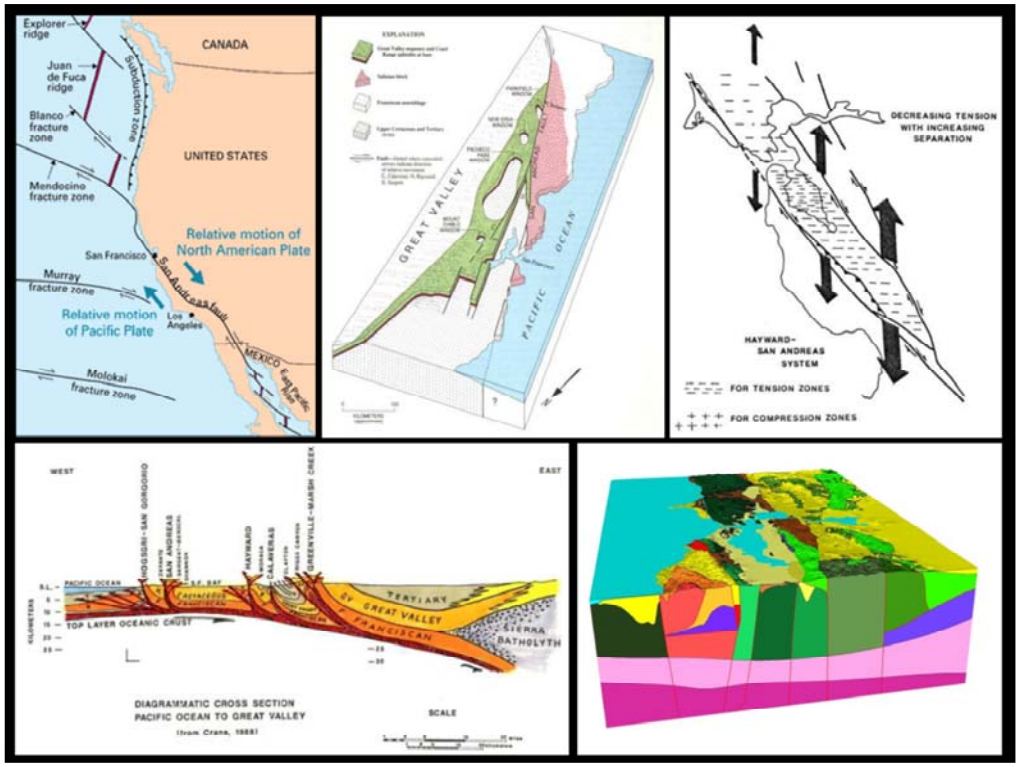


Geologic Setting of the Sacramento-San Joaquin Delta

J. David Rogers, Ph.D., P.E., P.G., C.E.G., C.HG.

Rune Storesund, D.Eng, P.E., G.E.

Berkeley NSF RESIN Project Meeting

January 26, 2011

http://web.mst.edu/~rogersda/levees/California/GeoSetting-Sacramento-San%20Joaquin-Delta.pdf

About 14.5 ka, sea level began rising markedly, world-wide.

The delta subsided more or less continuously throughout the Holocene, as sea level rose.

(The Holocene is the name given to the last 11,700 years; sometimes called the Anthropogene, the "Age of Man.")

During this same interim, faulting continued to elevate the bedrock narrows (Coast Range?) between the delta and the ocean.

As a consequence, the delta continued to enlarge itself over the past 5,000 years, backing further upstream, to the east, north, and south.

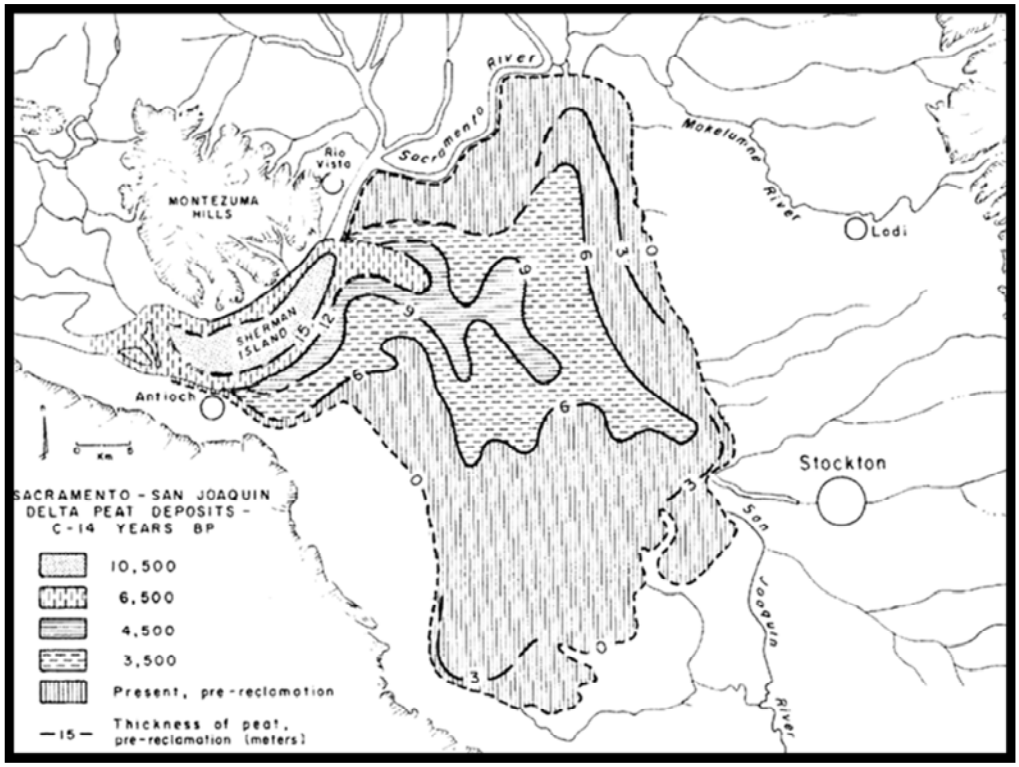
http://www.ucmp.berkeley.edu/quaternary/holocene.php

The Sacramento-San Joaquin Delta is one of only tectonically-controlled ***inverse deltas*** in the world.

Rapid expansion of the Delta occurred during the Holocene Epoch.

http://web.mst.edu/~rogersda/levees/California/GeoSetting-Sacramento-San%20Joaquin-Delta.pdf

http://earthquake.usgs.gov/research/structure/3dgeologic/otherviews.php



http://web.mst.edu/~rogersda/levees/California/GeoSetting-Sacramento-San%20Joaquin-Delta.pdf

For 6,000 years, sediment & tules formed peat soil in this unique, low-lying inverted delta (738,000 acres)

http://earthobservatory.nasa.gov/IOTD/view.php?id=6070

An inverted delta is the name geologists give to river deltas in which the braiding and branching out of the river channel occurs inland, *before* the river actually reaches the large body of water toward which it flows.

http://science.kqed.org/quest/2010/12/16/the-unique-geometry-of-the-sacramento-san-joaquin-delta/

http://www.wordiq.com/definition/Inverted_river_delta

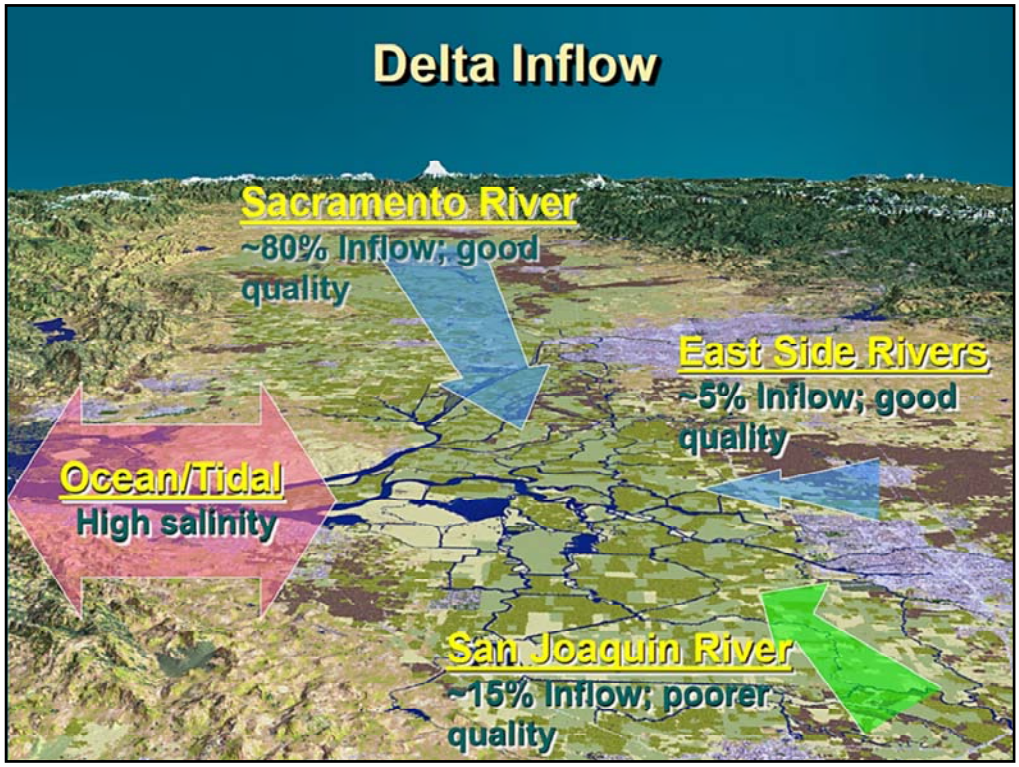
In a typical river delta, the narrow end of the delta is located at the point where a rivers enter a delta, with a wide fan-shaped sedimentation region extending outward into the body of water into which the river empties. In some rare cases, most notably in the case of the Sacramento River Delta, at the confluence of the Sacramento and San Joaquin Rivers in California, the delta is located at the waterway's exit from a large, flat valley, yet still inside the valley. The sediment is dropped within the valley and the clear water then exits into a bay or the ocean, so the apex of the delta is at this exit, a configuration said to be inverted from that usually seen. Inverted deltas typically do not last long in geological terms, since they tend to fill up with sediments rather quickly and eventually become normal deltas.

One of the other rare inverted delta can be found on the Tagus River in Portugal.

http://english.turkcebilgi.com/inverted+river+delta

http://earthfromspace.photoglobe.info/spc_sacramentoriver.html

This inland sediment-delivery system is one reason why the soils are so fertile and why farming is so productive in the valley.

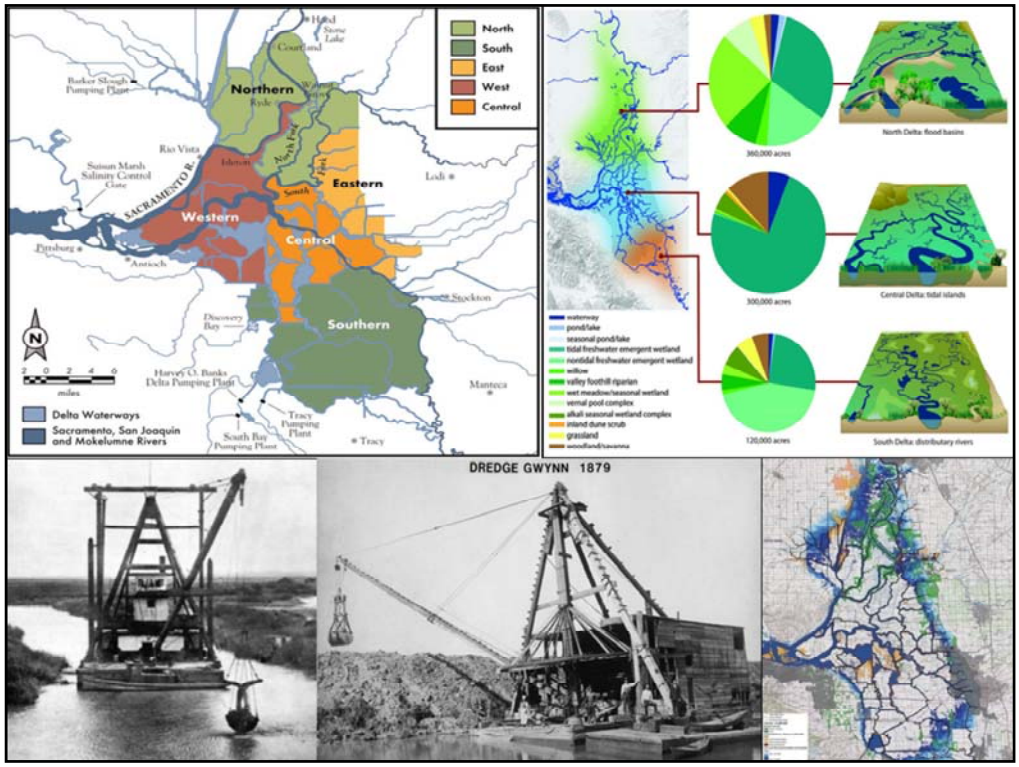

Delta Inflow
Sacramento River
~80% Inflow; good quality
East Side Rivers
~5% Inflow; good quality
Ocean/Tidal
High salinity
San Joaquin River
~15% Inflow; poorer quality

Sacramento River by Craig Miller Mar 10, 2010

https://picasaweb.google.com/107521149717650730589/SacramentoBasin#5528054783906548578

https://picasaweb.google.com/107521149717650730589/SacramentoBasin#

Snow and rain in the Central and Southern Sierra Nevada Range collect in streams draining the mountains and foothills before traversing croplands, vineyards, orchards, dust, and cities before their confluences with the San Joaquin River.



A relatively large swath of the Sacramento River floodplain was repurposed as the "Yolo Bypass" to protect Sacramento from flooding, and recent studies indicate that some ecosystem functions remain operative on the floodplain when it comes to providing food and shelter for native fishes. Otherwise, the Delta has been largely "straightjacketed" by 1,100 miles of levees.

Mount & Twiss (2005)
This figure re-printed from *Envisioning Futures for the Sacramento-San Joaquin Delta* (page 49).
http://www.ppic.org/content/pubs/report/R_207JLChapter3R.pdf

For more than 6,000 years, the Delta was a freshwater tidal marsh consisting of a complex network of tidal channels, sloughs, "islands" composed of tule marsh plains, complex branching ("dendritic") water channels, and natural levees colonized by riparian forests. A slow rise in sea level and gradual regional tectonic subsidence (subsidence of the land resulting from flexure of the Earth's crust) created what geologists refer to as "accommodation space" and made room for the relatively continuous accumulation of large volumes of sediment within the Delta. As accommodation space was formed by sea level rise over the last 6,000 years, it was quickly filled by the deposition of inorganic sediment from the Sacramento and San Joaquin Rivers and a similar amount of *in situ* production of organic material in the tule marshes. The preservation of

this material, as the peat soils of the Delta, benefited from the oxygen-poor conditions within saturated soils of the marshes.

PPIC "*Envisioning*" book, pages 44-45

Lund & Moyle 2013

http://www.escholarship.org/uc/item/1h57p2nb#page-3

http://kvpr.org/post/new-study-examines-how-delta-ecosystem-once-worked

USBR-ESRI: The California Delta—Ecosystem Restoration Targets and Levees at Risk.

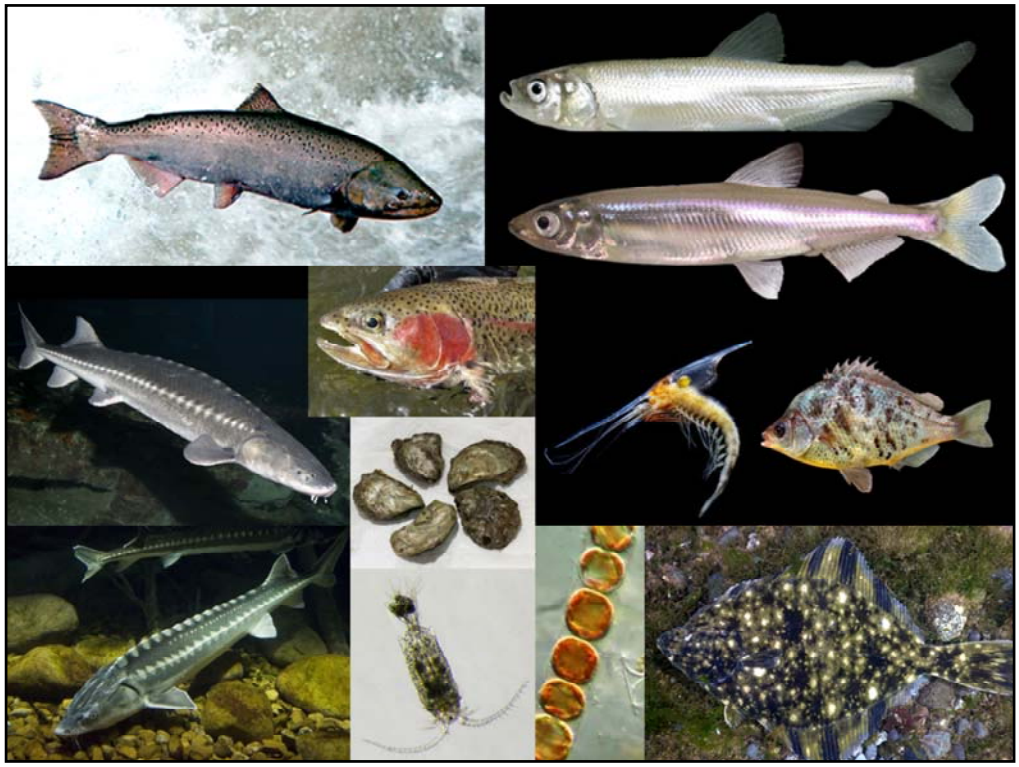
In comparing their maps of the early 1880s Delta with the early 2000s Delta (the latter not pictured in this paper), Grossinger and Whipple found the maps revealed a reduction in historical tidal channel complexity with the damming of smaller waterways, channel widening, meander cuts, and straight connecting canals. The mapping done by USBR-ESRI led them to conclude that subsidence and anticipated sea level rise have limited restoration opportunities for aquatic and terrestrial habitats. This would apparently exclude the western Delta from consideration as a restoration target, however, USGS has demonstrated that subsided islands in the western Delta are restorable, and the subsidence reversible, through carbon farming with tule-based wetlands.

http://archive.deltacouncil.ca.gov/delta_science_program/research/research_overview.html

http://www.pbs.org/newshour/multimedia/sanjoaquin/4.html

http://www.kcet.org/news/redefine/rewater/bay-and-delta/understanding-californias-bay-delta-in-63-photos.html

A clamshell dredge operates near Sherman Island, ca. 1907.
(National Maritime Museum, San Francisco)
http://pubs.usgs.gov/circ/circ1182/pdf/11Delta.pdf



Resident and migratory fishes

Prior to European settlement, the wild rivers of California produced millions of salmon. In the early 1900s, there were 21 canneries in California processing 5 million pounds of salmon annually, as well as sole, flounder, sardine, herring, and anchovy.

Longfin Smelt

http://superphotoscannerwallpaper.blogspot.com/2012/10/longfin-smelt.html

The longfin smelt, *Spirinchus thaleichthys*, is found in several estuaries and lakes along the northern Pacific coast of North America. Its most distinctive characteristic is the long pectoral fins that reach nearly to the base of the pelvic fins, and thus inspire the common name. The sides are silver, with the back ranging from an olive to a pinkish shade. The upper jaw is long, reaching nearly to the posterior edge of the eye, and the lower jaw projects slightly in front of the upper jaw. Both jaws have set of very small teeth. The lateral line is incomplete, reaching back only as far as the dorsal fin. Size is limited to about 20 cm. Their principal food item is the opossum shrimp, Neomysis mercedis, and species of Acanthomysis, but they will also eat copepods and other small crustaceans. In turn, they are eaten by a variety of fishes, birds, and marine mammals; for instance, they are an important prey for the harbor seal, Phoca vitulina, in the Columbia River.

Delta smelt

http://www.usbr.gov/pmts/tech_services/tracy_research/photos/fish/TracyFishImages028.html

Rene Reyes

Tule perch

http://www.usbr.gov/pmts/tech_services/tracy_research/photos/fish/TracyFishImages074.html

Rene Reyes

N. American green sturgeon

http://wildequity.org/images/3572

http://mthsecology.wikispaces.com/Green+Sturgeon

http://www.vijverexpert.com/vijver-vissen/

http://fishbio.com/field-notes/steelhead/spawn-another-day

People are often unaware that we have steelhead (*Oncorhynchus mykiss*) in California Central Valley rivers. The adult O. mykiss in the photograph above is a kelt that was encountered at a fish counting weir on the Stanislaus River. The term kelt is used to describe to a spawned-out salmon or steelhead that is returning to the ocean. Pacific Salmon are predominantly semelparous, dying after spawning only once. Conversely, steelhead don't necessarily die after spawning and can spawn multiple times (iteroparous).

http://www.sitkanature.org/wordpress/wp-content/gallery/aaronbaldwinmarine/crangon%20franciscorum%20angustimana%20whole%2002.jpg

http://en.wikipedia.org/wiki/Ecology_of_the_San_Francisco_Estuary
http://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=178

Eurytemora affinis
Native Range: *Eurytemora affinis* is native to Ponto-Caspian region, the North American Atlantic coast including the Gulf of Mexico, the North American Pacific coast, the western European coast, and parts of Asia, generally in brackish and saltwater regions (Mills et al. 1993; Torke 2001).
Eurytemora affinis grazes on algae, bacteria, organic detritus and protozoans, including ciliates and dinoflagellates. It can increase feeding on heterotrophic plankton rather than autotrophic plankton when suspended particulate matter increases in concentration. Feeding on microplankton ciliates is most efficient due to better perception, handling, and relative nutritional quality of these larger food particles in comparison to phytoplankton (Gasparini and Castel 1997; Merrell and Stoecker 1998; Torke 2001; David et al. 2006).

Diatoms
http://arch.ced.berkeley.edu/hiddenecologies/?p=550

Olympia oyster
http://www.greenerideal.com/science/1118-olympia-oyster-restoration-successful/

http://articles.latimes.com/2013/may/31/science/la-sci-sn-fish-climate-change-20130531

The authors of a new study published online in the journal PLOS ONE used 20 metrics -- including species population trends, physiological tolerance to temperature increase and ability to disperse -- to gauge the vulnerability of native fishes to climate change.

The results: 82% of 121 native species were deemed highly vulnerable.

"Almost all of those fishes are in decline already and climate change is going to accelerate the decline," said Peter Moyle, a UC Davis professor of fish biology and lead author of the paper.

Tale of two heavy metals – cinnabar ore in the Coast Range and gold deposits in the Sierra Nevada.
Discharges of "legacy" mercury into the Bay Delta from the Gold Rush era continues to stress the ecosystem, but evidence suggests that, by weight and composition, worldwide mercury emissions from coal-fired power plants and the resulting air deposition of mercury pose a serious environmental risk.

Also the tale of selenium loading from two sources – oil refining in the Carquinez Strait region and agricultural discharges of selenium laden drainage from the west side of the San Joaquin Valley. http://wwwrcamnl.wr.usgs.gov/Selenium/refining.htm

Mercury Contamination from Historic Gold Mining in California
http://www.irwinator.com/126/wdoc155.htm
http://pubs.usgs.gov/fs/2005/3014/
http://pubs.usgs.gov/fs/old.2005/3014/
Monitors (water cannons) were used to break down the gold-bearing gravel deposits with tremendous volumes of water under high pressure. Gravel deposits were washed into sluices (from center to lower part of figure) where gold was recovered

http://articulosdeviajes.wordpress.com/category/historias-y-leyendas/

http://commons.wikimedia.org/wiki/File:Metacinnabar-59226.jpg
Metacinnabar Locality: Mount Diablo Mine (Mt. Diablo Mine; Ryne Mine), Mount Diablo, Clayton, Contra Costa County, California, USA (Locality at mindat.org) Lustrous, complexly rounded, gray metacinnabar crystals to 3 mm richly cover matrix from the famous Mt. Diablo Mine of California. Ex Gene Meieran Collection (and he self-collected it 40 years ago). 3.3 x 2.1 x 2.0 cm

http://www.bemercuryfree.net/offsets.html
Hydraulic mine, ground sluice system, circa 1870s, Scott Valley mine, Siskiyou County

http://goldpanningtools.com/gold-guide/gold-prospecting-california.htm

http://wikimapia.org/6791767/New-Idria-Quicksilver-Mining-District

http://theironwolf.net/Adventures/2010/3-20-2010%20New%20Idria%20mine/NewIdreaMine.html

http://www.sciencedaily.com/releases/2013/10/131028163001.htm

http://sfbay.wr.usgs.gov/sediment/sanpablobay/bathy56-87.html
1856 - 1887 Massive quantities of sediment released by hydraulic gold mining in the Sierra Foothills overwhelmed San Pablo Bay. A volume of 263 million cubic meters (more than 8 million cubic meters a year on average) was deposited in San Pablo Bay.
http://geopubs.wr.usgs.gov/open-file/of98-759/of98-759.pdf
More than 350 million cubic meters of sediment was deposited in San Pablo Bay from 1856 to 1983.

http://ca.water.usgs.gov/mercury/
The 1848 discovery of gold in the Sierra Nevada created a ready market for mercury produced by the mines in California's Coast Ranges. Mercury forms a relatively insoluble amalgam with gold, and miners used this property to increase gold recovery. **Millions of pounds of mercury were used, especially in hydraulic placer mining operations that displaced and processed more than 1.5 billion cubic yards of gold-bearing sediments in the Sierra Nevada**. Gold- bearing sediments were washed through sluice boxes over mercury that was loosely held in riffles and troughs. Coarse gold was trapped primarily by gravity separation, while the recovery of fine-grained gold was achieved largely with mercury. An estimated 10 to 30 percent of the mercury was lost to the environment in this process and transported into streams and reservoirs along with the discharged sediments (tailings or "slickens") from the hydraulic mining operations.

http://www.thetimes.co.uk/tto/environment/article3084541.ece
A coal-fired power plant in China's Shanxi province Peter Parks/AFP/Getty Images

http://list25.com/25-biggest-man-made-environmental-disasters-in-history/
Considered one of the four major pollution diseases in the history of Japan, Minamata is caused by severe mercury poisoning that attacks the nervous system. In 1956, Chisso Corporation's industrial wastewater containing methylmercury was released into Minamata Bay and the Shiranui Sea; 2,265 fatalities are recognized as a direct consequence to this polluting even.

http://www.forbes.com/fdc/welcome_mjx.shtml

Federal and state water policy and projects, were predicated upon, and designed for, above normal precipitation conditions that characterized the early part of the 20th Century. Both the policy and the infrastructure are not suited for, or responsive to, long droughts and climate change.

Shasta Dam: Craig Miller (Vox/Terra):
http://picasaweb.google.com/107521149717650730589/MainstemSacramentoRiverWatershed?feat=embedwebsite#5516132433161550914
http://picasaweb.google.com/107521149717650730589/MainstemSacramentoRiverWatershed#
Central Valley Project (CVP) was completed in 1940 as part of the New Deal: Contra Costa Canal and Delta Cross Channel transferred Sacramento River water to the Bill Jones Pumping Plant. Friant Dam blocked the San Joaquin River.
State Water Project (SWP) was completed in 1967: diverted Feather River across Delta channels to Harvey O. Banks pumping facility.

Harvey O. Banks Pumping Plant. State Water Project. Image courtesy of San Diego County Water Authority
http://www.sdcwa.org/sites/default/files/images/baydelta_harveybankspumpingplant_aerial_hires.jpg

This orientation of the H.O. Banks pumping plant is looking toward the inlet from the NE to SW.

Link: <http://maps.google.com/?ie=UTF8&ll=37.799849,-121.62141&spn=0.006494,0.009624&t=h&z=17&vpsrc=6>

The water is moved from Clifton Court Forebay to the pumping plant intake, and then pumped uphill to the California Aqueduct for its journey to South to farms, factories, and families.

Only one free-flowing river remains in the Central Valley (Cosumnes) – only three free-flowing rivers statewide (Smith River, Santa Mararita River).
The San Joaquin River once teaming with a population of salmon 300,000 strong was dried up for a 60 mile stretch and the salmon run was destroyed. http://www.nmfs.noaa.gov/stories/2011/09/14_san_joaquin_salmon.html

Delta Mendota Canal – california aquaduct
http://www.flickr.com/photos/amenfoto/3285100067/
http://www.superstock.com/stock-photos-images/4029R-4635
http://geog321portland.blogspot.com/2010/11/chap-15-california.html

After all the plumbing for the CVP and the SWP was installed and the great water diversions commenced, we tried to produce salmon in hatcheries. But we have never matched nature in terms of abundance, genetic health, and cost.

Fish in a barrel at the US Fish & Wildlife Service's Coleman Hatchery. (Craig Miller/VoxTerra) Apr 23, 2008

https://picasaweb.google.com/107521149717650730589/MainstemSacramentoRiverWatershed#5516132950182573442

https://picasaweb.google.com/107521149717650730589/MainstemSacramentoRiverWatershed#

http://www.pressbanner.com/view/full_story/13530433/article-Let%E2%80%99s-go-fishin--Thousands-of-Chinook-salmon-injected-into-Monterey-Bay-

http://freeassociationdesign.wordpress.com/2010/04/26/problematic-surfaces-and-collateral-urbanism-reading-into-the-owens-lake-parable/

http://gallery.usgs.gov/photos/09_15_2010_b2Vi84Kxx6_09_15_2010_0

Description: Approximate point of maximum subsidence in the San Joaquin Valley, California. **Land surface subsided ~9 m (~29.5 feet)** from 1925 to 1977 due to aquifer-system compaction. Signs on the telephone pole indicate the former elevations of the land surface in 1925 and 1955.

Tilled land 2002 Stephen Johnson

Agricultural drainage from selenium-rich soils on the west side of the San Joaquin Valley is toxic to fish and wildlife.

http://www.climate-one.org/podcast/parched-california-111413

[At 7:40 minutes into the program]

Per Lester Snow: "We have systematically drawn down our groundwater reserves…we have overdrafted our Central Valley groundwater basins by the amount of Lake Tahoe." This equals 122,160,280 acre feet of water; enough to cover the entire state of CA in a foot of water (CA's land surface covers ~100,000,000 acres).

http://en.wikipedia.org/wiki/Tahoe

http://www.skiheavenly.com/lake-tahoe/lake-tahoe.aspx

A significant volume of irrigation water is diverted from CA rivers before they even reach the Delta.

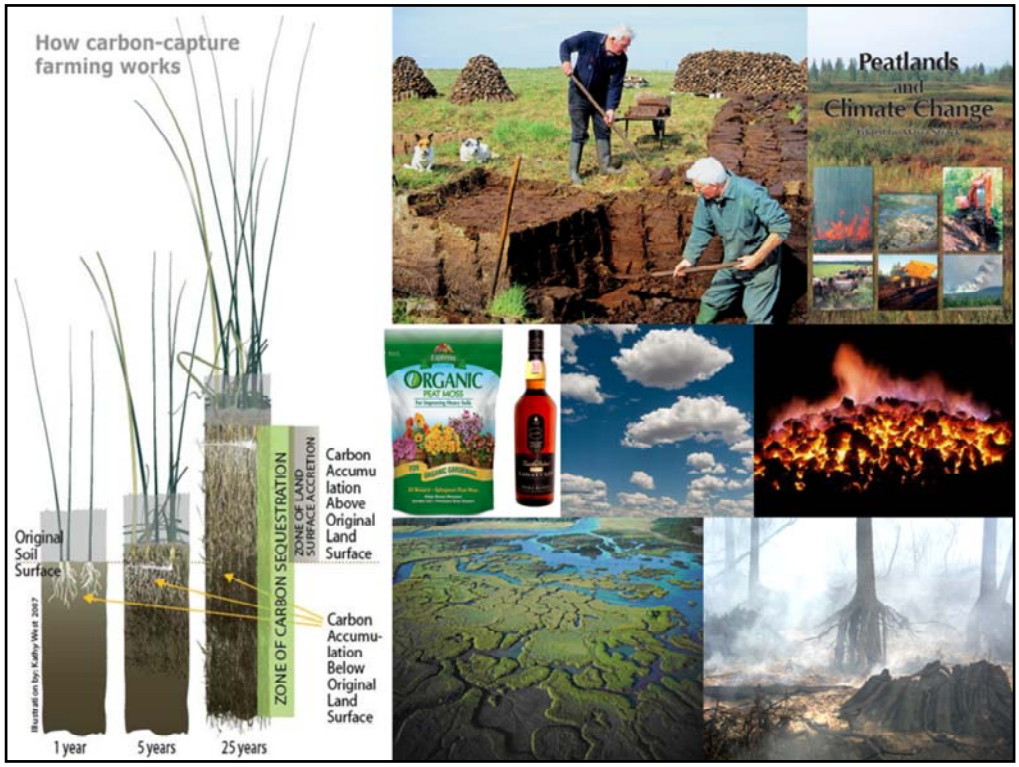
Pictured is the California Olive Ranch near Gridley where a vernal pool landscape was illegally destroyed to plant a "sustainable" olive orchard.

http://consumers.californiaoliveranch.com/2011/10/28/our-2011-harvest-a-more-robust-olive-oil-good-weather-so-far/

http://www.sacramentovalleyphotos.com/gallery/image.asp?image=2005_0611D_022

http://ca.water.usgs.gov/projects/central-valley/delta-mendota-canal.html

Delta-Mendota Canal: Evaluation of Groundwater Conditions & Land Subsidence



http://ca.water.usgs.gov/Carbon_Farm/

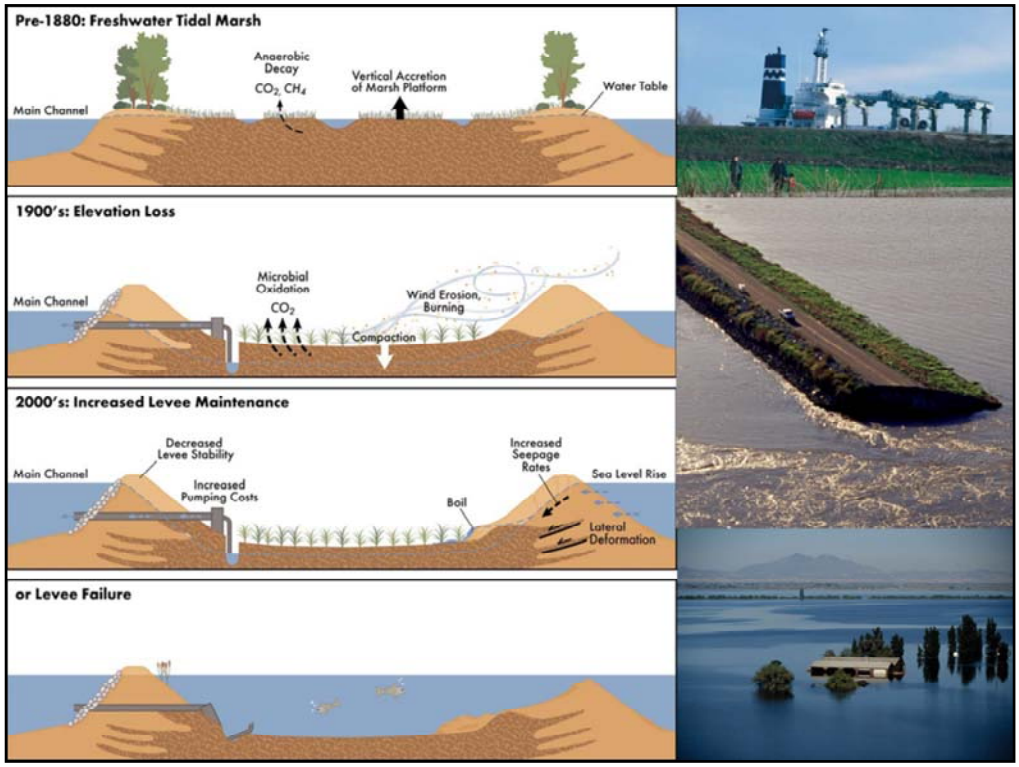
http://www.peatsociety.org/

http://whiskytastings.com/for-peats-sake-in-scotch-whisky-and-beyond/
http://boutique.maltsethoublons.com/whisky-lagavulin-distillers-43.html

http://politicalclimate.wordpress.com/tag/climate-change/

http://www.dealaboo.com/usa/Rody-Horse-Blue-51-deal-df8713302.html
http://sarawakcb.com/events/2010/09/24/international-peat-congress-2016/

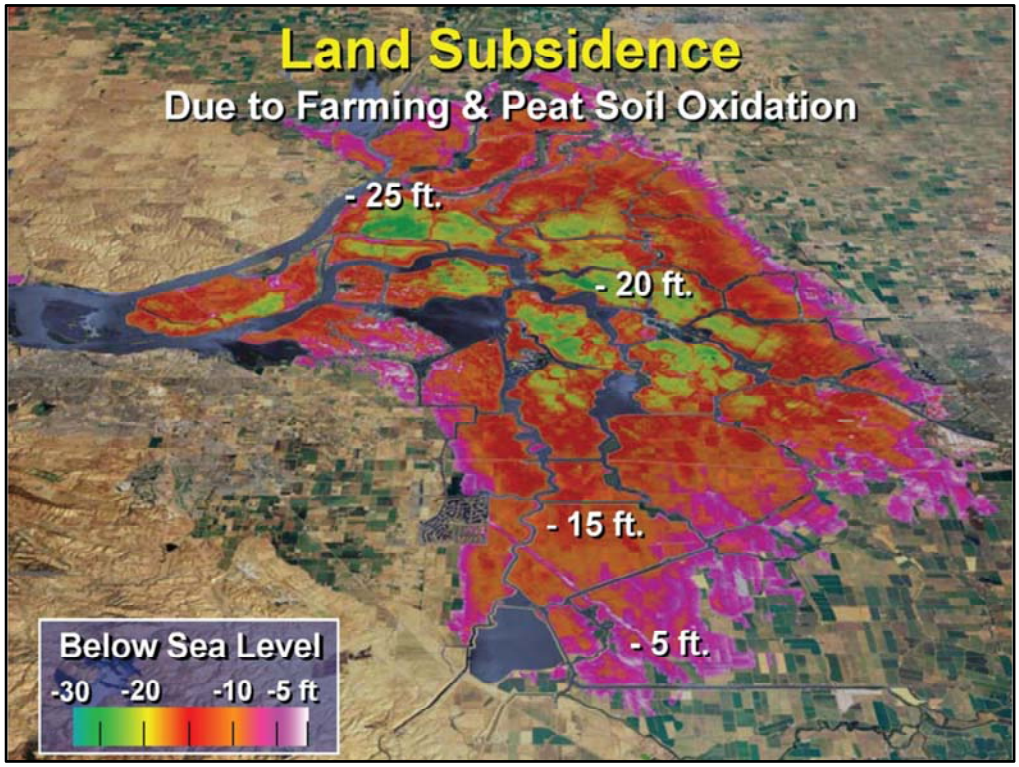
http://wx4cast.blogspot.com/2011/09/weather-forecasting.html



http://www.barryyeoman.com/pdfs/mount2005.pdf
Conceptual diagram illustrating evolution of Delta islands due to levee construction and island subsidence. Modified from Ingebritsen et al. (2000). Mount and Twiss

Most levees were built in the 1800s by Chinese laborers who converted much of the Delta marshlands were "reclaimed" for farmland. The levees were not designed for long-term flood protection of homes and infrastructure.

2004 levee break at Jones Tract flooded 12,000 acres. Aquafornia.
http://aquafornia.com/archives/category/levees/page/3


Land Subsidence
Due to Farming & Peat Soil Oxidation
- 25 ft.
- 20 ft.
- 15 ft.
- 5 ft.
Below Sea Level
-30 -20 -10 -5 ft

How unusual is the 2012–2014 California drought?
Evidence Suggests California's Drought is the Worst in 1,200 Years
http://www.whoi.edu/news-release/California-drought
University of Minnesota and Woods Hole Oceanographic Institution

Multi-century evaluation of Sierra Nevada snowpack
Sierra snowpack was probably the worst in 500 years
http://www.laobserved.com/archive/2015/09/sierra_snowpack_was_proba.php

During the ongoing drought, record low precipitation levels have combined with record high temperatures to virtually eliminate the snowpack across California's vast mountainous regions. *Sierra Snowpack is Virtually Gone..* http://www.water.ca.gov/news/newsreleases/2015/040115snowsurvey.pdf

California is prone to drought by virtue of its Mediterranean climate (characterized by wet and mild weather during winter and spring, and dry and warm conditions in the summer and fall). Scientists are now warning of an abrupt and permanent change in California's climate that will usher in "mega droughts" for generations to come.

Study Warns of Unprecedented Risk of Drought in the 21st Century
http://www.rawscience.tv/warming-pushes-western-u-s-to-driest-period-in-1000-yrs/

***Anthropogenic warming has increased drought risk in California*. Diffenbaugh et al. in PNAS; 2015.**
http://www.pnas.org/content/early/2015/02/23/1422385112

Could California's Drought Last 200 Years?
http://news.nationalgeographic.com/news/2014/02/140213-california-drought-record-agriculture-pdo-climate/

The paper below is among the most definitive and worrisome recently issued as it addresses the increased drying and degradation of topsoil, declining groundwater reserves, and the worsening of the adverse effects of drought cycles. By the 2060s, *"more or less permanent drought will set in, interrupted only by the rainiest years."*
Contribution of anthropogenic warming to California drought during 2012–2014
http://www.earth.columbia.edu/articles/view/3258
http://www.ldeo.columbia.edu/~jsmerdon/papers/2015_grl_williamsetal.pdf

http://www.routefifty.com/2015/09/valley-fire-northern-california/120893/?oref=dropdown

http://www.newsusauk.com//news/115907-california-s-valley-fire-forces-state-of-emergency-to-be-declared.html
Animal rescue group volunteer Chad Hughes, right, carries a goat to a trailer from a home threatened by a fire near Railroad Flat, California

http://www.nytimes.com/1994/07/19/science/severe-ancient-droughts-a-warning-to-california.html
BEGINNING about 1,100 years ago, what is now California baked in two droughts, the first lasting 220 years and the second 140 years.

Lake Oroville in 2005 (left) and November 2008 (right)

http://resources.ca.gov/climate_adaptation/docs/Statewide_Adaptation_Strategy_-_Chapter_7_-_Water_Management.pdf

http://www.calacademy.org/sciencetoday/trees%e2%80%99-bleak-future/559031/
The world's trees are facing serious challenges as the climate warms, especially in the Southwestern United States. Last February, a report from Texas A&M Forest Service determined that 2011's drought killed more than 300 million trees in Texas forests and another 5.6 million trees in Texas cities.

http://www.routefifty.com/2015/09/valley-fire-northern-california/120893/?oref=dropdown

http://www.nytimes.com/1994/07/19/science/severe-ancient-droughts-a-warning-to-california.html
BEGINNING about 1,100 years ago, what is now California baked in two droughts, the first lasting 220 years and the second 140 years.

http://resources.ca.gov/climate_adaptation/docs/Statewide_Adaptation_Strategy_-_Chapter_7_-_Water_Management.pdf

Multiple Stressors

Ag discharges
http://www.unmultimedia.org/radio/english/2013/02/

Channelized streams
http://kindertraeumeonline.de/blog/flood-control-channel

Northern Pike caught in Lake Davis

The overbite clam, *Corbula amurensis*.

http://science.calwater.ca.gov/publications/sci_news_0809_clams.html

http://www.exoticsguide.org/

Historically, most energy and carbon in the Bay Delta flowed through pelagic zooplankton and fish; currently most energy and carbon flow instead through the alien overbite clam which became established in 1986 (PPIC, Envisioning, p. 71).

The San Francisco Bay–Delta is arguably one of the most invaded estuaries in the world. More than 250 alien species of aquatic and terrestrial plants and animals have entered the

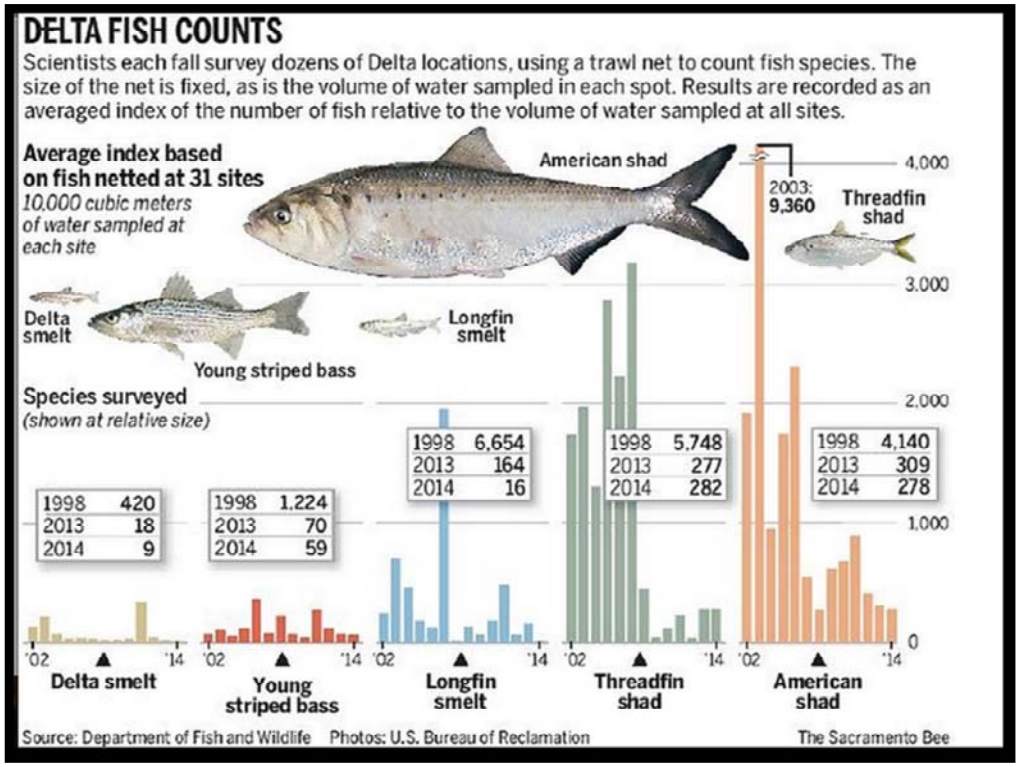
estuary since the first arrival of Europeans, and at least 185 alien species now inhabit the Delta and have profoundly changed Bay-Delta food webs and habitats, generating an array of effects—mostly negative—on native species. Today and for the indefinite future, we are managing an ecosystem composed of a mix of native and alien species that are in constant flux, as native species decline in abundance, new alien species invade, and established aliens wax and wane. *Alien species are a major and growing problem that significantly inhibits our ability to manage the Bay Delta in support of desirable species*.

in numbers. PPIC "*Envisioning*" book pages 54-55; 71.

http://www.ppic.org/content/pubs/report/R_207JLChapter3R.pdf

http://noyonews.net/?p=1933

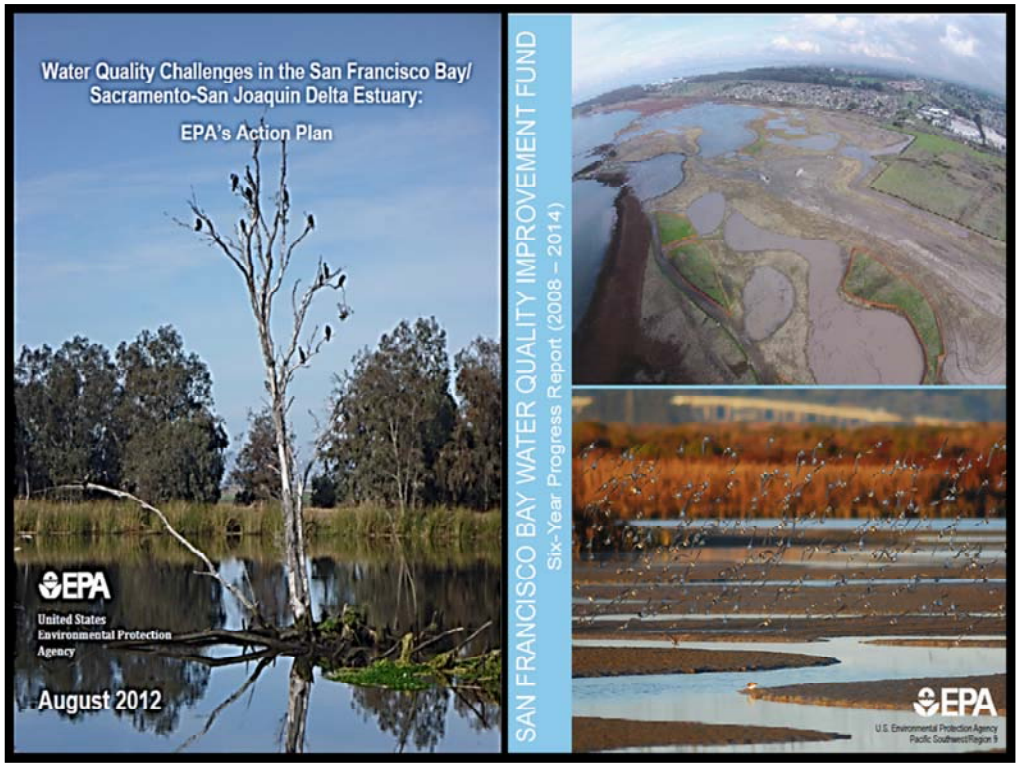
http://www.liveauctioneers.com/item/7629304
Treflan Balan



http://www.ppic.org/content/pubs/report/R_207JLR.pdf

Envisioning Futures

In the fall of 2004, routine fish surveys registered sharp declines in several pelagic species, including the delta smelt, a species listed as threatened under the Endangered Species Act. Subsequent surveys have confirmed the trend, raising concerns that the smelt—sometimes seen as an indicator of ecosystem health in the Delta—risks extinction if a solution is not found quickly (Figure 1.3).


Water Quality Challenges in the San Francisco Bay/
Sacramento-San Joaquin Delta Estuary:
EPA's Action Plan
EPA
United States
Environmental Protection
Agency
August 2012
SAN FRANCISCO BAY WATER QUALITY IMPROVEMENT FUND
Six-Year Progress Report (2008 – 2014)
EPA
U.S. Environmental Protection Agency
Pacific Southwest/Region 9

EPA's Bay Delta Action Plan

- Set year-round WQS for estuarine habitat.
- Regional WQ monitoring & assessment.
- Implement TMDLs and track performance.
- Set site-specific, numeric criteria for Se.
- Make FIFRA work - pesticides & species.
- Restore aquatic habitats – manage MeHg.
- Support Bay Delta Conservation Plan.

Aquafornia Exclusive: Why the Delta matters to every Californian:
http://aquafornia.com/archives/588.

PPIC Envisioning Delta Futures (page 41):
http://www.ppic.org/content/pubs/report/R_207JLR.pdf

https://watershed.ucdavis.edu/pdf/Madani-Lund_Delta_Conflict_A.pdf

http://pubs.usgs.gov/fs/2000/fs00500/pdf/fs00500.pdf

Monsen et al.: Effects of Flow Diversions on Water and Habitat Quality

http://www.science.calwater.ca.gov/pdf/iep_sag/Effects_of_Flow_Diversions_on_Water_and_Habitat_Quality_Monsen_et_al.pdf

http://baylandsgoals.org/

http://www.mercurynews.com/science/ci_28988730/san-francisco-bay-race-build-wetlands-is-needed

http://ww2.kqed.org/quest/2013/07/16/wetlands-horizontal-levees-sea-level-rise/

http://www.marinij.com/marinnews/ci_23985683/massive-new-wetlands-restoration-reshapes-san-francisco-bay

Construction crews and biologists are in the final stretch of a 20-year project to **restore 11,250 acres of former industrial salt ponds** back to a natural landscape. The aquatic renaissance is already the largest wetlands restoration project ever completed in the Bay Area, turning back the clock 150 years and transforming the area between Vallejo and Sonoma Raceway, despite little public awareness because of the distance from the Bay Area's large cities. The restoration — encompassing an area as big as 8,500 football fields — is also offering a road map for similar projects now under way in the East Bay and Silicon Valley, particularly the massive restoration of **15,100 acres of former Cargill Salt ponds that extend from Hayward to San Jose to Redwood City**.

http://arch.ced.berkeley.edu/hiddenecologies/

The show contains an interesting variety of works. My contribution the development of A 30" x 40" prints of the Saltscapes image layout developed for the Dean's Office exhibit. These are chemistry-based photographic prints on Fuji Professional SuperType PD Luster paper.

http://scc.ca.gov/15wetlands/

http://www.southbayrestoration.org/maps/

http://bluecarbonblog.blogspot.com/2011/09/wetland-restoration-in-ca-and-blue.html

South Bay salt ponds before and after restoration. In just a year, native pickleweed colonizes the mudflats. Photo: South Bay Salt Pond Restoration Project.

http://www.dailydemocrat.com/old/home/ci_23709237/improved-environment-lets-leopard-sharks-flourish-sf-bay

http://www.sfgate.com/science/article/Building-homes-for-oysters-in-S-F-Bay-3721430.php

http://blog.globe.gov/sciblog/2011/12/07/porpoises-in-the-san-francisco-bay/

Harbor porpoises as seen from the Golden Gate Bridge. (Photo: William Keener/Golden Gate Cetacean Research).

Dungenous crab

http://www.pinterest.com/pin/8092474302034274/

The rivers meet in the Delta before flowing to the San Francisco Bay and Pacific Ocean. Prior to 1850, the vast areas of wetlands and narrow river channels kept much of the floor of the valley as a slowly draining inland sea.

Riparian habitat near the Sacramento River.

Photo by Dan Strait, USFWS

http://www.prbo.org/calpif/pdfs/riparian_v-2.pdf

Delta Meadows State Park: http://www.sskpc.org/delta_meadows_state_park.htm
http://www.sskpc.org/Photos/Delta-Meadows-St-Park-038.jpg

Runoff from a January 1997 storm caused this levee on the Cosumnes River to break, temporarily re-creating the floodplains that were a regular feature of the aboriginal Delta. Photograph by Tom Myers.

Two of EPA's key priorities: (1) The Bay Delta Water Quality Control Plan; and (2) the Bay Delta Conservation Plan.

http://www.tunneltalk.com/California-water-Jul12-Governor-Brown-supports-mega-conveyance-tunnels-project-under-the-Delta.php

http://www.water.ca.gov/deltainit/posters0309.cfm

http://www.waterboards.ca.gov/board_info/index.shtml

http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/decision_1641/d1641_exhibit_list_of_parties.shtml

http://www.beesource.com/forums/showthread.php?280214-buzzkill-dan-rather-reports-on-bee-deaths-among-the-almonds/page2

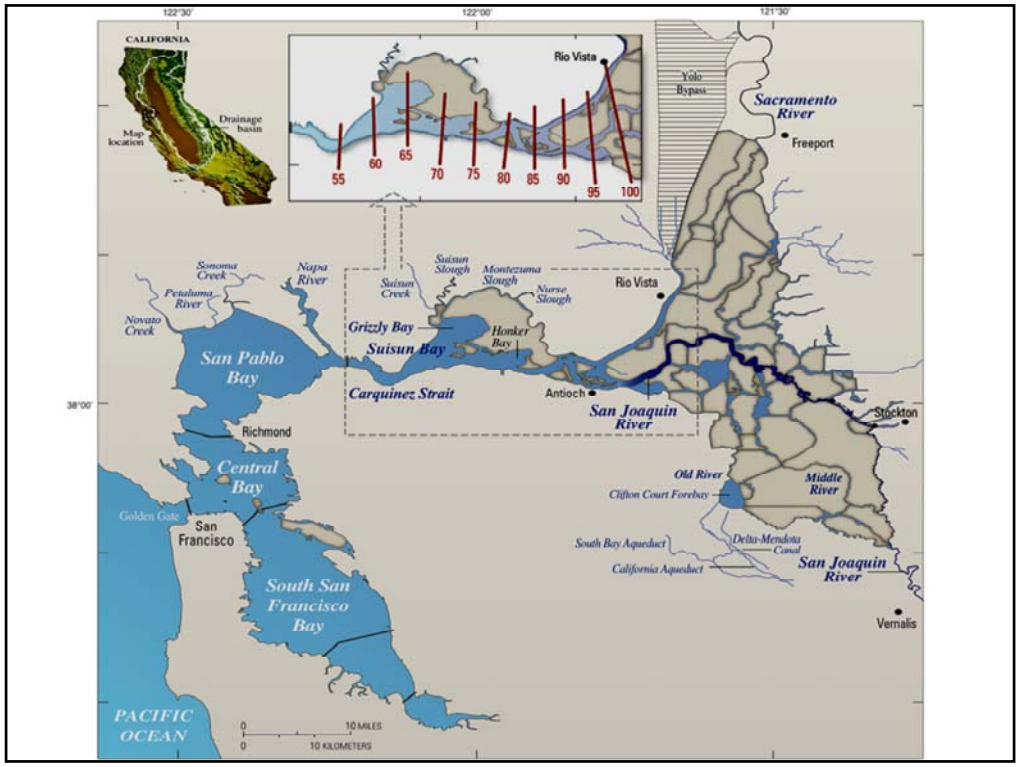
No Water No Jobs No Future

EPA's Key Concerns on CA Water Fix

- NEPA document convoluted/impenetrable.
- Poorly constructed *range of alternatives*.
- *Co-equal goals* not achieved – water supply security favored over ecosystem.
- Project baselines and assumptions chosen to favor project and downplay impacts.
- Existing WQS would be violated.
- Direct impacts on *waters* (775 acres), indirect impacts related to *opertations*.

Regulatory Framework for CA Water Fix

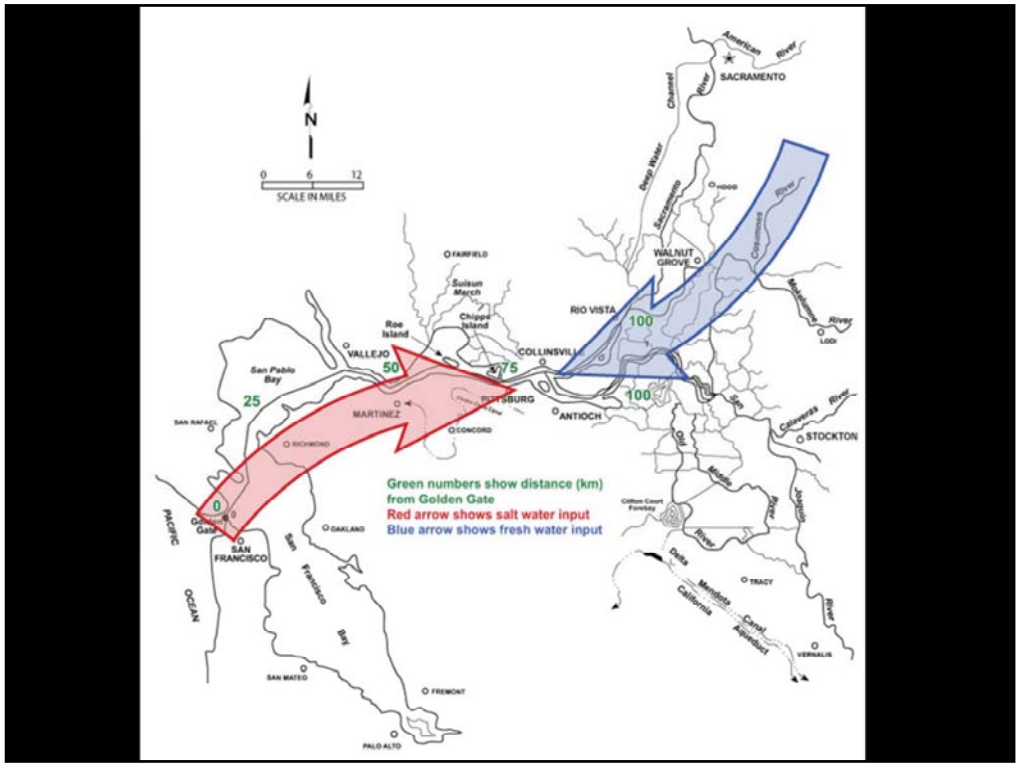
- SWRCB WaterRights, WQ Cert. (303/401)
- SWRCB Bay Delta WQCP (EPA approval)
- Corps permits: levees/wetlands (408/404)
- FWS consultation: fish & wildlife (ESA).
- NMFS consultation: migratory fish (ESA).
- CDFW fish & wildlife (State ESA).
- DSC consistency determination (DPA).



Graphic Art by:

Jeanne Sandra DiLeo
Physical Science Illustrator
USGS - 345 Middlefield Road, MS951
Menlo Park, CA 94025

Voice 650 329-4431
Fax 650 329-5051

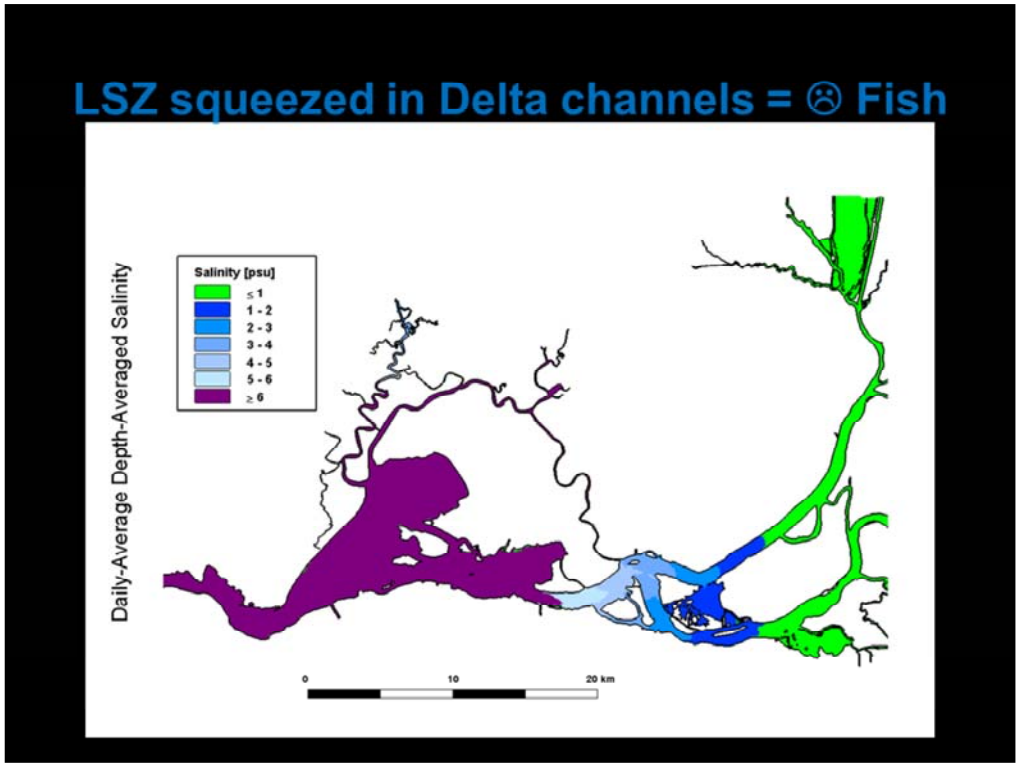


http://archive.deltacouncil.ca.gov/delta_science_program/publications/sci_news_0911_brain.html

Like all estuaries, the Bay-Delta is a place where freshwater mixes with saltwater. Where this transition from freshwater to saltwater takes place and how it changes through time is hypothesized as an important factor in aquatic ecosystem health. One measure of this freshwater-saltwater transition is a location in the estuary called X2. ("X" refers to distance. The number "2" refers to the amount of dissolved salts in the water in parts per thousand.) This is the location in the Bay-Delta where the tidally averaged bottom salinity is 2 parts per thousand. It is expressed as the distance in kilometers (km) from the Golden Gate Bridge.

The location of the freshwater-saltwater interface (X2) along the upstream-downstream axis of the estuary shifts with the seasons and from year to year depending on the amount of precipitation and Delta outflow (the amount of freshwater flowing from the Delta into Suisun Bay and then San Francisco Bay). Higher Delta outflow pushes saltwater further towards the Bay, lower Delta outflow allows the freshwater-saltwater interface to move upstream into the Delta.

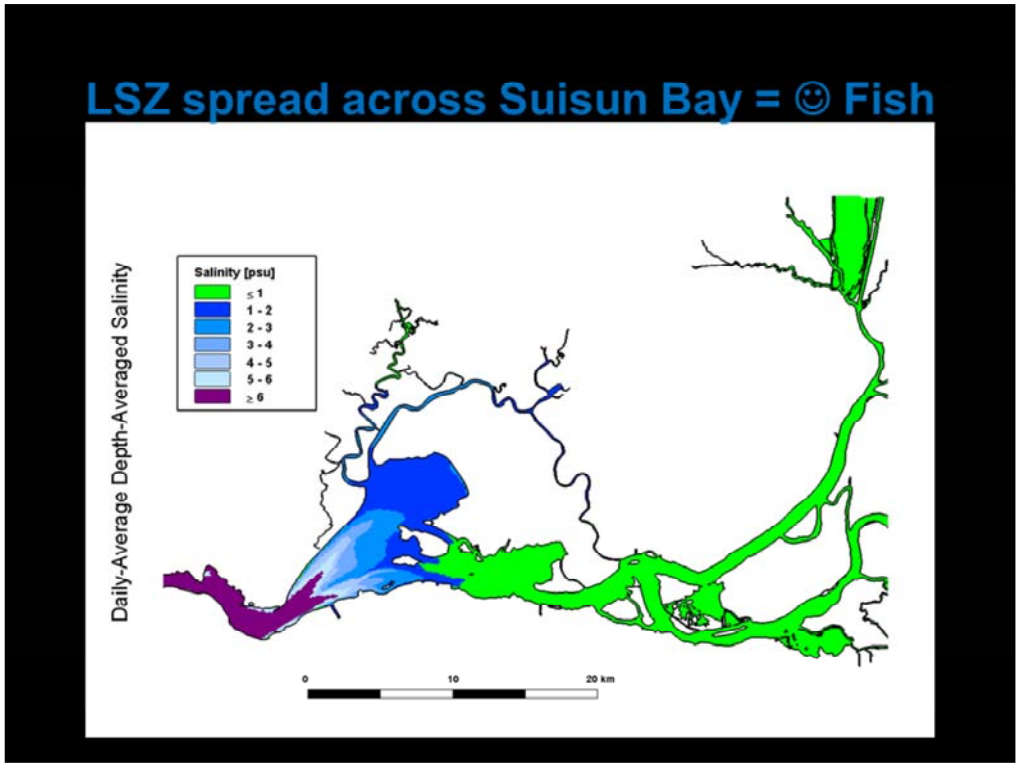
The following map shows where various values of X2 are located relative to Bay-Delta geographic features.



When X2 = 85 km, the isohaline approaches Antioch and all connections to Suisun Bay and Marsh are lost. A relatively high salinity zone moves into Suisun, Grizzly, and Honker bays; and the areal extent of estuarine habitat drops to 4262 hectares. For years, under the current regulatory regime, the X2 position has been maintained at 85 km during the fall season, and these environmentally-unfavorable salinity conditions have prevailed.

Historical Fresh Water and Salinity Conditions in the Western Sacramento-San Joaquin Delta and Suisun Bay

http://www.swrcb.ca.gov/waterrights/water_issues/programs/bay_delta/deltaflow/docs/exhibits/swrcb/swrcb_ccwd2010.pdf



When X2 = 65 km below Roe Island, the low salinity zone (in shades of blue from 1-6 psu or ppt) stretches across the broadest regions of Suisun Bay adjacent to Suisun Marsh and covers 7704 hectares.

We're waiting…