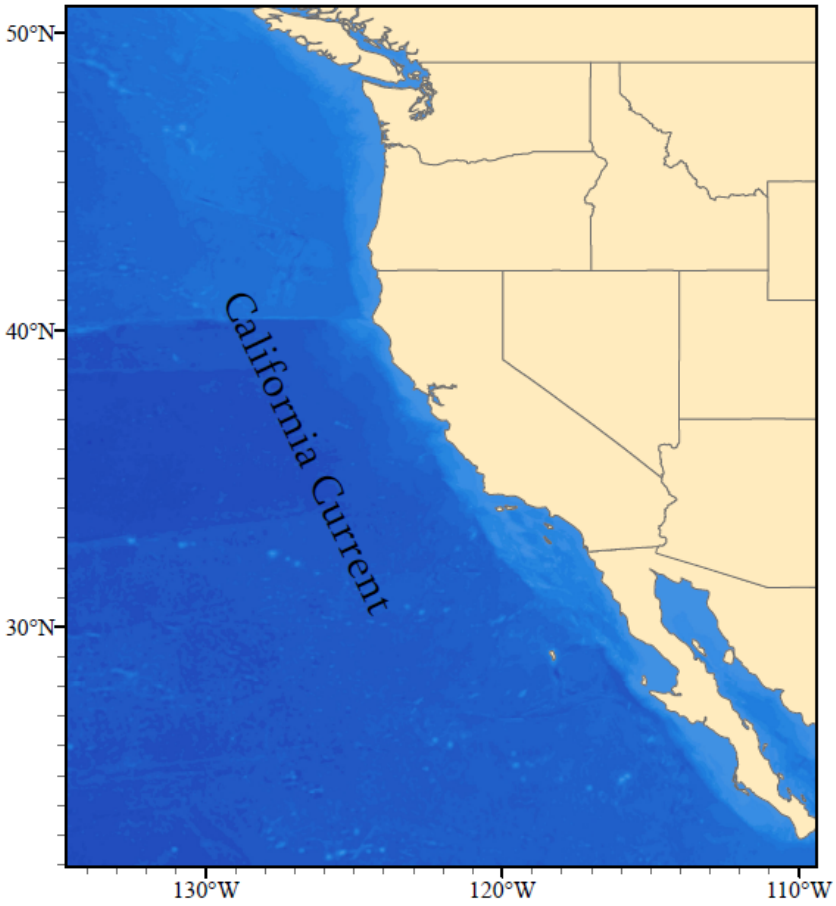
Climatic and Ecological Conditions in the California Current LME for Month to Month Year

Summary of climate and ecosystem conditions for Quarter 1, 2012 (January to March) for public distribution, compiled by PaCOOS coordinator Rosa Runcie (email: Rosa.Runcie@noaa.gov).
Full content can be found after the Executive Summary. Previous summaries of climate and ecosystem conditions in the California Current can be found at http://pacoos.org/



CLIMATE CONDITIONS IN BRIEF

- **El Niño Southern Oscillation (ENSO):** La Niña is expected to transition to ENSO-neutral conditions by the end of April 2012.
- **The Oceanic Niño Index (ONI):** The ONI continues to be negative through the winter of 2012. The La Niña conditions that have prevailed for the past year and a half and are expected to be La Niña neutral by the end of April 2012.
- **Pacific Decadal Oscillation (PDO):** The PDO continues to be negative, however it has been weakening since last fall.
- **Upwelling Index (UI):** The UI at 45°N for the January to March 2012 period was negative indicating downwelling with values similar to the long term mean (climatology). North of 33°N the upwelling index anomaly tended to positive values in January and February and negative values in March. Near average upwelling index values where computed for the first quarter south of 33°N.

- **Water Temperature and Salinity at Newport Hydrographic Line, Oregon:** Sea Surface Temperature and deep water temperatures on the shelf were among the coldest values since the first collected records in 1997.
- **Trinidad Head Line, California Observations:** Observations along the Trinidad Head Line show evidence of mild upwelling in late 2011 leading into a dry winter marked by limited freshening of coastal surface waters, a brief period of upwelling in February and March, and the subsequent effects of downwelling and freshwater run-off associated with late-arriving storms early spring 2012.
- **Winter 2012 CalCOFI Observations:** Hydrographic properties within the study domain were typical of winter conditions; mixed layer temperatures ranged from 13 °C in the north to 15 °C in the southern oligotrophic areas. The California Current was located well offshore, flowing southeast. Coastal and oceanic upwelling had enriched the surface waters in a large area off Pt. Conception. Concentrations of *Chl a* were low in most areas with high concentrations of nitrate. Anomalies of most properties in the mixed layer were neutral.

ECOSYSTEM CONDITIONS IN BRIEF

- **California Current Ecosystem Indicators:**
    1. **Copepods:** Copepod biodiversity (species richness): Copepod species values were slightly below average during January to March 2012 suggesting that northern species were dominating.
    2. **Salmon:** Up through April 3 only 30 Chinook salmon had been counted at Bonneville Dam, the first dam on the Columbia River. In a good year, several hundred to 1000s of adult Chinook salmon would have been counted. Does not mean that a poor run is expected (although this cannot be ruled out), as the run is not completed until approximately mid-June; the median number of adult Chinook pass the Dam by the end of April. Anadromous steelhead have been more abundant than the ten year averages.
- **Harmful Algal Blooms:**

  Oregon: In April multiple species *Dinophysis* including *D. acuminata* and *D. fortii* were seen in net tow samples collected along Clatsop Beach. No other harmful species have been recorded as of April. Diatoms including *Asterionellopsis spp.* and *Attheya spp*. remain common in surf zone sampling.

  California: Domoic acid was not detected in any shellfish samples during January. A low level of the paralytic shellfish poisoning toxins were detected in sentinel mussels from Santa Cruz Pier early January; these toxins were non-detectable in samples taken in late January. Domoic acid and paralytic shellfish poisoning toxins were not detected in any bivalve shellfish samples during the months of February and March.

PACIFIC COAST FISHERIES MANAGEMENT SUMMARIES IN BRIEF

- **Coastal Pelagics:**

  Market Squid: Commercial season opens April first.

  Pacific Sardine: About 1 /3 the first harvest guideline of 33,093 mt was landed in the first quarter.

  Northern Anchovy: 1,553 mt were landed in the first quarter, primarily in Monterey Bay area ports. Combined 1st qtr landings of coastal pelagic species was 14,055 mt.

  Commercial Market Squid: The commercial season that allows large landings using encircling reopened on April 16, 2012.

CLIMATE CONDITIONS

El Niño Southern Oscillation (ENSO):
Source: **http://www.cdc.noaa.gov/people/klaus.wolter/MEI/mei.html,**
http://www.cpc.noaa.gov/products/analysis_monitoring/enso_advisory/

A mature La Niña continued during January 2012, as below-average sea surface temperatures (SST) persisted across the equatorial Pacific Ocean. In February, La Niña weakened as near-to-above average sea surface temperatures emerged in the eastern equatorial Pacific Ocean. Equatorial SSTs remained at least 0.5°C below-average in the central Pacific, and above average in the eastern Pacific Ocean. La Niña continued to weaken during March, as below-average SSTs persisted primarily in the central Pacific.

Multivariate ENSO Index (MEI) values from 2009 to March 2012 are shown in Figure 2.

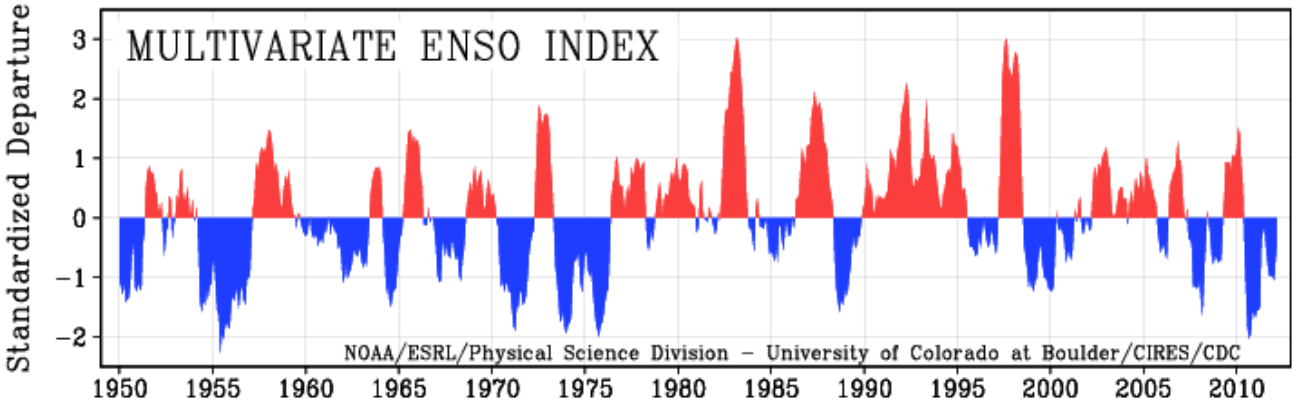


Figure 1. NOAA Physical Sciences Division attempts to monitor ENSO by basing the Multivariate ENSO Index (MEI) on the six main observed variables over the Pacific. These six variables are: sea-level pressure, zonal and meridional components of the surface wind, sea surface temperature, surface air temperature, and total cloudiness fraction of the sky.

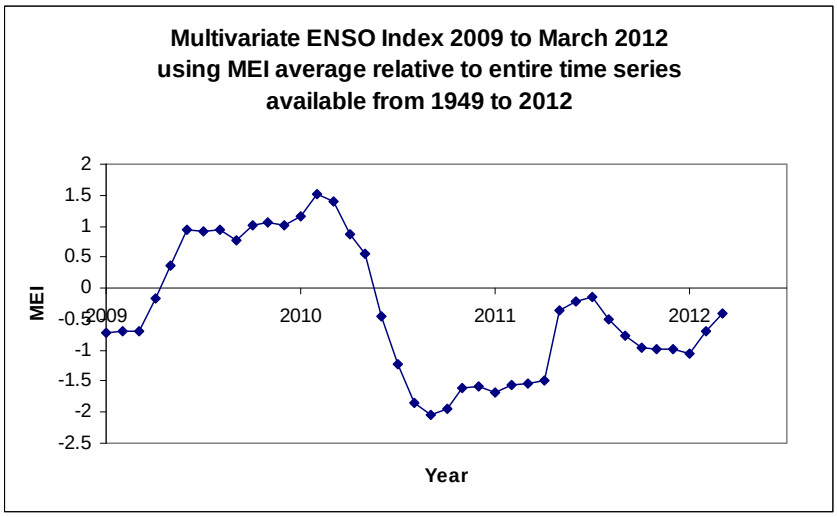


Figure 2. Multivariate ENSO Index from 2009 to March 2012. Mean used from bimonthly MEI values from the entire MEI Index time series, starting with December2008/January2009 thru February2012/March2012 (http://www.esrl.noaa.gov/psd/enso/mei/table.html).

Central & Eastern Equatorial Pacific Upper-Ocean (0-300 m) Heat Content Anomalies:
Source: The Coast Watch **http://coastwatch.pfel.noaa.gov/elnino.html**
http://www.cpc.noaa.gov/products/analysis_monitoring/enso_advisory/ensodisc.doc
Positive subsurface anomalies were evident from March-July 2011. Negative anomalies developed in late July 2011. Since January 2012, the negative anomalies have weakened considerably and have returned to near average.

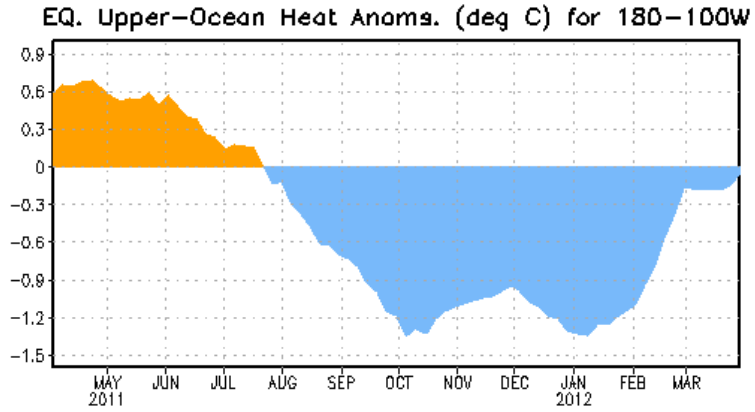


Figure 3. Area-averaged upper-ocean heat content anomalies (°C) in the equatorial Pacific (5°N-5°S, 180°-100°W). Heat content anomalies are computed as departures from the 1982-2004 base period pentad means.

PDO, ONI and SST at NOAA Buoy 46050. Newport OR:
Source: Bill Peterson, NOAA, NMFS
As 2012 begins to unfold, all signs are that ocean conditions will be among the best observed in recent years. The Pacific Decadal Oscillation (PDO) is still strongly negative (last fall, in November, saw one of the lowest PDO values since 1900). Equally important is that the Oceanic Niño Index (ONI) is also negative suggesting that La Niña will continue in equatorial waters. Both indices continue to track each other closely. This is generally viewed as a favorable sign for "good ocean conditions" for at least the next few months. Sea surface temperatures (SST) at the NOAA buoy offshore of Newport had negative anomalies from November 2011 until present, another good sign that good ocean conditions should prevail into the spring. Climatologists expect La Niña-neutral conditions by the end of April.

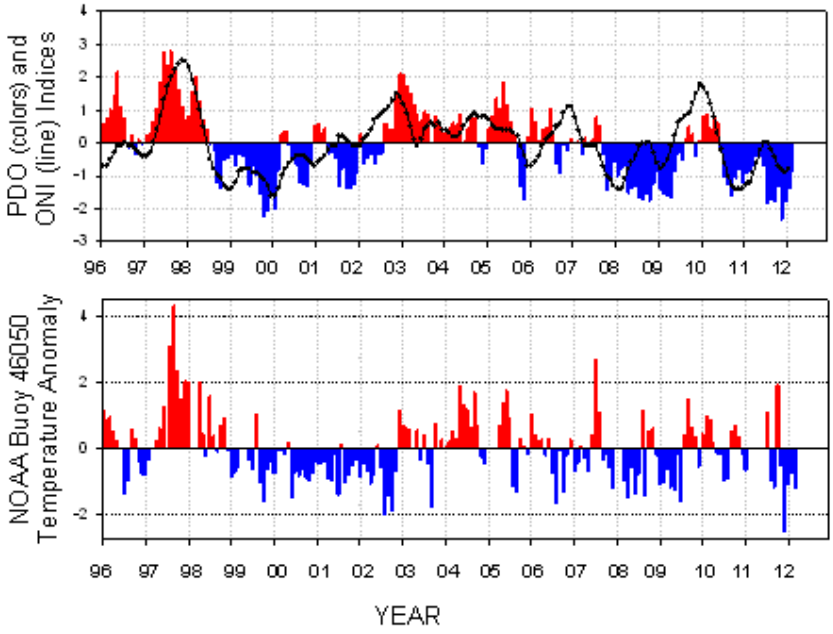


Figure 4. Time series of the PDO and ONI (upper panel) since 1996 and time series of SST (lower panel) measured at NOAA Buoy 46050 which is approx 22 miles due west of Newport Oregon. Note that both the PDO and ONI have had negative values since mid 2010 (indicating good ocean conditions); SST did not track this closely (but note that the buoy was out-of-service for several months in early 2011. The negative SST anomalies seen in late 2011-2012 were similar to those observed during other extended negative PDO periods, e.g., 1999-02 and 2008-09.

Upwelling Index:

Source: Pacific Fisheries Environmental Laboratory **http://www.pfeg.noaa.gov/products/PFEL/*, monthly surface pressure maps:*** **http://www.pfeg.noaa.gov/products/PFEL/modeled/pressure_maps/pressure_maps.html*, monthly IU values:*** **http://www.pfeg.noaa.gov/products/PFEL/modeled/indices/upwelling/NA/data_download.html**

Upwelling indices (UI) for December 2011 through March 2012 have similar variability with latitude. In December, UIs were negative, indicating movement of surface water toward the coast or downwelling, north of 45°N. During January, February and March the UI was negative north of 39°N and positive to the south. The similarity of the four consecutive months is not typical, as can be seen on the UI anomaly graph (right). December was highly anomalous in a positive sense. When the UI anomaly value near 100 at 45°N and 48°N for December is compared to the UI value (left) an average UI of about -100 is indicated. The December UIs were anomalously high from 33°N to 51°N. January and February UIs were also anomalously high over much of their range, but not as high as in December. Typically March will not have UI variability over latitude that is similar to the winter months. This shown in the anomaly plots where March UI anomaly is negative from 36°N to 54°N., with extremes of -61 and -59 computed for 42°N and 45°N, respectively. South of 36°N UIs are positive with small anomalies during the December – March period. Positive UI is associated with high atmospheric pressure systems in the temperate eastern Pacific. Low pressure systems from the Gulf of Alaska appeared blocked from the coast during December 2012 and parts of January and February. During March the low pressure in the Gulf of Alaska intensified and the high pressure moved offshore allowing Pacific storms associated with the low pressure systems to move farther south along the California coast.

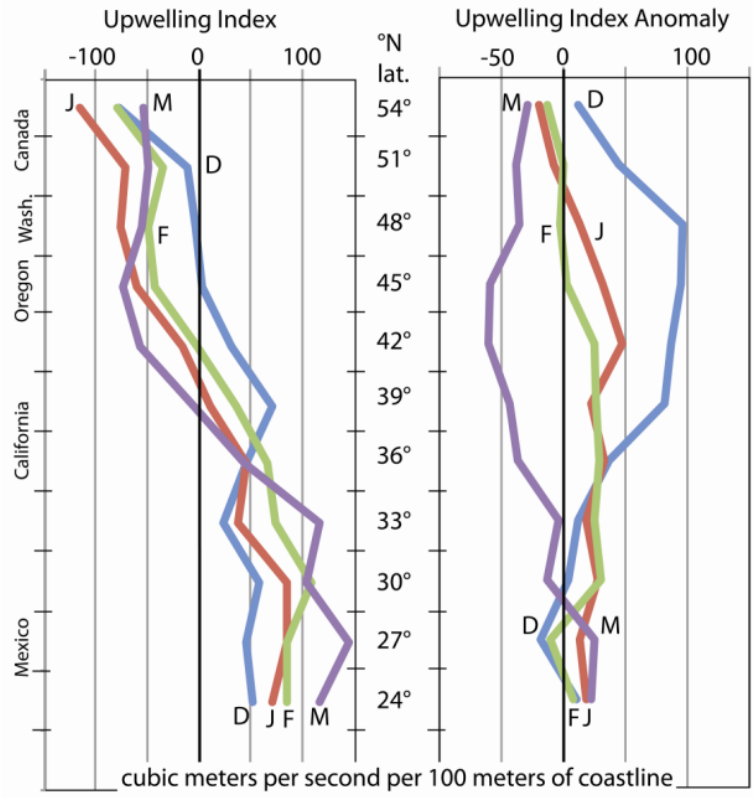


Figure 5. The variation of upwelling index (left) and upwelling index anomaly (right) with latitude is shown for December 2011 (blue) and January (red), February (green) and March (violet) 2012. Graphs are in cubic meters per second per 100 meters of coastline (top). These monthly upwelling indices (UIs) are computed from pressure gradients of monthly mean pressure fields and give a measured tendency of the atmosphere to force coastal ocean upwelling. Monthly UI and UI anomaly values are shown for each three degrees of latitude from 28°N to 54°N (center).

Coastal Upwelling at 45°N:

Source: Bill Peterson, NOAA, NMFS

The winter of 2012 has been particularly stormy in the Pacific Northwest, with a near record snowfall at Newport in February (6.5"). This value is the 10th highest amount of snow since records were first kept in 1930. There were two other measurable snowfalls in Newport which might be a record for the number of snowstorms in a single winter. In terms of upwelling, The PFEL daily upwelling index (Figure 6) shows that strong downwelling characterized January-March. The first three months of 2012 is similar to climatology (and similar to the winters of 2010 and 2011). In contract the winters of 2007-2009 were relatively quiescent. There was drought over much of California until March when high atmospheric pressure conditions that were directing storms to the north moved offshore.

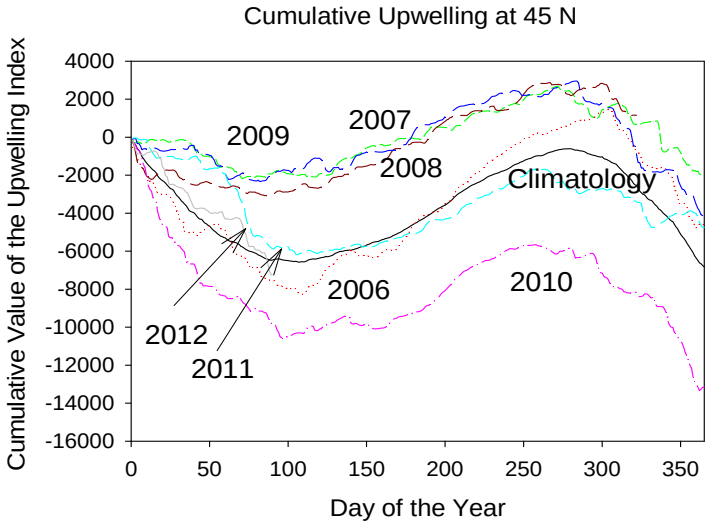


Figure 6. Cumulative upwelling values for 45°N, from the PFEL website. Note that the winter of 2012 is to date, similar to climatology.

Regional Oceanic Conditions:

Source: El Niño Watch, Advisory **http://coastwatch.pfel.noaa.gov/cgi-bin/elnino.cgi**

There was general cooling during the first quarter, as would be expected for winter and early spring. Negative SST anomalies observed in December 2011 weakened then intensified again in March, particularly along the coast as the 9°-12°C isotherms shifted about 300 km southward along the coast of the US. Negative SST anomalies were wide spread from the Southern California Bight to the Gulf of Alaska.

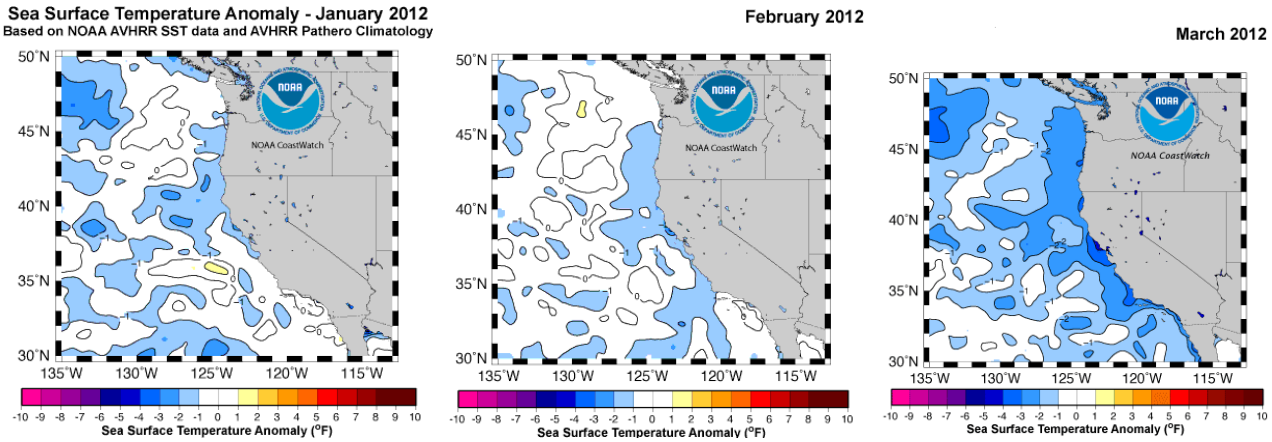


Figure 7. Regional oceanic conditions in the California Current Region.

Water Temperature and Salinity along the Newport Hydrographic Line, OR in Winter 2012:
Source: Bill Peterson, NOAA, NMFS

The deep waters of the inner-middle shelf during the winter of the year 2012 were the second coldest since our first records in 1998, the coldest winter was in 2008. Salinity was near the median value (~32.95). These data indicate chiefly that the winter months of 2012 were cold, not only with respect to SST, but for the entire water column.

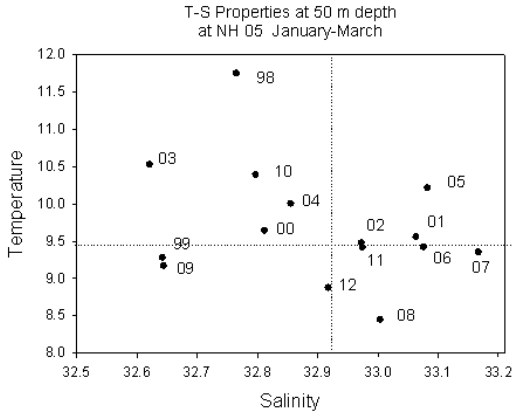


Figure 8. Temperature and salinity measured at a depth of 50 m at a baseline station off Newport, OR (Station NH 05) located 9 km west of Newport. Data reported here are for the winter months of January through March.

Observations along the Trinidad Head Line (41° 03.5' N):
Source: Eric Bjorkstedt (NMFS/HSU), Jeff Abell (HSU)

Recent observations along the Trinidad Head Line show evidence of mild upwelling in late 2011 leading into a dry winter marked by limited freshening of coastal surface waters, a brief period of upwelling in February and March, and the subsequent effects of downwelling and freshwater run-off associated with late-arriving storms early spring 2012. Phytoplankton concentrations have remained relatively low in early 2012, and so far the shelf waters off Trinidad Head appear to be less productive than has been observed in the early months of recent years.

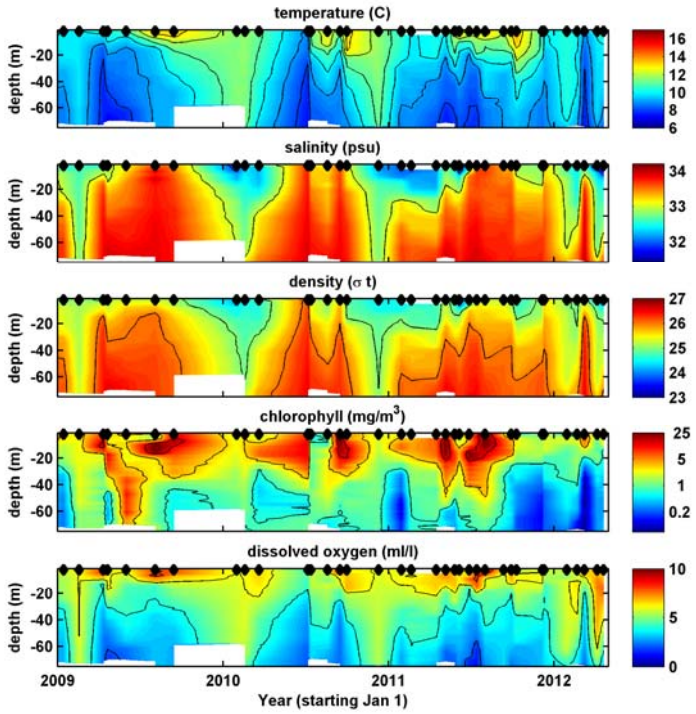


Figure 9. Hovmoller plots (time by depth) of temperature, salinity, fluorescence (converted to chl a concentration per instrument settings), and dissolved oxygen at station TH02 (41° 03.5' N, 124° 16' W, approximately 7 nm offshore, 75m depth at mid-shelf) along the Trinidad Head Line. Small diamonds along top of each plot indicate timing of each cruise; missing diamonds on the chlorophyll (fluorescence) plot indicate lack of data for two cruises in summer 2011 (14 July and 12 September). Interpolations between widely spaced points should be interpreted with greater caution. Collection of the most recent data has been supported by NOAA/NMFS and the California Ocean Protection Council.

Winter 2012 Observations by the SIO CalCOFI group:

Source: Ralf Goericke, SIO

The winter of 2012 CalCOFI cruise was carried out from Jan 30 until Feb 14th. Hydrographic properties within the study domain were typical of winter conditions; mixed layer temperatures ranged from 13 °C in the north to 15 °C in the southern oligotrophic areas (CalCOFI Fig. 10A). The California Current was located well offshore, flowing southeast. Coastal and oceanic upwelling had enriched the surface waters with plant nutrients (c.f. nitrate, CalCOFI Fig. 10C) in a large area off Pt. Conception. The spring bloom had not yet set in, as concentrations of Chl a (CalCOFI Fig. 10D) were low in most areas with high concentrations of nitrate. Anomalies of most properties in the mixed layer were neutral. Domain averages of hydrographic and biological properties were very similar to values observed since 2000. Unusual observations were only made at the bottom of the Santa Barbara basin, where concentrations of nitrate were severely depleted and concentrations of nitrite were unusually high. A pattern that was observed only once before, in 2005.

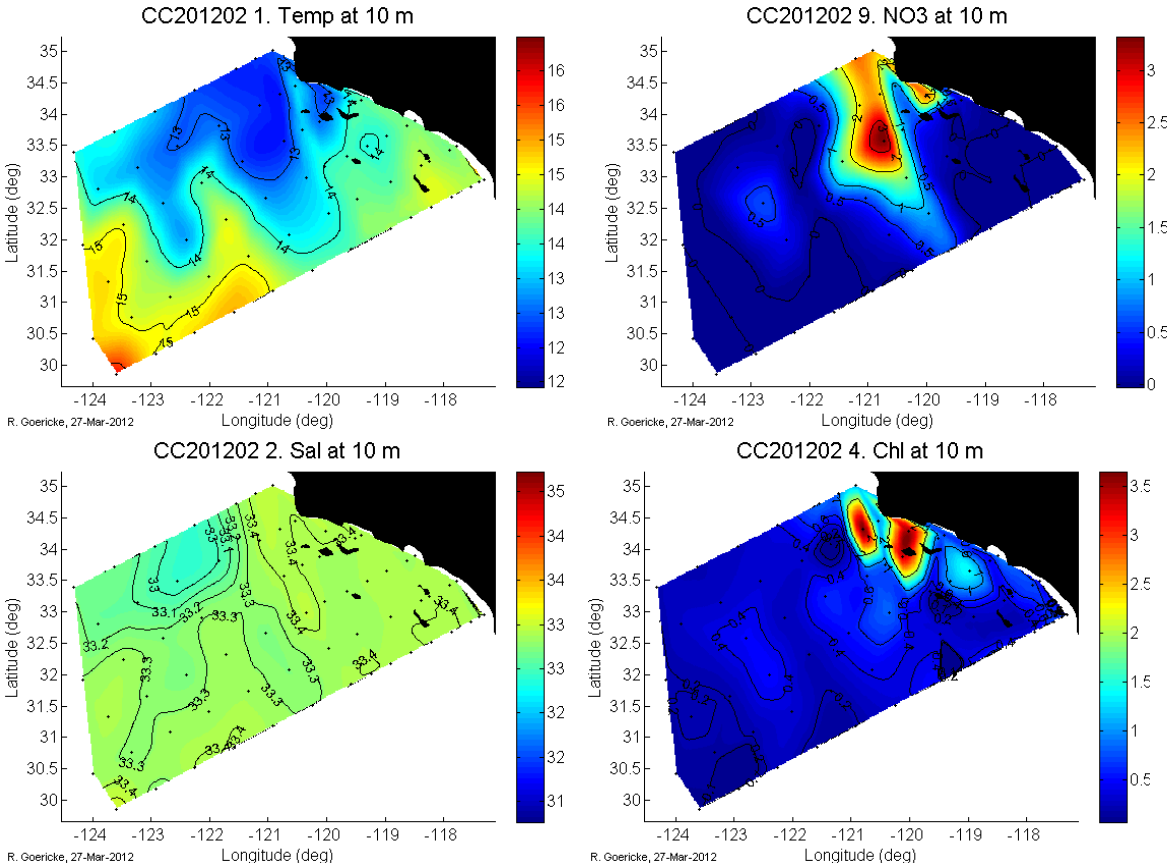


Figure 10. Hydrographic properties at a depth of 10 m off Southern California in Feb. 2012. Plotted are temperature (**A**, °C), salinity (**B**) and concentrations of nitrate (**C**, µM) and Chlorophyll a (**D**, µg/L).

ECOSYSTEMS

California Current Ecosystem Indicators:

Copepod Biodiversity (Species Richness):

Source: Bill Peterson, NOAA, NMFS

Copepod species richness tracks closely the PDO and ONI such that when either index is negative, the copepod community is dominated by only a few sub-arctic species; conversely when either is positive, SSTs are warm and the copepod community is dominated by warm-water subtropical species. The only exception to this "rule" came in autumn/early winter 2006-07 where the ONI was positive but the PDO was negative (and species richness had negative anomalies). Species richness values have had negative anomalies throughout much of 2011 and into 2012 with the exception of Oct-Dec 2011 when a greater than average number of species were found. This corresponds to the warm SSTs observed in the fall of 2011.

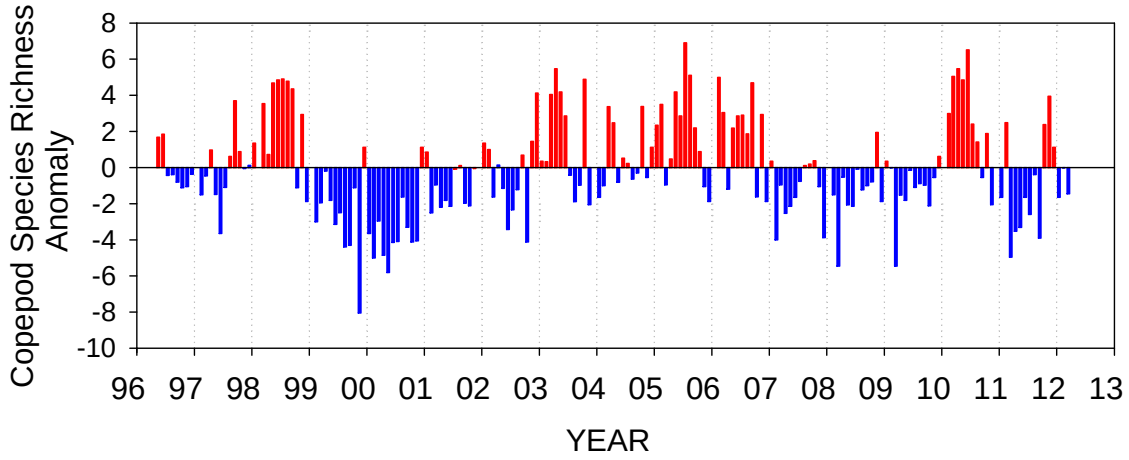


Figure 11. Time series of copepod biodiversity from 1996-present, taken from Newport Hydrographic (NH) line, Oregon. The winter of 2012 is showing to date that species richness values are below normal (note that Feb 12 had an anomaly of – 0.01 thus cannot be seen on the plot above). Negative anomalies are expected when the PDO is negative and the SST has cold anomalies.

Salmon:

Salmon Returns to the Columbia River:

Source: Bill Peterson, NOAA, NMFS

Spring Chinook salmon begin to return to the Columbia River in March. To date, only 30 adults have been counted at Bonneville Dam, the second lowest on record (since 1937). The lowest value was 24 fish in 1949, and the highest number counted through 3 April was in 2001, when 24,910 fish had been counted at Bonneville. See http://www.cbr.washington.edu/dart/adult.html if interested in tracking the daily counts of salmon.

Harmful Algal Blooms:

This section provides a summary of two toxin-producing phytoplankton species *Pseudo-nitzschia* and *Alexandrium* activity. *Alexandrium* is the dinoflagellate that produces a toxin called paralytic shellfish poisoning (PSP), and *Pseudo-nitzschia* is the diatom that produces domoic acid.

Washington HAB Summary

Washington's Olympic Region Harmful Algal Bloom (ORHAB) partnership monitors nine regular sites along Washington's outer coast for the presence of harmful phytoplankton species weekly. No first quarter 2012 summary was available at the time of this report. Please view the site http://ww4.doh.wa.gov/gis/mogifs/biotoxin.htm for the most current status.

Oregon HAB Summary

Source: Oregon Department of Fish and Wildlife http://www.dfw.state.or.us/MRP/shellfish/razorclams/plankton.asp

Source: Zach Forster, Oregon Department of Fish and Wildlife

Oregon's "Monitoring Oregon's Coastal Harmful Algae (MOCHA) project" samples ten sites along the coast of Oregon for the presence of harmful algae. These sites include three along Clatsop Beach, one on Cannon Beach, two on the central coast and four sites on the south coast. In April multiple species *Dinophysis* including *D. acuminata* and *D. fortii* were seen in net tow samples collected along Clatsop Beach. No other harmful species have been recorded as of April. Diatoms including *Asterionellopsis spp.* and *Attheya spp*. remain common in surf zone sampling.

California HAB Summary

Domoic Acid Update: In January, *Pseudo-nitzschia* was common at several sites along the Santa Barbara coast but cell mass was relatively low and not indicative of bloom conditions. *Pseudo-nitzschia* was absent in a sample from Anacapa Island. Domoic acid was not been detected in any shellfish samples during January. Domoic acid was not detected in any bivalve shellfish samples during the months of February and March.

Paralytic Shellfish Poisoning (PSP) Update: *Alexandrium* was observed at a number of sites during December and January. Elevated levels of PSP toxins were detected in sentinel mussels from Drakes Estero earlier in January. Toxin levels steadily declined and remained below the alert level during the last two weeks in January. A low level of the PSP toxins was also detected in sentinel mussels from Santa Cruz Pier in early January; these toxins were non-detectable in samples taken in late January. PSP toxins were not detected in any bivalve shellfish samples during the months of February and March.

PACIFIC COAST FISHERIES MANAGEMENT SUMMARIES AND RECOMMENDATIONS

Coastal Pelagics:

First Quarter 2012 Summary, CA Pacific mackerel and Pacific sardine fisheries: On November 4, 2011 the Pacific Fisheries Management Council adopted a coastwide harvest guideline (HG) of 109,409 mt for the 2012 Pacific sardine fishery. A Tribal Set Aside of up to 9,000 mt and an Exempted Fishing Permit (EFP) set aside of 3,000 mt provides at least 97,409 mt for the non-tribal general fishery which is allocated seasonally as follows:

Coastwide HG = 109,409 mt Tribal set aside = 9,000 mt EFP set aside = 3,000 mt Adjusted HG = 97,409 mt				
	Period 1	Period 2	Period 3	Total
	Jan 1 - June 30	July 1 - Sept 14	Sept 15 - Dec 31	
Seasonal Allocation (mt)	34,093	38,964	24,352	97,409
Incidental Set Aside (mt)	1,000	1,000	1,000	3,000
Adjusted Allocation (mt)	33,093	37,964	23,352	94,409

After a fast start to the 2012 Pacific sardine season, landings slowed in early March and remained stagnant. By the end of March 2012 the CA fleet had caught 32% of the coastwide allocation of 33,093 mt.

2012	PACIFIC MACKEREL (mt)			PACIFIC SARDINE (mt)		
	No. Cal	So. CA	TOTAL	No. Cal	So. CA	TOTAL
January	112	199	311	3,259	5,378	8,637
February	0	47	47	393	1,247	1,640
March	0	3	3	0	222	222
TOTAL	112	249	362	3,652	6,847	10,499

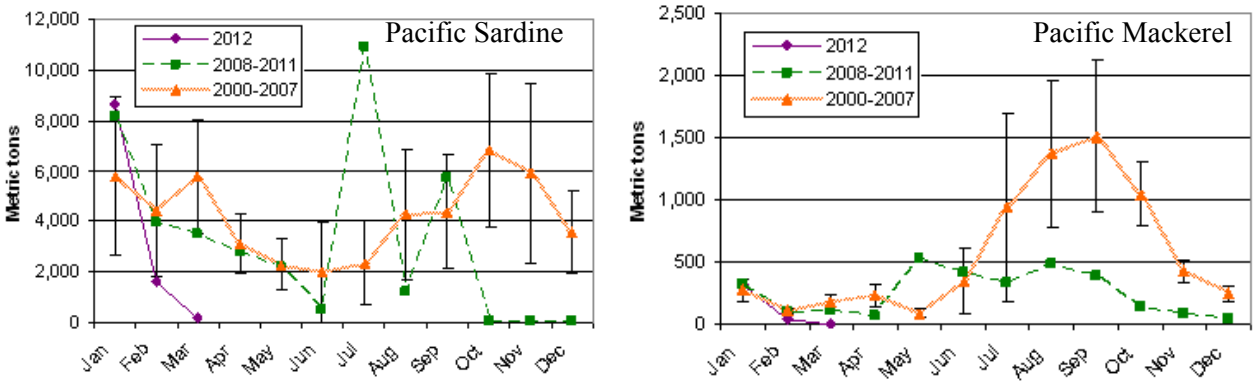


Figure 12. Comparisons of average landings by month for Pacific sardine (left graph) and Pacific mackerel (right graph).

Northern Anchovy: 1,553 mt were landed in the first quarter, primarily in Monterey Bay area ports. Combined 1st qtr landings of coastal pelagic species was 14,055 mt.

Commercial Market Squid: Commercial market squid (*Doryteuthis opalescens*) fishing was closed in mid-November when the California catch exceeded 107 metric tons. The commercial season that allows large landings using encircling reopened on April 16, 2012. Market squid have remained available to commercial fishers using lights to attract the squid and brails to dip-net loads less than 1.8 metric tons, allowing a steady supply for bait.

Jumbo Squid: There have been few verified reports of jumbo squid (*Dosidius gigas*) off the west coast of the U.S. over the last 20 months. Jumbo squid are not associated with prolonged periods of negative PDO index.