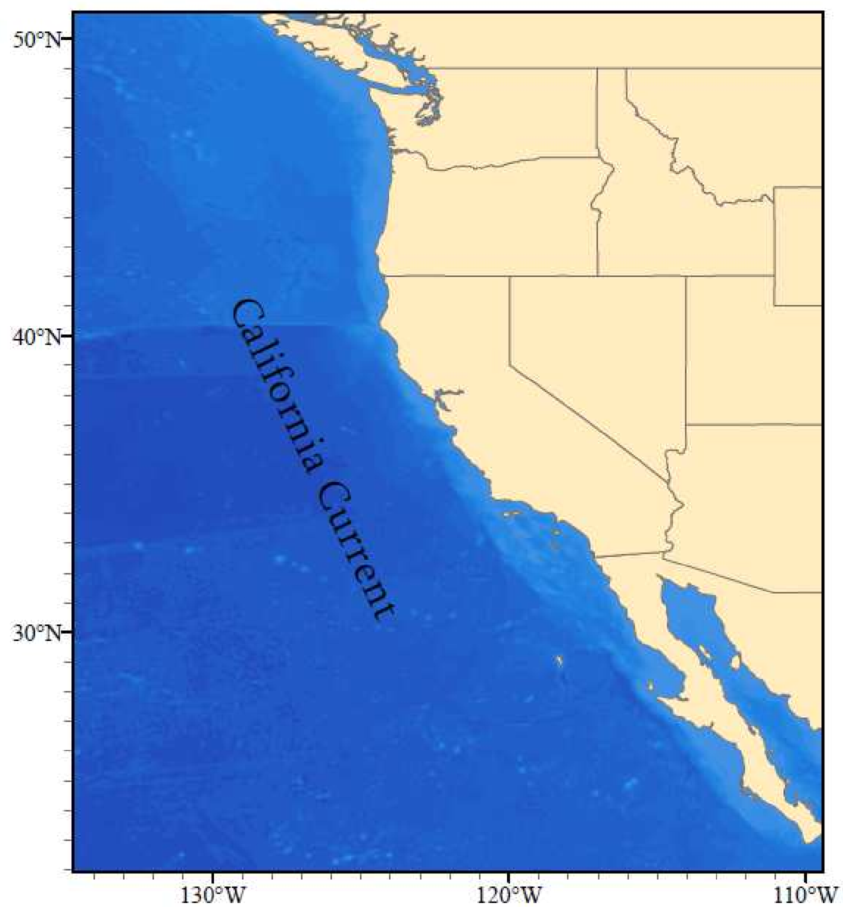
January to March 2013
Volume 6, Quarter 1

Climatic and Ecological Conditions in the California Current LME for January to March 2013

Summary of climate and ecosystem conditions for Quarter 1, 2013 (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):** ENSO indices continue to be negative through the winter of 2013, thus apart from a brief period of weak-El Niño conditions in 2012, the El Niño that was forecasted did not materialize.
- **Pacific Decadal Oscillation (PDO):** The PDO continues to be negative. Although weakened last fall, values over the last few months have become increasingly negative.
- **Upwelling Index (UI):** In the Pacific Northwest, downwelling was weak during the period January-March 2013 and there were no strong winter storms, similar to the winters of 2007-2009. Coastal upwelling was initiated on 1 April, two weeks earlier than climatology, also similar to 2007-2009. Ocean conditions in early 2013 off northern California reflect the effects of a relatively dry winter marked by unusually consistent, extended periods of upwelling favorable winds, and relatively infrequent storms of short duration.
- **Bottom Water Temperature and Salinity in Shelf Waters:** Off Newport, Oregon, Deep water temperatures on the shelf in winter 2013 were the saltiest and the second coldest since our first

records in 1997. Hydrographic conditions over the shelf off Trinidad, California were colder and saltier than in the previous year.

ECOSYSTEM CONDITIONS IN BRIEF

- **California Current Ecosystem Indicators:**
  1. **Phytoplankton:** Off Trinidad, California phytoplankton appear to be responding positively, which suggests a more robust start of production than in the previous year. Trends in chlorophyll concentration are consistent with modest blooms encountered during winter cruises in early 2013. Similar observations have been made off Newport, Oregon.
  2. **Northern and Southern Copepod Biomass Anomalies:** Biomass of northern copepod species was above average (and biomass of southern species was below average) during January-March of 2013. Although northern species dominated, there were small numbers of southern species which persisted through the winter months such that monthly values of species richness (biodiversity) were above average.
  3. **Salmon:** The spring chinook salmon run entering the Columbia and Willamette Rivers is stronger, at this time, than last year and weaker than the ten-year average.
- **Marine Mammals:**

  Emaciated California sea lion pups stranded on southern California coast on the winter of 2013. No obvious oceanographic cause. With no clear understanding of the process causing the stranding and mortality, an Unusual Mortality Event (UME) was declared. Subsequently, the number of stranded pups has declined and conditions have improved. However, collaborative work between biologists, oceanographers and fisheries scientists is continuing to improve the understanding between oceanography and sea lion prey.

PACIFIC COAST FISHERIES MANAGEMENT SUMMARIES IN BRIEF

- **Coastal Pelagics:**

  Pacific Sardine: Landings of CPS in CA for the first quarter of 2013 were minimal. Due to a lack of availability and poor weather conditions, statewide landings at the end of March were only 135 mt.

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/

From September to December 2012, the Pacific Ocean exhibited borderline ENSO-neutral/weak El Niño conditions. During December, equatorial SST anomalies were positive in the western Pacific Ocean, near zero in the central Pacific Ocean, and slightly negative in much of the eastern Pacific Ocean. January to March 2013 exhibited ENSO-neutral conditions, although below-average sea surface temperatures prevailed across the eastern half of the equatorial Pacific.

Multivariate ENSO Index (MEI) values from 2007 to March 2013 are shown in Figure 2.

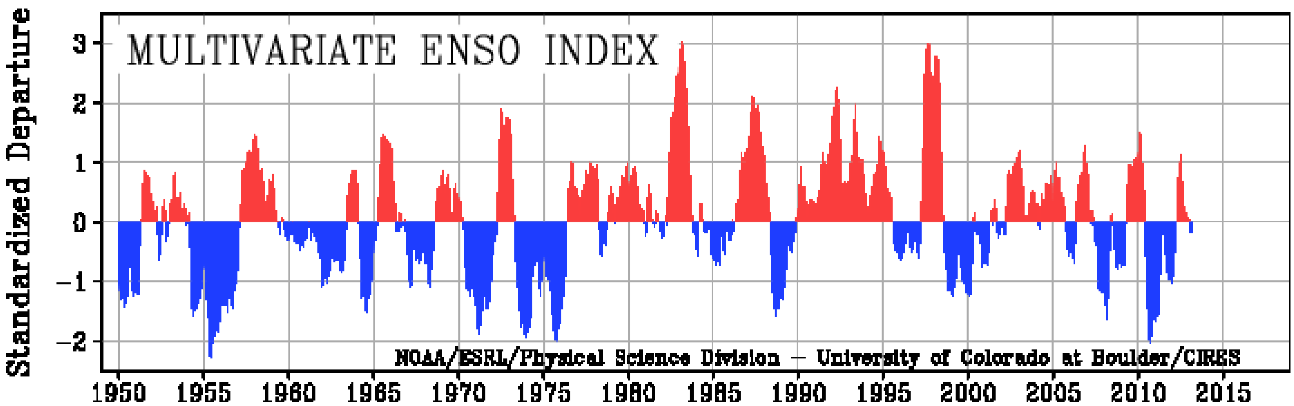


Figure 1. NOAA Physical Sciences Division monitors ENSO by basing the Multivariate ENSO Index (MEI) on the six main observed variables over the Pacific. These six variables are: sea-level pressure, zonal and meridional components of the surface wind, sea surface temperature, surface air temperature,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

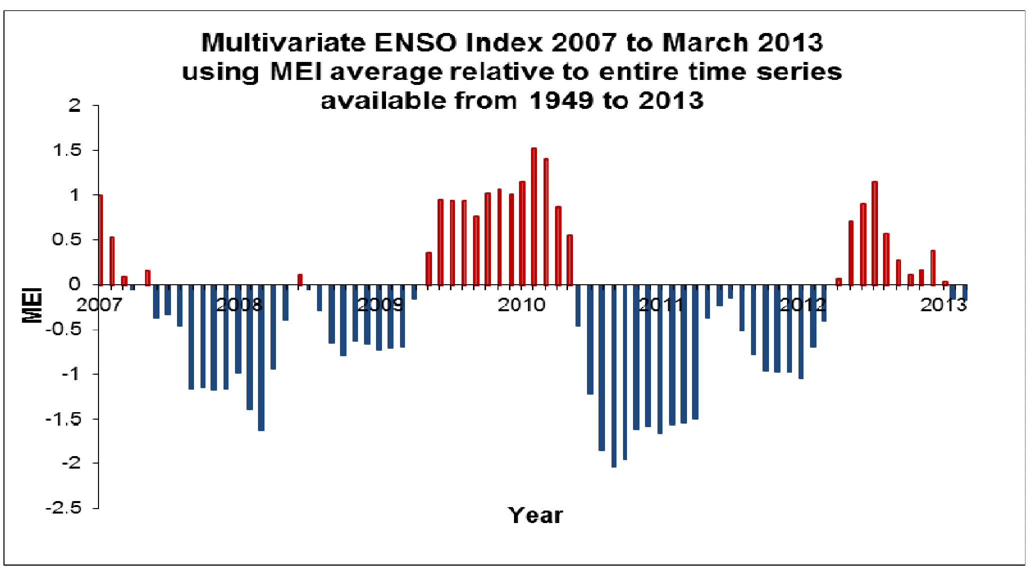


Figure 2. Multivariate ENSO Index from 2009 to March 2013. Mean used from bimonthly MEI values from the entire MEI Index time series, starting with December2006/January2007 thru February2013/March2013 (http://www.esrl.noaa.gov/psd/enso/mei/table.html).

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
Subsurface temperatures were above-average from April-November 2012, and below average during December 2012-early March 2013. Subsurface anomalies are now near zero.

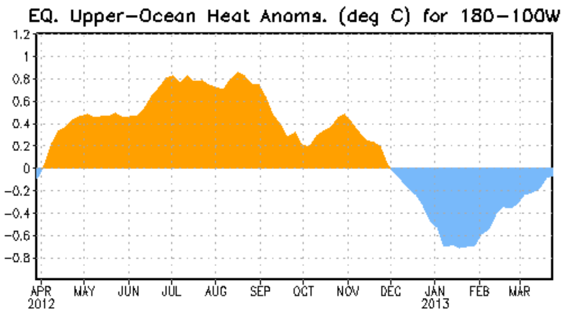


Figure 3. Area-averaged upper-ocean heat content anomalies (°C) in the equatorial Pacific (5°N-5°S, 180°-100°W). Heat content anomalies are computed as departures from the 1981-2010 base period pentad means.

PDO, ONI and SST at NOAA Buoy 46050, Newport OR:
Source: Bill Peterson, NOAA, NMFS
As 2013 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 summer, July and August, saw some of the lowest PDO values since the 1950s). Equally important is that the Oceanic Niño Index (ONI), although moving into positive territory in summer of 2012, is now negative again, suggesting that La Niña conditions are continuing in equatorial waters. Both the PDO and ONI continue to track each other closely. Since both are negative, 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 during much of 2012 and those anomalies continue through Jan-Mar 2013 (not shown).

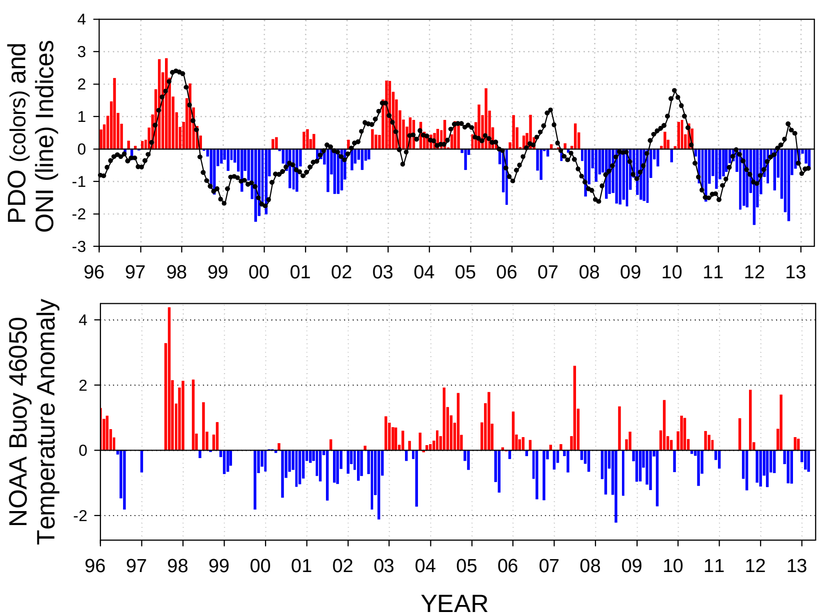


Figure 4. Time series of the PDO and ONI (upper panel) since 1996 and time series of SST measured at NOAA Buoy 46050 (located approximately 22 miles due west of Newport Oregon). Note that the PDO has had negative values since mid-2010 (indicating good ocean conditions); SST did not track this closely in 2012 (but note that the buoy was out-of-service for several months in early 2011) but winter 2013 is showing negative anomalies that average -0.52°C below climatology.

Upwelling Index:
Source: Jerrold Norton, NOAA, ERD, SWFSC (Jerrold.G.Norton@noaa.gov)
***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, http://www.pfeg.noaa.gov/products/PFEL/modeled/indices/upwelling/upwelling.html**

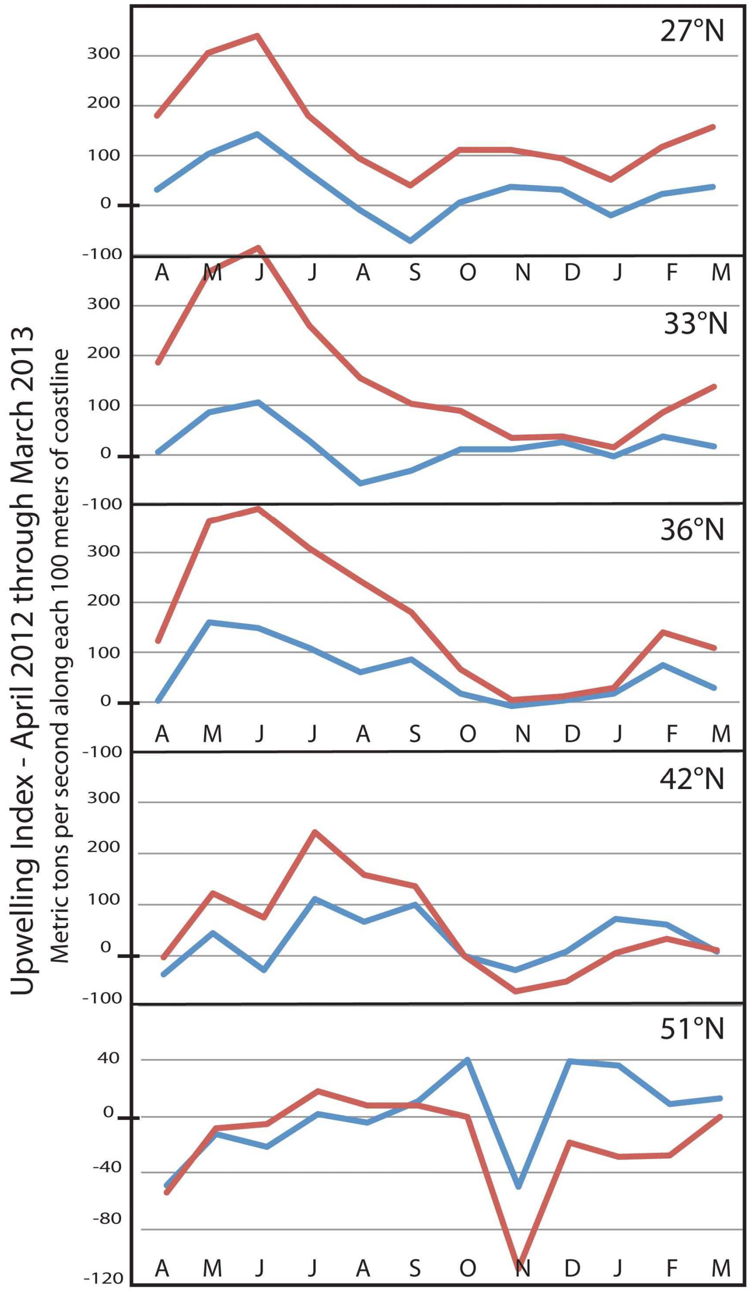


Figure 5. Time series graphs of the ERD / SWFSC upwelling index (UI) computed from monthly mean pressure fields. Values are given for each month from April 2012 through March 2013. The computation points from the top are: 27°N, Baja California, Mexico; 33°N, Southern California Bight; 36°N, Central California; 42°N, Northern California Border; and 51°N, Canada. The red lines give the monthly UI and the blue lines give the UI anomaly to the same scale. The anomaly is from comparison to 1948-1967 mean values. All graphs, except the bottom one (51°N), are on the same scale (-100 to 400).

At 27°N, UI and UI anomaly have been positive in every month, except January, since November 2012. Positive UI values are typical throughout the year at the 27°N location and to a lesser extent at the 33°N and 36°N locations, where the UI and anomaly was positive in February and March 2013. At 42°N the UI and UI anomaly were positive in February. Alternating upwelling and downwelling conditions produced low monthly mean UI values from October and November through March from 33°N to 42°N. Positive UI values are most common during the summer and fall at 51°N. UI anomaly values were greater than UI values from November through February at 42°N and 51°N, indicating less northward wind and downwelling than during the mean 1946 – 1976 period.

Coastal Upwelling at 45° N
Source: Bill Peterson, NOAA, NMFS
The winter of 2013 (January-March) has been relatively quiescent, and resembled ocean conditions during recent winters (2007-2009). Upwelling was initiated on 1 April thus this dates marks the "spring transition". This date is about two weeks earlier than climatology (13 April) for 45°N.

.

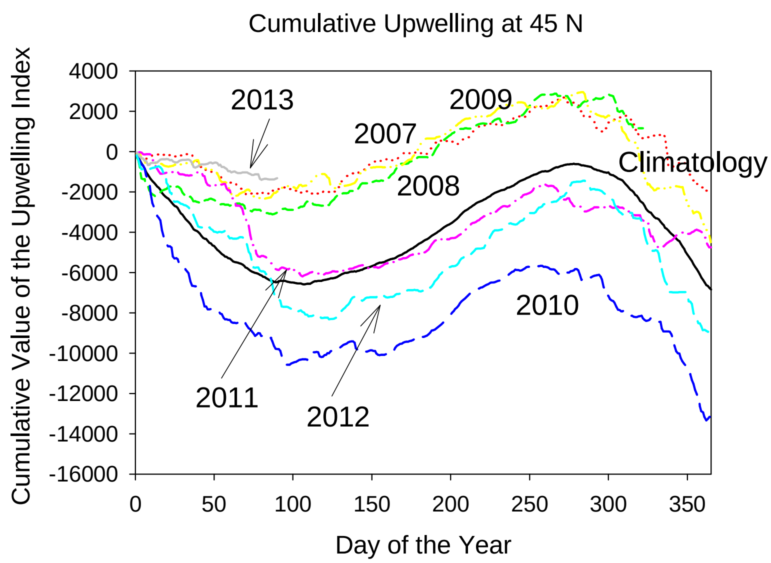


Figure 6. Cumulative upwelling values for 45°N, from the PFEL website. Note that the winter of 2013 is similar to the years 2007-2009 (and 2001, not illustrated). All other winters since 1998 had maximum cumulative values in winter ranging from -6000 to -12000.

Regional Oceanic Conditions from monthly mean AVHRR sea surface temperature:
Source: El Niño Watch, Advisory **http://coastwatch.pfel.noaa.gov/cgi-bin/elnino.cgi**
The positive coastal sea surface temperature (SST) anomalies of November and December 2012 dissipated through January 2013 and near average conditions occurred from 200 kilometer (km) to more than a 1000 km from the coast. Negative SST anomalies, less than -1.5°C, were common offshore east of 150°W and west of 140°W. A 50 – 100 km wide band of weak negative SST anomaly extended along the coast from Baja California to the northern California border. North of 43°N and east of 135°W, the isotherms were roughly parallel to latitude, while to the south the isotherms tended to lower latitude as they approached the coast. During January the 12°, 14° and 16°C isotherms were found at 39.3°, 35.6° and 34°N near 130°W and near 37.2°, 34° and 31°N at the coast. Trends in SST were generally negative in January and February. In February negative SST anomalies, to -1.5°C, spread off the west coast of the US and were similar in extent to the negative SST anomalies of March and April 2012. In February, the 8°, 10° and 12° isotherms shifted 100 to 300 km southward along the coast (cooling). The SST anomaly fields were similar in February and March, predominately negative off the coast of the US. These negative anomalies reached 300 to more than 1000 km seaward between 35°N and 45°N. Coastal anomalies less than -1.5°C were found from Point Conception to Cape Blanco. Offshore near 130°W, the 8°, 9° and 13°C isotherms withdrew to the north (warming) during March while the 10°, 11° and 12°C isotherms showed little movement and the 14°, 15° and 16°C isotherms shifted to the south (cooling). Near the coast, the 8°, 9° and 15° isotherms withdrew to the north in March, while the other isotherms remained near February positions. Negative SST anomalies typically extended southwest beyond the Hawaiian Islands and northwest into the Gulf Alaska during the first quarter. Persistent high atmospheric pressure and its anti-cyclonic circulation over the temperate eastern north Pacific was an important factor in surface ocean layer dynamics and SST evolution during 2013. These ocean

observations are based on smoothed AVHRR monthly mean SST maps found at the CoastWatch, West Coast Regional Node (http://coastwatch.pfel.noaa.gov/elnino.html). For SST anomalies, the AVHRR SST were compared to the Pathfinder + erosion (Pathero) climatology (1999).

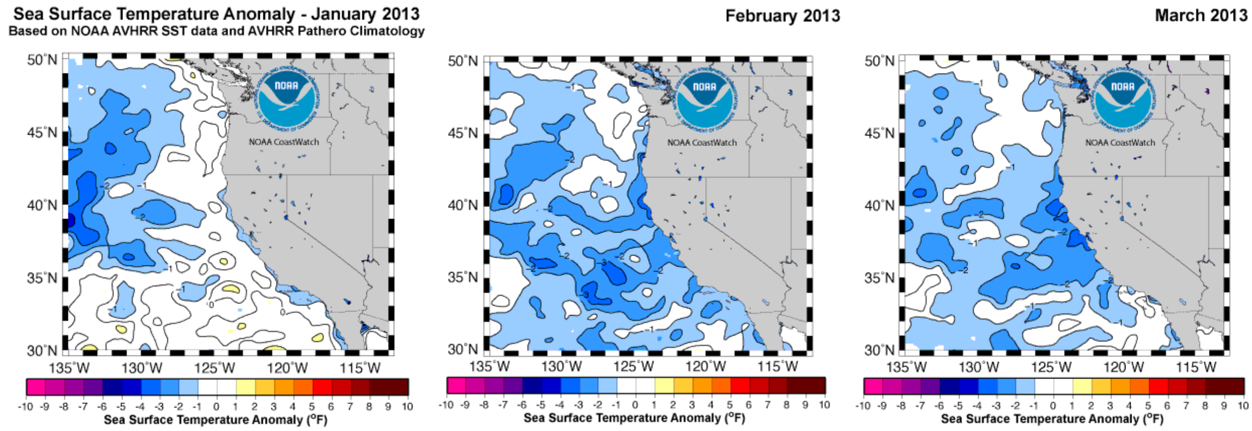


Figure 7. Regional oceanic conditions in the California Current Region.

Water Temperature and Salinity along the Newport Hydrographic Line, OR in winter 2013:

Source: Bill Peterson, NOAA, NMFS

The deep waters of the inner-middle shelf during the winter of the year 2013 were the second coldest since our first records in 1998. The coldest winter was in 2008. The saltiest water of the entire time series was observed in 2013. Cold and salty water is associated with coastal upwelling and in the case of 2013, winds were often from the north (or west) this winter as opposed to the “usual” southwesterly winds seen during most winters.

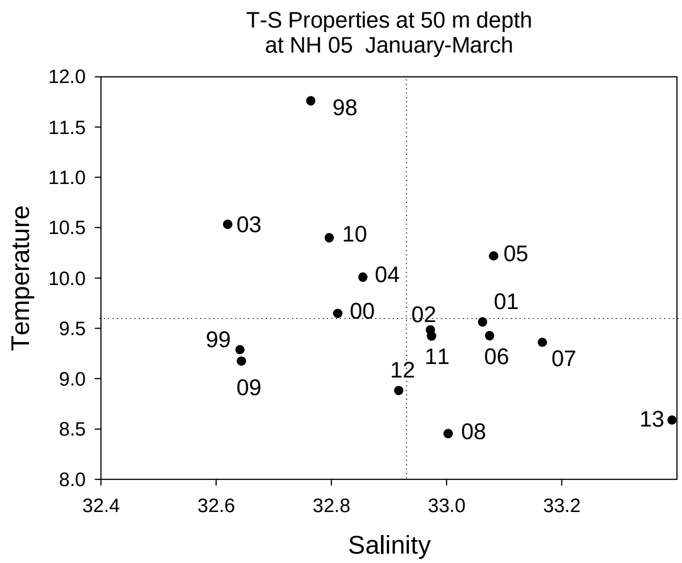


Figure 8. Temperature (T) and salinity (S) measured at a depth of 50 m at a baseline station off Newport OR (station NH 05) located 9 km west of Newport. Data reported here are for the winter months of January through March. The lines within in the graph indicate the median values of T and S.

Observations along the Trinidad Head Line (41° 03.5' N):

Source: Eric Bjorkstedt (NMFS/HSU), Jeff Abell (HSU)

In contrast to the stormy conditions observed in early 2012, ocean conditions in early 2013 off northern California (Trinidad Head Line) reflect the effects of a relatively dry winter marked by unusually consistent, extended periods of upwelling favorable winds, and relatively infrequent storms of short duration. Overall, conditions over the shelf (and further offshore; data not shown) are colder and saltier than in the previous year (Fig THL01, THL02). Phytoplankton appear to be responding positively (albeit from a low initial condition), which suggests a more robust start of production than in the previous year (Fig THL01). Trends in chlorophyll concentration are consistent with modest blooms encountered during winter cruises in early 2013.

Observation cruises in early 2013 were supported by NOAA/NMFS/SWFSC.

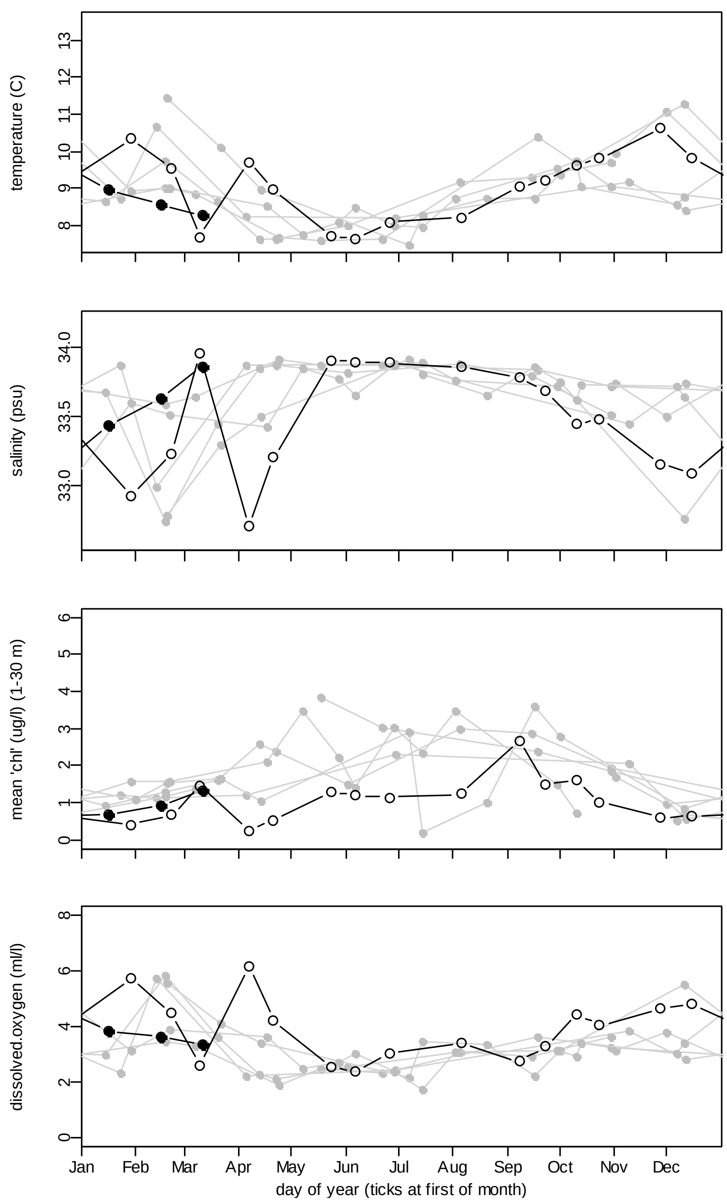


Figure 9. Ocean observations at station TH02 (approximately mid-shelf, 41° 03.5' N, 124° 16' W, 75m depth) along the Trinidad Head Line by calendar year. From top to bottom: temperature at 60 m, salinity at 60 m, mean 'chlorophyll' concentration (ug/l based on fluorometer) over the upper 30 m of the water column, and dissolved oxygen at 50 m. Dark lines indicate observations over 2012 (open black circles) and early 2013 (solid black circles); grey lines and symbols indicate observations over previous years (late 2006-2011).

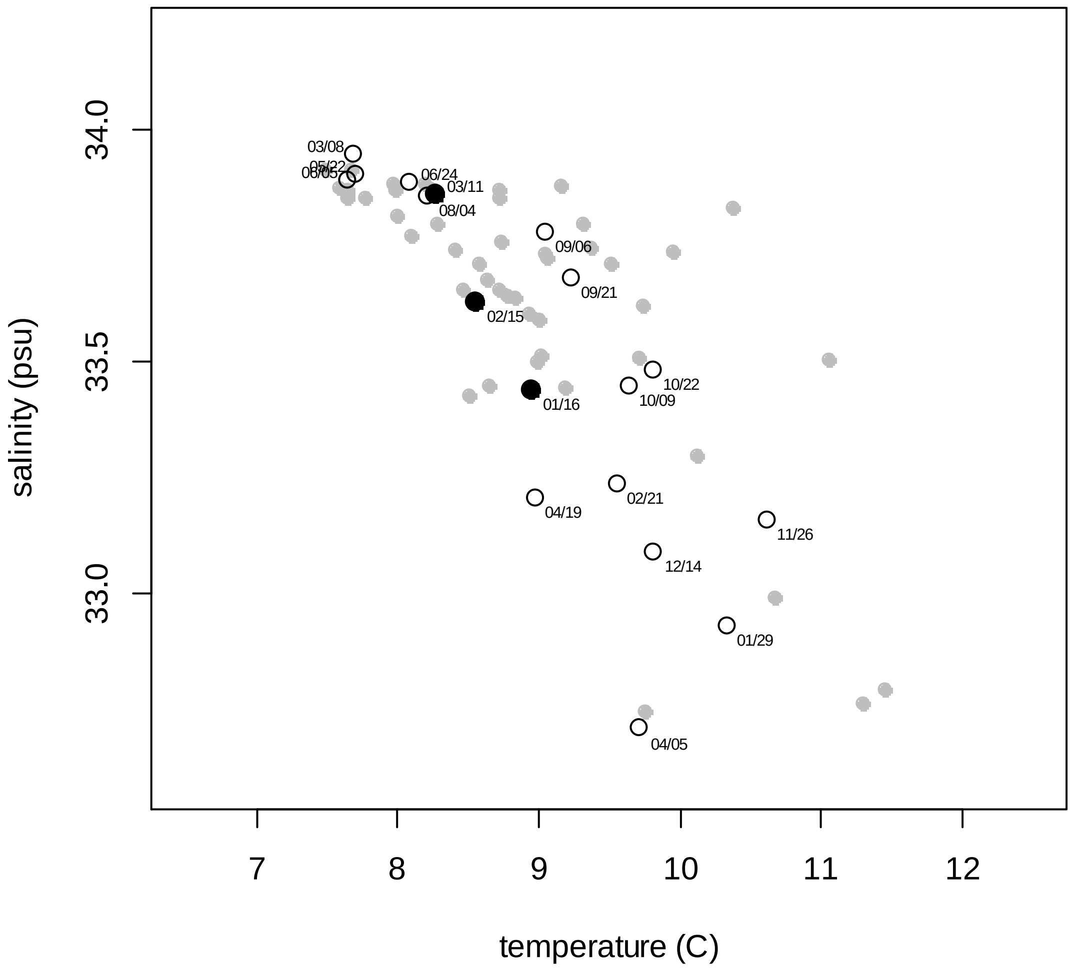


Figure 10. Temperature and salinity characteristics at 60 meters depth at station TH02 (approximately mid-shelf, 41° 03.5' N, 124° 16' W, 75m depth) along the Trinidad Head Line. Open black circles indicate observations during 2012, solid circles show observations from 2013, labeled by date. Grey circles indicate observations from previous years' cruises.

ECOSYSTEMS

California Current Ecosystem Indicators:

Copepod Biomass and Species Richness (Biodiversity):

Source: Bill Peterson, NOAA, NMFS

Biomass of northern copepod species was anomalously high during the winter of 2013, expected both because of negative values of the PDO *and* evidence of some upwelling, especially during February and March 2013. At the same time, the southern copepod species biomass was anomalously low suggesting that northward transport in the Davidson Current was anomalously weak in 2013.

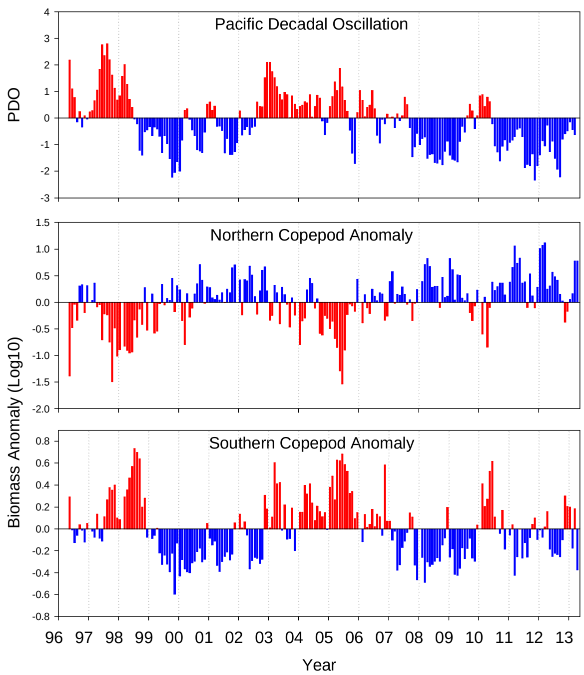


Figure 11. Time series of PDO and monthly-averaged copepod biomass anomalies for 'northern' and 'southern' species.

Species richness values had negative anomalies throughout much of 2011 and 2012, positive anomalies were seen for a few months in fall 2011 and fall 2012. These brief positive anomalies correspond with the warm SSTs observed in the fall of 2011 and 2012 as shown in the PDO-SST Figure; the anomalies in 2012 correspond with the positive values of the ONI. Positive species richness anomalies persisted into the winter of 2013suggesting a relationship between a weak PDO in fall 2012 and onshore transport of surface waters.

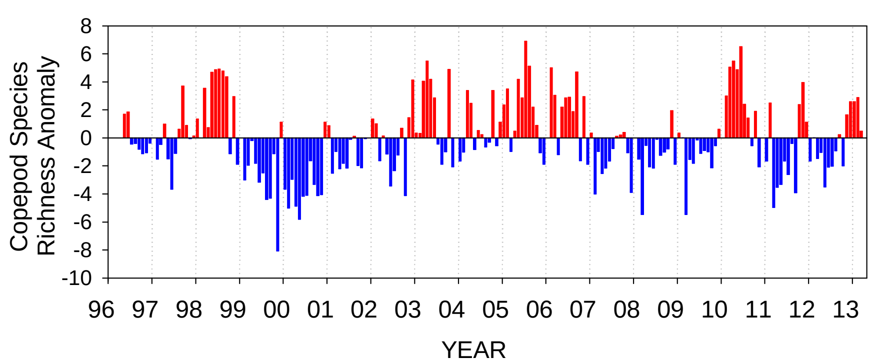


Figure 12. Time series of copepod biodiversity from 1996-present. The winter of 2013 is showing that species richness values are above normal, unexpected when the PDO is negative. Perhaps the relatively high species richness is linked to a weakening of the PDO in autumn 2012 and the positive values of the ONI.

West Coast Salmonids, First Quarter, 2013:

Source: Jerrold Norton, NOAA, ERD, SWFSC (Jerrold.G.Norton@noaa.gov)

Winter run steelhead are available for sportsmen fishing on Northern California, Oregon and Washington Rivers. Early accounts suggest that 2013 steelhead landings will be similar to landings and river returns of the last three years (2010 – 2012), which were all equal or better than returns in the four previous years (2006 – 2009). The spring chinook salmon run entering the Columbia and Willamette Rivers is stronger, at this time, than last year and weaker than the ten-year average. Spring chinook runs begin months later in the California Central Valley drainage.

Smaller, morphologically immature two-year old male salmon, called "jacks" often indicate the year class size of two-year old fish that will ascend to their natal streams and return to hatcheries in the following year. The estimated total count of California Central Valley non-hatchery (CVNH) or "natural area" fall chinook jacks was 39,788 in 2011, leading in 2012 to a fall run of 173,790 adult chinook. This was more than twice the average return of adult CVNH chinook (62,790) during the 2007 – 2011 period. However, the estimated number of jacks returning in 2012 was 20,365, about half the number of CVNH jacks returning in 2011. A similar situation was observed in Klamath Basin fall chinook runs. The estimated number of jacks returning to the Klamath in 2011 was 84,895. This was a record number of jacks leading to a record number of more than 300,000 returning adults, but the number of jacks returning to the Klamath basin in 2012 was estimated to be 21,474, about a quarter of the 2011 jack returns.

Smaller jack-run estimates for CVNH and Klamath chinook do not necessarily mean that the run of adults in the following year will be weak. The 21,182 jack count during 2000 lead to a 561,314 CVNH total the following year, which is the second largest CVNH run on record. In 2003, the Klamath jack estimate was 9,226 and the following year's run size was a better-than-average 191,949 adult fall chinook.

Marine Mammals:

Source: Jeff Laake, Sharon Melin, and Bob DeLong, AFSC, NOAA

Starting in January 2013, large numbers of California sea lion (*Zalophus californianus*) pups began stranding along the Southern California coast. Pups are born in May-June on the Channel Islands primarily on San Miguel and San Nicolas islands. The pups depend on their mother's milk until they are weaned at 10-11 months (April-May). Weights of pups on San Miguel Island in September 2012 and February 2013 were about 2/3 of the normal weights and were comparable to the weights during the strong 1997/98 El Niño. Pups left the rookery 3-4 months early in an emaciated state and many stranded.

We have observed similar stranding events during El Niño conditions when warm nutrient-poor ocean conditions replace the normal cold, nutrient-rich upwelling conditions. The low productivity in the ocean pushes sea lion prey farther north, farther offshore and deeper to areas where productivity is greater. Female sea lions take longer to forage when the prey is redistributed farther from the colony and less abundant and are often unable to provide enough milk for their pup; consequently, pup weights are lower and many pups die. Oceanographic processes other than an El Niño may cause the prey to be less available. In May of 2009, the normal coastal upwelling did not occur and 80% of the pups died by 3 months of age and pup weights were below normal in September 2009. This was a very short-lived event that was followed by El Niño conditions in the autumn.

Unlike previous large stranding events of California sea lions, there is no apparent environmental explanation for the stranding event in 2013. With no clear understanding of the process causing the stranding and mortality, NMFS declared an Unusual Mortality Event (UME) in March 2013 and initiated investigations into disease and environmental causes for the UME. Subsequently, the number of stranded pups has declined in southern California. However, collaborative research between sea lion biologists, oceanographers and fisheries scientists is continuing to improve our understanding between oceanography, sea lion prey availability and sea lion condition.

PACIFIC COAST FISHERIES MANAGEMENT SUMMARIES AND RECOMMENDATIONS

Coastal Pelagics:

First Quarter 2013 Summary, CA Pacific mackerel and Pacific sardine fisheries:

Monthly CPS landings tables can be found on the web at www.dfg.ca.gov/marine/cpshms/landings.asp.

On November 4, 2012 the Pacific Fisheries Management Council adopted a coastwide harvest guideline (HG) of 66,495 mt for the 2013 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 54,495 mt for the non-tribal general fishery which is allocated seasonally as follows:

Coastwide HG = 66,495 mt Tribal set aside = 9,000 mt EFP set aside = 3,000 mt Adjusted HG = 54,495 mt				
	Period 1	Period 2	Period 3	Total
	Jan 1 - June 30	July 1 - Sept 14	Sept 15 - Dec 31	
Seasonal Allocation (mt)	19,073	21,798	13,624	54,495
Incidental Set Aside (mt)	1,000	1,000	1,000	3,000
Adjusted Allocation (mt)	18,073	20,798	12,624	51,495

Landings of CPS in CA for the first quarter of 2013 were minimal. Due to a lack of availability and poor weather conditions, statewide landings at the end of March were only 135 mt.

2013	**PACIFIC MACKEREL (mt)**			**PACIFIC SARDINE (mt)**		
	No. Cal	So. CA	TOTAL	No. Cal	So. CA	TOTAL
January	0	<1	<1	84	43	127
February	0	2	2	<1	0	0
March	0	2	2	0	8	8
TOTAL	0	5	5	84	52	135