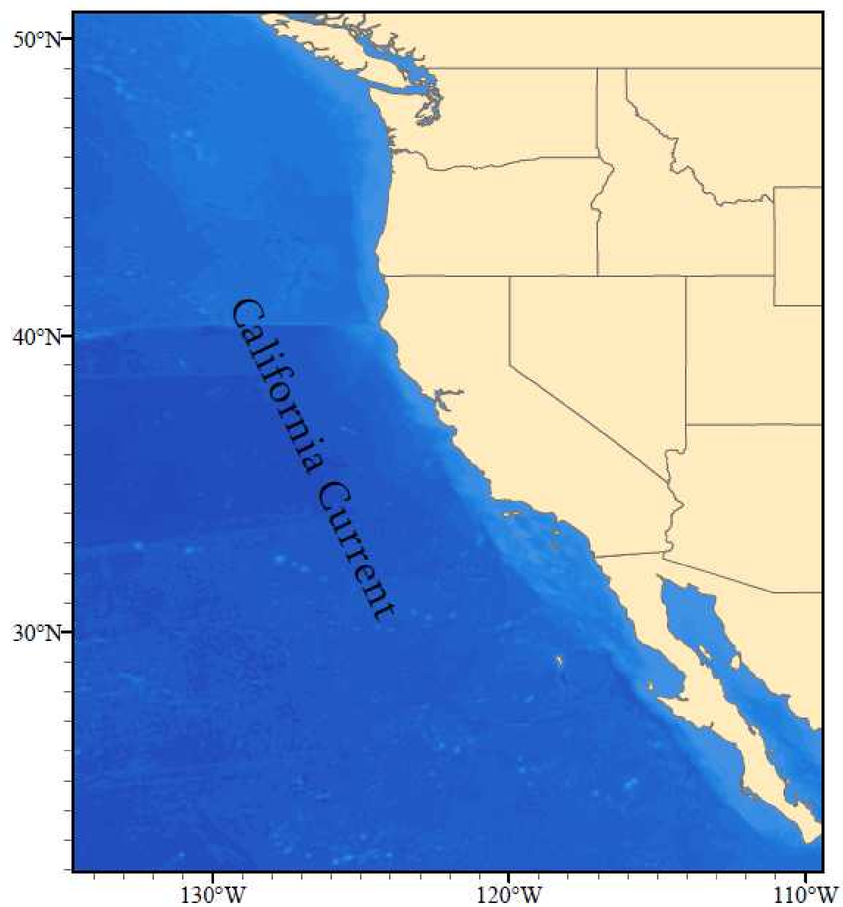
July-September 2012
Volume 5, Quarter 3

Climatic and Ecological Conditions in the California Current LME for July to September 2012

Summary of climate and ecosystem conditions for Quarter 3, 2012 (July to September) 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-neutral conditions continued during July and August 2012. September reflected borderline ENSO-neutral/weak El Niño conditions.
- **The Oceanic Niño Index (ONI):** The ONI continued to be weakly negative through May 2012 however in June, the ONI values became neutral (0.0), and remained in neutral conditions through the summer months.
- **Pacific Decadal Oscillation (PDO):** The PDO was weakly negative through spring 2012 but intensified in summer by August, extremely negative values were reached (-1.93).
- **Upwelling Index (UI):** The UI and UI anomalies were positive during the July – September quarter at 33°, 36° and 42°N. From 27°N to 36°N, UI values and UI anomalies were positive from May through August. At 45°N, the start of the upwelling season, as compared to climatology, was delayed about one month. It started on 3 May, but winds were weak and the season did not have robust expression until 6 July. The development of the third quarter UI at 51°N followed patterns similar to those observed at 42°N and 45°N, but the patterns were less robust.

- **Water Temperature and Salinity at Newport Hydrographic Line, Oregon:** The year began with colder-than-average deep waters over the inner-middle shelf. However, since upwelling was delayed and did not strengthen until early July, the deep waters (which ultimately upwell to the surface) had average temperatures (7.6°C vs. 7.75°C) and salinity (33.74 vs. 33.81 average).
- **Trinidad Head Line, California Observations:** Recent observations along the Trinidad Head Line suggest an upwelling system weakened by southerly wind and rain events that occurred intermittently through spring and into July. Phytoplankton concentrations appear to have remained relatively low during much of 2012. The copepod assemblage at station TH02 appears to have had relatively low densities of 'northern neritic' species well into spring 2012.
- **Spring 2012 CalCOFI Observations:** During the summer 2012 CalCOFI cruise, nitracline depth was found at a depth of 32 m, a value which is similar to the long-term average. Consistent with this observation, areas of active or recent upwelling were confined to small areas south of Point Conception. Nitrate concentrations measured were substantially lower than those that were observed in these upwelling areas during April. Surface layer Chl a, a proxy for phytoplankton biomass, was elevated in large areas off Point Conception. Oxygen at depth for the σ=26.4 isopycnal continues to decline and it appears as if this decline has accelerated over the last years.

ECOSYSTEM CONDITIONS IN BRIEF

- **California Current Ecosystem Indicators:**
  1. **<u>Copepods</u>:** The abundance (biomass) of northern copepod species was at a record high through the first half of 2012 but declined in June/July due to the delayed upwelling; however biomass became anomalously high in August and September.
  2. **<u>Salmon</u>:** Despite a slow start to the Spring Chinook salmon run passing by the Bonneville Dam on the Columbia River, the total number counted by the end of May (158,075) was a little above the 15 year average. Sockeye salmon, however, have been returning in record numbers. The 2012 sockeye salmon cumulative total of more than 500,000 fish has been phenomenal for the lower Columbia River; the fall run of Chinook salmon has begun and appears robust.

- **Harmful Algal Blooms:**

  <u>California</u>: In July, domoic acid was detected in southern California shellfish samples taken from Morro Bay and Santa Barbara. The elevated levels of domoic acid detected during July in Morrow Bay declined below the detection limit by the beginning of August. The high toxin levels in Santa Barbara shellfish decreased below the alert level by the beginning of August and were nondetectable by the third week.

  In northern California, low levels of domoic acid were detected the first week of August in shellfish from the Santa Cruz pier. Samples collected offshore of Ventura County in early September contained varying levels of domoic acid. Follow-up samples from the same region at the end of September were all below the alert level. Domoic acid was not detected in any northern California samples collected in September. Paralytic shellfish poisoning toxins were not detected in any shellfish samples collected from July to September.

PACIFIC COAST FISHERIES MANAGEMENT SUMMARIES IN BRIEF

- **<u>Coastal Pelagics:</u>**

  <u>Pacific Sardine</u>: Sardine landings in California remained low during the 2nd allocation due to a lack of availability of fish and the fleet's focus on an unusually high abundance of squid throughout the state. Landings in Washington and Oregon were strong and the directed fishery closed on August 23, 2012. The directed fishery re-opened on September 15, 2012, with an adjusted seasonal allocation of 30,000 mt. Landings remained low in California.

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/**

ENSO-neutral conditions continued during July and August 2012 despite above-average sea surface temperatures across the eastern Pacific Ocean. During September, the trend towards El Niño slowed in several key oceanic and atmospheric indicators. However, the Pacific basin reflects borderline ENSO-neutral/weak El Niño conditions that are expected to continue into the Northern Hemisphere winter 2012-2013.

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

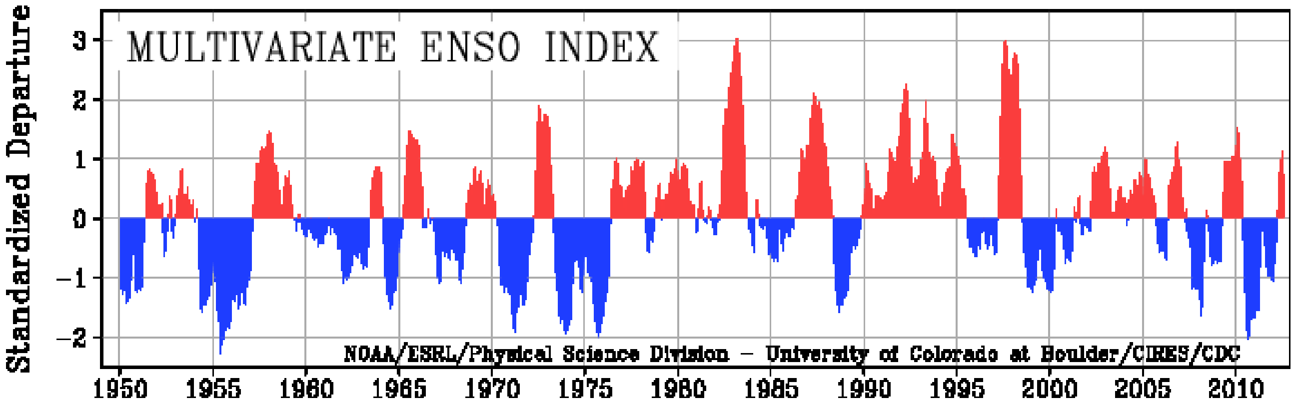


Figure 1. NOAA Physical Sciences Division attempts to monitor ENSO by basing the Multivariate ENSO Index (MEI) on the six main observed variables over the Pacific. These six variables are: sea-level pressure, zonal and meridional components of the surface wind, sea surface temperature, surface air temperature,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

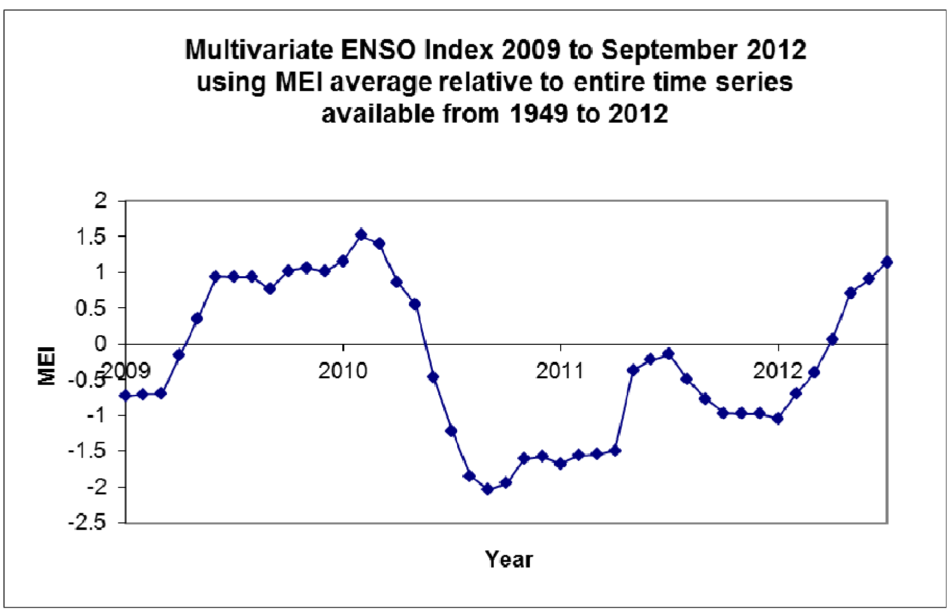


Figure 2. Multivariate ENSO Index from 2009 to August 2012. Mean used from bimonthly MEI values from the entire MEI Index time series, starting with December2008/January2009 thru August2012/September2012 (http://www.esrl.noaa.gov/psd/enso/mei/table.html).

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
Negative subsurface temperature anomalies from late July 2011 through March 2012 reflected La Niña. Since April 2012, the anomalies have been positive with increases during April and June. Since the beginning of September, positive subsurface anomalies have weakened.

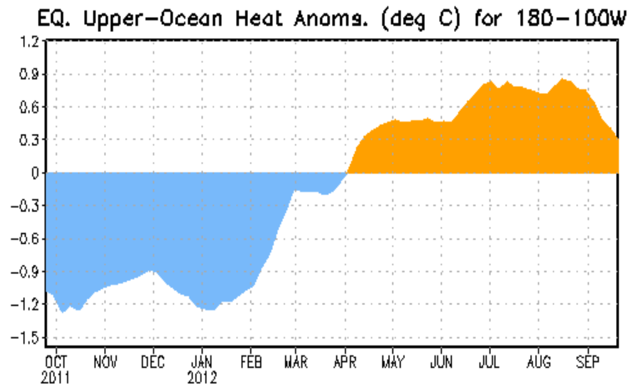


Figure 3. Area-averaged upper-ocean heat content anomalies (°C) in the equatorial Pacific (5°N-5°S, 180°-100°W). Heat content anomalies are computed as departures from the 1982-2004 base period pentad means.

PDO, ONI and SST at NOAA Buoy 46050, Newport OR:
Source: Bill Peterson, NOAA, NMFS
At the start of 2012, La Niña conditions began to weakened, as indicated by less negative values of the Pacific Decadal Oscillation (PDO) and Oceanic Niño Index (ONI). However, in May, the PDO once again began to strengthen such that by August, a negative value of -1.93 was seen. The ONI remains in neutral territory. Monthly averaged SST values at the NOAA Buoy were anomalously cool in spring 2012, warmed in June/July but cooled in August and September.

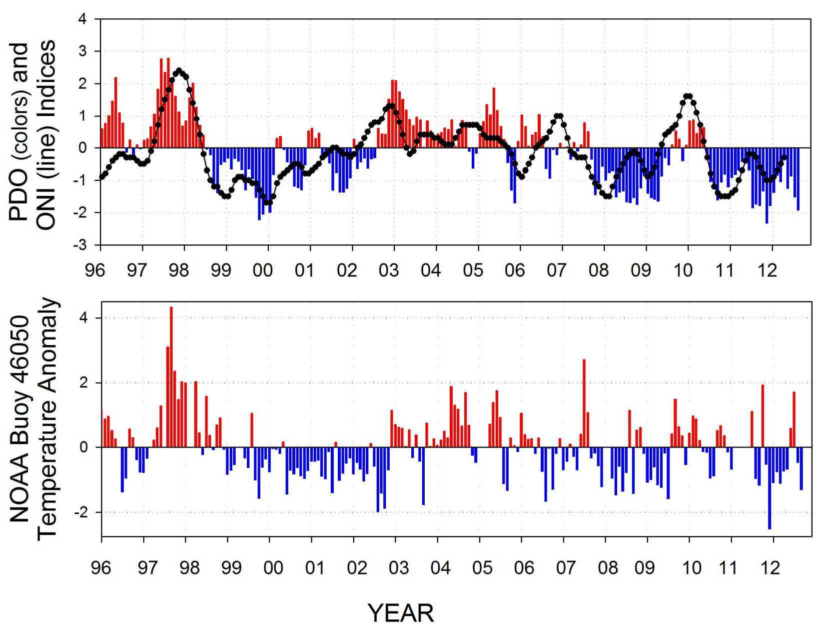


Figure 4. Time series of the PDO and ONI (upper panel) since 1996 and time series of SST (lower panel) measured at NOAA Buoy 46050 20 miles West of Newport, Oregon. SST generally tracks the PDO and ONI.

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**

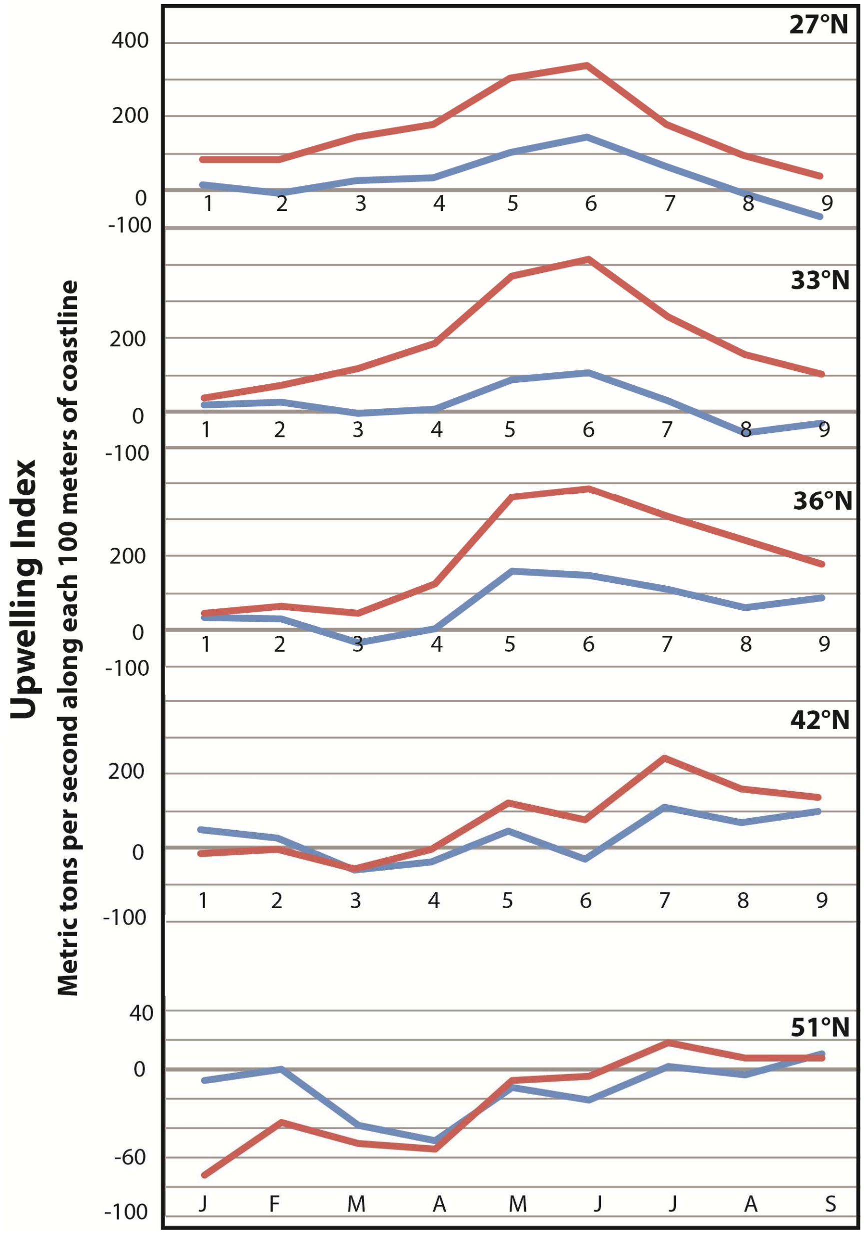


Figure 5. Plots of the ERD/SWFSC upwelling index (UI) computed from monthly mean pressure fields. The computation points are shown, from the top: 27°N, Baja California, Mexico; 33°N, Southern California Bight; 36°N, Central California; 42°N, Northern California Border; and 51°N, Canada. The red lines give the UI and the blue lines give the anomaly to the same scale. All graphs are on the same scale (-100 to 500) except the bottom (51°N). Values are given for the first nine months of 2012. The UI values and anomalies were clearly positive from May through August from 27°N to 36°N. The UI and UI anomalies were positive during the July – September quarter at 33°, 36° and 42°N. The third quarter index at 51°N followed patterns similar to those observed at 42°N, but were less robust and about average.

Coastal Upwelling at 45° N

Source: Bill Peterson, NOAA, NMFS

The start of upwelling was on May 3rd (Day 123) this year, over 2 weeks later than usual and the 3rd latest start in the past 15 years. Once upwelling started there were strong north winds for several weeks but by June the winds had diminished and remained in a more-or-less calm state until 6 July. This lack of strong wind contributed to the warmer than average SST in June and July (Figure 4, bottom panel). All in all, even though upwelling is continuing into October, the *rate* of upwelling has been "average" and when the season end, it will likely match climatology.

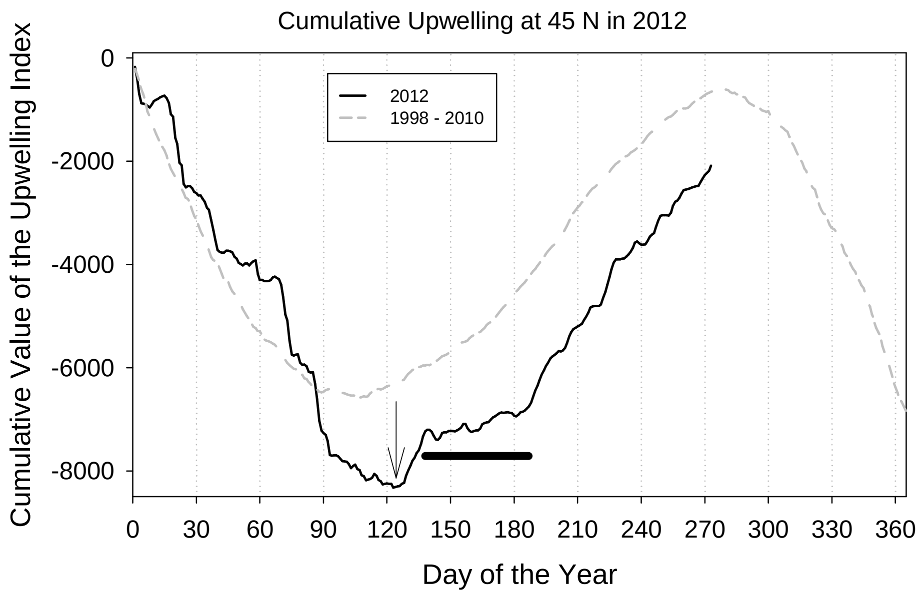


Figure 6. Cumulative upwelling values for 45°N, from the PFEL website. Upwelling began on Day 123 (3 May) indicated by the arrow, was strong initially, then weakened for six weeks (solid black bar). Since 6 July, the rate of upwelling has been the same as climatology, i.e., "average".

Regional Oceanic Conditions:

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

Monthly mean sea surface temperature (SST) and SST anomalies derived from NOAA AVHRR sensors showed that the ocean off the west coast of the U.S. cooled during the first quarter of 2012. This cooling trend reversed in April and warming continued through the second and third quarters. Offshore, the 14°C isotherm was at about 35°N in May. By June this isotherm had migrated poleward to 40°N at 130° W and is also delineated the coastal upwelling zone along the coast south of 39°N. Positive SST anomalies appeared in the Southern California Bight (SCB) during May and persisted through September. In August, these areas of positive SST anomalies became more extensive, reaching 100-200 km offshore along the coast from Mexico to southern Canada. In the SCB, SST exceeded 21°C and SST anomalies reached 1.5°C. In September, positive SST anomalies were continuous along the coast from the eastern equatorial Pacific to the SCB. North of the SCB coastal SST had returned to the normal season range by the end of the third quarter.

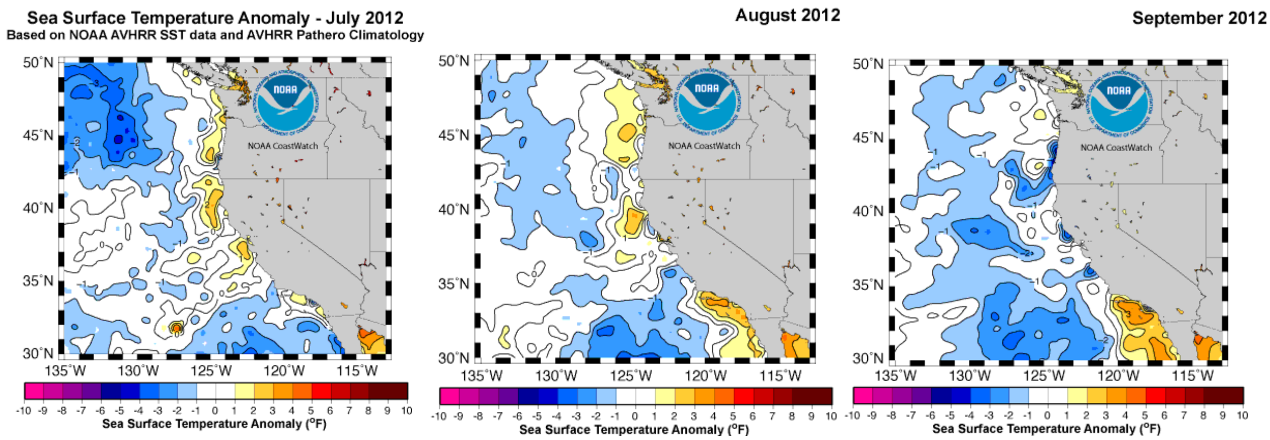


Figure 7. Regional oceanic conditions in the California Current Region.

Water Temperature and Salinity along the Newport Hydrographic Line, OR in Quarter 2, 2012:

Source: Bill Peterson, NOAA, NMFS

The year began with colder-than-average deep waters over the inner-middle shelf off Newport (44.65°N). During the second quarter, bottom water temperature was near the 1997-2012 mean and was slightly less salty than the previous two years. The third quarter was similar in that the water was cold but not as salty as during other cold years with values of 7.56°C and 33.74 S. These values are near the average for 16 years of observations of 7.75°C and 33.81 S, which is consistent with what would be expected for "average' upwelling as shown in Figure 6.

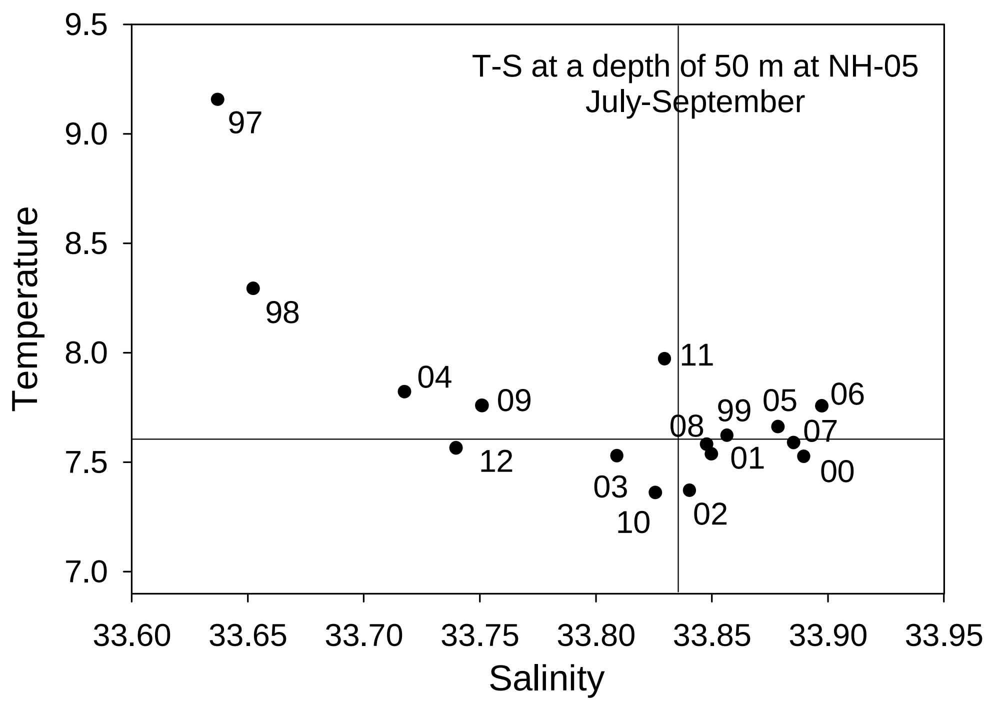


Figure 8. Temperature (T) and salinity (S) measured at a depth of 50 m at a baseline station (NH 05) located 9 km off Newport, OR. Data are averaged from July through September. The lines within in the graph indicate the median values of T and S.

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

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

Recent observations along the Trinidad Head Line indicate continued evidence of mild upwelling into summer 2012, which is consistent with the persistence of southerly wind and rain events into July. Phytoplankton concentrations appear to have remained relatively low during much of 2012. The copepod assemblage at station TH02 appears to have had relatively low densities of ‘northern neritic’ species well into spring 2012 (data not shown); copepod data for later cruises are still being developed. Please note that data shown in Figure 9 supersede those presented in previous updates, some of which included data from TH04 due to an array indexing error; temporal patterns noted in previous reports are not greatly affected by this error, and so previous observations remain informative.

Collection of the most recent data has been supported by NOAA/NMFS and the California Ocean Protection Council.

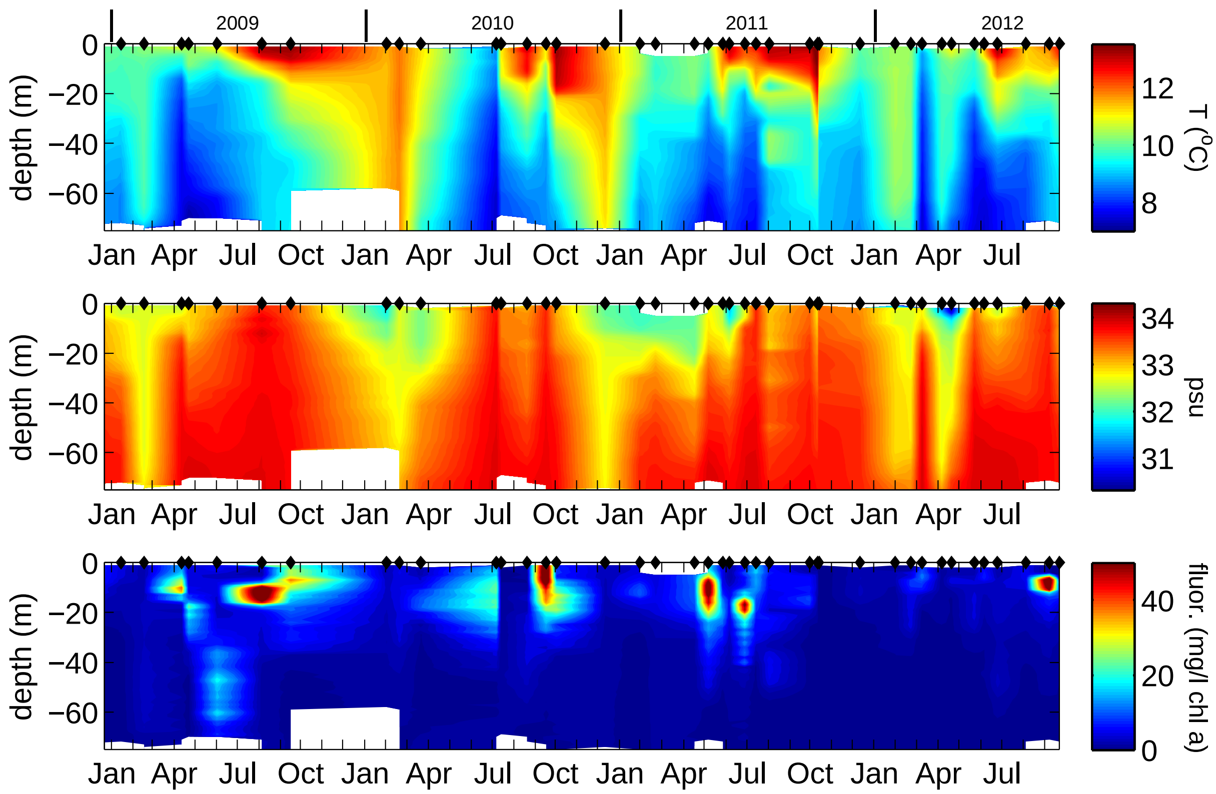


Figure 9. Hovmoller plots (time by depth) of temperature, salinity, and fluorescence (converted to chl a concentration per instrument settings) at station TH02 (41° 03.5’ N, 124° 16’ W, approximately 7 nm offshore, 75m depth at mid-shelf) along the Trinidad Head Line. Small diamonds along top of each 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.

Summer 2012 Observations by the SIO CalCOFI group:

Source: Ralf Goericke, SIO

The summer 2012 CalCOFI cruise occurred during July (2nd to 27th). The nitracline depth, which had been unusually close to the surface during the spring cruise, was found at a depth of 32 m (average over all 66 standard CalCOFI stations); a value which is similar to the long-term average. Consistent with this observation, areas of active or recent upwelling were confined to small areas south of Point Conception, which can be seen in Figure 10 as areas where the temperature is less than 14 °C and concentrations of nitrate larger than 2 μM. Note, that those concentrations of nitrate are substantially lower than those that were observed in these upwelling areas during April. Surface layer Chl a, a proxy for phytoplankton biomass, was elevated in large areas off Point Conception. This signal was likely driven not only by the current upwelling but also by past upwelling in other regions, either further offshore from Point Conception or by coastal upwelling.

Oxygen at depth for the σ=26.4 isopycnal (Figure 11, upper plot) continues to decline and appears as if this decline has accelerated over the last several years. The spatial pattern of this decline over the last 12 months (Figure 11) is very similar to the spatial pattern previously observed, i.e. strongest in the offshore areas and weaker in the coastal areas, suggesting that the mechanisms responsible for the long-term changes are still driving the current trends.

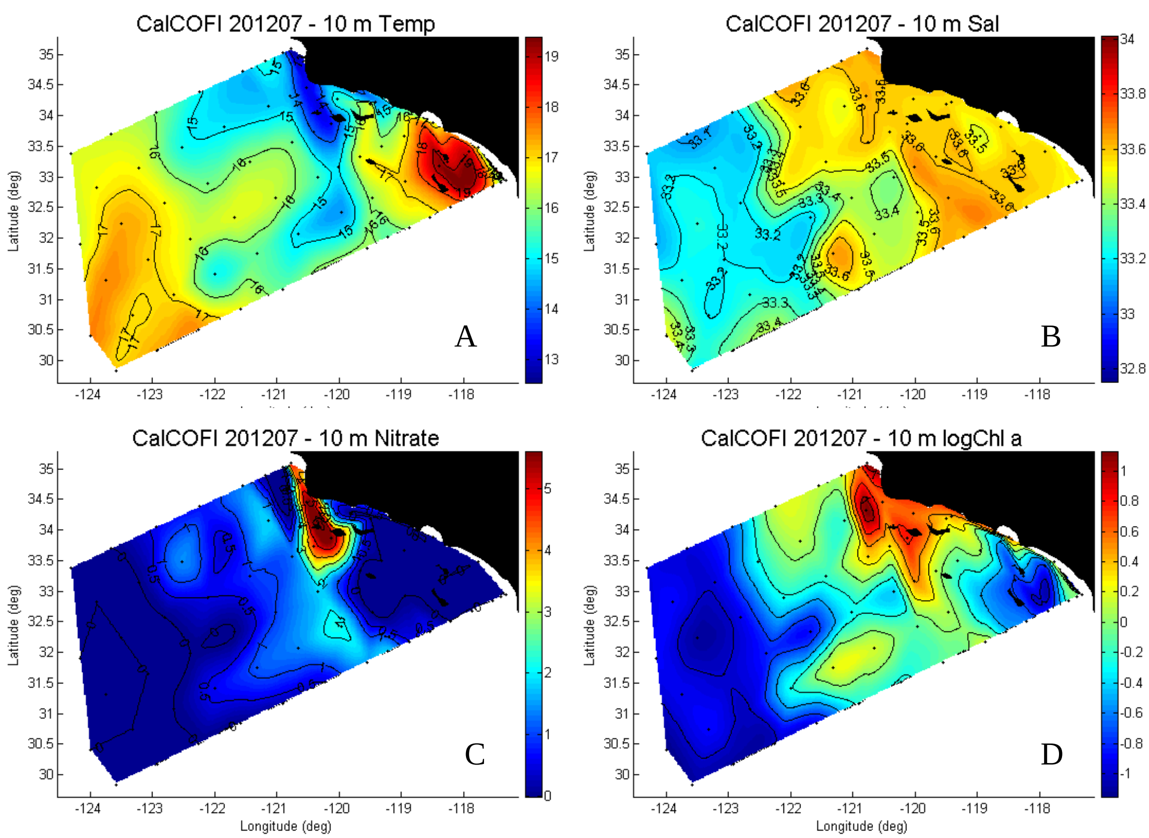
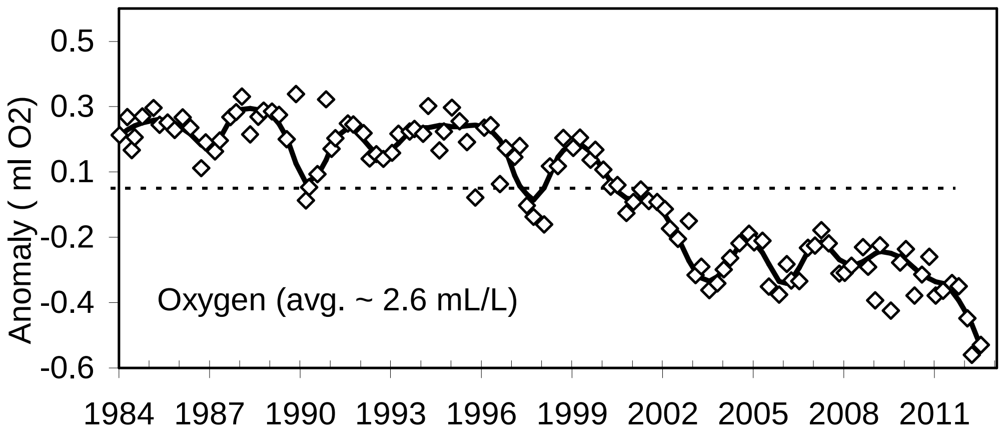


Figure 10. Hydrographic properties at a depth of 10 m off Southern California in July 2012. Plotted are **(A)** temperature (°C), **(B)** salinity, **(C)** concentrations of nitrate (μM) and **(D)** Chlorophyll a (log (μg/L)).



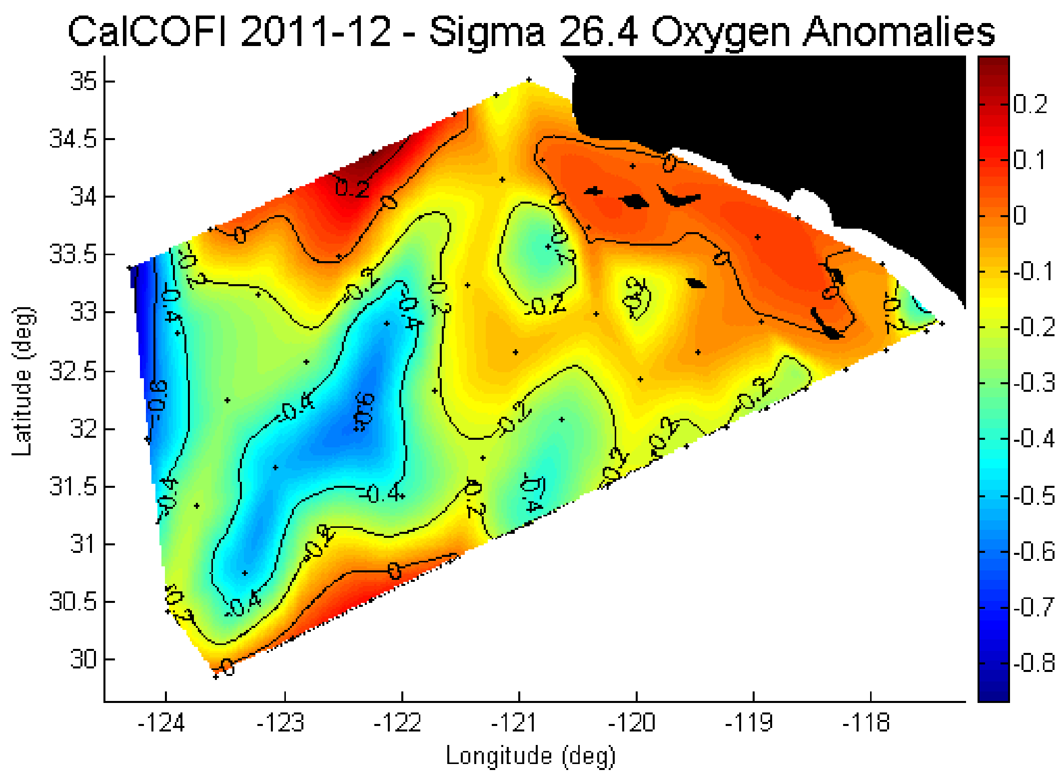


Figure 11. Upper plot: Oxygen concentrations on the sigma 26.4 isopycnal averaged over the 66 standard CalCOFI stations. Lower plot: Change in oxygen concentrations on the sigma 26.4 isopycnal over the last year relative to the 2008/10 time period.

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 pattern of species richness shown below reflects the "average" nature of coastal upwelling observed in 2012 – that is, upwelling was average as were the values of species richness. On the other hand, the biomass of the "northern" copepod species (*Pseudocalanus mimius, Calanus marshallae* and *Acartia longiremis*) shown in the lower panel reflects the influence of Pacific Decadal Oscillation. When the PDO is negative, the "northern" species dominate due to transport of sub-arctic into the northern end of the California Current. High biomass anomalies of the 'northern' copepod species is a good indicator of a favorable environment for salmon because northern species have a very high lipid content, thus contributes to a higher lipid-content (and higher energetic content) of upper trophic level organisms. Much of 2011 and 2012 have witnessed very high biomass of lipid-rich "northern" species.

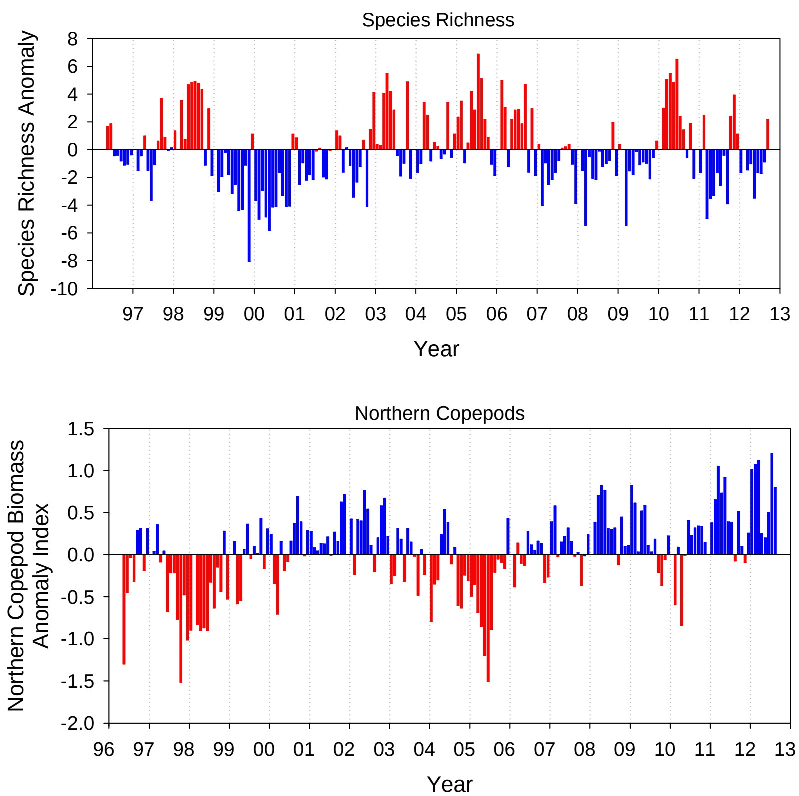


Figure 12. Time series of copepod biodiversity [species richness] (top panel) and northern copepod biomass (bottom panel) from 1996 – present, taken from Newport Hydrographic (NH) line. Much of 2011 and 2012 have witnessed very high biomass of lipid-rich 'northern' species.

Salmon:

Source: Bill Peterson, NOAA, NMFS

The *spring* Chinook run which was completed on 15 June was "average", at 186,434 fish counted at Bonneville Dam, the most down stream dam on the Columbia River. As of early October 2012, the *fall* Chinook run is well above average with a relatively strong run expected when the run is completed (usually in

November). The most remarkable run this year is that of the sockeye salmon. In early October 2012, record counts have already been registered, the most fish since records began being kept in 1938. By 5 October the count was 489,343. The second and third highest counts of fish by that same date were 373,195 (in 2010) and 197,524 in (2008); in contrast the lowest count was 8,219 in 1995. Annual return data can be found at http://www.cbr.washington.edu/dart/adult_annual.html.

West Coast Salmonids, Third Quarter, 2012:

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

North of 37°N, fall-run chinook salmon are entering their natal streams and rivers along the west coast of North America. The escapement of salmon into the Sacramento and Klamath – Trinity basins will be the best of the last five or six years due to intensive river improvement projects and favorable ocean conditions. Habitat improvement on Battle Creek above the Coleman National Fish Hatchery has allowed spring chinook escapement to improve several fold in 2012.

Returns to the Shasta River, a Klamath Tributary, are on track to reach the 35-year average totals. Fall chinook are reported to be holding in almost every depression along the Trinity. These fish will be moving upstream again when water flows increase. There are also reports of coho salmon schools entering the lower Trinity River. It is illegal to take coho in California due to its threatened status under the Endangered Species Act. A formal appeal for delisting of Klamath River coho was denied by NOAA in September.

Recreational fishing for coho salmon was good on the northern Oregon coast with just over one salmon per angler. Oregon ocean anglers caught all but 1,490 coho salmon remaining on the quota of 11,800 coho for the non-selective coho salmon season in the ocean from Cape Falcon to Humbug Mountain. The season closed on September 22 after one more day of recreational fishing. The upstream coho migration is just beginning in Oregon and Washington. Recreational angling for chinook and coho salmon has been good in Winchester Bay at the mouth of the Umqua River. Take of wild salmonids, with an intact adipose fin, is restricted in Oregon. At the Winchester counting station on the North Umpqua River, summer steelhead passage was about average by mid-August. The accumulated total of cutthroat trout was about 50% of 2011, but still the second highest total in the last ten years. Accumulated totals of spring chinook were 82% of ten-year averages at the Winchester counting station. Seine surveys at mile eight on the Rogue River indicate 74%, 27% 56%, and 100% of ten year average returns of fall chinook, coho, steelhead and immature steelhead (half-pounders), respectively, by the end of September.

At the Bonneville passage way on the Columbia river, coho salmon totals were 50% of the 10-year average and 35% of last year’s cumulative totals at the end of September. Sockeye salmon passage has been 393% of the 10-year average and 278% of last year. Steelhead passages at Bonneville were 62% of last year and 60% of the ten year averages.

About 2.1 million Canadian Fraser River sockeye salmon were in the 2012 run, with an estimated escapement of 1.6 million fish. This low run size has led to strict curtailment of American and Canadian sockeye fisheries. Alaskans in the Yukon, Kuskokwim and Cook Inlet regions are suffering from the effects of low chinook salmon returns. Fishery closures and restrictions necessary for chinook conservation added to the problems of commercial and subsistence fishers. The fishery was declared a disaster by the US Department of Commerce in September. The long period of predominately negative Pacific Decadal Oscillation indices may indicate ocean antecedents to the low chinook escapement into Alaskan Rivers. (http://jisao.washington.edu/pdo/).

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

Source: Washington State Department of Health http://ww4.doh.wa.gov/gis/mogifs/biotoxin.htm

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 third 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 Agriculture http://www.oregon.gov/ODA/FSD/Pages/shellfish_status.aspx
No third quarter 2012 summary was available at the time of this report. Please view the site http://www.oregon.gov/ODA/FSD/Pages/shellfish_status.aspx for the most current status.

California HAB Summary
Source: http://www.cdph.ca.gov/healthinfo/environhealth/water/Pages/Shellfish.aspx
Domoic Acid Update: *Pseudo-nitzschia* was observed along the entire southern California coast and at several sites along the northern California coast from July to September. *Pseudo-nitzschia* was observed at San Luis Obispo and Ventura sites during July and at most northern California sites during August. Domoic acid was detected in shellfish samples collected during the months of July and August. In July, domoic acid was detected in southern California shellfish samples taken from Morro Bay and Santa Barbara. The elevated levels of domoic acid detected during July in Morrow Bay declined below the detection limit by the beginning of August. The high toxin levels in Santa Barbara shellfish decreased below the alert level by the beginning of August and were nondetectable by the third week. Crab samples collected offshore of Ventura County in early September contained varying levels of domoic acid. Follow-up samples collected in the same region at the end of September were all below the alert level. In northern California, low levels of domoic acid were detected the first week of August in shellfish from the Santa Cruz pier, increasing to 38 ppm by August 15 before declining by August 22 to 3.6 ppm. Domoic acid was not detected in any northern California samples collected in September.
Paralytic Shellfish Poisoning (PSP) Update: *Alexandrium* was not observed at any sites during July and was observed at Pismo Pier and at Pacifica Pier during August. During September, Alexandrium was observed at several sites between Sonoma and Monterrey and at Ellwood Pier. PSP toxins were not detected in any shellfish samples collected from July to September.

PACIFIC COAST FISHERIES MANAGEMENT SUMMARIES AND RECOMMENDATIONS

Coastal Pelagics:

Third Quarter 2012 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, 2011 the Pacific Fisheries Management Council adopted a coastwide harvest guideline (HG) of 109,409 mt for the 2012 Pacific sardine fishery. Subtracting a Tribal Set Aside of up to 9,000 mt and an Exempted Fishing Permit (EFP) set aside of up to 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

The 2nd seasonal allocation of west coast Pacific sardine fishery opened for directed fishing on July 1, 2012. The uncaught remainder of the 1st allocation (12,061 mt) and the incidental set aside (1,000 mt) were added to the 2nd allocation for a new adjusted seasonal allocation of 51,025 mt. Sardine landings in California remained low during the 2nd allocation due to a lack of availability of fish and the fleet's focus on an unusually high abundance of squid throughout the state. Landings in Washington and Oregon were strong and the directed fishery closed on August 23, 2012. The directed fishery re-opened on September 15, 2012, with an adjusted seasonal allocation of 30,000 mt. Landings remained low in California.

2012	PACIFIC MACKEREL (mt)			PACIFIC SARDINE (mt)		
	No. Cal	So. CA	TOTAL	No. Cal	So. CA	TOTAL
July	0	220	220	0	1,532	1,532
August	0	492	492	0	1,770	1,770
September	0	412	412	423	623	1,046
TOTAL	0	1,124	1,124	0	3,926	4,349

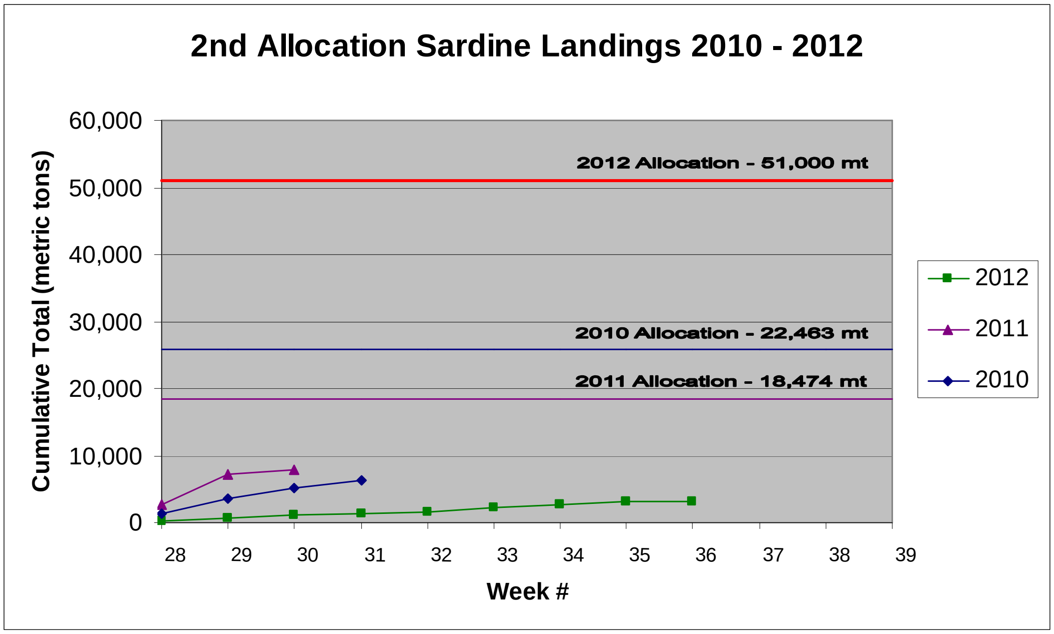


Figure 13. This graph compares weekly sardine landings during the second allocation period 2010-2012.