January, February, March, 2010
Volume 3, Quarter 1

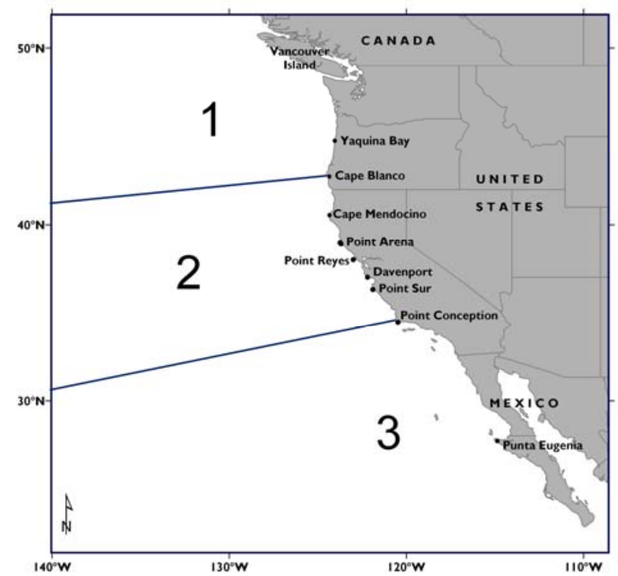
Physical and Ecological Conditions in the California Current LME for January to March, 2010

Summary of climate and ecosystem conditions for 2010 for public distribution, compiled by PaCOOS coordinator Rosa Runcie (email: Rosa.Runcie@noaa.gov). Data and management decisions are summarized when they are made available and don't necessarily coincide with the publication of the quarterly.
Full content can be found after the Executive Summary. Previous quarterly summaries of climate and ecosystem conditions in the California Current can be found at http://pacoos.org/

PHYSICAL CONDITIONS

- **El Niño Southern Oscillation (ENSO):** Oceanic and atmospheric anomalies reflect a moderate El Niño episode for Quarter 1, 2010. El Niño impacts are expected to last through the Northern Hemisphere Spring 2010.
- **Pacific Decadal Oscillation (PDO):** January and February Index values were the highest since July 2007. The first quarter SST positive anomaly patterns have been relatively stable in the northeastern Pacific and suggest continuation of PDO-positive conditions. In comparison to past warm events, these anomalies are smaller than observed during the strong 1997-1998 El Niño event and slightly stronger than the El Niño event of 2002-03.
- **Upwelling Index (UI):** During January, cyclonic circulation of Pacific storms caused coastal downwelling. Monthly mean UI values were strongly negative north of 36°N and UI anomalies were negative from 24°N to 60°N. These winds led to increased coastal SST and SST anomalies.
  Madden Julian Oscillation (MJO):

  Mid-December 2009 to mid-January 2010, the MJO index indicated eastward propagation and strengthening. Late January, an anticyclonic circulation was evident north of the equator across the sub-tropical Pacific. During the last week in January and early February, the enhanced phase of the MJO remained generally stationary across the west-central Pacific. Some eastward movement of the MJO index was indicated for a brief time during early-mid February before weakening dramatically. El Niño conditions contributed to the strong amplitude and non-steady behavior of the MJO index during the January to March period.



- **Newport, Oregon and Trinidad Head, California Water Temperature and Salinity Survey Line Observations:** Deep shelf (62 m) temperature and salinity at the Newport Hydrographic Line, OR during November to March 2009 was warmer and fresher water than the previous two years. Trinidad Head Survey Line conditions, during the first quarter in 2010, also were warmer and fresher than during similar months in previous years.

ECOSYSTEM CONDITIONS

- **California Current Ecosystem Indicators:**
  1. **Copepods:** Monthly average values for copepod species richness continue to track quite closely with the PDO and SST anomalies such that when the PDO is positive, SSTs are warm, and the copepod community is dominated by a greater number of warm–water, subtropical species and not cold water subarctic species.

2. **Krill**:
3. **Juvenile Rockfish**:
4. **Coastal Pelagics**:
   Pacific Sardine: The Pacific Fisheries Management Council adopted sardine fishery specifications for 2010, including an acceptable biological catch (ABC) of maximum harvest guideline (HG) of 72,039 metric tons (mt), based on a biomass estimate of 702,204 mt.
   Market Squid: The March monthly market squid report indicates 17 landings in the Ventura/PortHueneme/Santa Barbara area off Santa Rosa Island, and 7 landings in the San Pedro/Terminal Island area between Point Conception and San Miguel Island, off Santa Barbara Island, and Santa Catalina Island.
5. **Salmon:** In 2009, salmon returns in Washington and Oregon were below average ranking 7th out of 12 years (Figure 10). In 2010, low river flows are not expected to be as much of a problem for Salmonid species, entering rivers south of 39°N, as they were been during the preceding three years. At most counting locations in California, Oregon and Washington the 2009 total of Chinook jacks, precocious males returning a year early, increased over 2007 and 2008. This pattern may indicate increased adult Chinook returns to natal rivers in 2010. Total 2009 adult Chinook returns to the Columbia River were 85% of the ten-year average. On the Quillayute River, in northern Washington, the Spring Chinook run was about average, but the fall run was about 70% of average. Quillayute Coho Salmon, however, were plentiful in 2009 when the totals counts were among the highest recorded. Coho run totals in Washington and Oregon Rivers were as much as 200% of ten-year averages.
6. **Groundfish**:
7. **Pacific Hake**:
8. **Midwater species**:
9. **Sablefish**:
10. **Cassin's Auklet**:

- **Highly Migratory Species (tuna, sharks, billfishes):** The Western and Central Pacific Fisheries Commission (WCPFC) Northern Committee adopted a draft Conservation and Management Measure that calls on countries to not increase fishing effort on Pacific bluefin tuna beyond the 2002-2004 level in 2010.
- **Marine Birds and Mammals:**
  Marine Birds: Seabird observations of on the January CalCOFI survey showed a total of 35 species, which reflects relatively high species diversity for this time of year. The total number of birds seen was within normal range. Both northern (e.g., Tufted puffin) and southern (e.g., Cook's petrel) species were seen, indicating a mixture of species with boreal and sub-tropical zoogeographic affinities.
- **Harmful Algal Blooms:**
  Washington: In late January, PSP in razor clam tissue rose above the closure limit of 80 µg/100g tissue at Long Beach, the southernmost beach on the Washington coast. PSP levels have since declined to under the closure limit but remain elevated (48 µg/100g tissue) at Twin Harbors Beach only. Domoic acid levels in shellfish have remained well below closure level of 20 ppm along the entire Washington's outer coast. No significant blooms of *Pseudo-nitzschia* spp. occurred the first quarter of 2010 along the outer Washington coast. Cell counts remain very low at ≤ 1000 cells/L of the smaller cell type. *Alexandrium catenlla* was only recently observed in surf zone whole water samples taken from Copalis Beach in mid-March at 1000 cells/L and has not been observed in any net tow samples along the Washington coast.
  Oregon: Samples collected since the beginning of 2010 through the beginning of March have shown very few harmful algae species.
  California: Phytoplankton observations and toxin monitoring for March show that south of Pt. Conception several sites are experiencing diatom blooms. Most of the north coast remains in winter mode, with lots of detritus and a few cells. *Pseudo-nitzschia* has been on the increase at a number of southern California locations. *Alexandrium* has been observed only at Imperial Beach Pier in southern San Diego County. Currently there are no quarantines or health advisories in effect.

PHYSICAL CONDITIONS IN QUARTER 1, 2010

El Niño Southern Oscillation (ENSO):

Source:**http://www.cdc.noaa.gov/people/kl`aus.wolter/MEI/mei.html**,
http://www.cpc.noaa.gov/products/analysis_monitoring/enso_advisory/

A moderate El Niño persisted throughout the Pacific Ocean during winter 2009-2010. Since December, a series of downwelling oceanic Kelvin waves contributed to the build-up of heat content anomalies in the central and eastern Pacific with temperature departures exceeding +2°C down to 150m depth across the eastern half of the equatorial Pacific. The latest in this series of Kelvin waves is projected to reach the South American coast in early April 2010. Oceanic and atmospheric anomalies reflected a strong and mature El Niño episode.

These Kelvin waves have continued to propagate poleward along the west coast of the Americas. Their signature has also been detected by high coastal sea level and a deeper thermocline, corresponding to their passage north along the US west coast in mid-October, mid-December, late January and early March (source: Frank Schwing, NOAA). The next Kelvin wave is expected to reach California in May or June 2010.

A moderate-to-strong El Niño continued during February 2010, with sea surface temperature (SST) anomalies exceeding 1.5°C in parts of the equatorial Pacific Ocean at the end of the month. SSTs were more than 1.0°C above-average across much of the central and eastern equatorial Pacific. An oceanic Kelvin wave was initiated in early February, which acted to increase the subsurface heat content anomalies, and to strengthen subsurface temperature departures across much of the equatorial Pacific. El Nino conditions peaked in December 2009, and weakened steadily during January – March 2010.

Several models NWS and NCEP suggest continued weakening of El Niño conditions through 2010, while others predict the development of La Niña conditions later in the year. El Niño impacts are expected to last through Spring 2010 in the Northern Hemisphere, partly in response to the typical warming that occurs between March and April/May. ENSO-neutral conditions are projected for summer 2010.

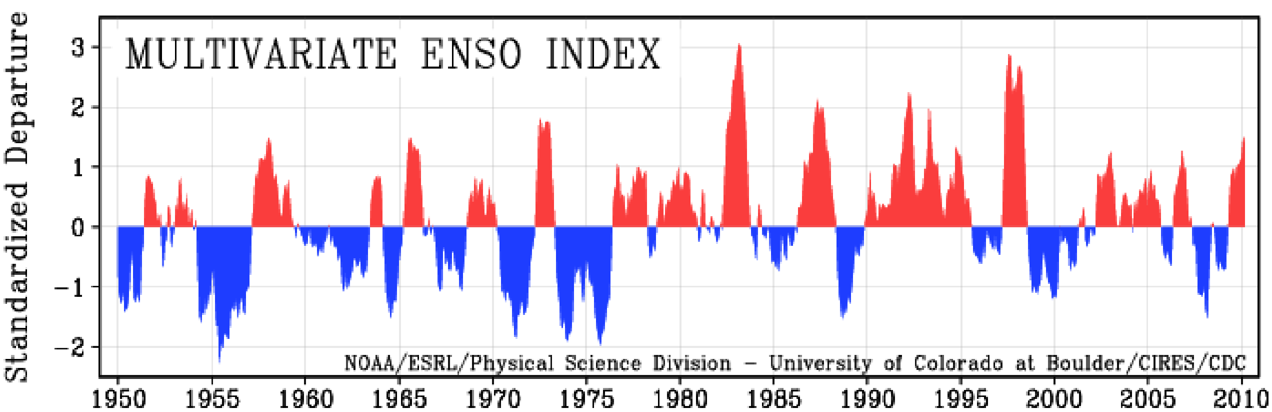


Figure 1. NOAA OAR attempts to monitor ENSO by basing the Multivariate ENSO Index (MEI) on the six main observed variables over the Pacific. These six variables are: sea-level pressure, zonal and meridional components of the surface wind, sea surface temperature, surface air temperature, and total cloudiness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

Central & Eastern Equatorial Pacific Upper-Ocean (0-300 m) Heat Content Anomalies:

Source: The Coast Watch **http://coastwatch.pfel.noaa.gov/elnino.html** ***(Advisory 2010)***
http://www.cpc.noaa.gov/products/analysis_monitoring/enso_advisory/ensodisc.doc ***(Jan, Feb, March 2010 report)***

Since April 2009, the upper-ocean heat content has been above average across the eastern half of the equatorial Pacific Ocean. Sharp increases in heat content between January and October 2009 and January 2010 coincided with the development and subsequent strengthening of the El Niño. During February 2010, heat content anomalies increased again in association with an oceanic Kelvin wave.

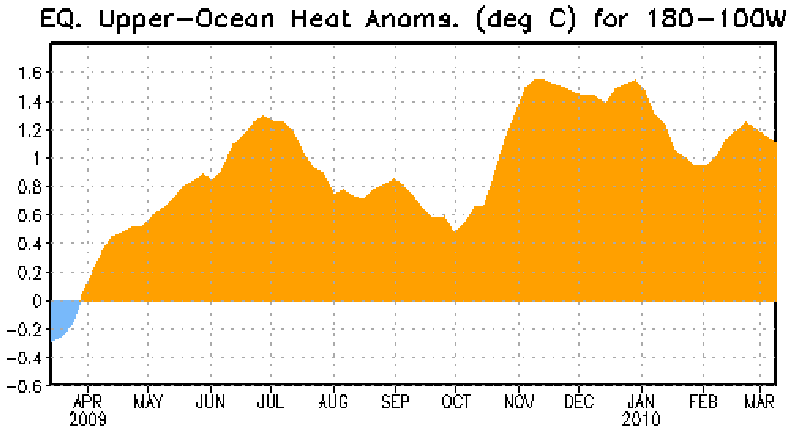


Figure 2. Area-averaged upper-ocean heat content anomalies (°C) in the equatorial Pacific (5°N-5°S, 180°-100°W). Heat content anomalies are computed as departures from the 1982-2004 base period pentad means.

Pacific Decadal Oscillation (PDO):

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

http://jisao.washington.edu/pdo/, http://www.pfeg.noaa.gov/products/PFEL/modeled/indices/upwelling/NA/data_download.html
http://coastwatch.pfel.noaa.gov/cgi-bin/elnino.cgi NMFS/SWFSC/ERD monthly coastal upwelling index, http://jisao.washington.edu/pdo/
http://jisao.washington.edu/pdo/PDO.latest

The first quarter of 2010 saw a continued positive value for the Pacific Decadal Oscillation Index in the North Pacific Ocean. Between July and January 2010 two index values were near zero, three values were weakly positive and one value was weakly negative. However, the last six months have been very different than early 2009 which had strongly negative Index values. The negative Index values were associated with below average rainfall in California. In the first quarter of 2010 precipitation has been near average corresponding to a positive Index value. January and February Index values (both at 0.82) were the highest since July 2007. The March value was lower, but still positive. The first quarter SST anomaly patterns have been relatively stable in the northeastern temperate Pacific and suggest continuation of PDO-positive conditions. Mildly positive SST anomaly (0.5°C) has persisted along the coast of North America from 20°N to 60°N and a negative oceanic SST anomaly pool, to -1.0°C, persists west of 120°N -140°W (http://www.osdpd.noaa.gov/ml/ocean/sst/anomaly.html).

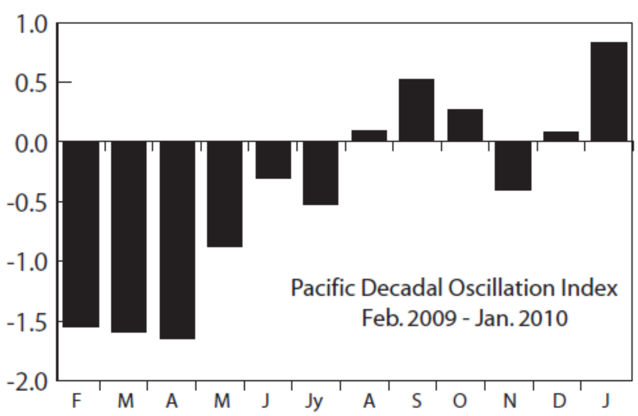


Figure 3. The graph shows monthly values for the PDO Index for February 2009 through January 2010. February's 2010 value is 0.82.

PDO and SST at NOAA Buoy 46050, Newport, Oregon:

Bill Peterson, NOAA, NMFS

http://jisao.washington.edu/pdo/, http://www.pfeg.noaa.gov/products/PFEL/modeled/indices/upwelling/NA/data_download.html
http://coastwatch.pfel.noaa.gov/cgi-bin/elnino.cgi NMFS/SWFSC/ERD monthly coastal upwelling index, http://jisao.washington.edu/pdo/

The trend of cold ocean conditions in the northern California Current that began in 2007 continued through 2008 and into the first half of 2009. Conditions began to change in June 2009 as upwelling winds relaxed and the ocean began to warm significantly, leading to detrimental changes in the pelagic food web and likely high mortality of juvenile salmonids. Among the better indicators of these changes include the Multivariate ENSO Index (MEI), the Pacific Decadal Oscillation (PDO), and local SST.

The MEI, which had been in negative (La Niña) phase since June 2007, became positive in May 2009, indicating that the extended La Niña had ended (Figure 4). Subsequent to the change in phase of the MEI, NOAA issued a warning that an El Niño event was developing at the equator, a fact which was confirmed in July 2009 (http://www.noaanews.noaa.gov/stories2009/20090709_elnino.html). As a result of the developing El Niño it is likely that an atmospheric teleconnection between the equator and the northern North Pacific led to a weakening of the PDO beginning in June 2009. The PDO then turned positive (warm phase) in August 2009 and SST measured at the NOAA Buoy 46050 (17 miles off Newport OR) showed + 0.9°C anomalies in August, 1.4°C in September and +0.7, +0.6 and +1.2°C in October, November and December respectively. Warm anomalies continue to persist with +0.4 °C (January 2010) +0.99°C (February), and +0.9°C through 18 March 2010. In comparison to past warm event, these anomalies are far smaller than anomalies observed during strong 1997-1998 El Niño event and slightly stronger than the El Niño event of 2002-03.

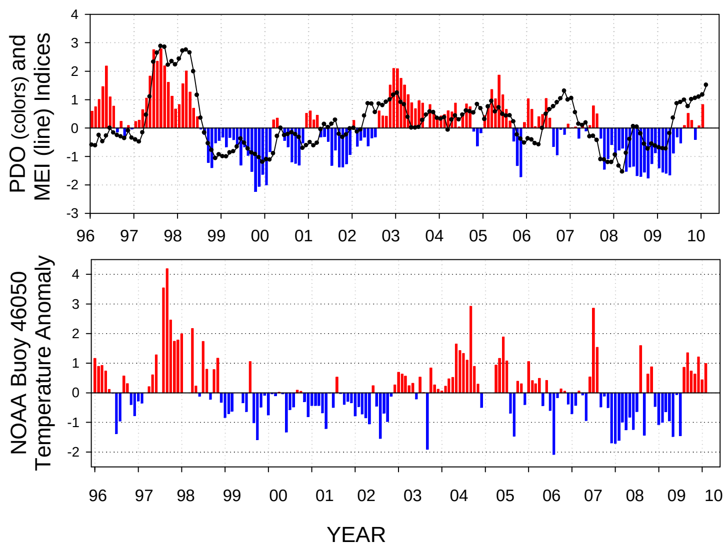


Figure 4. Upper Panel. Time series of the Pacific Decadal Oscillation (PDO) and Multivariate ENSO Index (MEI) from 1996-2001. **Lower Panel**. Time series of monthly averaged sea surface temperature anomalies measured at the NOAA Buoy 46050 located 17 miles off Newport Oregon. Anomaly is calculated from the base period of 1991-2008.

Upwelling Index:

Source: El Niño Watch, Advisory **http://coastwatch.pfel.noaa.gov/cgi-bin/elnino.cgi, NOAA/SWFSC/ERD Upwelling Index (UI)**

Source: Frank Schwing (NOAA)

An unusually strong storm crossed the coast during January 16-21, 2010. Winds were intense and northward along the coast from Cape Mendocino (40°N) to the Straits of Juan de Fuca (48°N); mixing in the upper ocean. Over these latitudes, wind stress curl (WSC) was positive within 500 kilometers of the coast. Mean winds were weak up to 1,000 kilometers offshore between Point Conception and Cape San Lazaro (25°N). The cyclonic circulation of Pacific storms caused coastal downwelling, shown in negative upwelling index (UI) values. Monthly mean UI values were strongly negative north of 36°N.

March 2010 upwelling was above normal south of 48N, which was reflected in anomalously high chlorophyll values. Concentrations exceeded 5 mg/m^3 within 50-100 km of the coast from Point Arena (39°N) to Point Eugenio (28°N). Many coastal areas that had 0.5 mg/m^3 of chlorophyll in February had concentrations exceeding 1.0 mg/m^3 in March. A large plume of higher chlorophyll water persisted 100-200 km south and southwest from Point Conception. Upwelling was below normal north of 48°N.

Northward, downwelling-positive winds were common at the coast through February. These winds led to increased coastal SST and SST anomaly. Strong downwelling, as indicated by a negative upwelling index, was found from 39°N to 60°N. Monthly mean UI values were positive between 24°N and 33°N, off Southern California and northern Mexico.

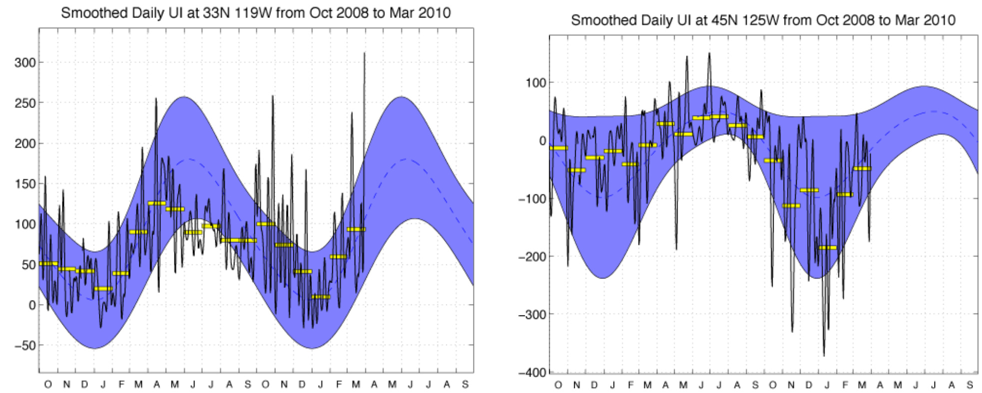


Figure 5. Left panel is recent 18 month record of upwelling for 33°N 119°W. Right panel is same for 45°N 125°W. Positive values are upwelling; negative values are downwelling. Dashed line is the climatological mean. Yellow bars are the means for each month during the period shown.

Regional Oceanic Conditions:

***Source: El Niño Watch, Advisory* http://coastwatch.pfel.noaa.gov/cgi-bin/elnino.cgi**
Source: Frank Schwing (NOAA)

The monthly mean Sea Surface Temperature anomalies (SSTa) field for January 2010 showed warming along the coast from 30°N to 50°N (Figure 6). The widespread negative SST anomalies of November decreased in December and were gone by January. Most of the areas within 1,000 miles of the coast had SST values that were within ±0.5°C of the monthly mean. Positive SST anomalies south of point Conception (35°N) persisted. Much of the area north of 50°N had near average SST.

The monthly mean SSTa field for February 2010 showed an increase in SST along the coast north of 42°N. Areas of positive SST anomaly increased within 100-200 kilometers of the coast north of 40°N. North of 45°N positive SST anomalies extended from the coast to 200-500 kilometers offshore. South of 45°N, many areas within 1,000 miles of the coast had average SST values, within ±0.5°C of monthly means. A large area of negative SST anomaly persisted west of 140°W between 20°N and 40°N. Areas of negative SST anomaly decreased in the Gulf of Alaska.

Monthly mean sea surface temperature (SST) fields for March 2010 show SST anomaly patterns that are similar to the patterns observed over the past two months. The coastal waters out 100-400 km have weak, positive anomaly (0.5°C) from northern Mexico to southern Canada. Negative SST anomalies were seen offshore (130°W to 170°W) between 35°N and 45°N. March large-scale SST anomaly patterns have persisted across the Pacific Ocean throughout the first Quarter of 2010.

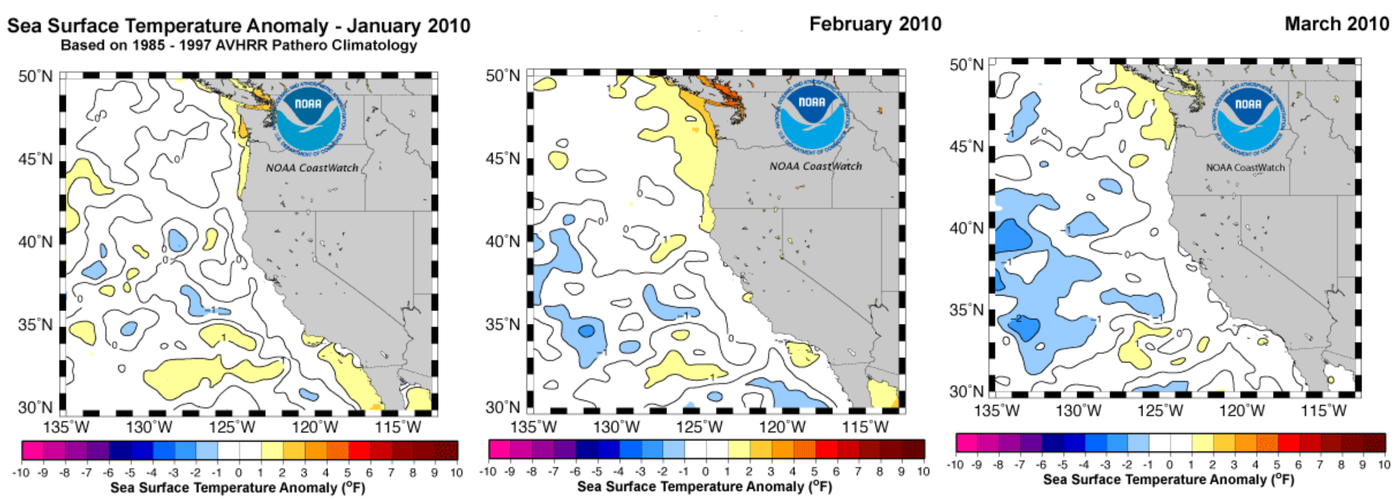


Figure 6. Regional oceanic conditions in the California Current Region.

Madden Julian Oscillation (MJO):
Source: **http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml** ***(Expert Discussions)***
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/ARCHIVE/ ***(summaries)***
850-hPa westerly wind anomalies increased slightly across the central and eastern Pacific during the first week in January, while easterly wind anomalies decreased across the western Pacific. Mid-January anomalies reversed sign near the Date Line with westerly anomalies present across most of the Pacific Basin. Strong 200-hPa westerly wind anomalies developed across much of the subtropics of the Northern Hemisphere. December 16, 2009 to January 24, 2010, the MJO index indicated eastward propagation and strengthening. Late January, an anticyclonic circulation was evident north of the equator across the sub-tropical Pacific. During the last week in January and early February, the enhanced phase of the MJO remained generally stationary across the west-central Pacific. El Niño conditions significantly contributed to the observed signal. Some eastward movement of the MJO index was indicated for a brief time during early-mid February before weakening dramatically. El Niño conditions contributed to the strong amplitude and non-steady behavior of the MJO index. During late February and early March the MJO signal varied in amplitude indicating weak or no MJO activity. El Niño conditions were contributing to some of the signal during the January to March 2010 period. Mid-March the MJO showed some signs of strengthening but any MJO activity was weak in the latter half of the month.

Water Temperature and Salinity at Newport Hydrographic Line, OR:
Source: Bill Peterson, NOAA, NMFS
An indicator of a change in ocean conditions during 2009 was shelf temperature and salinity measured at Newport, OR at a depth of 50 m at a baseline station five miles from the coast (water depth = 62 m) during winter cruises. Water temperature and salinity from November 2008 – March 2009 were warmer and fresher than the mean for the entire time series (1997 – 2009, Figure 7).

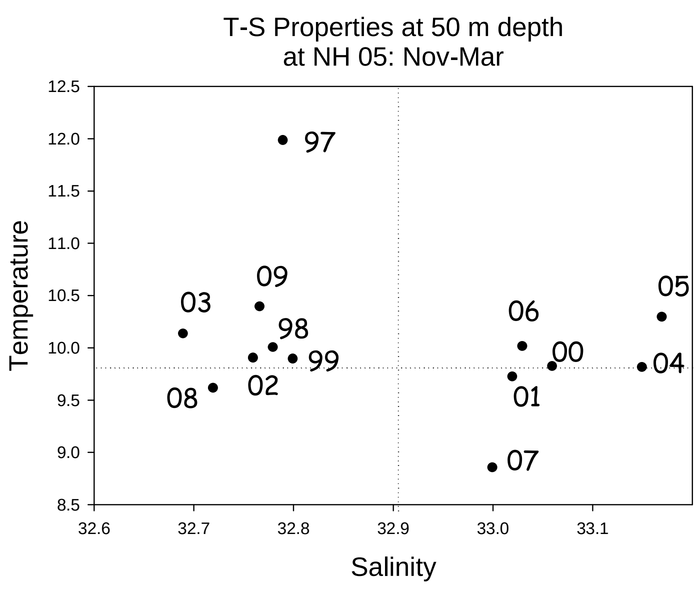


Figure 7. Temperature and salinity measured at a depth of 50 m at a baseline station off Newport Oregon located 9 km from shore during the winter months (November-March). Water depth at this station is 62 m. Note that the data fall into two groups: winters with relative fresh water at depth and winters with relative salty water at depth. Excluding the very warm winter of 1997-98, the average temperature in winter is 9.86°C and salinity, 32.91 (dotted lines).

Trinidad Head, California Survey Line Observations for 2009 ***(Eric Bjorkstedt, NOAA, NMFS)*****:**
Observations along the Trinidad Head Line indicate that waters present on the shelf during Quarter 1 of 2010 were warmer and fresher than during similar months in previous years of observation (Figure 8). This pattern is also apparent offshore along the Trinidad Head Line and suggests substantial onshore transport forced by southerly winds associated with numerous strong storm systems.

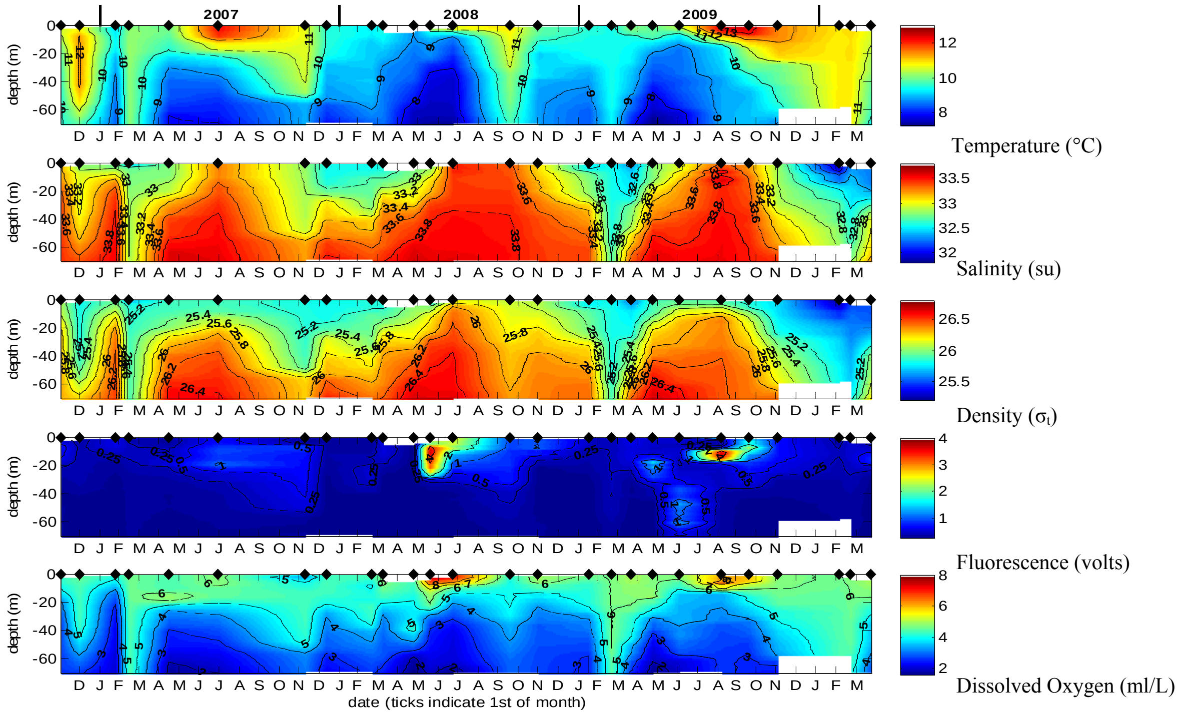


Figure 8. Time series of vertical structure at station TH02 (41° 3.50′ N, 124° 16.00′ W) along the Trinidad Head Line from late 2006 through early 2010. Panels from top to bottom display temperature (°C), salinity (su), density (σ_t), fluorescence (volts), and dissolved oxygen (ml/L). Black diamonds indicates sampling dates.

ECOSYSTEMS IN QUARTER 1, 2010

California Current Ecosystem Indicators:
Copepod Biodiversity (Species Richness)

Source: Bill Peterson, NOAA, NMFS

Copepod species richness (the number of copepod species observed in zooplankton samples) is a biological indicator of seasonal and interannual variations in ocean conditions. Monthly average values for copepod species richness continued to track quite closely with the PDO and SST (Figure 9; compare to Figure 4) such that when the PDO is negative, the copepod community is dominated by only a few cold–water, subarctic species. Conversely, when the PDO is positive, SSTs are warm, and the copepod community is dominated by a greater number of warm–water, subtropical species. During 2009, we found moderately low biodiversity, but no indication of an influx of an anomalously high number of subtropical species. This suggests that the warming SST observed in 2009 was localized, and that the zooplankton species observed in shelf waters were transported onshore from a location offshore of Oregon. During strong El Niño events, as in 1997/1998, subtropical zooplankton species such as the euphausiids *Nyctiphanes simplex* and *Euphausia recurva* and the copepods *Centropages bradyii* and *Calocalanus contractus* are transported to Oregon from southern California waters.

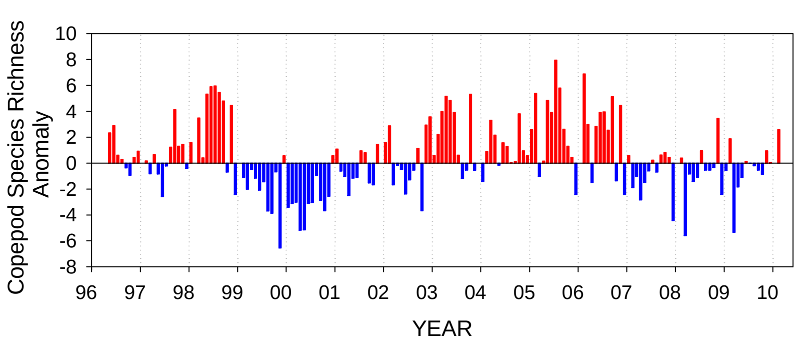


Figure 9. Time series of the anomaly of monthly averaged species richness of copepods collected at a baseline station located 9 km off Newport Oregon. The winter of 2009-2010 is certainly not showing strong indications of the effects of a strong El Niño.

Coastal Pelagics:

Pacific Sardine:

Source: Dale Sweetnam, California Department of Fish and Game

As of April 6, 2010, 12,467.10 mt of Pacific sardines have been caught in California. Eighty-five percent of the total landings are from southern California (primarily San Pedro and Terminal Island) totaling 55 percent of the 22,463 mt in the first allocation period (Jan 1 – June 30). Statewide the fleet is averaging 225.31 mt/day while fishing an average of 3.5 days/week (1-6 days).

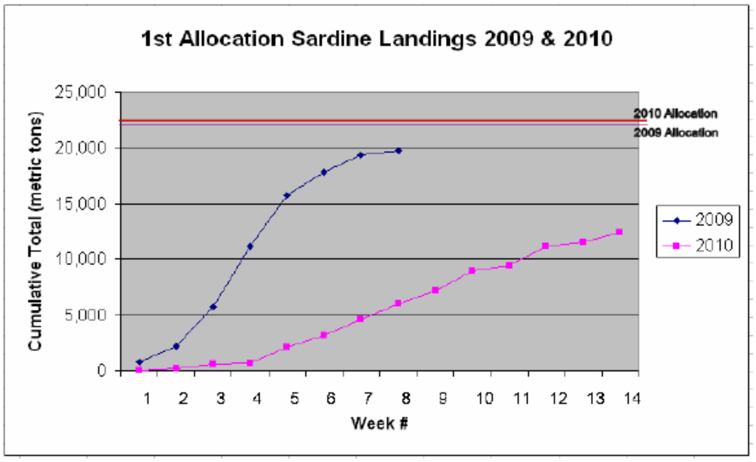


Figure 10. This graph compares the weekly Pacific sardine cumulative landings from 2009 and 2010.

Source: Pacific Fisheries Management Council Newsletter www.pcouncil.org
(Volume 33, No. 4) http://www.pcouncil.org/wp-content/uploads/Winter_2009_newsletter.pdf

2010 Pacific Sardine Harvest Specifications and Management Measures:

On November 3, 2009 the Council adopted a coastwide harvest guideline (HG) of 72,039 mt for the 2010 Pacific sardine fishery. The adjusted allocation of 60,039 mt is to be allocated seasonally as follows:

Coastwide Harvest Guideline = 72,039 mt – 5,000 mt = 67,039 mt				
	Period 1	Period 2	Period 3	Total
	Jan 1 – June 30	July 1 – Sept 14	Sept 15 – Dec 31	
Seasonal Allocation	23,463	26,816	16,760	67,039
Incidental Set Aside	1,000	1,000	1,000	3,000
Management Uncertainty Buffer	0	0	4,000	4,000
Adjusted Allocation	22,463	25,816	11,760	60,039

* Note: All data presented are considered preliminary and subject to change.

Market Squid:

Source: Dale Sweetnam, California Department of Fish and Game

Landings and samples from Monterey Bay, Santa Barbara, and San Pedro Port Areas for March**

Port Complex	Short Tons Landed		Season Totals Short Tons*****	Samples Collected
	2008/09***	2009/10****	2009/10	2009/10
Monterey/Moss Landing	693	0	808	0
Ventura/Port Hueneme/Santa Barbara	2,915	493	59,585	0
San Pedro/Terminal Island	497	30	31,662	0
	4,105	523	92,055	0

*Standard Deviation. **March 1-31; fishing season is from April 1 through March 31 the following year. ***Landings data from Dept. of Fish and Game Commercial Fisheries Information System (CFIS) database. ****Landings data from preliminary totals based on dockside tally of available landing receipts. *****Combination of landings data from preliminary totals from dockside tally of available landing receipts and CFIS.

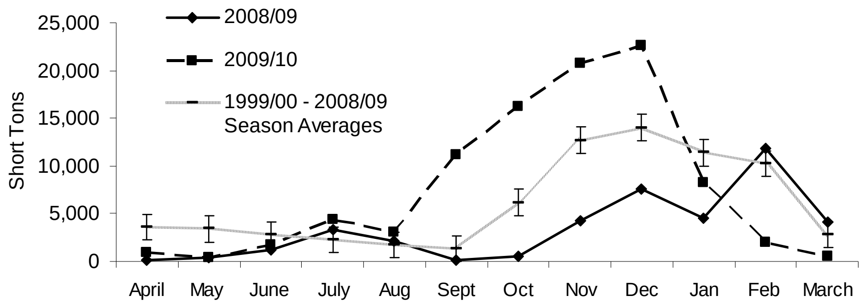


Figure 11. Statewide monthly market squid landings by fishing seasons.

Salmon:

Source: Bill Peterson, NOAA, NMFS

Many other observations of ocean conditions are made on a regular basis and these are summarized in a "stoplight" chart (Figure 12). This chart indicates good, average or poor ocean conditions, from the viewpoint of juvenile salmon in coastal waters of the northern California Current. The year 2009 ended as being a below average year, ranking 7th out of the 12 years over which we have data to complete such a chart.

Environmental Variables	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
PDO (December-March)	11	4	2	8	5	12	7	10	9	6	3	1
PDO (May-September)	9	2	3	4	6	11	10	12	8	7	1	5
MEI Annual	12	1	3	5	11	10	8	9	6	4	2	7
MEI Jan-June	12	2	3	5	8	10	7	11	4	9	1	6
SST at 46050 (May-Sept)	10	8	3	4	1	6	12	9	5	11	2	7
SST at NH 05 (May-Sept)	8	2	1	4	6	7	12	11	5	9	3	10
SST winter before going to sea	12	7	5	6	4	8	11	10	9	3	1	2
Physical Spring Trans (Logerwell)	8	7	2	1	4	10	9	12	10	3	6	5
Upwelling (Apr-May)	7	1	11	3	6	10	9	12	7	2	4	5
Deep Temperature at NH 05	12	5	6	3	1	8	9	10	11	4	2	7
Deep Salinity at NH05	12	5	6	4	3	10	11	8	7	1	2	9
Length of upwelling season	7	3	2	10	1	11	9	12	6	5	8	4
Copepod richness	12	2	1	5	3	9	8	11	10	6	4	7
N.Copepod Anomaly	12	9	3	6	2	10	7	11	8	5	1	4
Biological Transition	11	5	4	7	6	10	8	12	9	2	1	3
Copepod Community structure	12	3	4	6	1	8	9	11	10	7	2	5
Catches of salmon in surveys												
June-Chinook Catches	11	2	3	9	6	8	10	12	7	5	1	4
Sept-Coho Catches	9	2	1	4	3	5	10	11	7	8	6	12
Mean of Ranks of Environmental Da	10.4	3.9	3.5	5.2	4.3	9.1	9.2	10.8	7.7	5.4	2.8	5.7
RANK of the mean rank	11	3	2	5	4	9	10	12	8	6	1	7

Figure 12. Stoplight chart showing the ranks of environmental variables that define ocean conditions from the viewpoint of Chinook and coho salmon entering the ocean from rivers of Washington and Oregon. A rank of "1" indicates the best ocean conditions; rank of "12" the worst ocean conditions measured over the past 12 years (1998-2009). The rank of the mean rank (last row of numbers) succinctly summarizes ocean conditions among years.

Anadromous Salmonids:

Source: Jerrold Norton, NOAA (Jerrold.G.Norton@noaa.gov), Bill Peterson, NOAA, NMFS

In 2010, low river flows will not be as much of a problem for Salmonid species, entering rivers south of 39°N, as they were been during the preceding three years of below average California precipitation. So far, 2010 has seen about average precipitation, which is not sufficient to completely mitigate the effects of the extended drought. A few dozen Spring Chinook Salmon have entered the Columbia and Willamette river systems. Good Winter Steelhead passage has been observed at several counting stations in Oregon. Few Chinook Salmon runs south of 50°N were as plentiful as average in 2009. During 2007, 2008 and 2009 the California Central Valley adult Chinook returns were some of the lowest annual totals ever recorded. A few Central Valley hatcheries had greater returns in 2009 than in 2008, but this was not the norm. At most counting locations in California, Oregon and Washington the 2009 total of Chinook jacks, precocious males returning a year early, increased in 2009 over 2007 and 2008. This pattern may indicate increased adult Chinook returns to natal rivers in 2010. Total 2009 adult Chinook returns to the Columbia River were 85% of the ten-year average. On the Quillayute River, in northern Washington, the Spring Chinook run was about average, but the fall run has been about 70% of average for 2007-2009. Quillayute Coho Salmon, however, were plentiful in 2009 when the totals counts were among the highest recorded. Coho run totals in Washington and Oregon Rivers were as much as 200% of ten-year averages. These high returns are consistent with the high quality conditions that were observed for coho salmon entering the ocean in 2008, which ranked first out of all 12 years.

Salmon seasons opened coastwide for the first time in three years:

Source: Pacific Fisheries Management Council, News Release http://www.pcouncil.org/salmon/current-season-management/#salcurrent

Portland, Oregon, the PFMC adopted a set of salmon seasons that provides both recreational and commercial opportunities coastwide for the first time since 2007. The recommendation will be forwarded to the National Marine Fisheries Service for approval by May 1, 2010.

North of Cape Falcon, there is an overall non-Indian total allowable catch of 117,000 Chinook and 80,000 marked hatchery coho. The recreational Chinook season north of Cape Falcon begins June 12 and ends June 30 or when 12,000 marked Chinook are caught. Non-Indian ocean commercial fisheries north of Cape Falcon include traditional Chinook seasons in the May-June timeframe and all-salmon seasons in the July-to-September timeframe. The Chinook quota of 56,000 is more than twice the 2009 quota. The coho quota of 13,000 is about one-third of the 2009 quota.

South of Cape Falcon, recreational fisheries in Oregon will allow Chinook retention and run from Memorial Day through Labor Day weekends. There will also be a concurrent mark-selective coho fishery from starting June 26 and ending either September 6 or when the quota of 26,000 is reached. Recreational fisheries in California are for Chinook only and run from Memorial Day through Labor Day weekends in Eureka/Crescent City area, and from April 3 to September 6 in areas further south. Commercial fisheries from Cape Falcon to Humbug Mt., Oregon will be open from May 1 through August 25 with some three-day-a-week closures in July. Fisheries in the Humbug Mt. to California border area will be open in May, July and August, with the July and August fisheries on quotas of 1,500 Chinook for each month.

Commercial fisheries in California are very limited, but will include two four-day openers in July south of Point Arena, and additional quota fisheries in the Fort-Bragg area during late July and August.

Highly Migratory Species (HMS):

Source: Pacific Fisheries Management Council (PFMC) Newsletter www.pcouncil.org
(Volume 33, No. 4) http://www.pcouncil.org/wp-content/uploads/Winter_2009_newsletter.pdf

In November, the PFMC made recommendations to the U.S. delegation to the Western and Central Pacific Fisheries (WCPFC) to reduce fishing mortality on Pacific bluefin tuna, which is threatened by overfishing. In September the WCPFC Northern Committee adopted a draft Conservation and Management Measure that calls on countries to not increase fishing effort in 2010 on Pacific bluefin tuna beyond the 2002-2004 level. Of special concern is catches of juvenile (age 0-3) fish, which are being caught in high numbers in fisheries in Korea and Japan. In addition, the Inter-American Tropical Tuna Commission (IATTC) issued a statement on October 26, 2009, raising concern about further increases in fishing mortality, particularly of 0-year-old recruits, in the Eastern Pacific. The PFMC recommended that the WCPFC work with IATTC to adopt a complementary measure so that fishing effort would not be increased on Pacific bluefin tuna throughout the North Pacific, with special attention to 0-year-old fish.

Harmful Algal Blooms:

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

Washington HAB Summary

Source: Anthony Odell (University of Washington, Olympic Natural Resources Center), Vera Trainer (NOAA, NWFSC), and Stephanie Moore (NOAA, NWFSC).

Washington Department of Health http://ww4.doh.wa.gov/gis/mogifs/biotoxin.htm, http://www.wdfw.wa.gov/fish/shelfish/razorclm/season.htm

Washington's Olympic Region Harmful Algal Bloom (ORHAB) partnership monitors nine regular sites along Washington's outer coast (Figure 13) for the presence of several harmful phytoplankton species including *Pseudo-nitzschia* spp., *Alexandrium* spp., and *Dinophysis* spp. The smaller *Pseudo-nitzschia* cell type commonly includes *P. delicatissima, P. pseudo-delicatissima, P. cuspidata, P. calliantha* and the larger cell type commonly includes *P. australis, P. multiseries, P. pungens*, *P. heimii*, *P. fraudulenta*. When action levels for the 2 cell sizes are exceeded (50,000 cells/L for the larger cell type; 1,000,000 cells/L for the smaller cell type), toxin testing in seawater and shellfish is initiated.

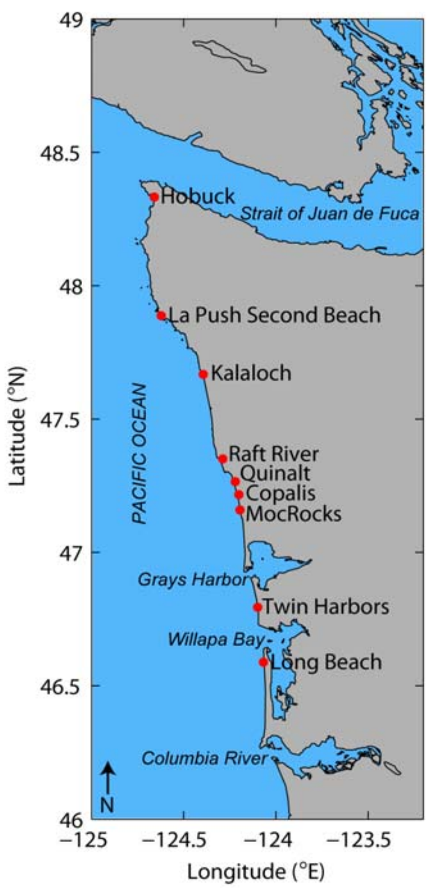


Figure 13: ORHAB monitoring locations on the outer coast of Washington State.

In late January, PSP in razor clam tissue tested by The Washington Department of Health rose above the closure limit of 80 µg/100g tissue at Long Beach, the southernmost beach on the Washington coast. This prompted the Washington Department of Fish and Wildlife to cancel the proposed razor clam opening at Long Beach. PSP levels have since declined to under the closure limit but remain elevated (48 µg/100g tissue) at Twin Harbors Beach only (as of March 22).

Domoic acid levels in shellfish have remained well below closure level of 20 ppm along the entire Washington's outer coast. The highest level of domoic acid in razor clams was on March 17th, 2010 at 2 pm at MocRocks Beach on the central Washington coast.

No significant blooms *Pseudo-nitzschia* spp. have occurred in Quarter 1 along the outer Washington coast. Cell counts remain very low at $\leq$ 1000 cells/L of the smaller cell type.

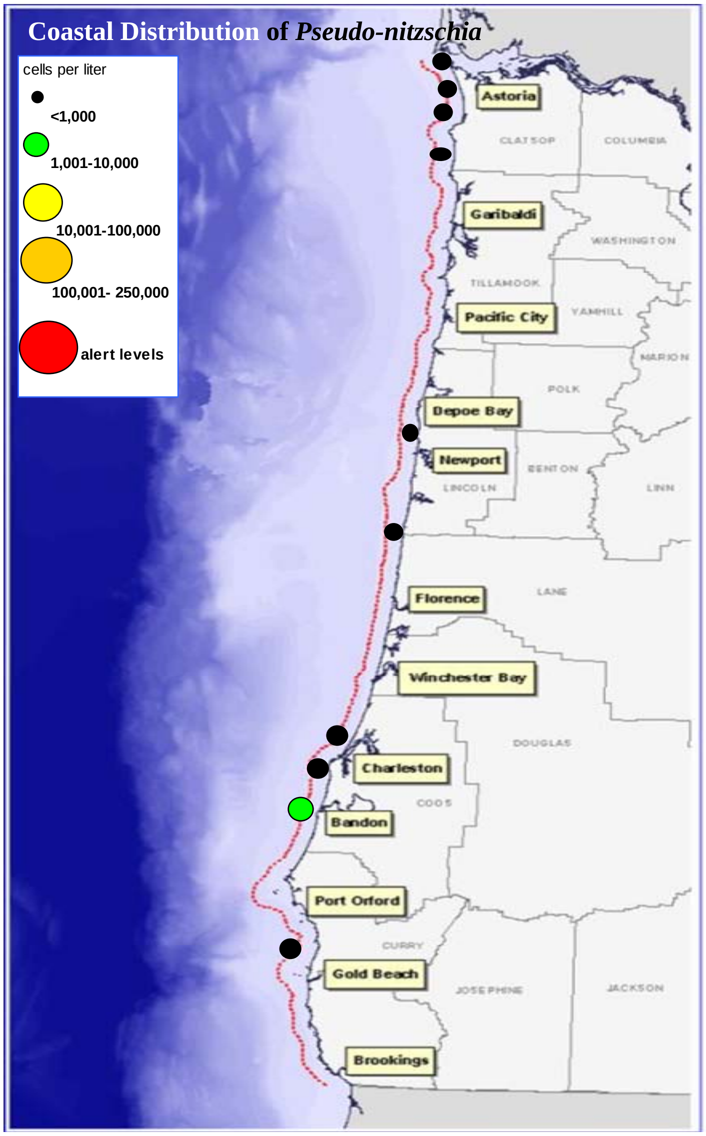
Alexandrium catenella was only recently observed in surf zone whole water samples taken from Copalis Beach in mid-March at 1000 cells/L and has not been observed in any net tow samples along the Washington coast.

Dinophysis spp. have been commonly observed in net tow samples during the last month and are found along the central coast of Washington from Copalis to Twin Harbors as well as Grays Harbor and Willapa Bay. The highest counts were 1,000 cells/L at both Copalis Beach (March 22) and Twin Harbors (February 25). The species observed were *D. acuminata*, *D. fortii*, *D. parva*, and *D. rotundata*.

The dominant diatom species among Washington State coastal phytoplankton were *Attheya armatus* until about early to mid-February when *Asterionellopsis* spp. (*A. glacialis and A. socialis*) became dominant. *Thalassiosira* spp. have also been predominant and occasionally dominant in recent samples along the central coast. Dinoflagellates, such as *Protoperidinium* spp., *Ceratium* spp., *Scrippsiella trochoidea,* and *Dinophysis* spp., are common on the central coast as well.

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



Samples collected since in Quarter 1, 2010 have shown very few harmful algae species. Those counted include *Dinophysis* spp. and a single *Pseudo-nitzschia* collected the first week of March on the south coast. Meat toxin tests provided by the Oregon Department of Agriculture showed an increase of both PSP and DA levels to 76.3 µg/100g and 8.6ppm respectively in razor clams collected along Clatsop Beach the last week of February. An exhaustive search of net tow samples from this time did not reveal any of the usual PSP producers.

Figure 14. Oregon's Harmful Algal Bloom monitoring project in conjunction with Oregon Department of Agriculture is working to monitor ten sites along the Oregon coast. The coastal distribution of *Pseudo-nitzschia* (cells per liter) for the first quarter of 2010.

California HAB Summary

Source: Gregg W. Langlois, CA Department of Public Health
http://www.cdph.ca.gov/healthinfo/environhealth/water/Pages/Shellfish.aspx

Phytoplankton observations and toxin monitoring for the end of Quarter 1 show that several sites are experiencing diatom blooms south of Pt. Conception. Most of the north coast remains in winter mode, with lots of detritus and a few cells. The exception is Humboldt Bay, where in mid-March an increase in the diversity and numbers of phytoplankton (with low levels of PSP toxins detected in sentinel mussels) was observed. *Pseudo-nitzschia* has been on the increasing at several southern California locations, but mussel samples in Morro Bay, Santa Barbara and San Diego remain negative for domoic acid based on field-screening results. *Alexandrium* has been observed at just one location (Imperial Beach Pier in southern San Diego County). Domoic acid and PSP toxins were not detected in any samples during January and February.

There are currently no quarantines or health advisories in effect. The annual quarantine on sport-harvesting of mussels is scheduled to go into effect on May 1 and will continue through October 31.