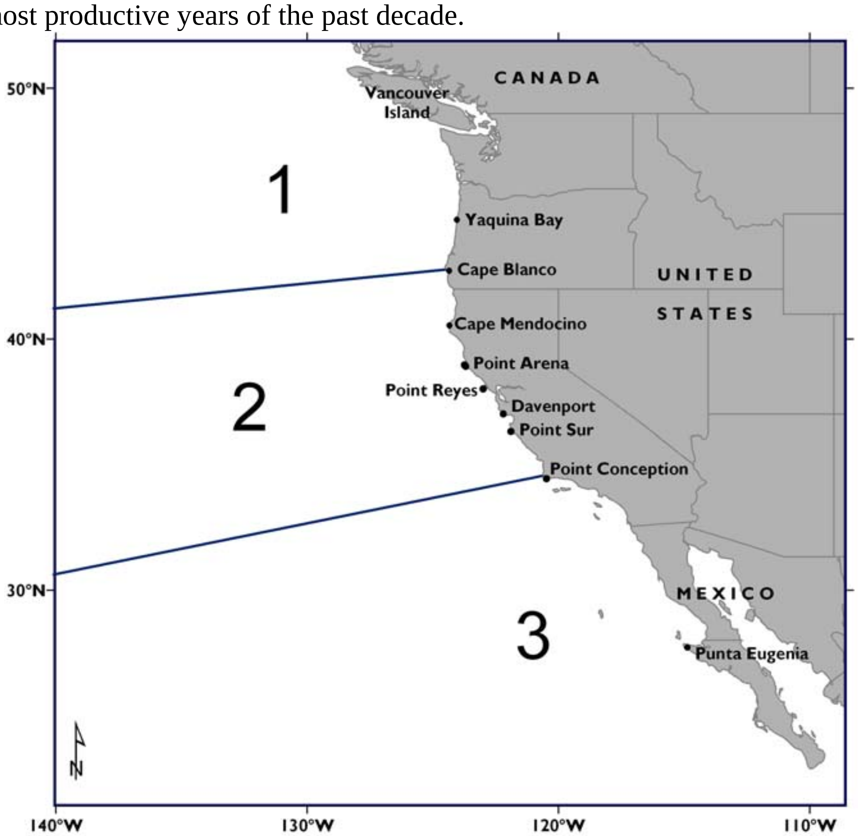
Climatic and Ecological Conditions in the California Current LME for October to December 2008

Summary of climate and ecosystem conditions for quarter 4, 2008 for public distribution, compiled by PaCOOS coordinator Rosa Runcie (email: Rosa.Runcie@noaa.gov).
Full content can be found by the links below.

CLIMATE CONDITIONS

- **El Nino Southern Oscillation (ENSO):** The Multivariate ENSO Index was negative since June 2007 signaling La Nina Conditions. Based on current atmospheric and oceanic conditions, and model forecasts, ENSO-neutral conditions are expected to continue into early 2009.
- **Pacific Decadal Oscillation (PDO):** The PDO continued to be strongly negative. The November value of the PDO index is the 15th consecutive negative value (September 2007 – November 2008) and the most extreme of the current series of negative values.
- **Upwelling Index (UI):** In October, UI values were positive south of Point Arena, CA (39°N). The highest UI values were from Punta Eugenia, Mexico (27°N) to Punta Baja, Mexico (30°N). In November, UI values were positive south of Point Arena, CA (39°N) and negative further south.
- **Madden Julian Oscillation (MJO):** The MJO strengthened in early September and eastward propagation was observed from September into late October. The MJO weakened in early November and its phase rapidly shifted eastward until early December when the MJO weakened and shifted westward.
- **Temperature and Salinity at Newport Hydrographic Line, Oregon:** During the summer of 2008, the coldest and saltiest water was observed since the time series began in 1997. 2008 may be among the most productive years of the past decade.



CCLME (~Vancouver Island to Punta Eugenia) and the three Eco-Regions as defined by U.S. GLOBEC (1992)

ECOSYSTEMS

- **California Current Ecosystem Indicators:**

1. **Copepods**

   Copepod Species Biodiversity: Monthly measures, taken along the Newport Hydrographic (NH) line, Oregon, of copepod species composition track those of the PDO and the SSTs quite closely. The PDO continued to be strongly negative throughout 2008. When the PDO is negative, the copepod community is dominated by a few cold-water, subarctic species. The copepod species-richness has had negative anomalies since 2007.

   Northern Copepod Anomalies: The year 2008 had the second highest biomass of northern copepods since 1996 (0.75) with the highest value observed in 2002 (0.83).

   Neocalanus species: During 2007 and 2008 the very large and lipid-rich species *Neocalanus plumchrus* has been roughly 5 times more abundant than during previous "cold phase" of the PDO. High numbers were seen far offshore, suggesting that more oceanic species of fishes will benefit from their presence.

2. **Krill**
3. **Juvenile Rockfish:** see Coastal Pelagics section below.
4. **Coastal Pelagics:** (Market Squid, Pacific Sardine and Northern Anchovy)

   SWFSC has conducted an annual midwater trawl survey along the Central California coast in late spring (May-June) since 1983. Although the survey targets pelagic juvenile rockfish, many other species are captured and enumerated as well. In 2008, most of the rockfish observed were "northern" species. Market squid were encountered at below average numbers in 2008, but had increased over the 2005-2007 period. By contrast, Pacific sardine numbers were down modestly in 2008, and northern anchovy numbers were down significantly, relative to the 2005-2007 period.

   Sardine:

   Pacific Council News: PFMC adopted an acceptable biological catch or maximum harvest guideline (HG) of 66,932 mt for the 2009 Pacific sardine fishery. The HG for 2009 is approximately 75 percent of 2008 harvest levels.

   NMFS California Current Ecosystem Survey (CCES) in April and July/August 2008 between San Diego, California and Cape Flattery, Washington (This is a coastwide survey by NMFS and separate than CalCOFI): During the April survey Pacific sardine eggs were found at sea surface temperatures (SST) higher than 10°C and less than 15°C. The highest concentration was found between 30 - 35°N. Northern Anchovy eggs were abundant in the Southern California Bight inshore of the sardine eggs.

   During the July/August survey a few sardine eggs were found at the most southern location sampled in waters as warm as 19-20°C SST and a few were also found offshore of the Columbia River where SST was 15-16°C. The highest concentration of anchovy eggs was found off Oregon and Washington at 45-46°N.

5. **Salmon:**

   Catches of juvenile spring Chinook in the June 2008 pelagic trawl survey off Oregon and Washington were the highest of the 11–year time series collected; this is a harbinger for strong returns of Columbia River Chinook beginning in 2010.

6. **Groundfish:**

   Special Management Note: Individual Fishing Quotas for groundfish will begin in 2011. See page 17 for more details. Catches of petrale sole in the limited entry trawl fishery had been tracking behind projections. Therefore, the Council adopted an increase in petrale sole cumulative landing limits beginning December 1.

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7. **Pacific Hake**
8. **Sablefish**
9. **Midwater species**
10. **Cassin's Auklet**

- **Highly Migratory Species (tuna, sharks, billfishes):**
Pacific Council News: According to the Pacific Fisheries Management Council Bigeye tuna biomass is in decline and overfishing may be taking place. Skipjack tuna are difficult to assess but appears to be no conservation concern. Overfishing is occurring with Yellowfin tuna. Striped marlin appears to be much reduced. The U.S. west coast vessels catch less than 1%Current levels of international fishing are considered unsustainable.
- **Invasive Species**
- **Marine Birds and Mammals:**
Birds: NMFS California Current Ecosystem Survey (CCES) results: The bird surveys between San Diego, California and Cape Flattery, Washington in April and July/August 2008 show a significant seasonal (spring vs. summer) shift in the species composition of the marine bird community, with more piscivorous individuals seen in July (72%) compared to April (43%). This shift likely is due to changes in seasonal fish production in the California Current Ecosystem.
Mammals: NOAA ORCAWALE survey completed Legs 3 & 4 (September to November). The survey is done every three years and is designed to estimate the abundance of marine mammals along the U.S. West Coast and to investigate as many aspects of their environment as possible. Results are highlighted on page 19.
- **Harmful Algal Blooms:** This section found on pages 19-21 provides a summary of two toxin-producing phytoplankton species *Pseudo-nitzschia* and *Alexandrium* activity. Reports from Oregon, Washington and California are included. In early December levels of PSP toxins were above alert levels along the OR coast and beaches were closed to mussel and scallop harvesting.
- **Dissolved Oxygen Concentration:** During 2008, oxygen concentrations at station NH 05, five miles Newport, Oregon, at a depth of 50 m were higher during summer months as compared to the past two years. Hypoxic conditions were observed in early August 2008 only.
- **Quarterly Publications and Websites related to the California Current (see Appendix for cumulative list for 2008)**

California Cooperative Oceanic Fisheries Investigations (CalCOFI) Report Vol. 49, 2008
http://www.calcofi.org/newhome/publications/CalCOFI_Reports/v49/CalCOFI_Rpt_Vol_49_2008.pdf

Cooperative Zooplankton Dataspace. Historical access for zooplankton data from southern and central CA.
https://oceaninfo-dev.ucsd.edu/zooplankton/

NOAA Northwest Fisheries Science Center, ocean environmental time series data; salmon forecasting webpage
http://www.nwfsc.noaa.gov, click on "Ocean Index Tools"

Rilov, G. and J.A. Crooks. 2008. "Biological Invasions in Marine Ecosystems: Ecological, Management, and Geographic Perspectives" Springer.
http://www.springerlink.com/content/u5112l/?p=70cc76d152cb42449e1966c136d5c5ec&pi=0

State of the Pacific Ocean 2007
Canadian Science Advisory Secretariat. Science Advisory Report 2008/028
http://www.dfo-mpo.gc.ca/CSAS/Csas/Publications/SAR-AS/2008/SAR-AS2008_028_E.pdf

Sydeman, W. J., and M. L. Elliott 2008
Developing the California Current Integrated Ecosystem Assessment. Module I: Select Time-Series of Ecosystem State
http://www.faralloninstitute.org/Publications/IEA%20Step%201%20Rpt%20Final.pdf

Thayer, J. A., D. F. Bertram, S. A. Hatch, M. J. Hipfner, L. Slater, W. J. Sydeman, and Y. Watanuki. 2008. Forage fish of the Pacific Rim as revealed by diet of a piscivorous seabird: synchrony and relationships with sea surface temperature. Canadian Journal of Fisheries and Aquatic Sciences 65: 1610-1622.
http://www.prbo.org/cms/docs/marine/Thayer2008.pdf

CLIMATE CONDITIONS

El Niño Southern Oscillation (ENSO):

Source: Bill Peterson, NOAA

The Multivariate ENSO Index (MEI) has been negative since June 2007 and has continued negative through 2008 (Figure 1). This indicates La Niña, and cold ocean conditions in equatorial waters of the eastern Pacific. La Niña conditions affect the Northeast Pacific through an atmospheric teleconnection, and generally result in colder–than–normal temperatures. Averaged from January to November 2008, the MEI value is similar to that seen during the last La Niña event of 1999 (-0.65 in 2008 compared to -0.85 in 1999).

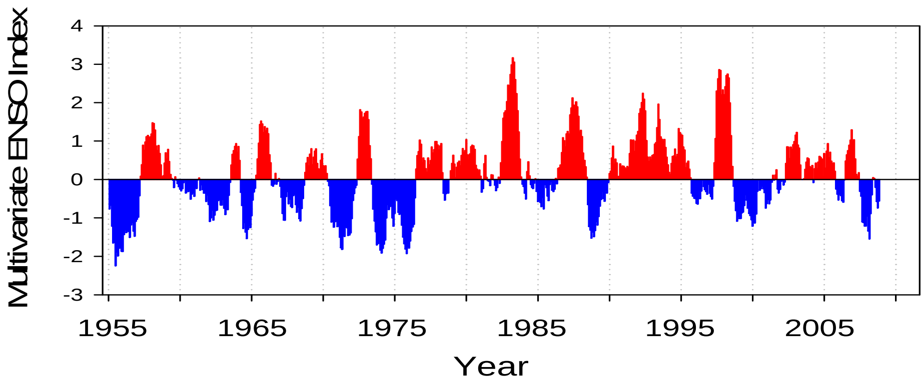

Figure 1. Time of the Multivariate ENSO Index (MEI), 1955 to 2008. Note the extended period of weak El Niño conditions (positive values) from 2002-2006 and the La Niña conditions(negative values) since 2007.

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

Source: The Coast Watch http://coastwatch.pfel.noaa.gov/elnino.html ***(Advisory 2008)***

http://www.cpc.noaa.gov/products/analysis_monitoring/enso_advisory/ensodisc.doc ***(October 2008 report)***

Since mid-October, negative SST anomalies along the central and eastern Pacific Ocean have strengthened in portions of the central and eastern equatorial Pacific Ocean. The subsurface oceanic heat content (average temperatures in the upper 300m of the ocean, Figure 2) continued to decrease in response to the strengthening of negative temperature anomalies at thermocline depth in the east-central Pacific.

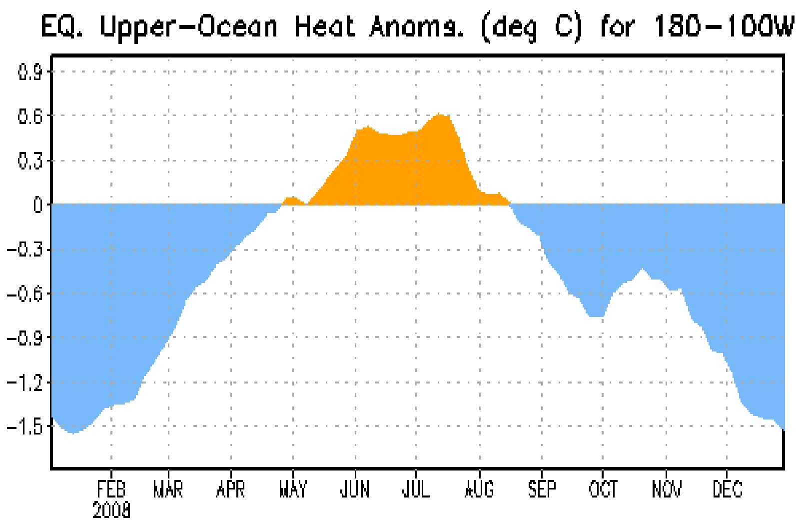

Figure 2. Area-averaged upper-ocean heat content anomalies (°C) in the equatorial Pacific (5°N-5°S, 180º-100ºW). Heat content anomalies are computed as departures from the 1982-2004 base period pentad means. The upper ocean heat content was below-average across the eastern half of the equatorial Pacific Ocean between January 2007 and April 2008, and above-average from early May 2008 through mid-August 2008. Since mid-August 2008, the heat content anomalies have been below-average. The negative heat content anomalies have strengthened since mid-October 2008.

While the model spread continues to include possibilities ranging from El Niño to La Niña, the recent decrease in subsurface and surface temperatures favors a return to La Niña over the development of El Niño. However, based on current atmospheric and oceanic conditions, recent trends, and model forecasts, ENSO-neutral conditions are expected to continue into early 2009.

Pacific Decadal Oscillation (PDO):

Source: Bill Peterson, NOAA

Seven hydrographic stations along the Pacific Coast of North America are sampled biweekly from 1 to 25 miles from shore with water depths at the stations ranging from 20 m to 300 m.

The PDO continued to be strongly negative throughout 2008 (Figure 3). Comparing PDO behavior over the past 13 years, shows that the most negative value for winter occurred in winter 1999–2000, and the second most negative value in winter 2007–2008. PDO values for summer also indicate that 2008 can be characterized as a year of greatly improved ocean conditions. Averaged over the May-September upwelling season, the PDO value was the most negative in the 13–year time series, and the most negative since 1956. The summer-averaged PDO in 2008 was -6.08; the next lowest value was -6.01 (in 1962) and -6.36 (in 1956).

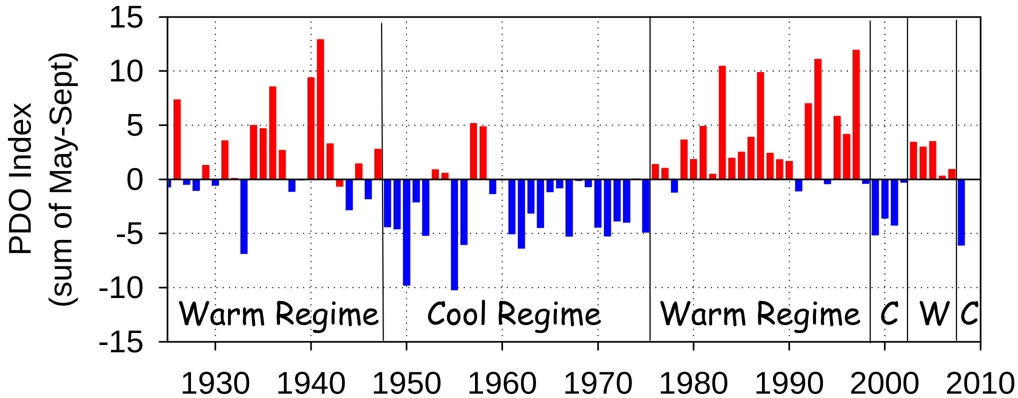

Figure 3. Time series of the PDO summed over May-September, 1925 to 2008. Note that the summer-time value in 2008 was the most negative since 1956.

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

Environmental Research Division, NOAA, NMFS

The October PDO index is the 14th consecutive negative value (Figure 4). It is interesting to note that El Niño Southern Oscillation (ENSO) indices are also tending toward more negative values, such as those recorded earlier in 2008 (Figure 2 and http://www.cpc.noaa.gov/products/analysis_monitoring/enso_advisory/).

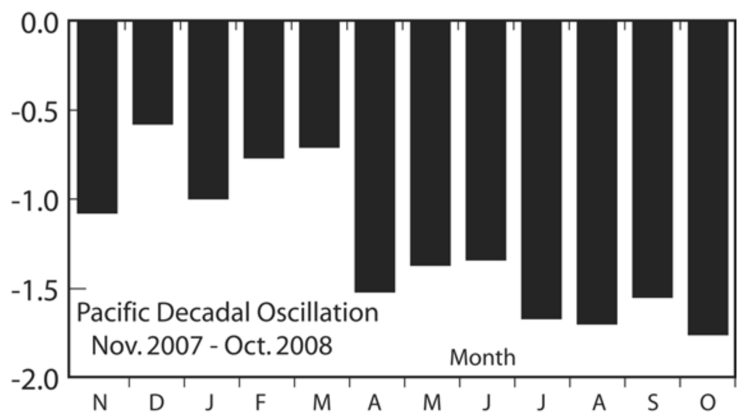

Figure 4. This graph presents monthly values for the PDO Index from November 2007 to October 2008 (http://jisao.washington.edu/pdo/). The October PDO index is the most extreme of the current series of negative values. The last four monthly PDO indices were the first since January 2000 to have values less than or equal to -1.55.

Regional Oceanic Conditions:

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

Monthly mean sea surface temperature (SST) fields showed weakening of the negative SST anomalies observed in September and October. Areas of positive anomaly, to 1.0°C, expanded and replaced negative anomalies along the coast between 34°N and 40°N. Offshore areas of negative anomaly dissipated west of 122°W and south of 40°N. Areas of negative SST anomaly, to -1.5°C, persisted north of 40°N and west of 125°N.

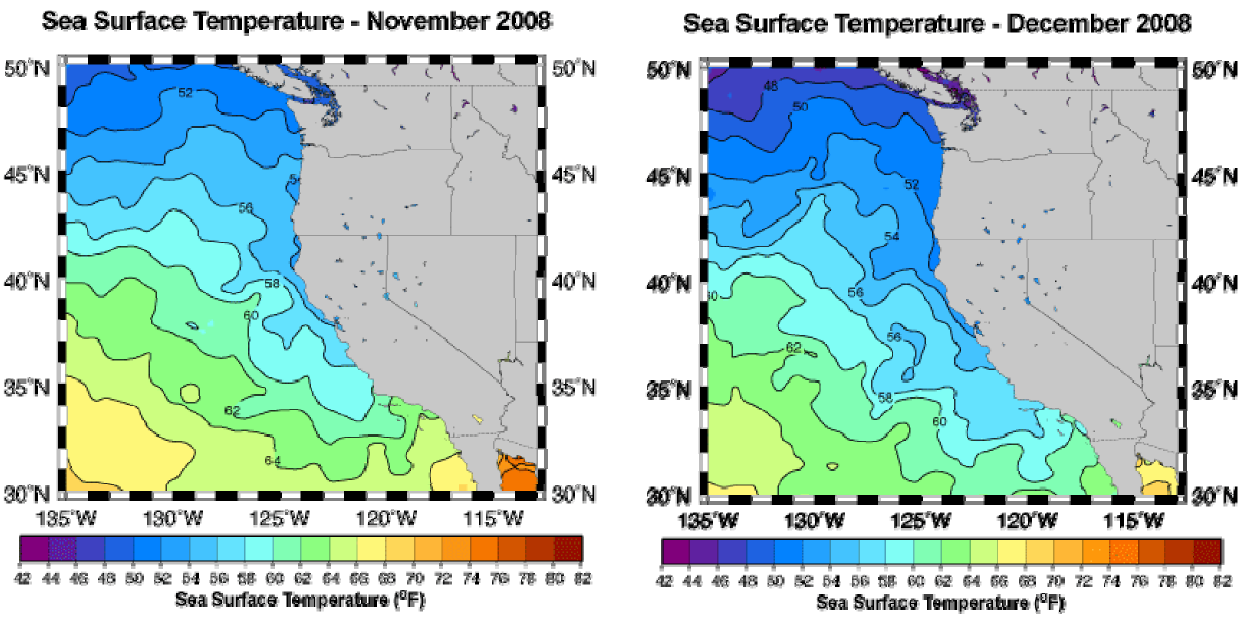

Figure 5. Regional oceanic conditions along the California current.

Upwelling Index:

Source: Bill Peterson, NOAA

Upwelling was initiated early in the year (day 88; 28 March), but did not become strong until one month later on 28 April. Winds remained steady through much of the summer except for a lull (and southwesterly storms) in August, from days 204 through 240.

October and November Upwelling:

Source: **http://coastwatch.pfel.noaa.gov/cgi-bin/elnino.cgi NMFS/SWFSC/ERD monthly coastal upwelling index**

Upwelling Index (UI) values were positive south of 39°N. The highest UI values were from 27° to 30°N. Positive wind-stress curl was observed along the coast between 35° and 42°N. In November, UI values were positive south of 39°N and negative further north. UI was positive throughout November at 33°N, but weakened after the 15th, indicating North Pacific high atmospheric pressure system weakening.

Sea Surface Temperature:

Source: Bill Peterson, NOAA

In line with the strongly negative PDO and MEI, wintertime sea surface temperatures (SSTs) measured at the NOAA Buoy 46050 off Newport, Oregon (Dec 2007-March 2008) were the coldest in 11 years. SSTs measured at the NOAA Buoy during the summer of 2008 were also among the coolest measured during the 13 year time series (Figure 6). The one exception was of August 2008 when a month-long warming event was observed. Summertime SST values at station NH 05, Newport, Oregon, were also cooler than normal by -0.7°C, second only to the year 2000 when the anomaly was -0.85°C.

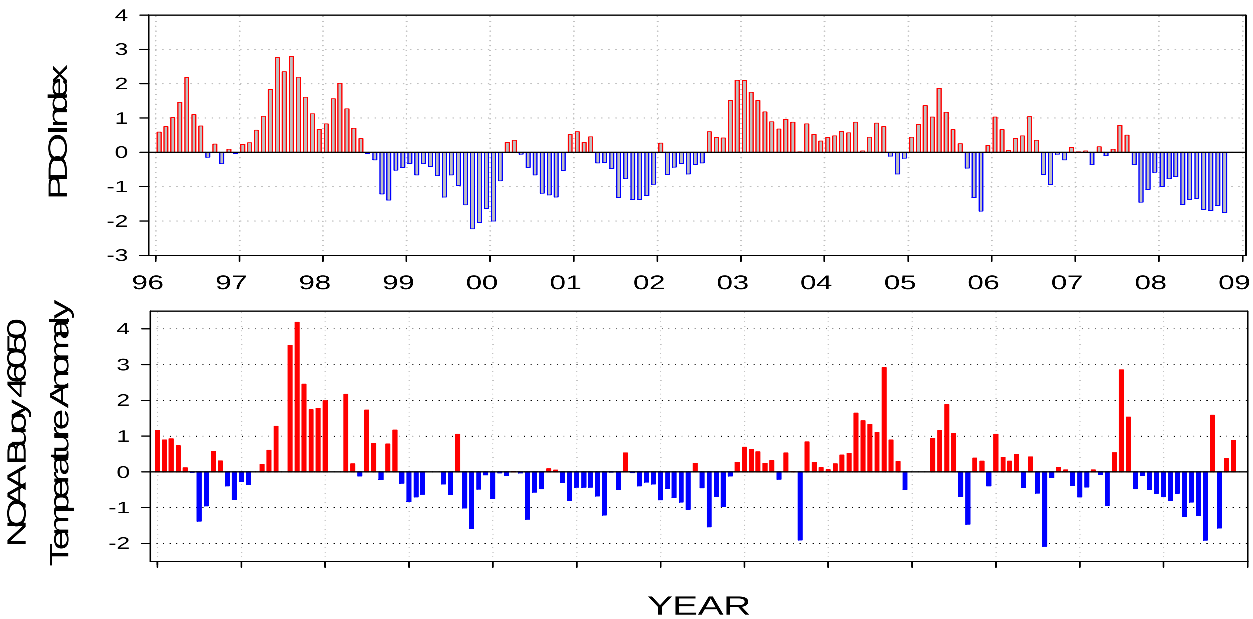

Figure 6. Time series of PDO (upper) and the monthly temperature anomalies at the NOAA Buoy 46050 (lower) since 1996. Note the close association of the PDO with SST.

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)***

October through early December:

The MJO strengthened in early September and eastward propagation has been observed from September into late October. The 200-hPa velocity potential anomalies (5°S-5°N) increased during late October. October 9th -13th 850-hPa vector westerly wind anomalies weakened across the Pacific. Late October, the MJO index indicated a continued strong MJO signal.

During the first week of November the MJO weakened and its phase rapidly shifted eastward to the eastern hemisphere. Westerly and easterly 200-hPa zonal wind anomalies shifted eastward from the Date Line to the east Pacific Ocean both in October and November. The MJO became less coherent during the month of November. Mid and late November, 850-hPa vector wind easterly anomalies decreased in the western Pacific Ocean but expanded eastward towards the central Pacific Ocean. Late November, the 200-hPa zonal westerly wind anomalies strengthened over the central Pacific Ocean. During the last week of November and into early December the MJO index weakened and shifted westward.

Deep Water Temperature and Salinity at Newport Hydrographic (NH) line, Oregon:
Source: Bill Peterson, NOAA
Temperature and salinity profiles are recorded every 2 weeks during the biweekly monitoring cruises off Newport. During the summer of 2008, the coldest and saltiest water was observed since the time series began in 1997 (Figures 7 and 8). Values were similar to those measured during the earlier years with negative PDO values – 1999 and 2001, but slightly colder. Sea surface temperatures at NH 05 were relatively low (except for August) indicating that winds were sufficiently strong to bring upwelled water to the surface, promoting high rates of phytoplankton production. Thus, 2008 may be among the most productive years of the past decade. This situation contrasts with that of summer 2007, when very cold, deep water was observed on the shelf but seldom reached the sea surface, as shown by the relatively high SST values during 2007.

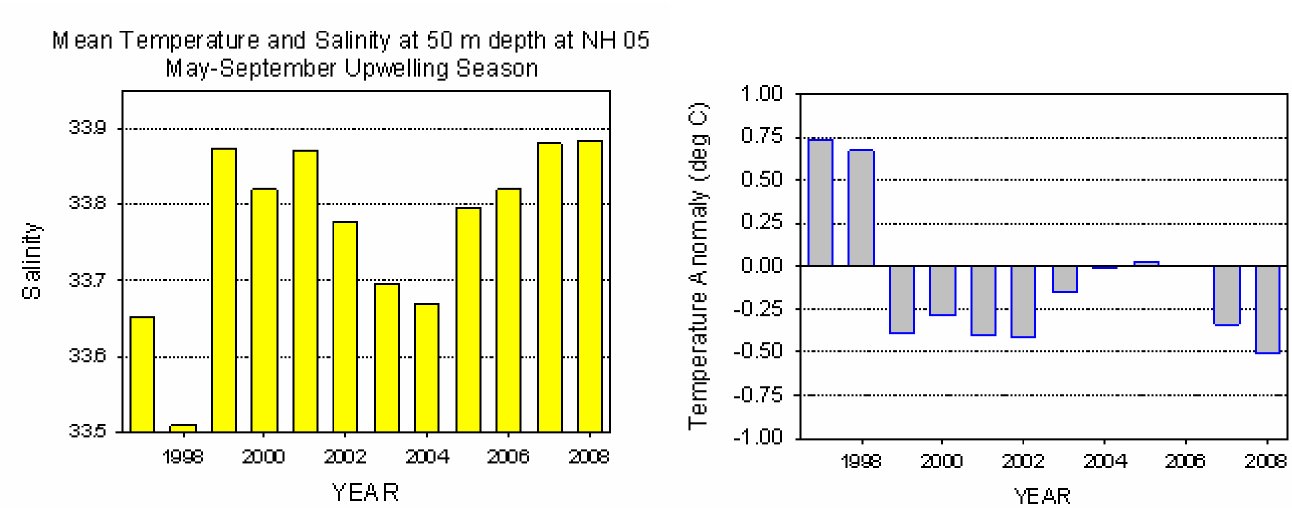

Figure 7. Salinity in deep water at station NH 05, 1997-present, averaged from May-September (Left). Temperature anomalies for the same period (Right). Note that the summer of 2008 was colder and saltier than other years.

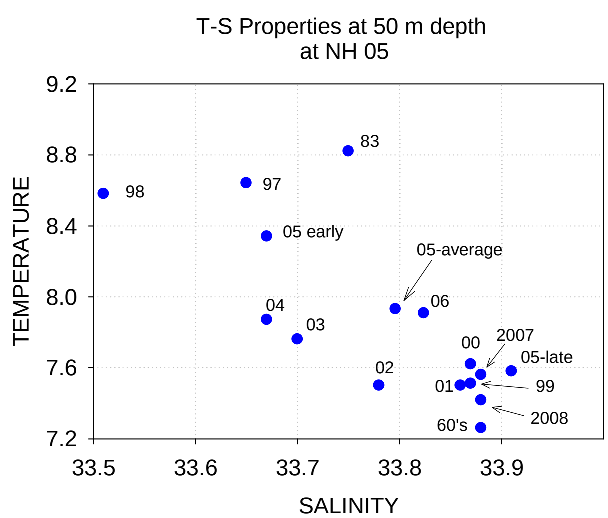

Figure 8. A plot of temperature and salinity,using values averaged over May-September from deep water at station NH-05. Note that 2008 is the coldest of the time series which began in 1997, but not as cold as the deep water temperatures averaged for data from the 1960s.

ECOSYSTEMS

California Current Ecosystem Indicators:

Copepods:

Source: Bill Peterson, NOAA

Copepod Species Biodiversity (Richness): Monthly measures, taken along the Newport Hydrographic (NH) line, Oregon, of copepod species composition track those of the PDO and SSTs quite closely (Figure 9). When the PDO is negative, surface waters are cold and the copepod community is dominated by only a few cold–water, subarctic species. However, when the PDO is positive, SSTs are warm, and the community is dominated by a greater number of warm–water, subtropical copepod species. Figure 9 shows moderately low species–richness values during 2008. These values are similar to those observed in the 1999–2002 cool phase of the PDO, but not as consistently low as seen during the year 2000.

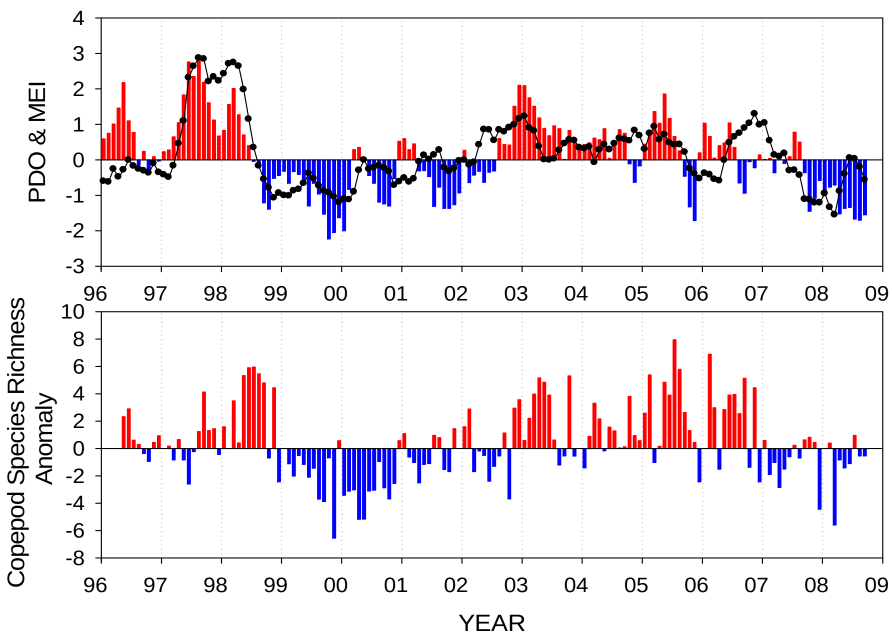

Figure 9. Time series of the PDO, MEI and Copepod species richness. Note that species richness tracks the PDO and MEI fairly closely; also note that richness has had negative anomalies since 2007.

Northern Copepod Anomalies: Copepods are transported to the Oregon coast either from the north or from the east and south. Copepods that arrive from the north are cold–water species that originate from the coastal Gulf of Alaska and are referred to as "northern copepods." Their presence indicates that coastal Gulf of Alaska waters are being fed into the coastal California Current. The "northern copepod index" is the log biomass anomaly of three species of cold water copepods, *Calanus marshallae*, *Pseudocalanus mimus* and *Acartia longiremis*. This index was recently re-calculated, using the monthly anomalies of the log biomass of these three species, with the averaging period based on the samples collected from 1996-2008. In the past, quarterly anomalies were used as the basis for making this calculation, therefore the values which we now use (based on monthly anomalies) are somewhat different from the old values (based on quarterly anomalies). New monthly anomaly values are available upon request to the author (bill.peterson@noaa.gov).

Figure 10 shows the time series of the PDO and the northern copepod biomass anomalies. The year 2008 had the second highest biomass of northern copepods since 1996 (a value of 0.75) with the highest value observed in 2002 (0.83). In contrast, the smallest biomass was during the 1998 El Niño event (-1.96) and during the summer of 2005 (-1.78). Biomass of northern copepods has been steadily increasing since the dismal summer of 2005. For example, the difference in $\log_{10}$ biomass between 2005 and 2008 was 1.78 + 0.75 = 2.53, or 339 times greater in 2008 compared to 2005 (339 = 10^2.53).

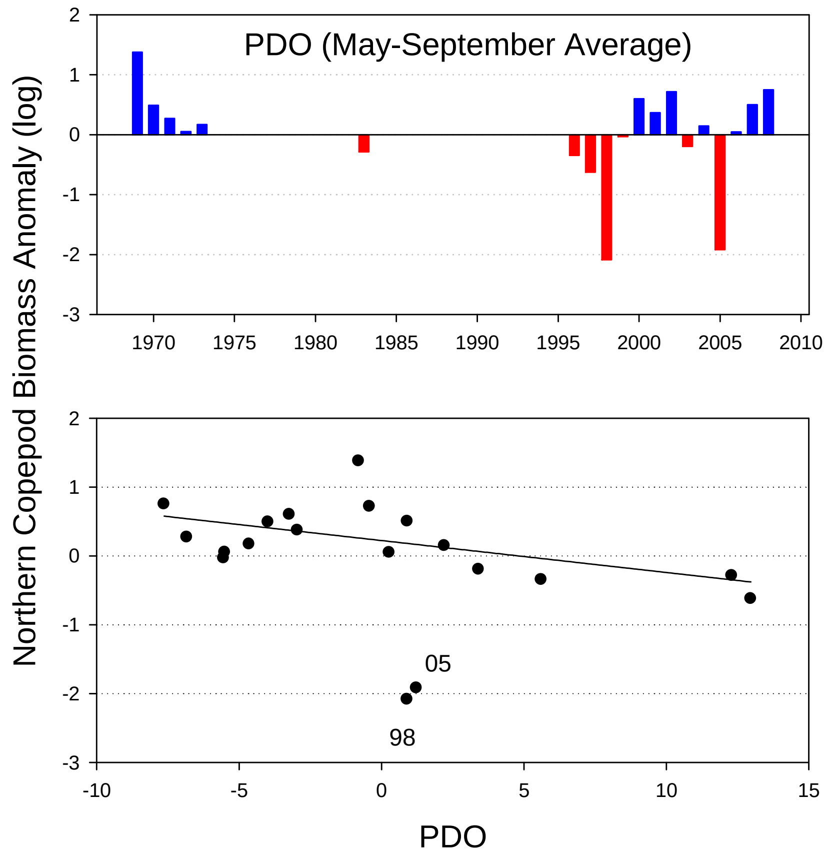

Figure 10. Northern copepod biomass anomalies from station NH-05, Oregon, including historical data (1969-1973, 1983) and data from 1996-present. The value of the biomass anomaly for 2008 is the similar to values seen in 2000 and 2002.
Lower plot: scattergram of the northern copepod biomass anomaly plotted against the PDO. Note that the more negative the PDO the greater the biomass of northern (lipid-rich) copepods. The line is the regression of copepods on PDO ($p = 0.015$) and excludes values from 1998 and 2005.

Neocalanus (copepod) species: Of particular interest in 2008 (and 2007) has been the presence in large numbers of the very large and lipid–rich *Neocalanus* species. They frequently occur off the Oregon coast during winter and spring months, and their presence indicates the presence of subarctic waters off Oregon that originated from the deep waters of the Gulf of Alaska. However, during both 2007 and 2008, the species *Neocalanus plumchrus* has been roughly 5 times more abundant than during the previous "cold phase" of the PDO. Moreover, high numbers were seen far offshore—to at least 125 miles from shore—suggesting great prey species for more oceanic species of fishes, such as sablefish. Zooplankton samples collected in December 2008 also contained high numbers of younger stages of *Neocalanus cristatus*, suggesting the initiation of high biomass of copepods of this genus for 2009.

Rockfish Juveniles:
See below: Ecosystem indicators for the Central California Coast, May-June 2008
Coastal Pelagics:

Ecosystem indicators for the Central California Coast, May-June 2008

***Source*: Steve Ralston, John Field and Keith Sakuma, Fisheries Ecology Division, SWFSC**

SWFSC has conducted an annual midwater trawl survey along the Central California coast in late spring (May-June) since 1983, on the NOAA ship David Starr Jordan. Although the survey targets pelagic juvenile rockfish for fisheries oceanography studies and for developing indices of year class strength, many other species are captured and enumerated as well. The results here (Figure 11) summarize trends since 1990, as not all species were consistently identified in earlier years.

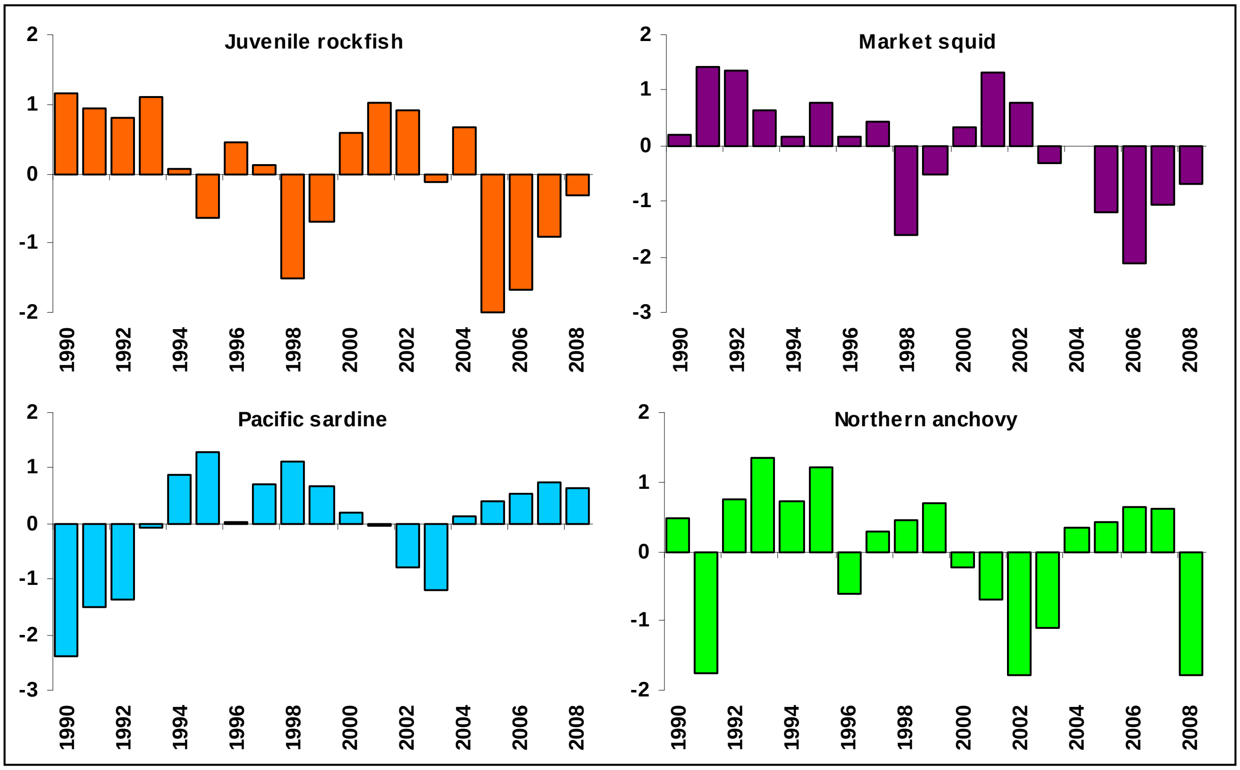

Figure 11. These graphs show the standardized anomalies from the log of mean values by year for four key forage species that are well sampled in this survey. There is typically strong covariance among the ten most frequently encountered rockfish species in the survey. However in 2008 most of the rockfish observed were "northern" species such as widow, canary, and yellowtail rockfish, while the traditionally most abundant species in this region, particularly shortbelly rockfish, remained at record low levels. Market squid were also encountered at below average numbers in 2008, but had increased over the 2005-2007 period. By contrast, Pacific sardine numbers were down modestly in 2008, and northern anchovy numbers were down significantly, relative to the 2005-2007 period.

The trends observed in these four indicators are consistent with trends across a number of other taxa. When the covariance among fifteen of the most frequently encountered species are evaluated in a Principal Components Analysis (PCA), there are strong loadings for the groundfish young-of-the-year taxa (rockfish, Pacific hake, rex sole and sanddabs) as well as cephalopods, and euphausiids, with slightly weaker and opposite loadings for Pacific sardine, northern anchovy, and several species of mesopelagic lanternfishes. The clupeoid-mesopelagic group was prominant during the 1998 El Niño and during the anomalous 2005-2007 years, while the groundfish group prospered during the cool-phase between 1999 and 2003. Results from this year seem to represent a return to approximately long term mean conditions. Figure 12 shows the first and second principle components of that analysis, while Figure 13 presents the loadings of the first and second PCs; these two PCs capture 39 and 14% of the total variability in these data respectively.

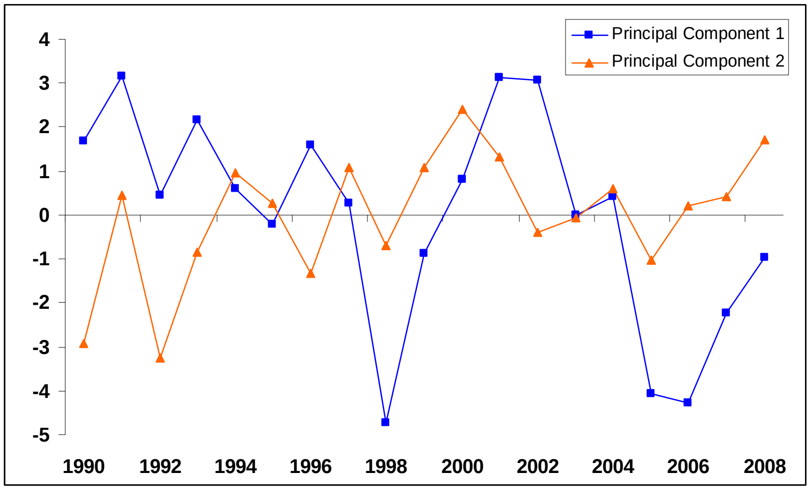

Figure 12. The first and second principle components.

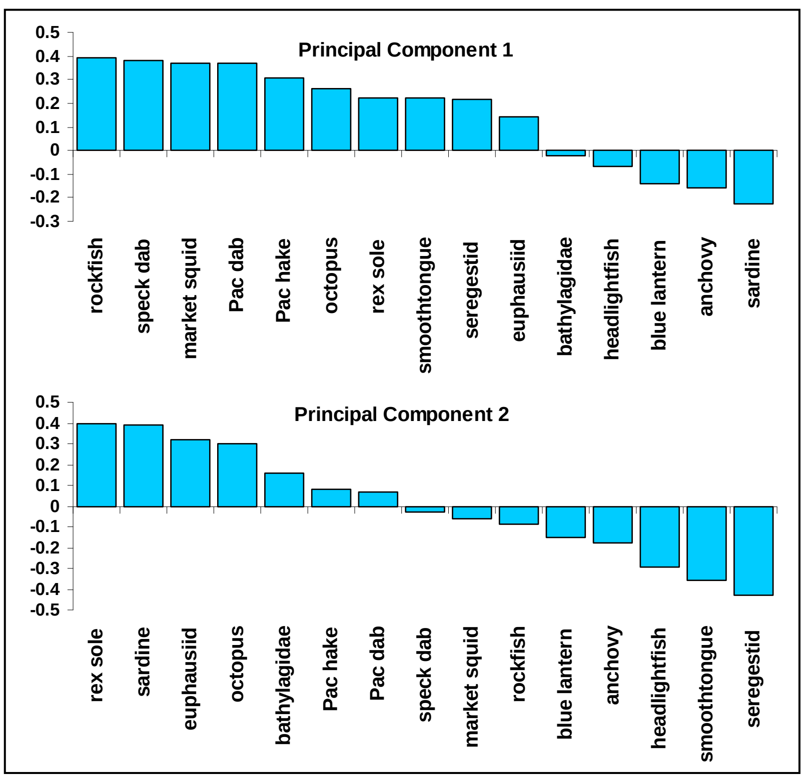

Figure 13. The loadings of the first and second principle components.

Sardine:

***Source: Pacific Council News* http://www.pcouncil.org/newsletters/currentnews.pdf**

Council Adopts Reduced Pacific Sardine Fishery Specifications for 2009

The Council adopted an acceptable biological catch (ABC) or maximum harvest guideline of 66,932 mt for the 2009 Pacific sardine fishery. The Council recommended that 1,200 mt of the allowable Pacific sardine harvest be set aside for dedicated research activities during the second allocation period in 2009. The Council also recommended an adjusted allocation of 59,232 mt as the harvest guideline for the directed fishery to be allocated seasonally per the existing allocation framework. To allow for incidental landings of Pacific sardines in other CPS fisheries, and to help ensure the fishery does not exceed the total harvest guideline or the ABC, the Council adopted a set-aside of 6,500 mt allocated across seasonal periods.

Total HG/ABC = 66,932 mt **Research set aside = 1,200 mt** **Adjusted HG = 65,732 mt**				
	Period 1	Period 2	Period 3	
	Jan. 1 – Jun. 30	Jul. 1 – Sept. 14	Sept. 15 – Dec. 31	Total
Seasonal Allocation (mt)	23,006	26,293	16,433	65,732
Incidental Set Aside (mt)	1,000	1,000	4,500	6,500
Adjusted Allocation (mt)	22,006	25,293	11,933	59,232

Pacific sardine & Northern anchovy egg distributions

Source: Sam McClatchie, NOAA, SWFSC, Report on the NMFS California Current Ecosystem Survey (CCES) between San Diego, California and Cape Flattery, Washington in April and July/August 2008 (Note the CCES is an additional survey to CalCOFI).

Pacific sardine and Northern anchovy egg distributions along the transects were well resolved by the Continuous Underway Fish Egg Sampler (CUFES). In April 2008 very few Pacific sardine eggs were found north of San Francisco (37.9°N), and no eggs at all were detected north of Paint Arena (or north of 39°N) (Figure 14). Sardine eggs were found in offshore waters to the south of San Simeon (36°N) (Figure 14). Highest concentrations were found between 30 - 35°N, and the distribution pattern indicates that eggs would likely be found to the south of the U.S.-Mexican border. There was some evidence for two sardine egg concentrations: one more offshore at approximately 123°W and a second concentration in the center of the Southern California Bight (SCB, 119°W) (Figure 14). In contrast to April very few sardine eggs were found anywhere along the U.S. West coast during the July/August survey (Figure 15). Northern anchovy eggs were abundant in the SCB inshore of the sardine eggs in April. No anchovy eggs were found north of the SCB in April (Figure 14). During the July/August survey a few anchovy eggs were found in the SCB, but the highest concentrations were found off Oregon and Washington at 45-46°N (Figure 15).

Pacific sardine eggs were found at sea surface temperatures (SST) higher than 10°C and less than 15°C in April (Figure 14). In July/August a few sardine eggs were encountered at the most southern location sampled in waters as warm as 19-20°C SST (Figure 15). Relatively few sardine eggs were also found offshore of the Columbia River where SST was 15-16°C (Figure 15).

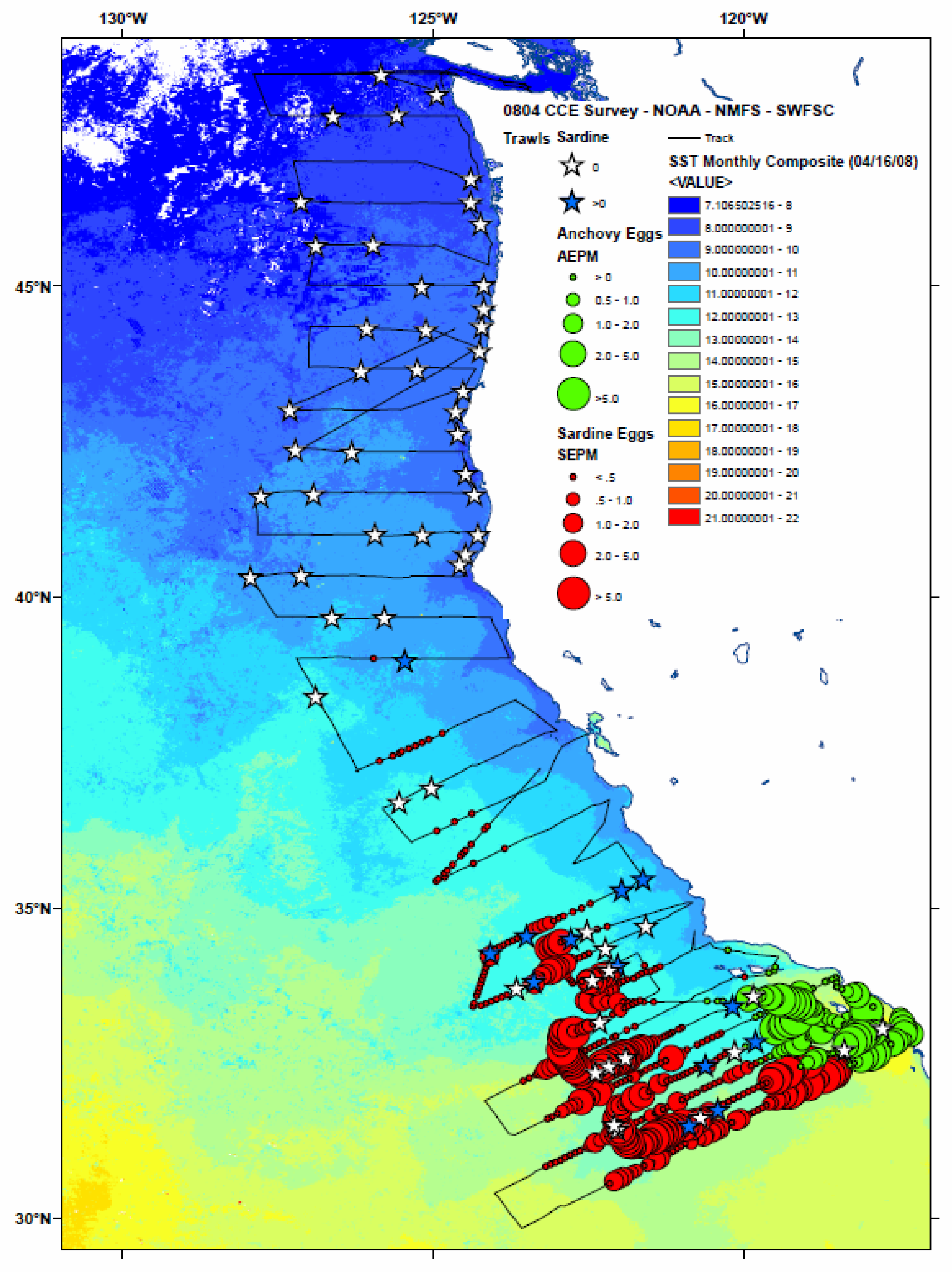

Figure 14. Egg distributions from CUFES and the locations and catches from surface trawls overlaid on a month-long composite of sea surface (satellite SST) for the April 2009 CCES survey.

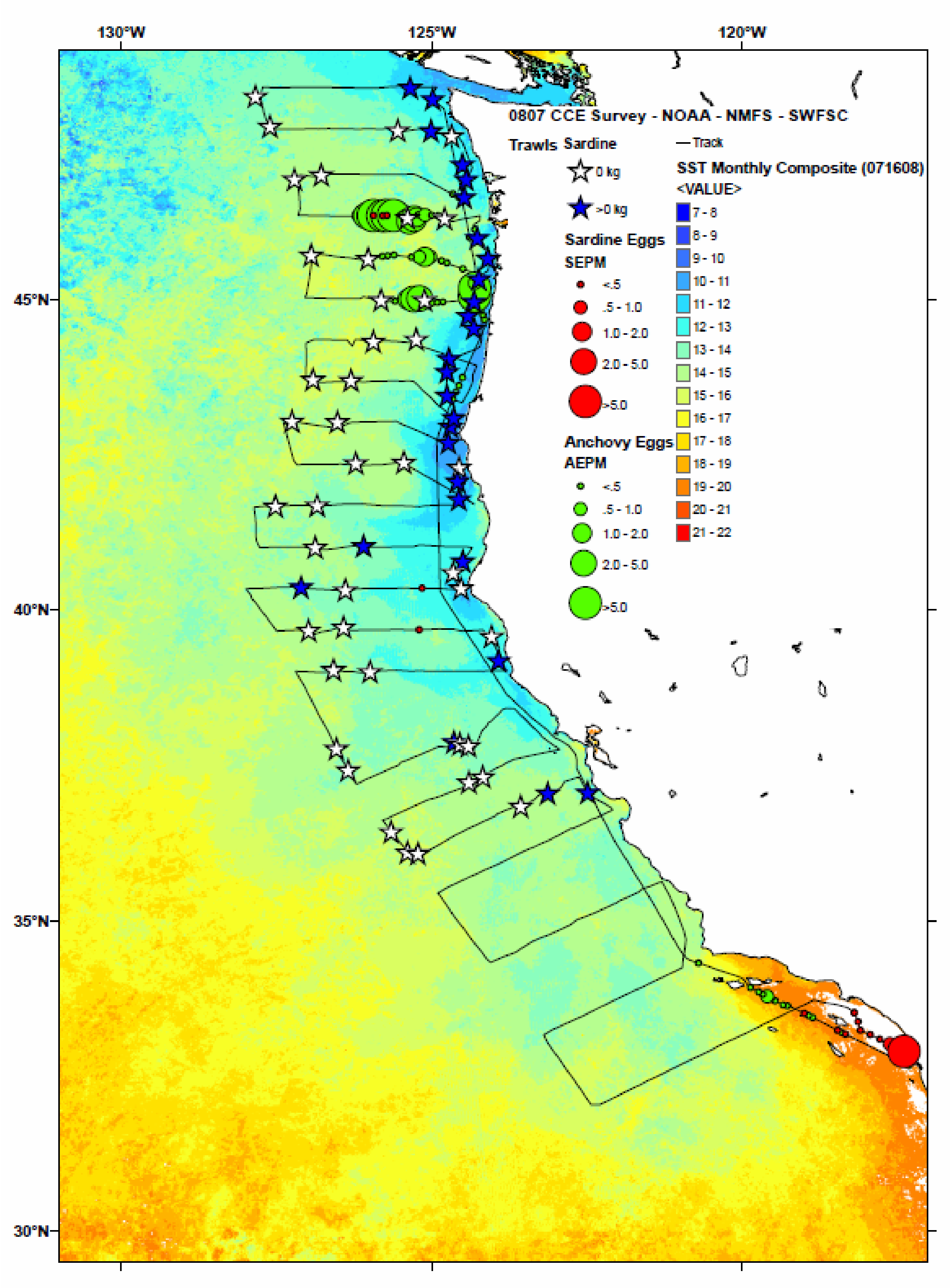

Figure 15. Egg distributions from CUFES and the locations and catches from surface trawls overlaid on a month-long composite of sea surface temperature (satellite SST) for the July/August 2009 CCES survey.

Coastal Pelagic Species

Salmon:

Pacific Council News on Salmon:

Source: Pacific Council News **http://www.pcouncil.org/newsletters/currentnews.pdf**

Salmon stocks showed upward trends in 2008 including Snake River spring Chinook, Snake River fall Chinook, Sacramento Winter Chinook, Central Valley spring Chinook, and Oregon Coastal Natural Coho. Salmon natural stocks continue to be depressed in other areas including Puget Sound Chinook, Lower Columbia River natural tule Chinook, Columbia River upriver spring Chinook, California coastal Chinook, lower Columbia River natural Coho, and California Central Coastal Coho.

Juvenile Chinook Salmon:

Source: Bill Peterson, NOAA

Juvenile spring Chinook juveniles caught in the June 2008 pelagic trawl survey in coastal waters off Washington and Oregon were the highest number recorded in the 11–year time series.

Counts of adult Fall-run and Spring-run Chinook salmon and Spring Coho salmon at Bonneville Dam show a positive trend from a recent low in 2006 (Figures 16 & 17 respectively).

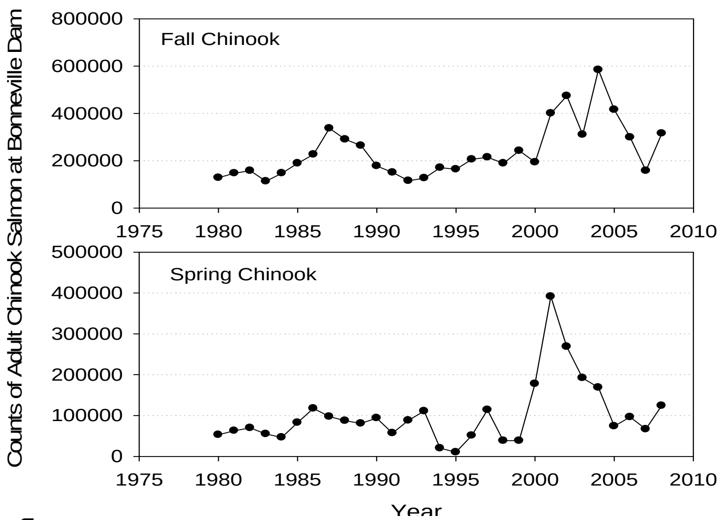

Figure 16. Counts of Fall-run Chinook salmon (upper) and spring-run Chinook salmon (lower) at Bonneville Dam. Note that both life-history types performed relatively well in the early part of the 21st century, during the negative phase of the PDO. Note also the increased run-size in 2008 for both types.

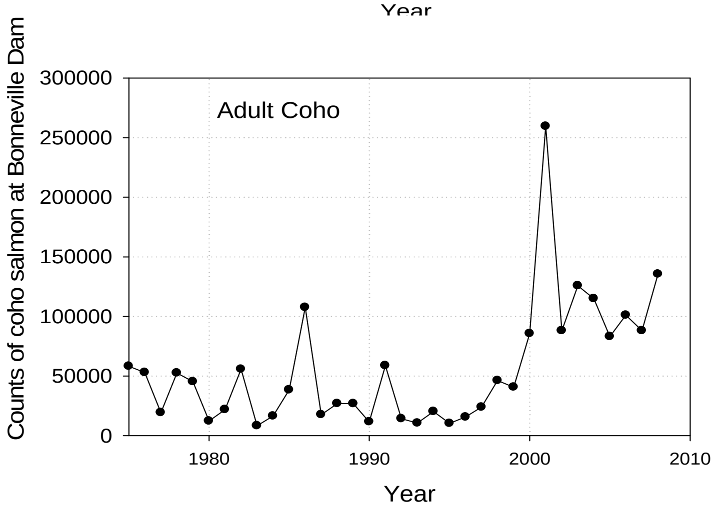

Figure 17. Counts of adult coho salmon at Bonneville Dam, 1975 to present. Note the recent increases in salmon counts, beginning in the year 2000, as compared to the runs from 1955 through 2000.

Groundfish Inseason Adjustments to 2008 and 2009 Groundfish Fisheries
Source: Pacific Council News **http://www.pcouncil.org/newsletters/currentnews.pdf**
"Management Note" At the PFMC November meeting the council voted to recommend a system of Individual Fishing Quotas (IFQs) for the shore-side trawl fishery. The IFQ and co-op programs will provide individual vessels a certain amount of fish to catch (quota), and will hold them responsible for not exceeding their allocation. Fishing under the IFQ program would start in 2011 at the earliest.
Inseason adjustments to 2008 Groundfish Fisheries:
Catches of petrale sole in the limited entry trawl fishery had been tracking behind projections. Therefore, the Council adopted an increase in petrale sole cumulative landing limits beginning December 1. Large footrope trawl gear can be deployed north of 40°10'N latitude and the catch limit increased from 45,000 lb/2 months to 60,000 lb/2 months. Also, all trawl gears can be used south of 40°10'N latitude and the catch limit increased limit from 65,000 lb/2 months to 75,000 lb/2 months.
Inseason adjustments to 2009 Groundfish Fisheries:
The Council adopted management measures based on the most recently available catch information and evaluated performance of the 2008 fisheries. The Council increased the 2009 Period 1 limits of sablefish, shortspine thornyhead, and Dover sole.

Highly Migratory Species (tunas, shark, billfishes):
Source: Pacific Council News **http://www.pcouncil.org/newsletters/currentnews.pdf**
There are Fisheries Management Plans for tunas, sharks, billfishes, and Dorado. Most highly migratory species are targeted by international fisheries and managed through international agreements. Current levels of international fishing are considered unsustainable: U.S. West Coast vessels catch 17% of the north Pacific albacore tuna catch. Albacore tuna are not considered overfished. However, there is some concern that albacore may be too aggressively fished, and the International Scientific Committee, which assesses albacore, has called for a precautionary approach to harvest.

U.S. West Coast vessels catch less than 1% of the following species: Bigeye tuna (biomass is in decline). Skipjack tuna (little known; but appears to be no conservation concern); Yellowfin tuna (overfishing is occurring); Striped marlin (appears to be much reduced).

Marine Birds and Mammals:
Marine Birds: Bird Observations by Point Reyes Bird Observatory (PRBO)
Source: Sam McClatchie, NOAA, SWFSC, Report on the NMFS California Current Ecosystem Survey (CCES) between San Diego, California and Cape Flattery, Washington in April and July/August 2008
The total distance surveyed for birds by PRBO in the Southern California Bight during the April, 2008 cruise was 1,149 km for a total surveyed area of 343 km^2. PRBO observers identified 904 out of 1200 total known marine bird species. Marine birds occurred in the highest numbers in nearshore areas, with concentrations north of Point Conception, in the middle of the Southern California Bight, and near San Diego (Figure 18). The most abundant marine birds represented both migratory and breeding species in the California Current System. Birds identified included: the red-necked phalaropes which were most concentrated close to shore north of Point Conception; Northern Fulmars which showed concentrations near San Diego and north of Point Conception; California Gulls whose concentrations seen in the survey area likely represent juveniles and non-breeding adults; Sooty Shearwaters that were widely dispersed in nearshore areas at the time of the survey; Western Gulls were found concentrated just north of Point Conception and near the Channel Islands.

Marine bird distributions generally reflected likely areas of enhanced productivity. All species showed concentration in the cold, productive waters north of Point Conception; this was especially true of the Red-necked Phalarope. Other areas of concentration included transition areas between water masses that are often sites of enhanced primary and secondary productivity. Most species also showed concentrations in a pocket of warm water near San Diego.

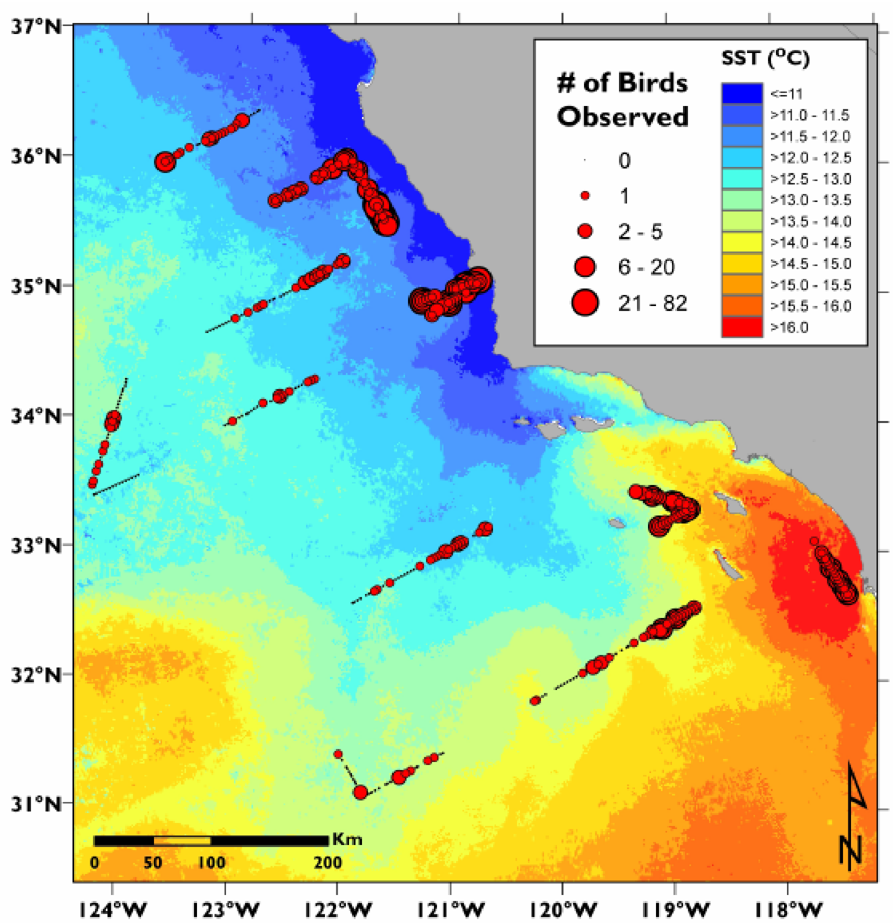

Figure 18. Along-transect spatial pattern of all birds counted in April 2008 overlaid on a monthly composite of satellite sea surface temperature.

Altogether, during the April CCES survey, 45 species of birds were identified. Most of these species were marine birds or water birds. During July and August CCES survey, 57 species of birds were identified.

During April, a total of 10,266 birds were counted. The most common bird was the red phalarope (28% of sightings), a planktivorous shorebird. The next most common bird (16%) was the common murre, a piscivorous (and occasionally planktivorous) diving bird. Other species seen that are capable of capturing anchovy and sardine included the sooty shearwater (8%), the rhinoceros auklet (7%), gulls (*Larus species*, 6%), the black-footed albatross (2%), the northern fulmar (2%) and the Pacific loon (2%).

During July and August, a total of 11,925 birds were detected during the survey. Unlike in April, when spring migrants accounted for almost half of the species seen, the summer resident sooty shearwater (29%) and common murre (20%) dominated the community. Both of these species consume pelagic schooling fishes such as anchovy and sardine. Other species seen include the gulls (*Larus species*, 9%), the pink-footed shearwater (4%), the northern fulmar (4%), the Brandt's cormorant (2%), the black-footed albatross (2%) and the rhinoceros auklet (2%)

These data clearly show a significant seasonal (spring vs. summer) shift in the species composition of the marine bird community, and that relatively more piscivorous individuals were seen in July (72%) compared to April (43%). This shift is likely due to changes in seasonal fish production in the California Current Ecosystem.

Marine Mammals:

October and November:

Source: PRD, SWFSC **http://swfsc.noaa.gov/textblock.aspx?Division=PRD&ParentMenuId=562&id=13024#**

NOAA's ORCAWALE survey is a 4-month long cruise is designed to estimate the abundance of marine mammals along the U.S. West Coast and to collect oceanographic data.

During Leg 3, September 14 – October 4, the ORCAWALE surveyed off the coast of northern and central California. Sightings and data collection during leg 3 included 71 cetacean sightings, collected 39 biopsies including 3 fin whales, and 92 acoustic encounters. Sightings during Leg 4, October 5 – November 1, included many short-beaked common dolphins, fin whales, blue whales, and assorted less abundant species. One notable observation was a sighting of two pygmy or dwarf sperm whales. This is a rare and cryptic genus that has not been recorded during ORCAWALE coastwide surveys since 1993. Another highlight was an enormous school of long-beaked common dolphins, *Delphinus capensis*, near Pt. Conception. During Leg 5, November 2-15, a single blue whale ID, along with 20 short-beaked common dolphin IDs were collected photographically. The acoustics report included three sperm whales, 10 common dolphins, 1 mixed common and striped dolphin school, 27 unidentified cetaceans (clickers) and 22 unidentified dolphins (whistlers).

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 paralytic shellfish poisoning (PSP), and *Pseudo-nitzschia* is the diatom that produces domoic acid.

Washington HAB Summary

Source: WA Department of Fish and Wildlife **http://www.wdfw.wa.gov/fish/shelfish/razorclm/levels/levels.htm**

The Washington Department of Fish and Wildlife (WDFW) provides the latest information on domoic acid levels from five major management zones, which include Long Beach, Twin Harbors, Copalis Beach, Mocrocks, and Kalaloch. Regular samples of both razor clams and Dungeness crab are collected by WDFW and are tested for domoic acid levels. The level of domoic acid determined to be unsafe for human consumption by the Federal Food and Drug Administration (FDA) is 20 ppm in shellfish meat tissue. No unusual events were reported in Quarter 4. Please visit the WDFW website for the most current information on domoic acid levels and closures.

Oregon HAB Summary

Source: Oregon Department of Agriculture Food Safety Division **http://egov.oregon.gov/ODA/FSD/shellfish_status.shtml**

Paralytic shellfish poisoning (PSP)

Mussel sampling for evaluation of shellfish toxin levels are done frequently by the Oregon Department of Agriculture. No unusual events were reported in Quarter 4. The shellfish safety toll-free hotline (1-800-448-2474) provides the most current information regarding shellfish safety closures for Oregon.

Source: Oregon Department of Fish and Wildlife **http://www.dfw.state.or.us/MRP/shellfish/razorclams/plankton.asp**
Source: Zach Forster, Phytoplankton Sampling Coordinator. MOCHA Project, Shellfish Project
Marine Resources Program, Oregon Department of Fish and Wildlife

Oregon's Harmful Algal Bloom (OHAB) monitoring project monitors ten sites along the coast of Oregon (three along Clatsop Beach, one on Cannon Beach, two on our central coast and four sites on the south coast, Figure 19) for any potential signs of the phytoplankton species *Pseudo-nitzschia* and *Alexandrium*.

Early December 2008: Mussel samples taken from the area indicate levels of PSP toxins produced by *Alexandrium* were above the alert level along the entire Oregon coast from the mouth of the Columbia River to the California border. These beaches are closed to mussel and scallop harvesting.

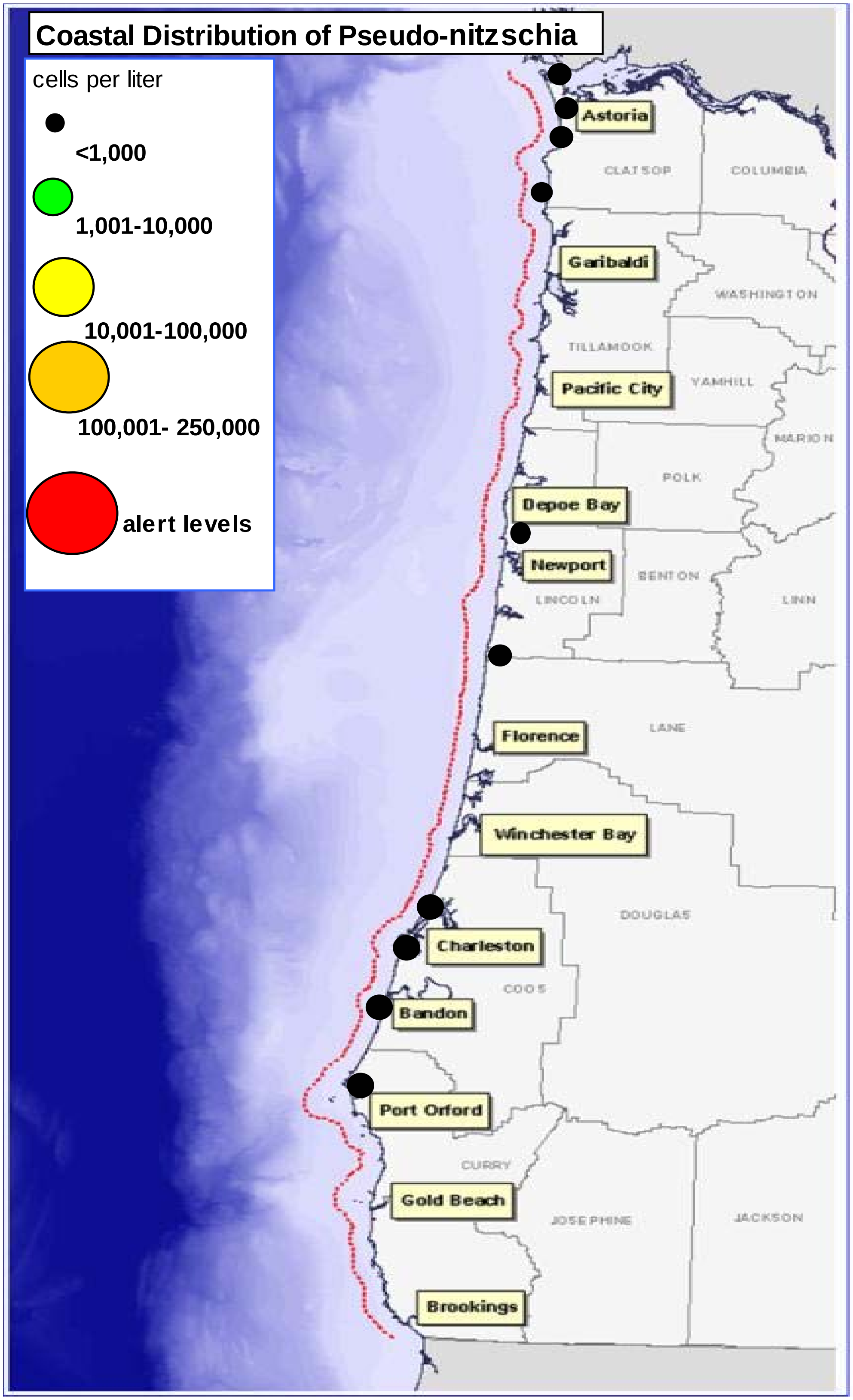

Figure 19. Oregon's Harmful Algal Bloom monitoring project in conjunction with Oregon Department of Agriculture is working to monitor ten sites along the Oregon coast. The coastal distribution of *Pseudo-nitzschia* (cells per liter) for November to early December, 2008 are shown.

Domoic acid results continue to be in safe range in Oregon.

Source: Oregon Department of Agriculture Food Safety Division http://egov.oregon.gov/ODA/FSD/shellfish_status.shtml

Most recent information is at the Oregon Dept. of Agriculture shellfish toll-free hotline (1-800-448-2474) which should be consulted prior to harvesting shellfish.

California HAB Summary

October:

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

Phytoplankton observations and toxin monitoring occurred along the California coastline for the month of October: During the first week of October, *Pseudo-nitzschia* was observed and common (10-49%) along the California coastline, but the most abundant species observed were mostly the nontoxic *delicatissima* complex. In early October, *Alexandrium* was observed but in very low numbers at a few locations, with very low levels of PSP toxins in shellfish in Humboldt and Marin counties.

December:

Phytoplankton observations and toxin monitoring for the beginning of December: *Alexandrium* was observed in several locations in northern California. Low levels of PSP toxins were detected in shellfish from Del Norte, Santa Cruz, and San Luis Obispo counties. *Pseudo-nitzschia* species had been increasing in numbers in San Mateo and Marin counties; however, cell mass remained low.

Dissolved Oxygen Concentration:

Source: Bill Peterson, NOAA

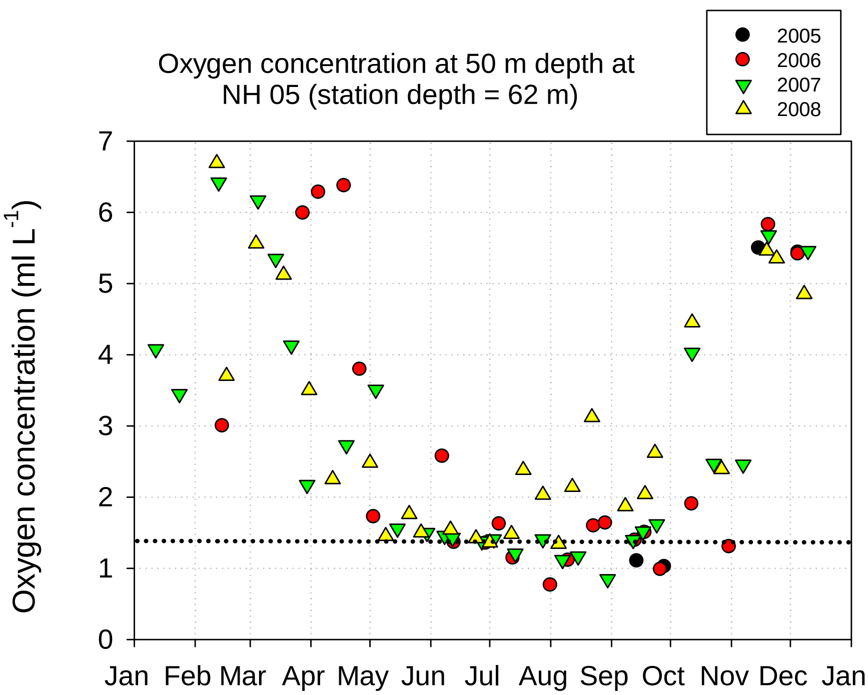

Figure 20. Oxygen concentration at station NH 05 (five miles off Newport, Oregon, along the Newport Hydrographic Line), at a depth of 50 m. Note that during 2008 (yellow triangles), oxygen concentrations were higher during summer months as compared to the past two years. Hypoxic conditions (oxygen concentrations less than 1.4 ml per Liter) were only observed in early August.

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