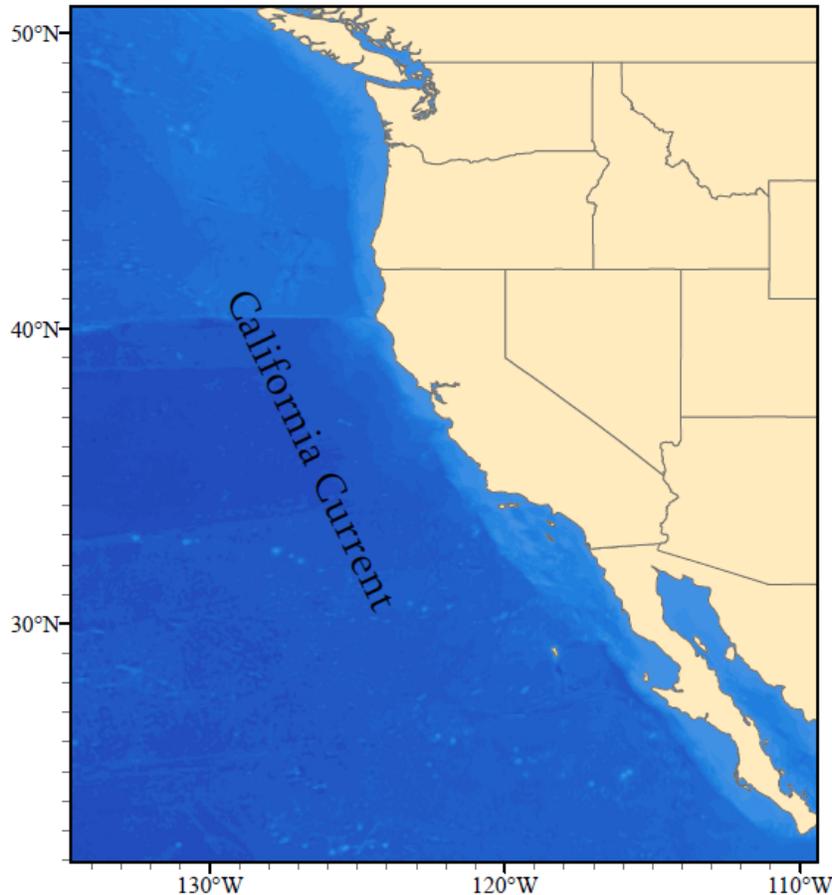


Summary of 2011 Climatic and Ecological Conditions In the California Current LME

This report is a 2011 summary of climate and ecosystem conditions for 2011, for public distribution, compiled by PaCOOS coordinator Rosa Runcie (email: Rosa.Runcie@noaa.gov).

Full content can be found after the Executive Summary. Previous summaries of climate and ecosystem conditions in the California Current can be found at <http://pacoos.org/>



CLIMATE CONDITIONS IN BRIEF

- **El Niño Southern Oscillation (ENSO):** La Niña to ENSO-neutral conditions occurred during May 2011 and continued through July 2011. La Niña conditions returned in August 2011 and strengthened during September and October. November and December 2011, La Niña conditions continued across the eastern and central equatorial Pacific Ocean. La Niña conditions are expected to gradually strengthen and continue into the Northern Hemisphere winter 2011-2012.
- **Pacific Decadal Oscillation (PDO):** The PDO has been mostly negative since September 2007 however the 2009-2010 El Niño event disrupted this pattern for 10 months. The PDO is now once again negative and values have been strongly negative (> -1.3) since July 2011.
- **Upwelling Index (UI):** The Upwelling Indices show that upwelling during 2011 was about average overall. However, there was considerable monthly variability relative to the 20-year (1948-67) upwelling index (UI) mean. During 2011 cool salty waters, characteristic of upwelling, were found from Baja California to Vancouver Island. The cessation of upwelling in mid-September resulted in one of the shortest annual upwelling periods since the 1997 El Niño.

The summaries provided and the appearance of external links do not constitute an endorsement by the Department of Commerce/National Oceanic Atmospheric Administration of the information, products or services.

- **Madden Julian Oscillation (MJO):** The MJO index did not indicate significant MJO activity from January to March. The MJO strengthened early April but began to weaken mid-April as it propagated eastward. The MJO index increased in amplitude early May. The MJO index did not indicate significant MJO activity from June through early August, and increased in amplitude late-August. The MJO strengthened the third week of September and indicated some irregular eastward propagation followed by an increase in amplitude the last week of September. The MJO continued an eastward propagation the first three weeks of October and increased in strength mid-October. The amplitude decreased early November followed by an increase mid-to-late November with continued eastward propagation. Mid-to-late December, the MJO continued eastward propagation, and was not as strong in activity during December 2011 as the activity during autumn 2011.
- **Water Temperature and Salinity at Newport Hydrographic Line, Oregon:** Analysis of water mass properties in terms of average temperature and salinity at a depth of 50 m at station NH 05 shows that interannual variations in water mass properties are in general related to the PDO: during positive PDO years, relative fresh and warm water is found at depth and vice versa. Upwelling in 2011 did not bring cold salty waters to the continental shelf. Rather, intermediate values of both temperature and salinity were seen in both the 2nd and 3rd quarters as well as in the May-September composite.
- **Observations along the Trinidad Head Line, California:** Unlike the previous two years, in which substantial downwelling and freshening of the entire water column was observed at the midshelf station (TH02) towards the end of the year, late 2011 was marked by periods of sustained northerly winds. Freshening of the surface waters occurred, possibly as a consequence of seasonal riverine discharge, but the physical effects of upwelling on water column characteristics are clearly evident into mid December. No substantial phytoplankton bloom has been observed in response to this late-year upwelling.

ECOSYSTEM CONDITIONS IN BRIEF

- **California Current Ecosystem Indicators:**
 1. **Oregon Copepods:** Two copepod indices continue to track closely the PDO and ONI. These indices are (1) the copepod species richness monthly anomaly and (2) the copepod community index monthly anomaly. The result can be interpreted as follows: when the PDO is in a negative phase, boreal, lipid-rich cold water copepod species are transported southward out of the Gulf of Alaska and become the dominant components of the lower trophic levels. When the PDO is in positive phase, warm water, and lipid-poor copepod species typical of subtropical waters that lie offshore and south of Oregon become important in the Northern California Current and in some years dominate.
 2. **Southern California Krill:** The abundance of euphausiids was assessed off Southern California (SC) and off Central California (CC) from springtime CalCOFI cruises. In Spring 2011, the abundance of the cool-temperate *Euphausia pacifica* and *Thysanoessa spinifera* was slightly-to-moderately higher than the long-term mean in both SC and CC, while the coastal subtropical species *Nyctiphanes simplex* was undetectable in both regions.
 3. **Central-Northern California Juvenile Rockfish:** The annual midwater trawl survey for juvenile rockfish and other pelagic nekton along the Central California coast in May-June showed trends in 2010 and 2011 were of increasing abundance for the species and assemblages that tend to do better with cool and productive conditions, including juvenile rockfish, juvenile Pacific hake, market squid and krill. In 2011, juvenile rockfish, market squid, and other groundfish (such as Pacific hake, shown, and Pacific sanddabs, not shown) were at their highest levels since the early 2000s. By contrast, the coastal pelagic forage species (adult northern anchovy and Pacific sardine) were at low levels in 2009 and 2010. As with the 2010 results, the 2011 survey continued to indicate a return to conditions similar to those seen in the early 1990s and early 2000s.

4. **Coastwide Coastal Pelagics:**

Pacific Sardine:

Canadian Program on High Seas Salmon: integrated epipelagic ecosystem survey off the west coast of British Columbia to Southeast Alaska: Sardine catches were lower off British Columbia in 2011 compared to 2010, and may be attributed to generally lower sea surface temperatures in 2011.

Summer trawl sardine survey off the West Coast of Vancouver Island (WCVI), 2011 update: Regional estimates of sardine catch density and seasonal biomass in the WCVI core survey region from night sampling in 2006 and 2008 to 2010 (no survey was conducted in 2007) show a declining trend, whereas the 2011 estimates are approximately double the 2010 estimates.

5. **Salmon:** Pelagic fishes have been sampled in June and September off the coast of Washington and Oregon since 1998. Catches of juvenile salmonids in the June survey were about average for juvenile coho and spring Chinook but well below average in September. Although it is difficult to assign a direct cause for what appears to be poor survival during the summer 2011, conditions indicate that the poor survival was due to generally weak upwelling conditions during the summer as a short upwelling season.

• **Marine Birds and Mammals:**

Marine Birds: The relative abundance of Cassin's auklets on CalCOFI surveys declined from the late 1980s to late 1990s before rebounding in the early-mid 2000s. The long-term trend showed no trend in auklet density over the past 15 years. The latter years (2010 and 2011) showed low relative abundance. The relative abundance of shearwaters showed a consistent decline over the 25-year time series (1987-present), though the rate of change has decreased recently. From low-points in the mid-1990s, shearwater relative abundance increased in the mid-late 1990s, before declining steadily thereafter. The latter years (2010 and 2011) showed a disparate pattern with higher abundance of shearwaters in 2010 and lower abundance in 2011.

• **Harmful Algal Blooms:**

Washington: No annual summary was available at the time of this report.

Oregon: *Alexandrium* persisted along much of the coast during the spring and summer while *Pseudo-nitzschia* was infrequently reported until August. Increases in phycotoxins in bivalve tissue resulted in one shellfish closures during the year. Other harmful algae encountered during 2011 include *Chochlodinium sp.*, *Akashiwo sanguinea* and *Dinophysis spp.*

California: *Pseudo-nitzschia* was observed at a number of sites along the entire southern California coast from January to May. During January to March, low numbers of *Alexandrium* were detected at sampling sites throughout southern California. *Alexandrium* was not observed at any northern California sampling sites in January and was observed at only two sampling sites in February. Domoic acid was not detected in any shellfish samples analyzed in northern California in September.

• **Dissolved Oxygen Concentration**

PACIFIC COAST FISHERIES MANAGEMENT SUMMARIES AND RECOMMENDATIONS IN BRIEF

- **Highly Migratory Species (tuna, sharks, billfishes):** Bigeye overfishing is still occurring, so members need to agree on a replacement measure at the February 2012 meeting.
- **Pacific Sardine:** Summary of the Oregon fishery for pacific sardine (*Sardinops sagax*): Lower estimates of biomass and the resultant lower Harvest Guidelines since 2008 have led to a derby style fishery and changed the timing of the fishery off Oregon and Washington with peak catch occurring in July during recent years for Oregon vessels.

Summary of the Washington purse seine fishery for pacific sardine (*Sardinops sagax*): A review of landings data from the top five vessels from 2000-2011 shows that a single vessel total annual landing average about 1,400 metric tons.

NEW RESEARCH ACTIVITIES IN THE CALIFORNIA CURRENT SYSTEM IN BRIEF

- **Marine Mammals:** “SOCAL-BRS” (Behavioral Response Study) is a multi-year effort (2010-2014) designed to better understand marine mammal behavior and reactions to sound. Altogether, 38 tags were deployed on 25 blue whales, 7 Risso’s dolphins, 2 bottlenose dolphins, and one Cuvier’s beaked whale. A summary of this study will be included in the SOCAL-11 project report that will be issued sometime in early 2012.

CLIMATE CONDITIONS

El Niño Southern Oscillation (ENSO):

Source : <http://www.cdc.noaa.gov/people/klaus.wolter/MEI/mei.html>,

http://www.cpc.noaa.gov/products/analysis_monitoring/enso_advisory/

The Multivariate ENSO Index (MEI) turned strongly negative in April 2010, to large negative values not seen since 1955 and the mid-1970s (Figure 1). A transition from La Niña to ENSO-neutral conditions occurred during May 2011. During June and July 2011, ENSO-neutral conditions continued and were reflected in the overall pattern of small sea surface temperature (SST) anomalies across the equatorial Pacific Ocean. La Niña conditions returned in August 2011 due to the strengthening of negative SST anomalies across the eastern half of the equatorial Pacific Ocean. During September and October 2011, La Niña conditions strengthened as indicated by increasingly negative SST anomalies across the eastern half of the equatorial Pacific Ocean. November and December 2011, La Niña conditions continued across the eastern and central equatorial Pacific Ocean. MEI values from 2005 to 2011 are shown in Figure 2. While it is not yet clear what the ultimate strength of this La Niña will be, La Niña conditions are expected to gradually strengthen and continue into the Northern Hemisphere winter 2011-2012.

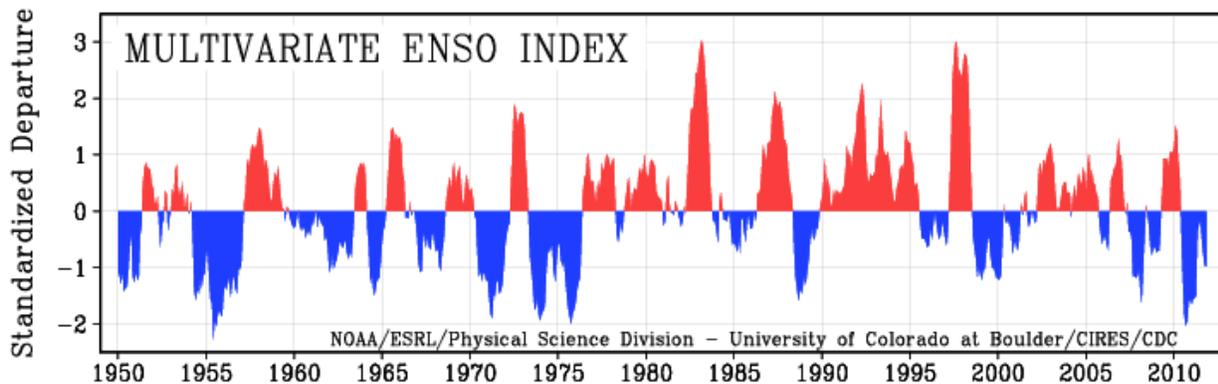


Figure 1. NOAA Physical Sciences Division attempts to monitor ENSO by basing the Multivariate ENSO Index (MEI) on the six main observed variables over the Pacific. These six variables are: sea-level pressure, zonal and meridional components of the surface wind, sea surface temperature, surface air temperature,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

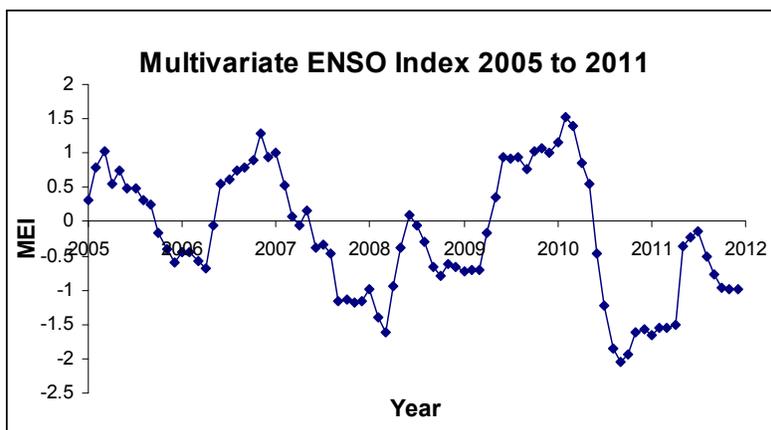


Figure 2. Multivariate ENSO Index 2005 to 2011. Mean used from bimonthly MEI values from the entire MEI Index time series, starting with Dec1949/Jan1950 thru Nov/Dec2011 (<http://www.esrl.noaa.gov/psd/enso/mei/table.html>).

Northern California Current ENSO Conditions:

Source: Bill Peterson, NOAA, NMFS

The transition to cold ocean conditions established in the northern California Current (NCC) in September 2007 was interrupted by a moderately strong El Niño event that warmed coastal waters of the NCC from August 2009 through May 2010. However, the NCC since has returned to cool phase conditions as a result of La Niña initiated in June 2010. This is indicated by a negative Oceanic Niño Index (ONI) and negative PDO value. Their values continue to be negative through November 2011. Should the La Niña conditions persist into spring 2012, the result will be perhaps the best ocean conditions (from the viewpoint of coastal pelagic fishes) observed in the past few decades. Juvenile salmon which enter the sea in spring 2012 (spring Chinook, coho and steelhead) might have very high survival. There is some uncertainty in this prognosis because some NOAA forecast models predict a weakening of La Niña conditions whereas others predict a strengthening. Regardless, cold ocean conditions will likely prevail through the spring of 2012.

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/el_nino.cgi NMFS/SWFSC/ERD monthly coastal upwelling index, <http://jisao.washington.edu/pdo/>
<http://jisao.washington.edu/pdo/PDO.latest>, <http://www.osdpd.noaa.gov/ml/ocean/sst/anomaly.html>,
<http://www.cpc.ncep.noaa.gov/products/GODAS/>

The Pacific Decadal Oscillation: The Pacific Decadal Oscillation index (PDO) is positive when there are positive sea surface temperature (SST) anomalies along the coast and extending 1500 km off of western North America and negative SST anomalies farther offshore and in the central and western North Pacific. Negative PDO index values indicate the reverse pattern where the positive anomalies are offshore and negative SST anomalies are characteristic of coastal regions. Negative SST anomalies have persisted in the northeastern Pacific Ocean over the last 16 months. The November PDO value is strongly negative (-2.33) and the lowest since December 1961, but statistically comparable negative values occurred in the last quarters of 1990 and 1999. These strongly negative values occur during runs of negative monthly PDO indices. Only about 25% of the last 60 monthly PDO have been positive. Negative PDO conditions are expected to persist into spring. More robust California salmon populations are associated with the negative PDO. The environmental conditions associated with the current persisting negative PDO pattern are probably partially responsible for the success of recent salmon stock rebuilding efforts in California. It is also likely that the current persisting PDO pattern is partially responsible for the return of robust market squid fisheries to the Monterey Bay area.

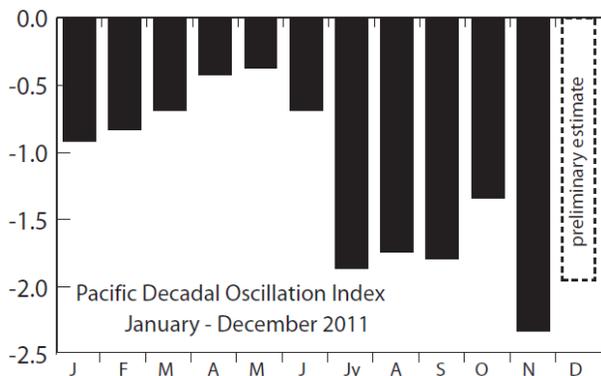


Figure 3. The graph shows monthly values for the Pacific Decadal Oscillation (PDO) Index for January 2011 through December 2011. The PDO is considered a long-lived El Niño like pattern of Pacific climate variability based on sea surface temperature measurements north of 10°N. Monthly PDO index values are found at <http://jisao.washington.edu/pdo/PDO.latest>.

Pacific Decadal Oscillation (PDO), the Oceanic Niño Index (ONI), and Sea Surface Temperature at Newport, Oregon:

Source: Bill Peterson, NOAA, NMFS

The PDO has been mostly negative since September 2007 however the 2009-2010 El Niño event disrupted this pattern for 10 months. The PDO is now once again negative and values have been negative (< - 1.3) since July 2011. Logerwell et al. (2003) showed that one prerequisite for good coho salmon survival is a cold winter preceding the spring when they enter the sea as juveniles. Assuming that the same is true for yearling Chinook salmon, the strongly negative values of the PDO observed in autumn 2011, if they persist through

the winter and early spring of 2011-2012, could result in the best ocean conditions for salmon in decades. This is an early indication that 2012 could result in some of the highest catches and returns of salmon to the Columbia River and coastal streams of Washington and Oregon in 2013 (for coho) and 2014 (spring Chinook). Values of the PDO averaged over the summer months of May-September are shown in Figure 4.

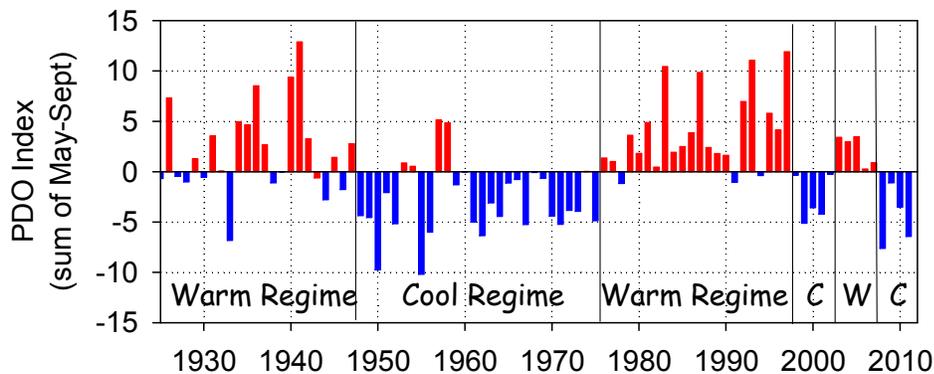


Figure 4. Time series of the PDO showing values summed from May through September of each year. Note that the “decadal” pattern has now shifted to a semi-decadal pattern, with shifts more frequently.

The Oceanic Niño Index (ONI): The PDO and ONI are often highly correlated (Figure 5). The ONI is a three month running mean of SST anomalies in the Niño 3.4 region (5°N-5°S; 120°-170°W). The change in sign of the PDO to negative in June 2010 was accompanied by a change in sign of the ONI in the same month. The ONI presently (November 2011) has a value of -0.7 , and although this is not a strongly negative value, it is noteworthy that it has been becoming more negative each month since July 2010 (Figure 5). Negative ONI values are expected to continue (as indicated by the forecast of for continued La Niña conditions at the equator) which suggests that the northern North Pacific will also remain cold into the spring 2012.

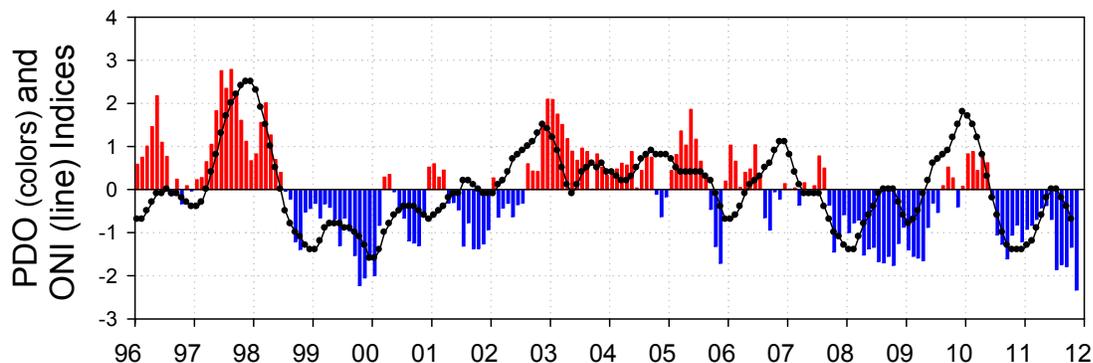


Figure 5. Time series of monthly values of the Oceanic Niño Index (ONI) and Pacific Decadal Oscillation (PDO), from 1996 to present. Note that the two indices are often correlated with the ONI often leading the PDO. Both changed sign at the same time in 2010 (in July). It is also noteworthy that the PDO has been in negative phase for most months from August 2007 until present.

Sea surface temperatures measured at Newport, Oregon: In past reports SST from the NOAA Buoy 46050 located 20 miles off Newport have been reported. The NOAA buoy was damaged by a storm in February 2011 and not repaired until July 2011. Instead for 2011, SST measured at station NH-05 (five miles from shore along the Newport Hydrographic Line) are reported, and upwelling season temperature anomaly (averaged over the months of May-September are shown (Figure 6). SSTs during the summer of 2011 were cooler than normal as expected during the negative phase of the PDO.

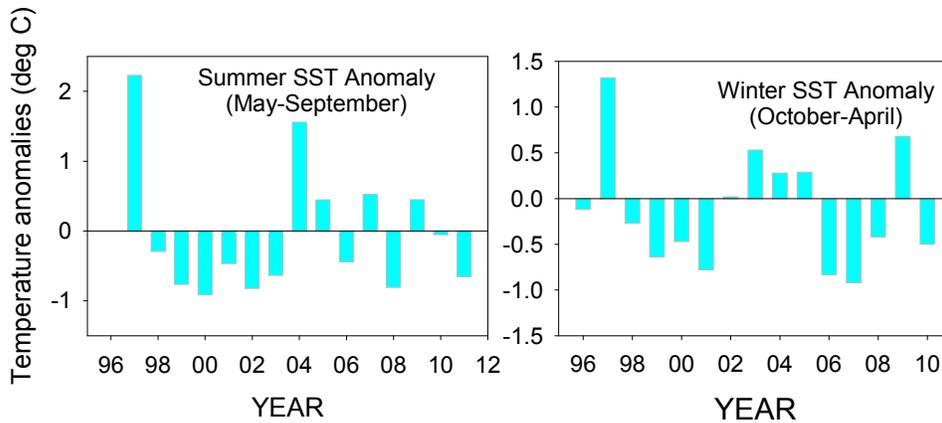


Figure 6. SST anomalies at station NH 05 during summer (left) and winter (right). Note that during the winter of 2010-11 and during summer 2011, waters were colder than normal in accord with the negative values of the PDO observed during the same time period.

Upwelling Index:

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

The Upwelling Indices (Figure 7) show that upwelling during 2011 was about average overall. However, there was considerable monthly variability relative to the 20-year (1948-67) upwelling index (UI) mean. The season of consistent upwelling favorable winds is variable with latitude and from year-to-year. Equator ward, upwelling favorable, winds are associated with the eastern Pacific subtropical high atmospheric pressure system that is persistent throughout the year off southern Baja California. As this high pressure builds northward in the spring upwelling becomes more intense progressively farther north. Upwelling is less intense and has a shorter season at northern locations (Figure 7, top panel). During 2011 cool salty waters, characteristic of upwelling, were found from Baja California to Vancouver Island. Some observers found pulsed, rather than more continuous presence of upwelled water. Variation in the monthly upwelling pattern is shown by the upwelling index anomalies (Figure 7, bottom panel).

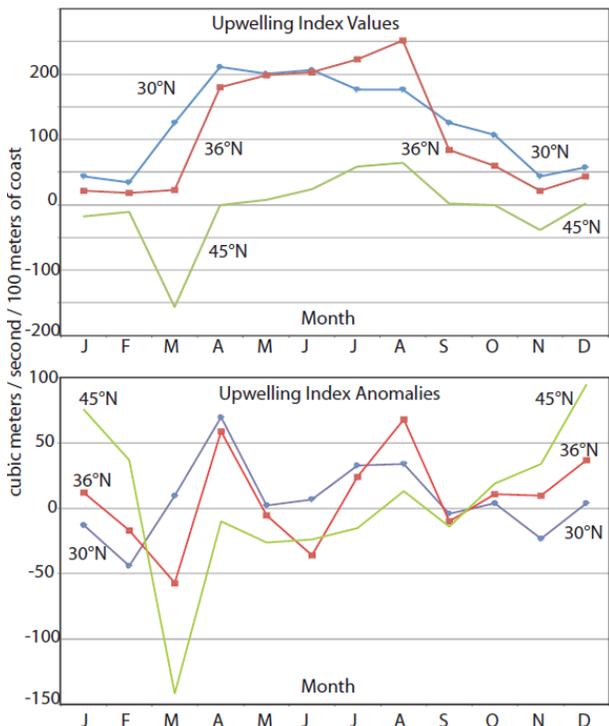


Figure 7: Monthly Upwelling Indices and anomalies at 30°, 36° and 45°N (http://www.pfeg.noaa.gov/products/pfel/modeled/indices/upwelling/NA/upwell_menu_NA.html).

Source: Bill Peterson, NOAA, NMFS and El Niño Watch, Advisory <http://coastwatch.pfel.noaa.gov/cgi-bin/elniño.cgi>
 Upwelling was initiated on day 105 (15 April) in 2011 (Figure 8). However, the winds were relatively weak during the beginning of the season, and significant upwelling did not start until day 155 (June 4). There was an early end to the ‘season’, with a reversal to primarily downwelling conditions on day 259 (16 September). The cessation of upwelling in mid-September resulted in one of the shortest annual upwelling periods since the 1997 El Niño. The total amount of upwelling for 2011 was 4,555 m /s per 100 m of coastline, which is 26% lower than the 40–year average of 6,163 m /s per 100 m.

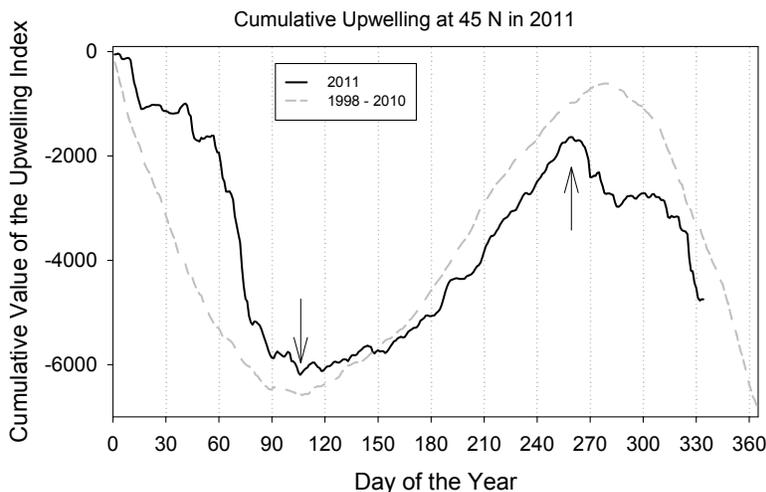


Figure 8. Cumulative values of the PFEL coastal upwelling index compared to climatology of 1998-2010. Upwelling in 2011 began at about the same time as the “average” year, but ended significantly earlier than climatology. The vertical arrows indicate the date of spring and fall transitions points (spring transition on day 105 (15 April); fall transition on day 259 (16 September)).

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*)

The MJO is an intraseasonal fluctuation or “wave” occurring in the global tropics with a cycle on the order of 30-60 days. The MJO has wide ranging impacts on the patterns of tropical and extratropical precipitation, atmospheric circulation, and surface temperature around the global tropics and subtropics. The MJO does not cause El Niño or La Niña, but can contribute to the speed of development and intensity of El Niño and La Niña episodes. The MJO index did not indicate significant MJO activity during the first week of January. During mid-January the MJO strengthened and by late January the 850-hPa easterly zonal winds weakened and westerly anomalies developed near the Date Line due to increased MJO activity. The MJO weakened the first two weeks in February. Westerly 200-hPa vector wind anomalies weakened during the first week across the equatorial Pacific Ocean. The MJO remained weak throughout February and March, although the MJO index indicated an increase in amplitude with eastward propagation of 200-hPa velocity potential anomalies during the first half of March. The MJO strengthened early April and began to weaken mid-April as it propagated eastward. Late April, the MJO index indicated a slight strengthening of the signal with eastward propagation and faster speeds than typically associated with the MJO. The MJO index increased in amplitude early May, with the enhanced convective phase of the MJO located over the western Pacific. The MJO index did not indicate significant MJO activity all of June and through early August 2011. Westerly 850-hPa vector wind anomalies persisted across the eastern Pacific Ocean early-to-mid June with a slight increase in intensity late June. Westerly anomalies persisted across the eastern Pacific Ocean early July. Mid-July, the MJO index indicated fast eastward propagation associated with other subseasonal coherent tropical variability. Late July, westerly anomalies shifted northward and weakened. Early to mid-August, westerly anomalies continued and strengthened across the Pacific. Late August, the MJO index increased in amplitude with eastward propagation. The MJO index indicated weak activity during the first two weeks of September. The MJO strengthened the third week of September and indicated some irregular eastward propagation followed by an increase in amplitude the last week of September. The MJO continued an eastward propagation the first three weeks of October and increased in strength mid-October. Late October, the MJO index indicated a decrease

in amplitude with reduced eastward propagation. The MJO amplitude decreased early November followed by an increase mid-to-late November with continued eastward propagation. Early-to-mid December the MJO index began to weaken with little eastward propagation. Mid-to-late December, the MJO increased in amplitude with continued eastward propagation. The MJO was not as strong in activity during December 2011 as the activity during autumn 2011.

Deep Water Temperature and Salinity at Newport Hydrographic Line, OR:

Source: Bill Peterson, NOAA, NMFS

Analysis of seasonally averaged temperature and salinity at a depth of 50 m at station NH 05 (water depth 62 m), shows that interannual variations in water mass properties are in general related to the PDO; during positive PDO years, relatively fresh and warm water is found at depth and vice versa. Figure 8 shows these relationships for the upwelling season (May-September) and subdivides this into quarterly values (2nd quarter, April-June which is early in the upwelling season), and 3rd quarter (July-September, when upwelling is strongest). Upwelling in 2011 did not bring cold salty waters to the continental shelf (a result that could be deduced from the upwelling index data in Figure 9). Rather, intermediate values of both T and S are shown in Figure 9.

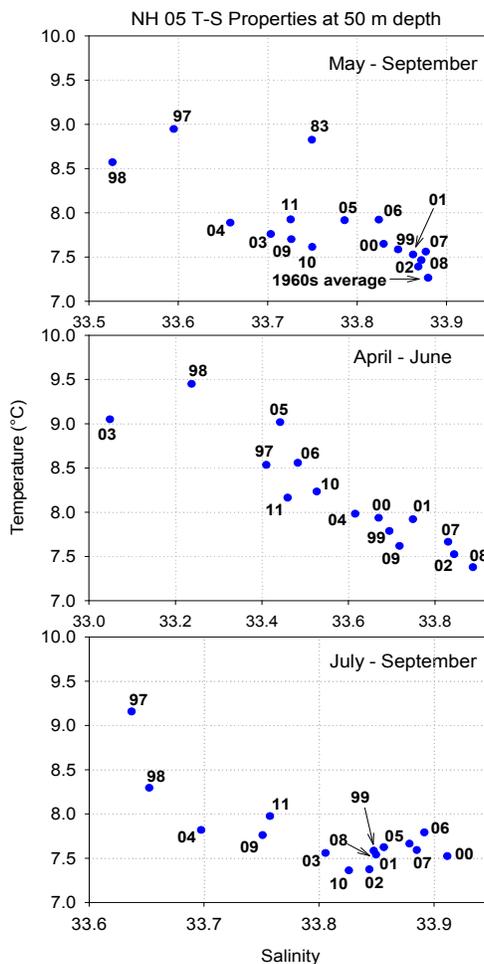


Figure 9. Temperature-Salinity at a depth of 50 m at station NH 05 (water depth 62 m), showing the interannual variations in water mass properties.

Quarterly update and annual summary of observations along the Trinidad Head Line (41° 03.5' N)

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

Observations along the Trinidad Head Line¹ during 2011 captured the response of the coastal ocean to the strong upwelling and downwelling events that occurred during the early part of the year, and the subsequent transition to summer conditions intermediate to those observed in 2009 and 2010, with a shallow, warmer layer lying over cooler waters on the shelf. Unlike the previous two years, in which substantial downwelling and freshening of the entire water column was observed at the midshelf station (TH02) towards the end of the year, late 2011 experienced periods of sustained northerly winds. There is some freshening of the surface waters, possibly as a consequence of seasonal riverine discharge, but the physical effects of upwelling on water column characteristics are clearly evident into mid December. No substantial phytoplankton bloom has been observed in response to this late-year upwelling.

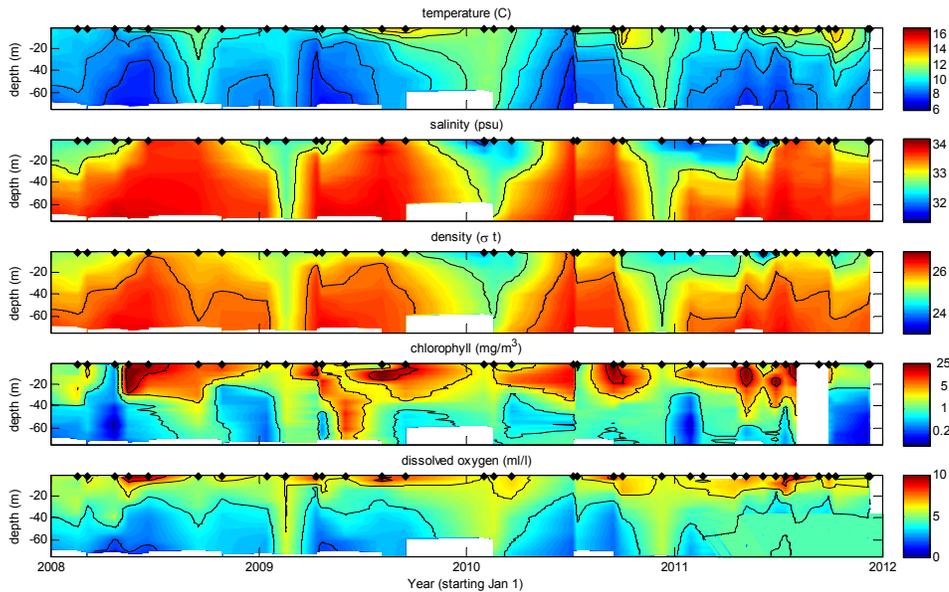


Figure 10. Preliminary observations of the evolution of water column characteristics at station TH02 (41° 03.5' N, 124° 16' W, approximately 7 nm offshore, 75m depth at mid-shelf) along the Trinidad Head Line. Top to bottom: Hovmoller plots (time by depth) from 2008 through 2011 of temperature, salinity, density, fluorescence, and dissolved oxygen. Blank areas indicate missing data. Small symbols along top of each plot indicate time of each cruise. Interpolations between widely spaced points should be interpreted with greater caution.

¹Cruises along the Trinidad Head Line were supported by NOAA Fisheries SWFSC and by the Ocean Protection Council under a grant to Jeff Abell at Humboldt State University. We gratefully acknowledge the support and skill of Captain Scott Martin and crew of the R/V Coral Sea, and the assistance of Kathryn Crane, Jose Montoya, Caymin Ackerman, Ted Cumiskey, Greg O'Connell and the several other students, technicians, and volunteers who have helped to collect these data.

ECOSYSTEMS

California Current Ecosystem Indicators:

Oregon Copepods:

Source: Bill Peterson, NOAA, NMFS

Two copepod indices continue to track closely the PDO and ONI (Figure 11). These indices are (1) the copepod species richness monthly anomaly (based on the number of species in a given sample) and (2) the copepod community index monthly anomaly (based on an ordination of species abundance data from the same station NH05). When the PDO is in a negative (or “cold”) phase, boreal, lipid-rich cold water copepod species are transported southward out of the Gulf of Alaska (GOA) and become the dominant components of the lower trophic levels. These species are also dominant zooplankton of the coastal ecosystem of the Bering Sea and coastal GOA. When the PDO is in positive (or warm) phase, warm water, and lipid-poor copepod species typical of subtropical waters that lie offshore and south of Oregon become important in the NCC and in some years dominate. “Species richness” tracks the PDO closely as well. It is low -PDO and high during +PDO, because subarctic water has lower copepod biodiversity than does the sub-tropics. Also, during warm phase of the PDO, upwelling tends to develop later in the year and subtropical copepod species that have been transported northwards with the Davidson current in winter will linger longer in shelf waters, into the spring/summer months, leading to a “subtropical copepod community” on the shelf in spring. These shifts at the base of the food chain between lipid-poor and lipid-rich plankton communities may significantly impact the feeding conditions for salmon and forage fishes.

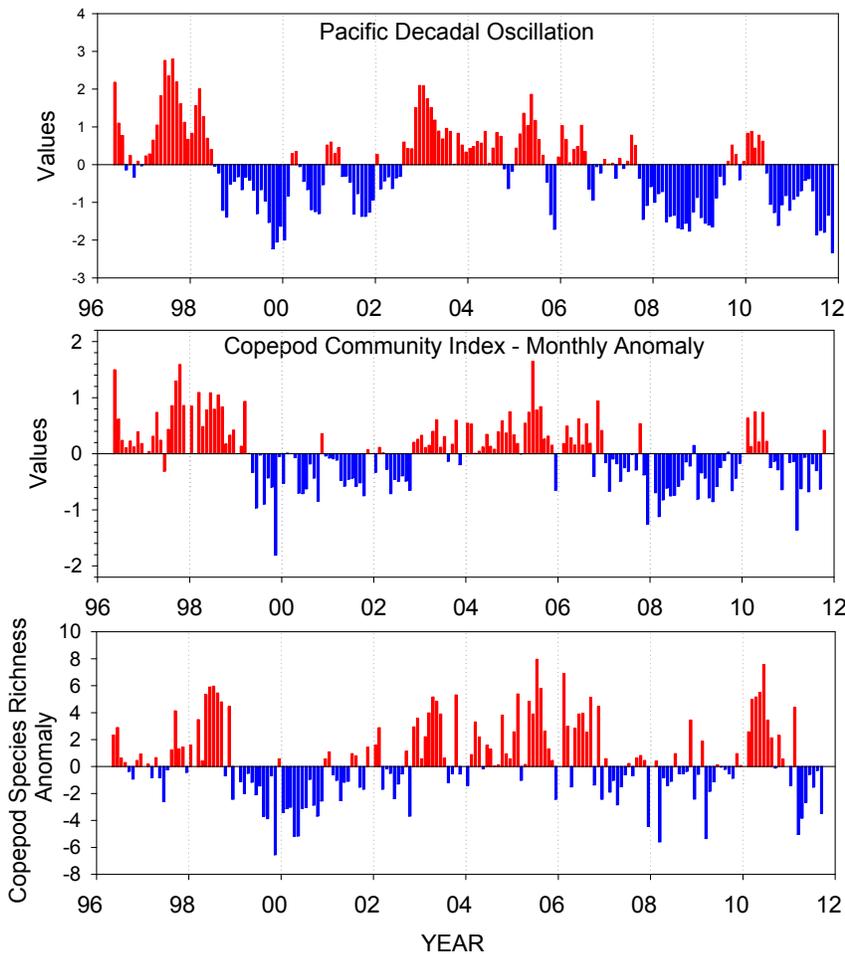


Figure 11. Monthly time series of the PDO compared to the monthly anomalies of the Copepod Community Index (derived from the x-axis scores of an ordination) and the monthly anomaly of the Copepod Species Richness (species richness is the number of species in a sample).

Southern California Krill:

Source: Mark D. Ohman, Scripps Institution of Oceanography (mohman@ucsd.edu)

Euphausiids: The abundance of euphausiids was assessed off Southern California (SC) and off Central California (CC) from springtime CalCOFI cruises. In Spring 2011, the abundance of the cool-temperate *Euphausia pacifica* and *Thysanoessa spinifera* was slightly-to-moderately higher than the long-term mean in both SC and CC, while the coastal subtropical species *Nyctiphanes simplex* was undetectable in both regions.

Ecosystem indicators for the Central California Coast, May 2011:

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

The Fisheries Ecology Division of the SWFSC has conducted an annual midwater trawl survey for juvenile rockfish and other pelagic nekton along the Central California coast in late spring (May-June) since 1983. The survey targets pelagic juvenile rockfish for fisheries oceanography studies and for developing indices of year class strength for stock assessments, although many other commercially and ecologically important species are captured and enumerated as well. The results here summarize trends in the core area since 1990, as not all species were consistently identified in earlier years. From 1983 through 2008 cruises took place on the NOAA ship David Starr Jordan, but since 2009 a series of different ships has been utilized; in 2011 the cruise took place onboard the F/V Excalibur and had limited temporal and spatial coverage relative to the post-2003 period. The data for the 2011 survey presented here are preliminary, and the analysis does not account for potential differences in catchability among vessels (although see Sakuma et al. 2006). Although this survey has sampled a greater spatial area (roughly Cape Mendocino to the U.S./Mexico border) from 2004 onward, the results presented here focus on the core survey area (corresponding to the region just south of Monterey Bay to just north of Point Reyes, CA) as the length of the time series leads to more informative insights.

The standardized anomalies from the log of mean catch rates are shown by year for six key forage species and assemblages that are sampled in this survey (Figure 12). Most are considered to be well sampled, although the survey was not designed to accurately sample either krill or coastal pelagic species which have variable depth distributions, and those numbers should be considered with caution. Trends in 2010 and 2011 were of increasing abundance for the species and assemblages that tend to do better with cool and productive conditions, including juvenile rockfish, juvenile Pacific hake and market squid. In 2011, juvenile rockfish, market squid, and other groundfish (such as Pacific hake, shown, and Pacific sanddabs, not shown) were at their highest levels since the early 2000s. By contrast, the coastal pelagic forage species (adult northern anchovy and Pacific sardine) were at low levels in 2009 and 2010, although this is likely a greater reflection of their local availability and ocean conditions rather than their coast wide or regional abundance. As with past reports (e.g., Bjorkstedt et al. 2010), the trends observed in these six indicators are consistent with trends across a broader suite of taxa within this region, with the first and second components (of a principle components analysis) explaining 39% and 14% of the variance in the data respectively (representing strong covariance among young-of-the-year groundfish, cephalopods and euphausiids, which in turn tend to be negatively correlated with coastal pelagic and mesopelagic fishes). As with the 2010 results, the 2011 survey continued to indicate a return to conditions similar to those seen in the early 1990s and early 2000s.

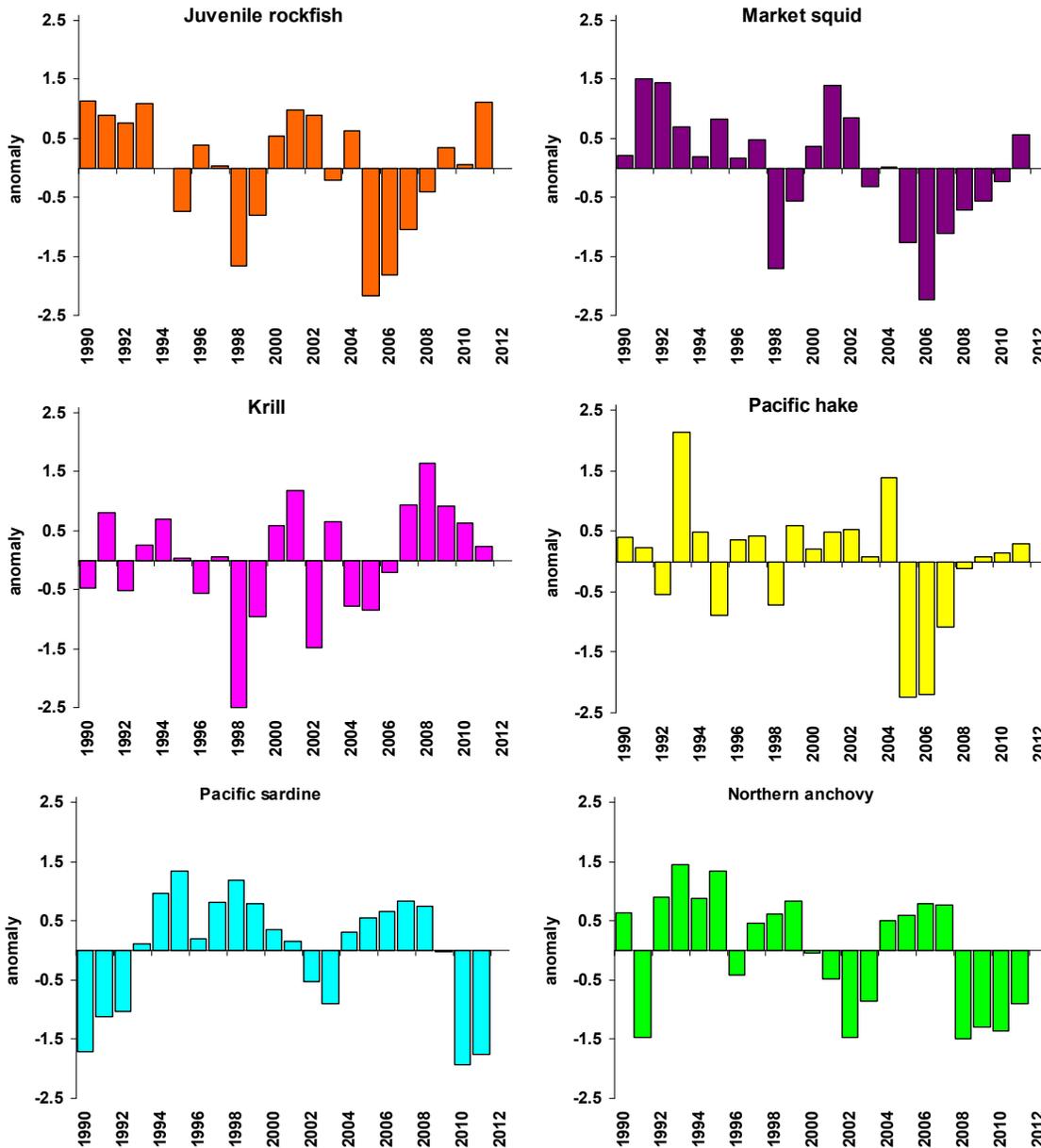


Figure 12. Long-term standardized anomalies of several of the most frequently encountered pelagic forage species from the central California rockfish recruitment survey in the core region (1990-2011 period only, not all taxa were recorded from 1983-1989).

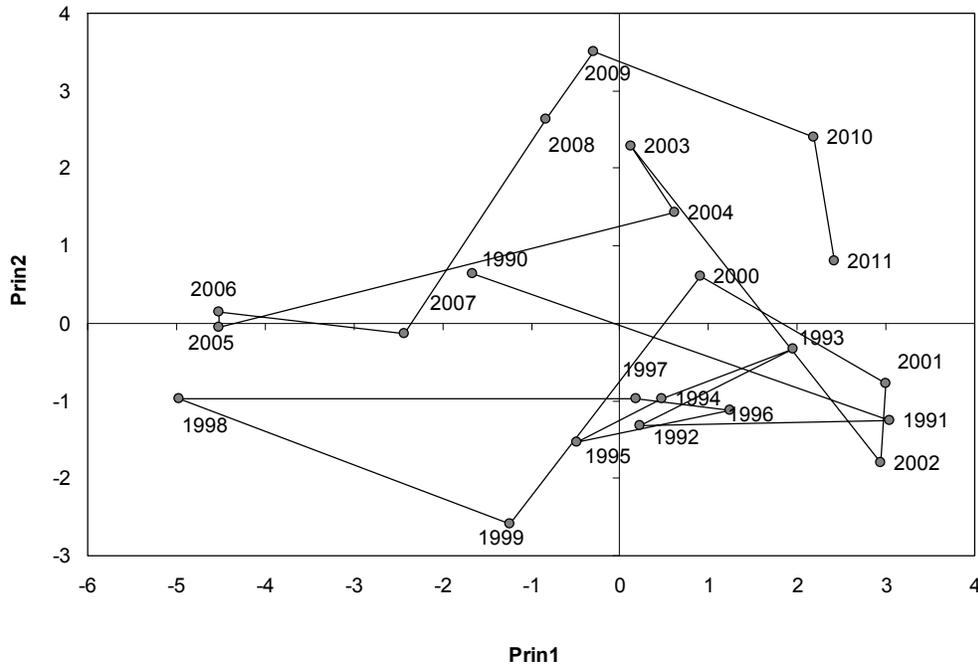


Figure 13. Principal component scores plotted in a phase graph for the fourteen most frequently encountered species groups sampled in the central California core area in during 1990-2011.

Pacific Sardine:

Canadian Program on High Seas Salmon: integrated epipelagic ecosystem survey off the west coast of British Columbia to Southeast Alaska.

Source: Marc Trudel, Fisheries and Oceans Canada, Nanaimo, BC

The Canadian Program on High Seas Salmon has been conducting integrated epipelagic ecosystem surveys from the west coast of British Columbia to Southeast Alaska since 1998 to assess the effects of ocean conditions and climate change on the distribution, migration, growth and survival of Pacific salmon, and to forecast salmon returns to British Columbia. These surveys are usually conducted in late spring-early summer (June-July) and in the fall (October-November). In addition, these surveys have been conducted during winter (February-March) since 2001 to assess the effects of winter conditions on the ecology, bioenergetics, and survival of juvenile salmon. Results are shown for 2005-2011 (Figures 14-16).

Overall, sardine catches were lower off British Columbia in 2011 compared to 2010 (Figure 15), and may be attributed to generally lower sea surface temperatures in 2011. No sardines were caught in February-March 2011, whereas a few sardines were caught off the west coast of Vancouver Island during this time of year from 2005-2007 and in 2010 (Figures 14 and 15). Catch-per-unit effort and prevalence was also lower in June-July 2011—in fact, both measures were the lowest observed since our reporting started in 2005 (Figure 16). By October-November 2011, nearly all sardines had left the west coast of British Columbia—a pattern not observed since 2008. In contrast, sardines were still relatively abundant off the west coast of Vancouver Island during previous autumn surveys (other than 2008), and even as far north as the central coast of British Columbia (in 2005), presumably due to warmer waters in those years.

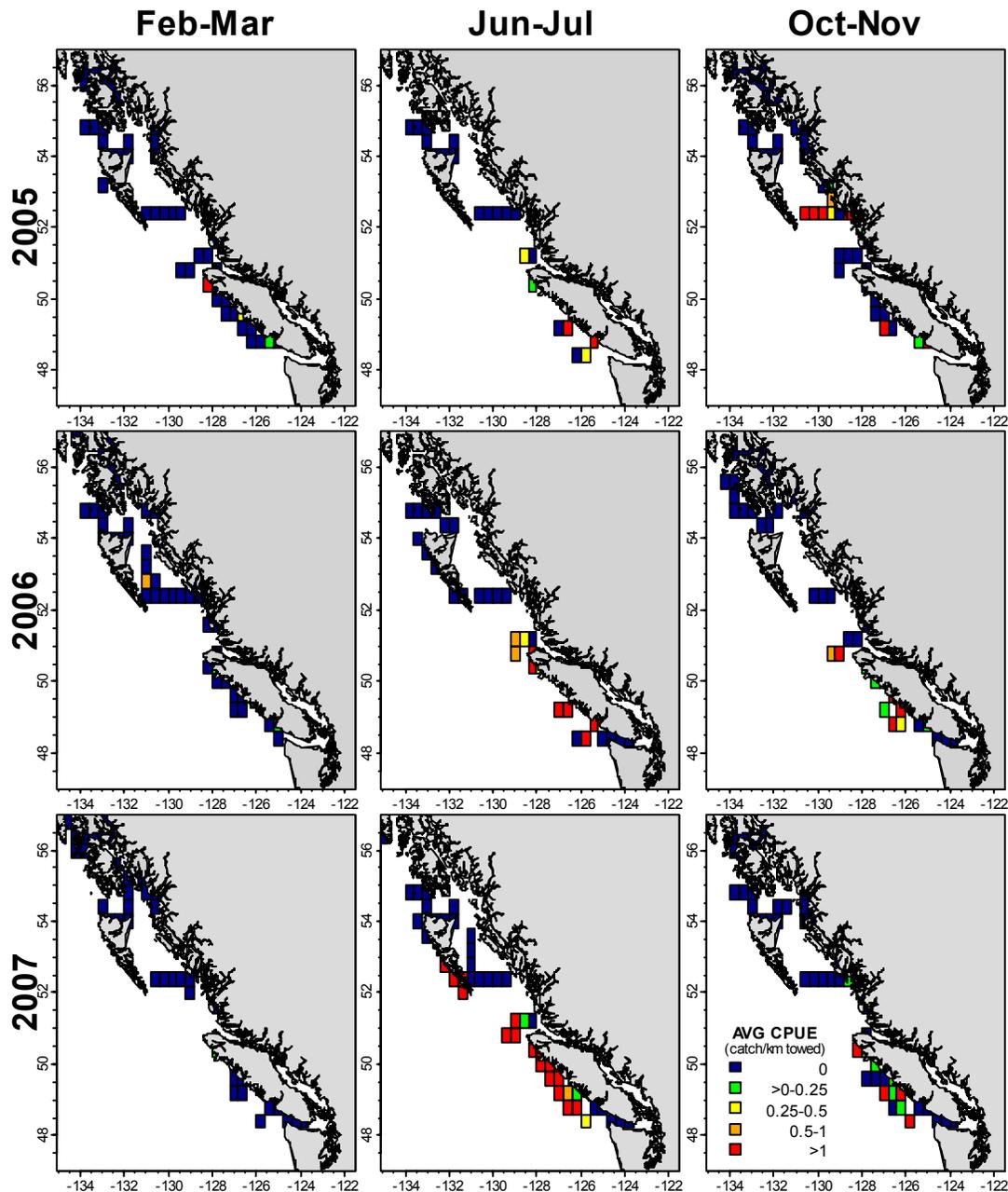


Figure 14. Average sardine CPUE by season and year, 2005-2007. Each cell represents a 0.4° latitude by 0.4° longitude area, and is colored based on the average CPUE of stations found in the cell.

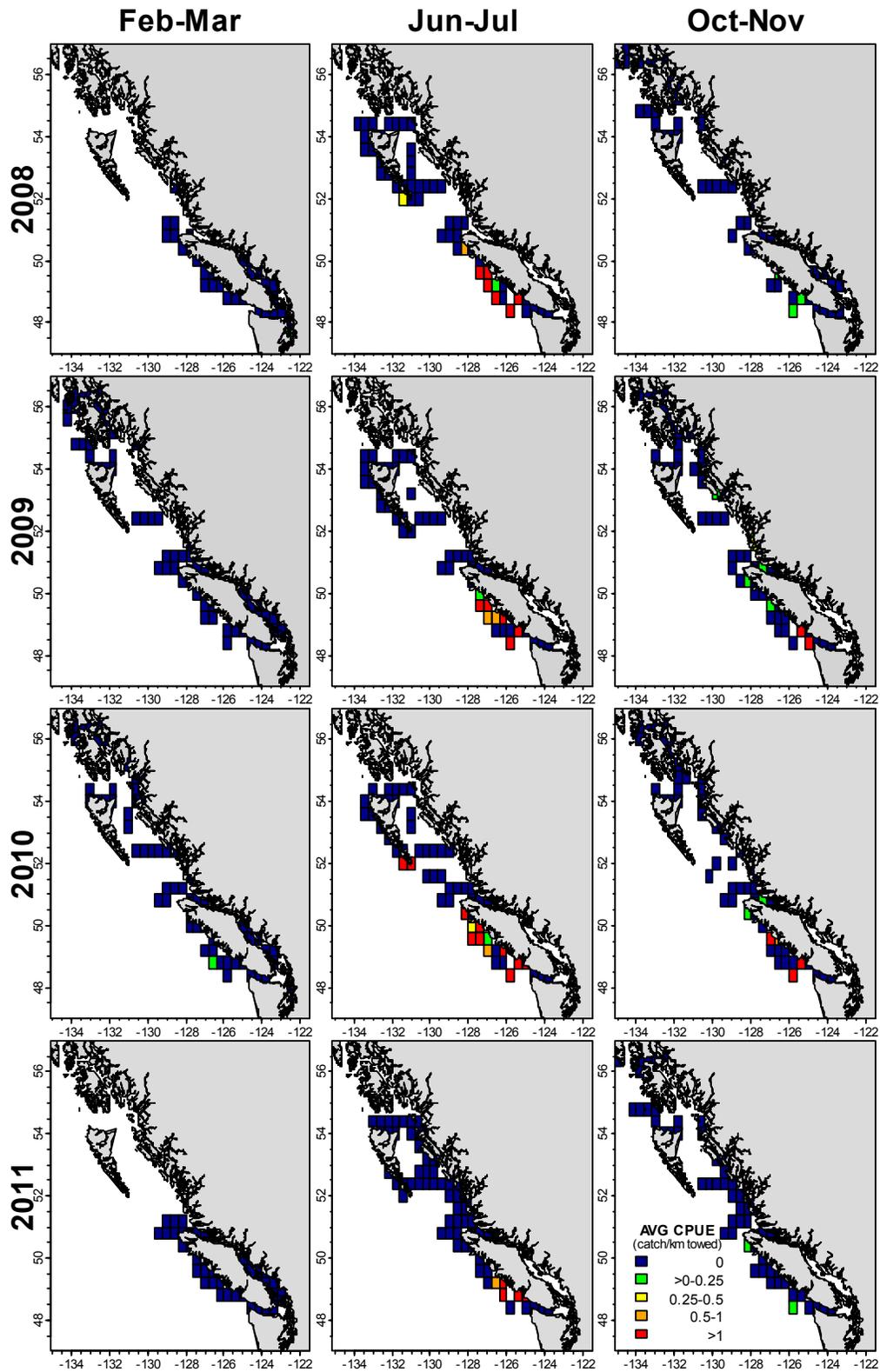


Figure 15. Average sardine CPUE by season and year, 2008-2011. Each cell represents a 0.4° latitude by 0.4° longitude area, and is colored based on the average CPUE of stations found in the cell.

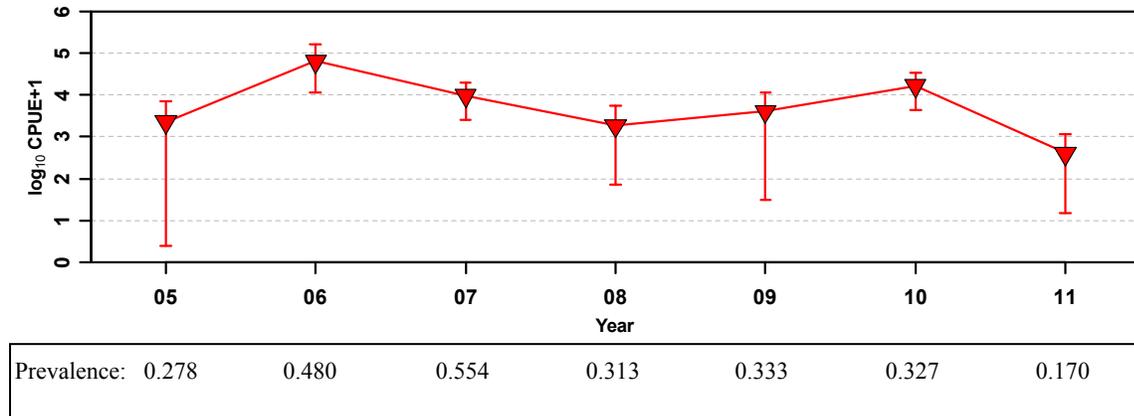


Figure 16. Annual variation in CPUE of sardines (all size classes combined) caught in High Seas Salmon trawl surveys off the west coast of Vancouver Island in summer (June-July). Prevalence indicates the percentage of stations from the survey that contained sardines.

Summer trawl sardine survey off the west coast of Vancouver Island, 2011 update.

Source: Jake Schweigert, Fisheries and Oceans Canada, Nanaimo, BC

Survey background

Summer surveys directed at collecting information on sardines off the West coast of Vancouver island (WCVI) started in 1992 (McFarlane and MacDougall, 2001). Fishing is conducted using a mid water trawl towed near the surface (e.g. <30 m) using floats on the headlines at average speeds approximating 4.0 to 5.5 knots. Since 2006, sampling has been conducted at night (Schweigert et al., 2009). Surveys are conducted to observe biological trends of sardine related to regional distribution, abundance, morphometrics and ecological conditions.

The 2011 survey was conducted between July 19 and August 1 and sampling sites were based on intersections of a regional 10x10km grid extending approximately 2 to 52 km from shore with a range in latitude of 50.7-48.5° extending southward to 10 km from the U.S. border. The region was further subdivided into 8 zones to aid in the planning of sampling coverage across the region and for future exploration of possible stratification schemes. Assignment of sampling stations was done by applying proportional probabilities to possible stations so that each sub-region would receive approximately equal sampling intensity. This was planned by assuming that 70 coastal stations would be sampled over the region. In 2011, 68 coastal stations were sampled and 41 of the tows had sardines. Relatively high catch densities occurred off Brooks Peninsula and southward throughout the region at varying distances from shore, whereas sampling sites further offshore and in the southeast corner of the region had many of the tows lacking sardines (Figure 17).

WCVI survey catch densities and biomass estimates

Biomass estimates for the region (and by sub-region in past reports) have been calculated using sardine catch densities (metric ton /km³) and average sardine catch density extrapolated over the represented area’s size and surface volume (Schweigert and McFarlane 2001; Schweigert et al., 2009; DFO, 2011). Sardine catch weights have been recorded for all tows and estimates of the volume of water swept during a tow have been determined by multiplying the length and width dimensions of the trawl net mouth by the effective fishing distance covered during the tow (time between end of net deployment and beginning of net retrieval). The core area of the survey region is approximately 16,740 km² and catch densities are assumed to represent sardine distributions in the top 30m of the region, therefore the region’s surface volume is estimated at ~ 502.2 km³ (Figure 1, DFO 2011). Recent regional estimates of sardine catch density and seasonal biomass in the WCVI core survey region from night sampling in 2006 and 2008 to 2010 (no survey was conducted in 2007) show a declining trend, whereas the 2011 estimates are approximately double the 2010 estimates (Figures 17 and 18).

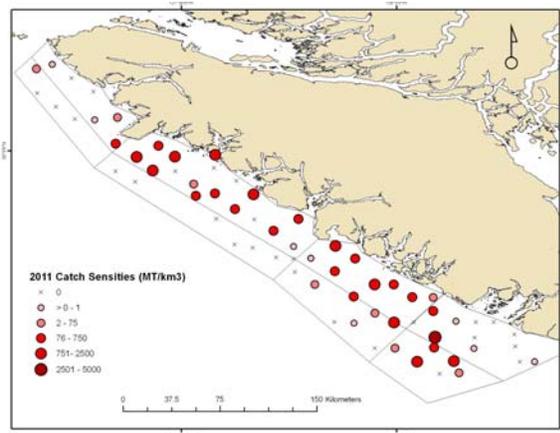


Figure 17. West coast of Vancouver Island 2011 night surface trawl locations and approximate Pacific sardine catch densities for night sampling, occurring between July 19- August 1.

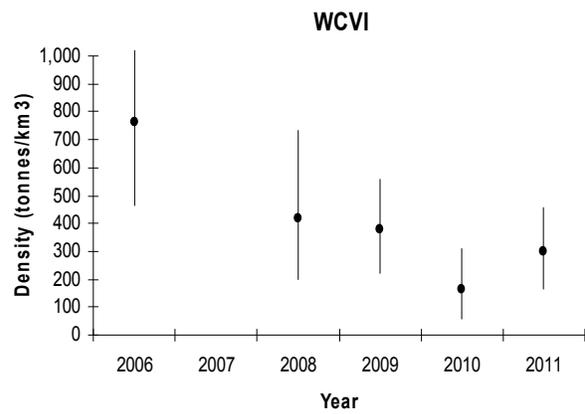


Figure 18: West coast of Vancouver Island 2006-2011 night surface trawl survey average sardine catch density estimates (in metric tons per km³) and no survey conducted in 2007. Vertical bars represent 95% Confidence Intervals derived from bootstrapping observed densities for each year's set of samples.

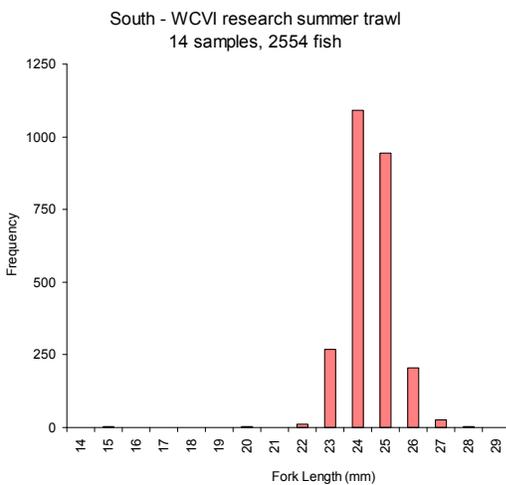
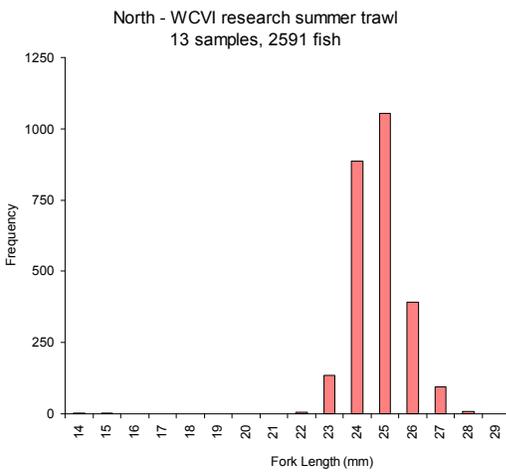
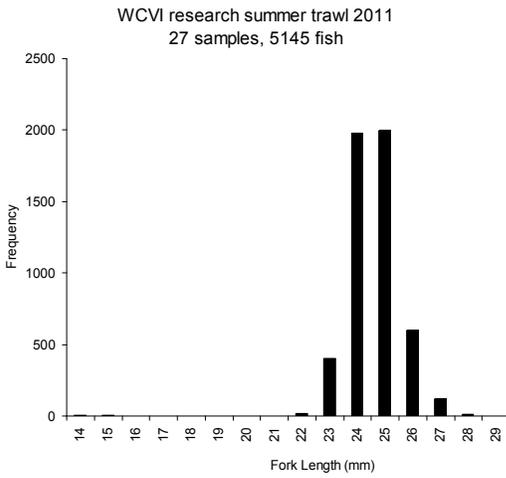
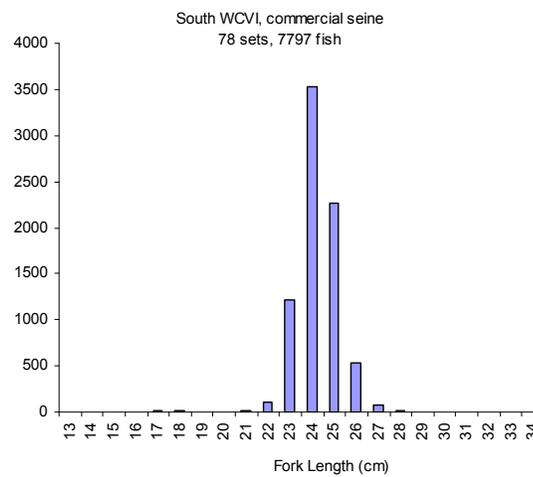
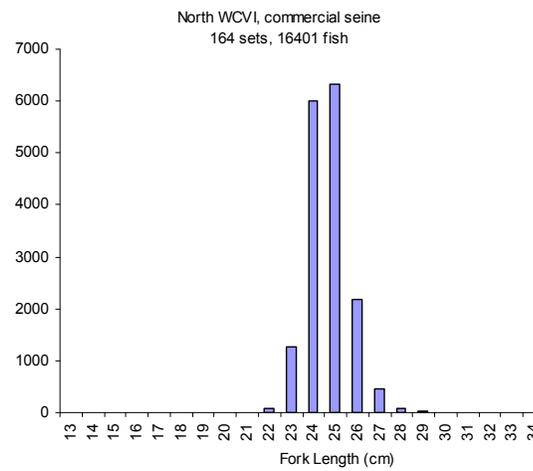
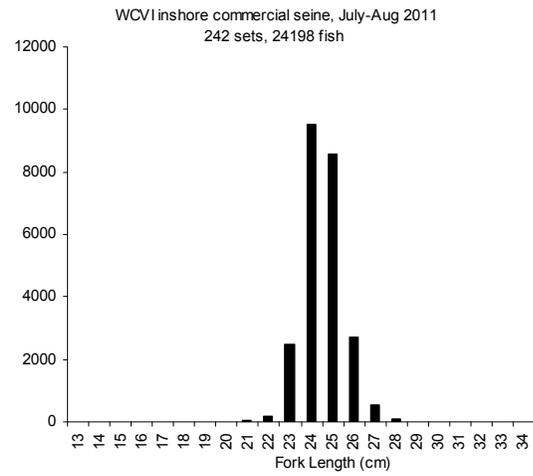
A**B**

Figure 19. Fork length distributions representing sardines collected in 2011 from the WCVI summer surface trawl survey between July 19 and August 1 (A) and from commercial purse seine catches between July 5 and August 26. A perpendicular line seaward off Esperanza Peninsula delineates northern and southern groupings.

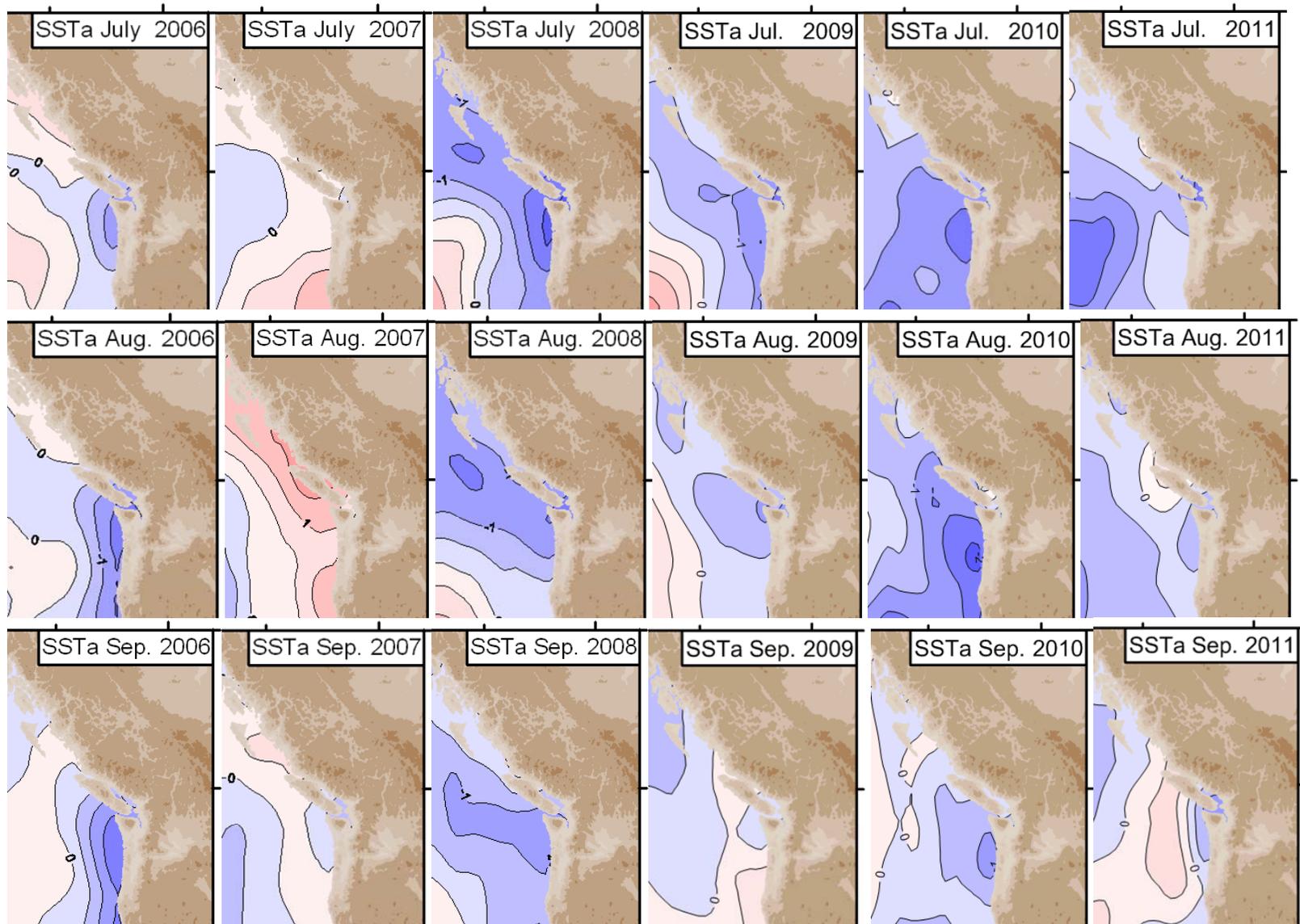


Figure 20. Mean sea surface temperature anomalies for waters surrounding British Columbia in June, August and September. Information from: <http://www.pac.dfo-mpo.gc.ca/science/oceans/data-donnees/sst-tsm/index-eng.htm>

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Salmon:

Source: Bill Peterson, NOAA, NMFS

Pelagic fishes have been sampled in June and September off the coast of Washington and Oregon since 1998, using a Nordic 264 rope trawl. Catches of juvenile salmonids in 2011 were about average for juvenile coho and spring Chinook in June but below average in September (Figure 21). Although it is difficult to assign a direct cause for what appears to be poor survival during the summer 2011, conditions indicate that the poor survival was due to generally weak upwelling conditions during the summer as a short upwelling season.

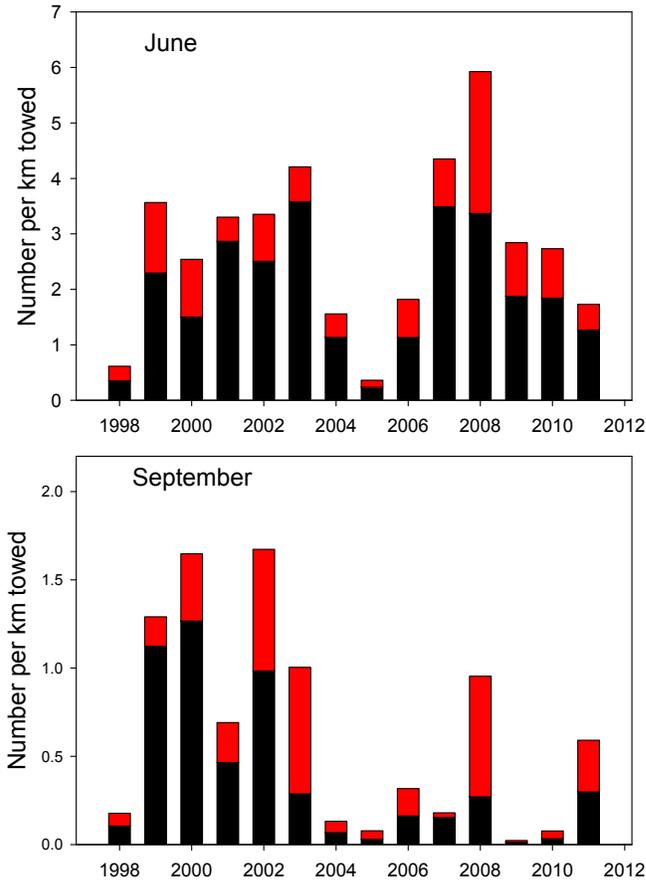


Figure 21. Catches of juvenile salmonids in pelagic trawl surveys carried in June and September in coastal waters off Washington and Oregon. Black indicates juvenile coho; red juvenile Chinook salmon. Catches in both months were below average.

Marine Birds and Mammals:

Marine Birds:

Auklets and shearwaters as indicators of ecosystem change off southern California

Source: William J. Sydeman and Sarah Ann Thompson (Farallon Institute for Advanced Ecosystem Research)

Seabirds are the most conspicuous marine organisms living at the interface of the atmosphere and the ocean. As such, they may provide useful information on spatial and temporal variability of marine ecosystem productivity and 'health'. Climate change and fishing may be decreasing ecosystem productivity and the ocean's carrying capacity, with effects on seabirds and other species at the upper trophic levels.

The Cassin's Auklet (*Ptychoramphus aleuticus*) and Sooty Shearwater (*Puffinus griseus*) are abundant seabirds of the North Pacific Ocean. Auklets are resident to the California Current, and forage mainly on euphausiids and larval fish (Ainley et al., 1996, Abraham and Sydeman, 2004). Shearwaters are seasonal migrants and feed on zooplankton and forage fish (Briggs and Chu, 1987). Surveys of marine birds have been conducted in conjunction with seasonal California Cooperative Oceanic Fisheries Investigation (CalCOFI) and California Current Ecosystem-Long-Term Ecological Research (CCE-LTER) cruises since May 1987 (Veit et al., 1996). The resulting database now contains 87 surveys over 25 years, including information through July 2011. While the ship is underway at speeds >5 k, seabirds are identified and counted by an experienced observer using a 300-m strip-width transect (see Yen et al., 2006 for details). We tested the hypothesis that auklet and shearwater densities have decreased through time in accordance with hypothesized decreases in ecosystem productivity (Veit et al., 1997, McGowan et al., 1998, Hyrenbach and Veit, 2003). The shearwater and auklet indicators are important because they may reflect complex biological processes occurring in the marine environment that are difficult to measure directly.

As an ecosystem indicator, auklets are most abundant off southern California in the fall and winter. The shearwater is a trans-hemispheric migrant (Shaffer et al., 2006); shearwaters may be found in the California Current year-round, but their relative abundance is greatest during the spring and summer. In winter, and to a lesser extent, fall, the at-sea density of auklets declined, but the decline was most pronounced in the early portion of this time series (Figure 22). The relative abundance of auklets declined from the late 1980s to late 1990s before rebounding in the early-mid 2000s. The data show no linear trend in auklet density over the past 15 years. There was, however, clear autocorrelation in these data, with increasing and then decreasing abundance in the early-mid 2000s. The latter years (2010 and 2011) showed low relative abundance. The relative abundance of shearwaters showed a consistent decline over the 25-year period, though the rate of change has decreased recently (Figure 22). From low-points in the mid-1990s, shearwater relative abundance increased in the mid-late 1990s, before declining steadily thereafter. The latter years (2010 and 2011) showed disparate patterns with higher abundance in 2010 and lower abundance in 2011.

Overall, these observations support previous assessments and calculations of seabird population change in the Southern California Bight (Veit et al., 1996, 1997, Hyrenbach and Veit 2003, Sydeman et al., 2009). These patterns of population variability in shearwaters and auklets at sea support the hypothesis that environmental change is affecting the marine ecosystem off southern California. Auklets and shearwaters are high-energy diving species with cold-water affinities (Hyrenbach and Veit, 2003). While we found secular trends in abundance for these species, we also demonstrated interannual variability and some strongly contrasting patterns of variability between these species. Thus, there are some similarities (both species have declined), but also some major differences in the population variability of these species. We hypothesize this variation is related to the fact that shearwaters are wintering migrants while the auklets are resident and local breeders.

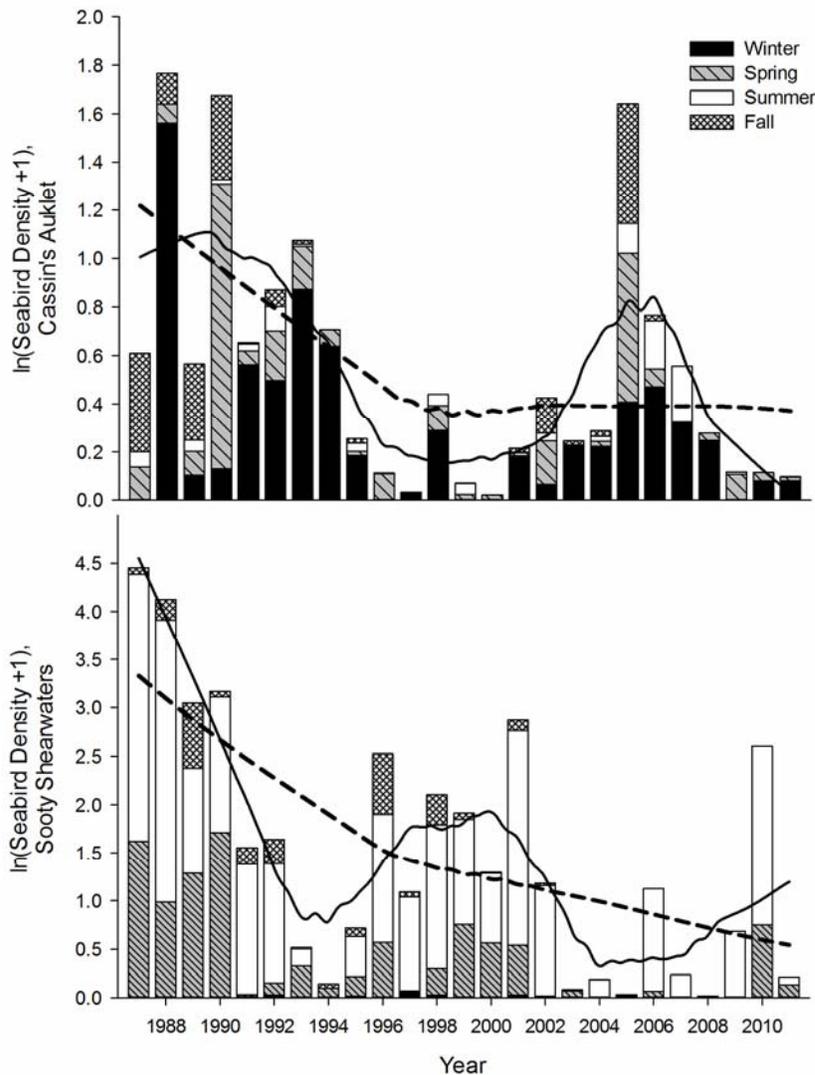


Figure 22. Changes in Sooty Shearwater and Cassin’s Auklet relative abundance (birds km⁻²) on 87 CalCOFI surveys, May 1987 - July 2011. Stacked bars denote seasonal density estimates, with a dashed Lowess smoothing line (bandwidth=0.8) shown for each species based on the averaged annual value, and a solid Lowess smoothing line (bandwidth=0.3) to illustrate interannual autocorrelation.

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: <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 annual summary was available at the time of this report. Please view the <http://ww4.doh.wa.gov/gis/mogifs/biotoxin.htm> site for the most current status.

Oregon HAB Summary

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

Source: Zach Forster, Oregon Department of Fish and Wildlife

The Monitoring Oregon's Coastal Harmful Algae (MOCHA) project monitors ten sites along the coast of Oregon for the presence of harmful algae. These sites include three along Clatsop Beach, one on Cannon Beach, two on the central coast and four sites on the south coast. *Alexandrium* persisted along much of the coast during the spring and summer while *Pseudo-nitzschia* was infrequently reported until August. Increases in phycotoxins in bivalve tissue resulted in one shellfish closure during the year. Other harmful algae encountered during 2011 include *Chochlodinium* sp., *Akashiwo sanguinea* and *Dinophysis* spp..

Alexandrium was first detected in the nearshore waters of the Oregon coast in May. By June, *Alexandrium* was encountered regularly during weekly sampling along the northern and central Oregon coast. *Alexandrium* abundance and diversity continued to increase on the north coast through the later part of August with cell counts reaching as high as 5,000 cells/L at multiple sample sites. Subsequent increases in paralytic shellfish toxins resulted in a month long closure of all mussel harvesting from the Columbia River south to Cascade Head.

Three distinct blooms of *Pseudo-nitzschia* (*P-n*) were captured along the Oregon coast beginning in late July (Fig. 23). On the north coast, an accumulation of larger type *P-n* cells persisted for six weeks. A small increase of domoic acid in razor clam tissue, well below the regulatory closure limits, occurred during this time. On the south coast, sample sites from Gold Beach to Coos Bay experienced a bloom of the smallest type *P-n* which lasted from July through August. Finally, in September, a third bloom of larger type *P-n* cells was recorded at Gold Beach with cell counts exceeding a million cells per liter. Mussels collected from an adjacent sample site in Gold Beach during this time increased from 0 to 7.3 ppm domoic acid. However, no shellfish harvest closures due to domoic acid occurred in 2011.

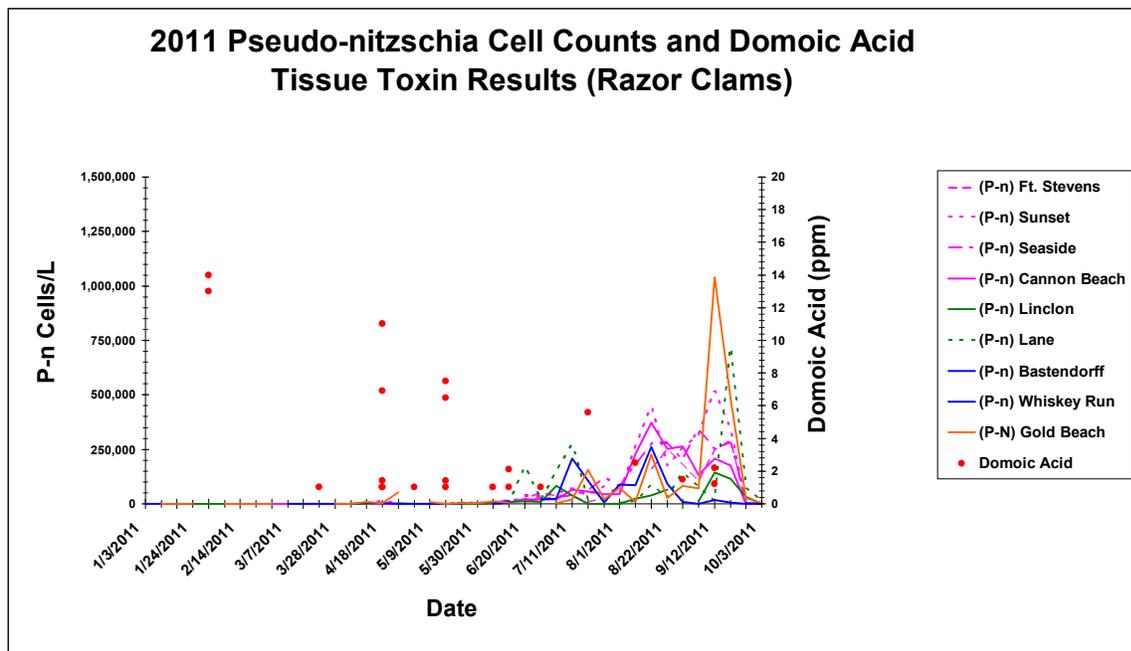


Figure 23. Cells per liter of *Pseudo-nitzschia* and *Alexandrium* during 2011 along the Oregon Coast.

California HAB Summary

Source: Gregg W. Langlois, CA Department of Public Health

<http://www.cdph.ca.gov/healthinfo/environhealth/water/Pages/Shellfish.aspx>

Shellfish samples are collected at different sites along the coast of California. Some stations are sampled on at least a weekly basis. Cell concentrations of *Pseudo-nitzschia* and *Alexandrium* were very variable spatially and from week-to-week during 2011. Often domoic acid (DA) levels were fine during one week only during a month at a single location.

Pseudo-nitzschia was observed at a number of sites along the entire southern California coast from January to May. January to March, low numbers of *Alexandrium* were detected at sampling sites throughout southern California. *Alexandrium* was not observed at any northern California sampling sites in January and was observed at only two sampling sites in February. In February, the concentration of domoic acid remained high in samples of lobster viscera from offshore near Anacapa and Santa Cruz islands. *Alexandrium* was observed at sites in most northern California counties in March. In March, domoic acid was detected at numerous sites between San Luis Obispo and Ventura counties, and toxin levels exceeded the alert level throughout this range. In April and May, *Alexandrium* was mostly absent from samples along the entire California coast. PSP toxins were absent from all shellfish samples from January to March, and in May. During the third week in April mussels from offshore of Santa Barbara contained a low concentration of PSP. Throughout April, domoic acid was also detected at numerous sites between San Luis Obispo and Ventura counties. Domoic acid concentrations dropped below the detection limit by the beginning of May at sites in Santa Barbara and Ventura counties. During the second week of June, offshore of Santa Barbara the toxin concentration in shellfish exceeded the federal alert level and continued to increase throughout the month. The levels of domoic acid decreased below the detection limit by the first week of July, but the decline was temporary, as the toxin level increased during the second week and exceeded the alert level the last two weeks of July. Domoic acid was not detected in any samples analyzed in northern California during June or July. In July, a low level of the PSP toxins was detected in mussels collected from Portuguese Bend in the Palos Verdes region. During the first week of September, a low level of domoic acid persisted in shellfish from the aquaculture lease offshore of Santa Barbara, then declined below the detection limit for the remainder of the month. By the end of the month a low concentration of this toxin was detected in sentinel mussels in outer Morrow Bay. By August domoic acid concentrations exceeded alert levels throughout California. Domoic acid was not detected in any shellfish samples analyzed in northern California in September.

In September, paralytic shellfish poisoning (PSP) toxins were not detected in any shellfish samples in southern California. In northern California, low levels of PSP toxins were detected in sentinel mussels from outer Humboldt Bay during the first week of the month and farther inside the bay by the second week. Low concentrations of these toxins were also detected in shellfish from sites in San Mateo and Santa Cruz counties. Sentinel mussels at the Santa Cruz Pier contained low levels of the PSP toxins throughout the month.

PACIFIC COAST FISHERIES MANAGEMENT SUMMARIES AND RECOMMENDATIONS

Summary of the Oregon Fishery for Pacific Sardine (*Sardinops sagax*)

Source: Oregon Department of Fish and Wildlife, Marine Resources Program (November, 2011).

Oregon Fishery Summary: The sardine fishery is prosecuted with purse seine vessels. Off the Pacific Northwest, weather events such as storms, heavy fog, or high seas are major factors in the success rate of catching sardines. These types of events make it difficult to predict how many pounds of sardines will be delivered during any given day. Another variable that can affect Oregon based fishermen is the quality of the sardines. Belly thickness, quantity of food in the stomach tissues, average size of the fish, and oil content can all influence the quality of the fish. All of these factors can affect the ex-vessel price paid to the fishermen. Sardines caught in the summer months in the area of Oregon and Washington are feeding in productive nutrient rich waters. During this time, the fish are increasing their oil content or “fat”. High oil content is

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important in the palatability for human consumption. The peak oil content for sardine off Oregon and Washington generally occurs in August and September, which coincided with the peak months of sardine landings in Oregon from 2005 – 2007. The federal coastwide harvest guideline was not a limiting factor for the fishery until 2008, when all three sardine catch allocation periods were closed early because the allocation was reached. Lower estimates of biomass and the lower Harvest Guidelines since 2008 have led to a derby style fishery and changed the timing of the fishery off Oregon and Washington with peak catch occurring in July during recent years for Oregon vessels (Figure 24).

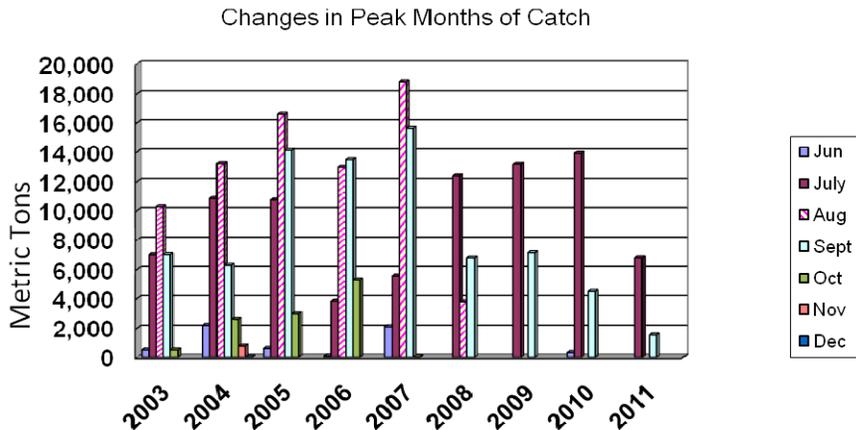


Figure 24. Oregon landings for the months of June through December from 2003 to 2011.

Summary of the Washington Purse Seine Fishery for Pacific Sardine (*Sardinops sagax*)

Source: Washington Department of Fish and Wildlife (October, 2011).

Pacific sardines are the primary coastal pelagic species harvested in Washington waters. Washington annual and monthly information is presented in Tables 1 - 2.

Table 1. Comparison of Landings (metric tons), Number of Landings and Number of Vessels in the Washington sardine purse seine fishery 2004-2011.

	2011*	2010	2009	2008	2007	2006	2005	2004
No. of Vessels	7	8	8	5	6	7	11	14
Total Landings (mt)	7,918	12,379	8,009	6,432	4,663	4,362	6,714	8,911
No. of Landings	126	232	173	150	106	108	207	236
Average Landing (mt)	63	53	46	43	44	39	32	37

* Preliminary

A review of landings data from the top five vessels from 2000-2011 shows that single vessel total annual landings average about 1,400 metric tons (Table 2). Factors such as season length, weather and ocean conditions, sardine abundance relative to proximity to port, processing capacity and skipper experience. Prior to 2008 the fishery did not attain the periodic allocation quotas or the annual harvest guideline. Due to reduced harvest guidelines, the fishery has experienced closures. In Washington, weather and ocean conditions are typically most favorable from May through October. Processor capacity does limit the number and size of deliveries; however, upgrades have increased facility capabilities compared to earlier years of the fishery.

Table 2. Total annual landings (mt) for top five vessels, 2000-2011, ranked from highest to lowest. *Preliminary

Vessel	2011*	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000
1	1,655	3,036	2,192	1,762	1,152	1,953	1,901	2,689	3,307	4,056	2,702	1,920
2	1,276	1,913	1,519	1,636	952	668	1,745	2,504	2,393	2,164	1,902	1,800
3	1,267	1,707	1,296	1,291	797	664	1,480	986	2,258	1,735	1,218	542
4	1,218	1,510	1,141	1,249	734	534	927	775	1,167	1,338	925	264
5	992	1,372	1,005	494	610	452	248	580	1,080	1,331	887	133

Highly Migratory Species:

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

Source: Pacific Fisheries Management Council (<http://www.pcouncil.org>)

Eighth Meeting of the Western and Central Pacific Fisheries Commission: The Council made recommendations to the U.S. delegation to the WCPFC8 meeting, which has been rescheduled to a future date in February 2012. The recommendations focused on conservation of bigeye tuna in the Western Pacific, encouraging better cooperation between the WCPFC and the Inter-American Tropical Tuna Commission, and supporting a variety of management, control and surveillance measures under consideration by the WCPFC.

The WCPFC's conservation measure for tropical tunas, which aims to end overfishing on bigeye tuna in the Western and Central Pacific Ocean expired at the end of 2011. Bigeye overfishing is still occurring, so members need to agree on a replacement measure at the February 2012 meeting.

NEW RESEARCH ACTIVITIES IN THE CALIFORNIA CURRENT SYSTEM

Marine Mammals:

SOCAL-BRS (Behavioral Response Study)

Source: Jay Barlow, NOAA, NMFS <http://sea-inc.net/socal-brs/socal-11/> and <http://sea-inc.net/2011/10/06/end-socal-11/>

“SOCAL-BRS” (Behavioral Response Study) is a multi-year effort (2010-2014) designed to better understand marine mammal behavior and reactions to sound. It is an interdisciplinary research collaboration, building on previous efforts in the Bahamas and Mediterranean Sea. The overall objective is to provide a better scientific basis for estimating risk and minimizing effects of active sonar for the U.S. Navy and regulatory agencies. SOCAL-BRS is also part of a larger international collaboration to measure the impacts of noise marine mammals using opportunistic and experimental approaches (including controlled exposure experiments, or “CEEs”). SOCAL-11 extends existing collaborations among scientists from private sector and academic scientists, the U.S. National Oceanic and Atmospheric Administration (NOAA), and U.S. Navy researchers and operational personnel. It is jointly funded by the U. S. Navy, Chief of Naval Operations, Environmental Readiness Division (OPNAV N45) and the Office of Naval Research (ONR).

In summary, 38 tags were deployed (including v2 and v3 Dtags (Woods Hole Oceanographic Institution), and Wildlife Computer MK-10 TDRs and TDR-satellite tags) on 25 blue whales, 7 Risso's dolphins, 2 bottlenose dolphins, and one Cuvier's beaked whale. CEEs were conducted on 18 individuals (13 total sequences) including 13 blue whales, 4 Rissos, and one Cuvier's beaked whale. All of these were completed within all specified protocols, animals were observed following CEEs, and several were cut short because marine mammals ignored the sound source and came within the specified safety zone during transmissions. Three focal follow sequences were completed in testing tagless group follow protocols, including two with common dolphins and one with bottlenose dolphins.

A summary of this study will be included in the SOCAL-11 project report that will be issued sometime in early 2012. A blog post and other messages will announce the availability of this report, and it will be posted on www.socal-brs.org.

Literature Cited:

- Abraham, C. L., and W. J. Sydeman. 2004. Ocean climate, euphausiids and auklet nesting: inter-annual trends and variation in phenology, diet and growth of a planktivorous seabird, *Ptychoramphus aleuticus*. *Marine Ecology Progress Series* 274:235-250.
- Ainley, D. G., L. B. Spear, and S. G. Allen. 1996. Variation in the diet of Cassin's auklet reveals spatial, seasonal, and decadal occurrence patterns of euphausiids off California, USA. *Marine Ecology Progress Series* 137:1-10.
- Bjorkstedt, E., R. Goericke, S. McClatchie, E. Weber, W. Watson, N. Lo, B. Peterson, B. Emmett, R. Brodeur, J. Peterson, M. Litz, J. Gomez-Valdes, G. Gaxiola-Castro, B. Lavaniegos, F. Chavez, C. A. Collins, J. Field, K. Sakuma, S. J. Bograd, F. B. Schwing, P. Warzybok, R. Bradley, J. Jahncke, G. S. Campbell, J. A. Hildebrand, W. J. Sydeman, S. A. Thompson, J. L. Largier, C. Halle, S. Y. Kim, J. Abell. 2011. State of the California Current 2010-2011: Regionally variable responses to a strong (but fleeting?) La Niña. *California Cooperative Oceanic Fisheries Investigations (CalCOFI) Report Vol. 52*.
- Briggs, K. T., and E. W. Chu. 1987. Trophic relationships and food requirements of California seabirds: updating models of trophic impact. Pages 279-301 in J. P. Croxall, editor. *Trophic relationships and food of California seabirds*. Cambridge University Press.
- DFO. 2011. Evaluation of Pacific sardine (*Sardinops sagax*) stock assessment and harvest guidelines in British Columbia. *DFO Can. Sci. Advis. Sec. Science Advisory Report*. 16.
- Hyrenbach, D. K., and R. R. Veit. 2003. Ocean warming and seabird communities of the Southern California Current System (1987-98): response at multiple temporal scales. *Deep-Sea Research Part II - Topical Studies in Oceanography* 50:2519-2536.
- Logerwell, E. A., N. J. Mantua, P. W. Lawson, R. C. Francis, and V. N. Agostini. 2003. Tracking environmental processes in the coastal zone for understanding and predicting Oregon coho (*Oncorhynchus kisutch*) marine survival. *Fisheries Oceanography* 12(6): 554-568.
- McFarlane, G. A., and L. A. MacDougall. 2001. Biological information for Pacific sardine captured during research cruises, 1992-2000. *Can. Tech. Rep. Fish. Aquat. Scie.* 2372:149.
- McGowan, J. A., D. R. Cayan, and L. M. Dorman. 1998. Climate-ocean variability and ecosystem response in the Northeast Pacific. *Science* 281:210-217.
- Schweigert, J., and G. A. McFarlane. 2001. Stock assessment and recommended harvest for Pacific sardine in 2002. *DFO Can. Sci. Advis. Sec. Res. Doc.* 126:12.
- Schweigert, J., G. A. McFarlane, and V. Hodes. 2009. Pacific sardine (*Sardinops sagax*) biomass and migration rates in British Columbia. *DFO Can. Sci. Advis. Sec. Res. Doc.* 088:14.
- Shaffer, S. A., Y. Tremblay, H. Weimerskirch, D. Scott, D. R. Thompson, P. M. Sagar, H. Moller, G. A. Taylor, D. G. Foley, B. A. Block, and D. P. Costa. 2006. Migratory shearwaters integrate oceanic resources across the Pacific Ocean in an endless summer. *Proceedings of the National Academy of Sciences of the United States of America* 103:12799-12802.
- Sydeman, W. J., K. L. Mills, J. A. Santora, S. A. Thompson, D. F. Bertram, K. H. Morgan, B. K. Wells, J. M. Hipfner, and S. G. Wolf. 2009. Seabirds and climate in the California Current--A synthesis of change. *California Cooperative Oceanic Fisheries Investigations Reports* 50:82-104.
- Veit, R. R., P. Pyle, and J. A. McGowan. 1996. Ocean warming and long-term change in pelagic bird abundance within the California current system. *Marine Ecology Progress Series* 139:11-18.
- Veit, R. R., J. A. McGowan, D. G. Ainley, T. R. Wahls, and P. Pyle. 1997. Apex marine predator declines ninety percent in association with changing oceanic climate. *Global Change Biology* 3:23-28.
- Yen, P. P. Y., W. J. Sydeman, S. J. Bograd, and K. D. Hyrenbach. 2006. Spring-time distributions of migratory marine birds in the southern California Current: Oceanic eddy associations and coastal habitat hotspots over 17 years. *Deep-Sea Research Part II - Topical Studies in Oceanography* 53:399-418.