

The State of the Northeast Pacific in 2009

by William Crawford, David Mackas, William Peterson and Skip McKinnell

The beginning of 2009 brought La Niña conditions back to the equatorial Pacific and to the Northeast Pacific Ocean, maintaining the pattern of cool ocean surface temperatures along the Canadian and U.S. and Alaskan coasts (Fig. 1a). In general, a La Niña sets up a basin-scale wind pattern that brings cooler than normal surface waters to the coastal Northeast Pacific. With the relaxation of La Niña and the onset of an El Niño pattern from April to July 2009, equatorial and Northeast Pacific coastal waters warmed through the boreal spring (Fig. 1b).

Zooplankton surveys of the Vancouver Island continental margin were done in June and September 2009. Continuing the “cool ocean” pattern from 2008, the June 2009 samples contained above average abundances of large “cool water” species (e.g., copepods *Calanus marshallae*, *Neocalanus plumchrus*, and *N. cristatus*; euphausiids *Thysanoessa spinifera* and *Euphausia pacifica*; chaetognath *Parasagitta elegans*). However, by September, several warm water oceanic taxa had become the community dominants at deeper and more offshore locations along the continental

margin (especially, the doliolid *Doliolletta gegenbauri* off southern Vancouver Island, and the pteropod *Clio pyramidata* off northern Vancouver Island). A cool water crustacean-dominated community remained abundant at more nearshore locations. This combination suggests that the source and delivery path for the warm water zooplankton was by northeastward transport of oceanic surface water during the mid- and late summer.

Hydrographic and zooplankton surveys off central Oregon (Newport) continued on a fortnightly basis throughout the year. Anomalously cold ocean conditions observed throughout 2008 continued into 2009, but only until mid-July (−1°C to 2°C SST anomalies). The Pacific Decadal Oscillation (PDO) turned to positive in August and much of August and September was characterized by +2°C to +3°C SST anomalies, due to onshore transport of oceanic waters. The PDO reverted to negative in November 2009. Regardless, the zooplankton community of the mid-shelf continued to be dominated by cold water neritic copepods (*Pseudocalanus mimus*, *Calanus marshallae* and *Acartia*

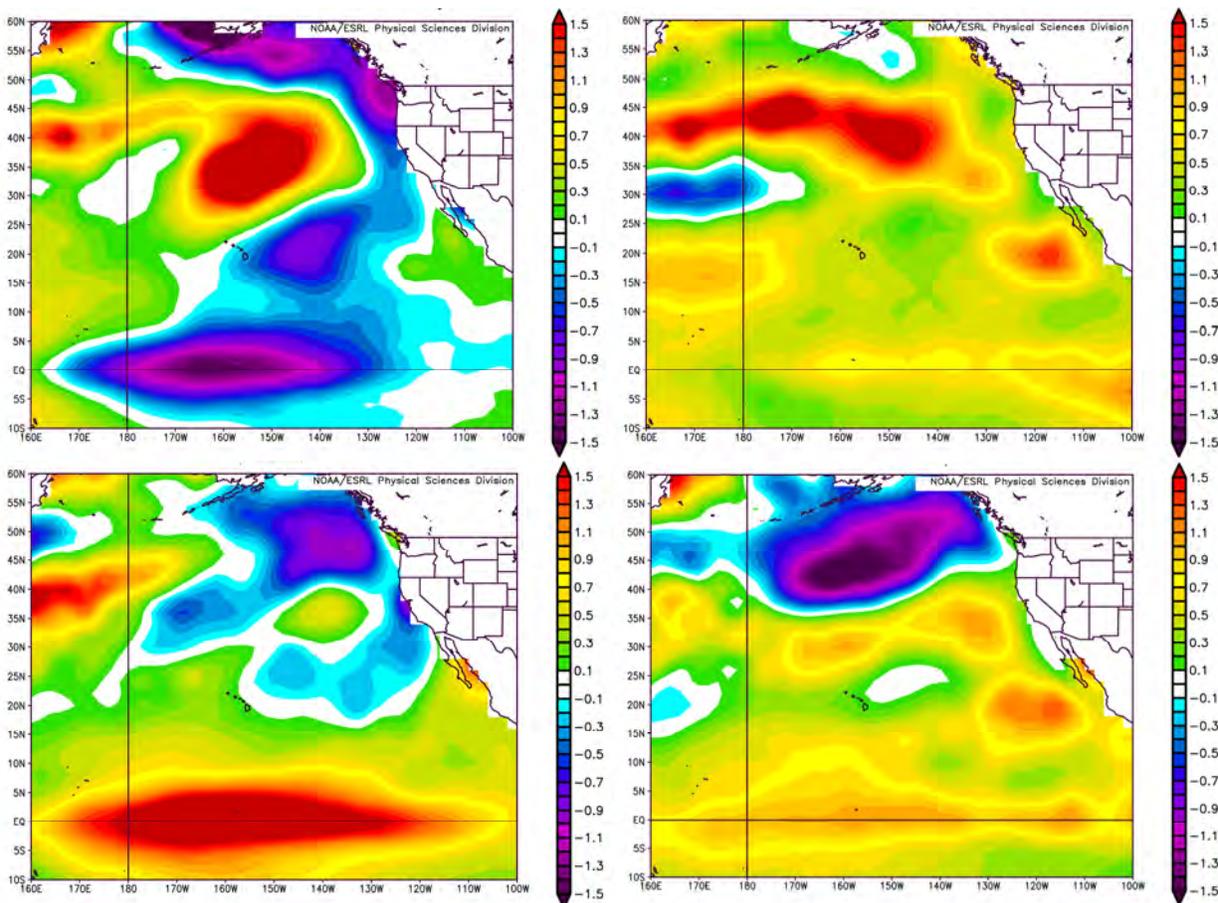


Fig. 1 (Clockwise from top left) Sea surface temperature anomalies (°C) in 2009 for the months of January, June, September and November.

longiremis) through mid-September. As was noted off Vancouver Island, sampling at the continental margin found unusually large numbers of *Dolioletta gegenbauri* in late July. A transition to a warm water neritic community was initiated in mid-September, and by October, the numerically dominant copepod species was *Paracalanus parvus*.

The change observed in August and September may have led to the demise of coho salmon off Oregon, as numbers of juveniles caught during the September salmon survey were the lowest in 12 years of sampling. Among the more common fishes seen in coastal waters during this survey was the ocean sunfish (*Mola mola*). Another unusual event was a bloom of the harmful alga, *Akashiwo sanguinea*, which persisted off Washington and Oregon from September through November. This dinoflagellate was responsible for the deaths of thousands of sea birds along the U.S. West Coast.

Newport, Oregon was the northern extent of a region of reduced average upwelling during the summer of 2009. In southern California, the mean monthly upwelling index in summer was >1 s.e. below normal (Fig. 2, top), while the reverse was true from northern Washington into Canada (Fig. 2, bottom).

By the end of November 2009, ocean temperature anomalies in the Niño 3.4 region in the central equatorial Pacific had been above +0.5°C for five consecutive overlapping three-month intervals, indicating that an “official” El Niño was underway. In general, the west coasts of the U.S. and British Columbia have positive temperature anomalies during the boreal winter of an El

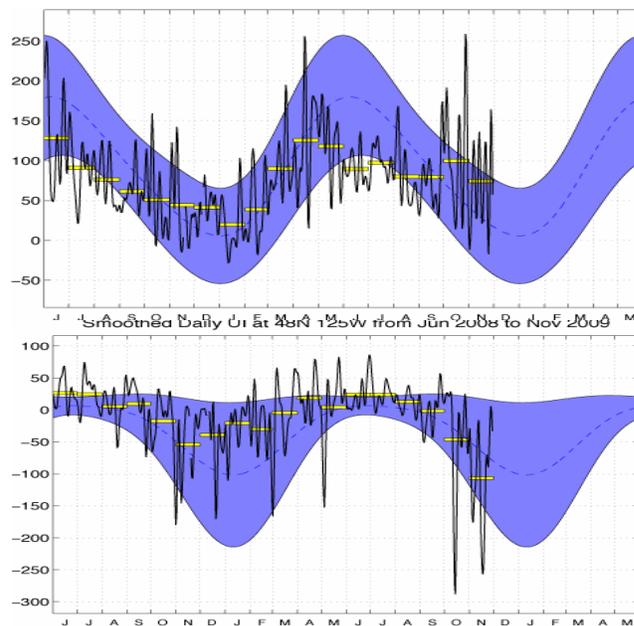


Fig. 2 Solid line is smoothed daily coastal upwelling off (top) southern California, and (bottom) northern Washington from June 2008–November 2009. The dashed curve is a biharmonic fit to the period 1967–1991. The shaded area denotes ± 1 s.e., and the yellow bars denote monthly means (Source: NOAA/PFEL website).

Niño rather than the negative anomalies observed in November 2009. As the winter season begins in December, perhaps it is a little too early to say whether this El Niño is abnormal for the West Coast, but clearly, at the onset of Canadian and U.S. winter, typical El Niño temperatures were not evident.



Left: Dr. William (Bill) Crawford (Bill.Crawford@dfo-mpo.gc.ca) is a Research Scientist with Fisheries and Oceans Canada at the Institute of Ocean Sciences in Sidney, British Columbia. He is co-editor of Canada’s annual State of the Pacific Ocean Report and serves as president of the Canadian Meteorological and Oceanographic Society.

Center left: Dr. David Mackas (Dave.Mackas@dfo-mpo.gc.ca) is a biological oceanographer at the Institute of Ocean Sciences. His research focuses on zooplankton spatial distributions, and (especially lately) on how low-frequency zooplankton temporal variability is linked to ocean climate. Dave has been a member of several PICES standing committees and expert groups.

Center right: Dr. William (Bill) Peterson (bill.peterson@noaa.gov) is an oceanographer and zooplankton ecologist at the Hatfield Marine Science Center in Newport, Oregon. His research focuses on climate effects on zooplankton, particularly euphausiids and copepods, and on forecasting return rates of salmon to their natal streams one year in advance. Bill has served on several PICES expert groups and is currently a member of the Biological Oceanography Committee and Co-Chairman of the Working Group on Comparative Ecology of Krill in Coastal and Oceanic Waters around the Pacific Rim.

Right: Dr. Stewart (Skip) McKinnell (mckinnell@pices.int) is Deputy Executive Secretary of PICES. Among the many things Skip is involved in, his main focus now is on co-editing of the upcoming PICES report on status and trends of the North Pacific.