

# Marine nekton off Oregon and the 1997–98 El Niño

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## Abstract

Several species of migratory, warm-water, oceanic fishes invaded Oregon waters during the summer of 1997. Also, the jumbo squid (*Dosidicus gigas*), common in the eastern tropical Pacific, was reported for the first time in 1997 and was caught in large numbers. The occurrence of these oceanic nekton was associated with inshore advection of anomalously warm water. During 1998, after arrival of the main El Niño signal, some warm-water coastal fishes appeared off Oregon. However, unlike observations off California, fewer species of warm-water coastal fishes were noted during the 1997–98 El Niño than during the 1982–83 El Niño. © 2002 Elsevier Science Ltd. All rights reserved.

## 1. Introduction

The 1997–98 El Niño, like the 1982–83 event, was one of the strongest on record (Cane, 1983; McPhaden, 1999; Quinn, Neal, & Antunez de Mayolo, 1986: see Fig. 1 for the multivariate ENSO index

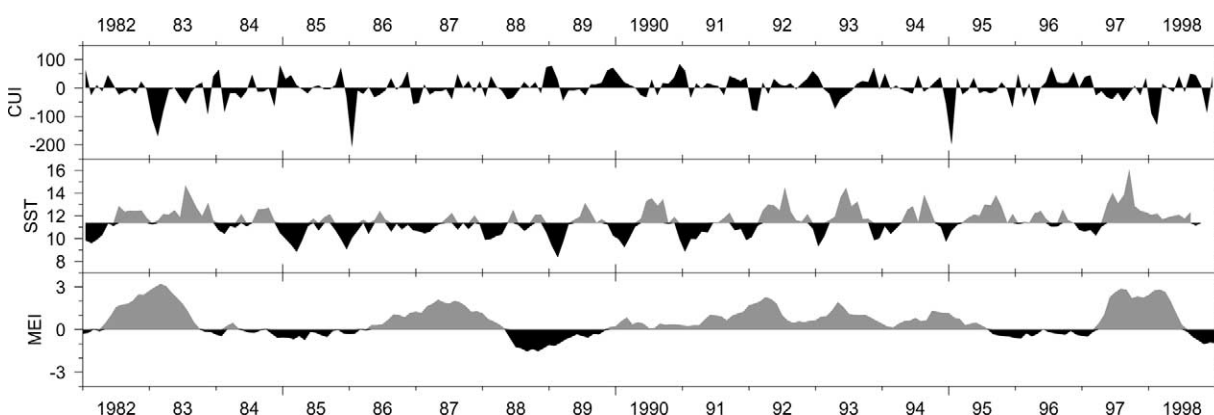


Fig. 1. Coastal upwelling index (CUI) anomalies at 45°N, sea-surface temperatures (SST) at Charleston, OR (43°20.7'N), and the Multivariate ENSO Index (MEI), 1982–98 (from [ftp://nemo.ucsd.edu/pub/shore/](http://nemo.ucsd.edu/pub/shore/)).

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(MEI), coastal upwelling index and sea surface temperatures along the Oregon coast, 1982–1998). Both of these El Niños had dramatic effects on the physical oceanography and biology along the Oregon coast and in the California Current (Lea & Rosenblatt, 2000; Lynn et al., 1998; Percy & Schoener, 1987; Wooster & Fluharty, 1985).

## 2. Methods

As in 1982–83, an ‘El Niño Watch’ was initiated along the Oregon coast in the spring of 1997 (Percy & Schoener, 1987). Its purpose was to alert the Oregon Department of Fish and Wildlife and the Sea Grant Marine Advisory agents along the coast, as well as fishery biologists and recreational and commercial fishermen, to the impending El Niño and to ask them to report observations of any unusual fishes or other organisms. In addition, operators of several fish packing plants were interviewed to gather information on unusual squids and fishes landed.

## 3. Results

During the late summer and fall of 1997 warm-water, oceanic fishes rarely encountered off Oregon were frequently caught or sighted by recreational or commercial fishermen off the coast (Table 1). The first record was of a dorado, *Coryphaena hippurus*, in late July, followed by reports of yellowtail, *Seriola lalandi*, and yellowfin tuna, *Thunnus albacares*, and striped marlin, *Tetrapturus audux*, in September. In

Table 1

Occurrences of unusual fishes and squid of the Oregon coast during 1997–98 (TL = total length).

Date	Species	Location	Notes
1997			17.5°C
7/31	Dorado— <i>Coryphaena hippurus</i>	74 km off Charleston	
9/15	Yellowtail— <i>Seriola lalandi</i>	off southern Oregon	
9/13	2 Rosy rockfish— <i>Sebastes rosaceus</i>	5km mi off Newport	
9/28	3 Yellowtail— <i>Seriola lalandi</i>	off Depoe Bay	TL about 90 cm
9/28	3 Yellowfin tuna— <i>Thunnus albacares</i>	55 km mi off Cascade Head	62°F; TL about 90 cm
9/30-DEC	Jumbo squid— <i>Dosidicus gigas</i>	Newport to Bandon	DML 45–55 cm
9/24	Striped marlin— <i>Tetrapturus audux</i>	47–00N; 125–34W	20°C
9/9	Striped marlin— <i>Tetrapturus audux</i>	hooked off Brookings	
10/10	Dorado— <i>Coryphaena hippurus</i>	75 km mi off Florence	
Oct 97	Albacore— <i>Thunnus alalunga</i>	Oregon coast	some to 25 kg
Oct 97	Sockeye salmon— <i>Oncorhynchus nerka</i>	Rogue, Smith, Klamath rivers	
10/15	Pacific mackerel— <i>Scomber japonicus</i>	Yaquina Bay	TL 7–13 cm
10/27	Jack mackerel— <i>Trachurus symmetricus</i>	Charleston dock	TL about 8.0 cm
12/5–6	2 Ocean sunfish— <i>Mola mola</i>	Coos Bay jetty	13°C
Aug.–Sept. 1998	Pacific sardine— <i>Sardinops sagax</i>	Coos Bay	juveniles
4/16	Lumptail searobin— <i>Prionotus stephanophrys</i>	Charleston	TL 28 cm
4/29	Popeye catalufa— <i>Pseudopriacanthus serrula</i>	Newport	TL 28 cm
6/24	California barracuda— <i>Sphyrna argentea</i>	4 km off Cape Perpetua	
7/26	Pacific sardine— <i>Sardinops sagax</i>	Yaquina Bay	massive die-off
8/17	Striped marlin— <i>Tetrapturus audux</i>	83 km off Coos Bay	54 kg; TL 230 cm
9/26	Northern anchovy— <i>Engraulis mordax</i>	Yaquina Bay	die-off

addition, albacore, *Thunnus alalunga*, were caught in commercial quantities in the warm water very close to shore, and some individuals were exceptionally large (over 23 kg). Pacific mackerel (*Scomber japonicus*) and jack mackerel (*Trachurus symmetricus*) were other common warm water species that were found close to shore and even in estuaries along the coast. All of these fishes are strong migrators that are usually associated with warm surface waters.

The most unusual nektonic animal that invaded Oregon waters in 1997 was the jumbo squid, *Dosidicus gigas*. This large voracious squid is endemic to the eastern tropical Pacific (Wormuth, 1976), but occasionally occurs off southern California. It invaded California coastal waters in large numbers in 1934–37 (Clarke & Phillips, 1936). This is the first record of this large ommastrephid as far north as Oregon. It was so common off Oregon during June through November of 1997 that commercial trawlers were targeting it for a lucrative squid market in southern California. Hallmark Fisheries in Charleston, Oregon provided records of landing of this species for 1997. Landings for June, September, October, November, December and January (in kilograms) were 17,756, 1906, 1126, 1986, 42, and 0, respectively. These were large squid with dorsal mantle lengths ranging from 45–55 cm. They were first encountered in the hundreds as bycatch of trawlers fishing for rockfish (*Sebastes* spp.) and pink shrimp (*Pandalus jordani*). Some fishermen observed schools of jumbo squid feeding on Pacific saury (*Cololabis saira*) under night-lights. These squid were caught over the continental shelf and slope off southern Oregon where bottom depths ranged from 100 to 1500 m, from 43°N to at least 43°40'N. Although some were landed in Newport (44°37'N), it is not certain that they were captured that far north. Sea-surface temperatures on November 17 off southern Oregon at Charleston, before the squid disappeared, ranged from 13.4 to 14.3 °C.

During the following year, 1998, large, migratory, warm-water epipelagic nekton were not reported, with the exception of a striped marlin. Instead several species of coastal and demersal fishes were caught from April to June 1998. These included the lumptail searobin, *Prionotus stephanophrys*, the popeye catalufa, *Pseudopriacanthus serrula*, and the California barracuda, *Sphyræna argentea* (Table 1). All of these species have southern distributions and are rare north of California (Eschmeyer, Herald & Hammann, 1983).

During the summers of both 1997 and 1998 the Pacific sardine (*Sardinops sagax*) was reported inside Oregon estuaries. During the summer of 1998 massive die-offs of both sardine and northern anchovy (*Engraulis mordax*) were reported inside Yaquina Bay although water temperatures were not abnormally warm and El Niño conditions faded after June 1998 (Huyer, Smith, & Fleischbein, 2002).

#### 4. Discussion

Based on the observations of nektonic animals off Oregon, the influx of large oceanic fishes and squid from June to November, 1997 was related to the advection of warm oceanic waters from offshore, as a result of atmospheric forcing rather than coastally-trapped Kelvin waves along the coast from the equatorial El Niño, and to weak coastal upwelling (Fig. 1). During the spring and summer of 1997, warming created a huge pool of warm-water in the eastern North Pacific with positive sea-surface temperature anomalies that ranged from 0.5° to >4.0°C (Schwing, Murphree and deWitt, 2002). Huyer, Smith, and Fleischbein (2002) also reported an anomalously warm ocean off Oregon in July, 1997 independent of El Niño. This warm anomaly appeared to be primarily related to regional wind forcing and Ekman convergence rather than to equatorial El Niño processes (Lynn et al., 1998; Schwing, Murphree and deWitt, 2002).

Later, during November, 1997 to February, 1998, the large, second pulse of the El Niño arrived along the Oregon coast as indicated by abrupt deepening of the thermocline (Lynn et al., 1998; Huyer, Smith, & Fleischbein, 2002) and elevation of coastal sea level (Strub & James, 2002). Hence the coastal and benthic fishes found in 1998 off Oregon, as well as the occurrence of the euphausiid, *Nyctiphanes simplex* (W. Peterson, personal communication) are likely to have been the result of transport from southern waters along coastal margin as a result of the El Niño.

Off California, the unusually warm water during 1997 was also associated with the catches of large, epipelagic fishes including large landings of albacore near the coast, jumbo squid, yellowtail, yellowfin tuna, bonito (*Sarda chilensis*), bigeye tuna (*Thunnus obesus*), bluefin tuna (*Thunnus thynnus*), skipjack (*Katsuwonus pelamis*), and California barracuda (*Sphyræna argentea*). The high catches of these species continued in 1998 (California Department of Fish and Game, 1998, 1999). More striking are the observations by Lea and Rosenblatt (2000) who reported a remarkable occurrence of 29 families of warm-water Panamic fishes in Californian waters during 1997–1999. The majority of these unusual warm-water fishes were coastal and nearshore species, and most were reported during 1998. They concluded from this influx of diverse southern fishes that the 1997–98 El Niño was the stronger than the 1982–83 event and ‘appears to be the strongest warm-water event off California during the twentieth century’.

Off Oregon, however, observations indicated that the effects of the 1997–98 El Niño on nekton were subdued relative to those of 1982–83. During 1982–83 most of the unusual animals, including eight of nine range extensions, were for coastal, epibenthic animals presumably transported by coastal currents from the south. Of the fishes that were either ‘rare occurrences’ or ‘increases in abundance’, eight of 11 (73%) were coastal species (Percy & Schoener, 1987). In contrast in 1997–98, the range extensions were for yellowfin tuna and jumbo squid, both of which are large, warm-water oceanic species, and of the 10 unusual sightings in 1997–98 only four (40%) were coastal species (Table 1).

These two big El Niños also had different impacts on coho salmon survival off Oregon. During the 1983 El Niño unprecedented mortality of coho salmon occurred off Oregon and California, and the mean size of adult salmon was markedly reduced (Johnson, 1988; Percy & Schoener, 1987). Such dramatic changes were not obvious during 1998. The mean weight of Oregon hatchery coho salmon caught in gillnets in the Columbia River was exceptionally low in 1983 (2.3 kg) but not for either 1997 or 1998 (3.6 and 3.8 kg, respectively) (Pacific State Marine Fisheries Commission coded-wire tag data base (see <http://www.rmfs.org>)).

In summary, during 1997–98 two physical forcing mechanisms affected coastal waters and the incursions of warm-water nekton off Oregon. During the summer and autumn of 1997 atmospheric forcing resulted in the influx of warm, offshore water into coastal waters carrying with it many oceanic, migratory fishes and jumbo squid. Late in 1997 and early 1998, the poleward transport of warm water along the coast from the south as a result of the strong El Niño was associated with the transport of only a few species of southern, coastal nekton into Oregon waters, compared to the influx of many southern species into California waters. Off Oregon the effects of the 1997–98 El Niño event on nekton appear to be weaker than those of the 1992–83 El Niño, but were stronger off California.

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