

Ocean Conditions and the Blob of 2014-2015

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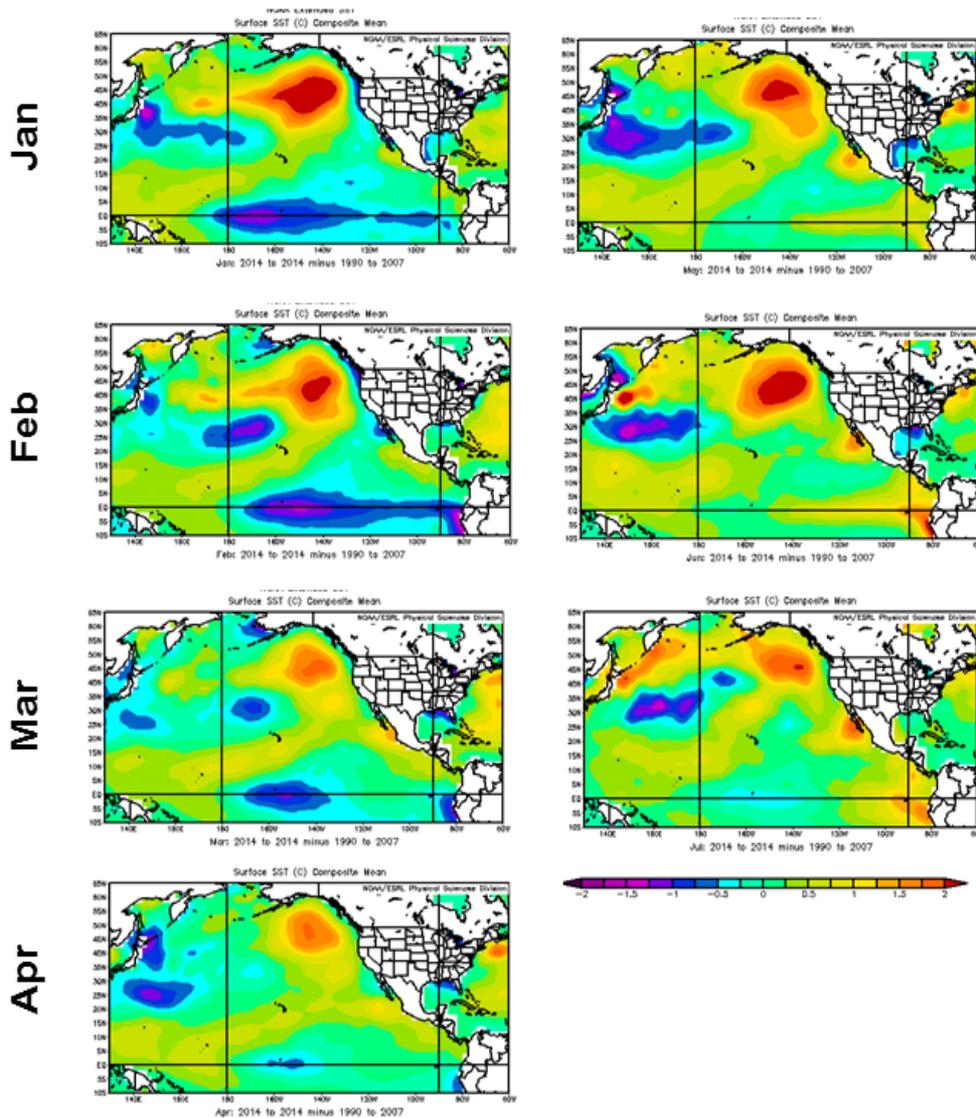
If you read the newspapers or follow internet blogs,
you might know that 2014 was a wild and crazy year
throughout much of the North Pacific Ocean

2015 WAS EVEN CRAZIER

Development of the warm blob

- November 2013, Aleutian Low fails to develop
 - Surface waters of GOA did not cool due to lack of deep mixing; by summer 2014 SST anomalies were 3.5°C which was 1.5°C greater than any year since at least 1948.
- Blob persists through summer 2014 across the entire North Pacific
 - Weak westerly winds along 40°N (weakest zonal winds on record (1.6 m s⁻¹ vs 4.5 m s⁻¹))
 - No SW winds along west coast of US in winter
- Blob collapses eastward in autumn 2014

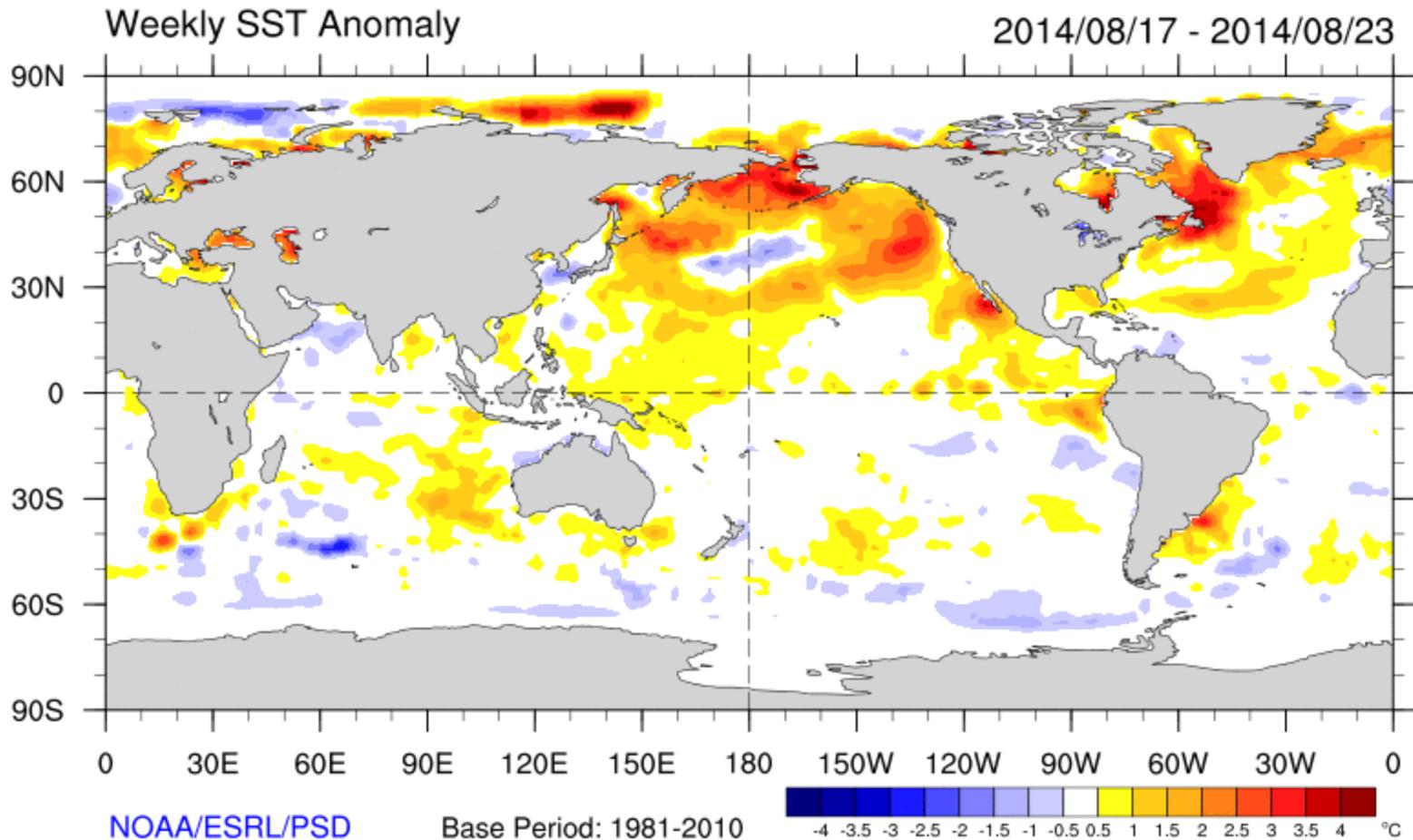
The Blob – Jan-July 2014



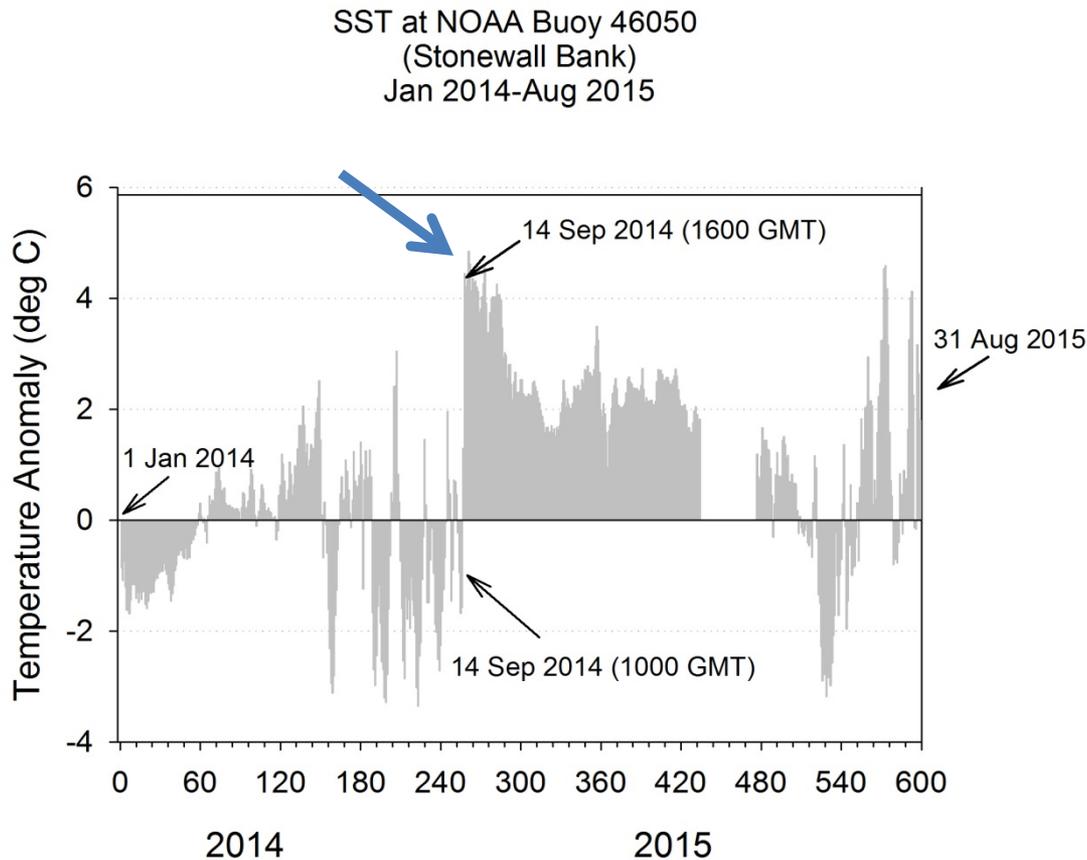
- May**
- Jan-Apr: The Blob confined to GOA
 - May-June: Warm anomalies seen in Bering Sea and in western Pacific
- Jun**
- June-July + 2 to + 3°C anomalies, but California Current cool at the coast due to coastal upwelling
- Jul**

17-23 August 2014: SST Anomaly

- Note: (1) Cooler waters off WA, OR and N. CA due to upwelling
(2) Lack of any SST anomaly at the equator



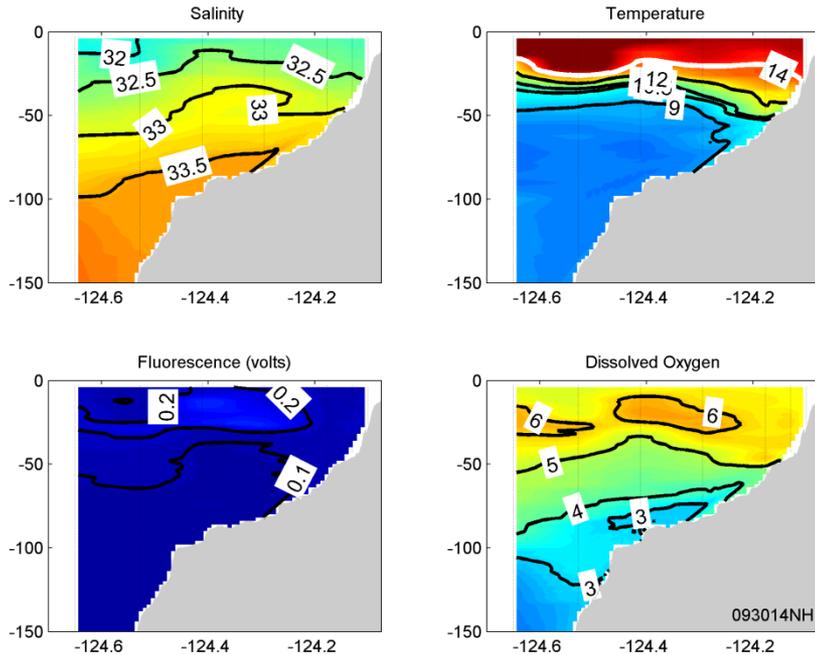
SST at a Buoy 20 miles off Newport: 1 Jan 2014 - 31 Aug 2015



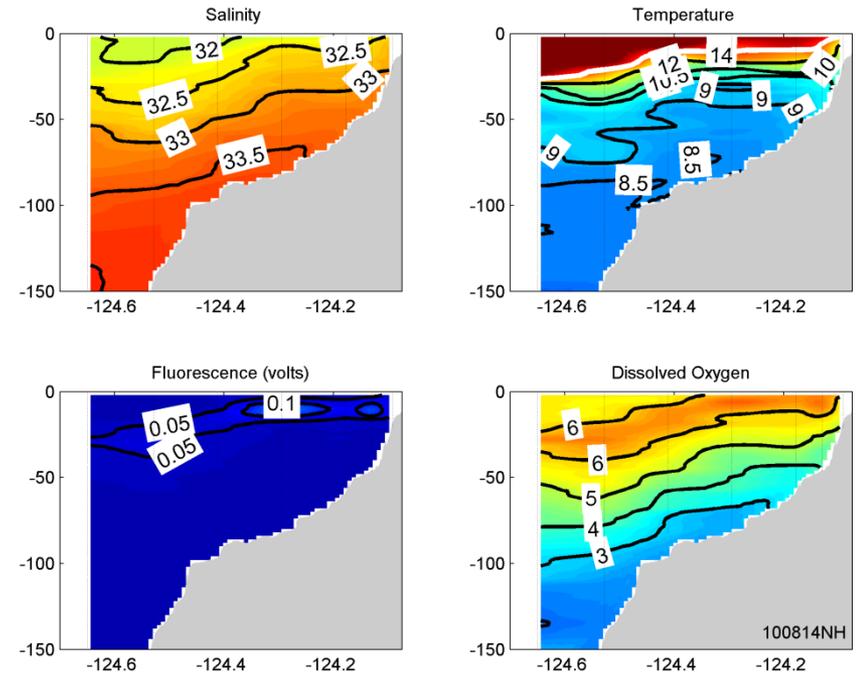
- On 14 Sep 2014 upwelling winds weakened allowing the Blob to come onshore. SST jumped 6°C in 6 hours.
- Anomalies of $+2^{\circ}$ during 2015 and now $+4^{\circ}\text{C}$ are seen off Newport.

Hydrographic sections of temperature, salinity, fluorescence and oxygen along the Newport Hydrographic (NH) Line

25 September 2014
Newport Line



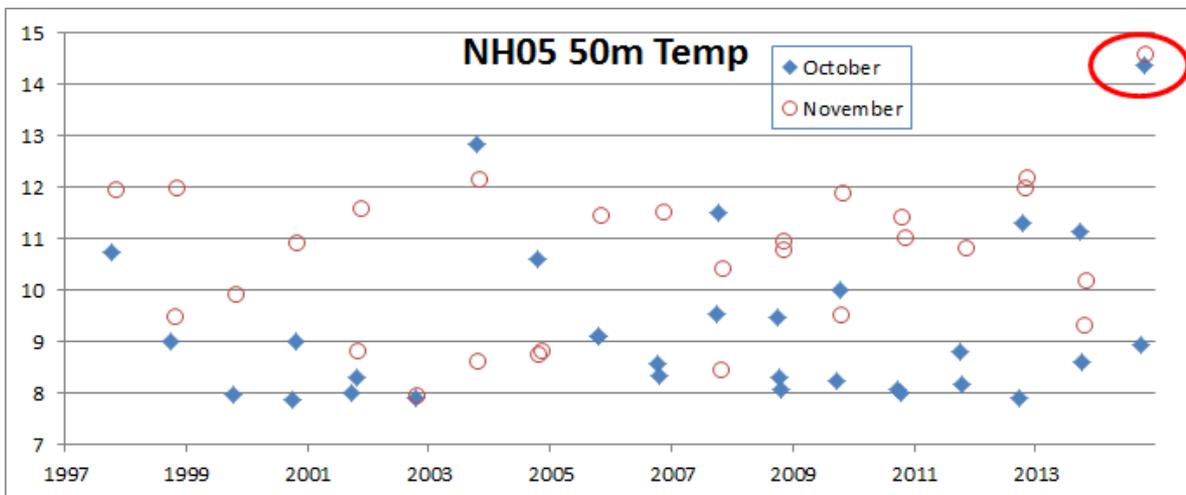
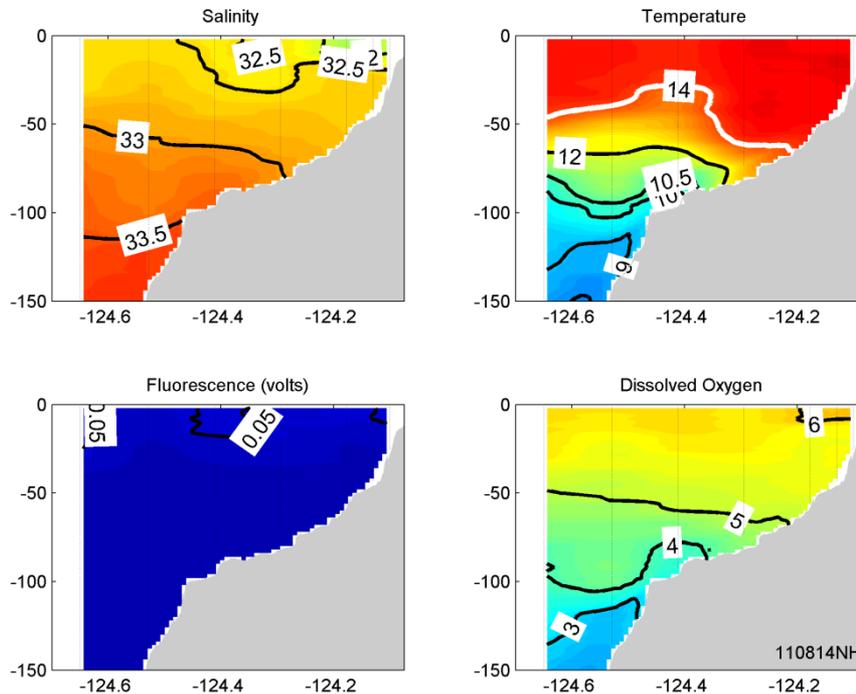
8 October 2014
Newport Line



On both cruises, only the upper 20-30 m was excessively warm

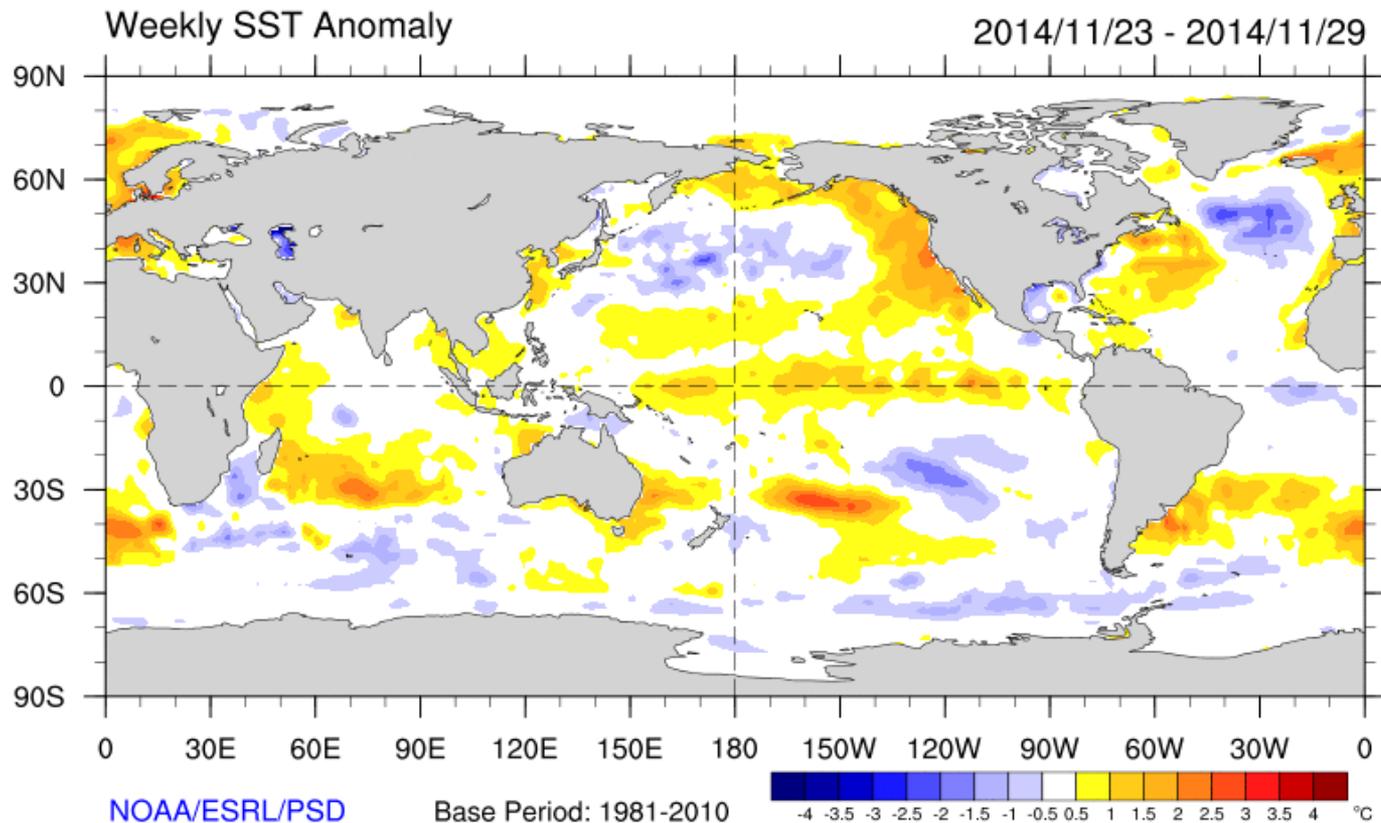
8 Nov 2014 Newport Line

By early November the thick lense of “Blob Water” is seen, with excessive warmth to depths of 50-80 m. Same pattern seen through March 2015.



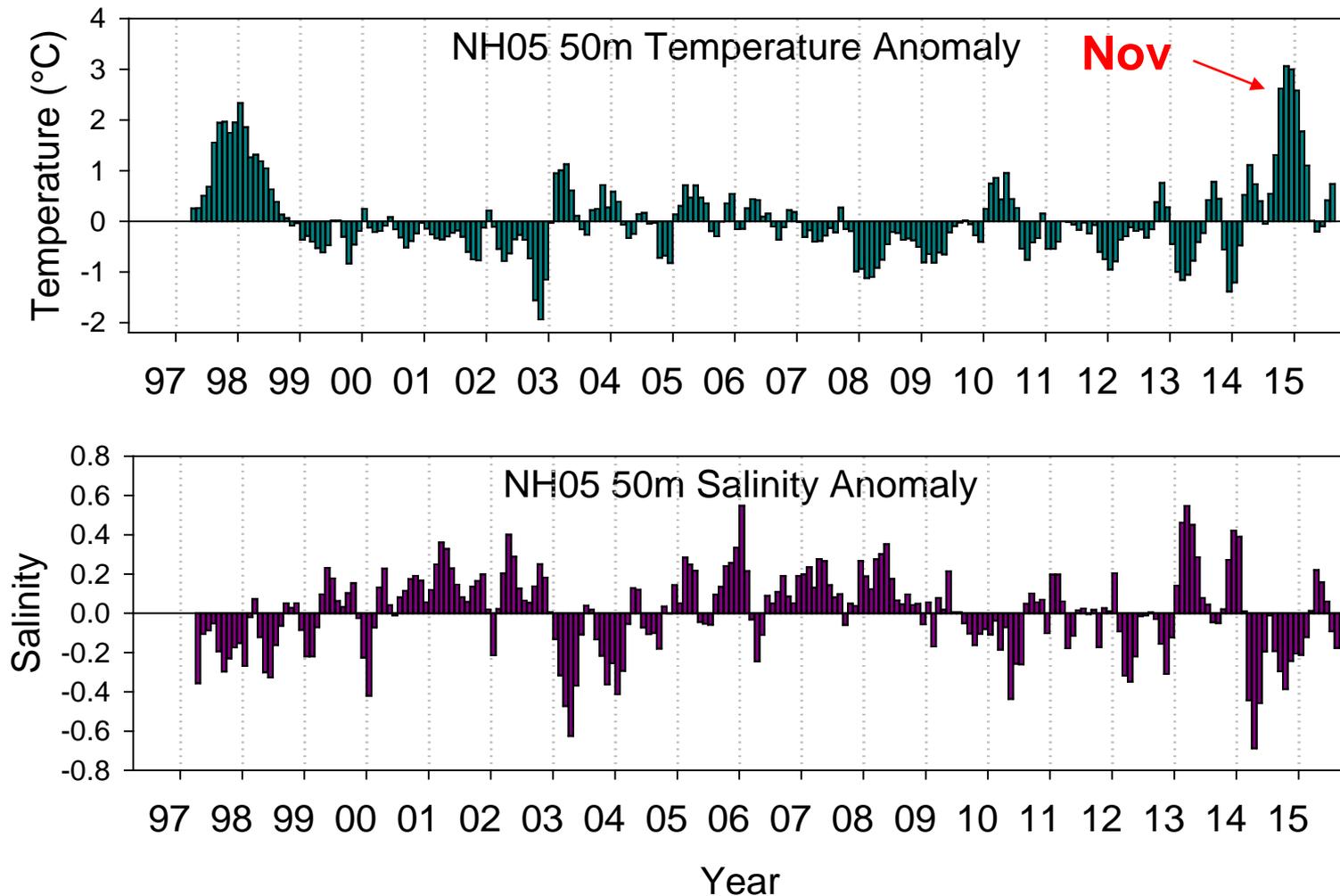
In fact at 50 m, temperatures were **2°C above** anything we have seen in our 19 year time series.

23 -29 November 2014



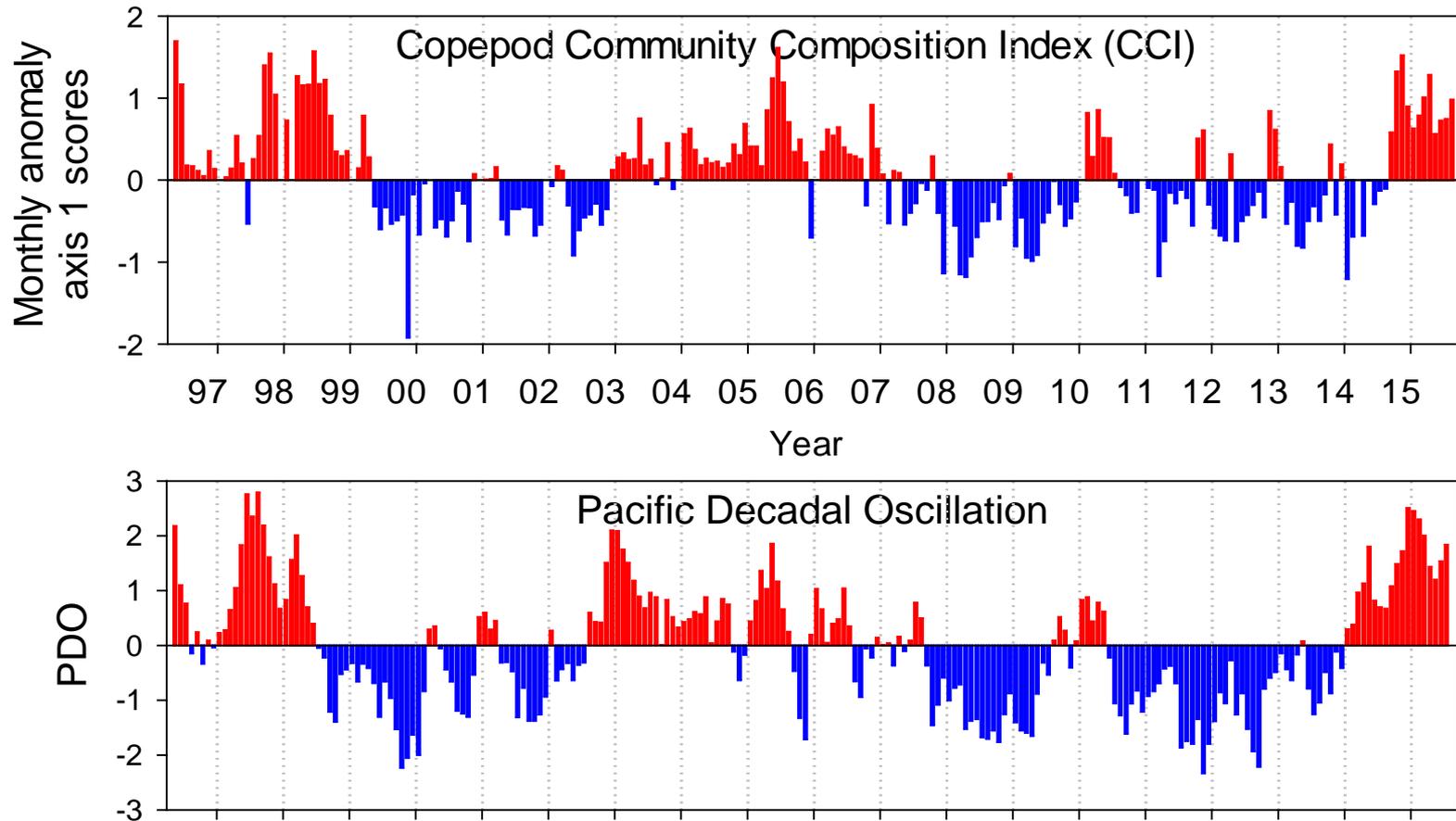
By late November, The Blob has moved eastward and occupies the entire California Current and eastern GOA. The equator is warm as well and a positive PDO pattern is established. Winter PDO values the highest on record.

Deep shelf waters anomalously warm and fresh



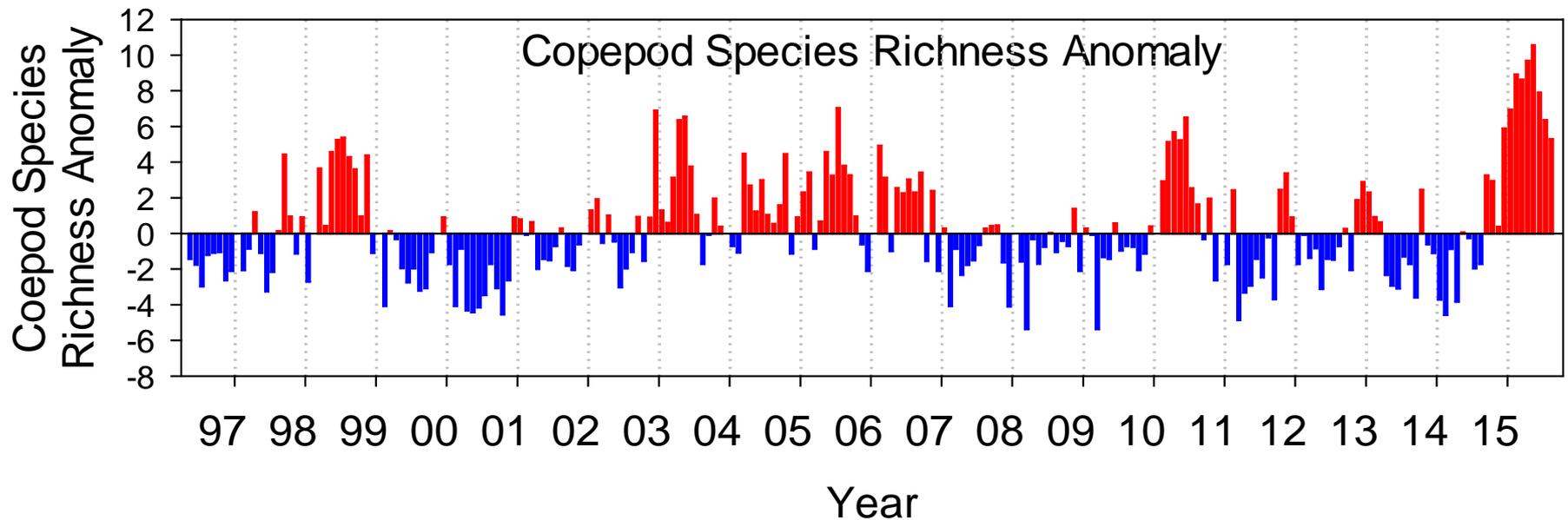
50 m temperatures were **3°C above** average,
the warmest in the past 19 years

NH-5 copepod community



similar pattern at NH-25

Anomaly of the number of copepod species (species richness) in samples from station NH 5: 2015 had values higher than during the big 98 Niño event



8 copepod species new to the northern California Current and 8 others rarely observed occurred in 2014-2015. Many are Transition Zone and Central Gyre species, not coastal southern species that appear off during El Niño events .

Some unusual bugs seen since Oct 2014

TRANSITION ZONE

- Rhincalanus nasutus
- Scolecithricella ovata
- Centropages bradyii
- Pleuromamma borealis
- Acartia pacifica *
- Clausocalanus farrani *
- Clausocalanus furcatus *
- Calocalanus pavo

SUBTROPICAL GYRE

- Mecynocera clausi
- Euchaeta media
- Eucalanus hyalinus
- Eucalanus subcrassus *
- Pleuromamma xiphias *
- Calocalanus pavoninus *

TROPICAL NERITIC

- Acartia negligens *
- Temora discaudata *
- Penilia spp (Cladoceran)

* New record for the N. California Current

Consequences of a warm North Pacific: all kinds of tropical fish and birds have shifted north in 2014/15

- Gulf of Alaska
 - Pomfret, skipjack tuna, thresher shark. Ocean sunfish common everywhere
- Prince William Sound
 - Sunfish
- Oregon/Washington
 - Green turtle, Florence, 5 Sep 2014
 - Opah, 21 September 2015
- California
 - Opah (moonfish) seen regularly off San Diego
 - *Veleva* (by-the-wind sailors) seen commonly everywhere (off Oregon as well)
 - Green turtle off San Francisco
 - Mahi mahi caught commonly
 - 335 lb yellowfin tuna caught at Cabo (a record)
 - 50 lb wahoo caught off Dana Point (first record for CA)
 - Market squid fishery shifted north from Monterey Bay to Eureka
- Salmon
 - Fraser River sockeye all returned through Johnstone Strait (Canadian Waters), none through Strait of Juan de Fuca.
 - Columbia River sockeye and summer-run Chinook suffered mortality in summer 2015 due to drought, low flow and high temperatures in the River.



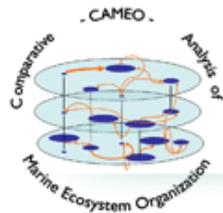
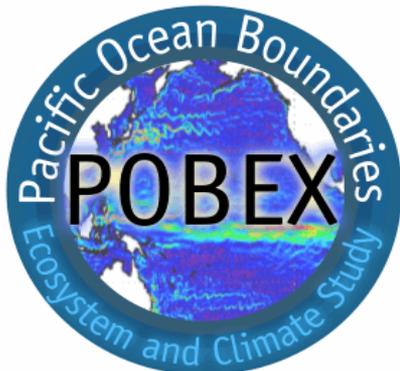
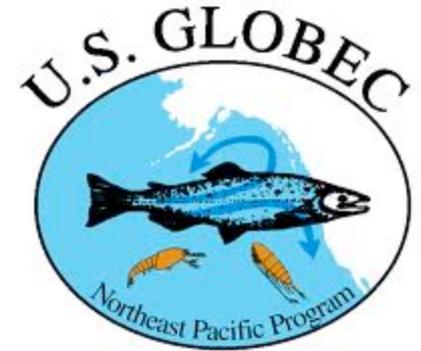
Notable seabird issues

- Unusual (tropical) seabirds seen off OR during the tri-annual west coast mammal survey
 - Band-rumped storm petrel, black storm petrel, brown booby
- Two major mortality events of Cassin's auklets
 - 16 Nov 2014, Marin County
 - 22 Dec 2014, Seaside OR
- Story in Audubon magazine in March/April 2015 on the auklet mortality events, featuring Bill Peterson.

Funding Sources over the past 20 years



GLOBEC
Global Ocean Ecosystem Dynamics



CAMEO

COMPARATIVE ANALYSIS OF MARINE ECOSYSTEM ORGANIZATION

