Climate Change & Ecological Surprises: Recent Observations from California's "Lost" North Coast

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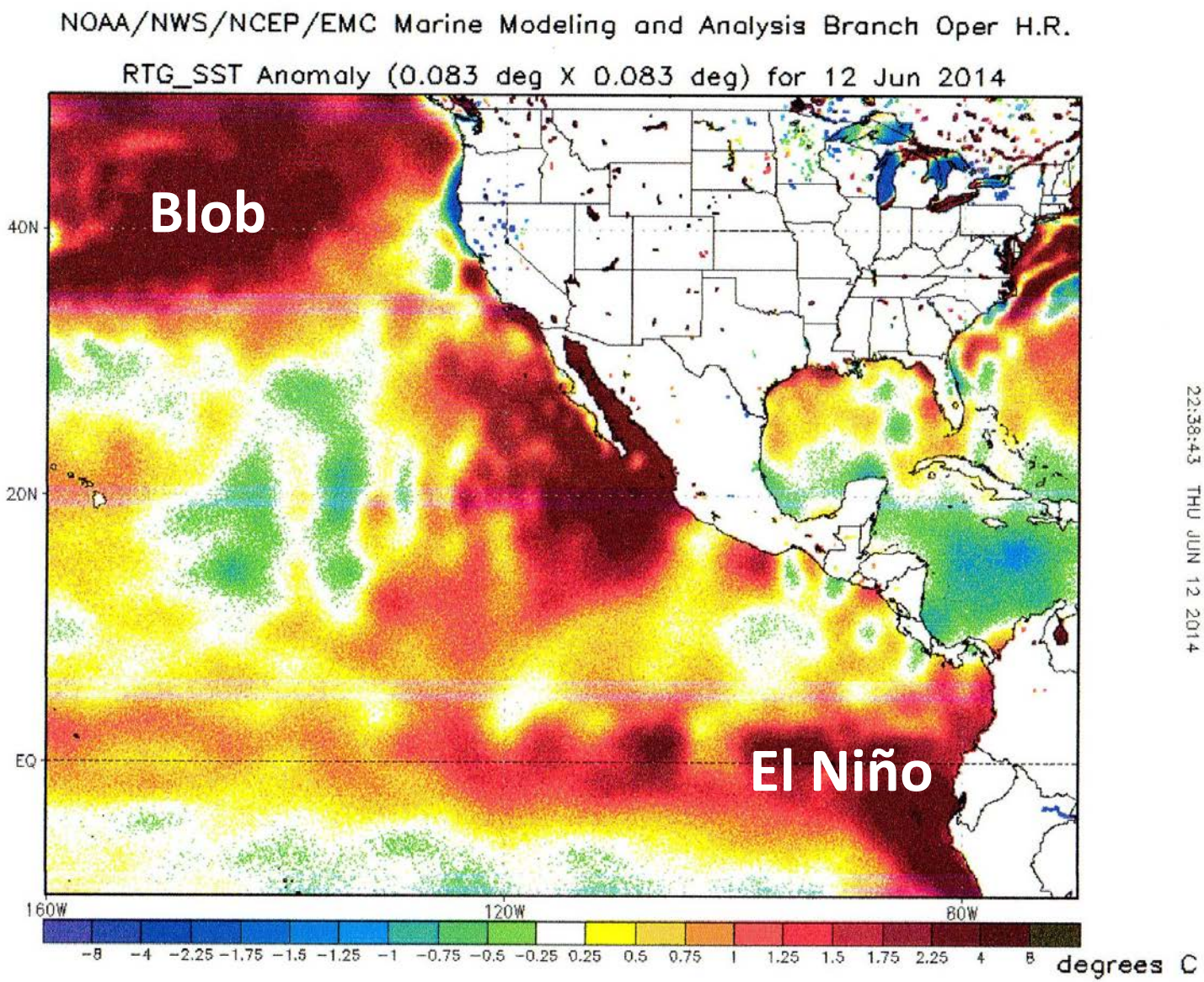
past 3+ years: *unprecedented* climate variability & impacts on the local marine environment, ecosystem, and coastal communities

What happened?
Large Scale

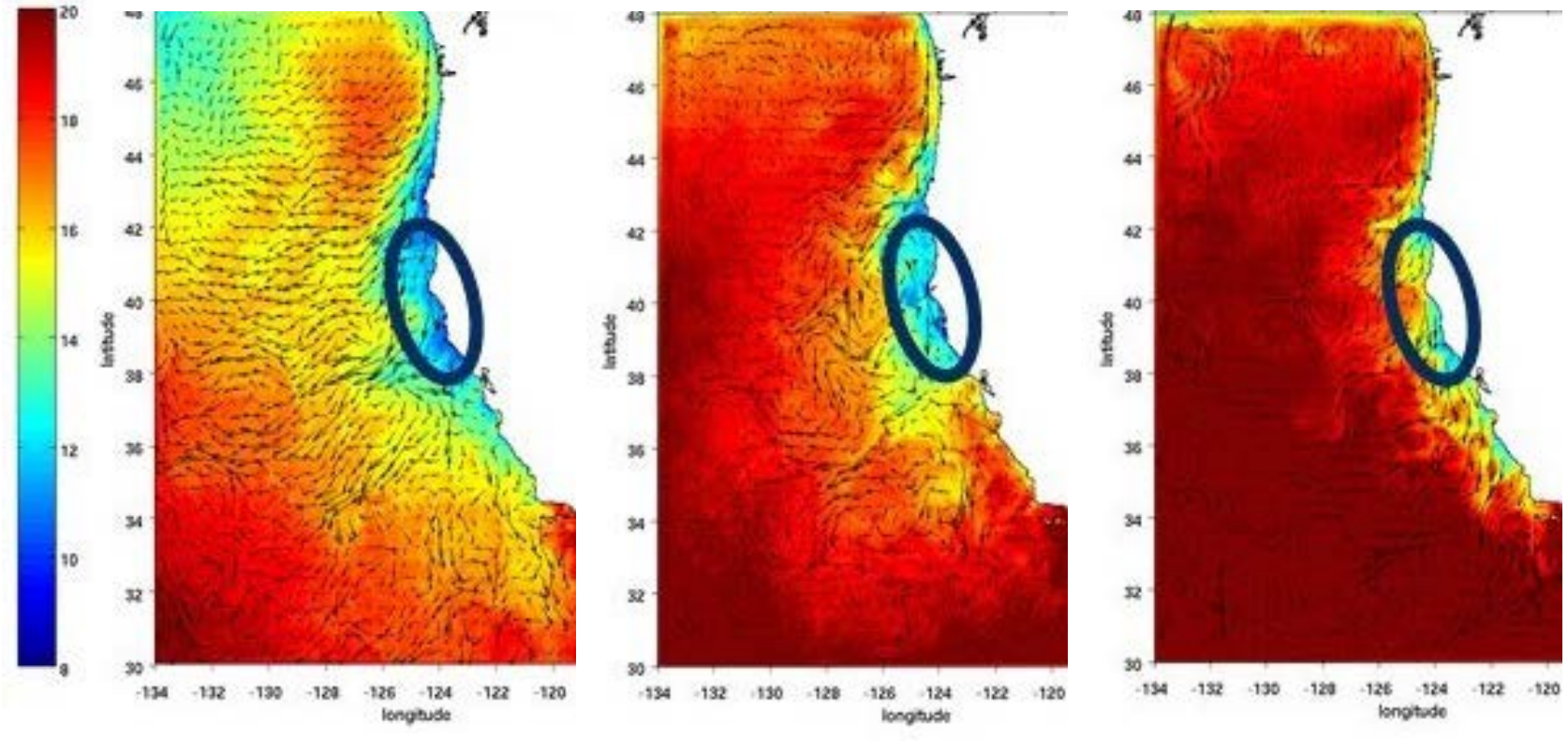
June 2014: Perfect ‘Climate’ Storm



Consequences? Locally

Upwelling Winds, May 2014, Mendocino Head

Habitat Compression



July 28, 2011
Normal conditions

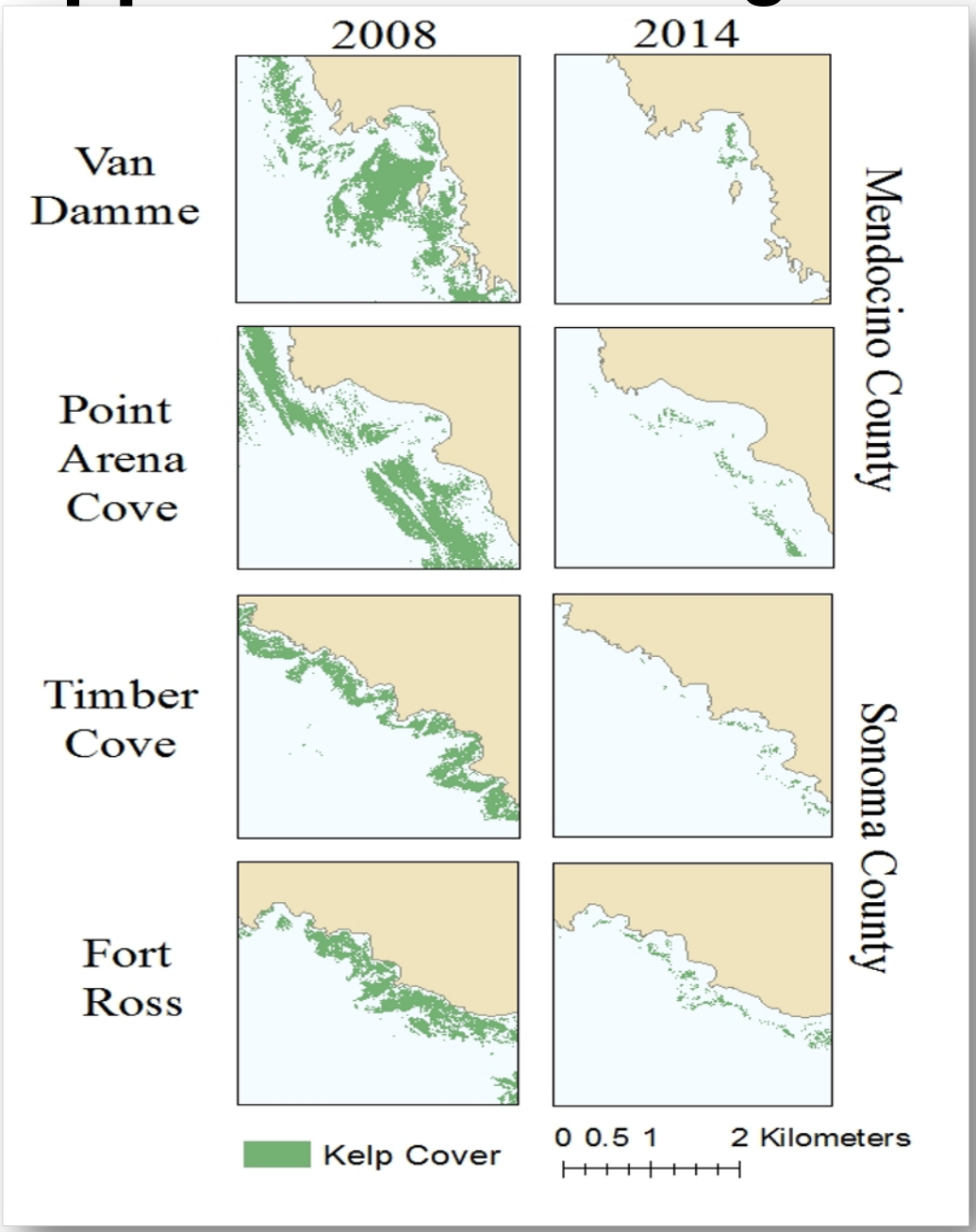
July 28, 2014
“warm Blob”

July 28, 2015
“warm Blob”
+ strong El Niño

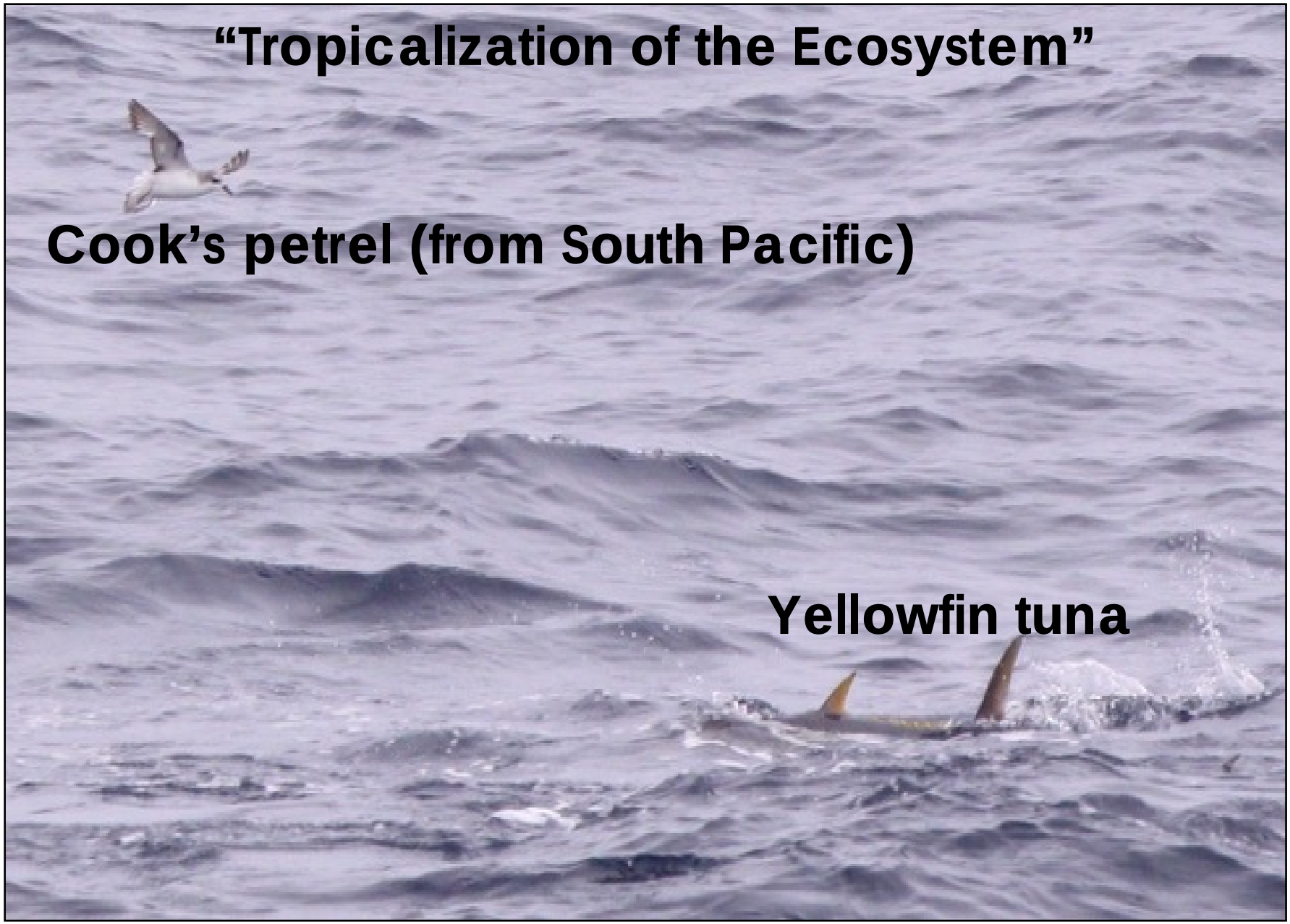
Fall 2014/Winter 2015: ~ 100,000 auklets died from northern California to Washington State

UW/COASST, GFNMS/Beachwatch, and MBNMS/BeachCombers Surveys

Disappearance of Biogenic Habitat



CDFW Surveys

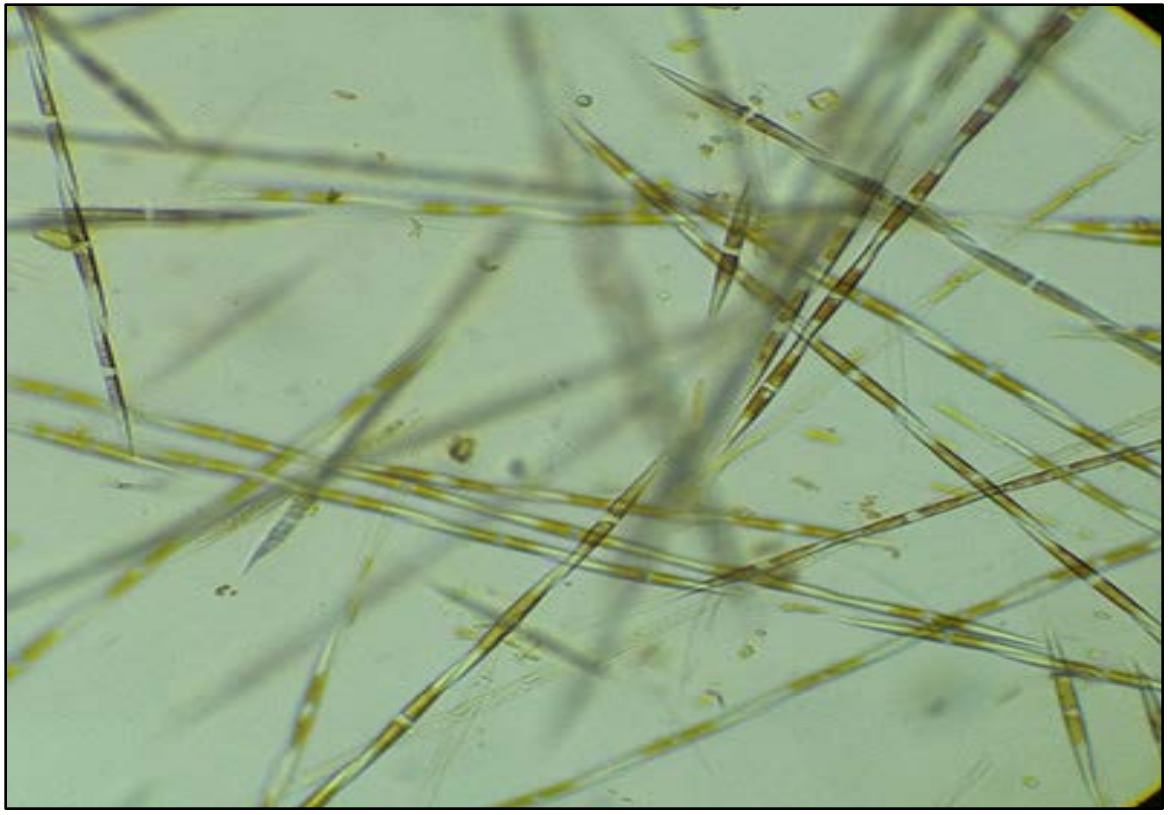


Farallon Institute Surveys

It's easy to see big animals

What about the small stuff?

Pseudo-nitzschia spp.



- **like it warm *and* nutrient-rich, as would be provided by upwelling**

Thanks to Raphe Kudela/UCSC for explaining this story!

High levels of toxins (domoic acid) in clams and crabs = fisheries closures, 2015-2016

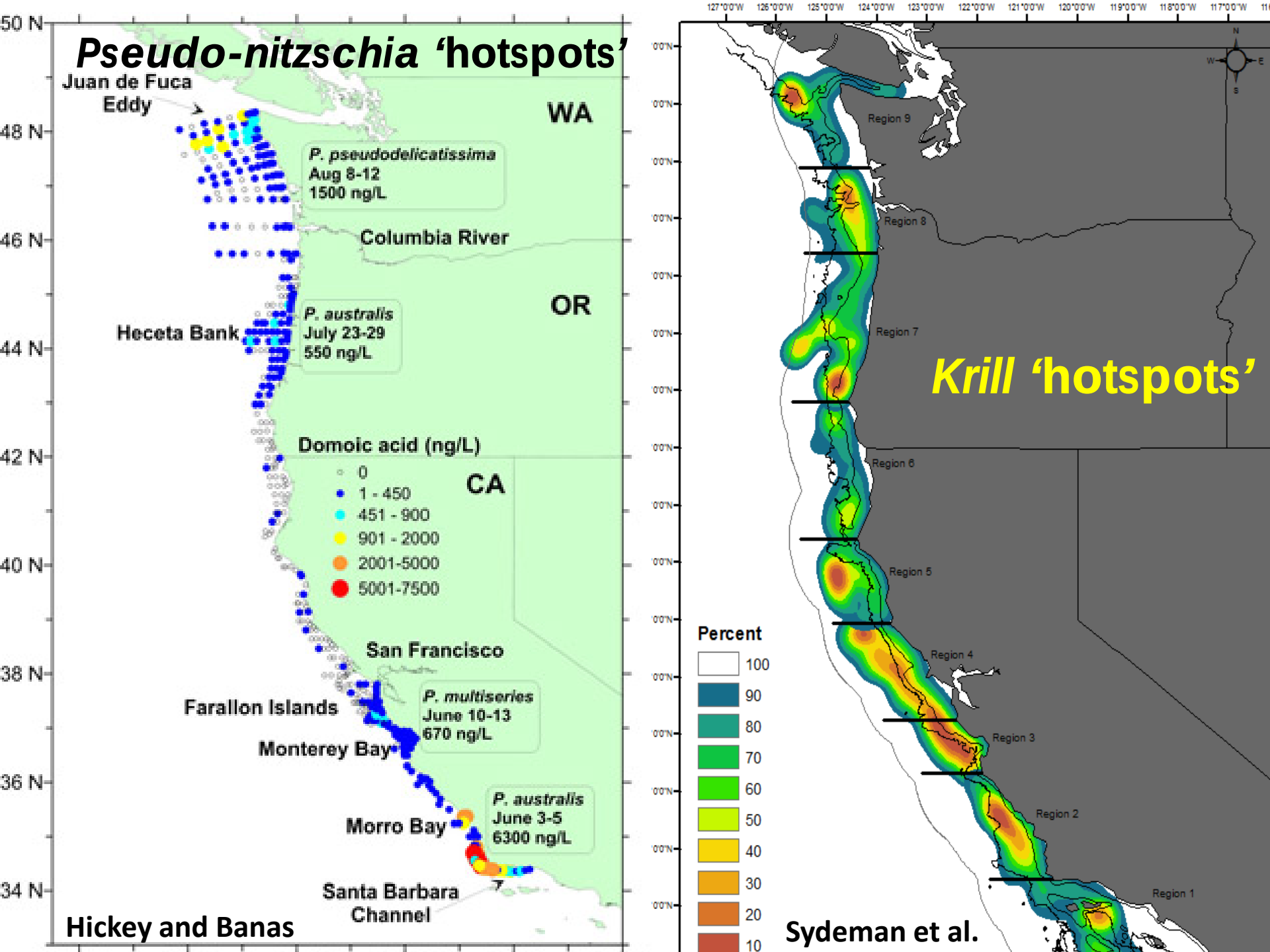
Domoic acid detected in marine wildlife from the Pacific Northwest to Southern California during a record-setting bloom of toxic algae in the North Pacific in the summer of 2015

NOAA FISHERIES
Northwest Fisheries SCIENCE CENTER

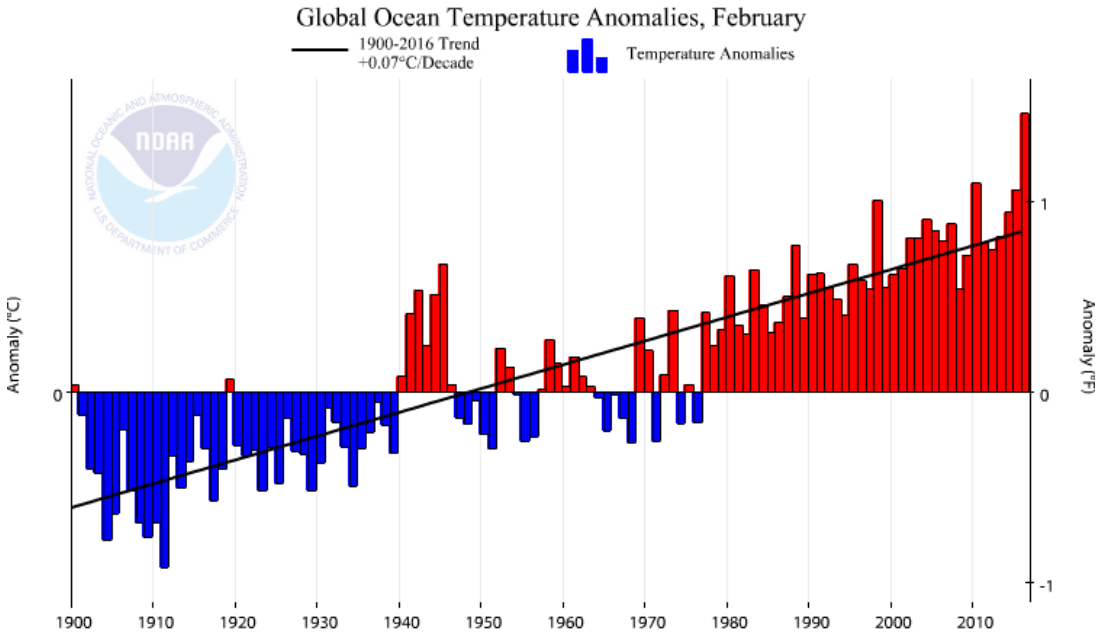
Toxin Level
high
low
seizures

dolphins/ porpoises
harbor seals
sea lions/ fur seals
whales
seabirds

NWFSC research contact: kathi.lefebvre@noaa.gov

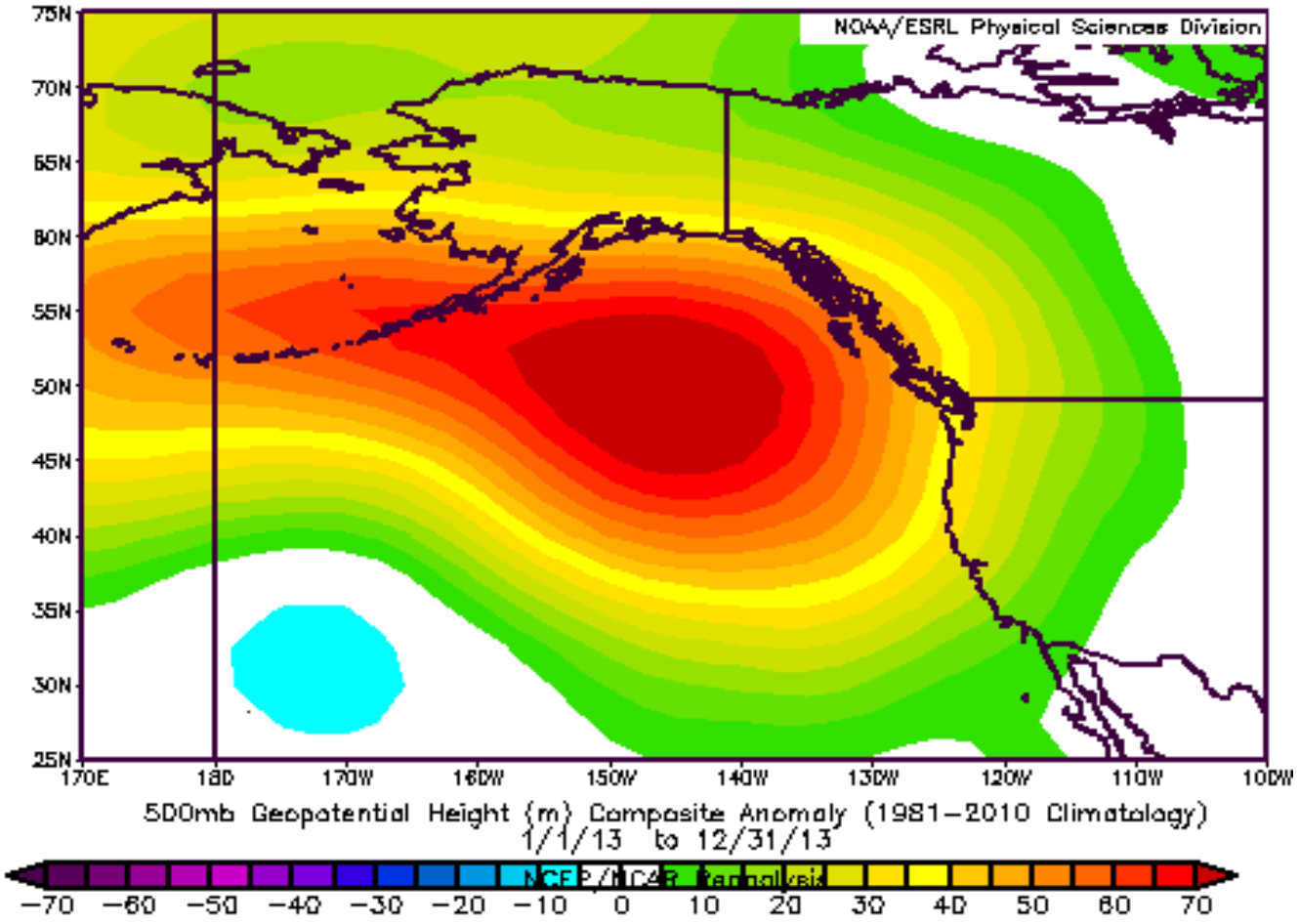

Pseudo-nitzschia 'hotspots'
Juan de Fuca Eddy
WA
P. pseudodelicatissima
Aug 8-12
1500 ng/L
Columbia River
OR
Heceta Bank
P. australis
July 23-29
550 ng/L
Domoic acid (ng/L)
0
1 - 450
451 - 900
901 - 2000
2001-5000
5001-7500
CA
San Francisco
Farallon Islands
P. multiseries
June 10-13
670 ng/L
Monterey Bay
Morro Bay
P. australis
June 3-5
6300 ng/L
Santa Barbara Channel
50 N
48 N
46 N
44 N
42 N
40 N
38 N
36 N
34 N
Hickey and Banas
Krill 'hotspots'
Region 9
Region 8
Region 7
Region 6
Region 5
Region 4
Region 3
Region 2
Region 1
Percent
100
90
80
70
60
50
40
30
20
10
Sydeman et al.

is it Anthropogenic Global Warming?



What Caused The Blob to Form?

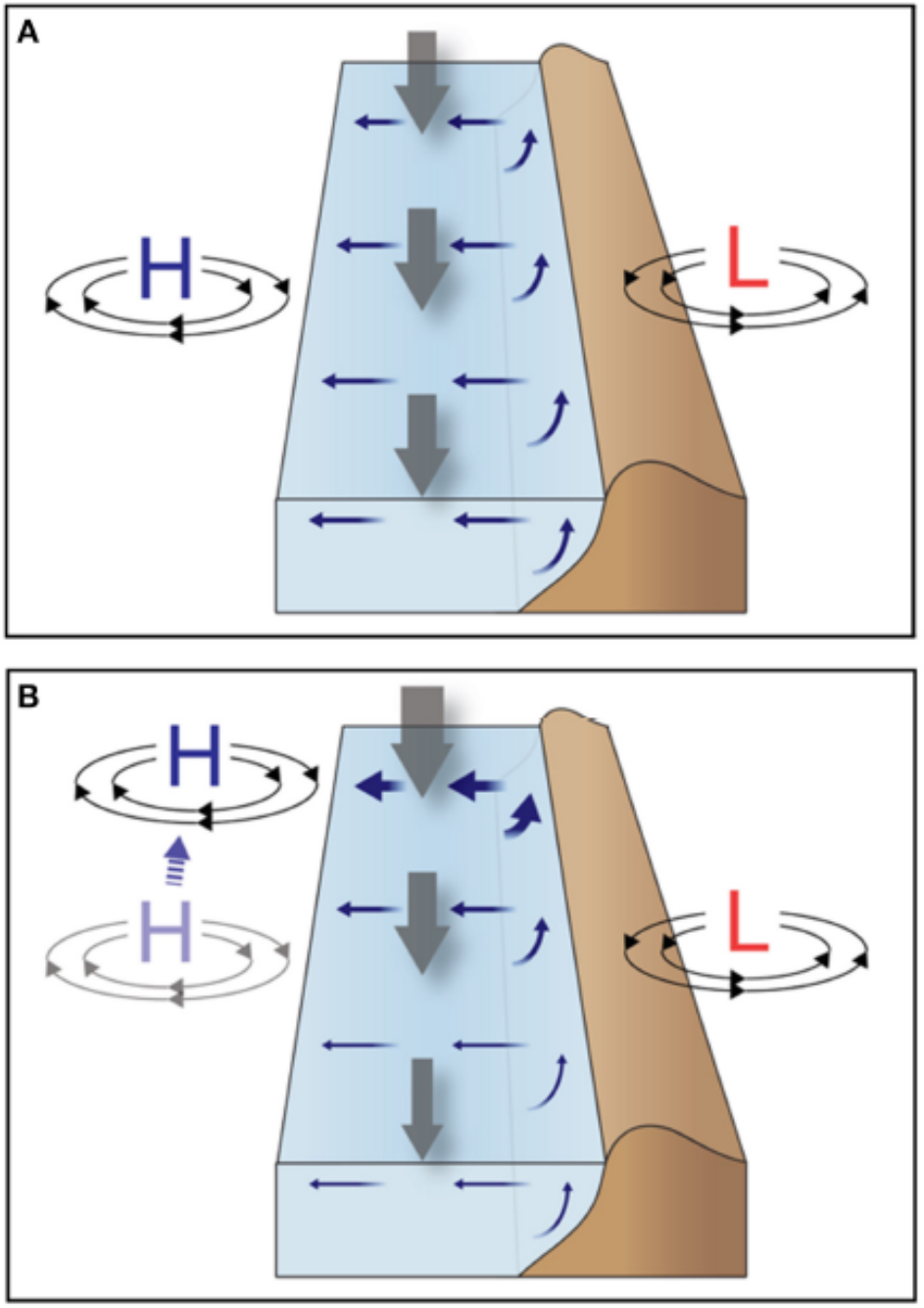
North Pacific High shifted pole-ward, blocking storms, limiting cooling



Blocking High also accounts for the <u>drought</u> (winters 2013, 2014, and 2015)

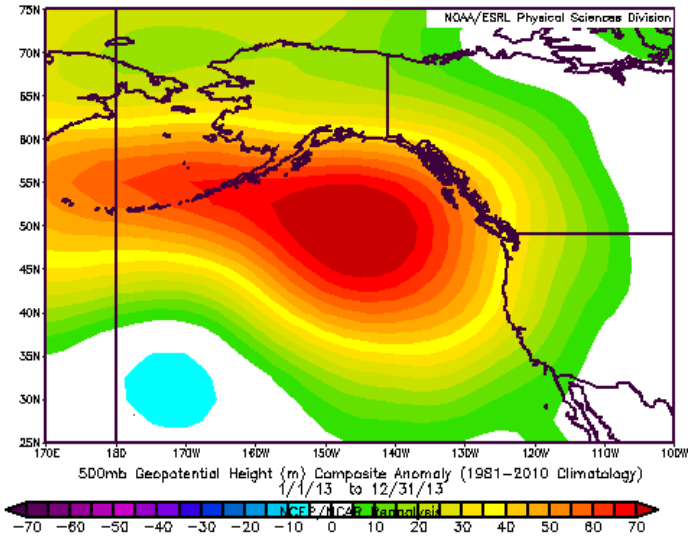
Prediction from IPCC Models: Poleward Shifts of Oceanic High Pressure Systems

- Observed here (NP High) and off South Africa (SA High) -- similar upwelling ecosystems)



Garcia-Reyes et al. 2016 Front. Mar. Sci.

Summary



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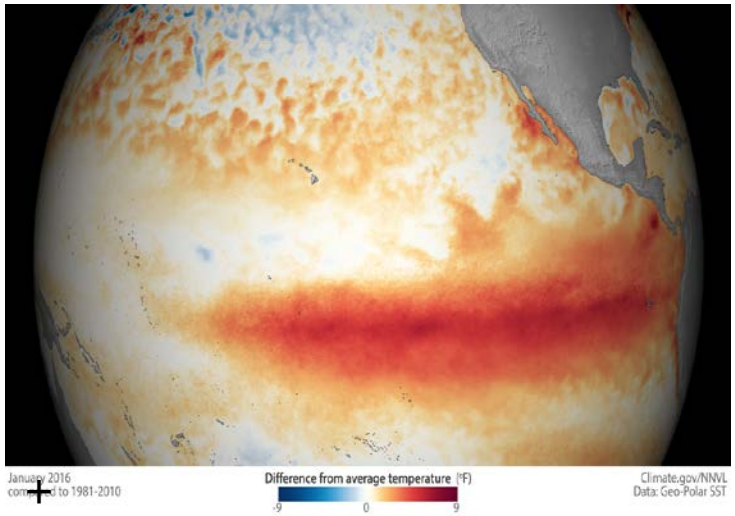

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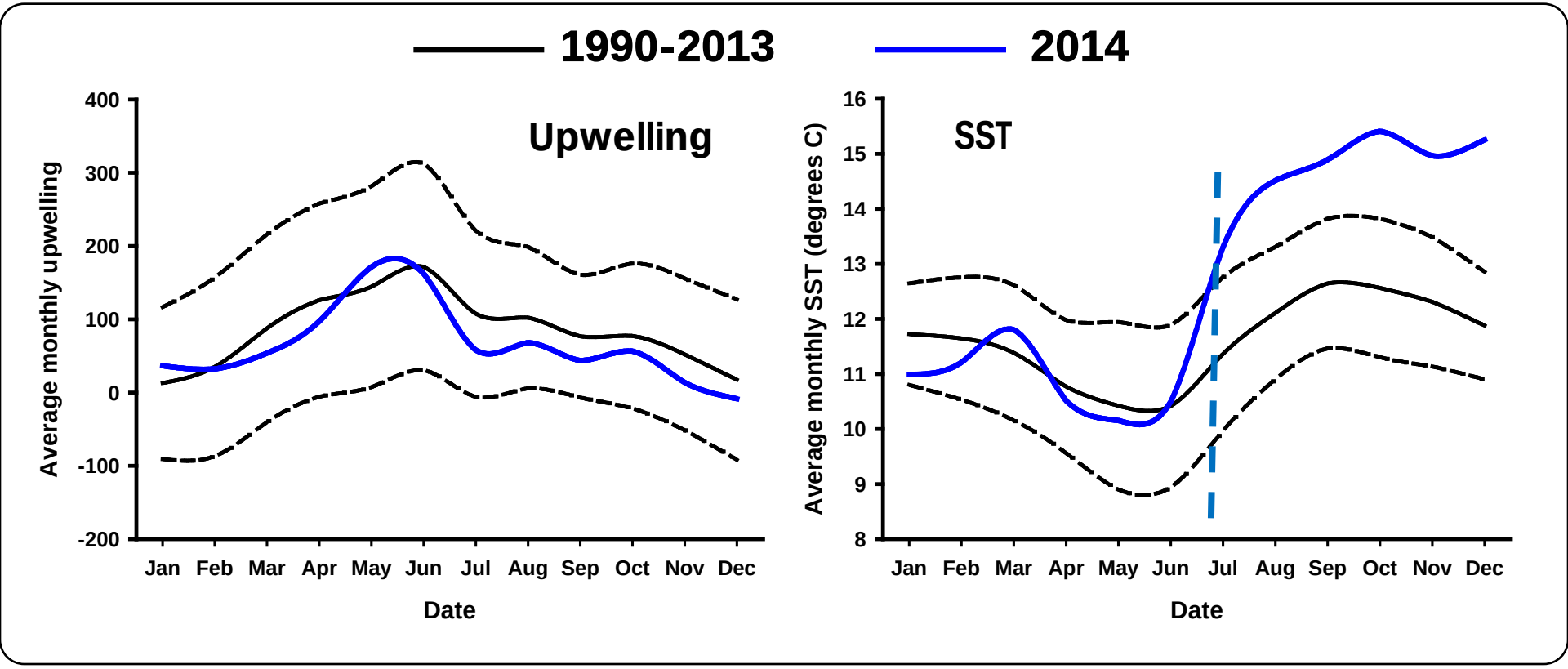
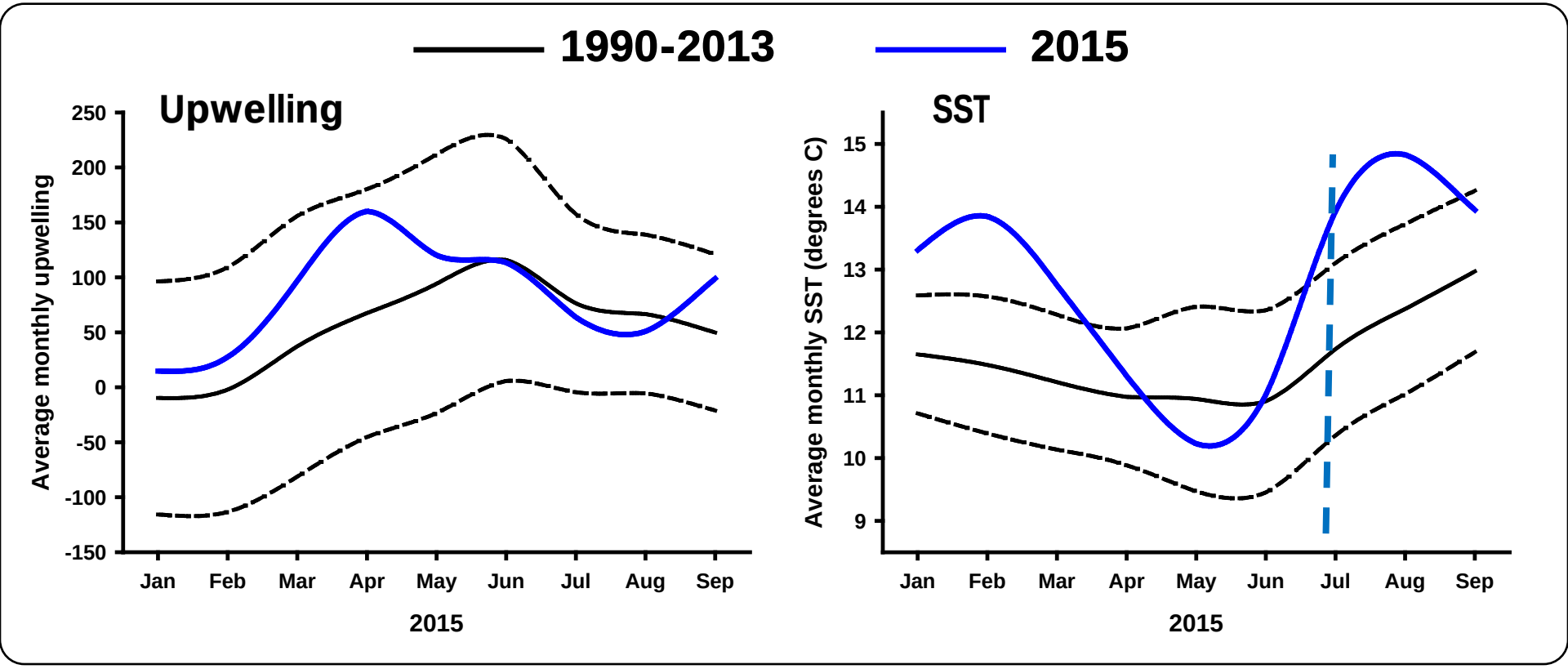
<u>SURPRISES. NO ANALOG ECOSYSTEM</u>:

= Unprecedented re-distributions, mortality events, toxicity, and *socio-economic impacts* (fisheries closures).

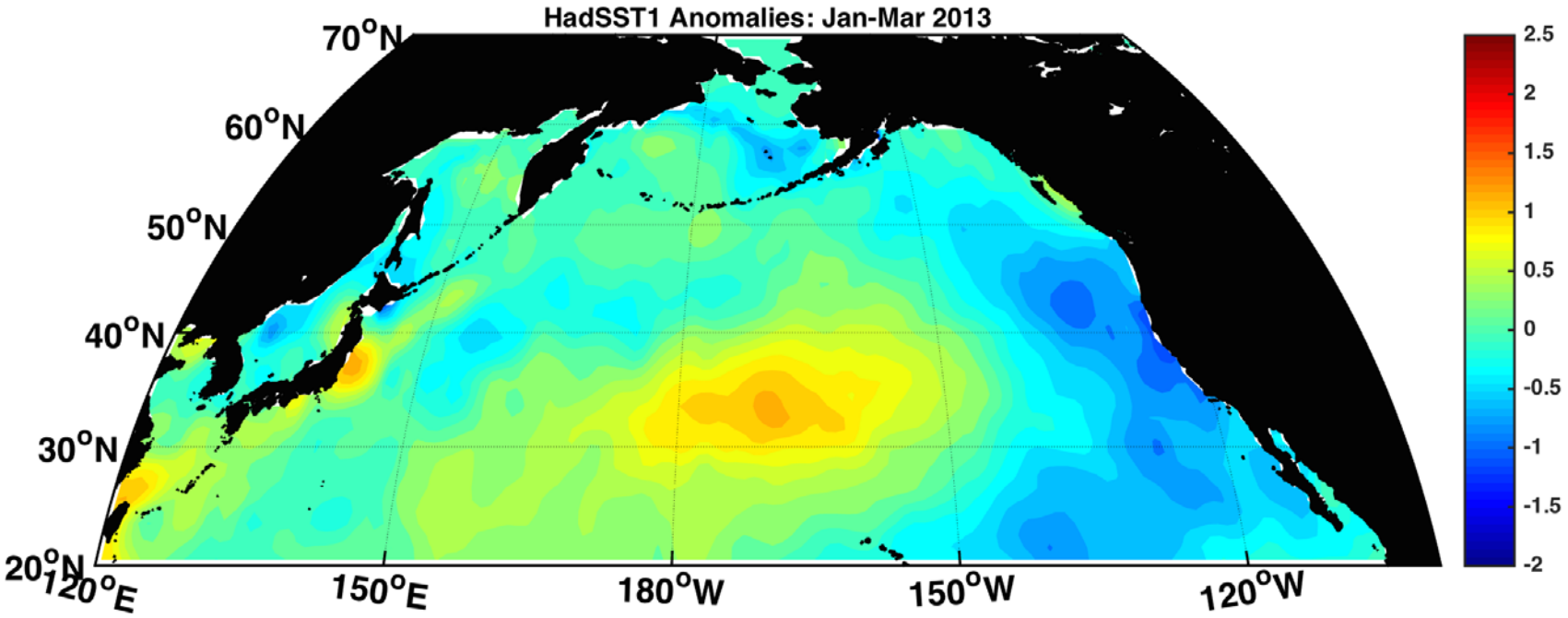
Upwelling ‘Normal’, SST Elevated, 2014



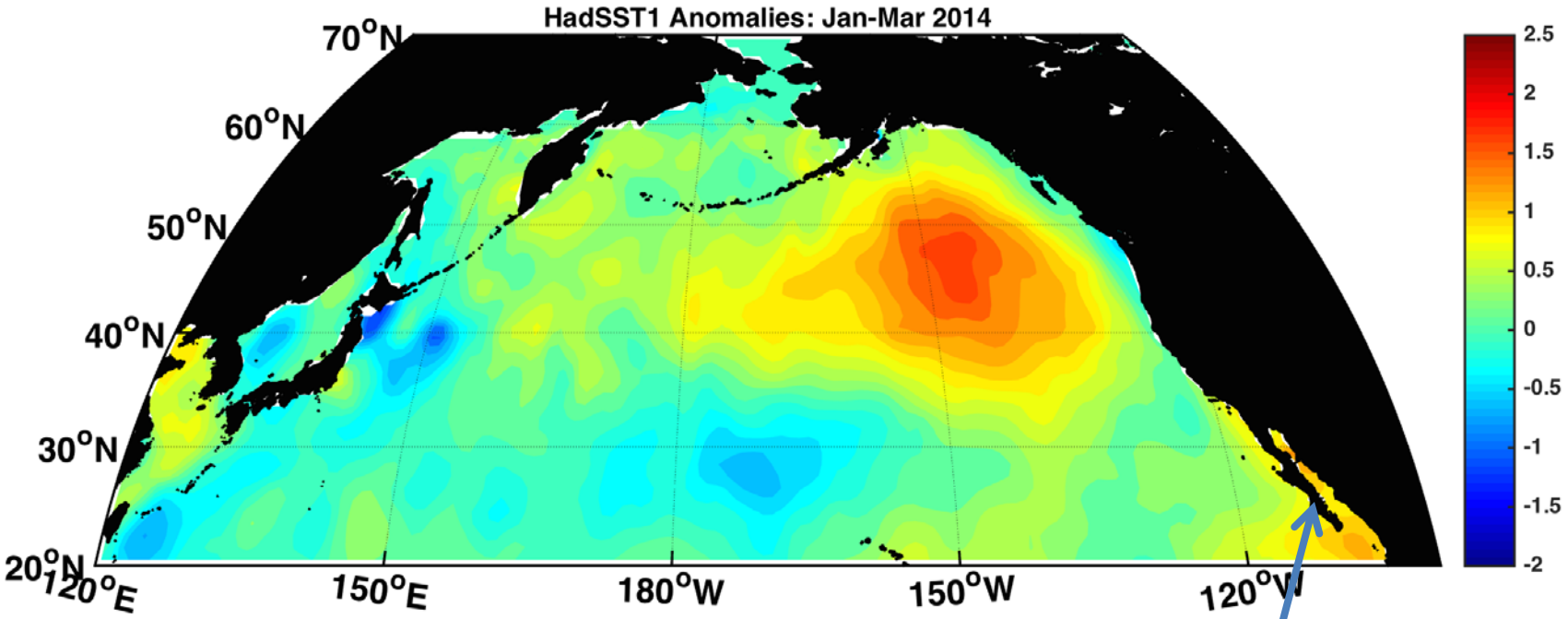
Upwelling ‘Normal’, SST Elevated, 2015



Winter 2013: NE Pacific is very cold; record upwelling along North Coast



Winter 2014: Emergence of the *'Blob'*



Note: Baja warming too; harbinger of 2015-2016 El Niño

Winter 2015: NE Pacific is very warm; morphing of Blob and ENSO