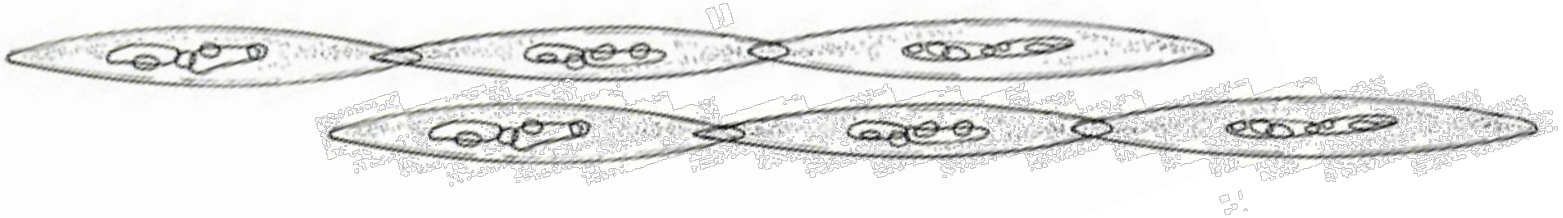
The 2015 West Coast Harmful Algal Bloom in California: Detection, Impacts, and Assessment for 2016

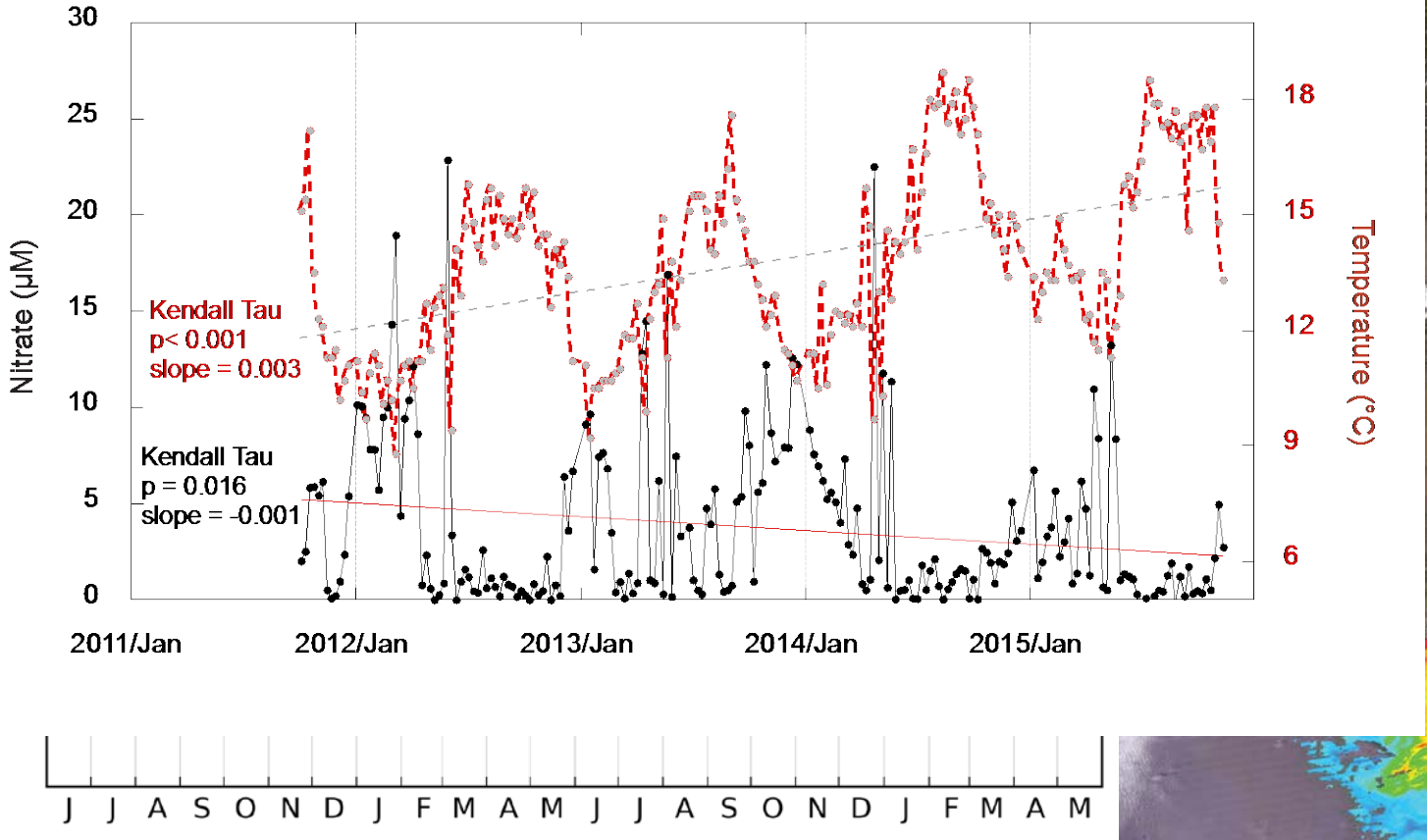


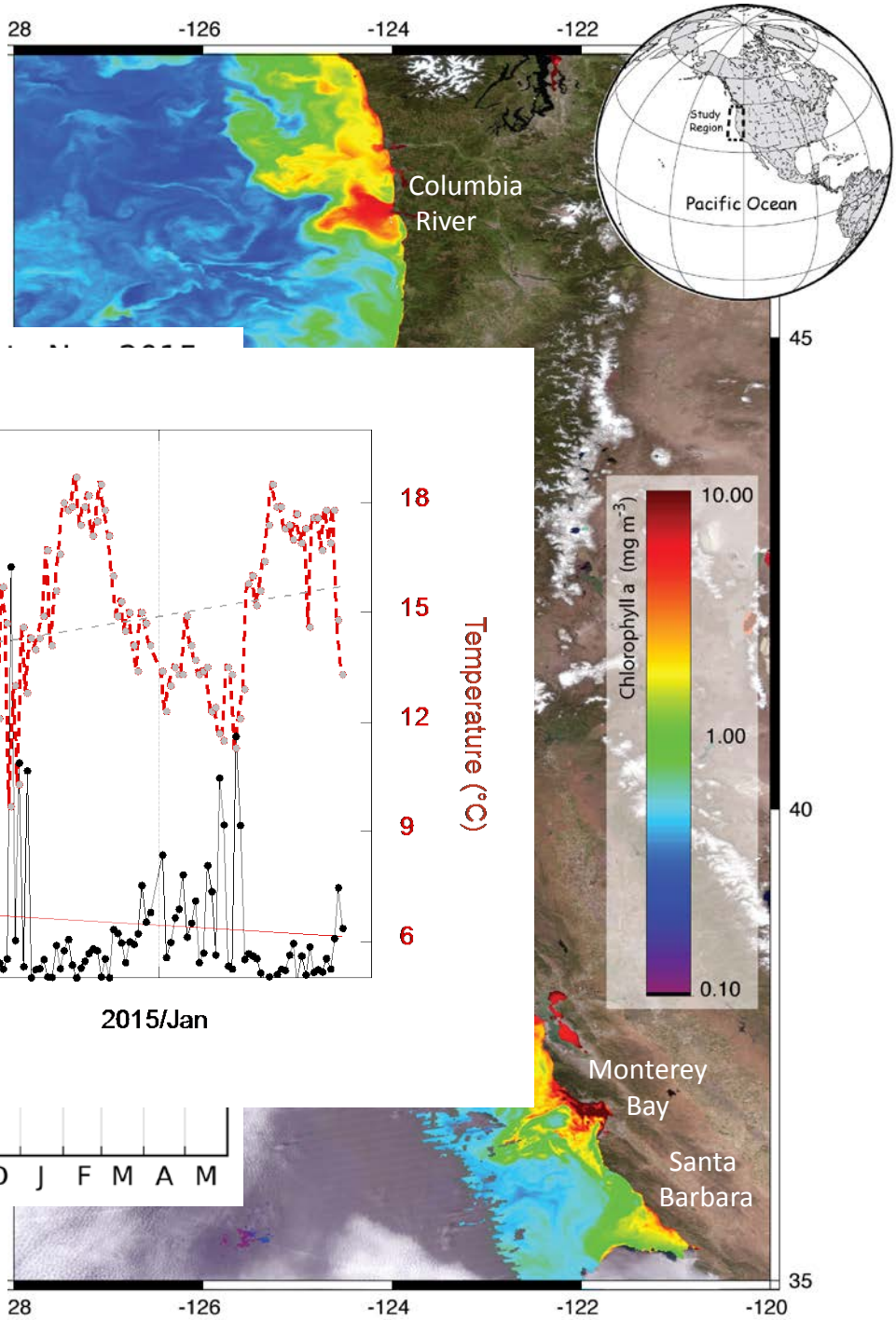
Raphael Kudela

University of California Santa Cruz

http://oceandatacenter.ucsc.edu/

Upwelling Drives Abundance & Diversity

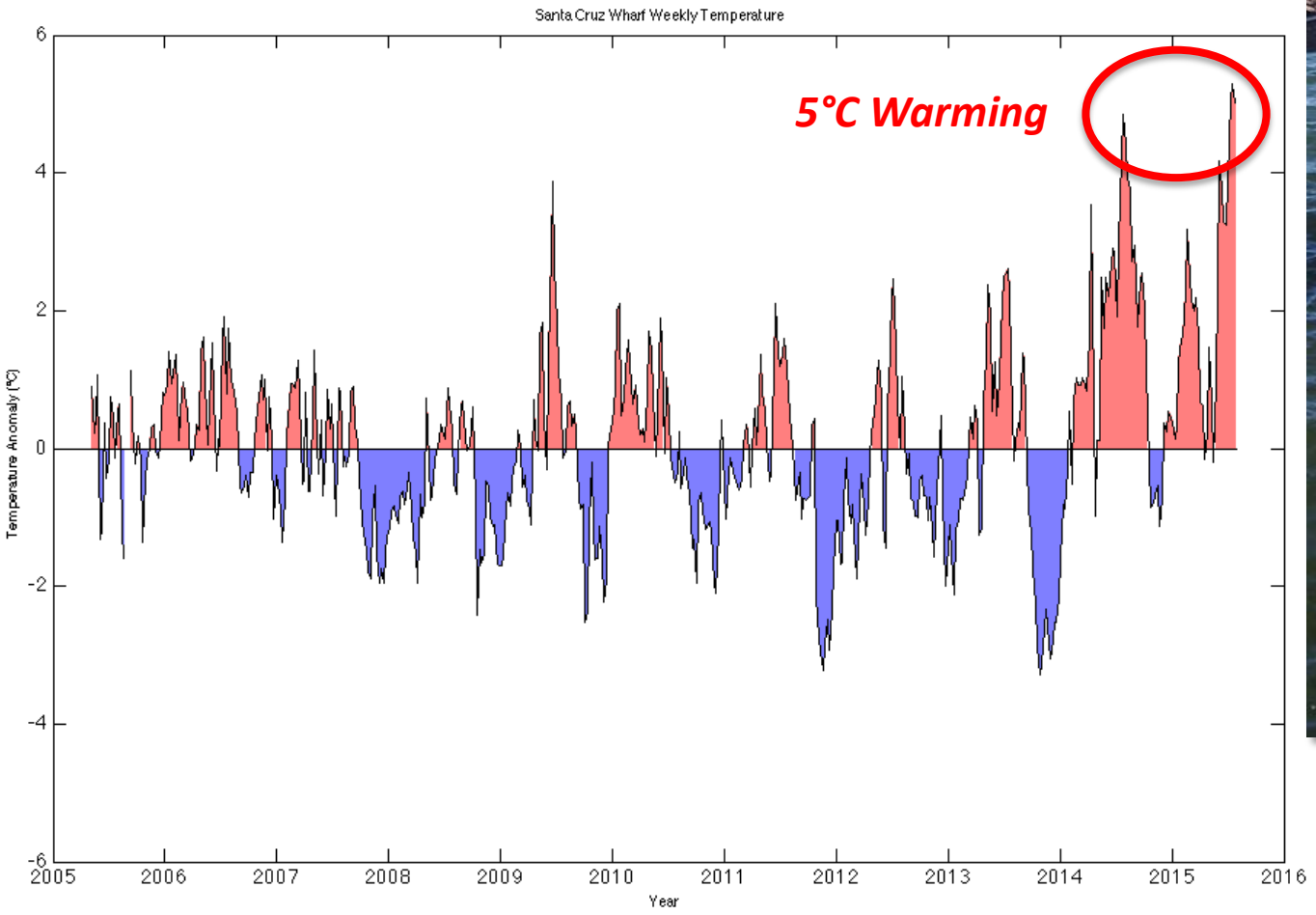


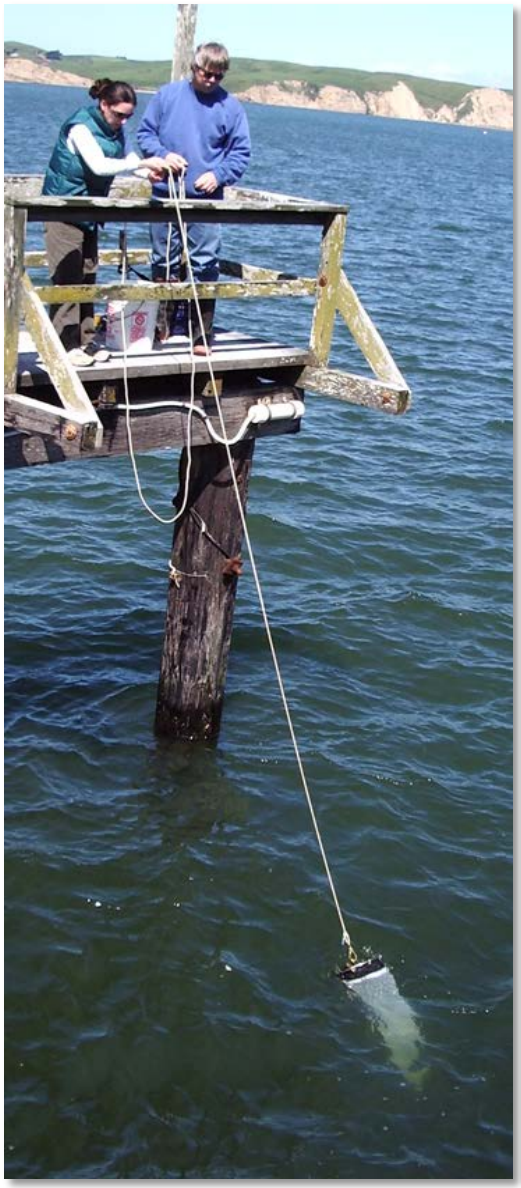


NOAA PFEL Upwelling Index

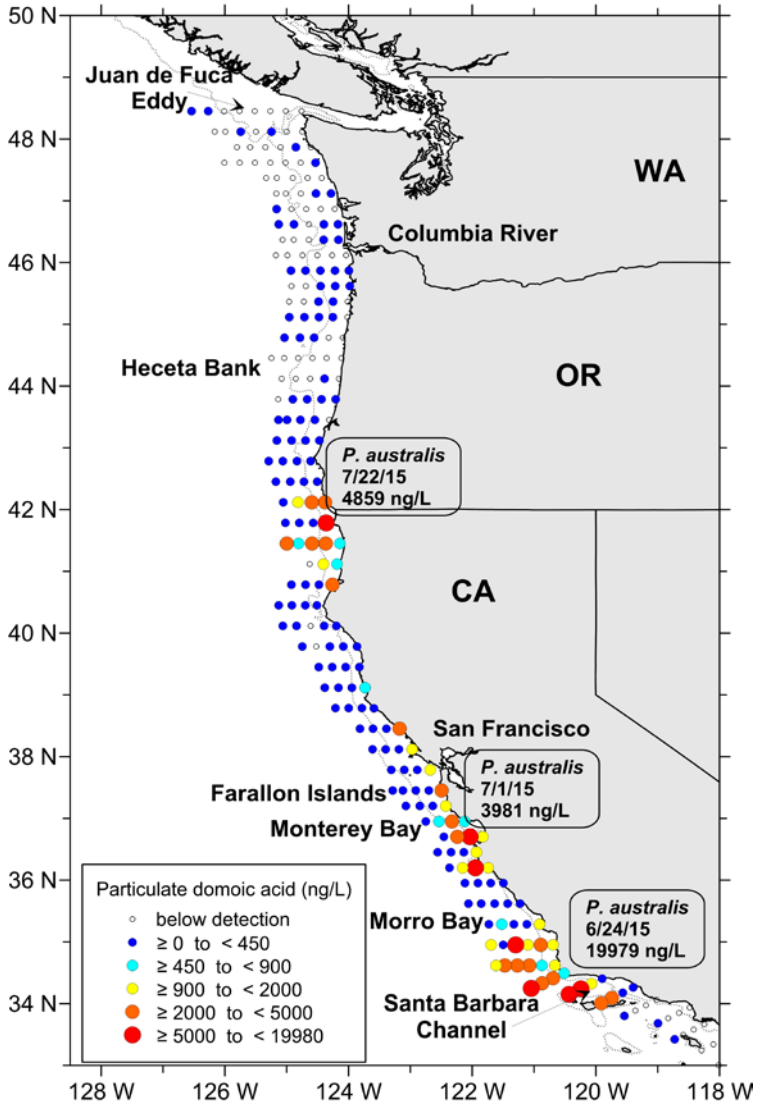
Coastal California temperatures show how warm the ocean has become

For comparison, the 1997-98 El Niño resulted in 3-4°C warming



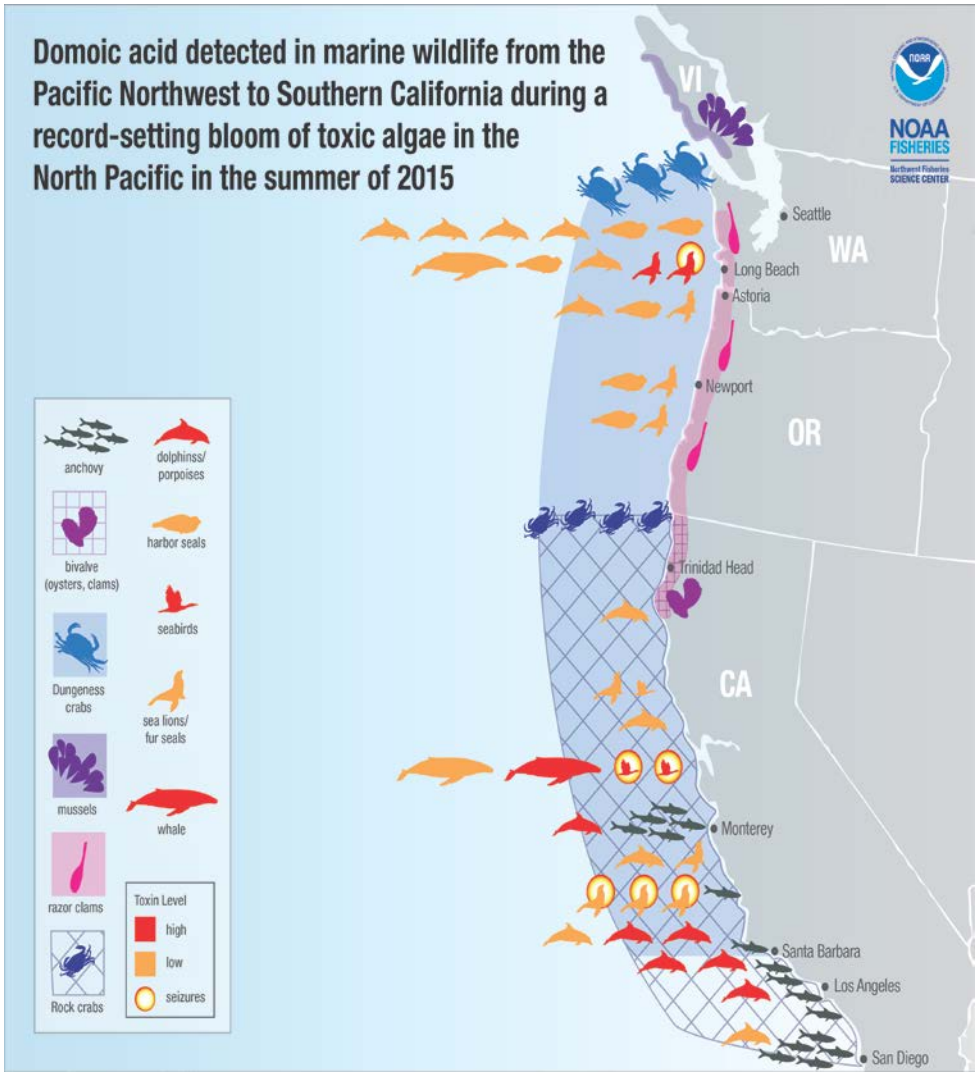


2015: An Unprecedented Year



Particulate Domoic Acid (ng/L)

(R/V *Shimada*, NOAA Fisheries)



Bloom Impacts, 2015

(*Trainer and Kudela, unpublished)*

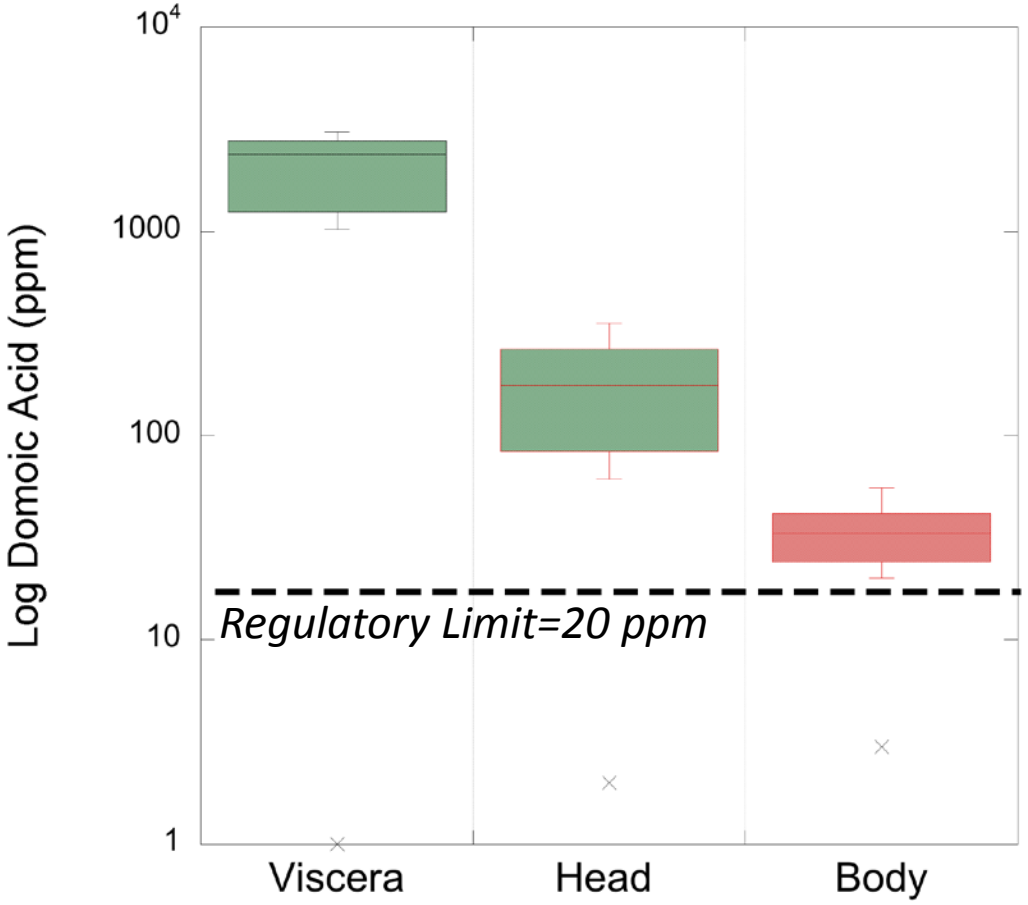
2015: An Unprecedented Year

- Peak toxin levels of >100,000 ng/L (new record)
- ***Trophic Transfer:***
  - Mussels up to 200 ppm
  - Anchovy 100-600 ppm, viscera >3,000 ppm
  - Razor Clam 340 ppm
  - Rock Crab = 1,000 ppm
  - Dungeness = 270 ppm
  - West Coast survey: 100% of fish contaminated
- Massive economic, ecological losses

Anchovy Contamination

- **Fish caught by CDPH, frozen immediately**
- **Dissected frozen**
  - **Head, Gills, & Spine**
  - **Viscera**
  - **Body (filet & skin)**
- **Analyzed individually for domoic acid**

Anchovy Contamination



Average Domoic Acid:

Viscera = 2076 ppm

Head = 184 ppm

Body = 35 ppm

N=10 individuals

News Release

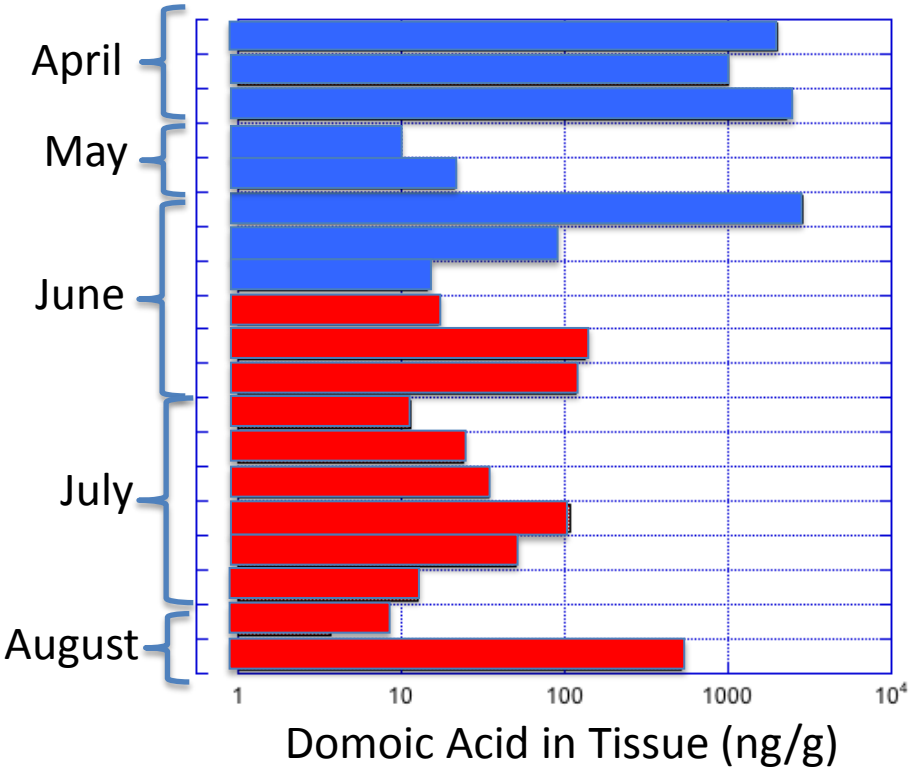
CALIFORNIA DEPARTMENT OF PUBLIC HEALTH

FOR IMMEDIATE RELEASE
November 3, 2015
PH15-082

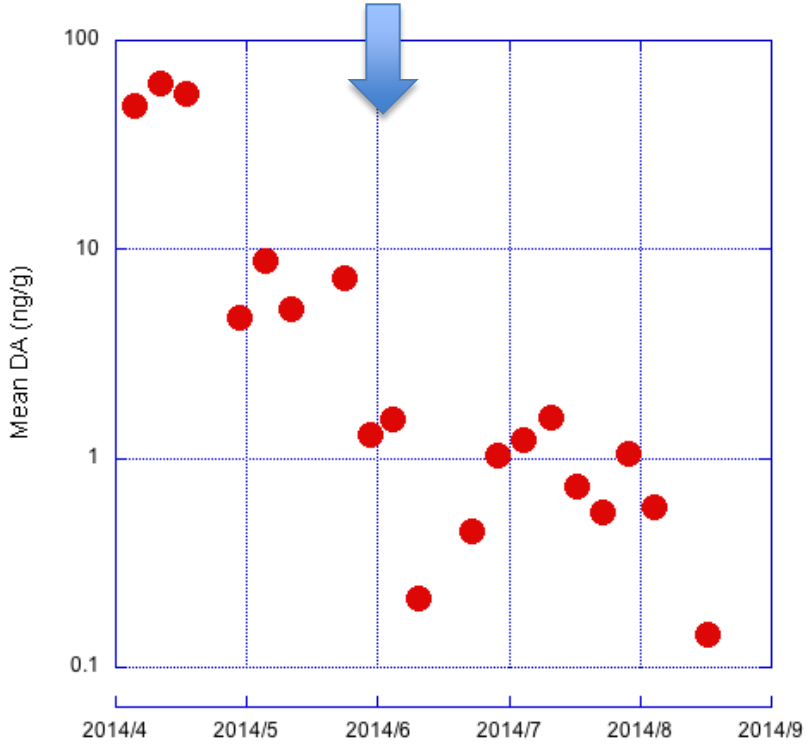
CONTACT: Anita Gore
Orville Thomas
(916) 440-7259

CDPH Issues Warning about Dungeness and Rock Crabs Caught in Waters Along the Central and Northern California Coast

Toxin disappears from water column

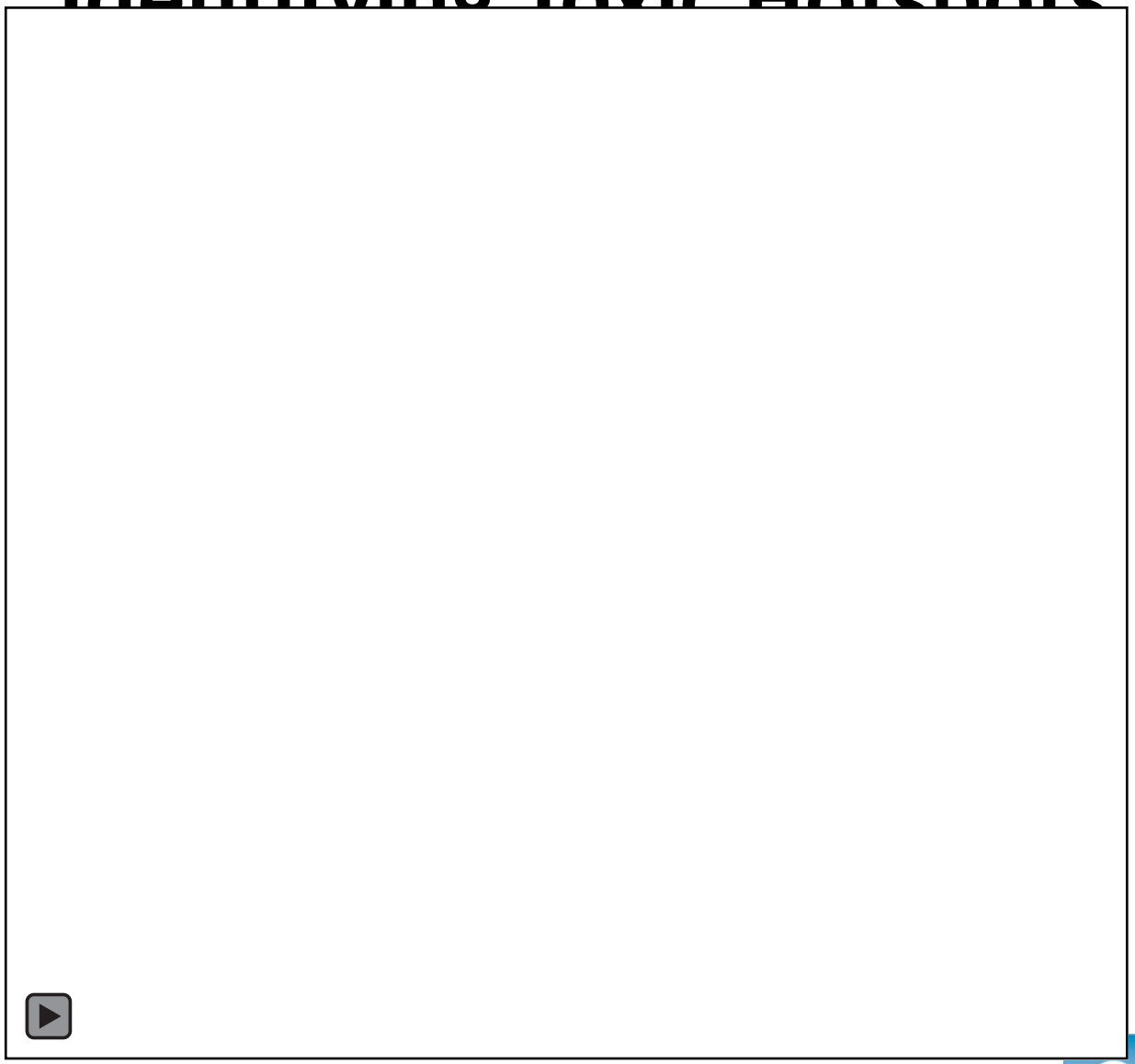


Domoic Acid in Tissue (ng/g)



Domoic Acid in Sediment (ng/g)

Identifying Toxic Hotspots

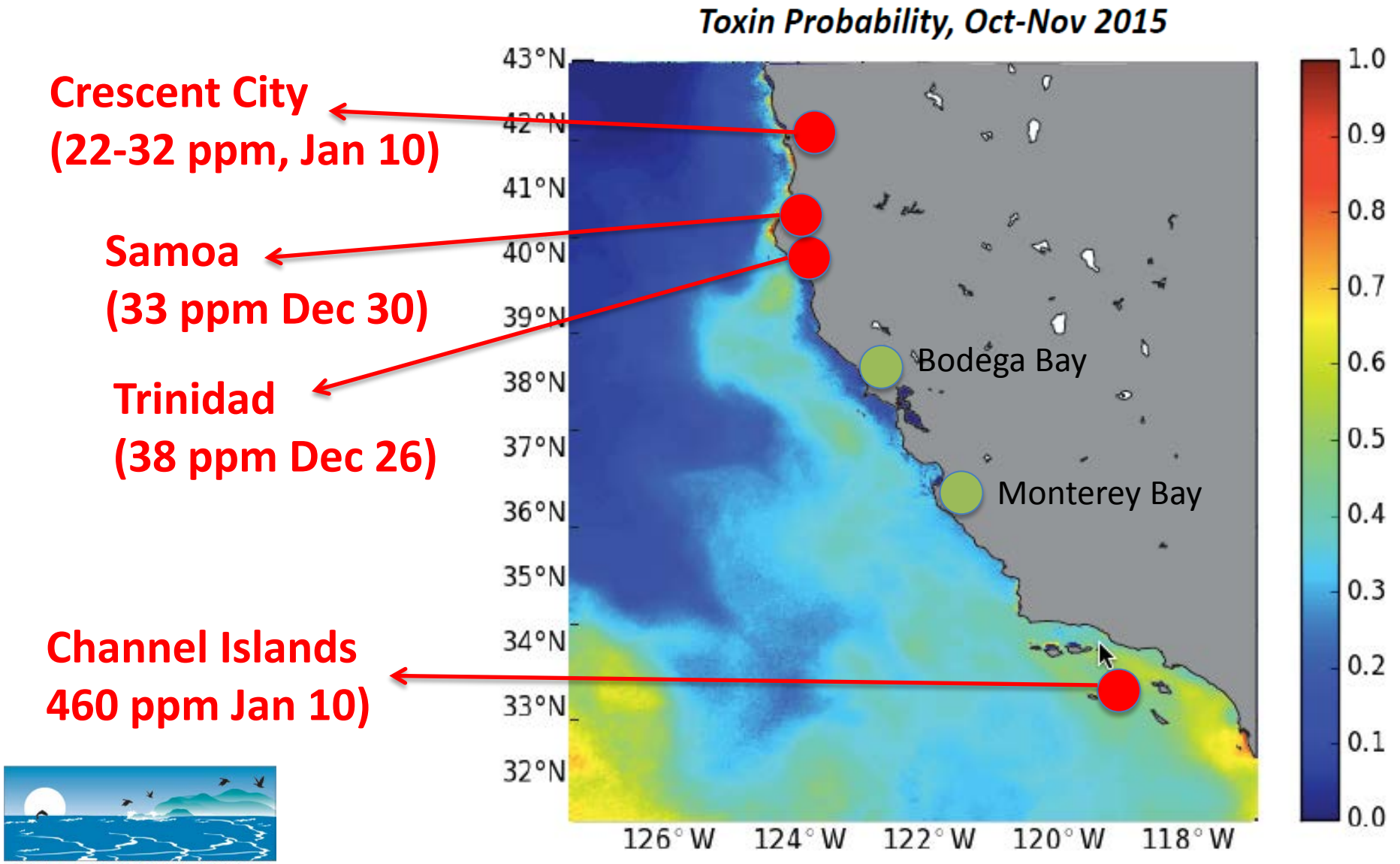


Modeled Toxin Probability

(CeNCOOS/NOAA/NASA, developed by OPC)

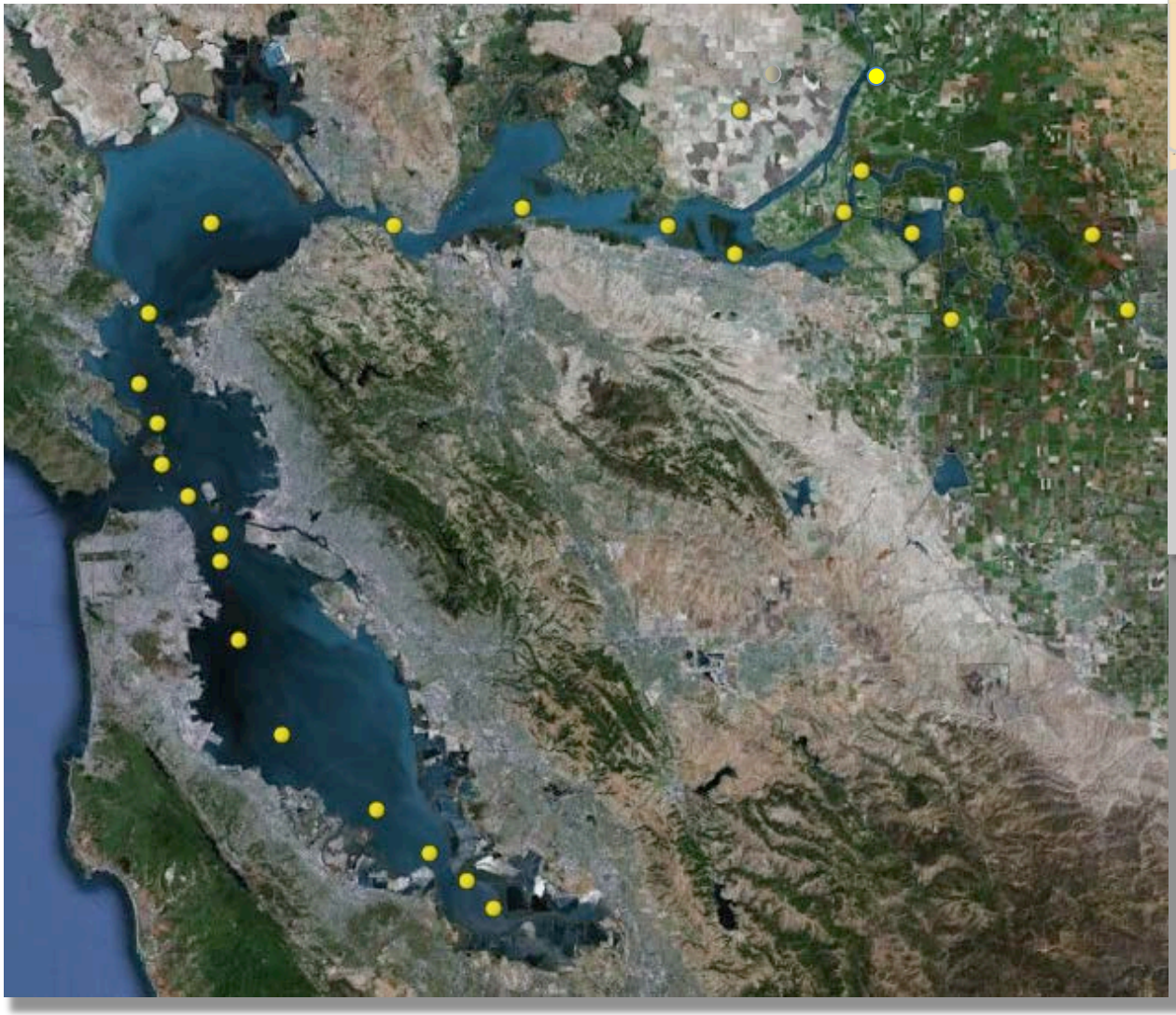
OCEAN PROTECTION COUNCIL

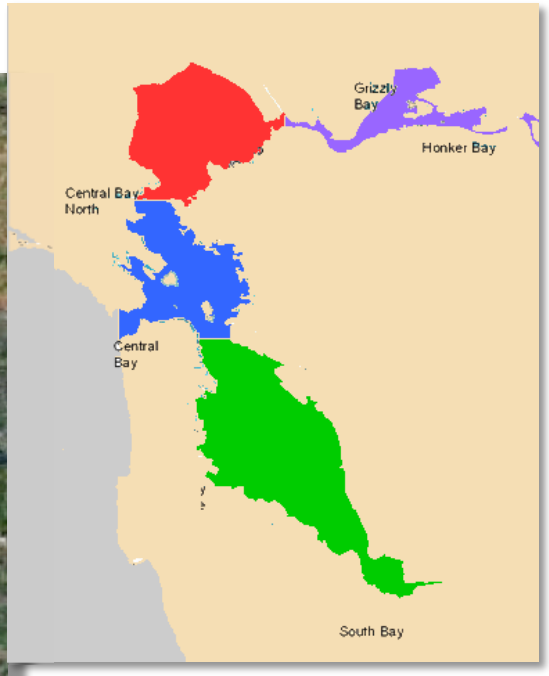
The model provides ~seasonal prediction of trophic transfer



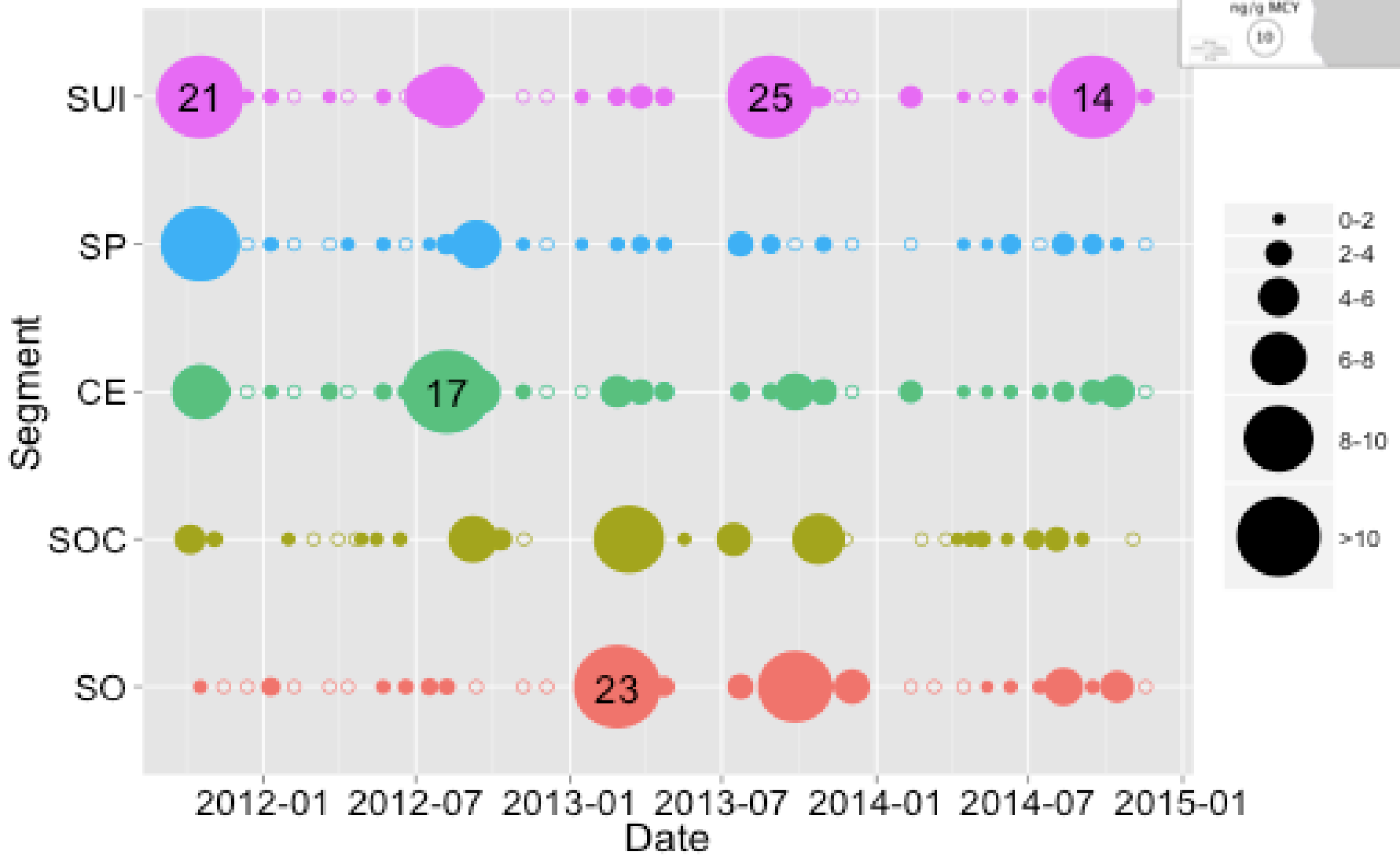
OCEAN PROTECTION COUNCIL

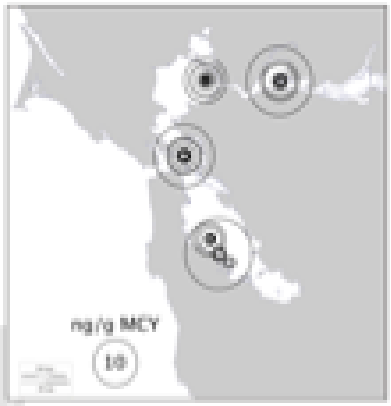
How Unusual is 2015? Toxin Data for San Francisco Bay from 2012-2014



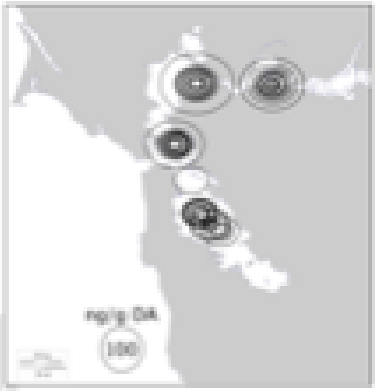


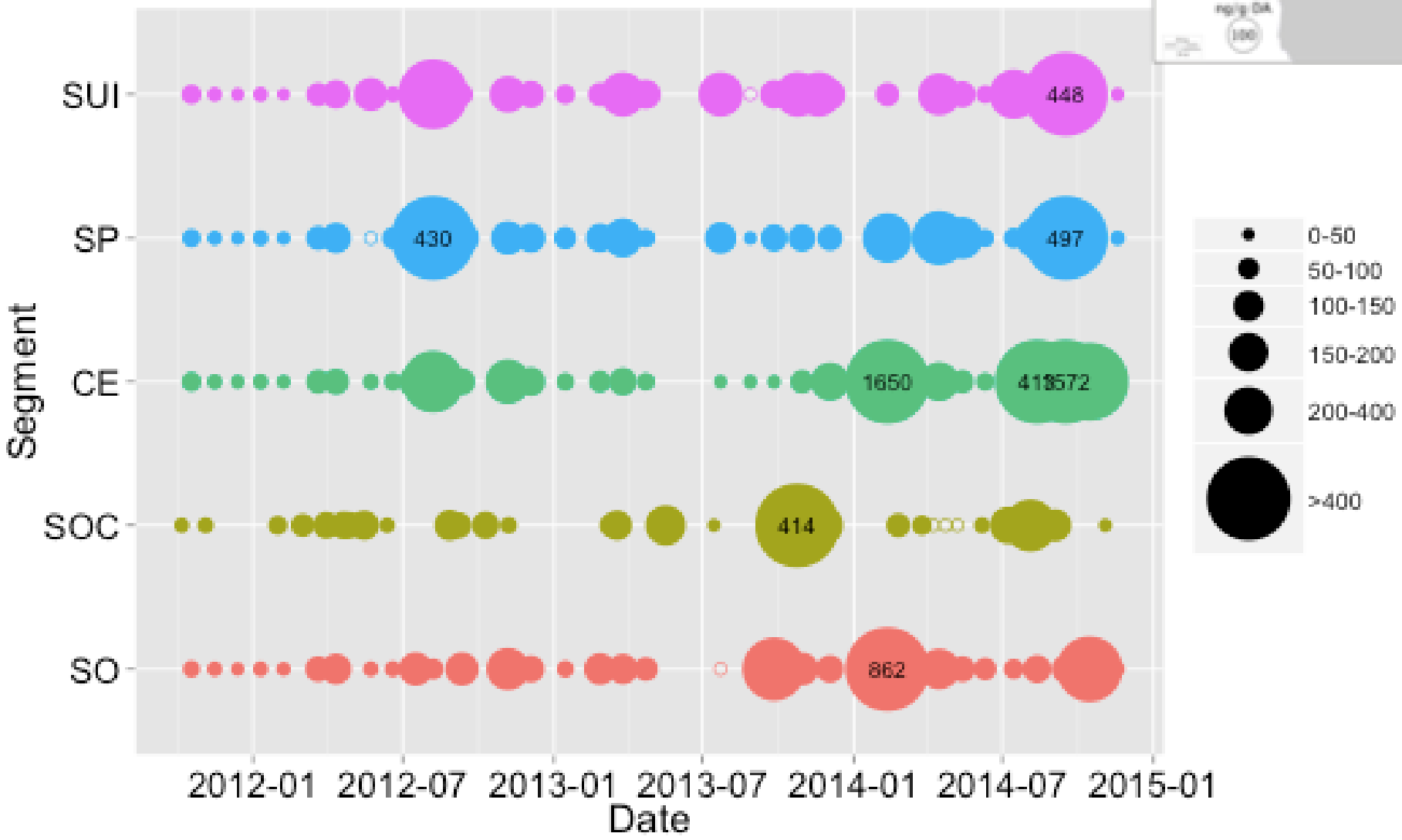
Microcystins are ubiquitous in San Francisco Bay





Domoic Acid is ubiquitous in San Francisco Bay

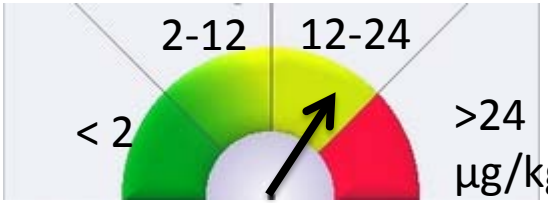




Are Toxins in the Foodweb?

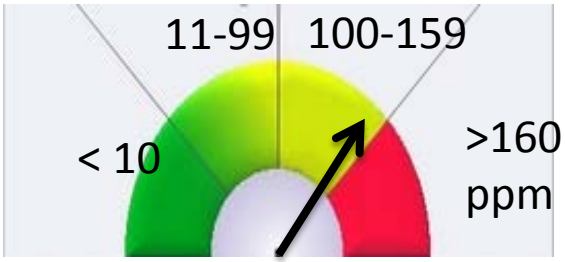
Mussels Deployed in 2012, 2014 for ~6 months

Domoic Acid
(100% of mussels contaminated)



Microcystins
(82% of mussels contaminated)

Paralytic Shellfish Toxins
(25% of mussels contaminated)

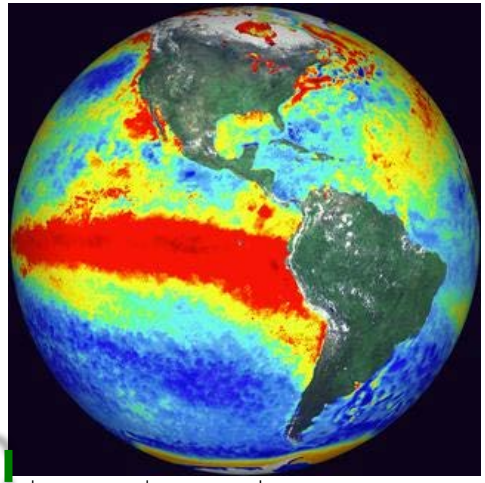


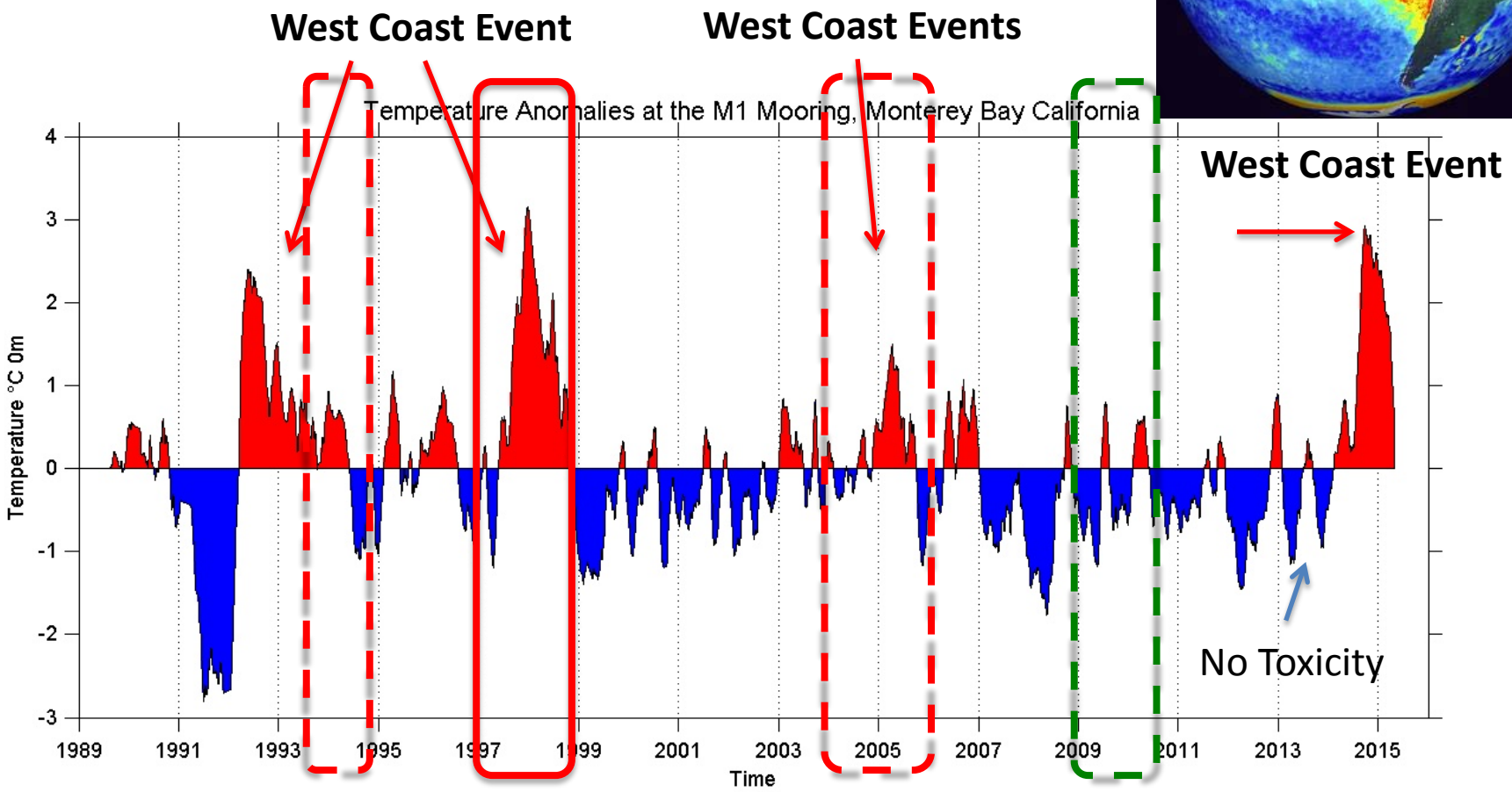
Okadaic Acid and DTX-1
(100% of mussels contaminated)

The Importance of Monitoring

25% of mussels had 4 toxins (100% contamination with at least one toxin), all were still safe for human consumption. How common is this? What does it mean?

2014-2016: From Bad to Worse? Will El Niño Save Us?

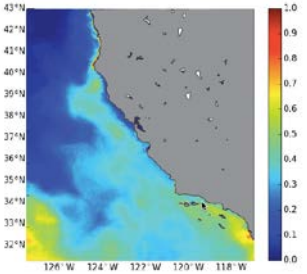




Note: 60 point moving average applied to daily averaged values.

Monterey Bay Aquarium Research Institute

Updated:20-Jul-2015



Capitalizing on Success

- Model developed with OPC funding—being transitioned to NOAA with NASA funding. Works well even during an unusual event.
- We can predict offshore, but have very little validation—opportunities to collaborate with NOAA Fisheries cruises
- Catalina Sea Ranch (Southern California) is a potential partner for an offshore, downscaled model with validation by stakeholders
- Overprediction likely during runoff events—we could use the El Niño to adjust the model (add seasonality/runoff)
- Long-term: move away from statistics towards a biogeochemical model with HABs (successful example from Pacific Northwest, merging HABs, hypoxia, OA)
- Ideally, add other HAB organisms using a similar framework