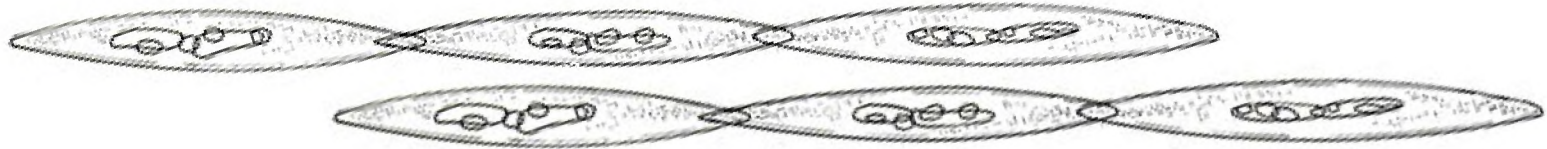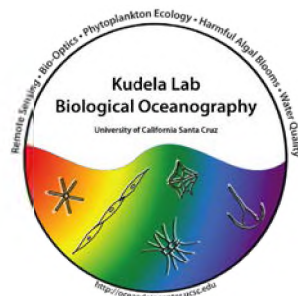# The 2015 West Coast Harmful Algal Bloom in California: Detection, Impacts, and Assessment for 2016
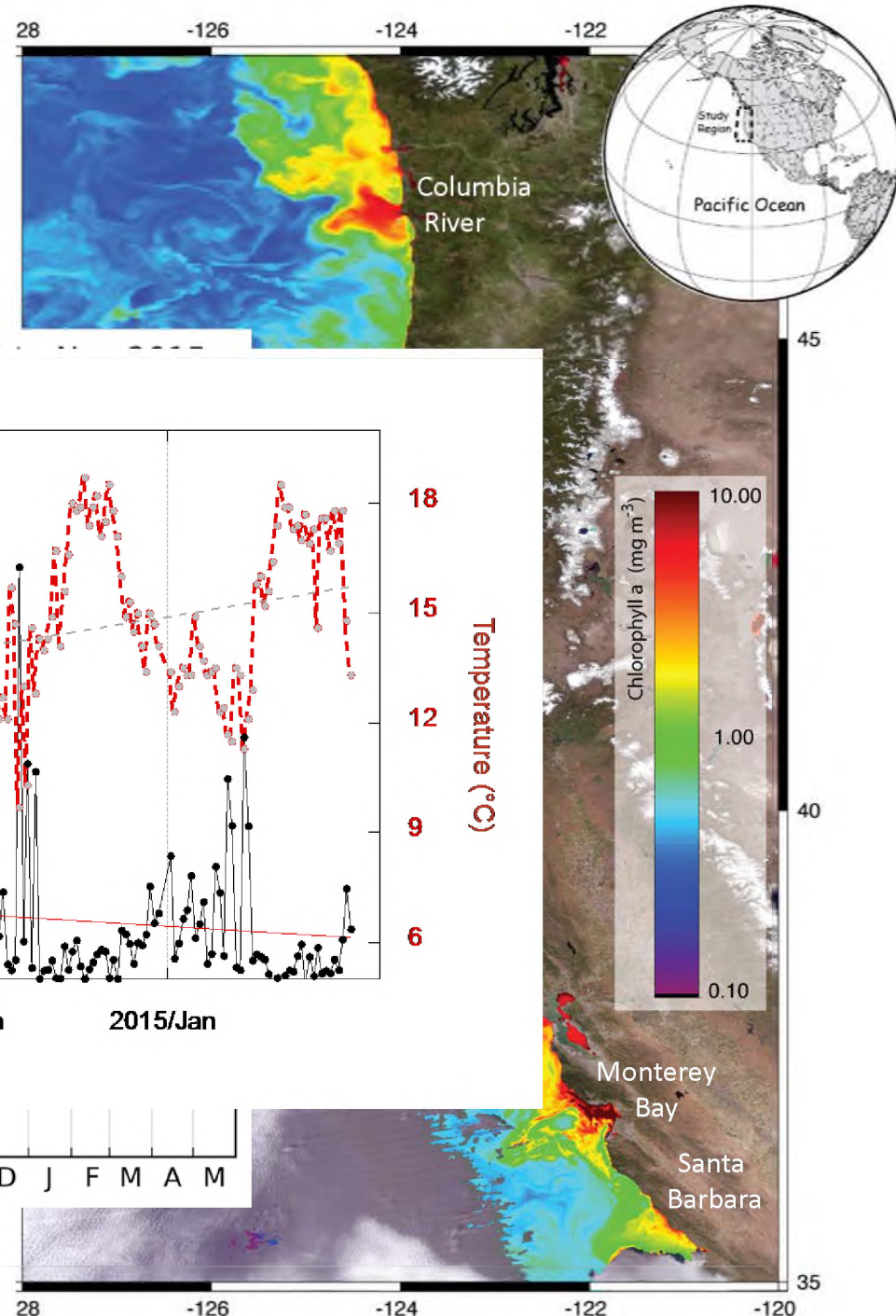
Raphael Kudela

University of California Santa Cruz
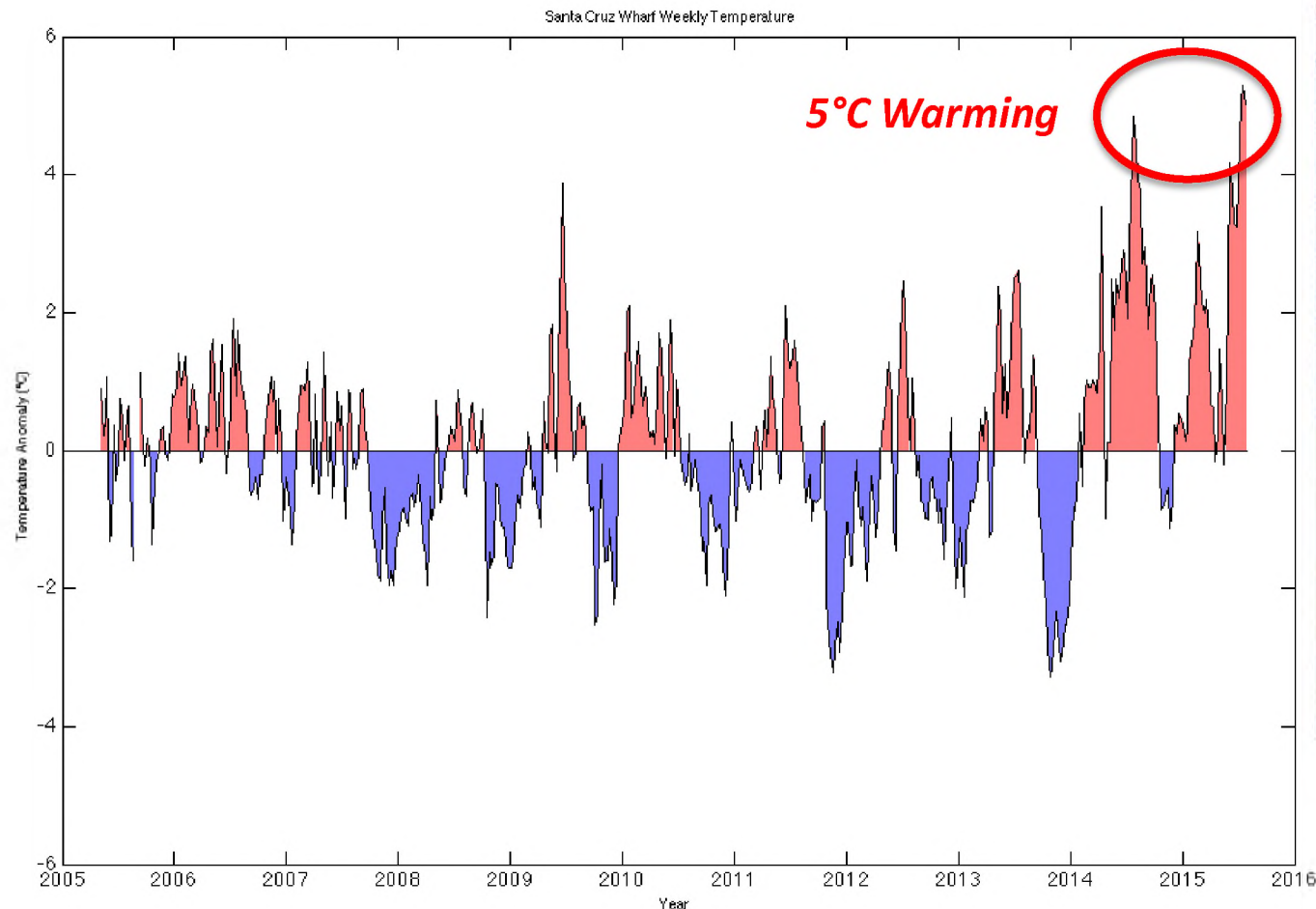
http://oceandatacenter.ucsc.edu/

Upwelling Drives Abundance & Diversity

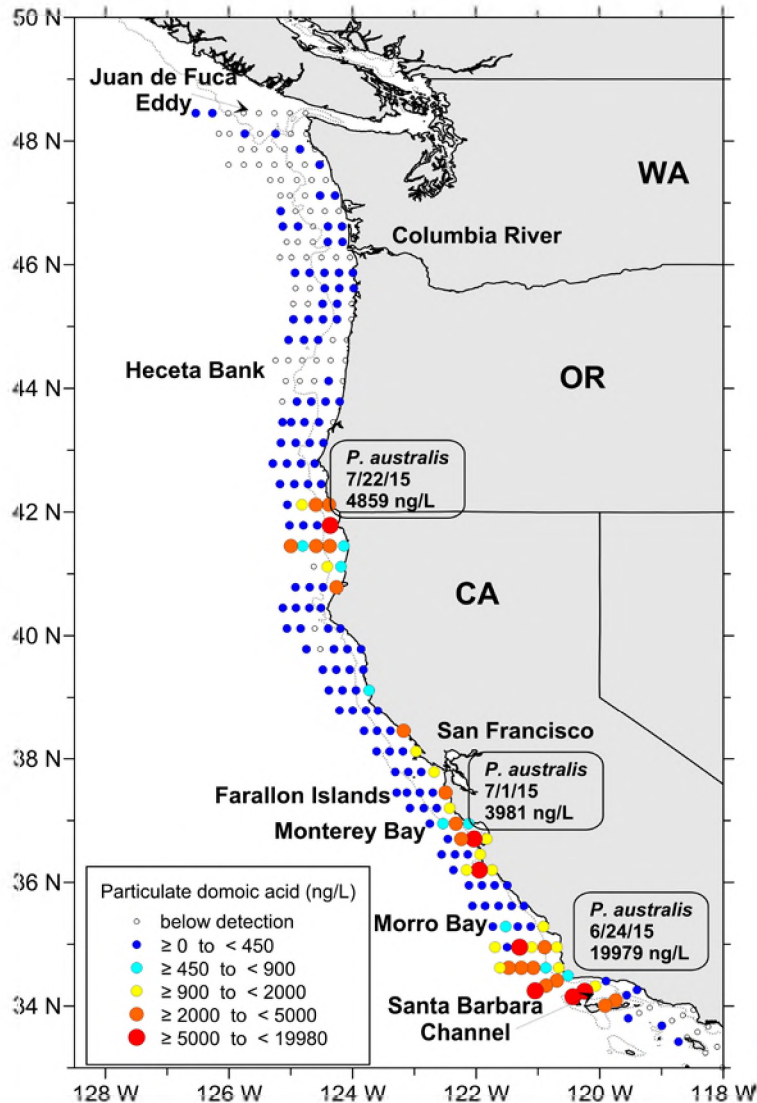# Coastal California temperatures show how warm the ocean has become

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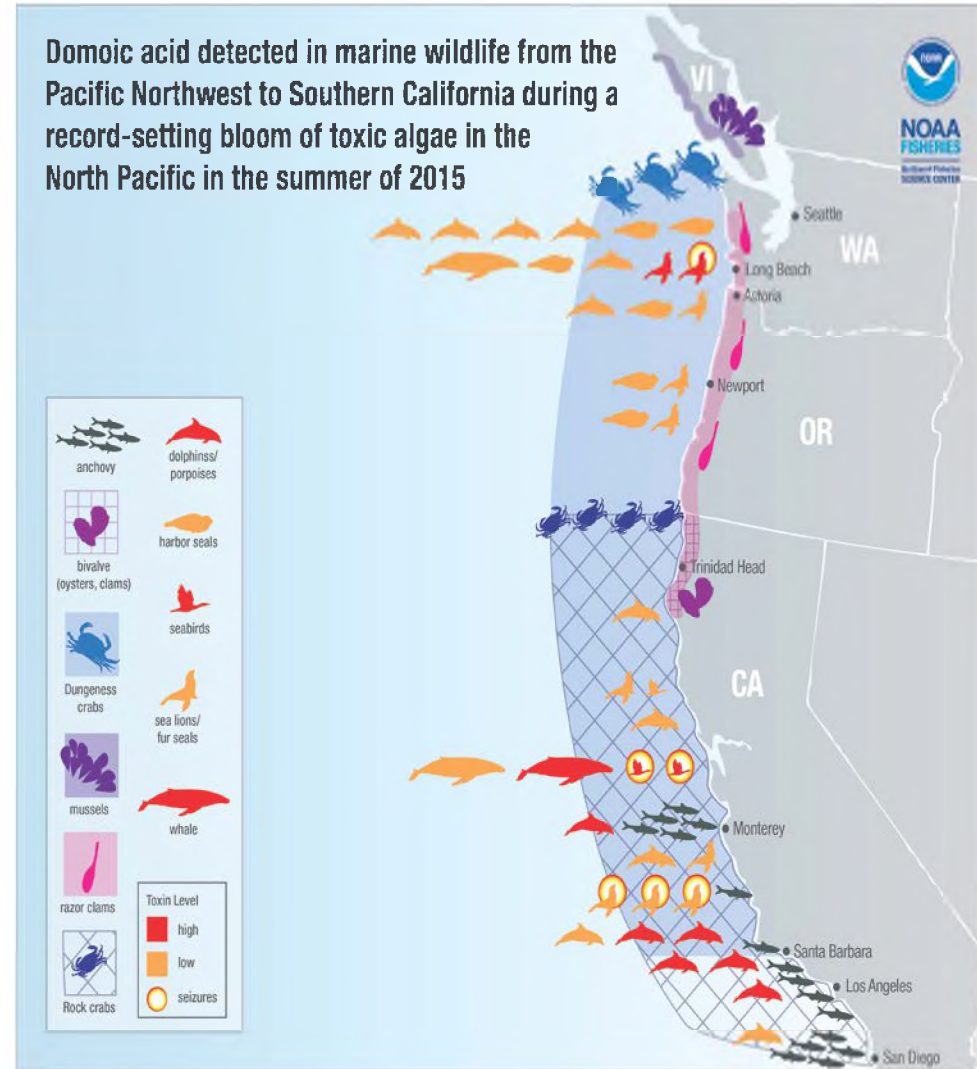

Santa Cruz Wharf Weekly Temperature

5°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(*Trainer and Kudela, unpublished*)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

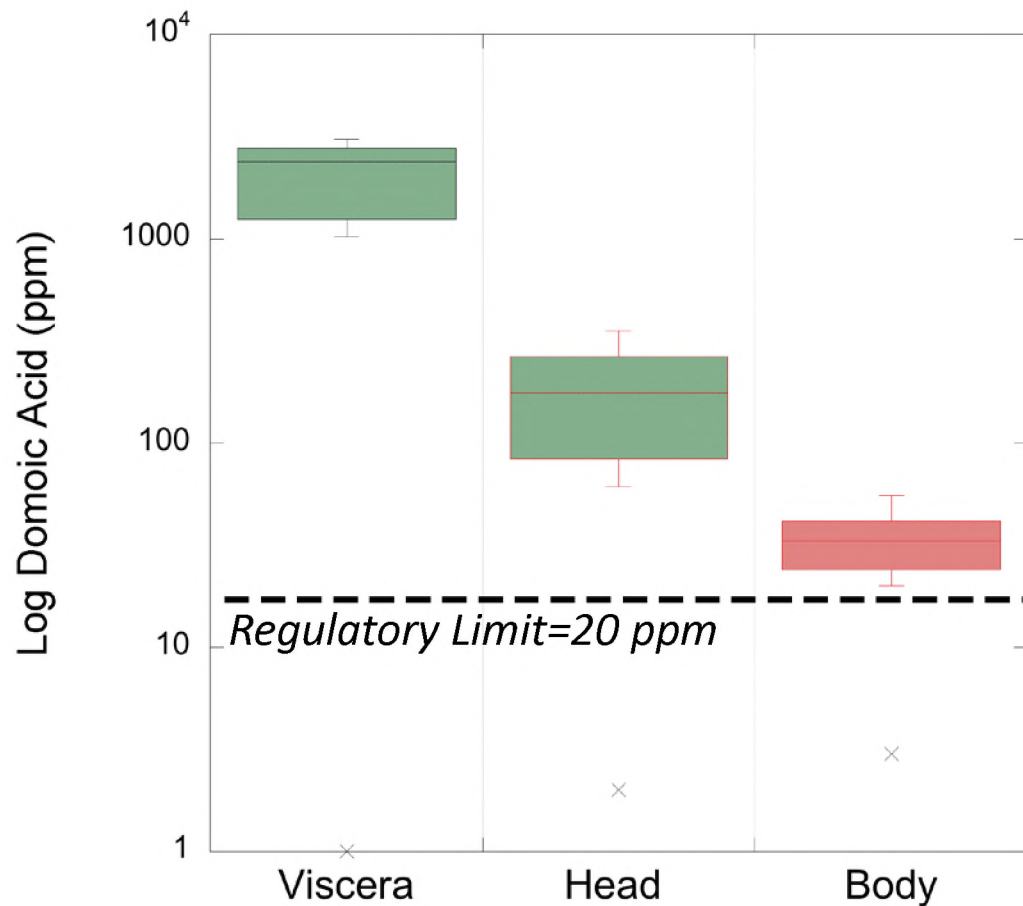- Massive economic, ecological losses

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
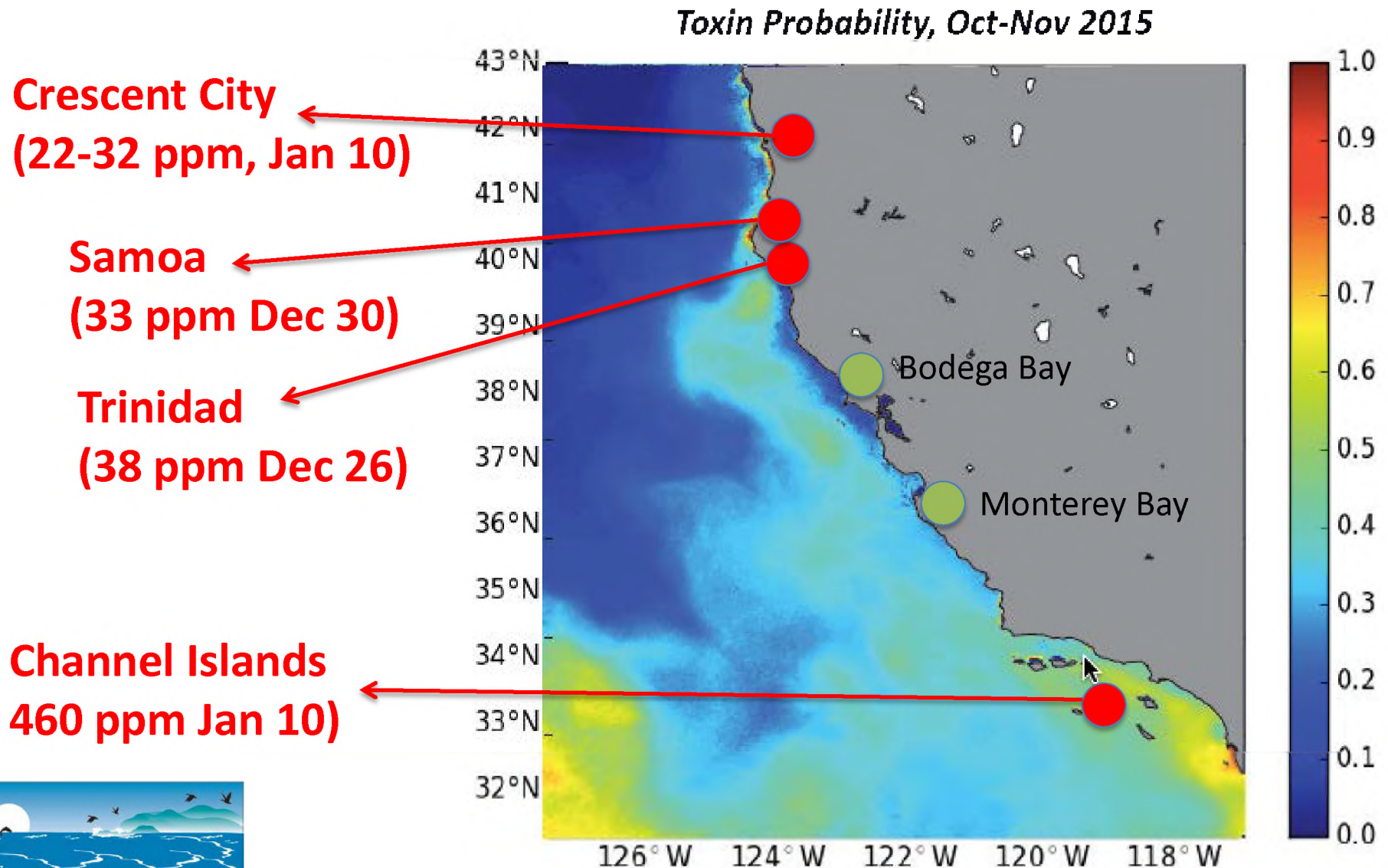
N=10 individuals
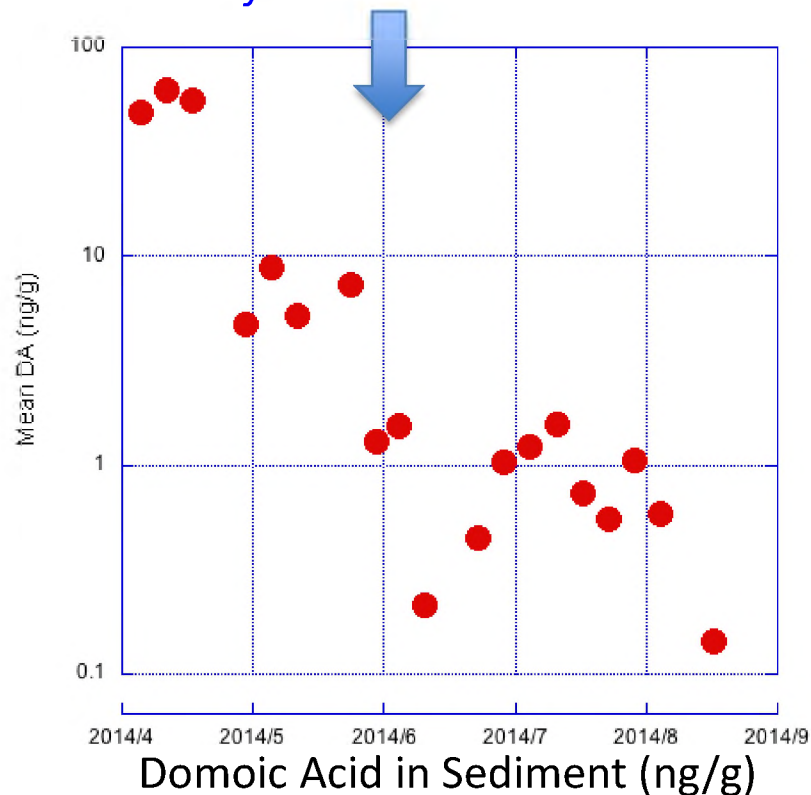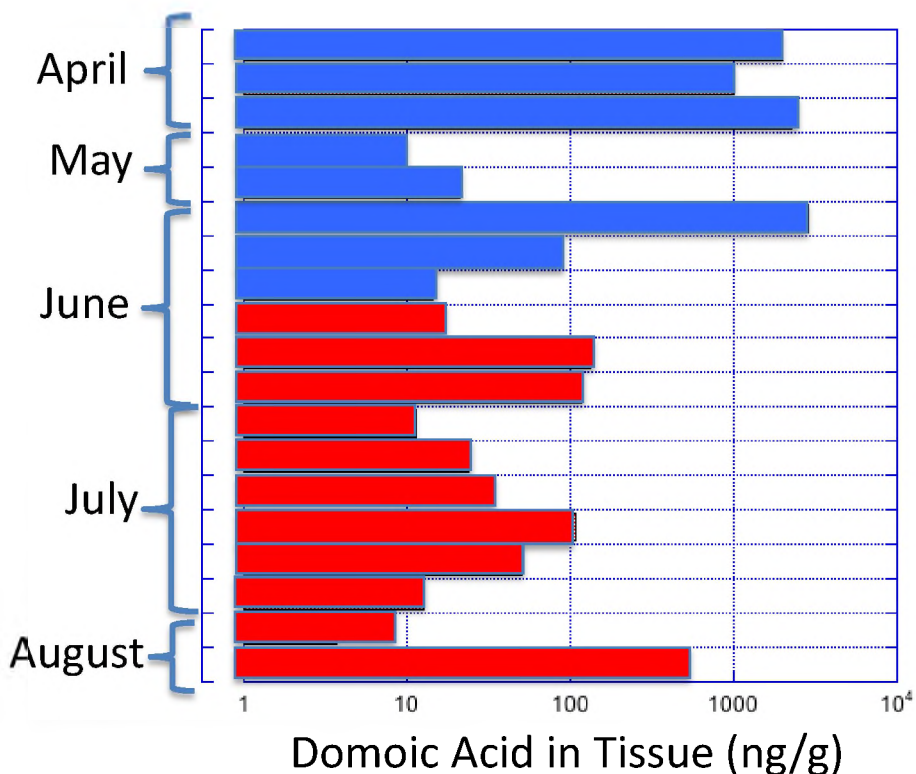
Identifying Toxic Hotspots

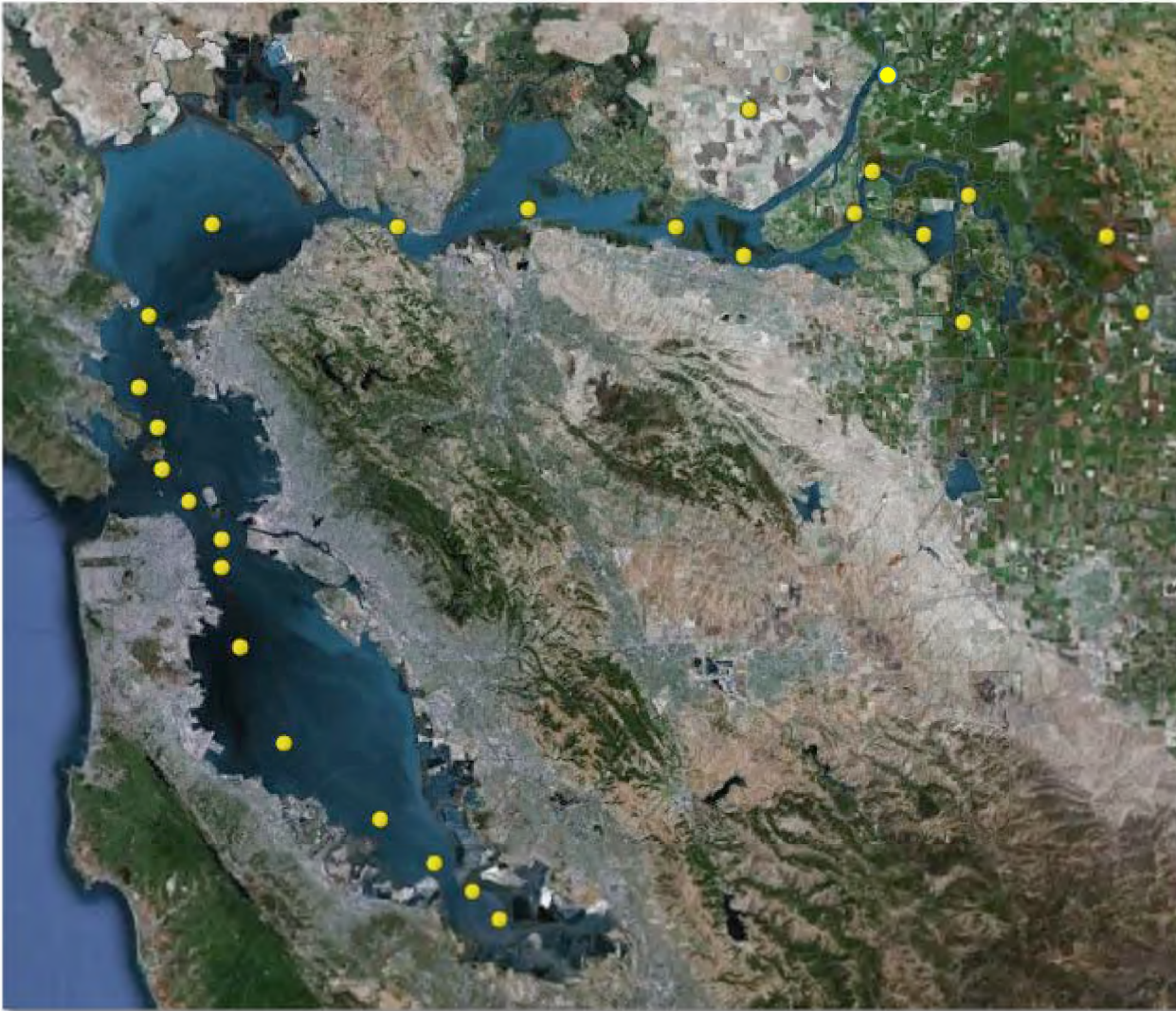**Modeled Toxin Probability**
(CeNCOOS/NOAA/NASA, developed by OPC)

The model provides ~seasonal prediction of trophic transfer

Toxin Probability, Oct-Nov 2015

Crescent City
(22-32 ppm, Jan 10)

Samoa
(33 ppm Dec 30)

Trinidad
(38 ppm Dec 26)

Channel Islands
460 ppm Jan 10)
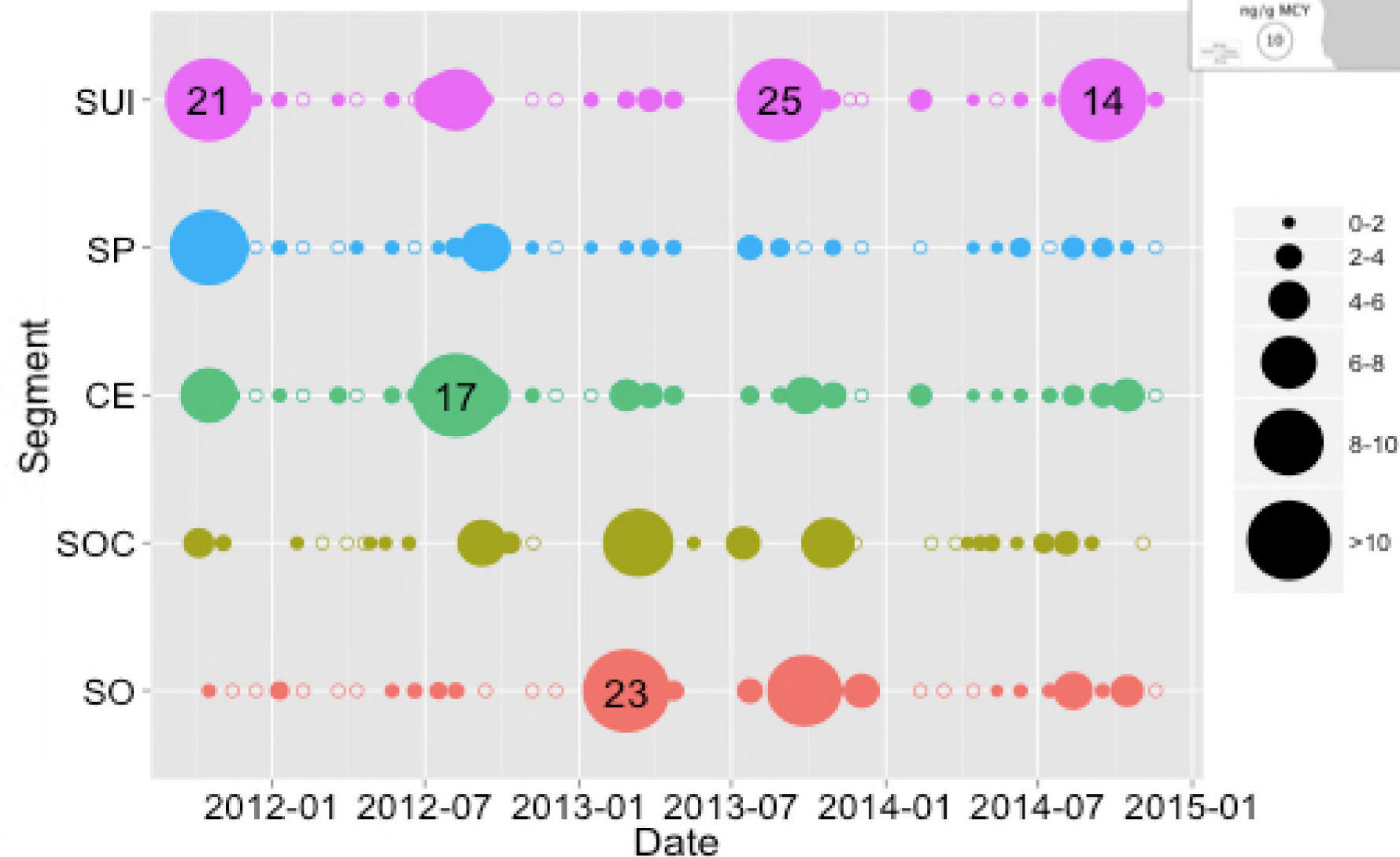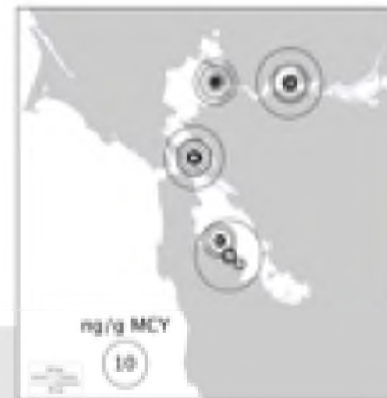
Bodega Bay

Monterey Bay

OCEAN PROTECTION COUNCIL

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

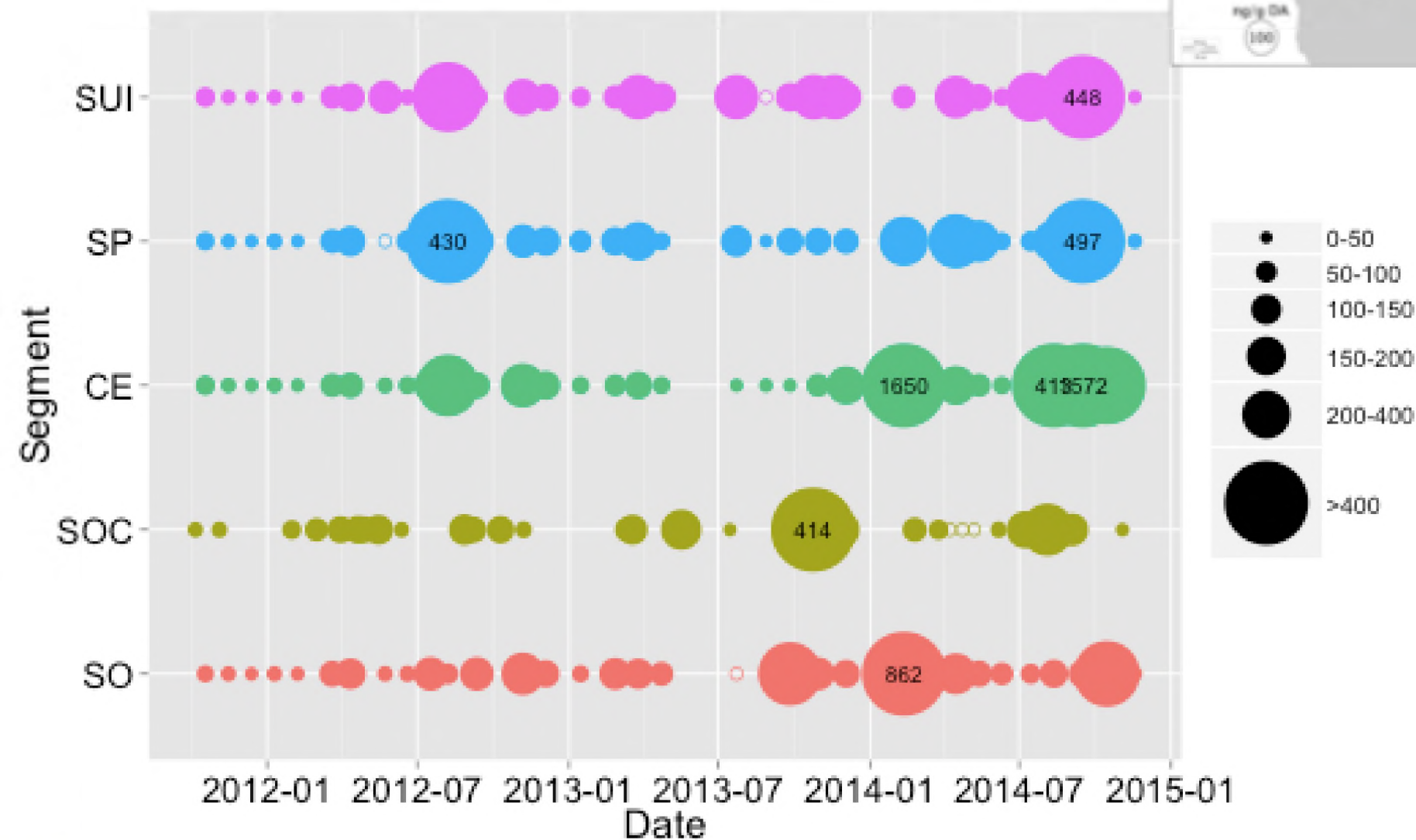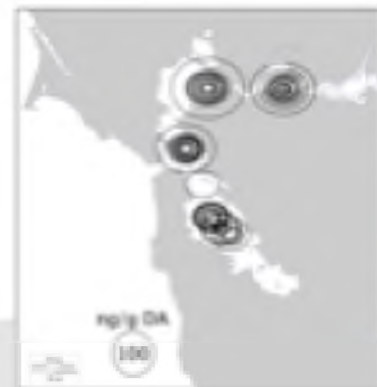Microcystins are ubiquitous in San Francisco Bay

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
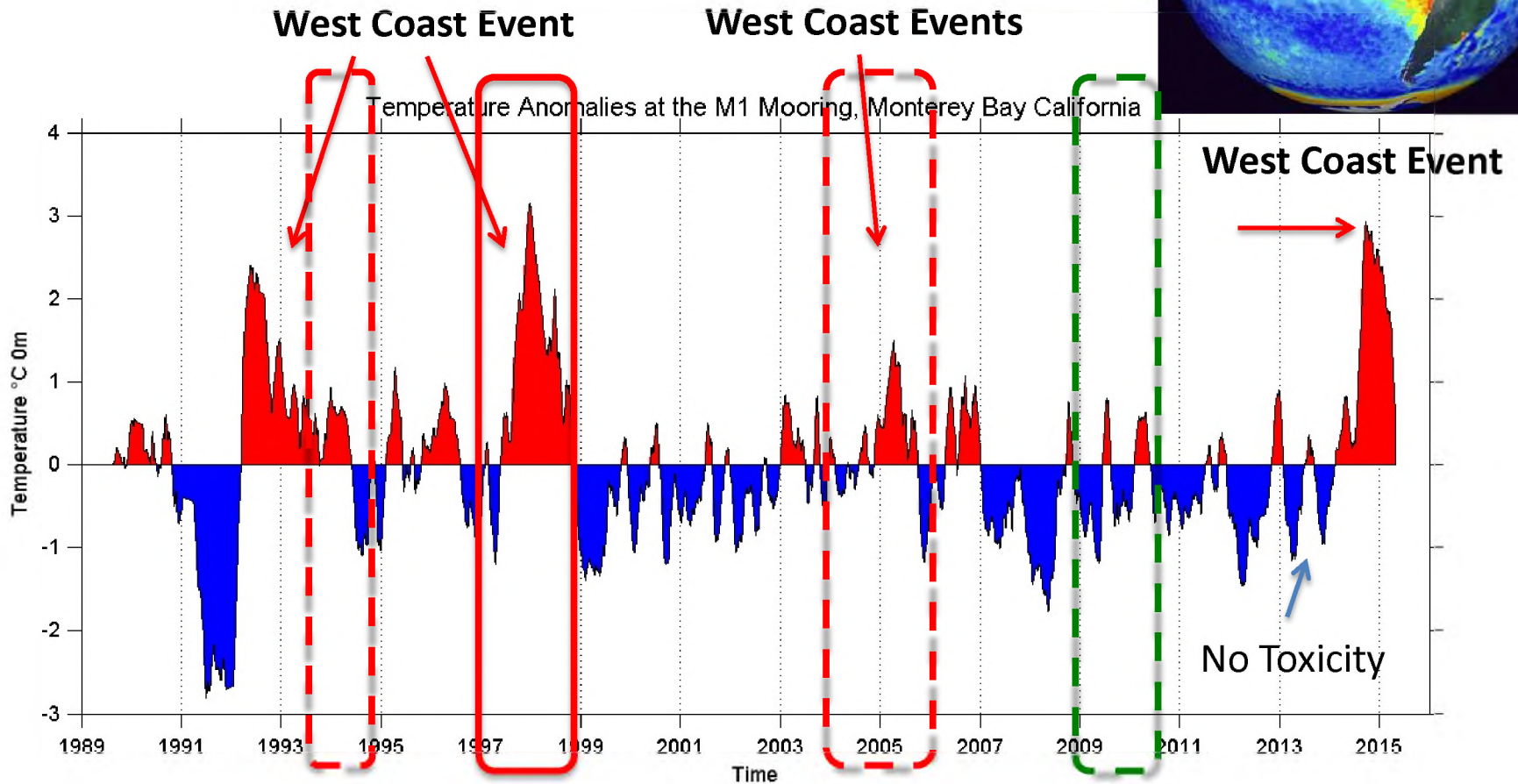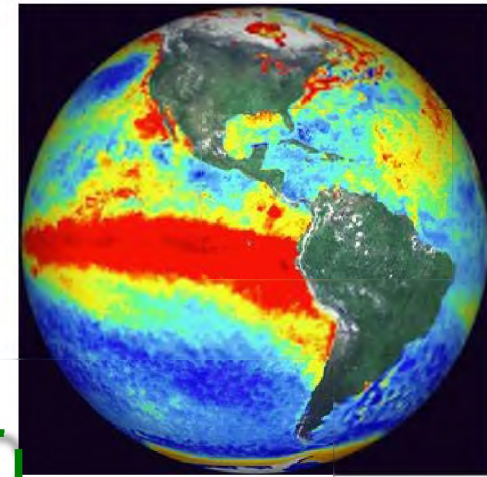*(100% of mussels contaminated)*

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?

West Coast Event

West Coast Events

West Coast Event

Temperature Anomalies at the M1 Mooring, Monterey Bay California

No Toxicity

CA / OR Event
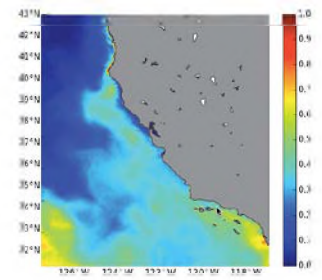
Note: 60 point moving average applied to daily averaged values.
Monterey Bay Aquarium Research Institute
Updated:20-Jul-2015

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