BLURRED LINES: MULTIPLE FRESHWATER AND MARINE TOXINS AT THE LAND- SEA INTERFACE

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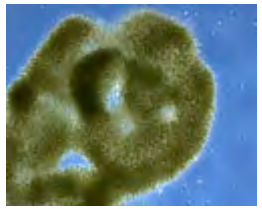
SAN FRANCISCO ESTUARY INSTITUTE & THE AQUATIC SCIENCE CENTER

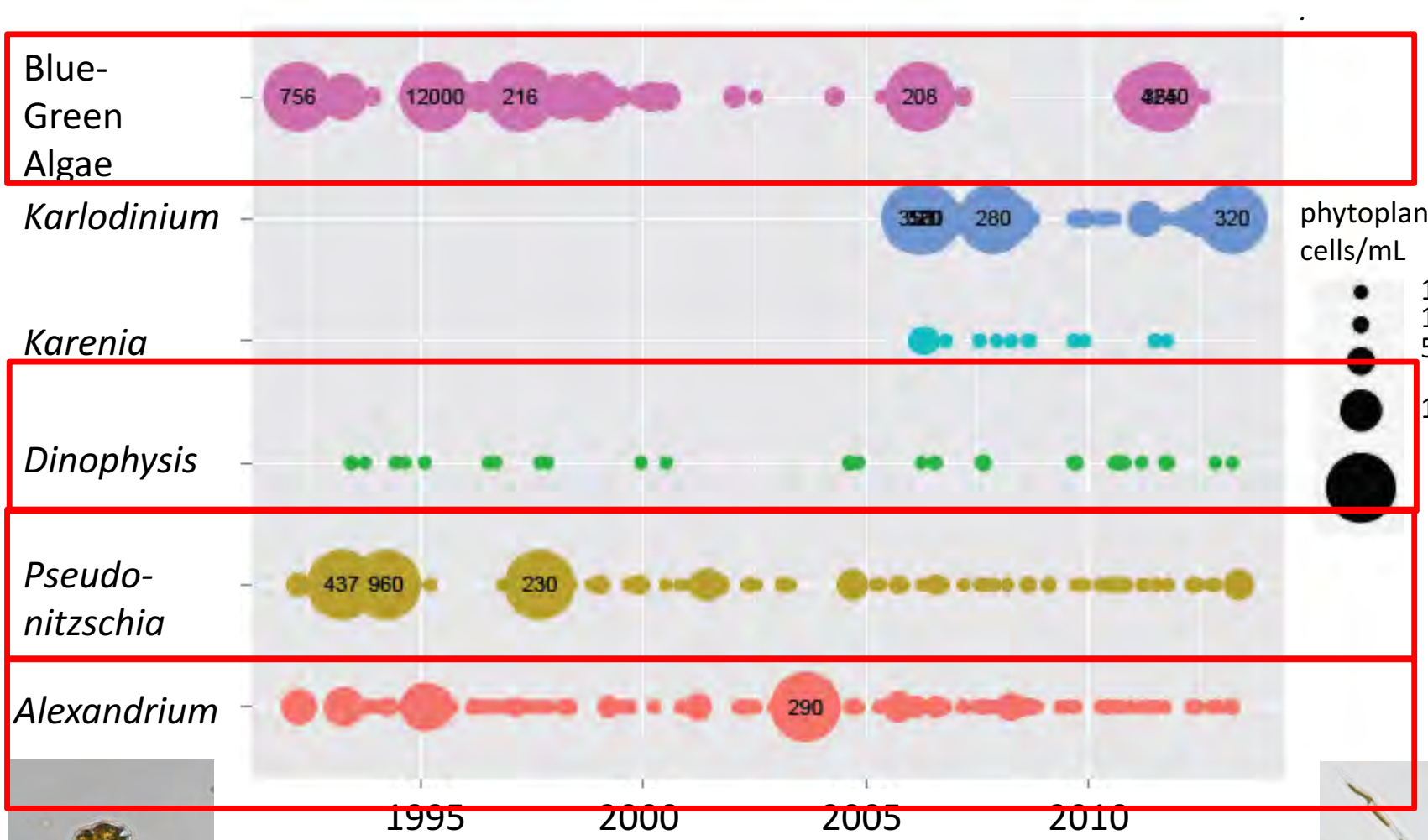
science for a changing world

San Francisco Bay

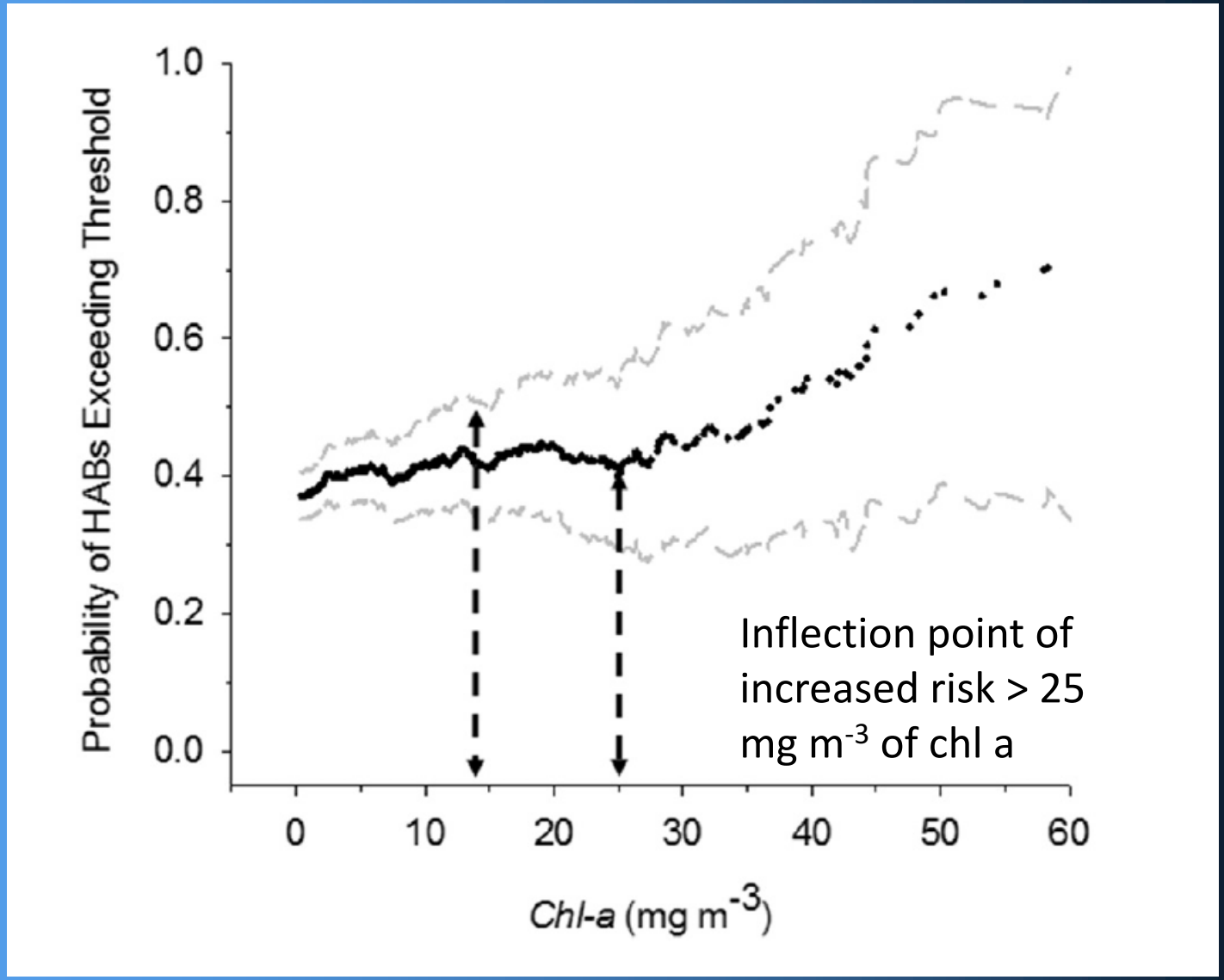
- USGS Water Quality
- Twice monthly cruises from 1992 – present
- > 20,000 unique counts for phytoplankton

Four Toxic Species of Concern





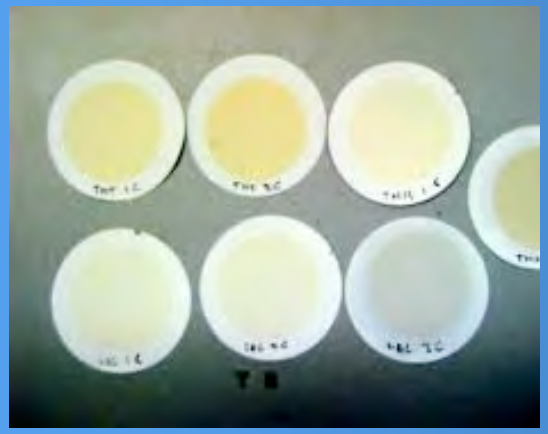
Chlorophyll-a used as a proxy for harmful algae



Sutula et al. 2017

So, there are harmful algae, what about toxins?

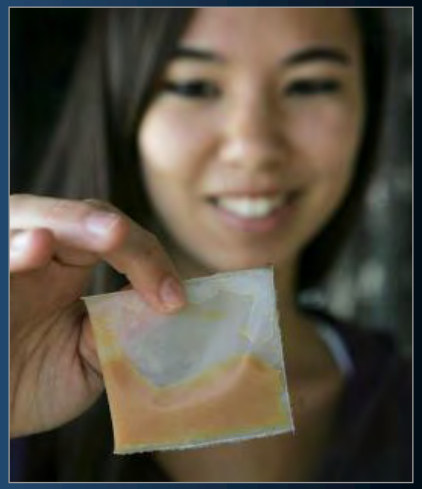
Particulate Toxin



Domoic Acid

Microcystin

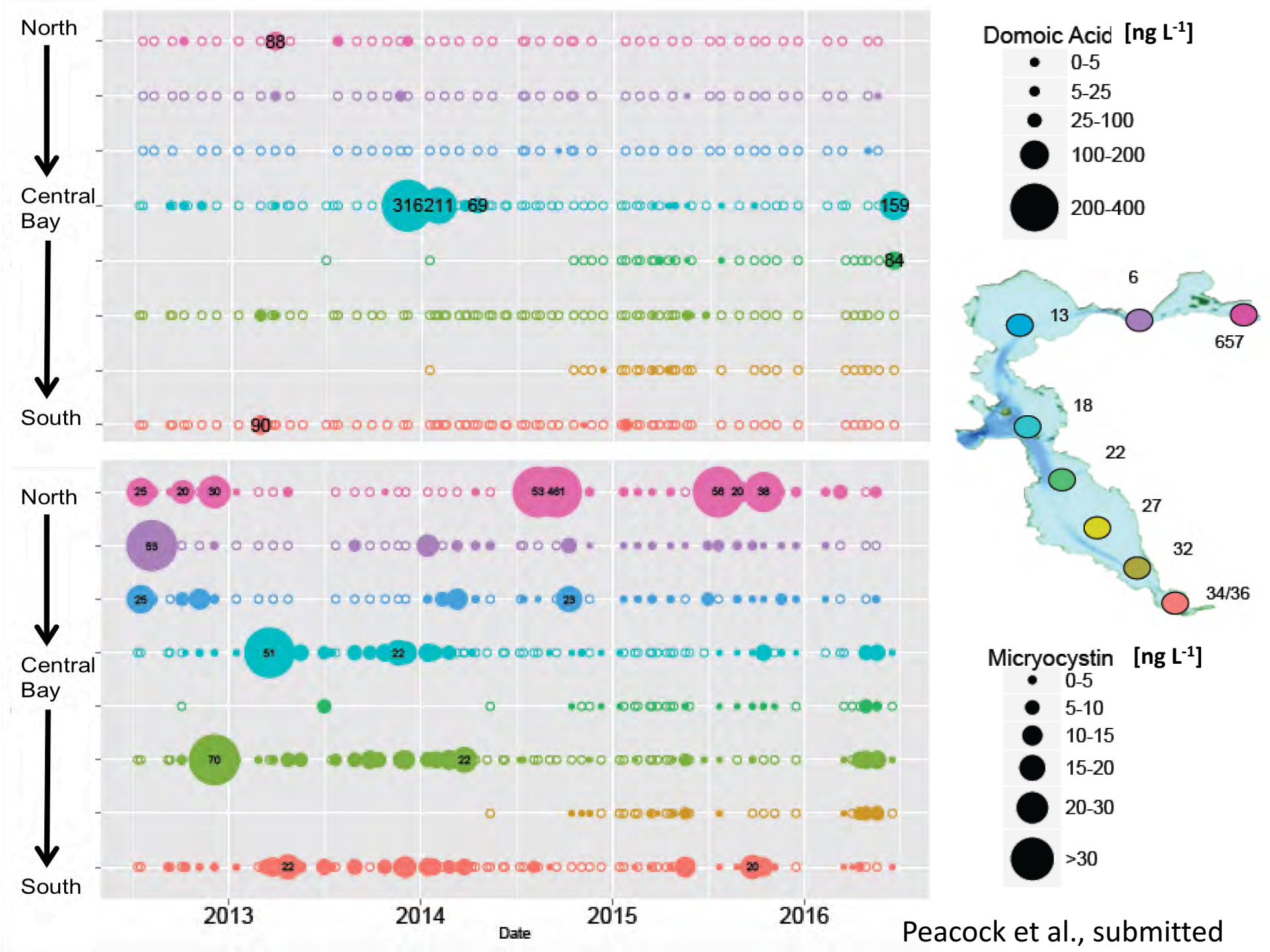
Dissolved Toxin



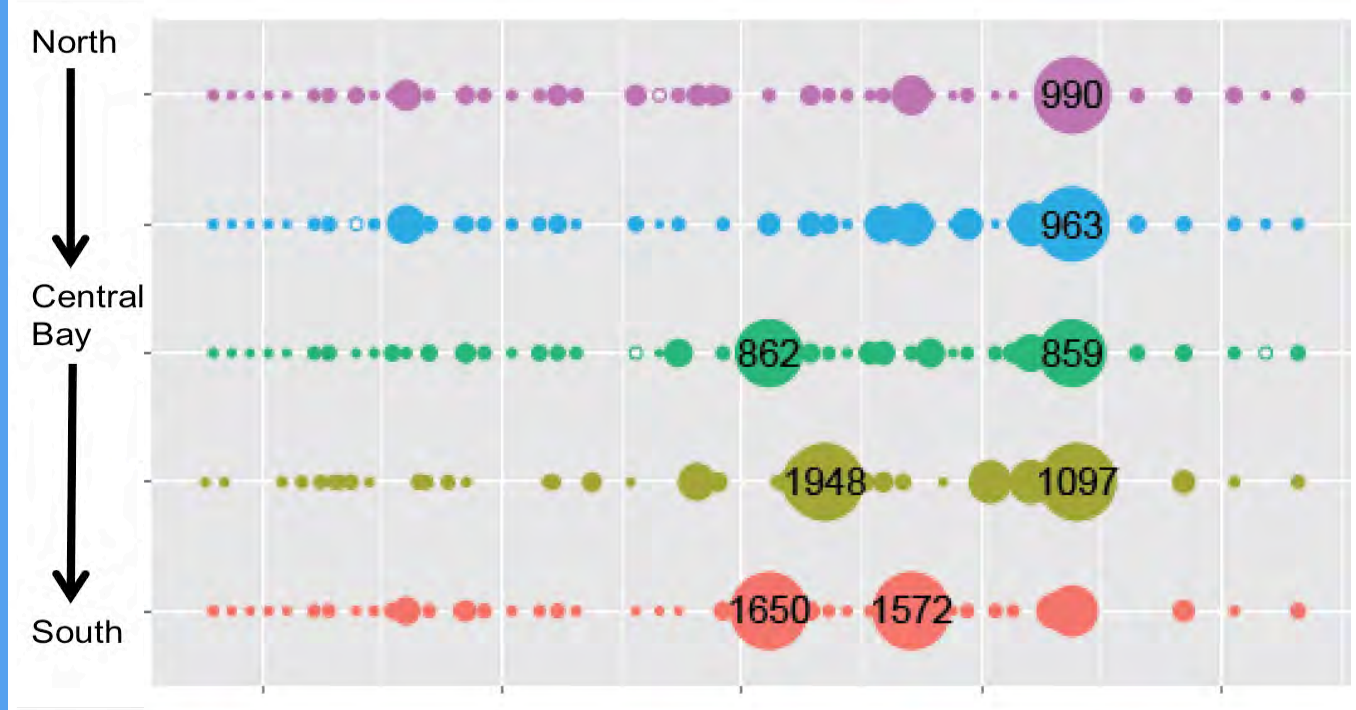
K Borchers / San Jose Mercury News

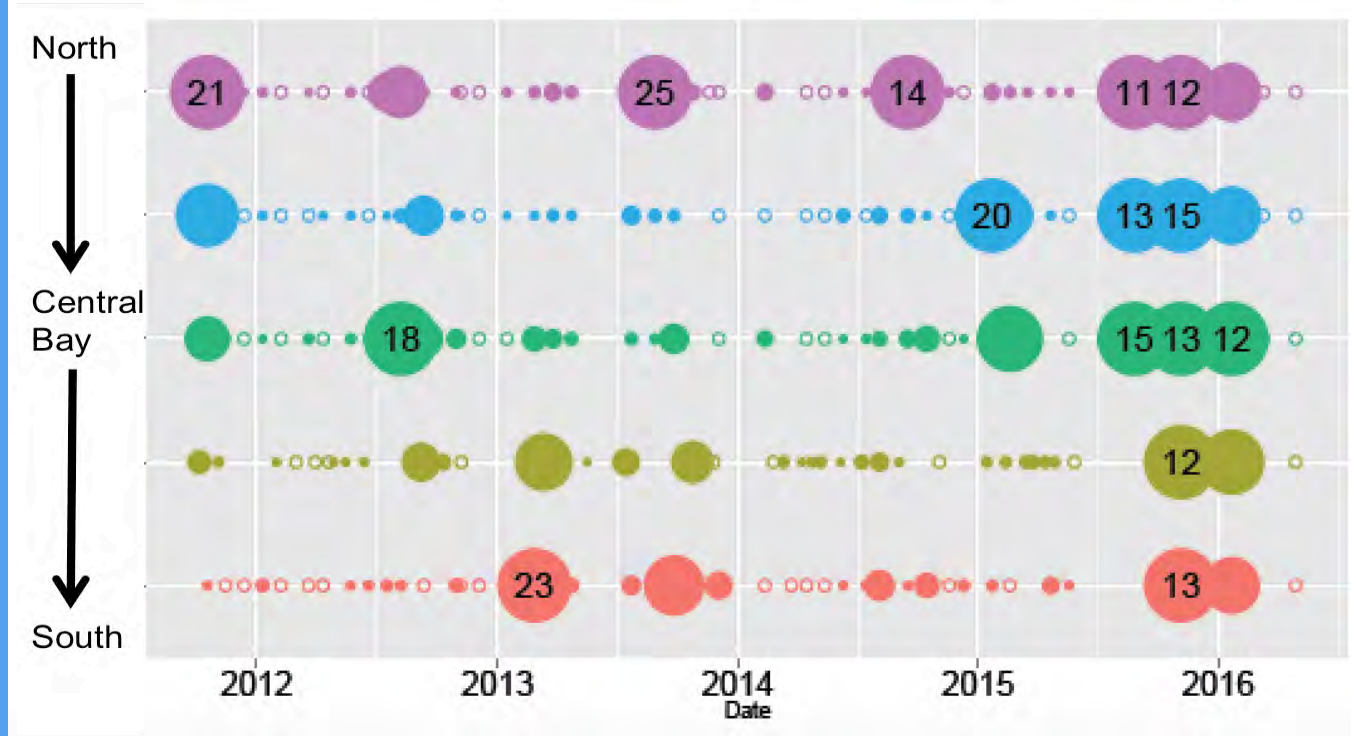
Paralytic Shellfish Toxins

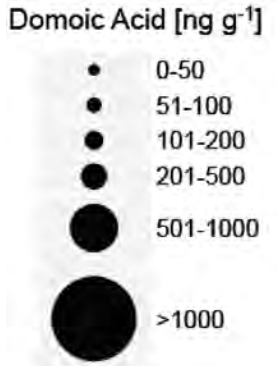
Okadaic Acid and DTX

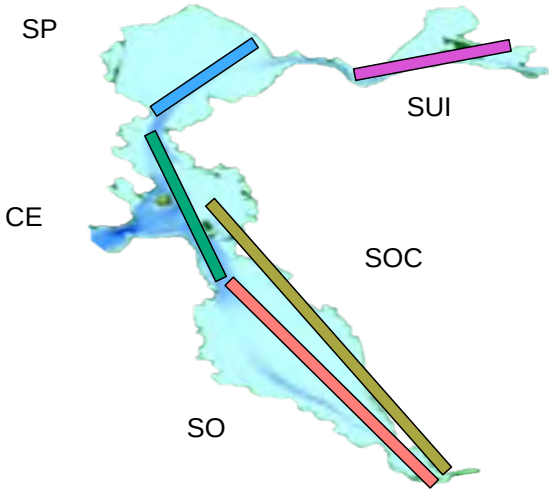


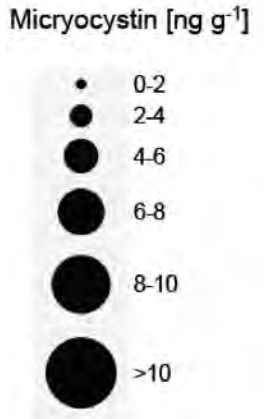
Peacock et al., submitted







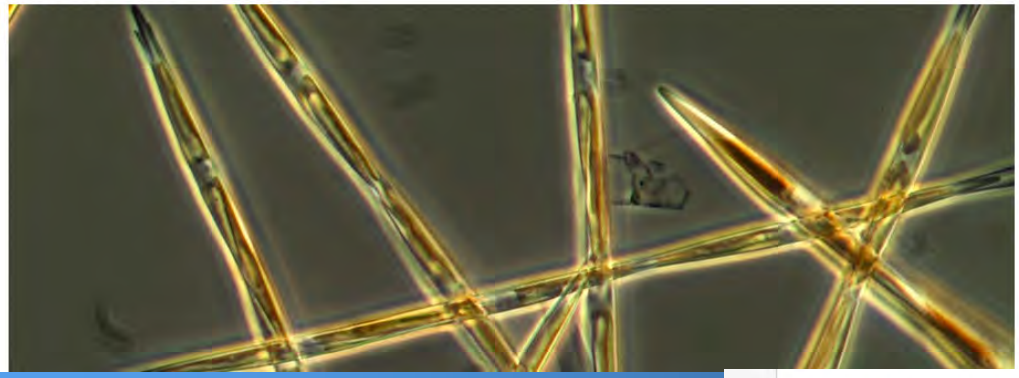




Peacock et al., submitted

Meanwhile in 2015 ….

Toxic algae blooming in 'The Blob' along the West Coast, forcing shutdown of vital fisheries



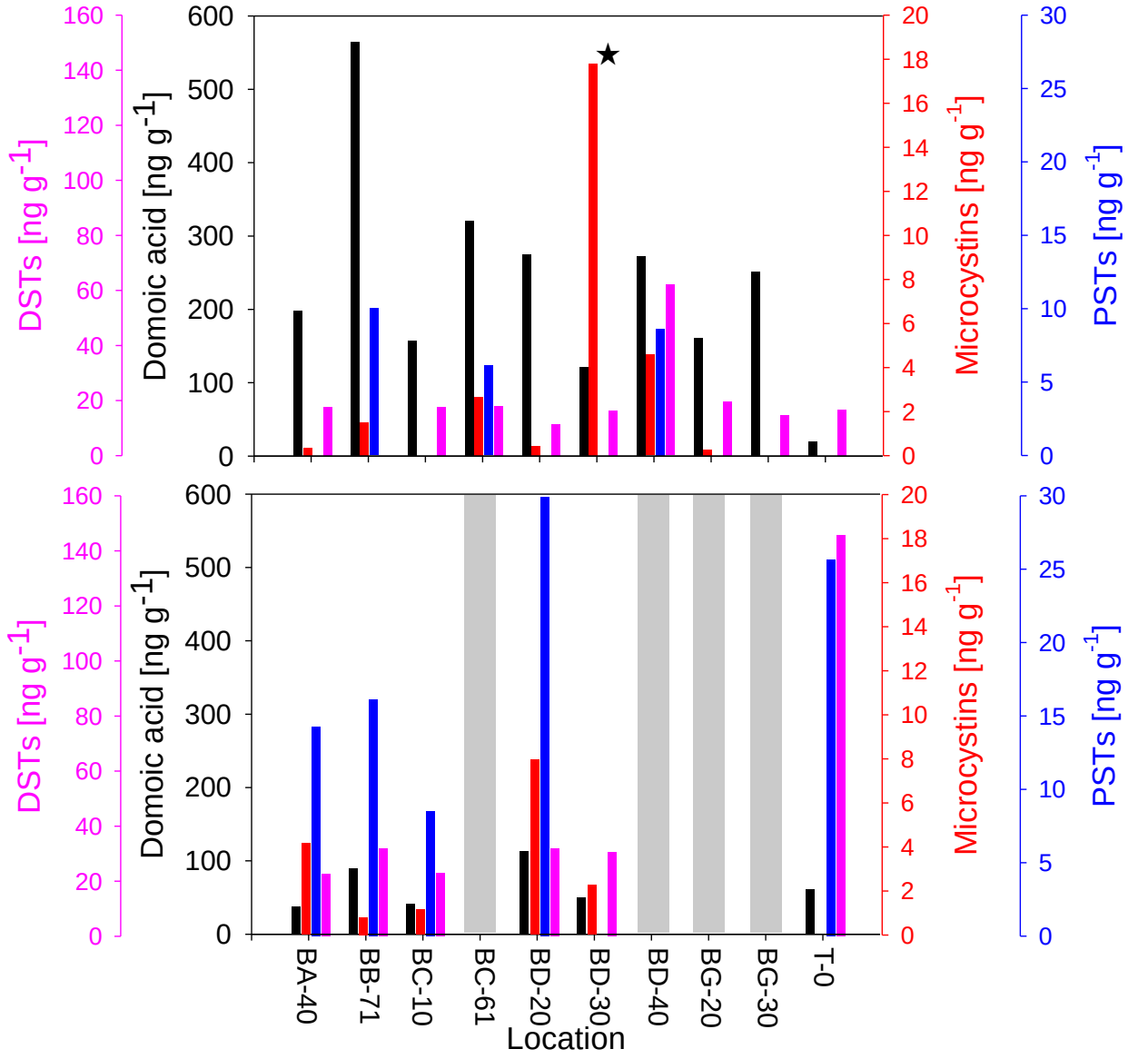
And simultaneously ….

Lake Temescal reopens after toxic scare

Are these toxins accumulating?

- Environmental/placed mussel samples
- June – Sept 2012, 2014
- April – September 2015
- Each mussel tested for Domoic Acid, Microcystin, PST, Okadaic Acid and DTX-2

California Mussel



PSTs = 800 ng g^{-1}

Microcystins = 10 ng g^{-1}

DSTs = 160 ng g^{-1}

Domoic Acid = 20,000 ng g^{-1}

These toxins accumulate in the food web

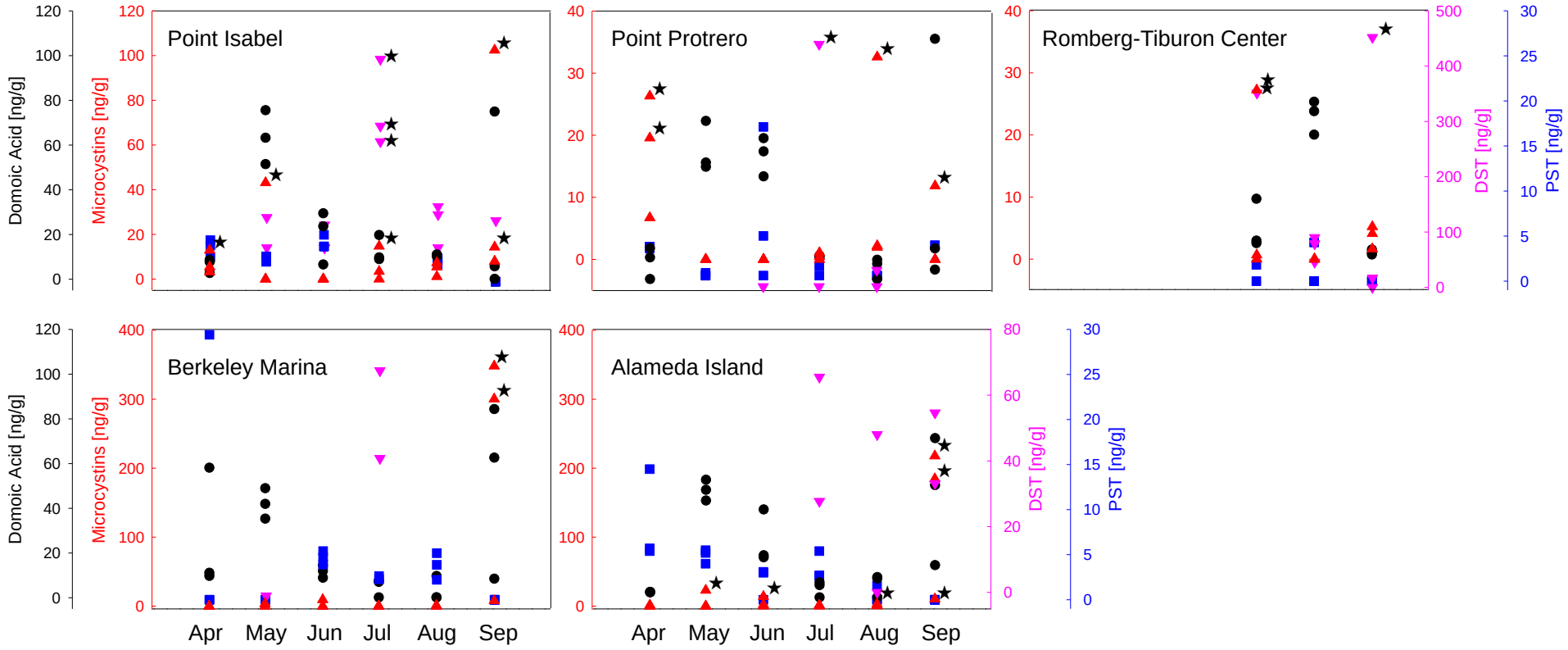
2012, 2014 RMP Caged Mussels (n=20)

Domoic Acid
(100% of mussels contaminated)

Microcystins
(88% of mussels contaminated)

Paralytic Shellfish Toxins
(59% of mussels contaminated)

Okadaic Acid and DTX-2
(94% of mussels contaminated)



PSTs = 800 ng g^{-1}

Microcystins = 10 ng g^{-1}

DSTs = 160 ng g^{-1}

Domoic Acid = 20,000 ng g^{-1}

These toxins accumulate in the food web

Naturally Occurring Mussels

(n=24-81)

Domoic Acid

(~~100%~~ of mussels contaminated)

98%

Microcystins

(~~88%~~ of mussels contaminated)

82%

Paralytic Shellfish Toxins

(~~59%~~ of mussels contaminated)

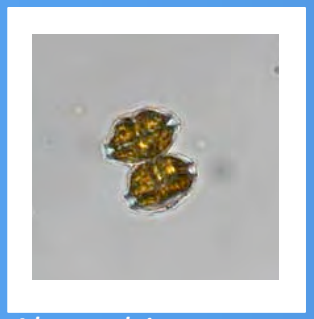
59%

Okadaic Acid and DTX-2

(~~94%~~ of mussels contaminated)

71%

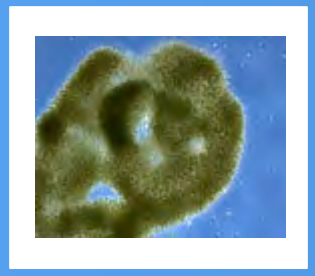
Why should we worry?



Alexandrium spp.

Dinophysis spp.

Pseudo-nitzschia spp.



Microcystis spp.

California mussel

Marine birds

Human consumption

Marine mammals

Why should we worry?

WILD KITCHEN

Foraging Mussels

FEBRUARY 1, 2011

http://www.foragesf.com/blog/wild-kitchen/foraging-mussels

I love collecting mussels. These pics are from a couple weeks ago when me and my girlfriend went down south. Was a lot of fun, mix of work and play. We actually got approached by a fish and game officer, so I was happy that I bought us both fishing licenses. Its worth it if you are going to collect mussels, because the fines are pretty intense. The limit for mussels is 10 lbs a person. Go at low or minus tide. Have fun! Things to bring:








Subsistence Harvesters

Figure 3.6 Origin of Consumed Seafood

Subsistence harvesters are more likely to ingest higher than average amounts of shellfish

Harmful Algae 61 (2017) 31–45

Contents lists available at ScienceDirect

Harmful Algae

journal homepage: www.elsevier.com/locate/hal

Review

A review of microcystin detections in Estuarine and Marine waters: Environmental implications and human health risk

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Environment International 101 (2017) 70–79

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Acute and chronic dietary exposure to domoic acid in recreational harvesters: A survey of shellfish consumption behavior

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Blurred Lines: Multiple Freshwater and Marine Toxins

- Microcystins and Domoic Acid toxins are present *nearly all the time* in the water column For San Francisco Bay
- Microcystins, Domoic Acid, PST, Okadaic Acid or DTX-2 were present in 99% of the shellfish we tested, 37% having all four toxins
- Not just San Francisco Bay! Multiple toxins also detected along the open coast

Even low toxin in the food web should be cause for concern and Microcystin, Okadaic Acid and DTX are alarming