Does San Francisco Bay have a Harmful Algal Bloom problem?

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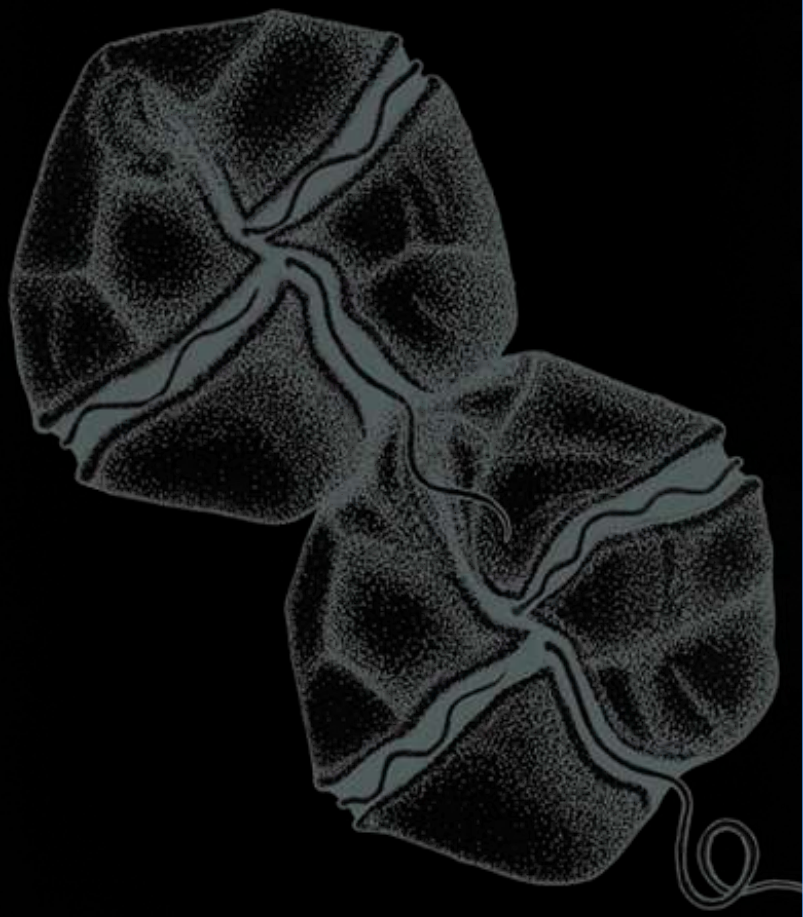
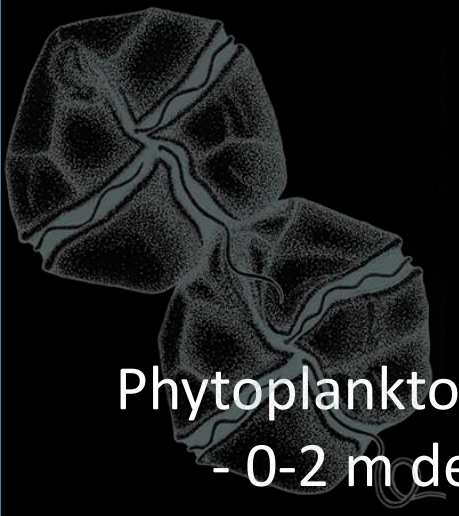




DATA SOURCES

Phytoplankton species counts from USGS data from 1993-2013
- 0-2 m depth, chlorophyll > ~5 µg/L
- Biased low for *Microcystis*

SPATT (toxin) data from 2011-2014
- Underway flow-through on USGS cruises (surface)
- Domoic Acid and Microcystins
- 2011-2014

NEW! RMP Bivalve Samples
- Preliminary data from 2012 presented today
- 2014 samples to be analyzed
- ~300 filters from USGS cruises

USGS Data Summary, 1992-2013

16,428 Unique counts for phytoplankton taxonomy

817 Stations with HABs present

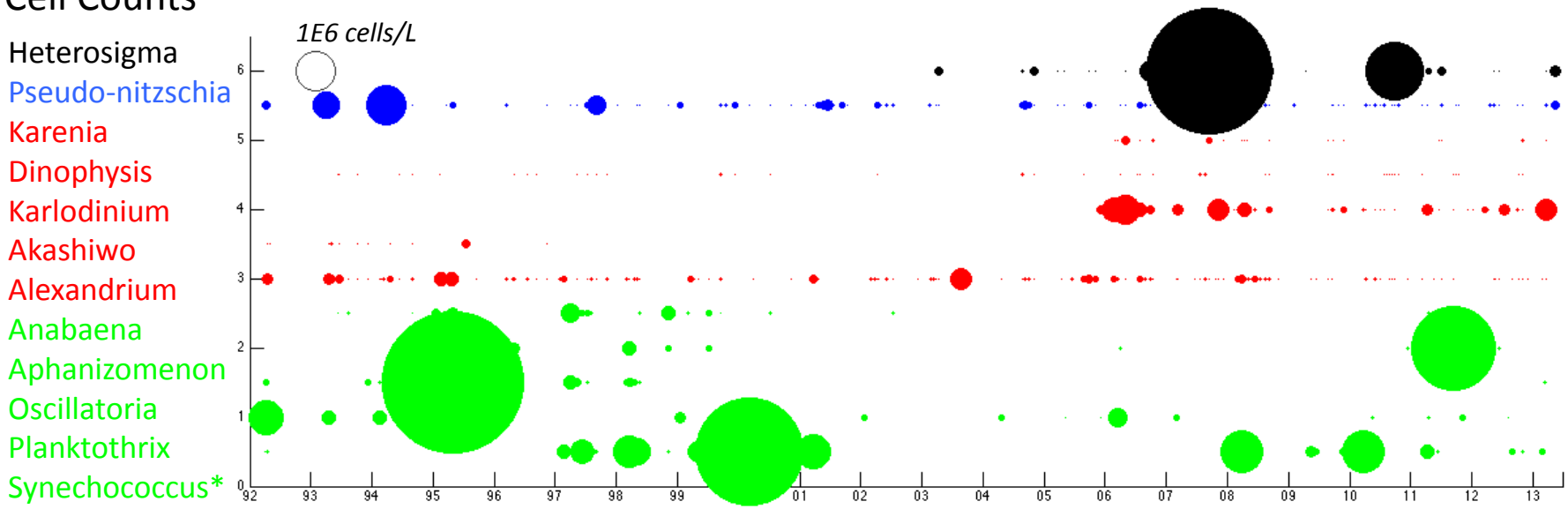
34% Historical Average Percent Stations with HABs Above a Defined Threshold

Presence of HAB species defined as cell counts at a given station above defined thresholds from other monitoring programs; it does NOT include stations where HAB species are present, but below the thresholds.

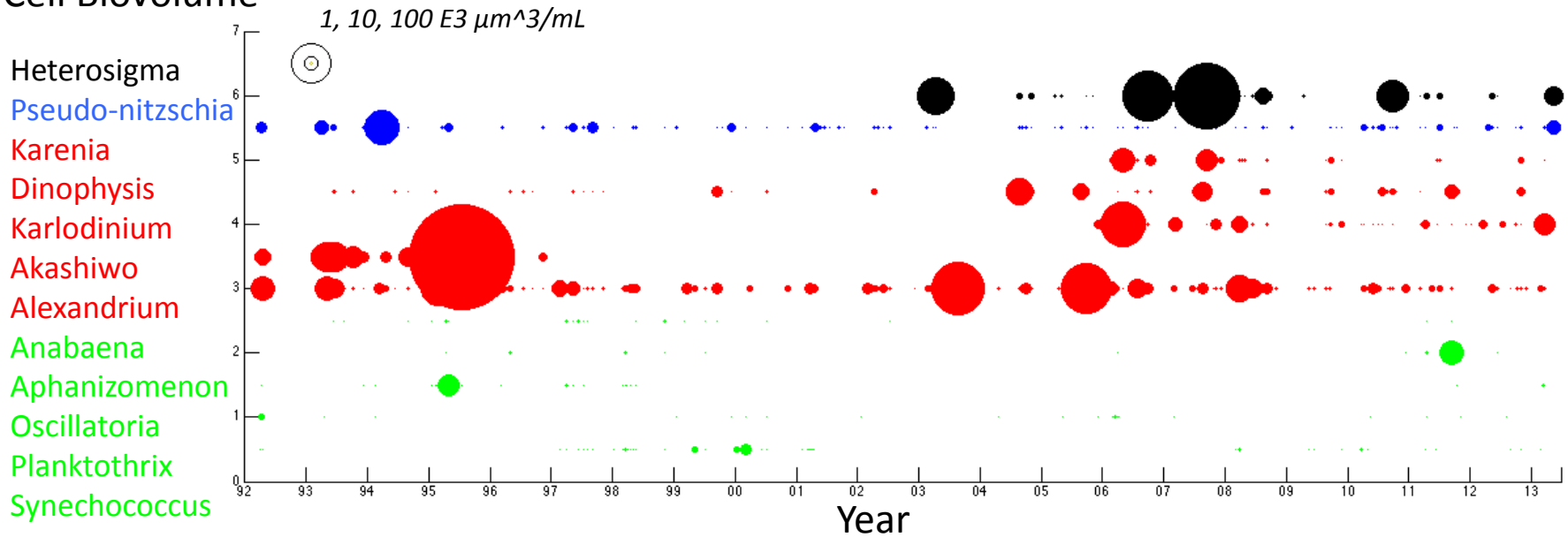
EXAMPLE: Dinophysis threshold is 100 cells/L based on Scotland National Shellfish Monitoring Program

Potentially Harmful Species Cell Counts and Biovolume

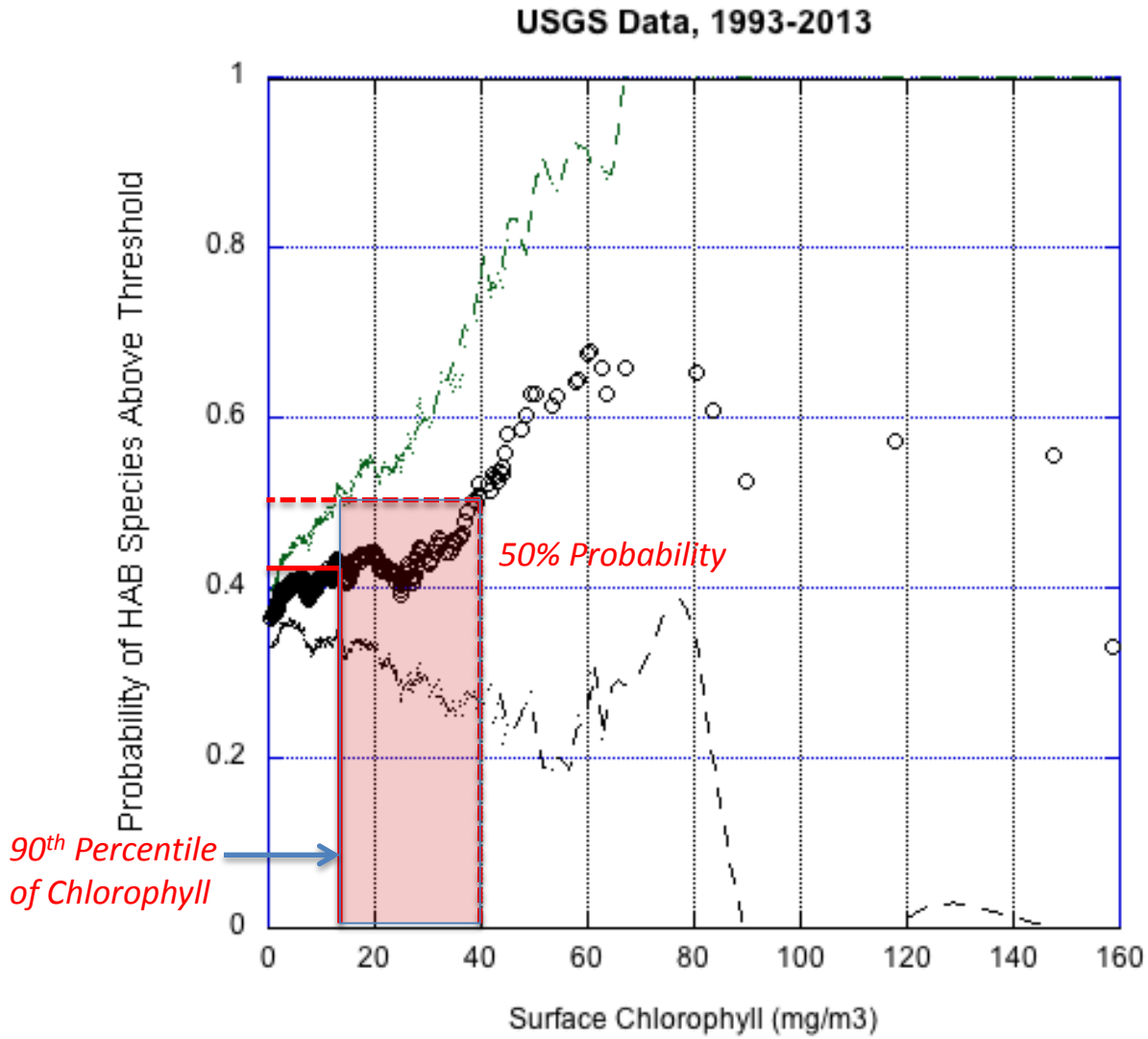
Cell Counts



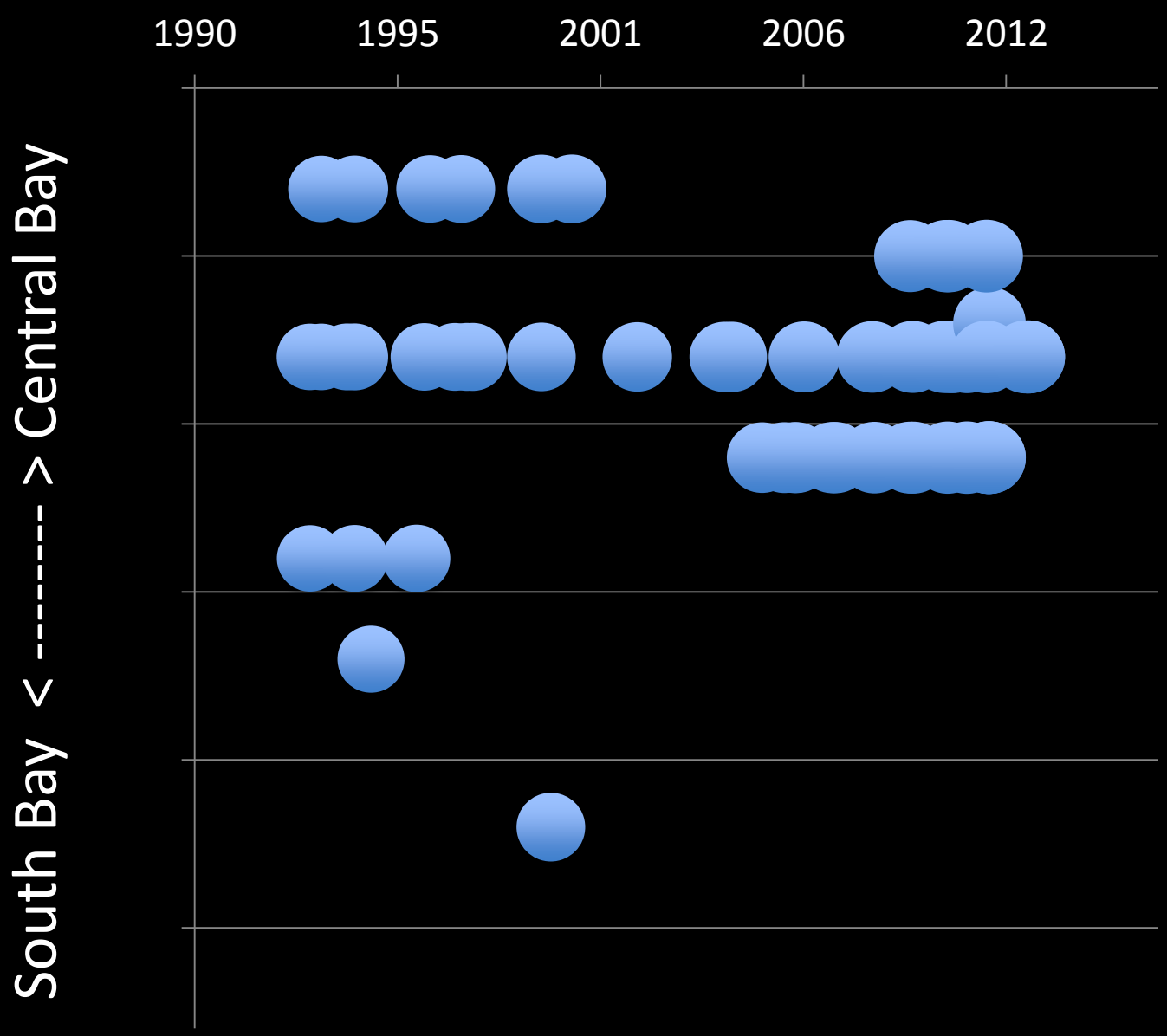
Cell Biovolume



Probability of HAB Species Above Threshold (i.e. of Concern)

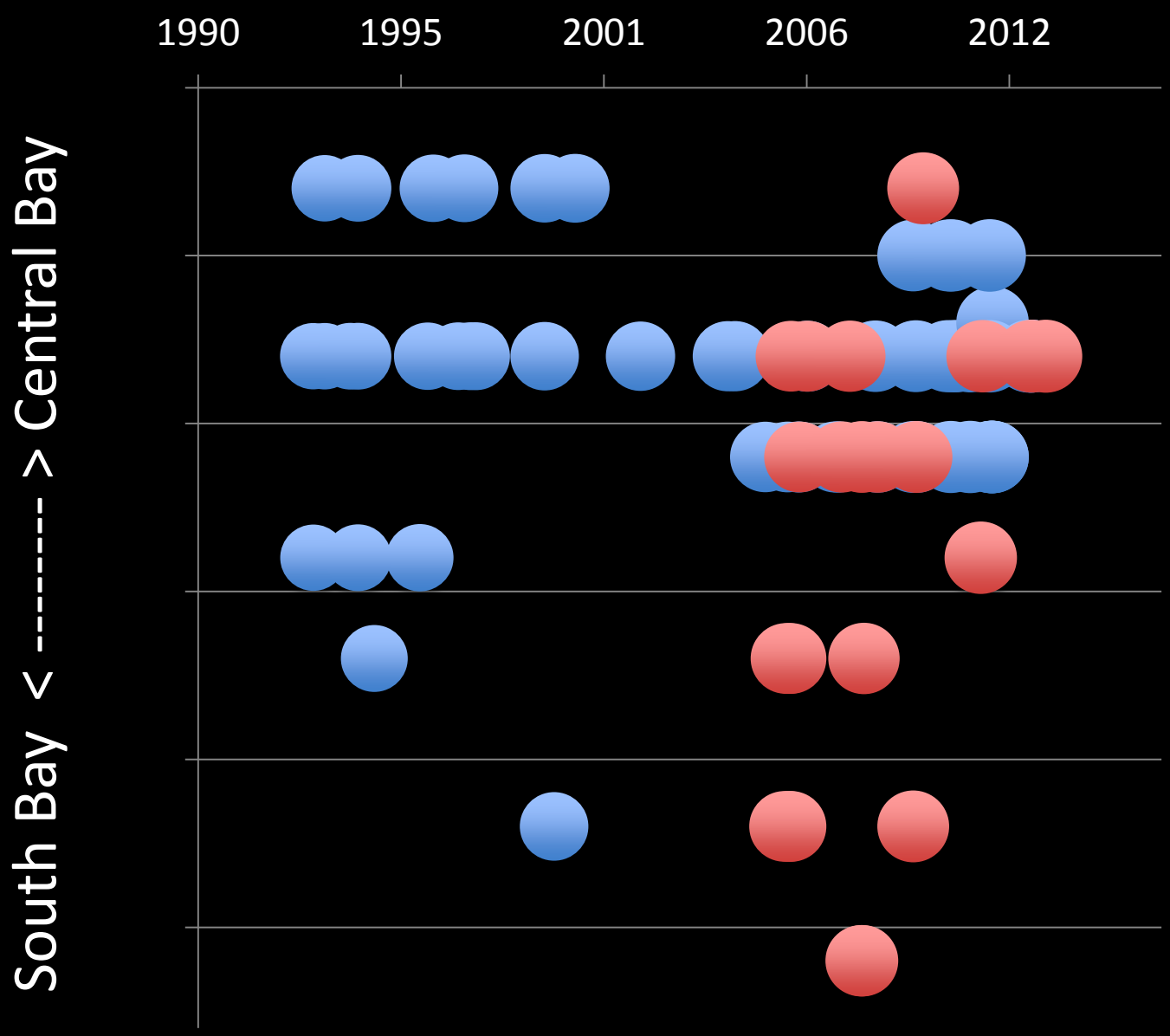


South Bay– An Area of Emerging Concern



Dinophysis

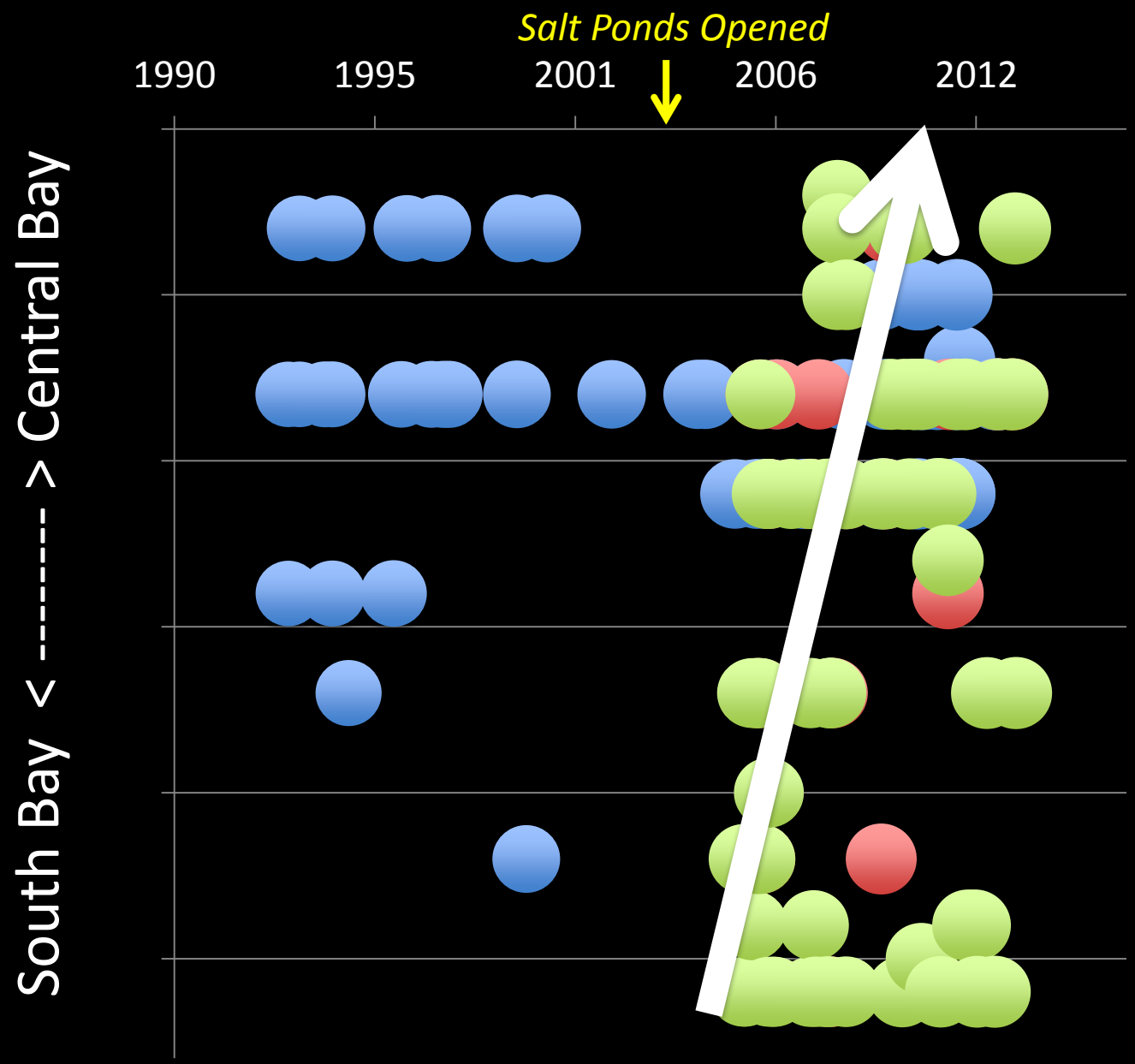
South Bay– An Area of Emerging Concern



Dinophysis

Karenia

South Bay– An Area of Emerging Concern



Dinophysis
Karenia
Karlo

Solid Phase Adsorption Toxin Tracking

"A simple and sensitive *in situ* (monitoring) method… involves the passive adsorption of biotoxins onto porous synthetic resin filled sachets (SPATT bags) and their subsequent extraction and analysis."

MacKenzie et al. (2004) Toxicon

K Borchers / San Jose Mercury News

M Roddam / UCSC

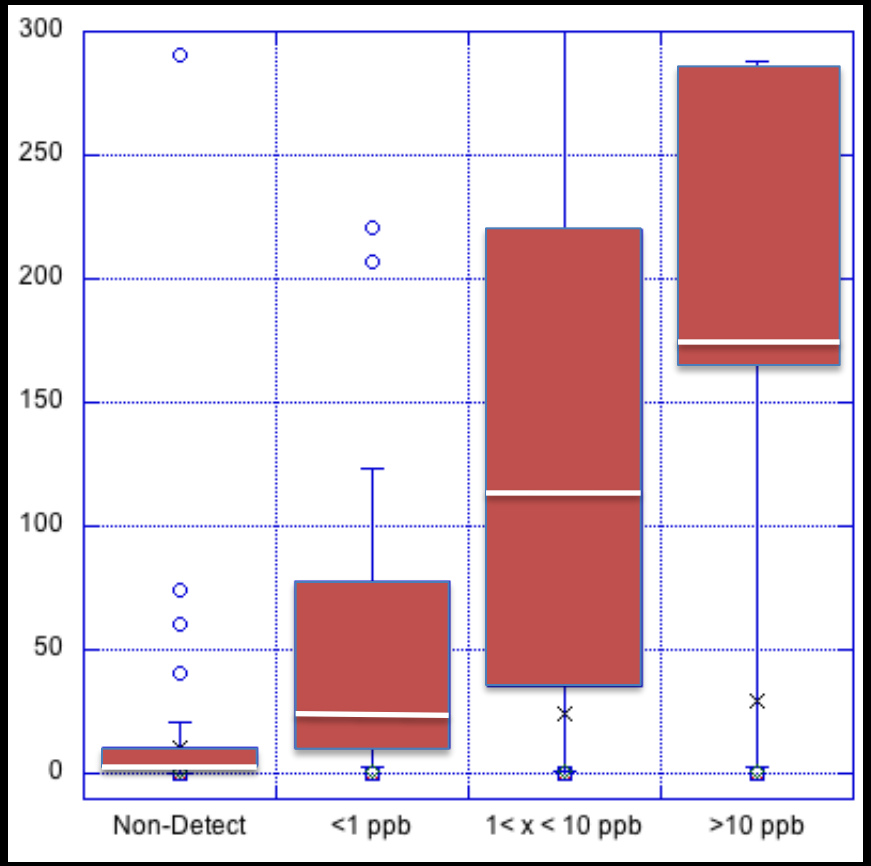
M Roddam / UCSC

SPATT: an “Artificial Mussel”

Values are reported as mass toxin per gram resin, for some period of time. Difficult to directly compare to regulatory limits, which are typically based on grab samples or contamination of food products.

Microcystin Grab Sample (ppb)	SPATT (ng/g)
Non-Detect	5-13
< 1 ppb	10-50
1< x < 10 ppb	50-200
> 10 ppb	175-275

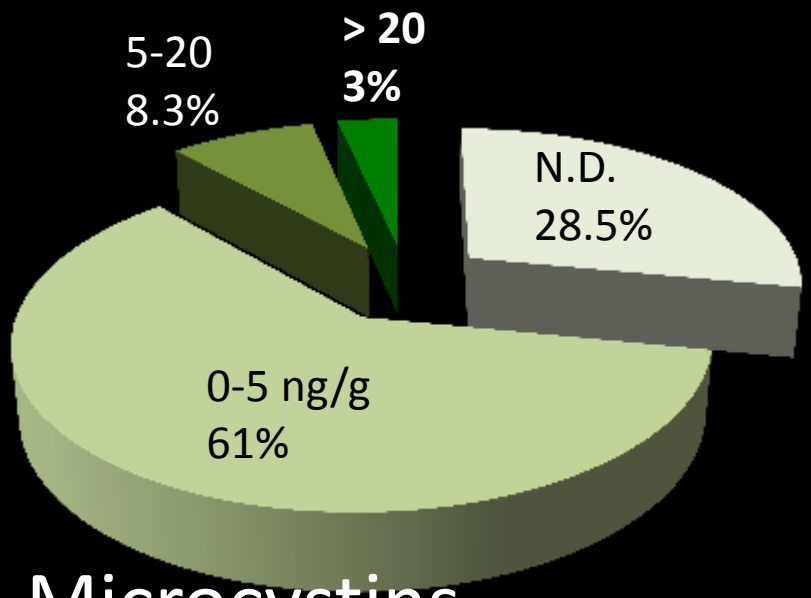
Domoic Acid Mussel (ppm)	SPATT (ng/g)
0-5 ppm	0-30
5-10 ppm	30-50
10-20 ppm	50-75
>20 ppm	>150



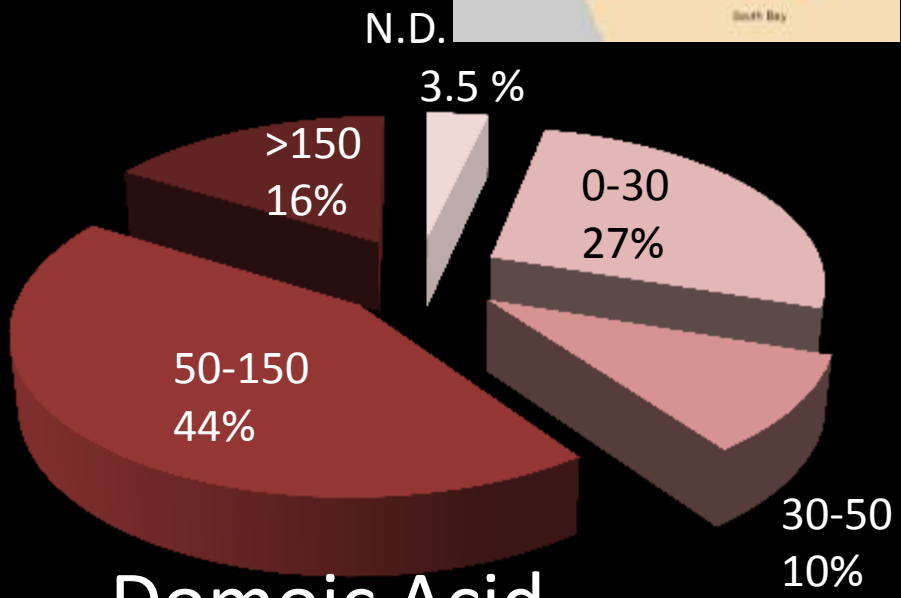
2011-2014: USGS Deployment of SPATT

October 2011 – July 2014

- 25 Full-Bay cruises
- 28 South Bay cruises

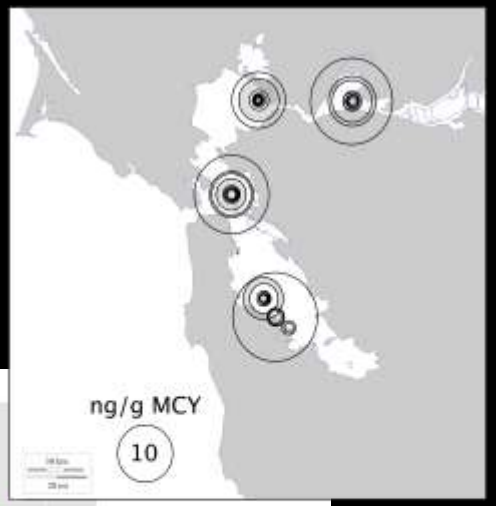


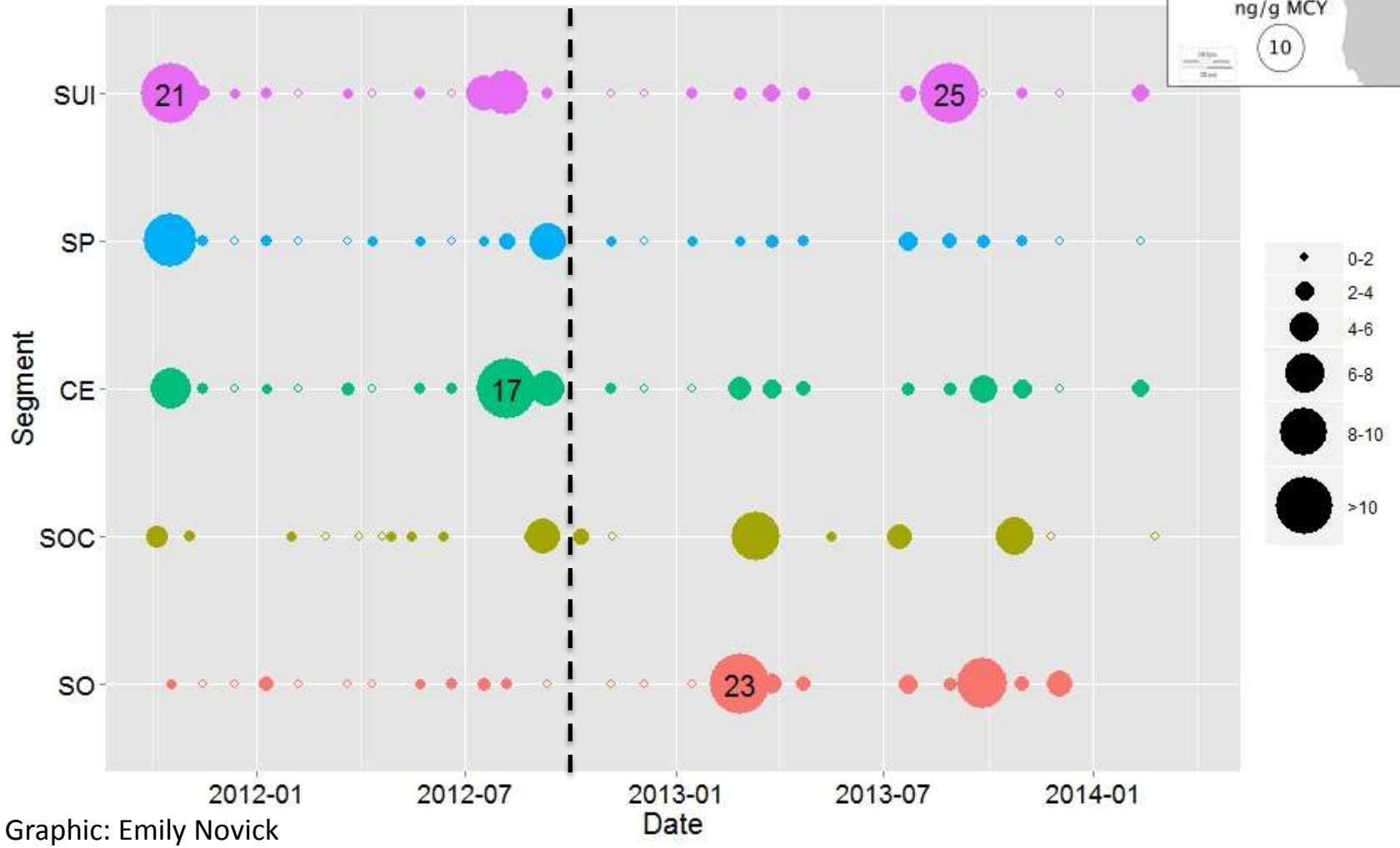
Microcystins
(>20 is "high")



Domoic Acid
(>100 is "high")

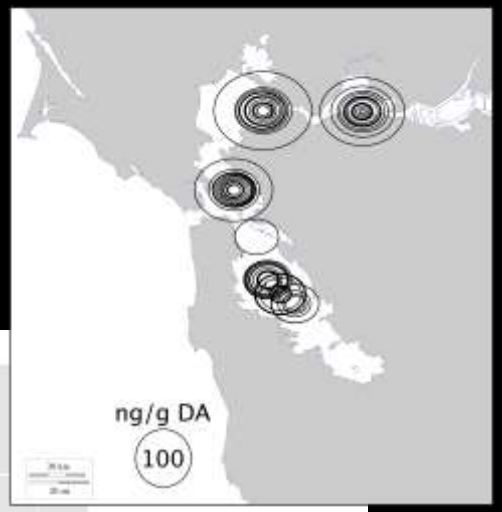
SPATT Microcystins
Less Than 20 is low risk

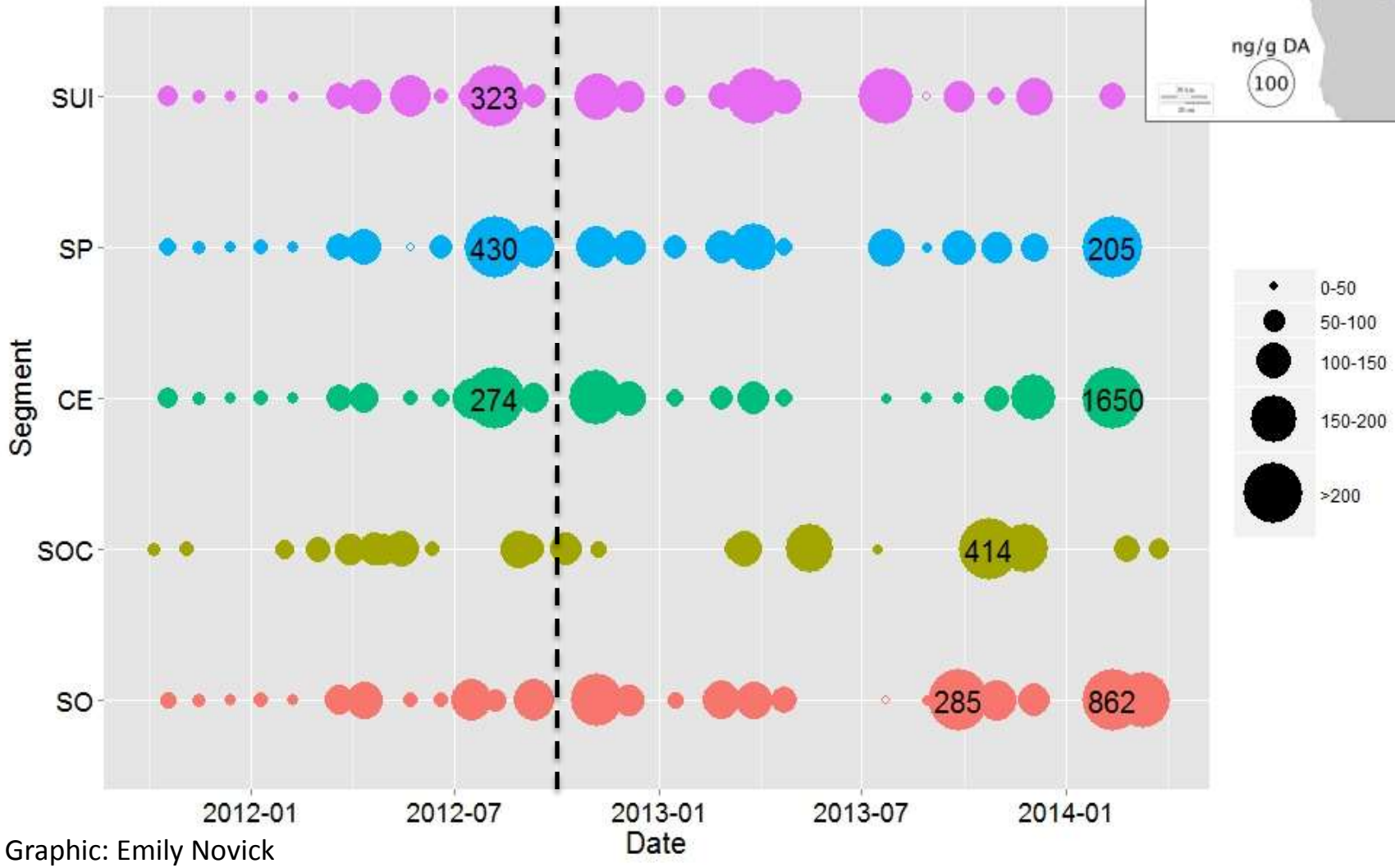




Graphic: Emily Novick

SPATT Domoic Acid
Less Than 100 is low risk

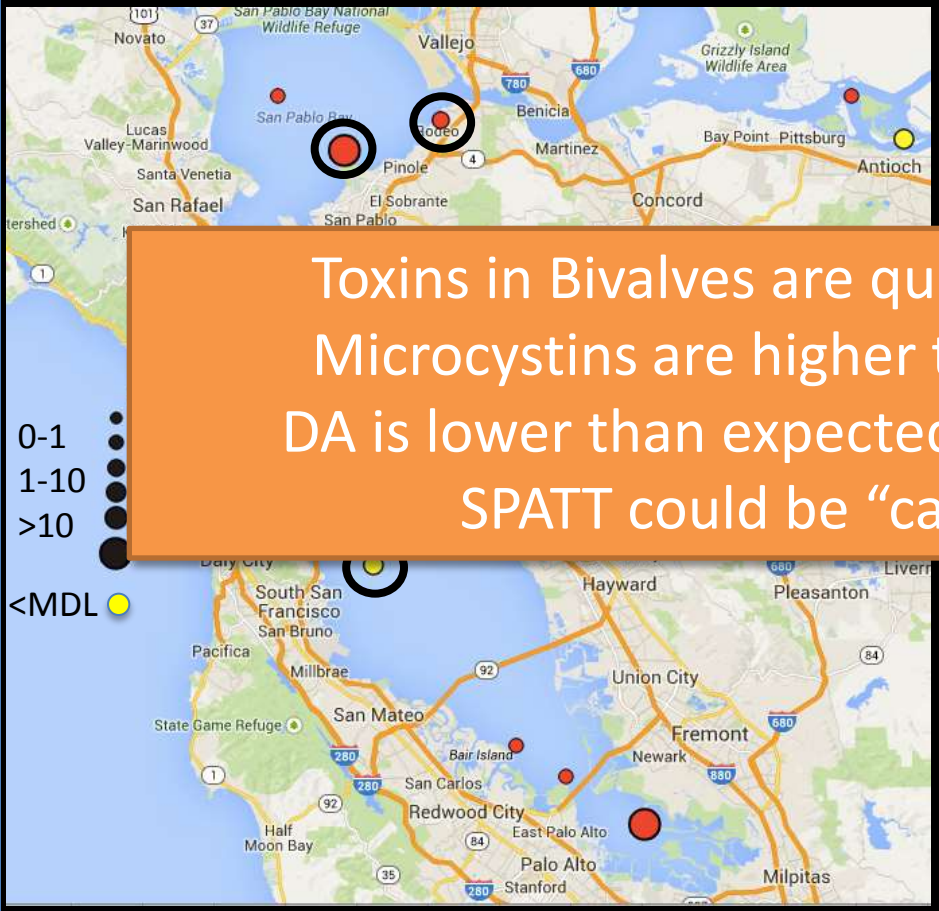




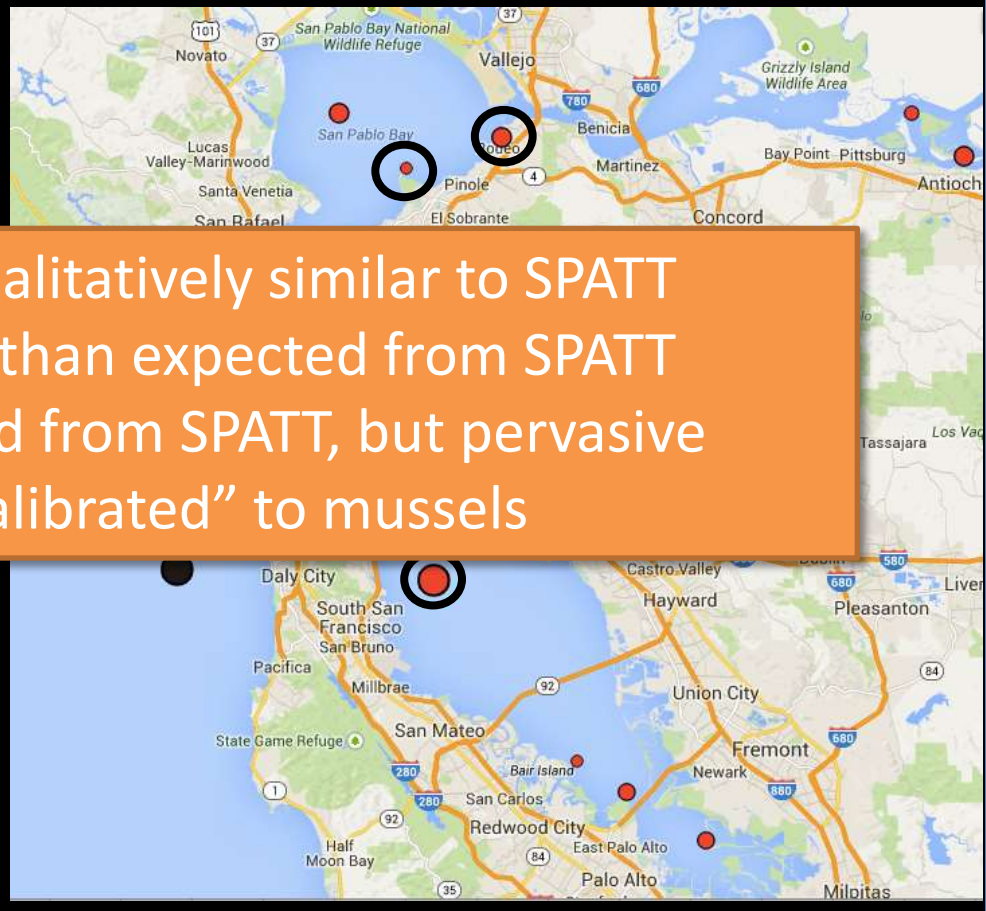
Graphic: Emily Novick

If SPATT is an Artificial Mussel, How Does it Compare To… A Mussel?

RMP 2012 Bivalve Samples, Analyzed by LC/MS



Toxins in Bivalves are qualitatively similar to SPATT
Microcystins are higher than expected from SPATT
DA is lower than expected from SPATT, but pervasive
SPATT could be "calibrated" to mussels



Microcystins, 0-18 ppb

Domoic Acid, 0.12-1 ppm

First-Order Question: Does San Francisco Have a HAB Problem?

- HAB organisms are present ~35% of the time, may be "exported" from South San Francisco Bay

- Chlorophyll values exceeding ~13-25 µg / L are reason for concern

- Microcystins and Domoic Acid are present *nearly all the time*
  - We **DO NOT KNOW** what chronic exposure means for water quality
  - We **DO NOT KNOW** if trophic transfer is significant
  - We **DO KNOW** that toxins can exceed levels of concern/action
  - We **DO KNOW** that toxins are present in bivalves (…and the food web)

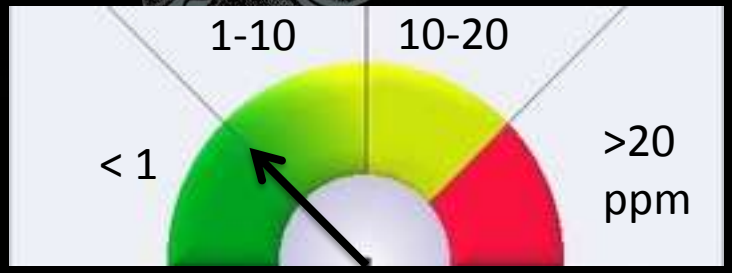
- **Are HABs of concern in San Francisco Bay?**

  Yes—but we can't say yet how concerned we should be….

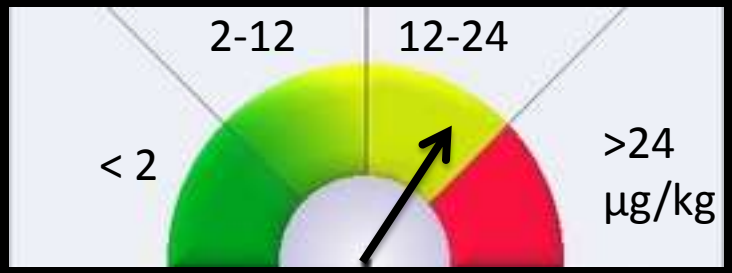
- **Ongoing efforts as part of RMP, SFEI, USGS will answer some questions, including optimal monitoring and trophic transfer**

First-Order Question: Does San Francisco Have a HAB Problem?

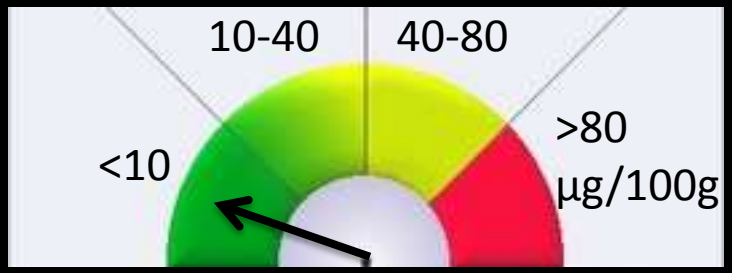
25% of sites have all three toxins



Domoic Acid
(100% of mussels contaminated)



Microcystins
(82% of mussels contaminated)



Paralytic Shellfish Toxins
(25% of mussels contaminated)

Thank You!

Collaborators:

Jim Cloern, USGS
California Harmful Algal Bloom Monitoring and Alert Program
Central and Northern California Ocean Observing System
RMP Program (special thanks to Meg Sedlak)

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US Geological Survey
California Sea Grant/Ocean Protection Council
Environmental Protection Agency

More Information:

http://www.habmap.info
http://oceandatacenter.ucsc.edu
http://www.cencoos.org