Does San Francisco Bay have a toxic algae problem?

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David Senn, SFEI

Jim Cloern, USGS

Bay-Delta Conference 2016

San Francisco Bay

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

Cloern and Jassby, 2012

Four Toxic Species of Concern

Blue-
Green
Algae

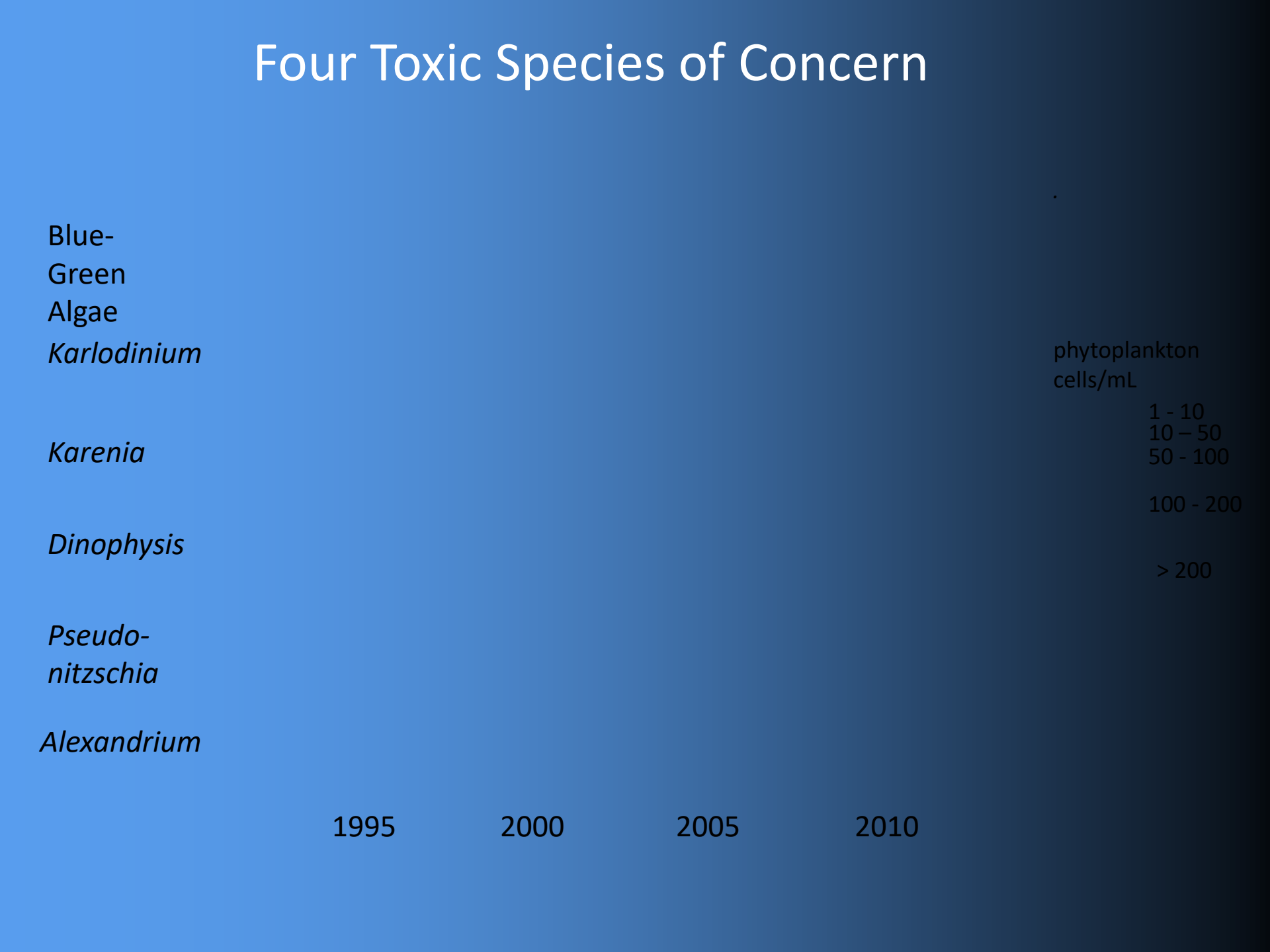
Karlodinium

Karenia

Dinophysis

*Pseudo-
nitzschia*

Alexandrium



Not new to San Francisco Bay!

San Francisco Examiner
Monarch of the Dailies
SAN FRANCISCO, JULY 16, 1927

MUSSELS KILL MAN, INFANT, MAKE FIVE ILL

Two Families Stricken After Eating Meal of Shellfish Gathered Near Half Moon Bay

Most Favored of Fete

SUNSET BORE TROLLEY LINE FUND URGED

$116,000 for Track and Power Supply Recommended by Supervisors' Finance Body

Ye Town Gossip

MISS ELITA PARRAGA, San Francisco-educated Guatemalan maid, who has returned here after being elected queen of beauty at recent Guatemala celebration.

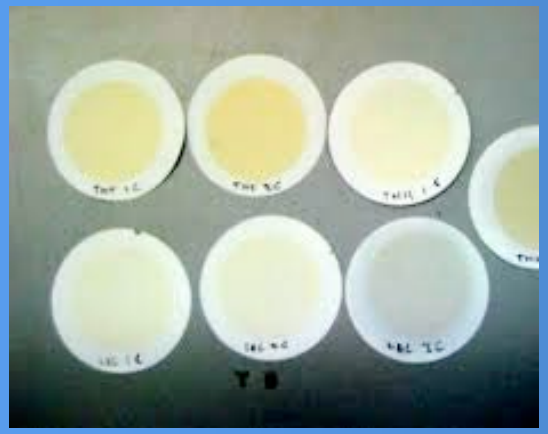
LATIN BEAUTY QUEEN ARRIVES

Missing Mate Sought by Wife

- From 1992 – 2016: 876 stations from USGS cruises had harmful algae present
- Historical average: 34% of stations have harmful algae above a 'threshold'
- This does NOT include stations where harmful algae were present, but not above recognized monitoring threshold

So, there are harmful algae, what about toxins?

Particulate Toxin



Domoic Acid

Microcystin

Dissolved Toxin

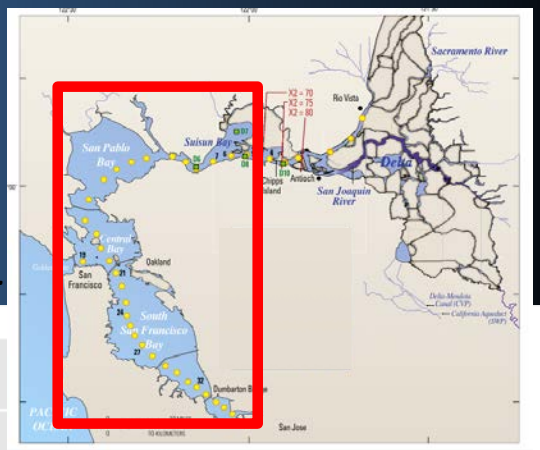
K Borchers / San Jose Mercury News

Paralytic Shellfish Toxins

Okadaic Acid and DTX

Particulate Domoic Acid

Pseudo-nitzschia spp.



North

Central Bay

South

88

316211

69

159

84

90

2013

2014

2015

2016

Date

Domoic Acid [ng/L]

0-5

5-25

25-100

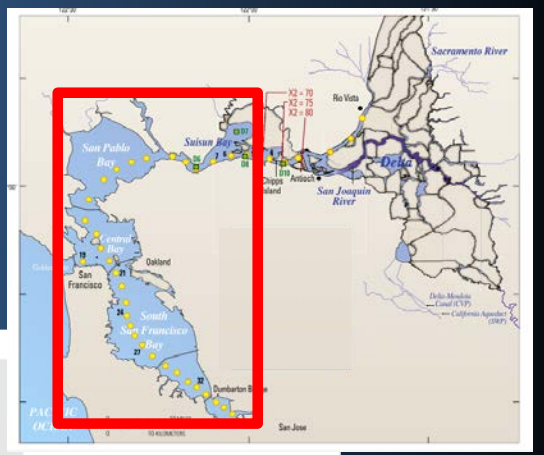
100-200

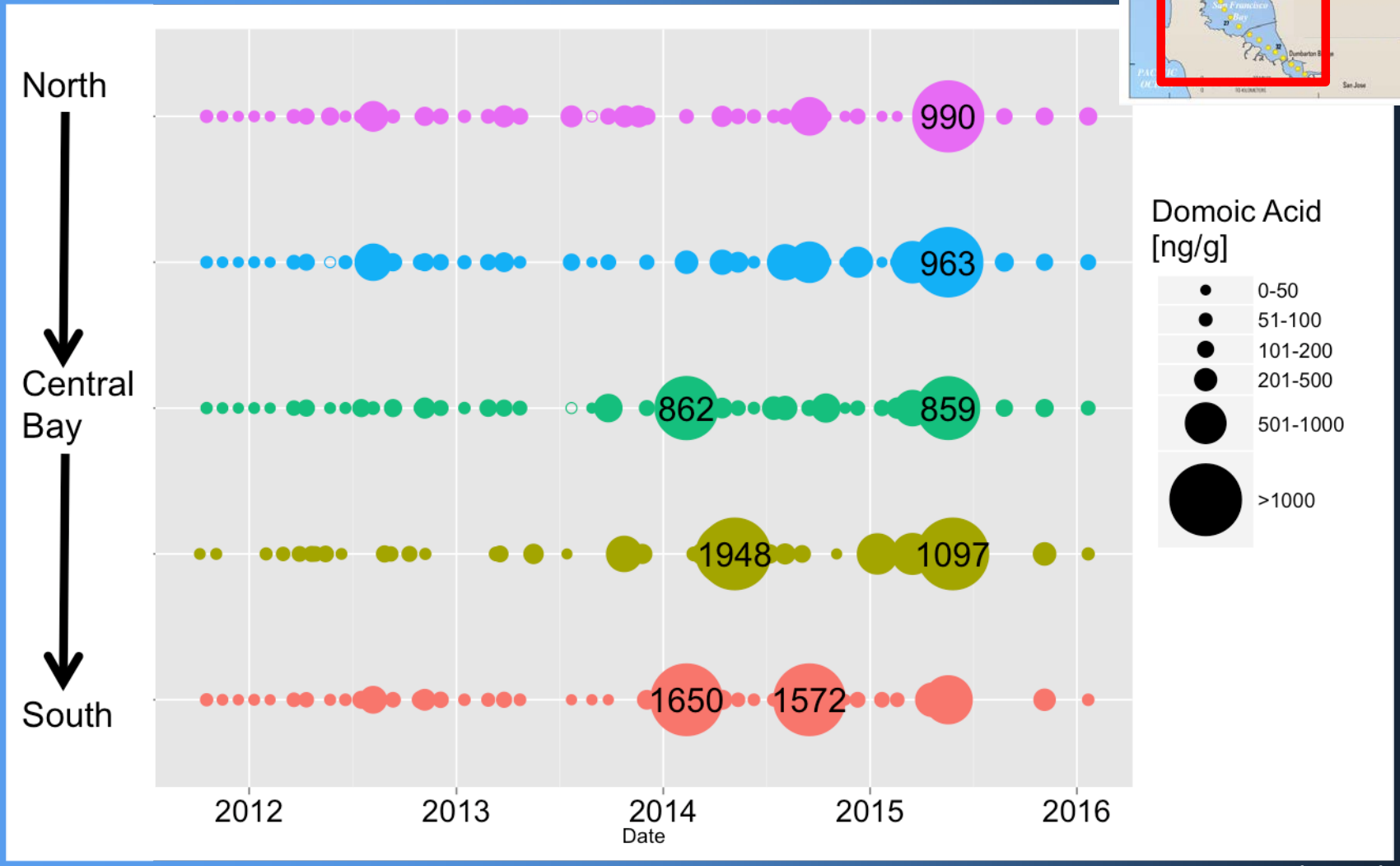
200-400

Peacock et al. in prep

Dissolved Domoic Acid

Pseudo-nitzschia spp.

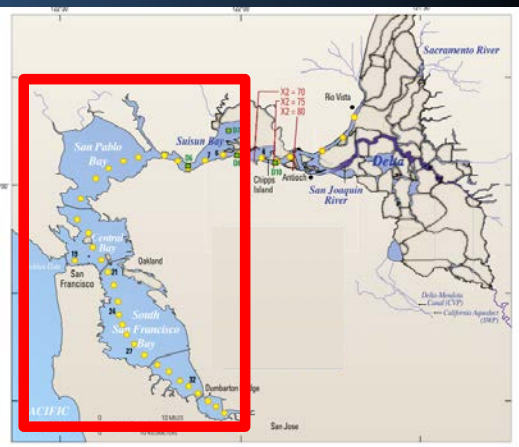




Peacock et al. in prep

Particulate Microcystin

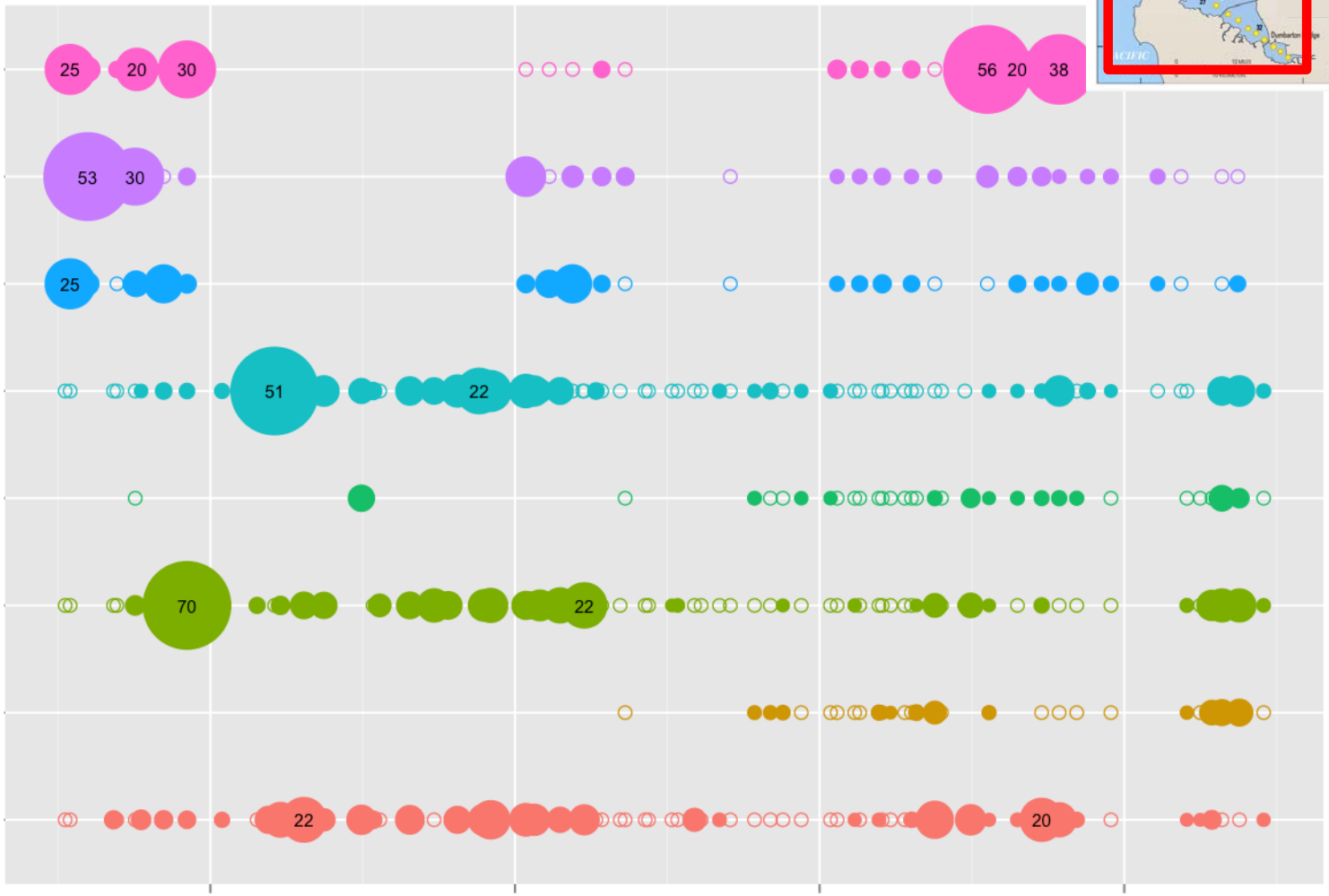
Microcystis spp.



North

Central Bay

South



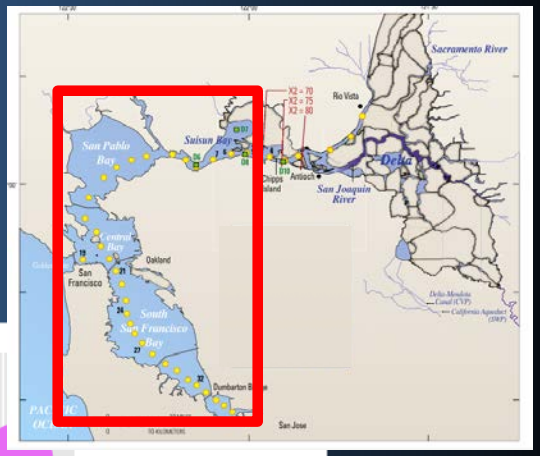
Microcystin [ng/L]

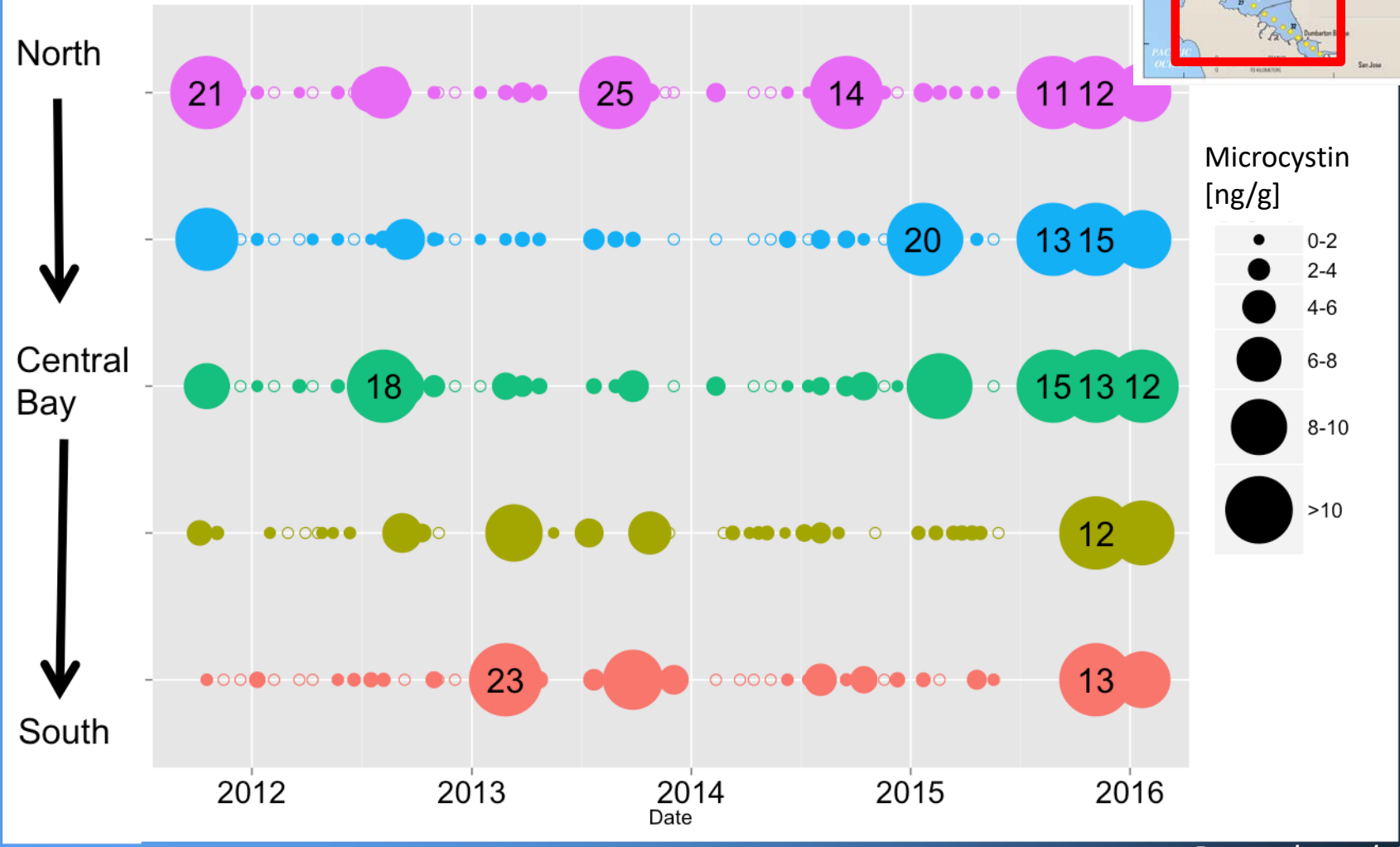
- 0-5
- 5-10
- 10-15
- 15-20
- 20-30
- >30

Peacock et al. in prep

Dissolved Microcystin

Microcystis spp.



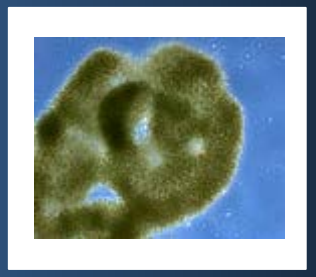


Peacock et al. in prep

What do cell counts, grab, and SPATT samples tell us?

- Harmful algae organisms are present ~35% of the time, both marine and freshwater organisms
- Microcystin and Domoic Acid toxins are present *nearly all the time!*
- Both are ubiquitous throughout the Bay

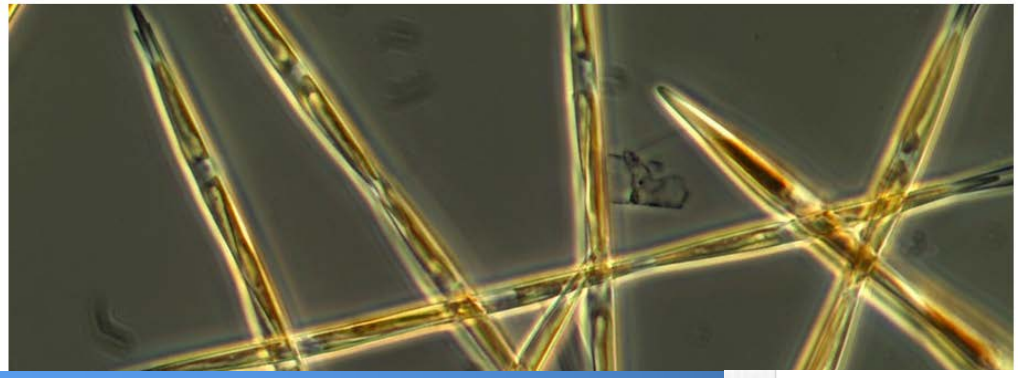
Pseudo-nitzschia spp.



Microcystis spp.

Meanwhile in 2015 ….

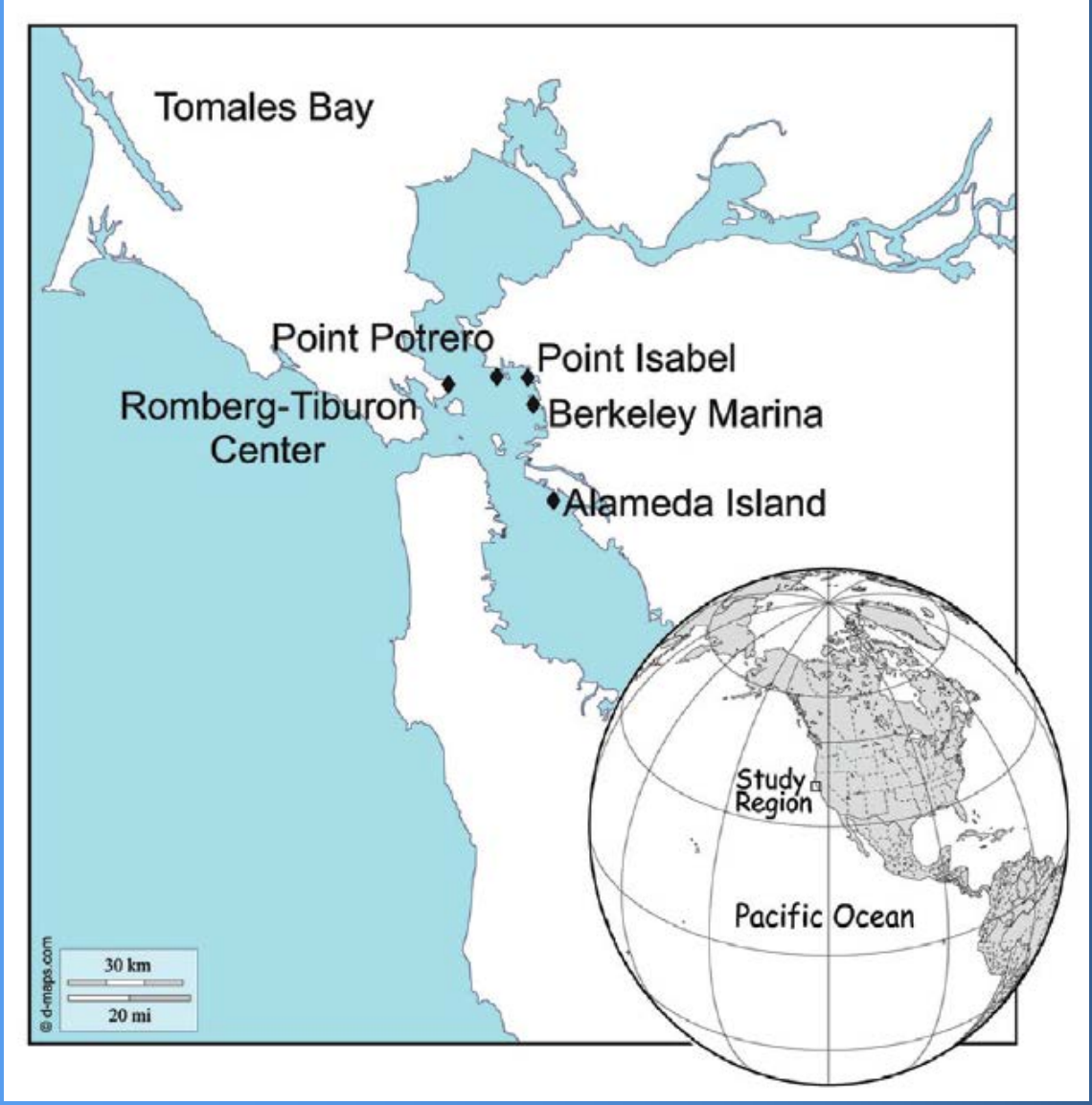
Toxic algae blooming in 'The Blob' along the West Coast, forcing shutdown of vital fisheries



And simultaneously ….

Lake Temescal reopens after toxic scare

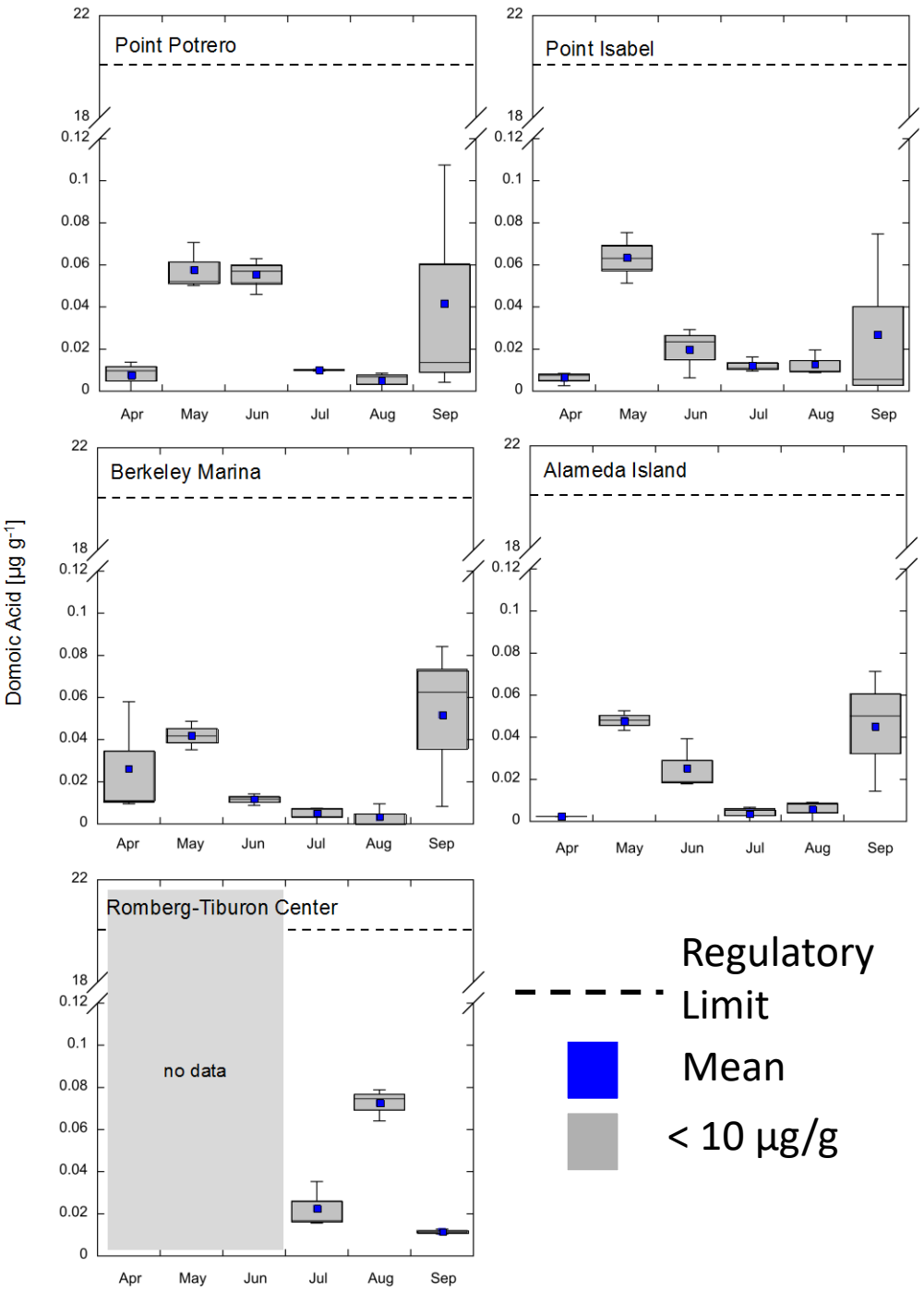
Mussel Collection

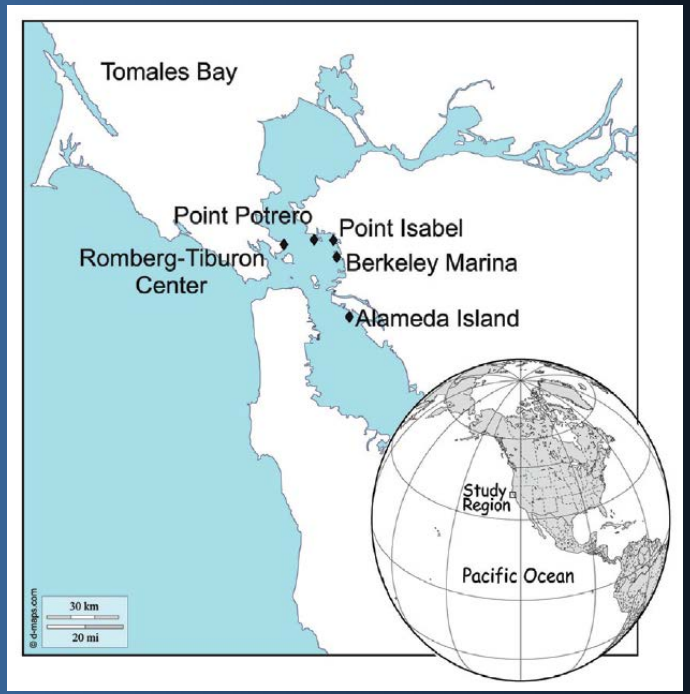


- Environmental mussel samples
- 5 locations, 1x per month
- April – September 2015
- Each mussel tested for Domoic Acid, Microcystin, PST, Okadaic Acid and DTX-2

California Mussel

Domoic Acid in Mussels

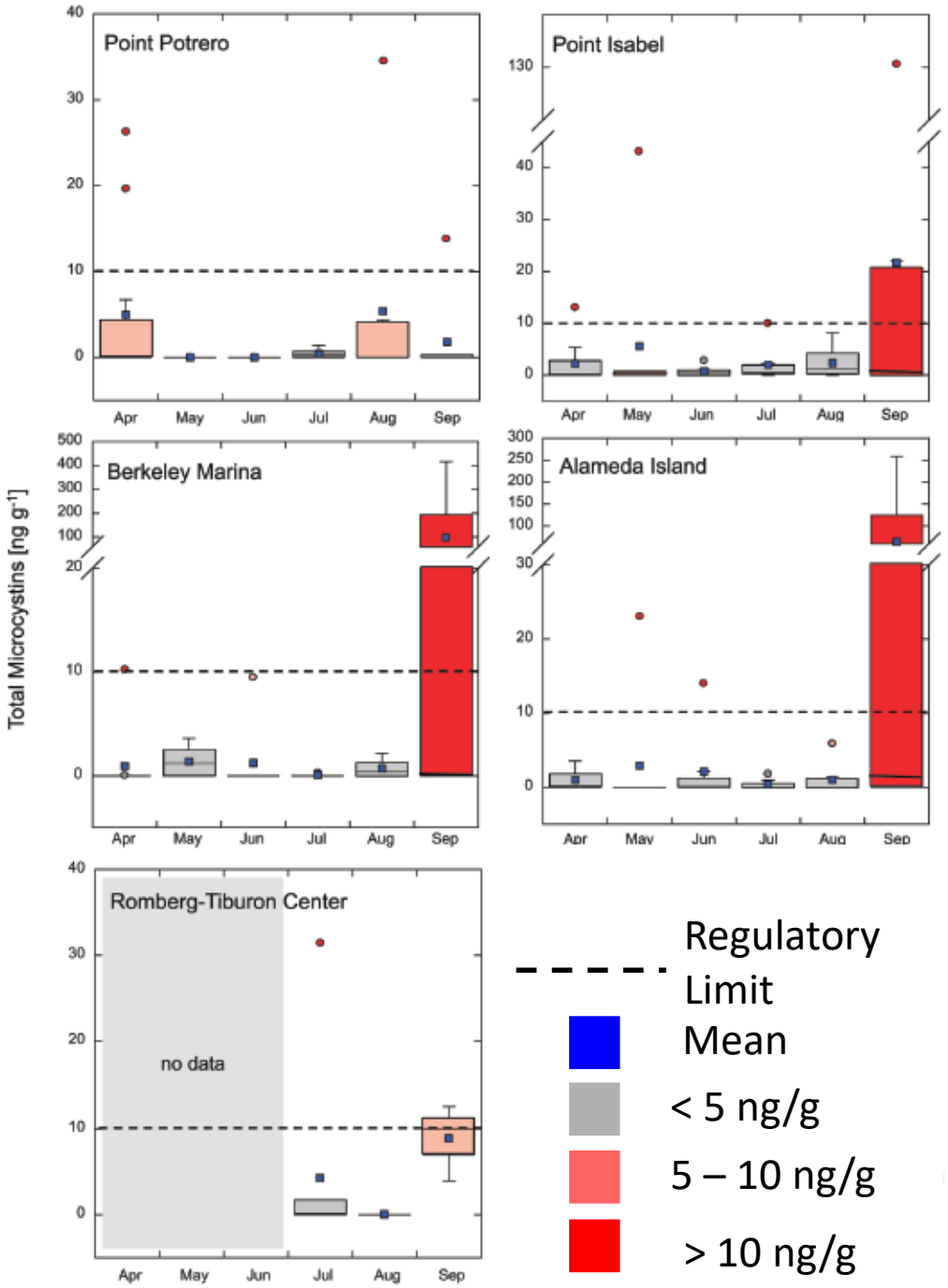


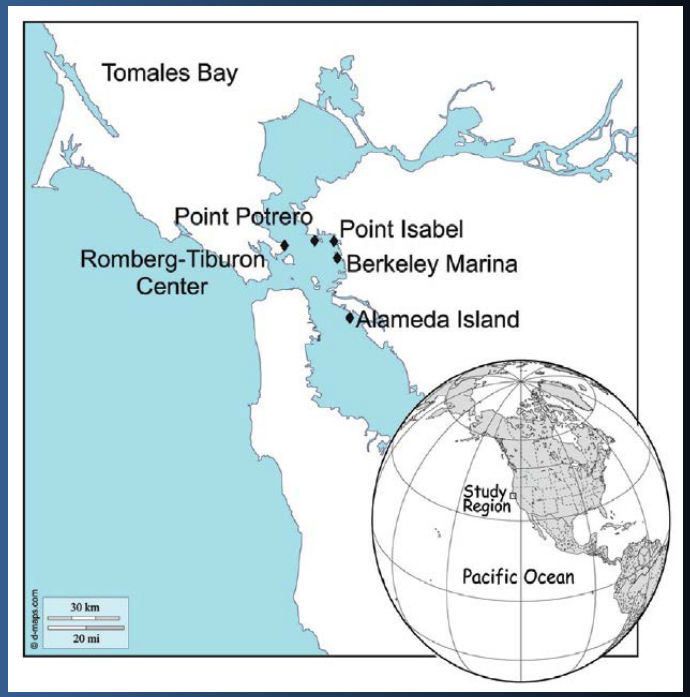


- Low but measurable DA
- Followed the trend of West Coast bloom
- But NOT the magnitude

Peacock et al. in prep

Microcystins in Mussels



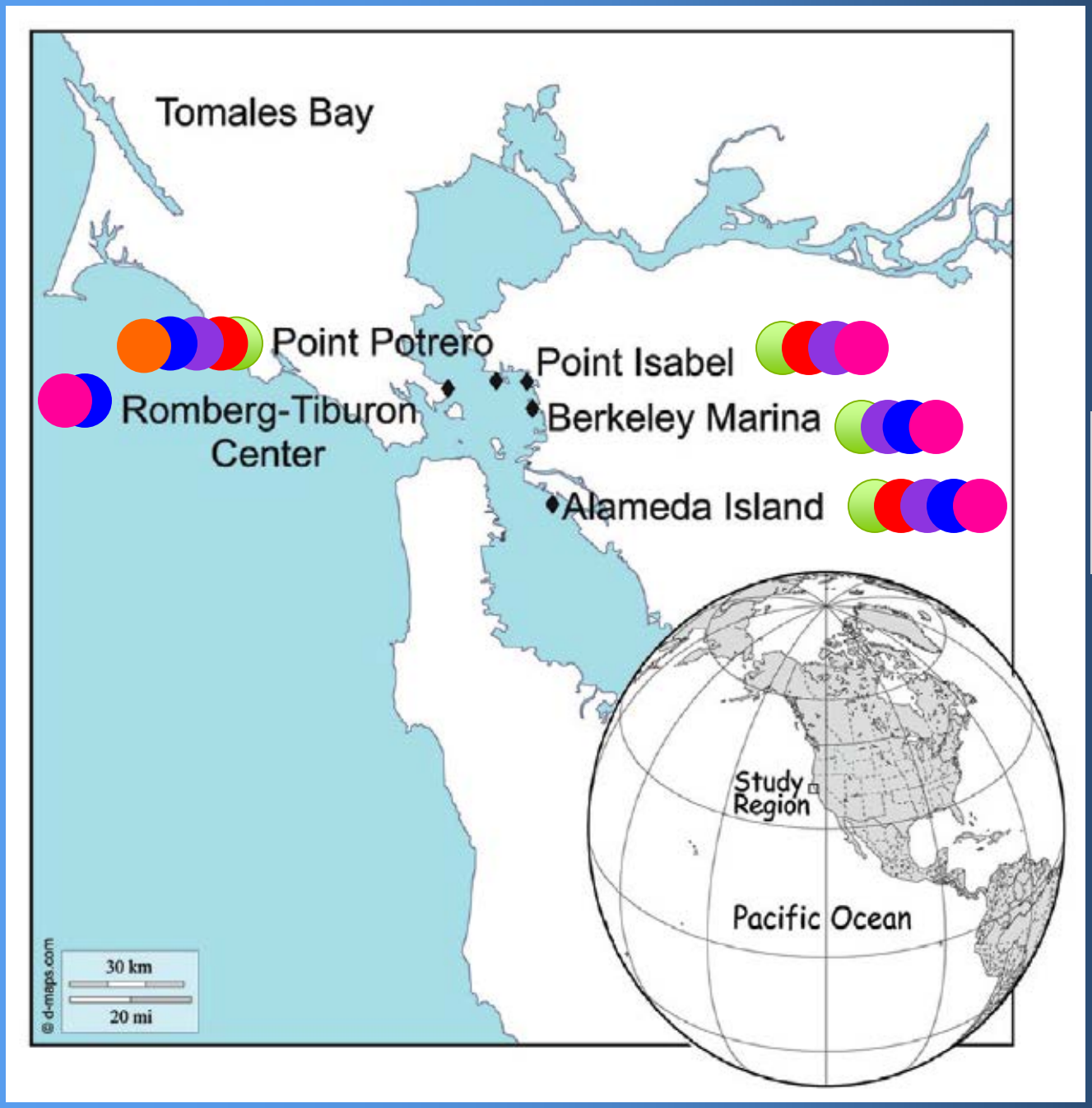


- Sometimes HIGH microcystin
- Variability
- No regulatory limit
- Are NOT monitored for

Gibble et al., 2016

PST in Mussels

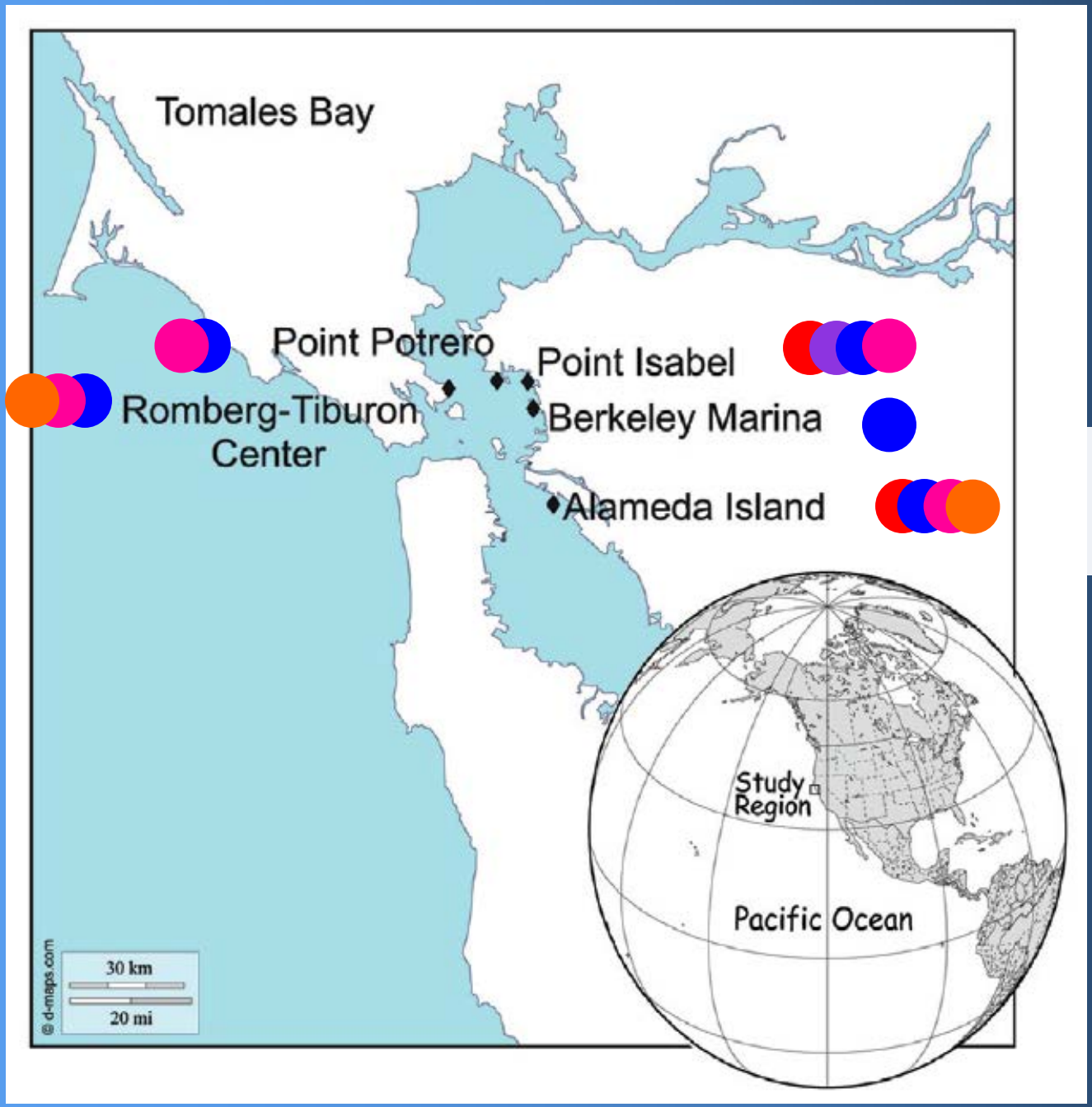
- Can be marine or freshwater toxins
- Low but measurable



- April
- May
- June
- July
- August
- September

Okadaic Acid and DTX-2 in Mussels

- Sometimes HIGH OA and DTX
- Variability



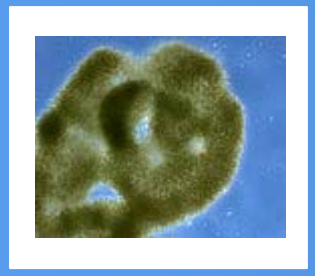
- April
- May
- June
- July
- August
- September

Why should we worry?

Alexandrium spp.

Dinophysis spp.

Pseudo-nitzschia spp.



Microcystis spp.

California mussel

Marine birds

Human consumption

Marine mammals

These toxins accumulate in the food web

2012, 2014 RMP Caged Mussels

Domoic Acid
(100% of mussels contaminated)

Microcystins
(82% of mussels contaminated)

Paralytic Shellfish Toxins
(59% of mussels contaminated)

Okadaic Acid and DTX-2
(71% of mussels contaminated)

These toxins accumulate in the food web

2012, 2014 RMP Caged Mussels

Domoic Acid

(~~100%~~ of mussels contaminated)
100%

Microcystins

(~~82%~~ of mussels contaminated)
82%

Paralytic Shellfish Toxins

(~~25%~~ of mussels contaminated)
59%

Okadaic Acid and DTX-2

(~~100%~~ of mussels contaminated)
71%

Does San Francisco Bay have a toxic algae problem?

- Microcystins and Domoic Acid toxins are present *nearly all the time* in the water column
- Microcystins, Domoic Acid, PST, Okadaic Acid and DTX-2 were present in at least 59% of the shellfish we tested
- We don't know (precisely) how these toxins are getting into SFB, but they *are* in the food web
- We do not know if there are synergistic effects

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

Thank You!