Heavy Hitters in the San Francisco Bay

Phytoplankton Community – Diatoms, Dinoflagellates, and Cryptophytes

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Nutrients in San Francisco Bay

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Science and Management Goals

In response to the apparent changes in the Bay's resilience to nutrient loading, the San Francisco Bay Regional Water Quality Control Board and Bay Area stakeholders have been working collaboratively to develop the San Francisco Bay Nutrient Strategy. The goal of the Nutrient Strategy is to lay out a well-reasoned and cost-effective program to generate the scientific understanding needed to fully support major management decisions.

The Nutrient Strategy has 6 main goals:

1. Define the problem: develop conceptual models for Bay segments that characterize important processes linking nutrient and organic matter loading, biological responses, and indicators of adverse effects of nutrient over-enrichmen
2. Establish guidelines (water quality objectives; i.e., assessment framework) for nutrients, including ammonium, focusing on the endpoints of eutrophication and other adverse effects of nutrient overenrichment;
3. Implement a monitoring program that supports regular assessments of the Bay;
4. Develop and utilize nutrient-load response models to support nutrient management decisions;
5. Evaluate control strategies to reduce nutrient inputs from wastewater treatment plants and other sources; and
6. Consider alternative regulatory scenarios for how to move forward with nutrient management in SF Bay.

http://bayareanutrients.aquaticscience.org/goal

Why do we care about the phytoplankton community?

Nutrients

Phytoplankton

Toxicity

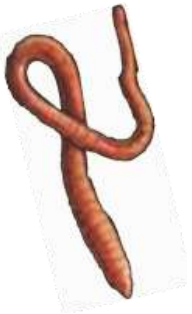
Shape

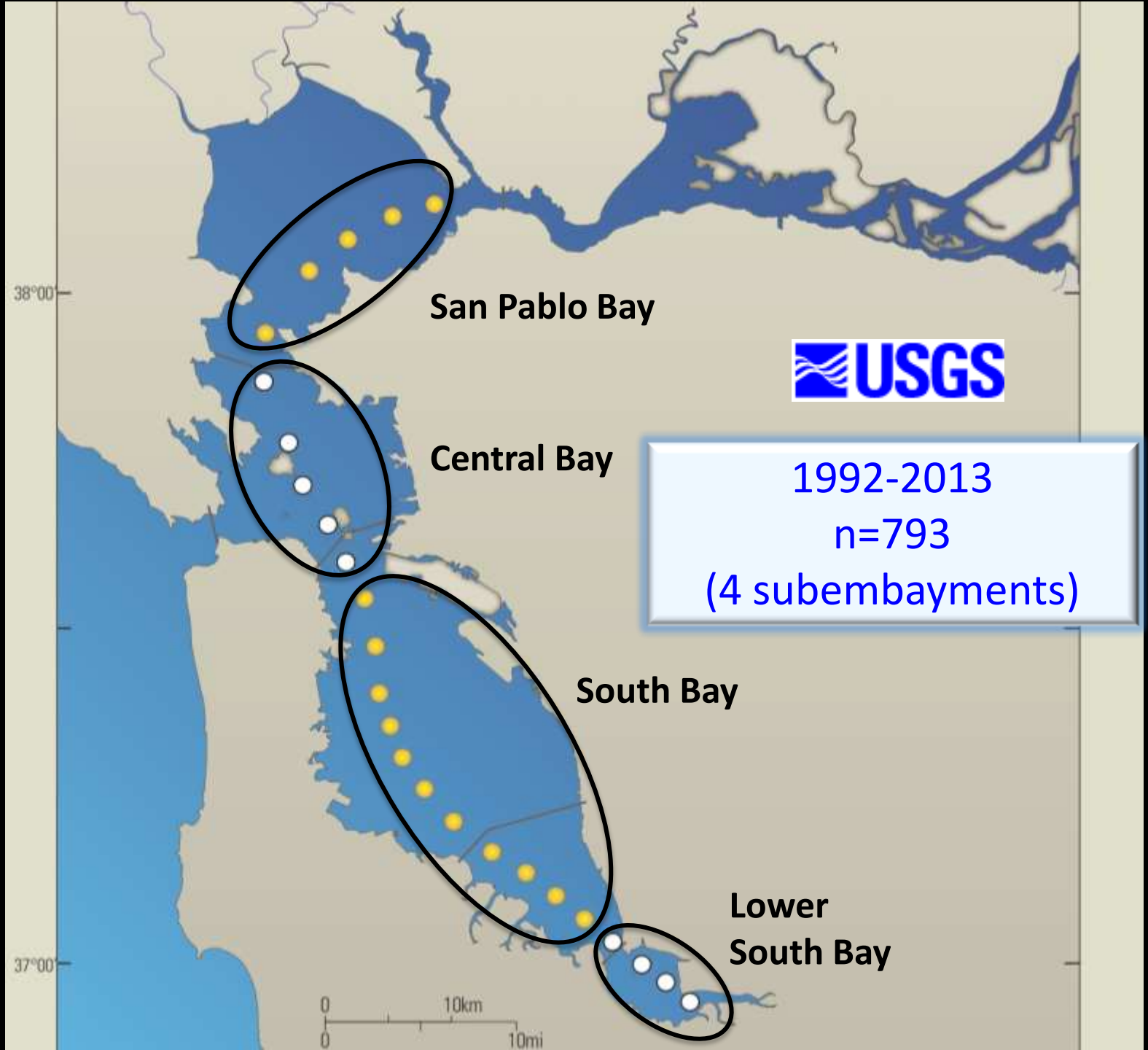
Size

Sinking rate

Nutrition

Swimmer





USGS

1992-2013
n=793
(4 subembayments)

Phytoplankton Taxonomy Methodology

- Preserved with acid Lugol's solution
- 2-50 ml settled in chambers for 6 to 24 h
- All cells > 30 µm enumerated at 125× magnification
- The strip count method was used to detect cells < 30 µm at 1250x, with at least 100 cells of the most numerous taxon counted (APHA 1989)
- Diatom and dinoflagellate cell contents cleared in 30% H_2O_2
- Cell volumes (μm^3) estimated for dominant taxa by measuring 10 to 100 cells and applying standard geometric formulas (Hillebrand et al. 1999, Wetzel & Likens 1991)
- **Total BIOVOLUME (μm^3/ml)** = abundance (# cells /ml) x cell volume (μm^3)

Phytoplankton taxonomic groups in SF Bay

- Diatoms (Bacillariophytes)
- Chlorophytes
- Chrysophytes
- Cryptophytes
- Cyanophytes
- Dinoflagellates (Dinophytes)
- Euglenophytes
- Eustigmatophytes
- Haptophytes
- Prasinophytes
- Raphidophytes

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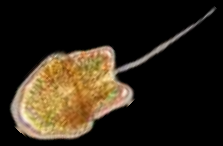
Salty regions n=793

Diatoms

- large cells
- fast growing
- rich in an EFA
- critical for food webs that are supporting fisheries
- one HAB species, *Pseudonitzschia*



Dinoflagellates

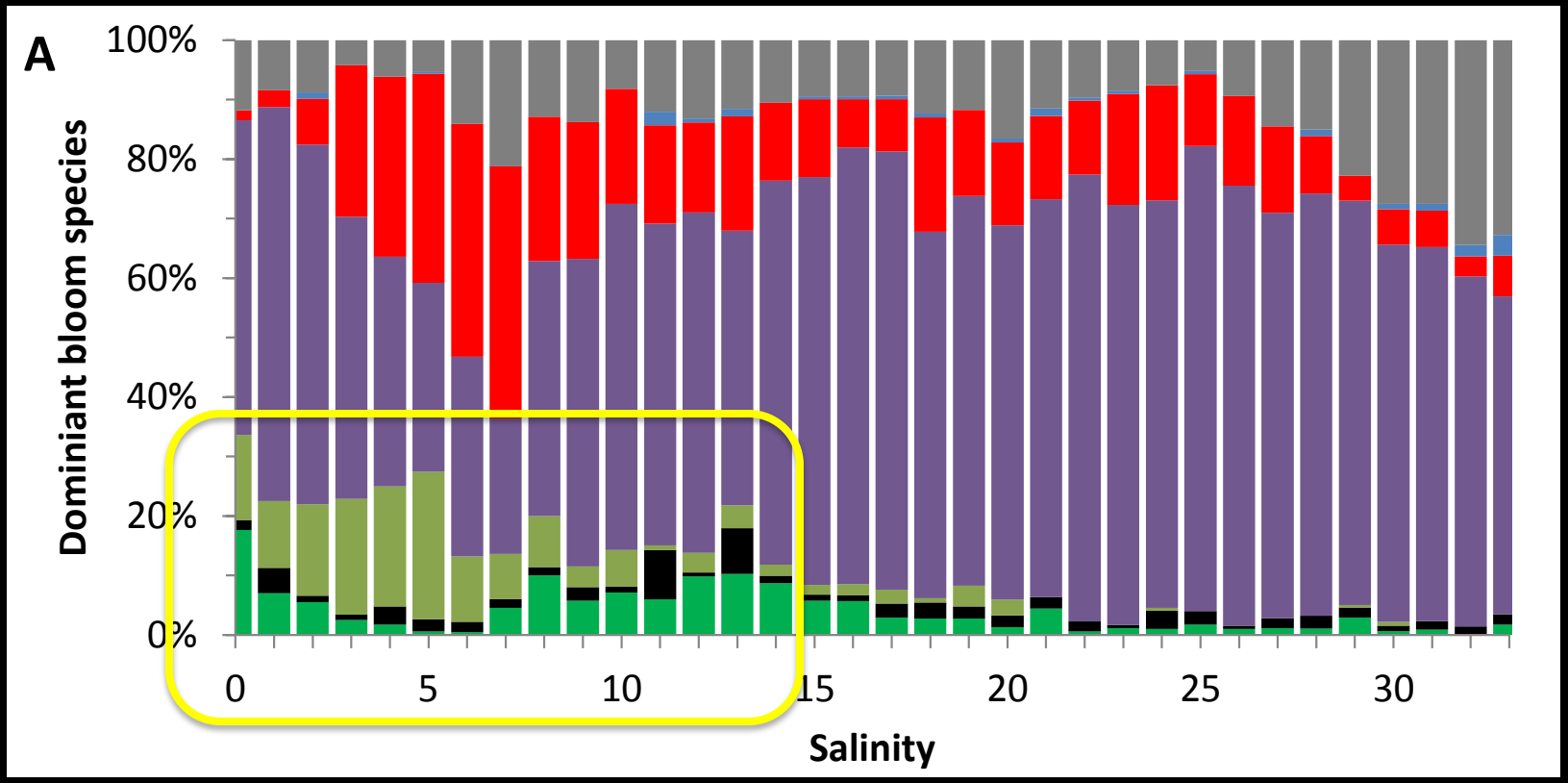
- large cells
- rich in another EFA
- SFB copepods select dinos
- Some toxin producers

Cryptophytes

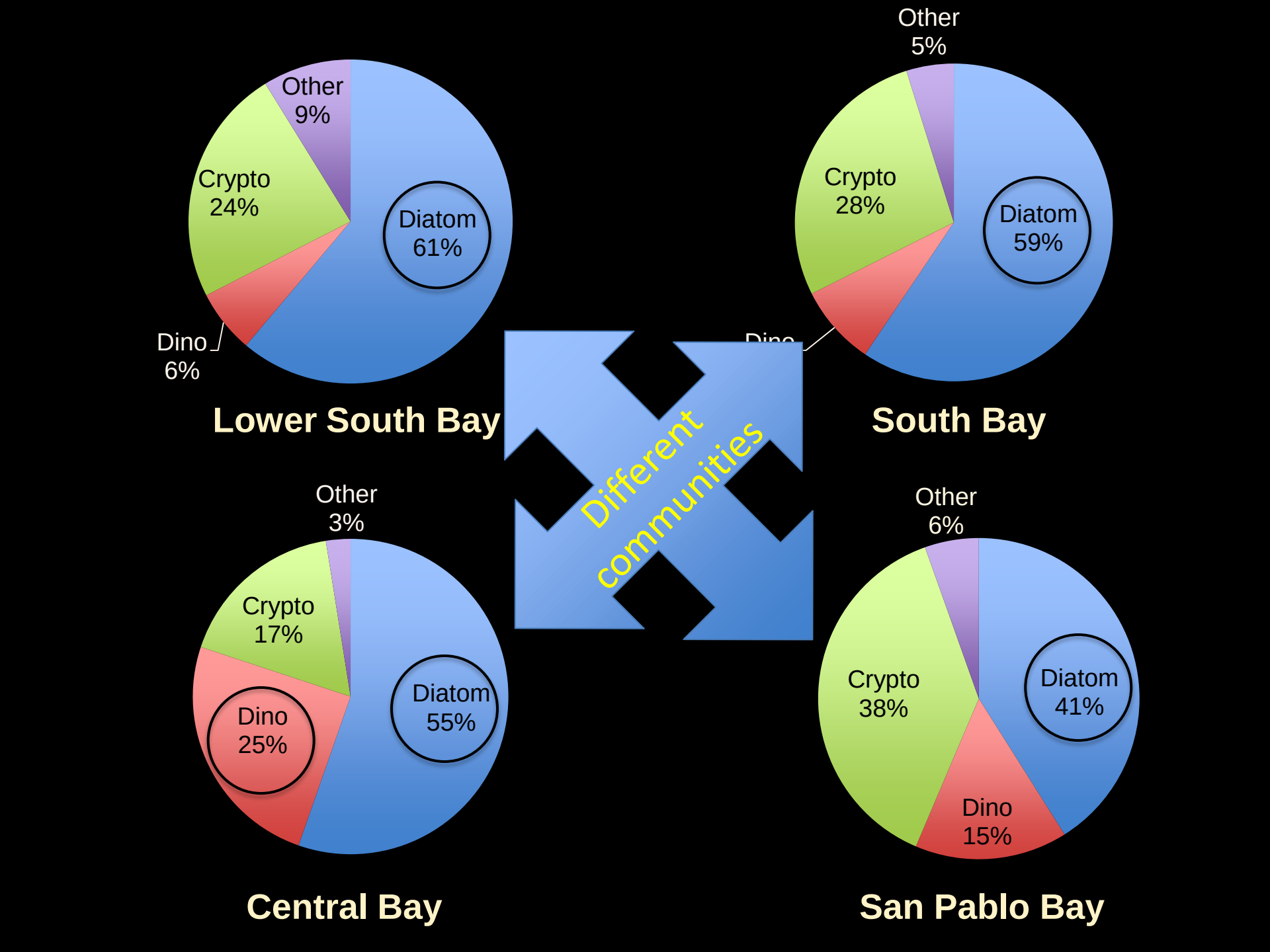
- small cells
- highly enriched in in both EFAs
- No toxins!

these flagellates are a primo food resource!

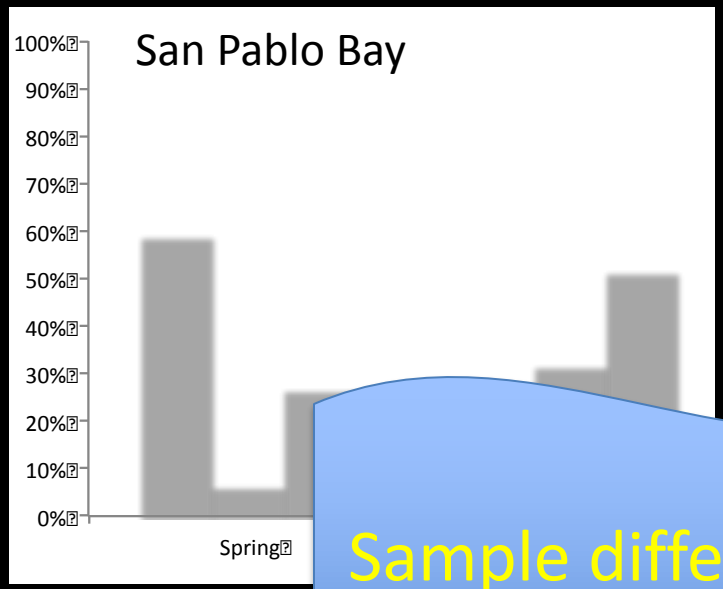
Global study of dominant phytoplankton groups in 86 estuarine-coastal sites
> 30,000 samples

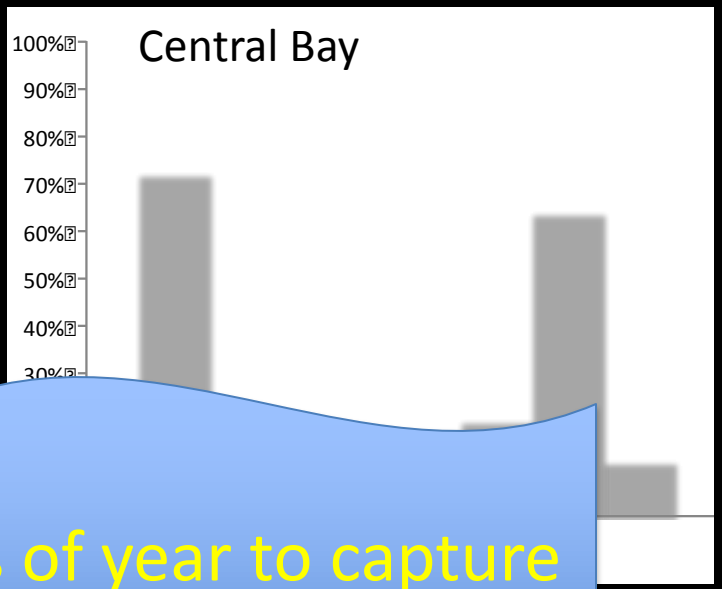


From: Carstensen, Klais and Cloern (almost submitted)

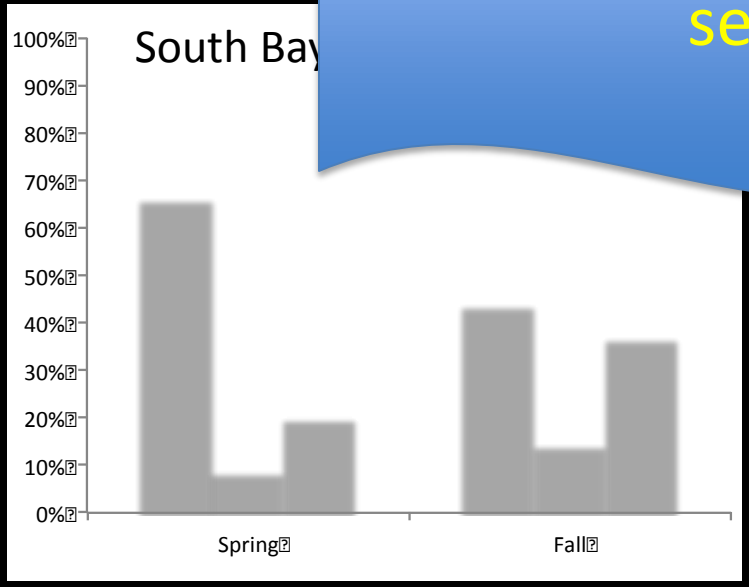

Other
9%
Crypto
24%
Diatom
61%
Dino
6%
Lower South Bay
Other
5%
Crypto
28%
Diatom
59%
South Bay
Different communities
Other
3%
Crypto
17%
Diatom
55%
Dino
25%
Central Bay
Other
6%
Crypto
38%
Diatom
41%
Dino
15%
San Pablo Bay

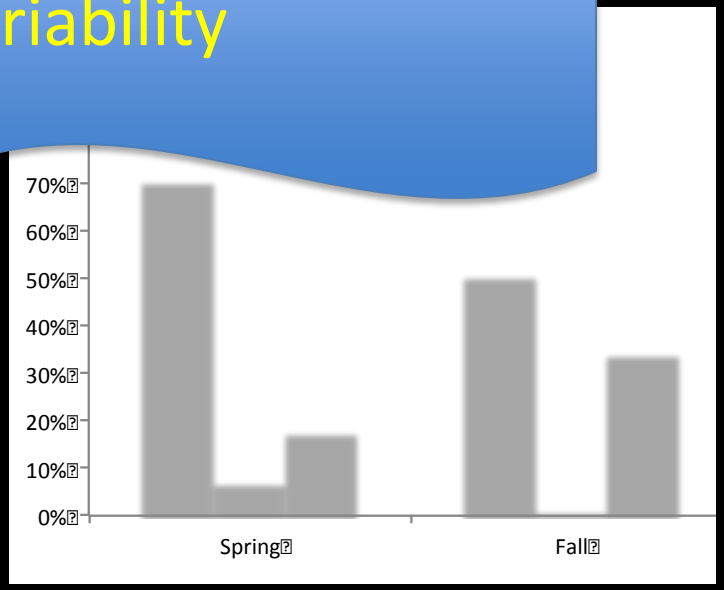
Seasonal patterns





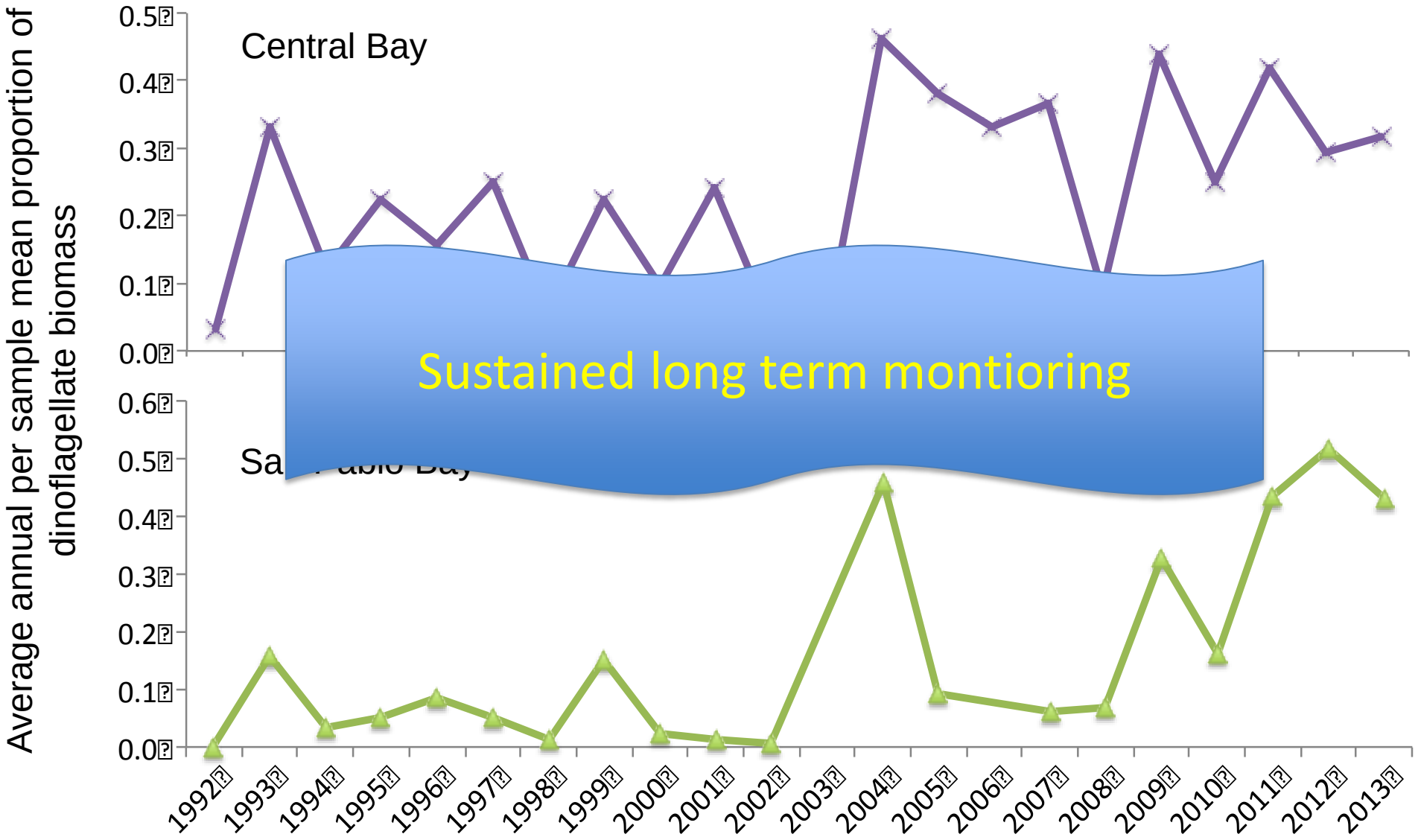
Sample different times of year to capture seasonal variability





Spring = Feb through May Fall = Sept and Oct

Increasing Importance of Dinoflagellates?

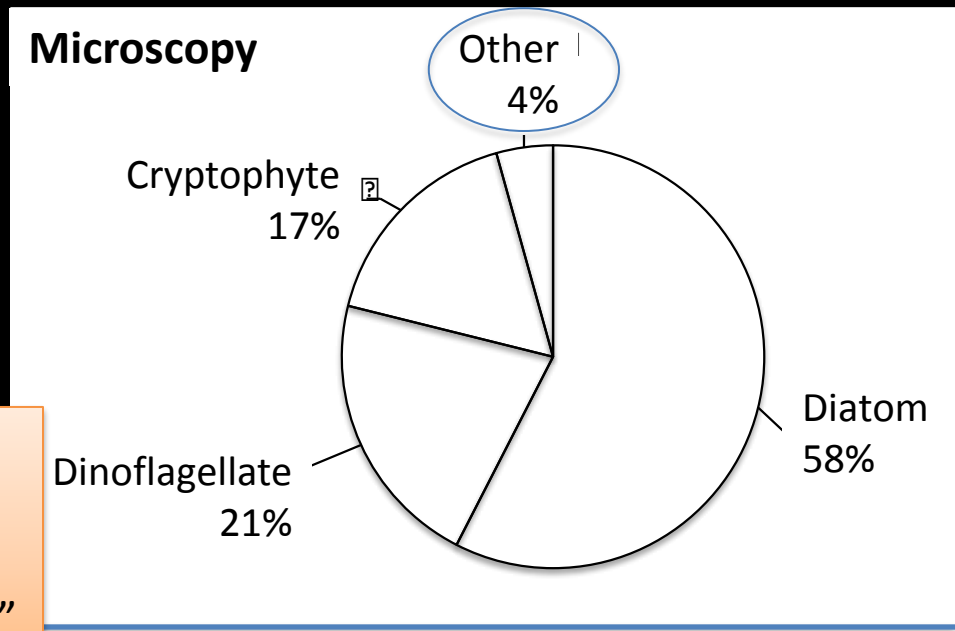


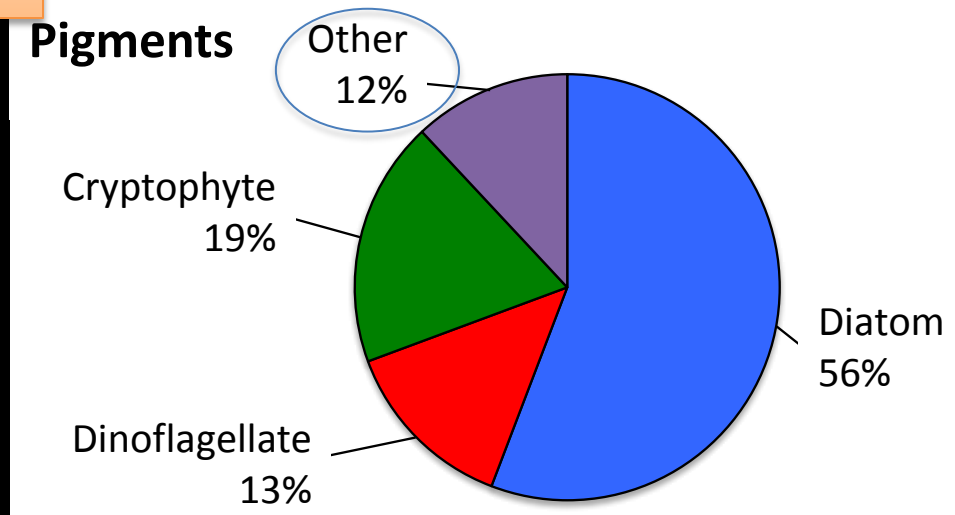
A new method for a nutrient based monitoring program

Pros:
Detection to species level
Detection of HAB organisms

Poster #169
Melissa Peacock "What Does a Pigment-Based Analysis Tell Us About the Phytoplankton Community Composition in San Francisco Bay?"

Pros:
Inexpensive
Fast
Well correlated to microscopy
Tiny cells detected





Both plots = all SFB stations
Nov 2011 – April 2014

What does all this mean for design of a monitoring program?

A phytoplankton taxonomic sampling regimen should include:

~ Spatially variable sampling

~ Seasonal variable sampling

~ Sustained sampling over the long term

~ Consideration of new, more efficient technologies

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Photo of actual phytoplankton arranged on a microscope slide!