Spatial and Temporal Patterns in Bay-Delta Sediment Quality: Relationship to Sediment Quality Objectives

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Presentation Overview

- **Regulatory and management background regarding sediment quality**
- **Sediment quality conditions in Bay-Delta (2007-08)**
- **Comparison to San Francisco Estuary**
- **Research needs to improve our understanding and make connections**

California Sediment Quality Objectives

- **State Water Board has adopted sediment quality objectives (SQOs) for enclosed bays and estuaries**
  - **Same regulatory importance as water quality objectives**
- **Narrative objectives to protect three types of beneficial uses**
  - **Aquatic life (benthic community)**
  - **Human health (seafood consumption risk)**
  - **Wildlife (prey consumption): under EPA review**
- **Within each category, a quantitative assessment framework is used to determine compliance**
  - **Multiple indicators or lines of evidence**
  - **Standardized chemistry, toxicity, and bioassesment methods and interpretation thresholds**

Phased SQO Development

- **Benthic community SQO**
  - **Approved in 2009**
  - **Uses sediment quality triad to assess impacts**
    - **Sediment chemistry, toxicity, benthic community disturbance**
  - **In use for compliance monitoring and TMDLs in marine bays**
- **Human health SQO**
  - **Assessment framework under development**
- **Wildlife SQO**
  - **??**

2007: Data Gaps Limit Assessment Tool Development for Bay-Delta

- **Delta sediment quality largely unknown**
  - **Extensive data on benthic macrofauna**
    - **Dept. Water Resources monitoring**
  - **Few measurements of sediment chemistry and toxicity**
    - **Gradients and patterns largely undescribed**
- **Relationships among indicators uncertain**
  - **Natural vs. impacted conditions?**
    - **Benthic communities and toxicity**
    - **Geochemistry**
  - **What levels of sediment contamination are biologically significant?**
  - **Which tools are best for describing condition?**

Bay-Delta Study: 2007 & 2008

- **Objectives**
  - **Obtain matched chemistry, toxicity, benthos data**
  - **Describe gradients of contamination/response**
- **Sediment quality survey in collaboration with DWR**
  - **Biological community analysis**
  - **Sept. 2007 and May 2008 sampling events**
  - **Focus on fine grained sediments**
- **Triad analysis on a subset of stations**
  - **Screen stations for acute toxicity to amphipods**
  - **Select 75 stations for sublethal toxicity and chemical analysis**

Funding provided by SWRCB SQO program and DWR

Methods

- **Toxicity (UC Davis Marine Pollution Studies Lab)**
  - ***Hyallela azteca* survival (10-days)**
  - ***Chironomus dilutus* survival/growth (10 days)**
- **Geochemistry (DFG, AMS, Brooks Rand Labs)**
  - **Particle size**
  - **TOC/TN**
  - **Metals**
  - **PCBs and chlorinated pesticides**
  - **PAHs**
  - **Current use pesticides**
    - **Pyrethroids, carbamates, diuron, PBO, chlorpyriphos**
- **Benthic Macrofauna (DWR, Hydrozoology)**
  - **Species identification and abundance**

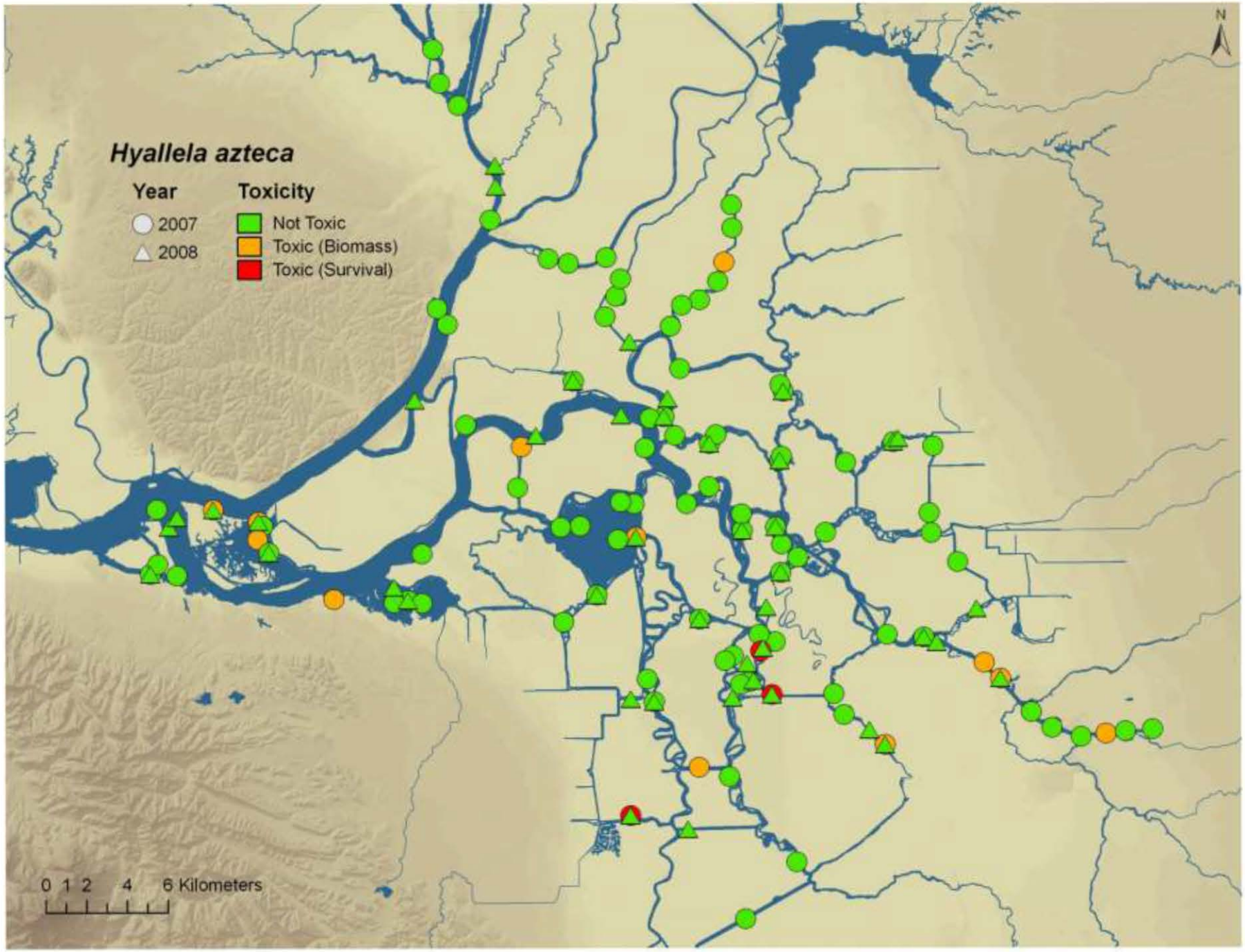
Toxicity Summary

Percent toxic sites by endpoint

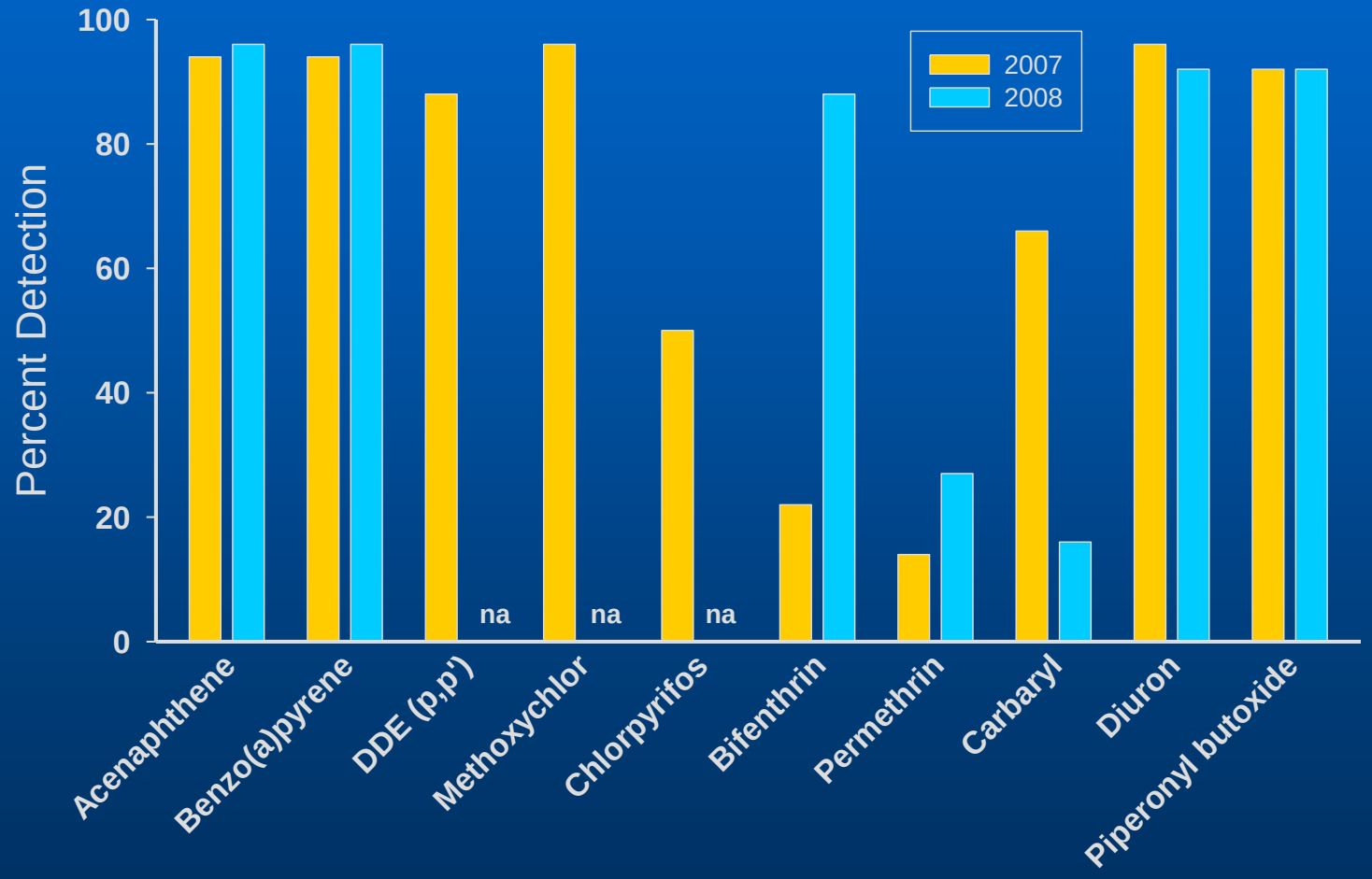
Species	2007				2008			
	Any Endpoint	Survival	Growth	Biomass	Any Endpoint	Survival	Growth	Biomass
Hyallela azteca	17	3	13	14	0	0	0	0
Chironomus dilutus	16	2	10	14	28	0	24	24

Low frequency of mortality in either survey
Growth effects varied between species and sampling events

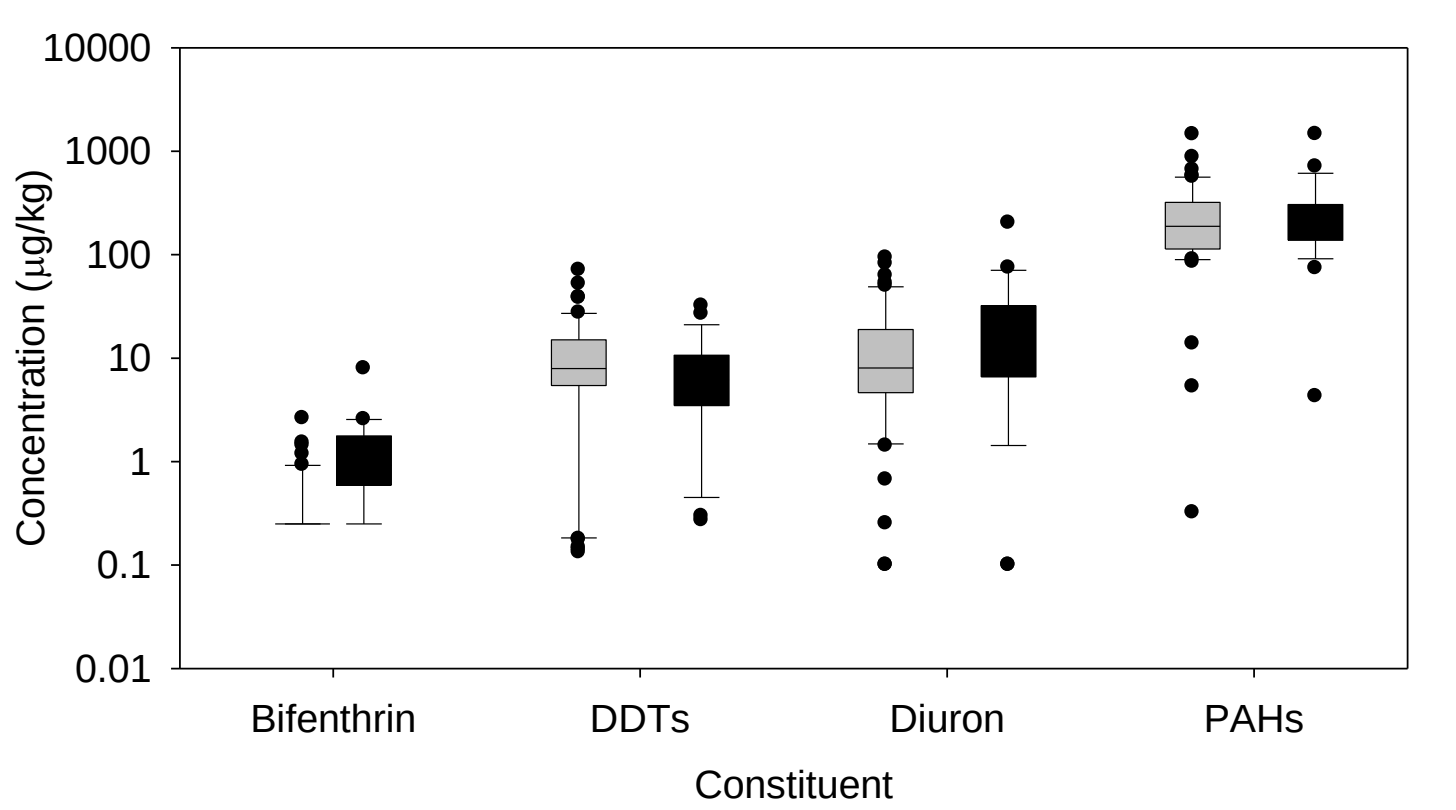
N = 100 for *H. azteca* in 2007 and 44 in 2008.
N = 50 for *C. dilutus* in 2007 and 25 in 200


Hyallela azteca
Year
2007
2008
Toxicity
Not Toxic
Toxic (Biomass)
Toxic (Survival)
N
0 1 2 4 6 Kilometers

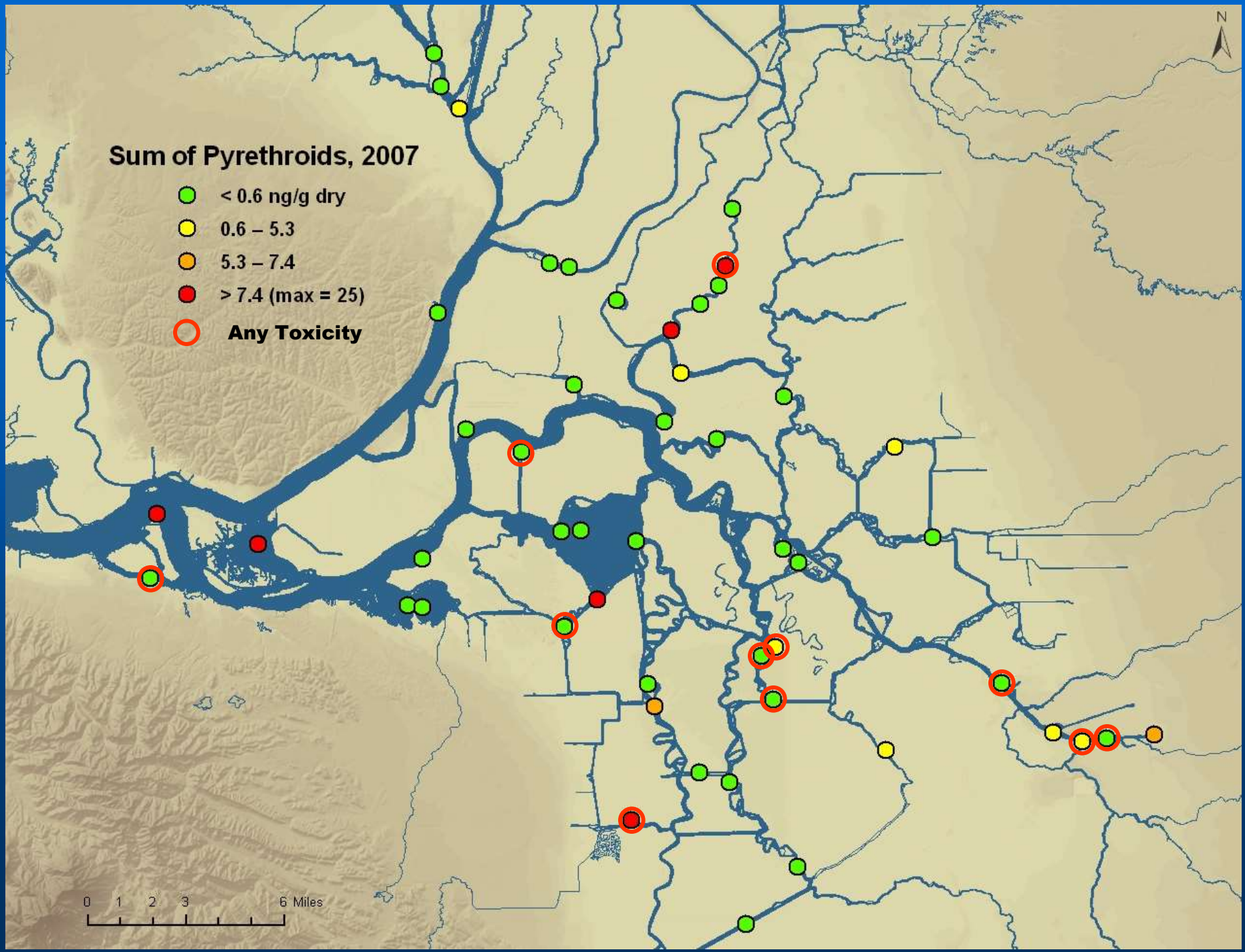
Bay-Delta Contaminant Detection



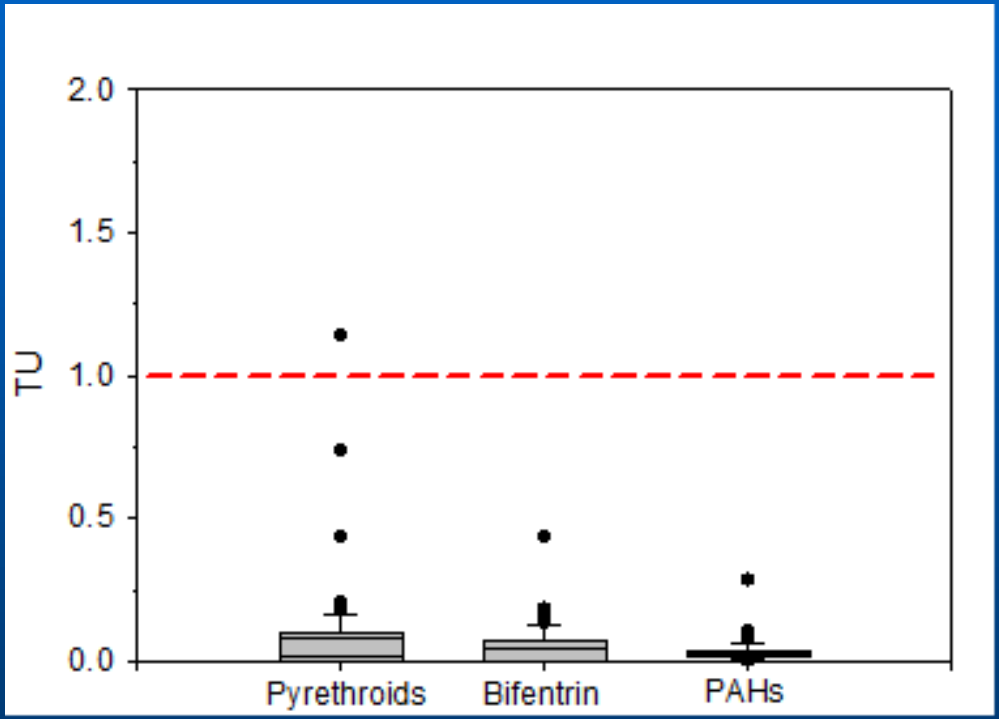
Trace Organics: Seasonal Comparison



- **Generally low and stable concentrations**


Sum of Pyrethroids, 2007
< 0.6 ng/g dry
0.6 – 5.3
5.3 – 7.4
> 7.4 (max = 25)
Any Toxicity
N
0 1 2 3 6 Miles

Unknown Cause of Toxicity

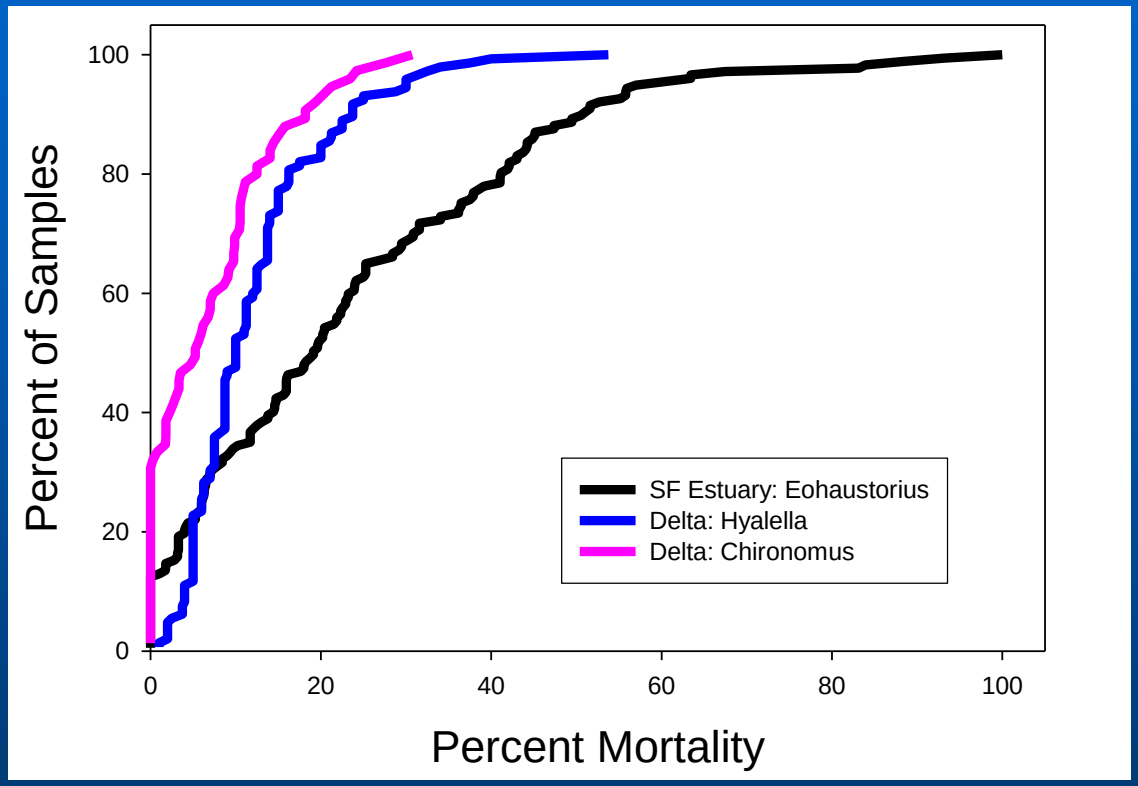


- **None of measured contaminants present at likely toxic concentrations**

San Francisco Estuary Sediment Quality

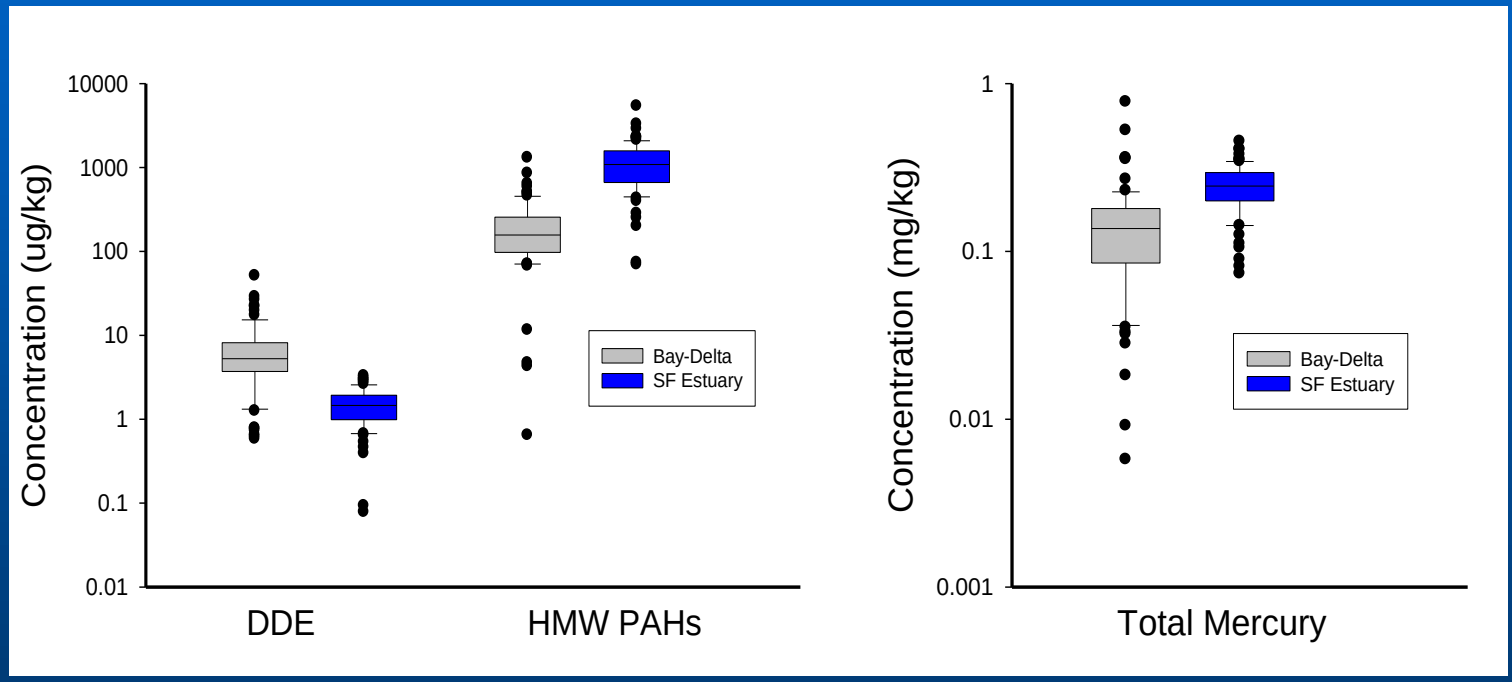
- **Evaluated 2008-10 RMP sediment monitoring data using SQO assessment framework (75 stations)**
  - **2 toxicity tests (Eohaustorius, Mytilus)**
  - **2 chemical indices**
  - **3-4 benthic indices**
- **Categorical impact outcome based on WOE**
  - **Unimpacted, Likely Unimpacted**
  - **Possibly Impacted, Impacted, Clearly Impacted**

Sediment Toxicity Comparison



- **Lower prevalence and magnitude of sediment toxicity in Delta**

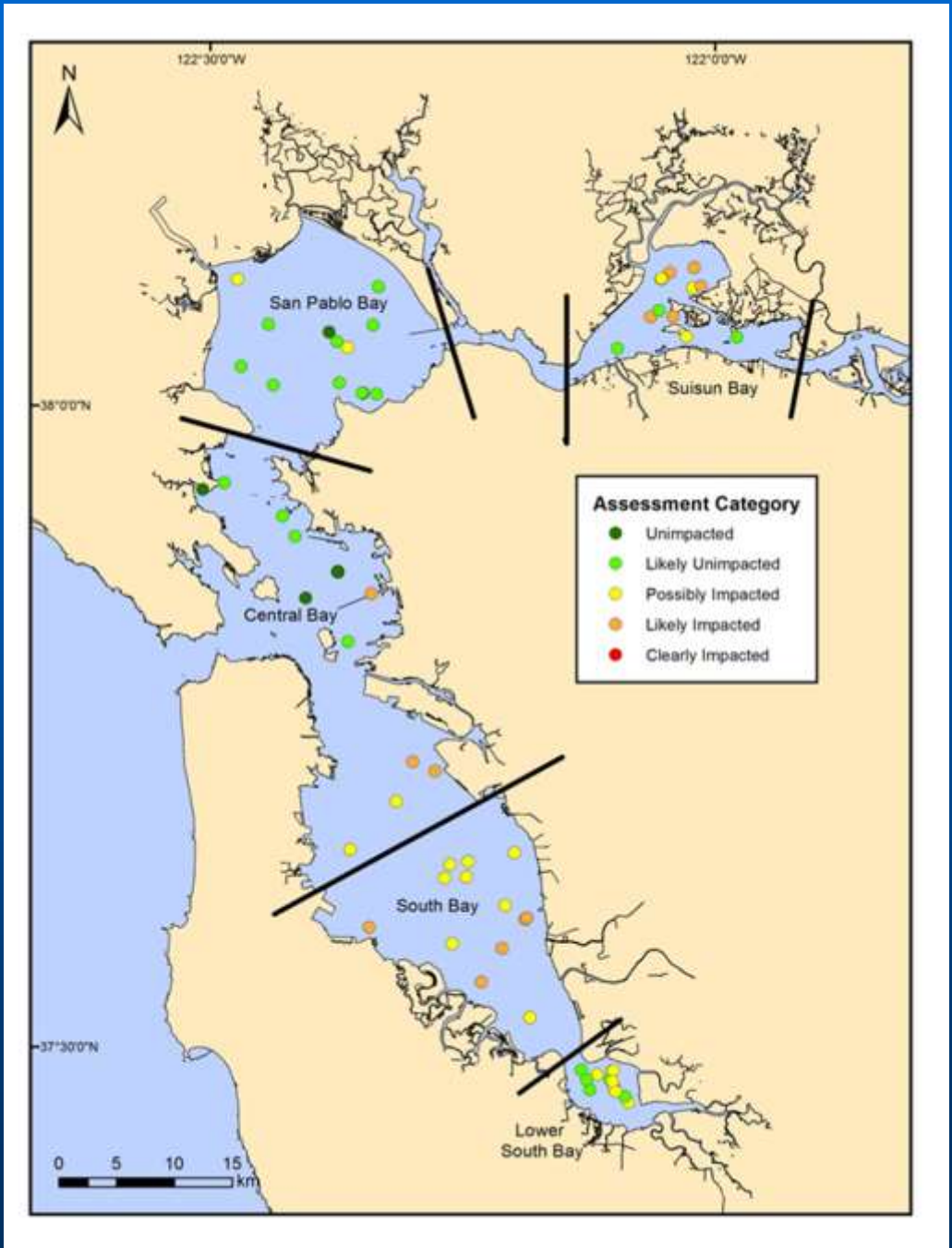
Sediment Chemistry Comparison



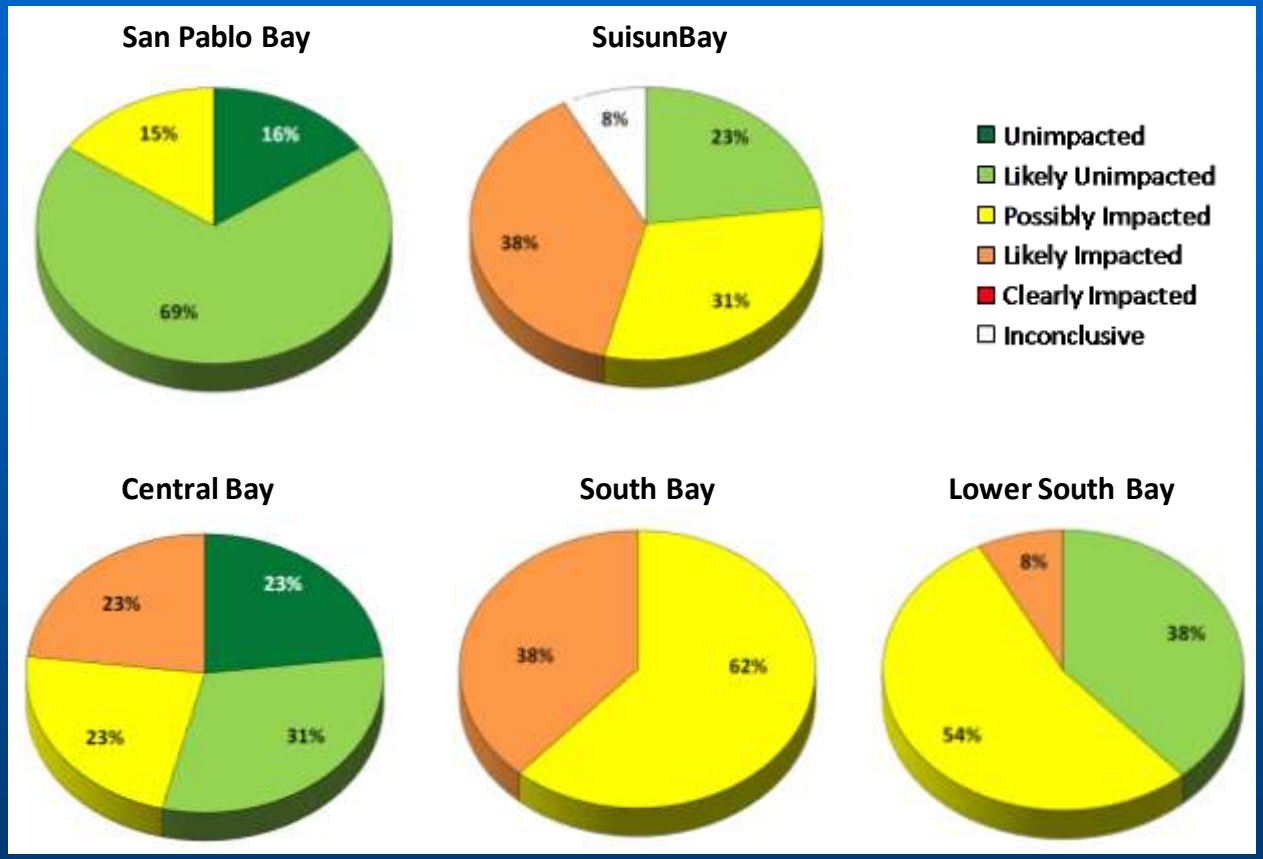
- **Lower concentration of most chemical contaminants in Delta relative to SF Estuary**

Spatial Patterns

- South Bay and Suisun Bay with more impacted sites than other regions
- Sediment toxicity and benthic community disturbance prevalent
- Cause of impacts not determined
  - Chem mixtures?
  - Unmeasured chems?
  - Sediment particle size?
  - Algal toxins?

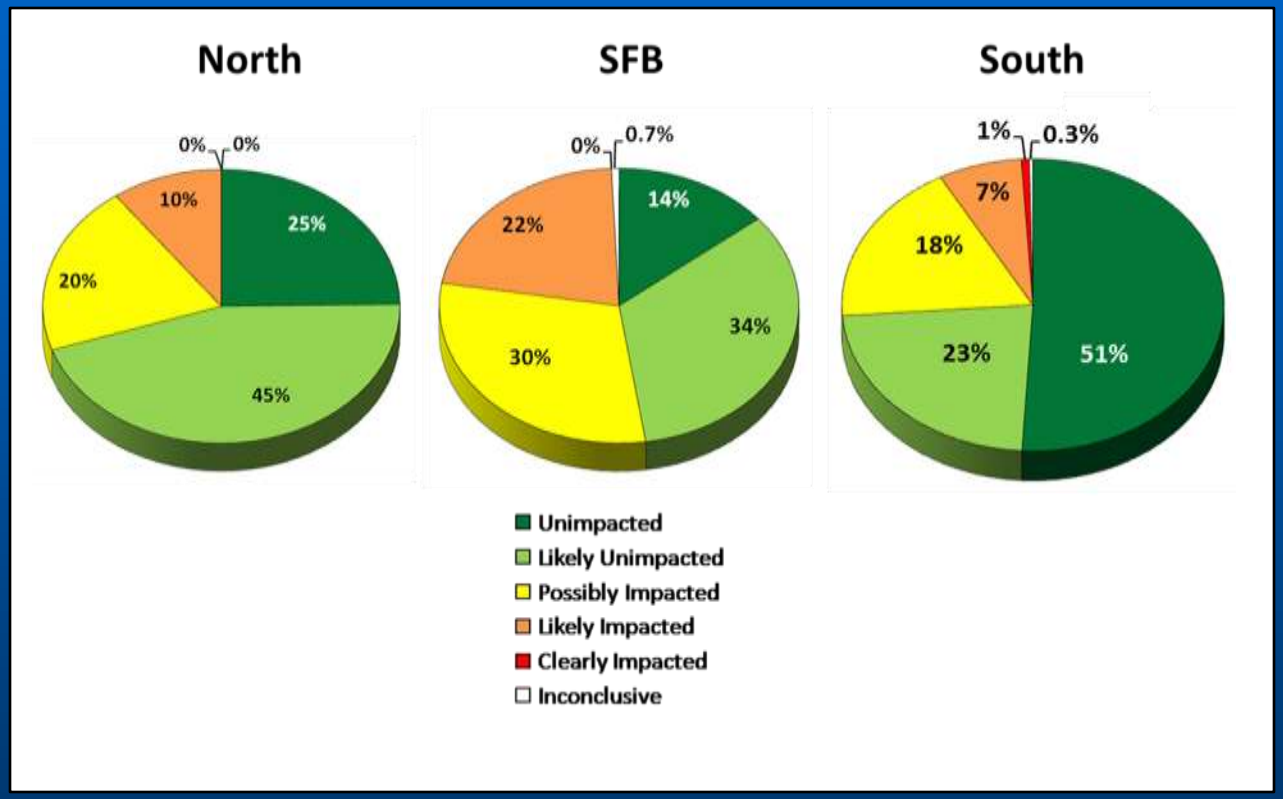


Regional Conditions



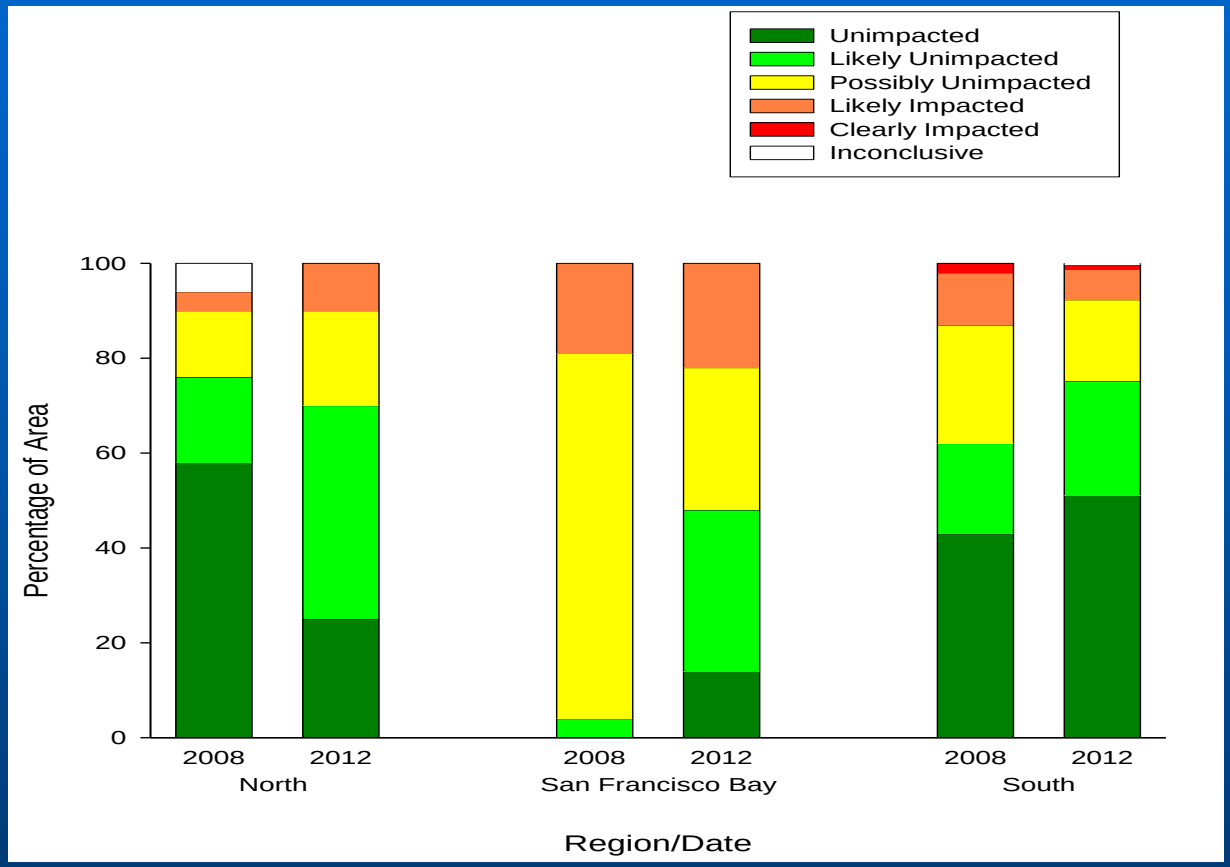
- **Spatial variation suggests multiple causes of impacts**
  - **Delta influence?**

2008-2010 Regional Survey Results



San Francisco Estuary has greatest extent and severity of impacts among CA embayments

Temporal Changes



- **Conditions may be improving in SF Estuary**
- **Reduced RMP effort will make it difficult to verify**

Summary

- **Understanding Bay-Delta and SF Estuary sediment quality is important**
  - **Regulatory and management importance**
  - **Biological impacts apparent**
- **Bay-Delta sediment quality appears to be better relative to SF Estuary**
  - **Limited data and tools to connect the assessments**
  - **Few recent data to support assessment**
- **Sediment contamination is widespread, but relatively low**
  - **Mixture of historic and current activities**
  - **Influence on benthic community health is uncertain**

Recommendations

- **Support integrated regional monitoring efforts in all parts of the Estuary**
  - **Comparable measurements and analyses**
  - **Bay-Delta RMP is a good opportunity**
- **Benthic community health indices need to be developed for Bay-Delta**
  - **Promising approaches available, but no support for development**
  - **Can't compare Bay-Delta to other regions without them**
- **Sediment stressor identification should be a high priority**
  - **Linkage between large channels, basins, and drains**
  - **Can't make good management decisions for the Estuary without understanding cause of toxicity**
    - **Prioritization**
    - **Controls**