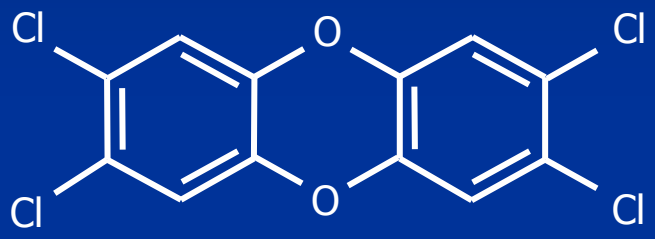
Update on Dioxin Results



Don Yee,

RMP TRC Meeting
March 5th, 2013

Dioxin Strategy Team

- Last meeting October 2011
- Dioxin sampling since then
  - WY 2012 tributary stations
  - Bird eggs (2012)
- Deferred/cancelled
  - 2012 S&T sediment

2012 Surface Sediments Analysis

Proposed options

1) Analyze 2012 wet season samples (n=27)
   - Funding approved
2) Analyze 2011 dry season samples (n=47)
   - Funding needed for additional 20 samples
3) Analyze a subset of 2012 and 2011 samples
   - 2011 dry fixed, repeat sites (n=15) and all 2012 wet sites (n=27)
   - Funding needed for more than 27 samples ($800/sample)

4) No more surface sediment analyses.
   - Cores instead?

Sediment samples

2008

- Dry season sampling
- n=15 samples
- Fixed, repeat RMP S&T sites

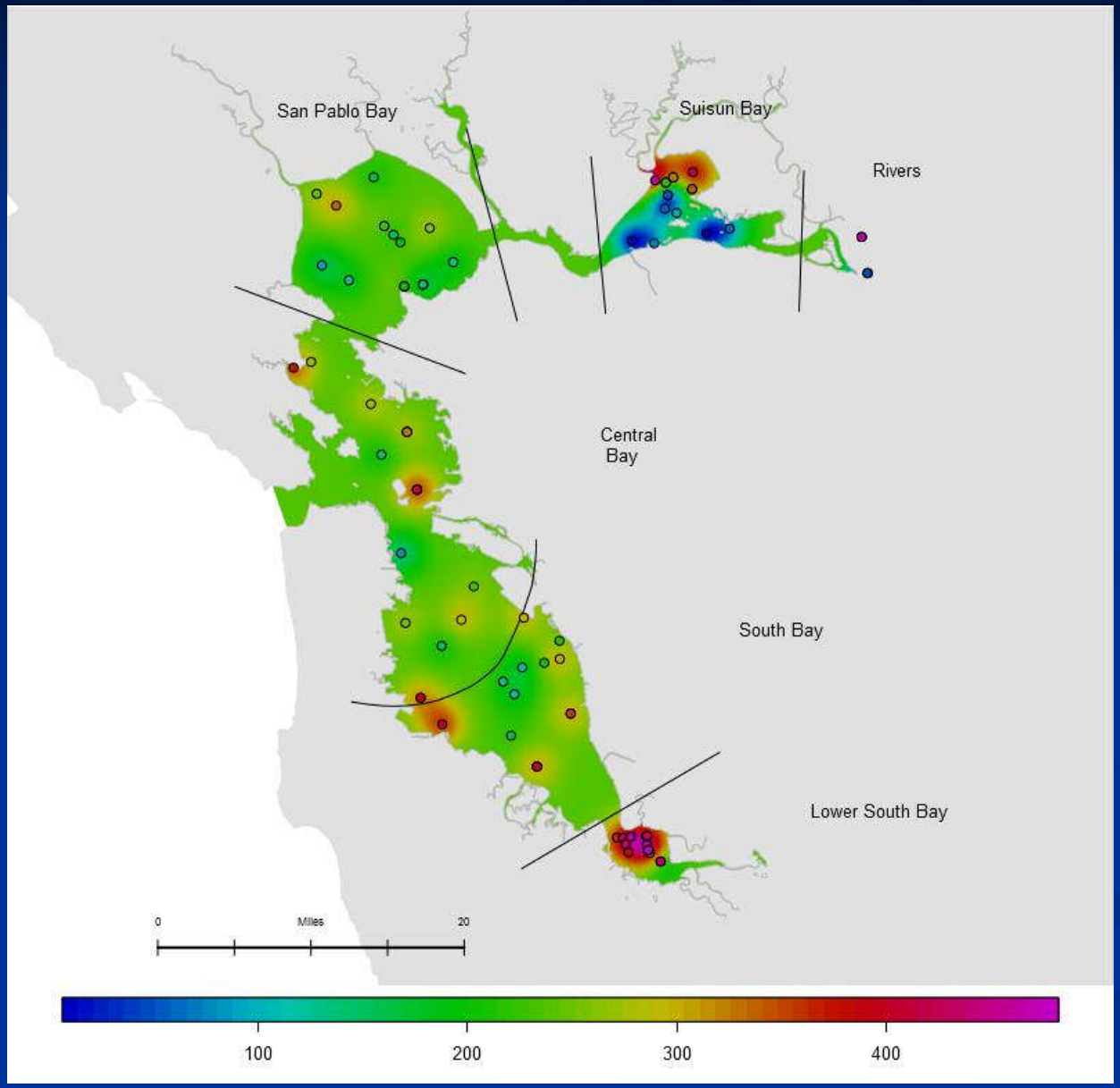
2009

- Dry season sampling
- n=47 samples
- All S&T sites

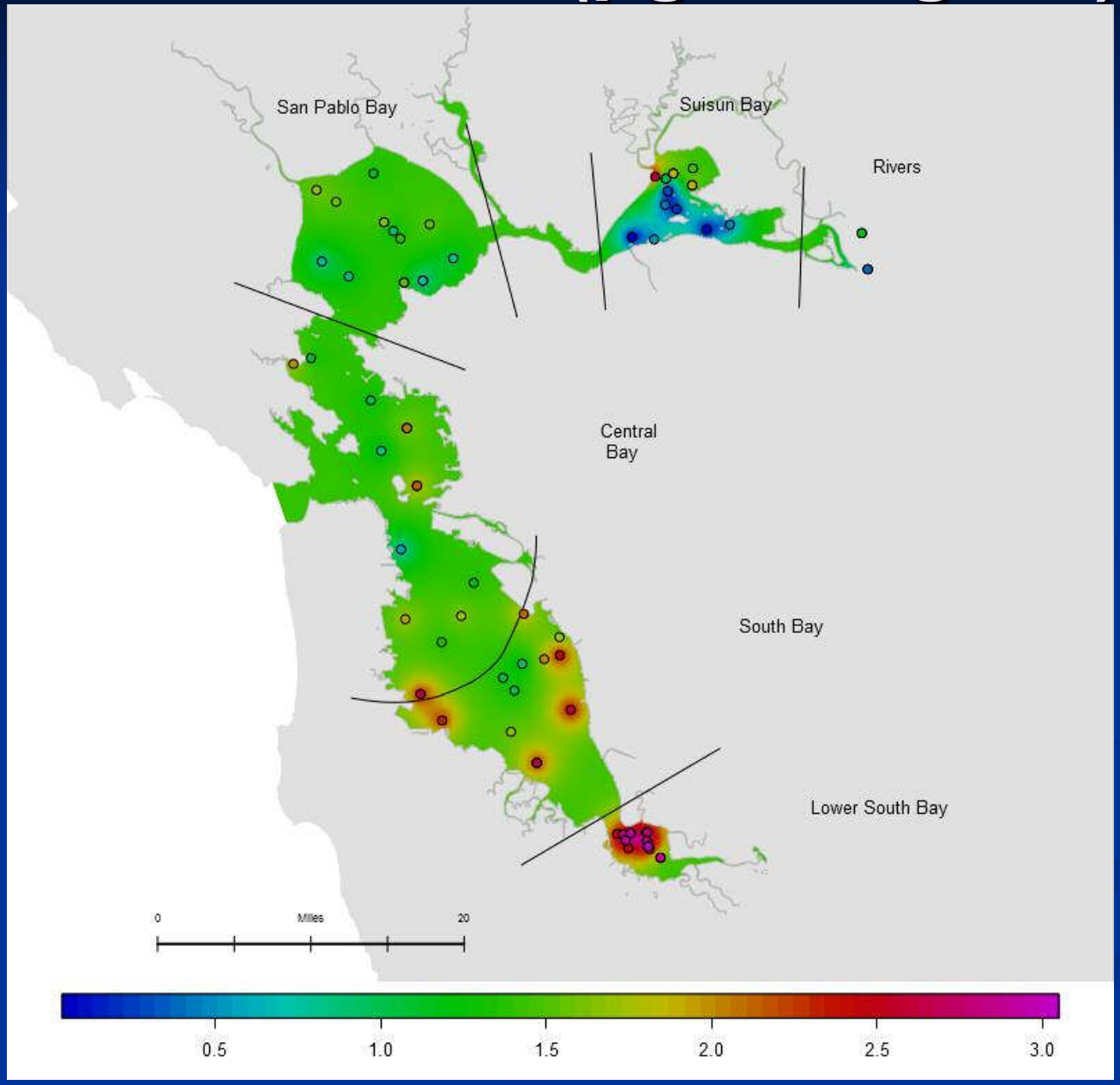
2010

- Wet season sampling
- N=27 samples
- All S&T sites

Total Dioxins (pg/g dw)

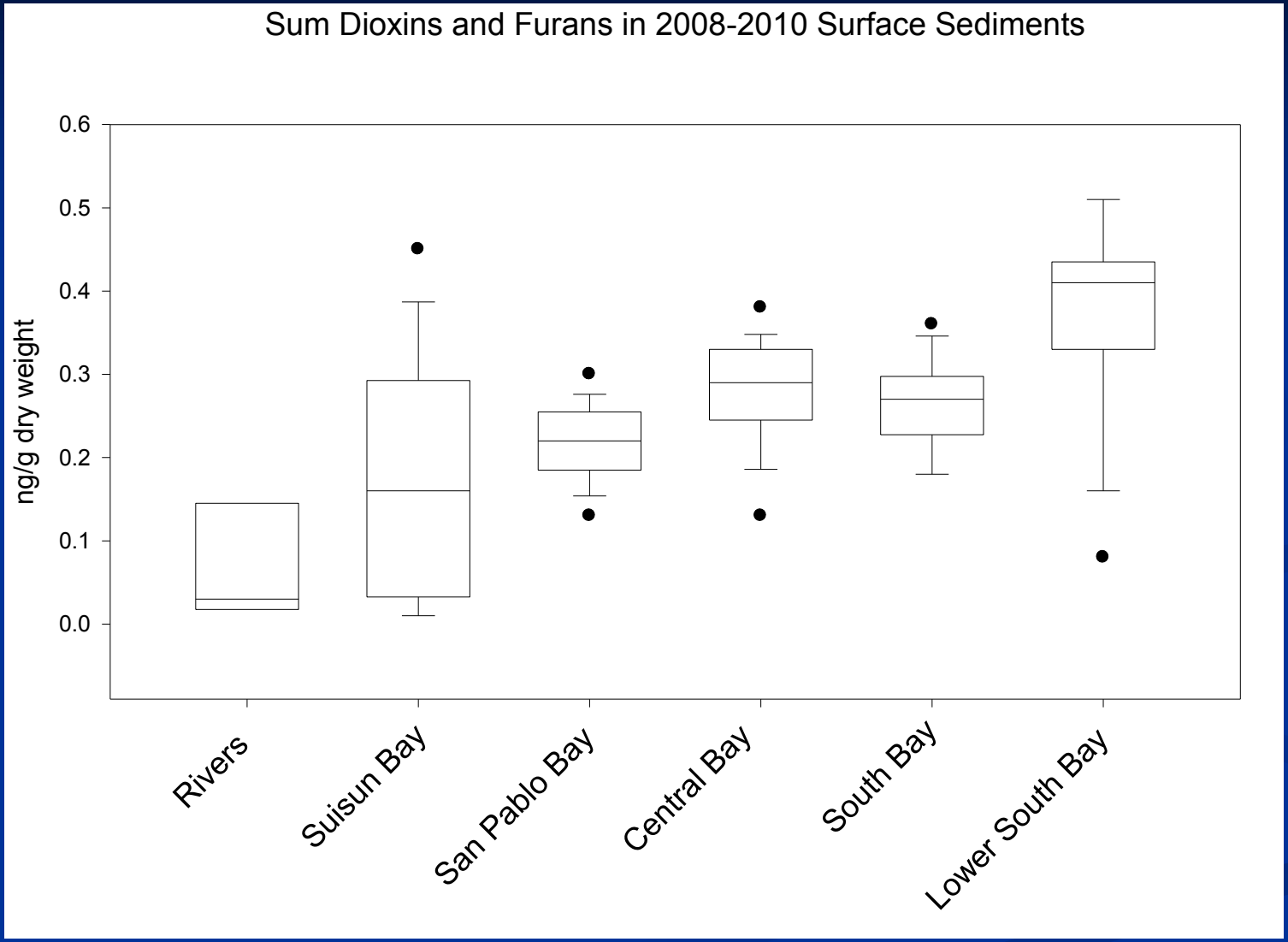


Total Dioxins (pg TEQ/g dw)

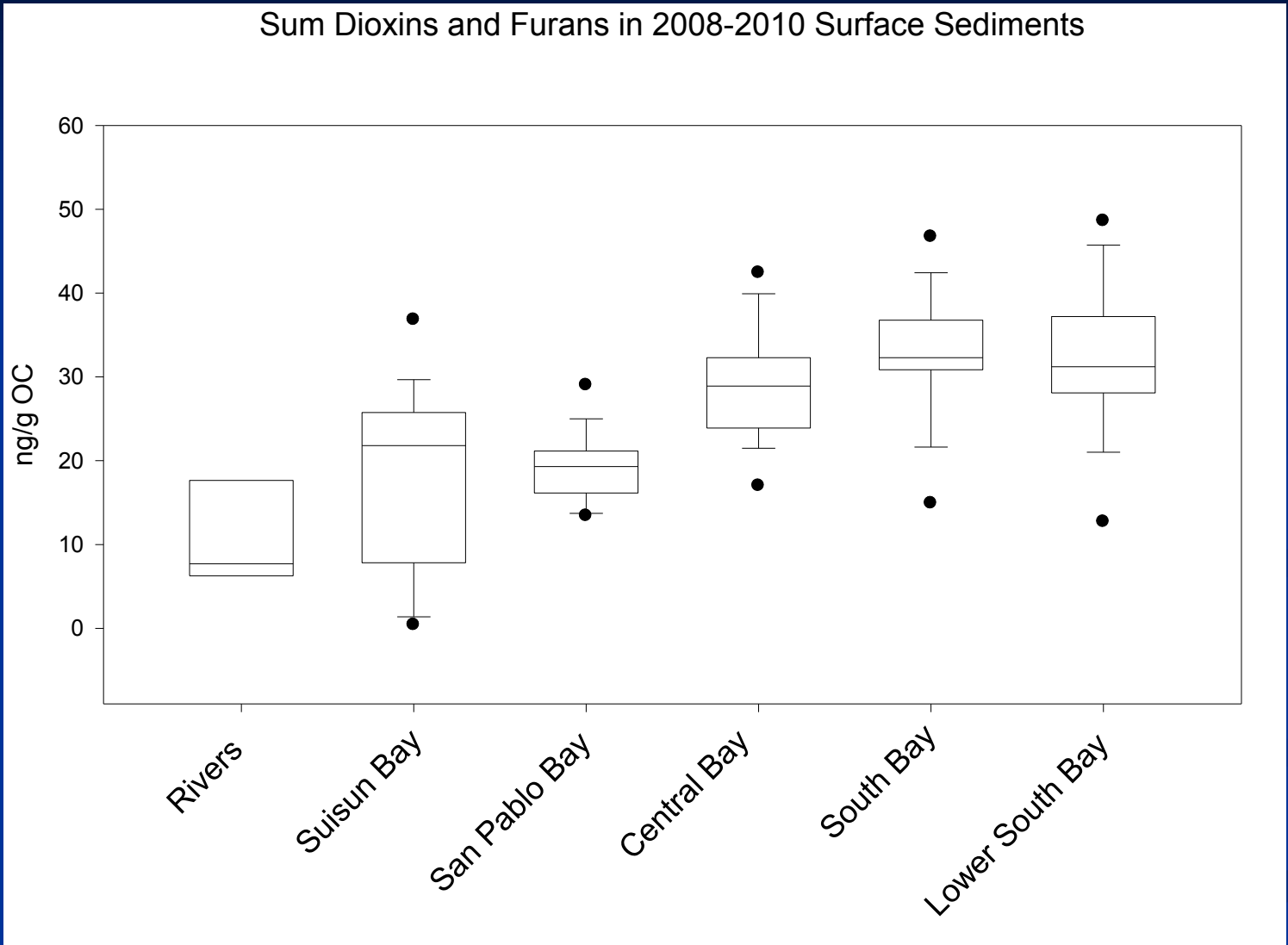


Same patterns as total PCDD/Fs

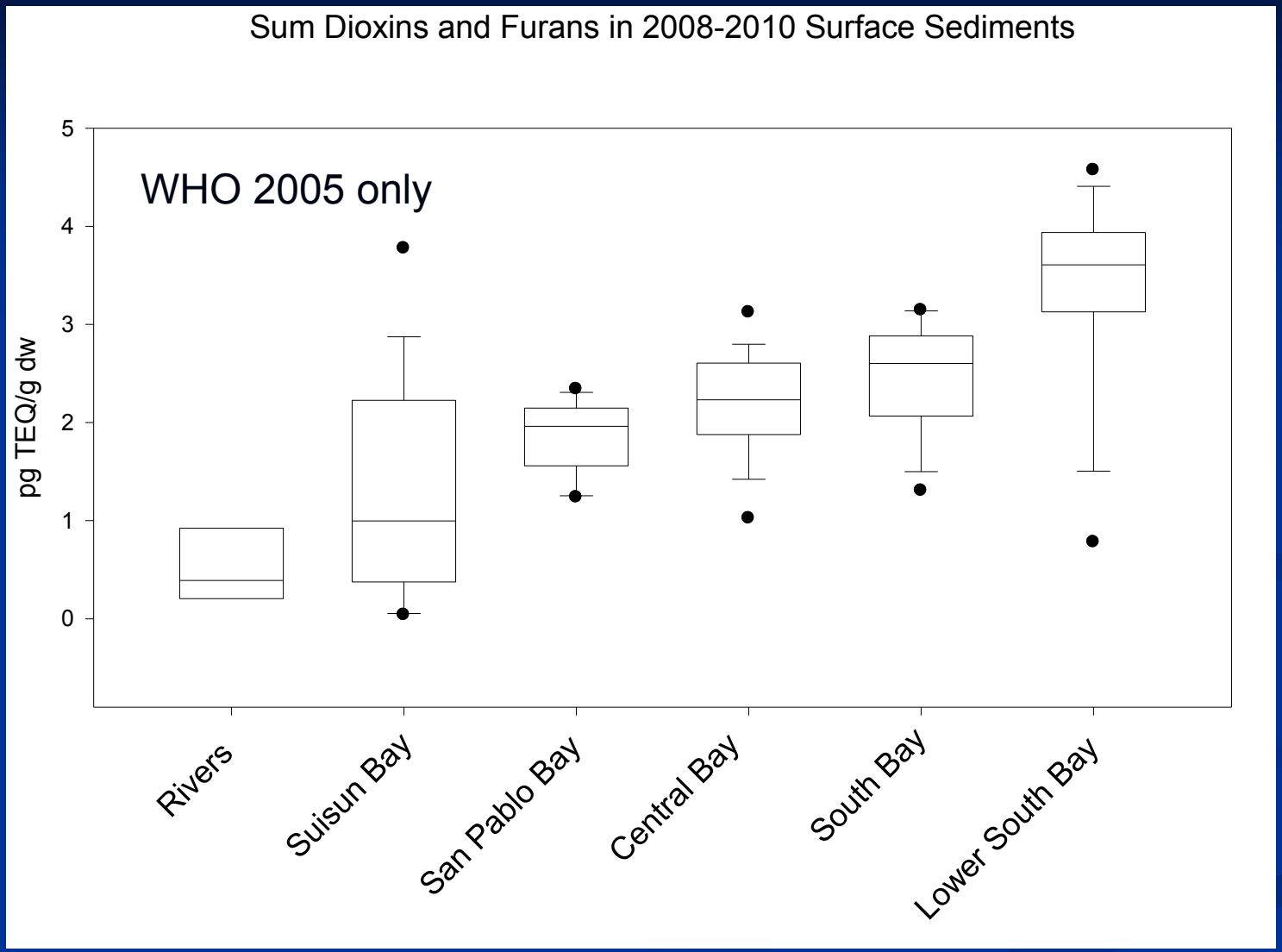
Total Dioxins (ng/g dw)



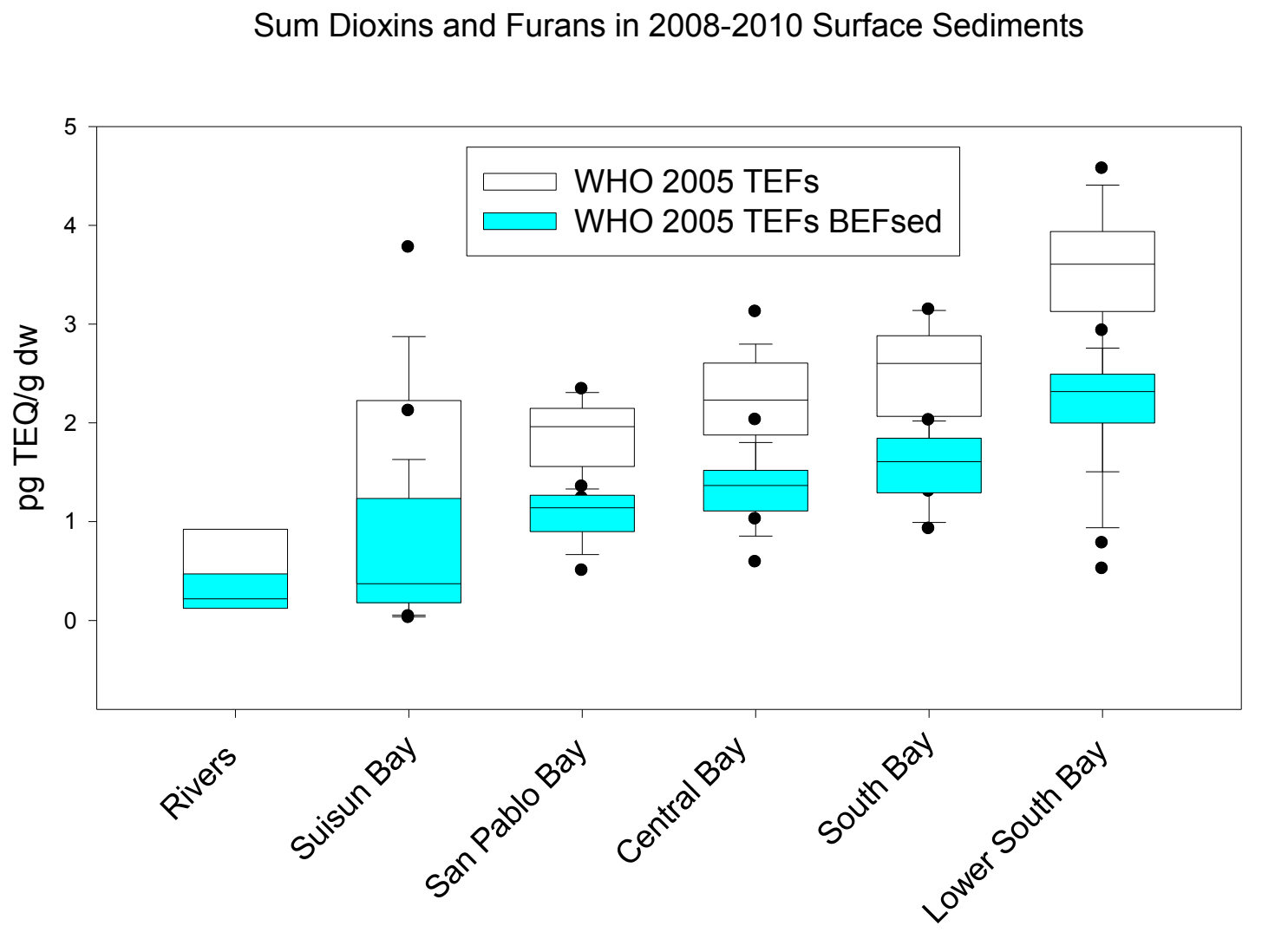
Total Dioxins (ng/g OC)



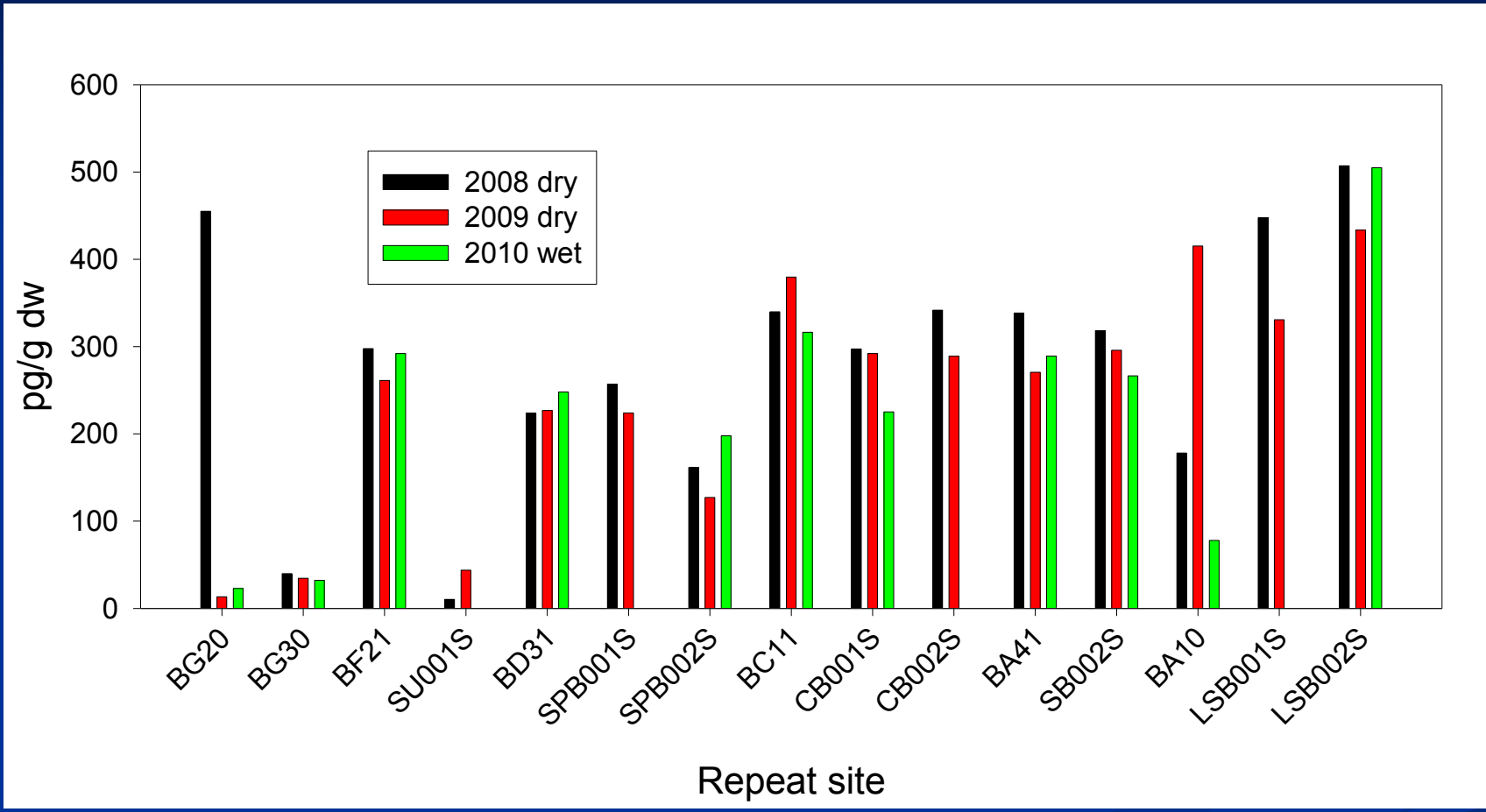
Total Dioxins (pg TEQ/g dw)



Total Dioxins (pg TEQ/g dw)

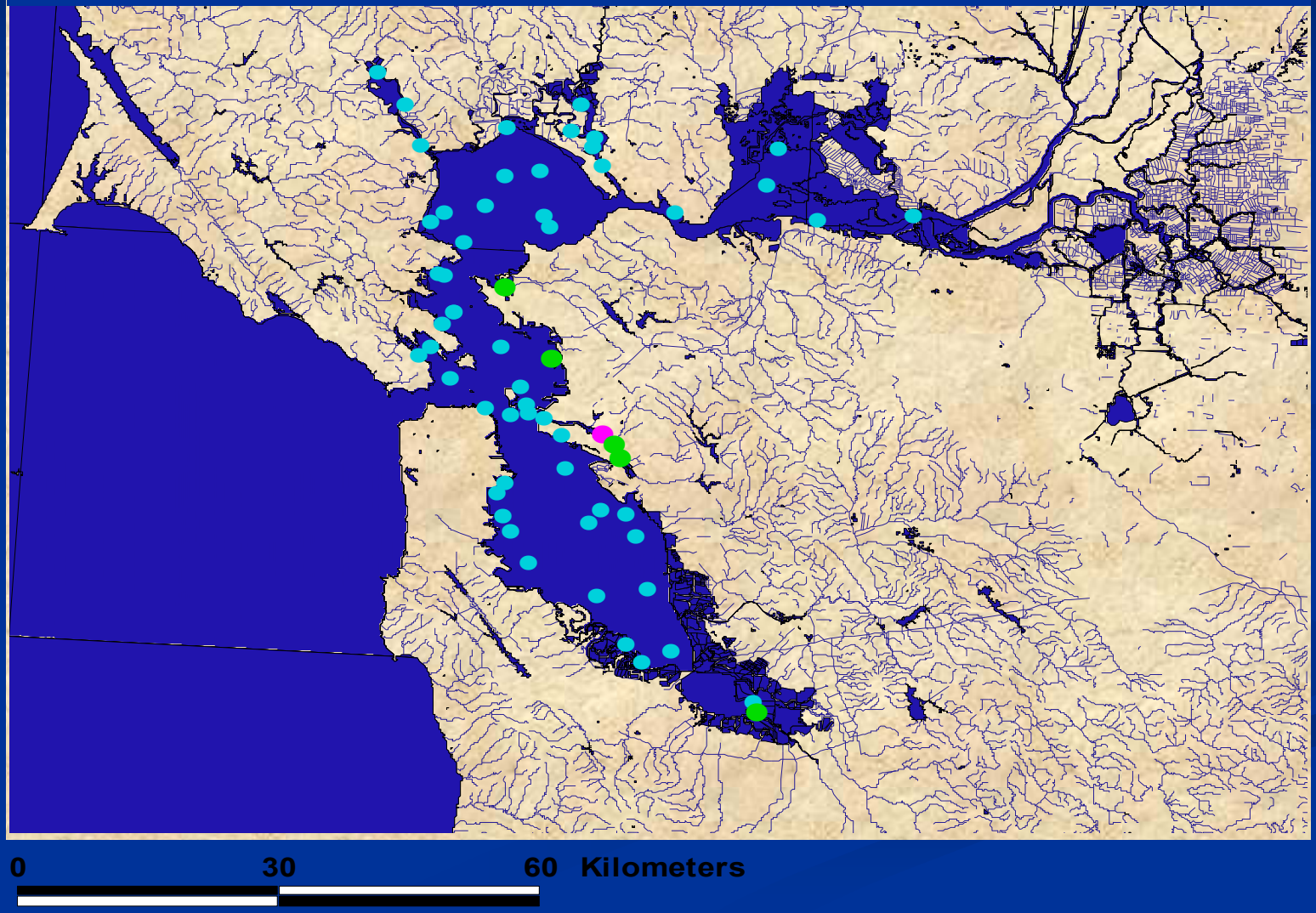


Seasonal Comparison (pg/g dw)

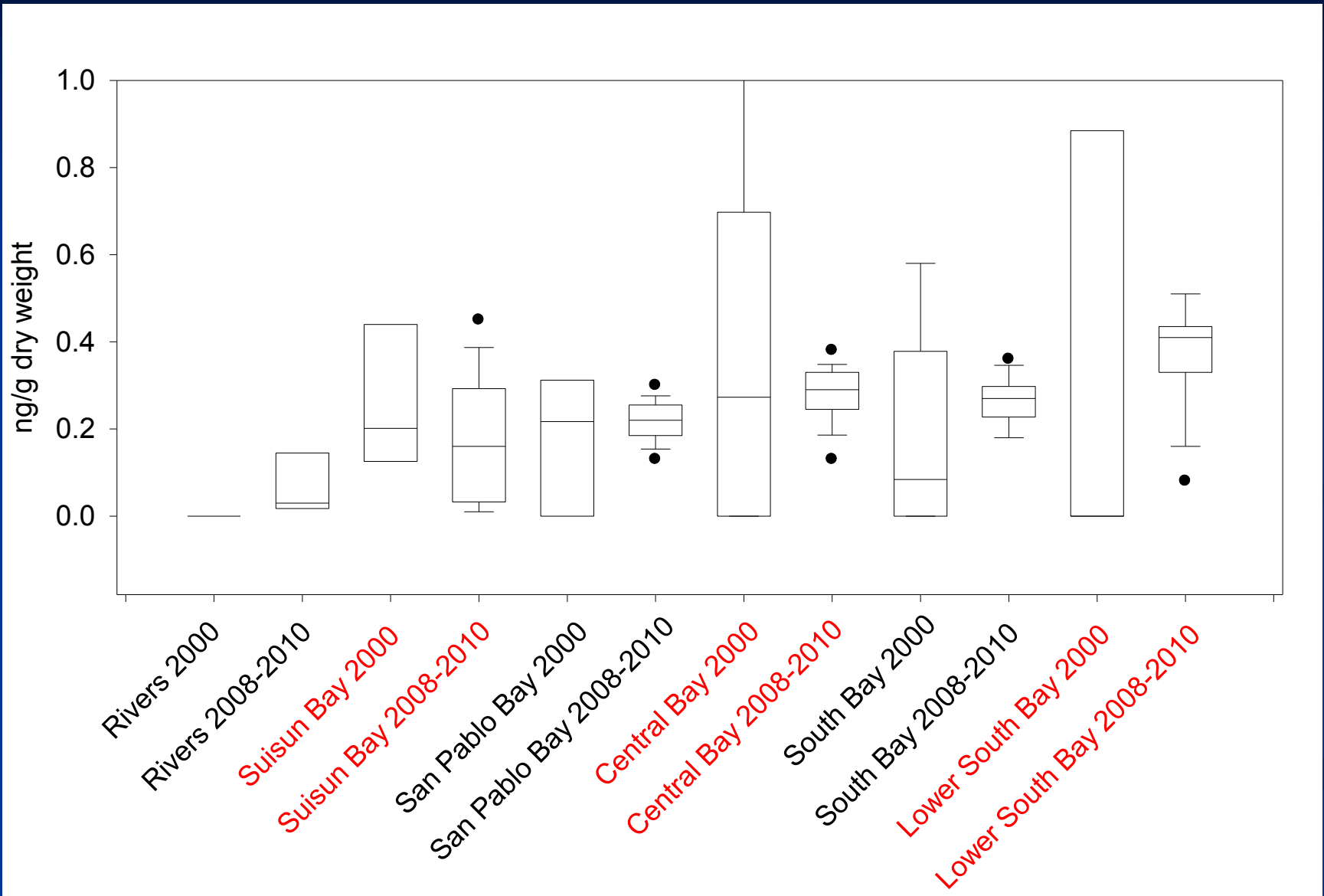


EMAP Dioxins (pg TEQ/g dw)

FIGURE 2. Distribution of dioxin-like compounds expressed as TEQ_{DFP}-WHO_{98}



EMAP 2000 vs RMP 2008-2010 (ng /g dw)



Surface sediment congener profile (pg/g)

Surface sediment congener profile (pg TEQ/g)

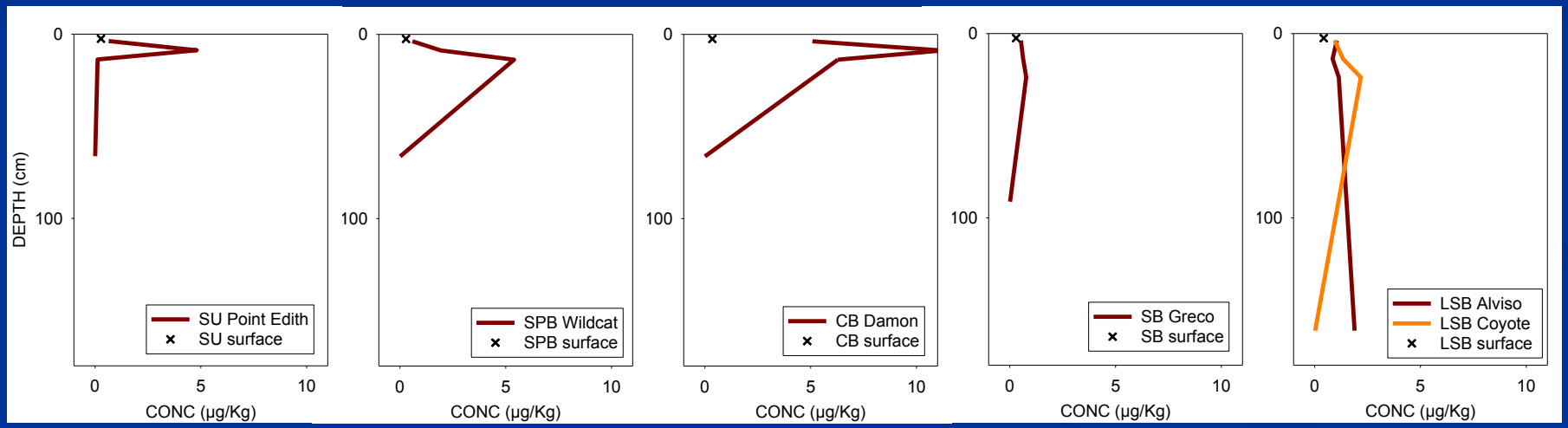
Surface Sediment Summary

- Concentrations highest in South Bay, Lower South Bay
- No consistent seasonal concentration differences
- Congener profiles similar Bay-wide
- Not enough ‘good’ data for long-term trend analysis; concentrations within range of NOAA EMAP 2000 data

- More surface sediments can provide somewhat more “representative” distribution for characterization of state, but unlikely to change short/mid-term decisions
- Data at longer intervals needed for long-term trends

More Core Sediments?

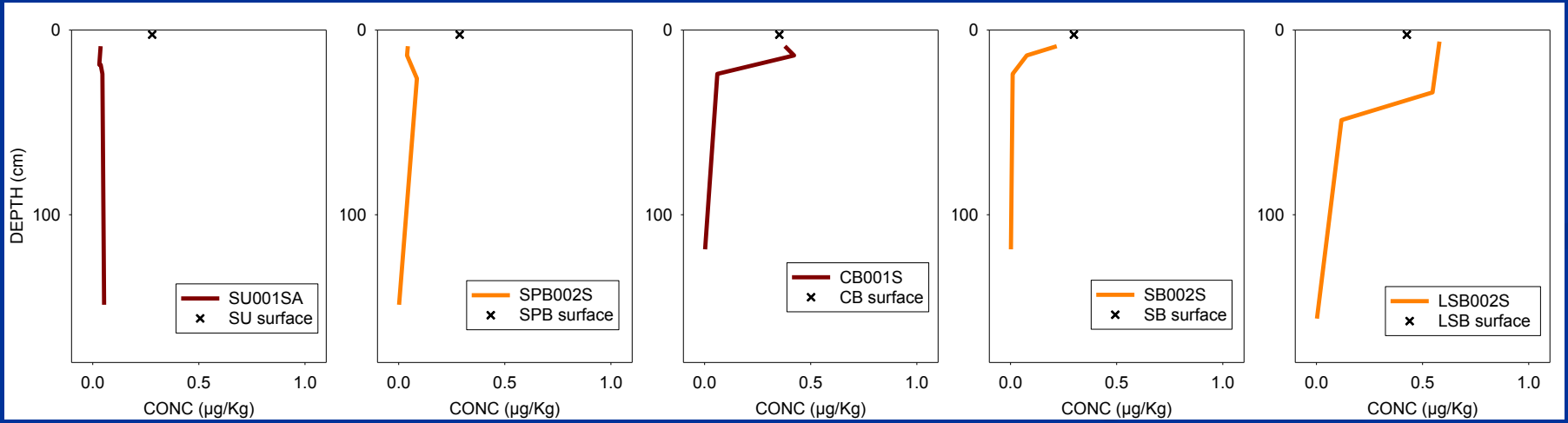
- PCDD/Fs in wetlands show past peaks



Concentrations in ug/kg fine sediment (<63um)

PCDD/Fs in Bay Cores

- PCDD/Fs in Bay slightly elevated near surface



Concentrations in ug/kg fine sediment (<63um)

*note different scale

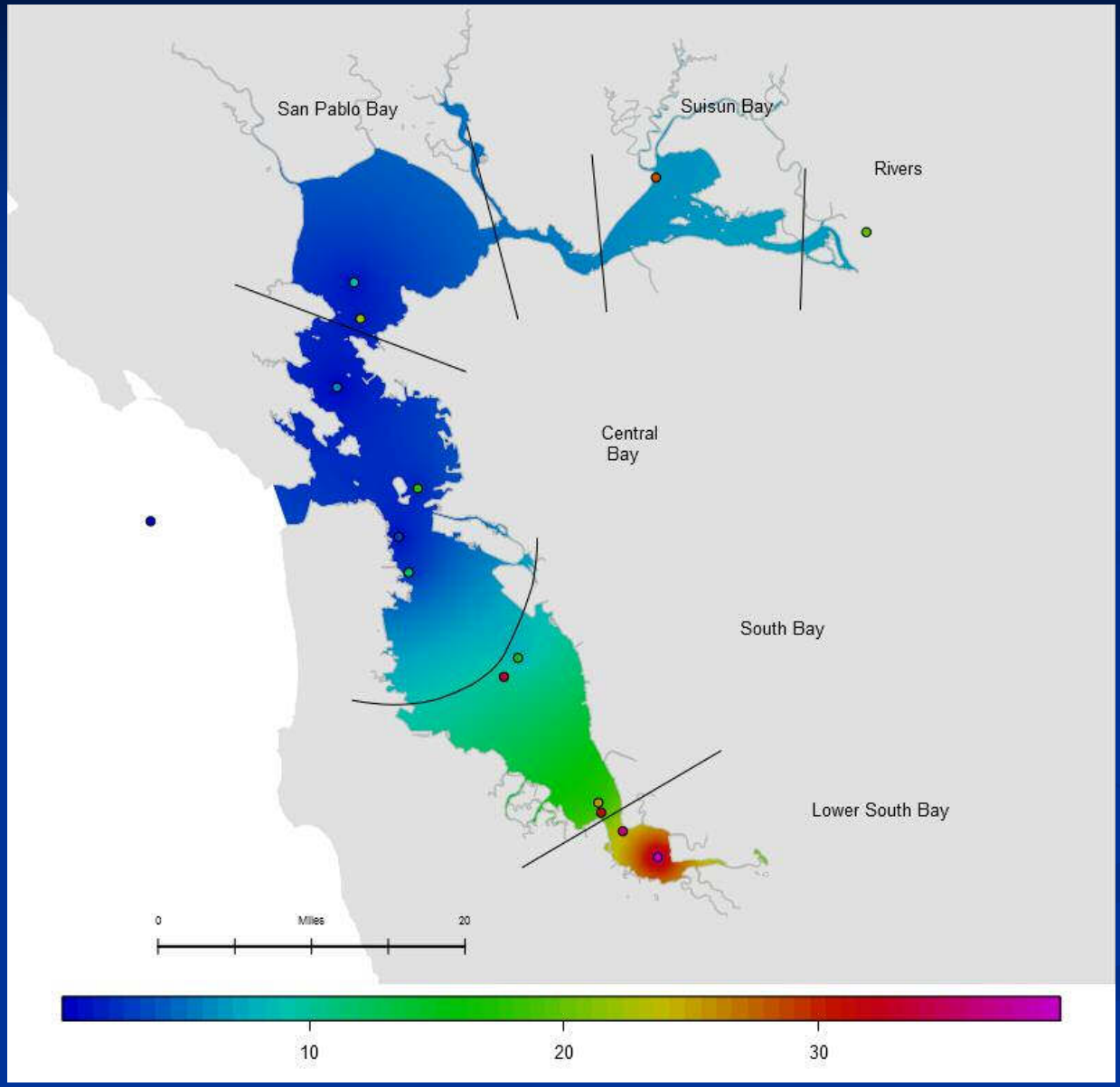
Core Objectives?

- Evidence of sediment processes?
  - Analytes with distinct release histories (introductions, bans) probably better
- History of sources
  - Some information already from wetland cores for non-specific sources
  - Other sources, which ones?

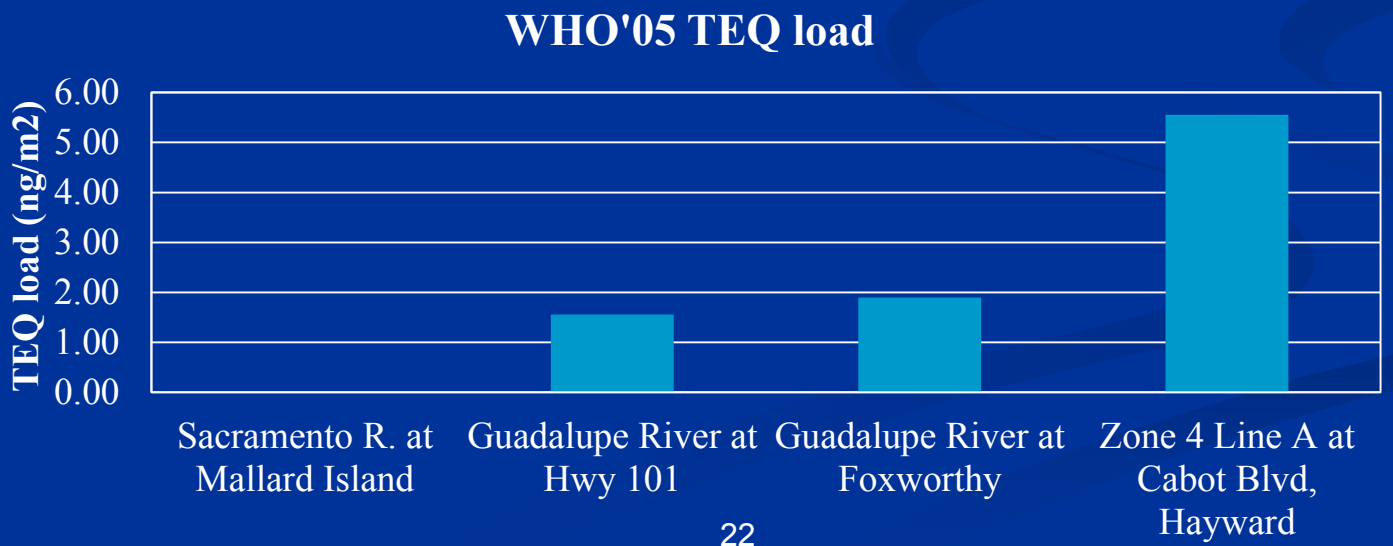
Other Alternatives

- More Bay water samples?
  - Currently only two years in Bay
  - Likely driven by/mirroring surface sediment
    - Most variation with SSC
    - Residual differences hint at regional sediment patterns
- More tributary data?
- Margins sediment?
  - Conceptual model – margins important sources and pathways for many contaminants
  - Not sampled in RMP, sparsely in other programs

Water Total Dioxins (pg/L)

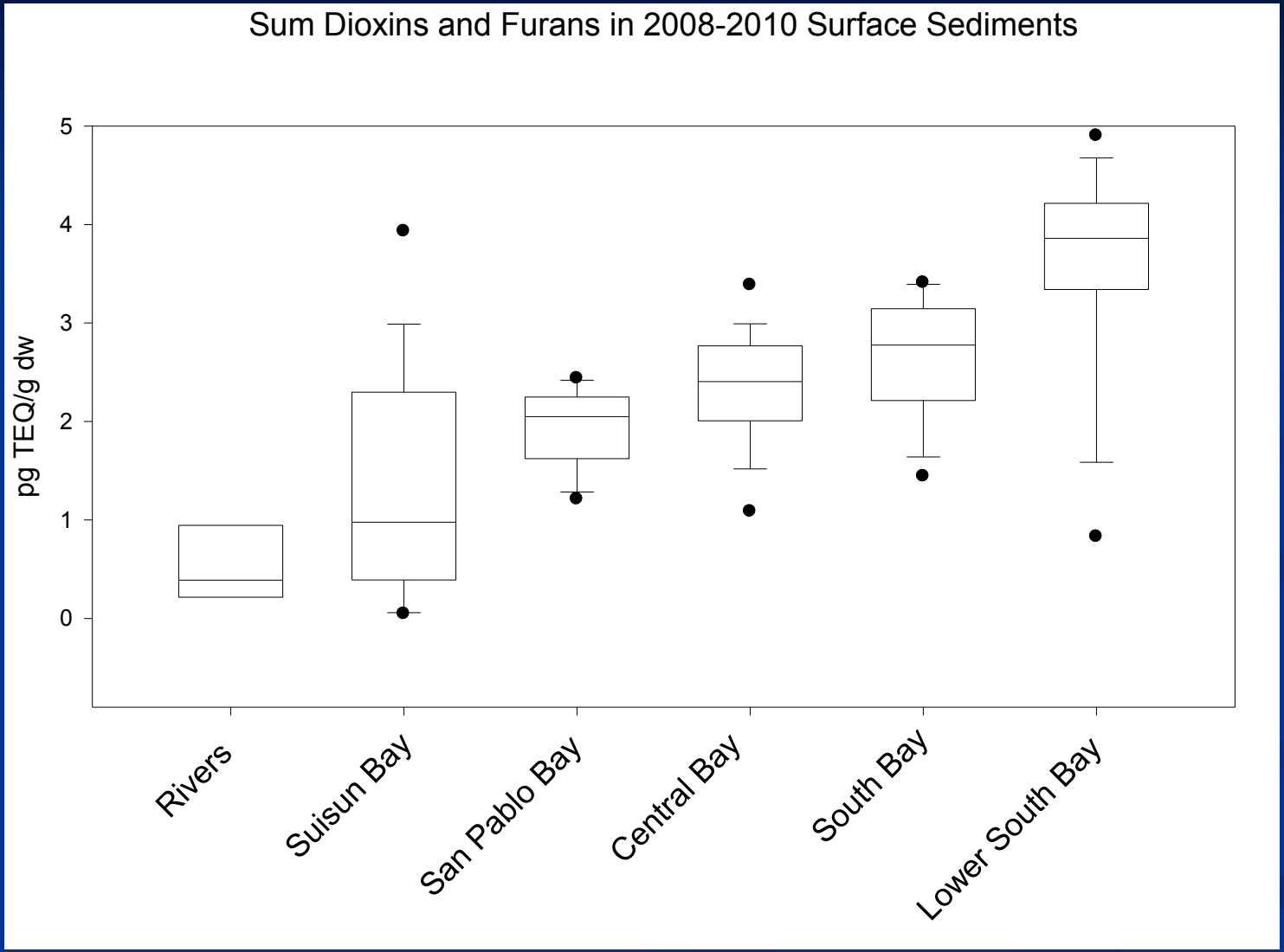


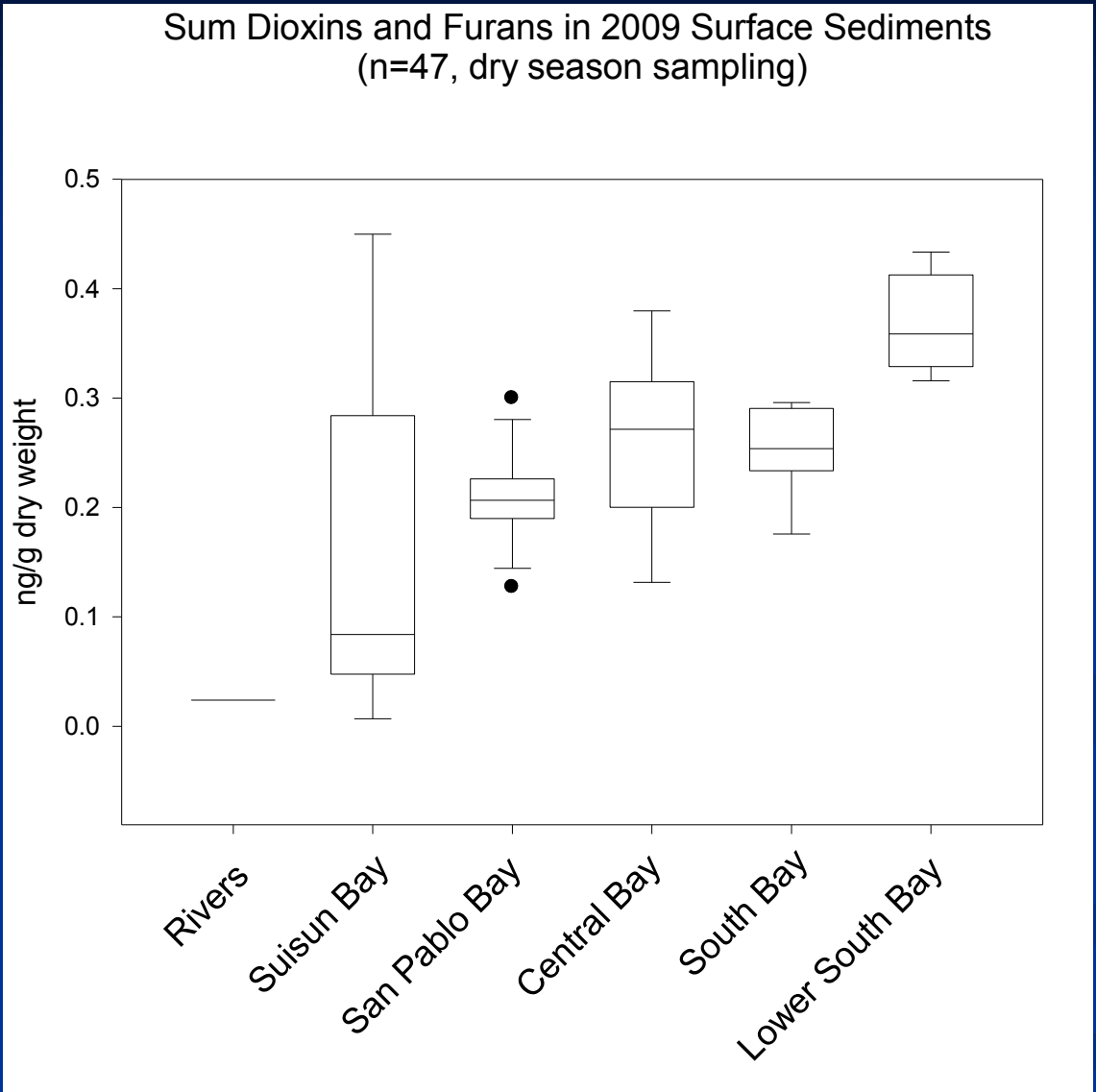
Tributary Loads (preliminary)



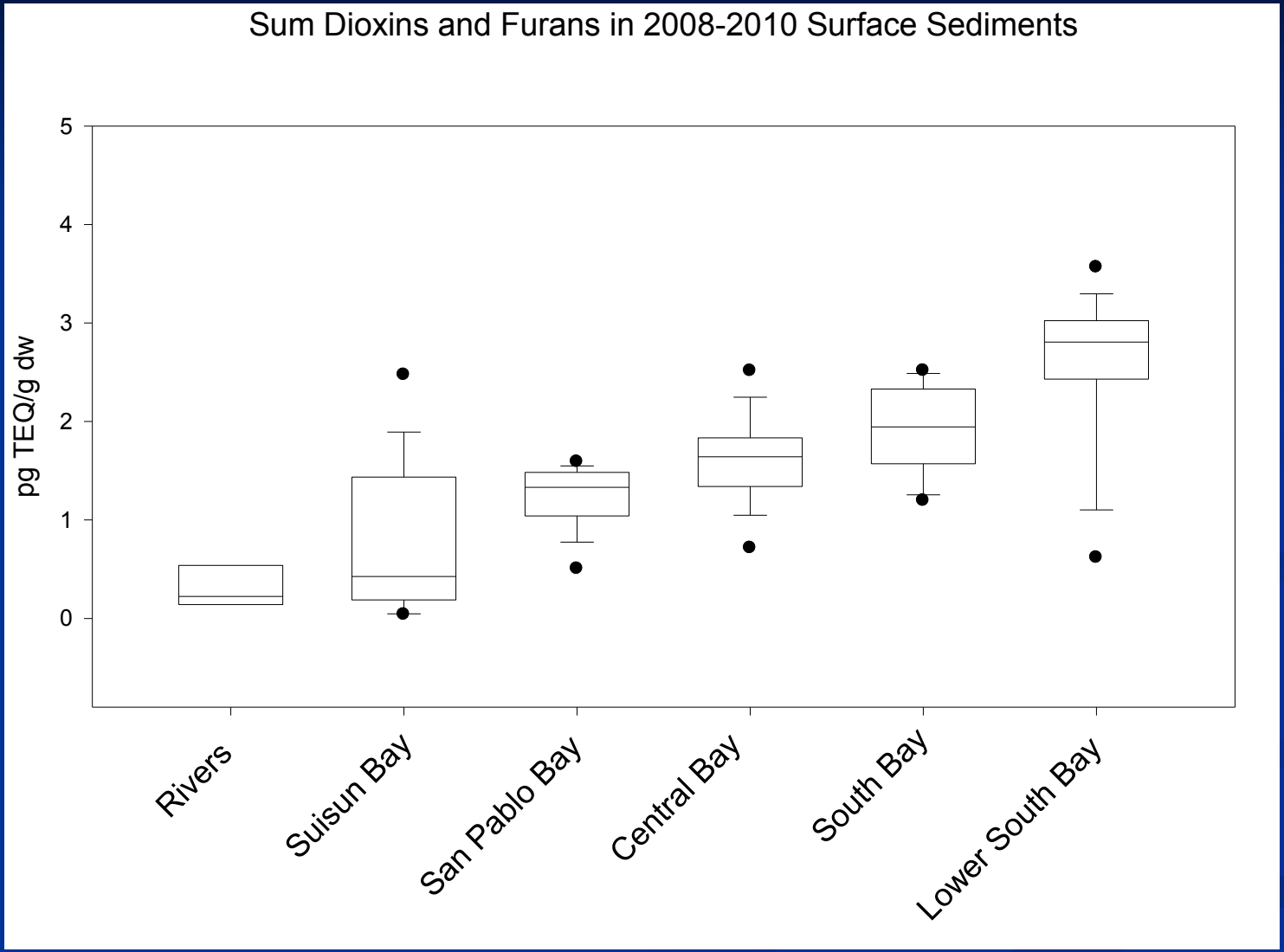
Preliminary data and analysis

WHO98 only

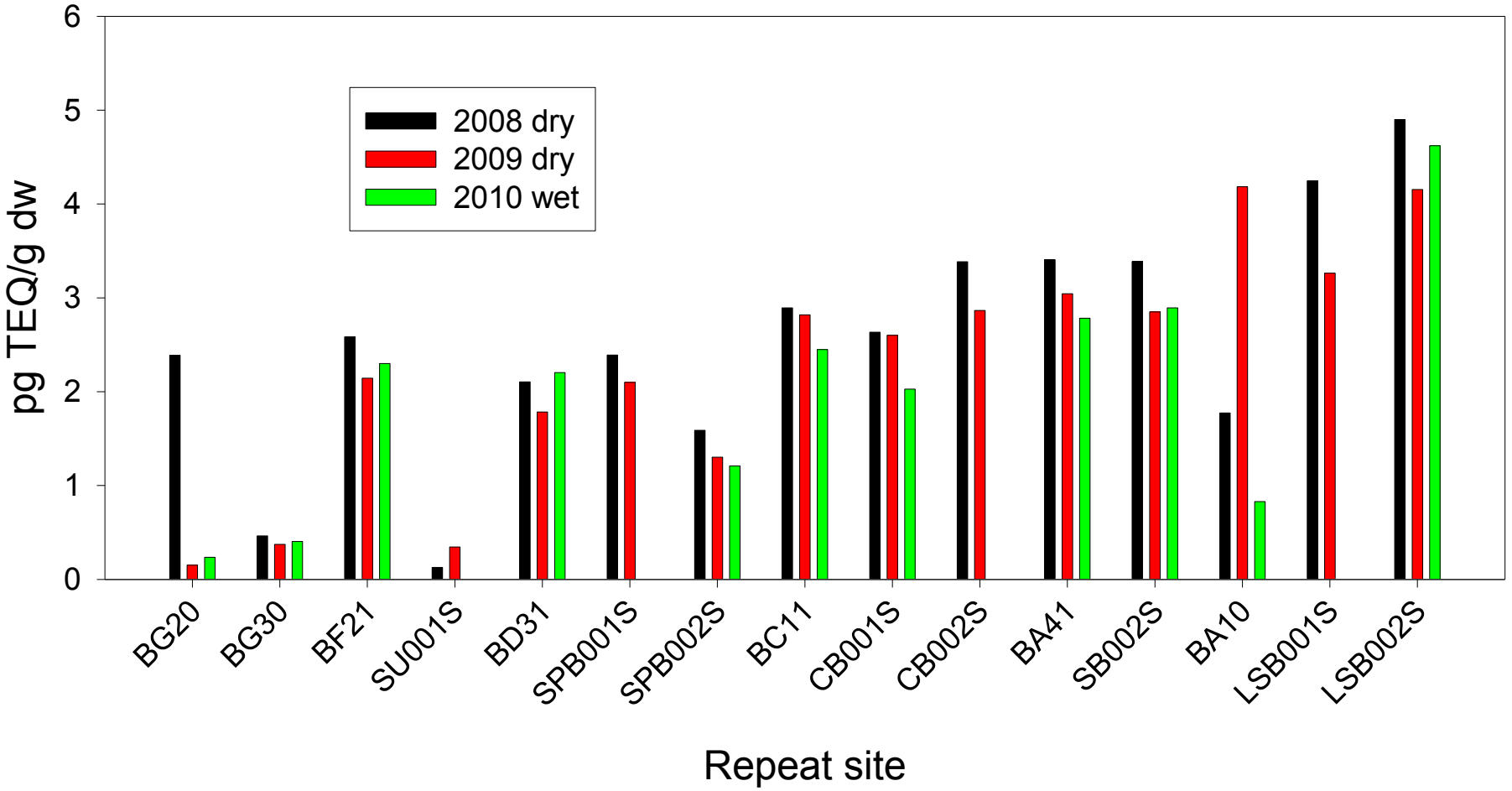

Sum Dioxins and Furans in 2008-2010 Surface Sediments
pg TEQ/g dw
0
1
2
3
4
5
Rivers
Suisun Bay
San Pablo Bay
Central Bay
South Bay
Lower South Bay


Sum Dioxins and Furans in 2009 Surface Sediments
(n=47, dry season sampling)
ng/g dry weight
0.5
0.4
0.3
0.2
0.1
0.0
Rivers
Suisun Bay
San Pablo Bay
Central Bay
South Bay
Lower South Bay

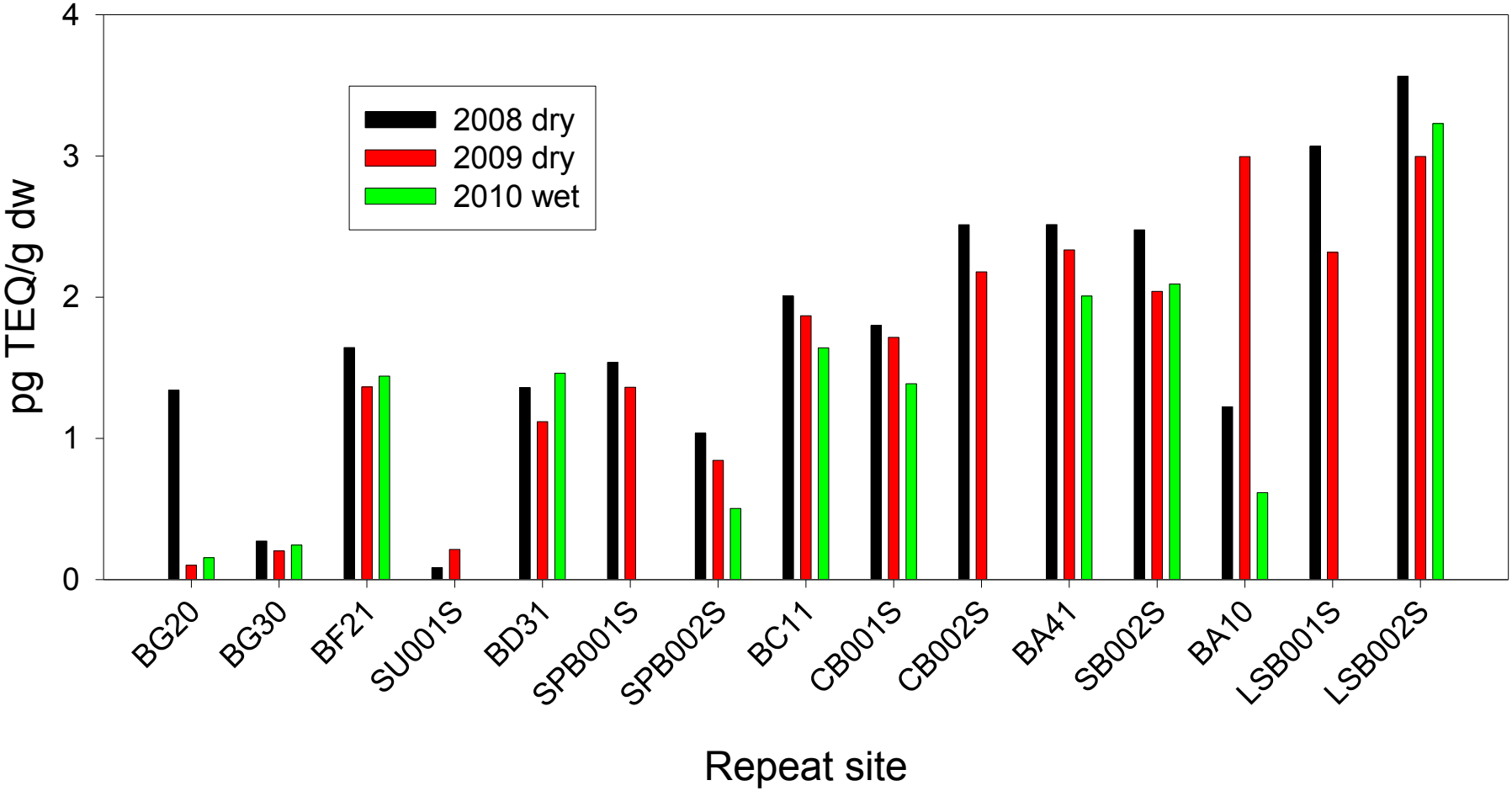
WHO 98 BEFsed



WHO 98


2008 dry
2009 dry
2010 wet
pg TEQ/g dw
0
1
2
3
4
5
6
BG20
BG30
BF21
SU001S
BD31
SPB001S
SPB002S
BC11
CB001S
CB002S
BA41
SB002S
BA10
LSB001S
LSB002S
Repeat site

WHO 98 BEFsed



PCB Synthesis Update

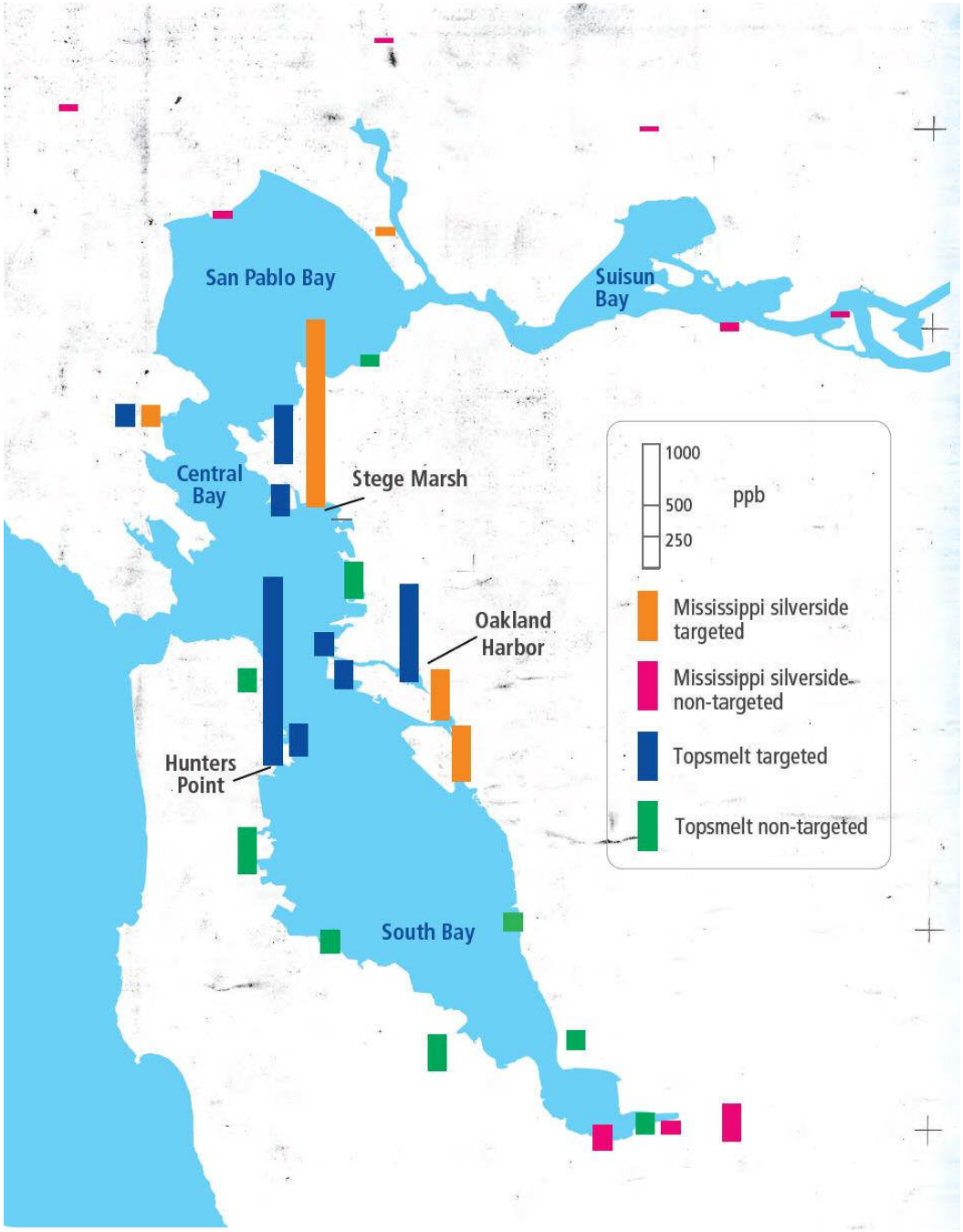
- Original target March 2012
- Work window in January & February, not March (Pulse and BOG report)
- Current target for draft is May 15

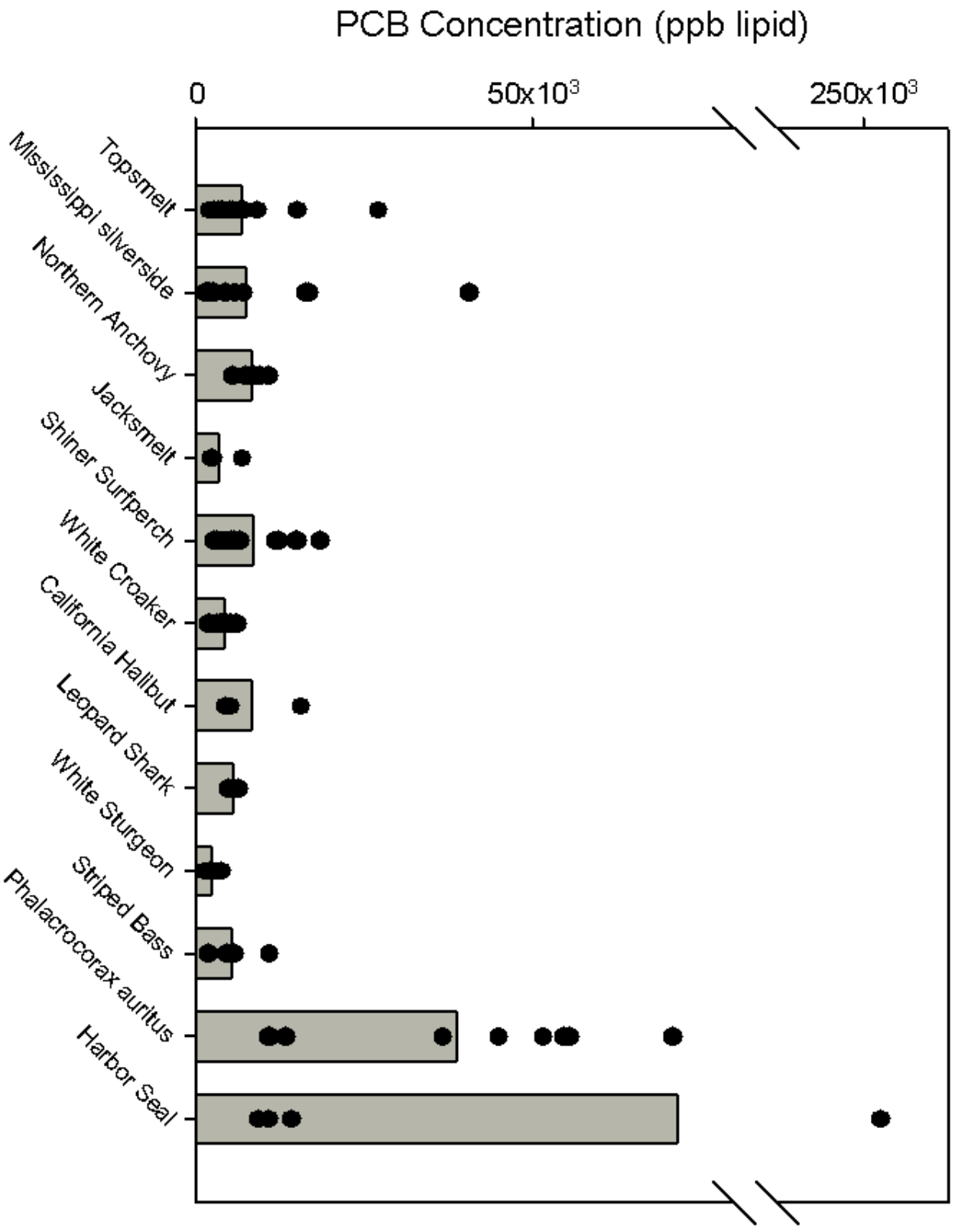
Outline

1. Potential for impacts on humans and aquatic life
2. Appropriate guidelines for protection of beneficial uses
3. Rates of recovery of the Bay, its segments, and in-Bay contaminated sites
4. Total maximum daily load (Thomas, Don)
5. Present loads and long-term trends in loading from each of the major pathways (Lester)
6. Role of in-Bay contaminated sites in segment-scale recovery rates
7. Small tributaries and contaminated margin sites that are the highest priorities for cleanup (Lester)
8. Management actions with the greatest potential for accelerating recovery or reducing exposure (Lester)
9. Most appropriate index for sums of PCBs

For each topic:

a. New developments and information, conceptual advances
b. Priority information gaps


San Pablo Bay
Suisun Bay
Central Bay
Stege Marsh
Oakland Harbor
Hunters Point
South Bay
1000
500
250
ppb
Mississippi silverside targeted
Mississippi silverside non-targeted
Topsmelt targeted
Topsmelt non-targeted


PCB Concentration (ppb lipid)
0
50x10^3
250x10^3
Topsmelt
Mississippi silverside
Northern Anchovy
Jacksmelt
Shiner Surfperch
White Croaker
California Halibut
Leopard Shark
White Sturgeon
Striped Bass
Phalacrocorax auritus
Harbor Seal

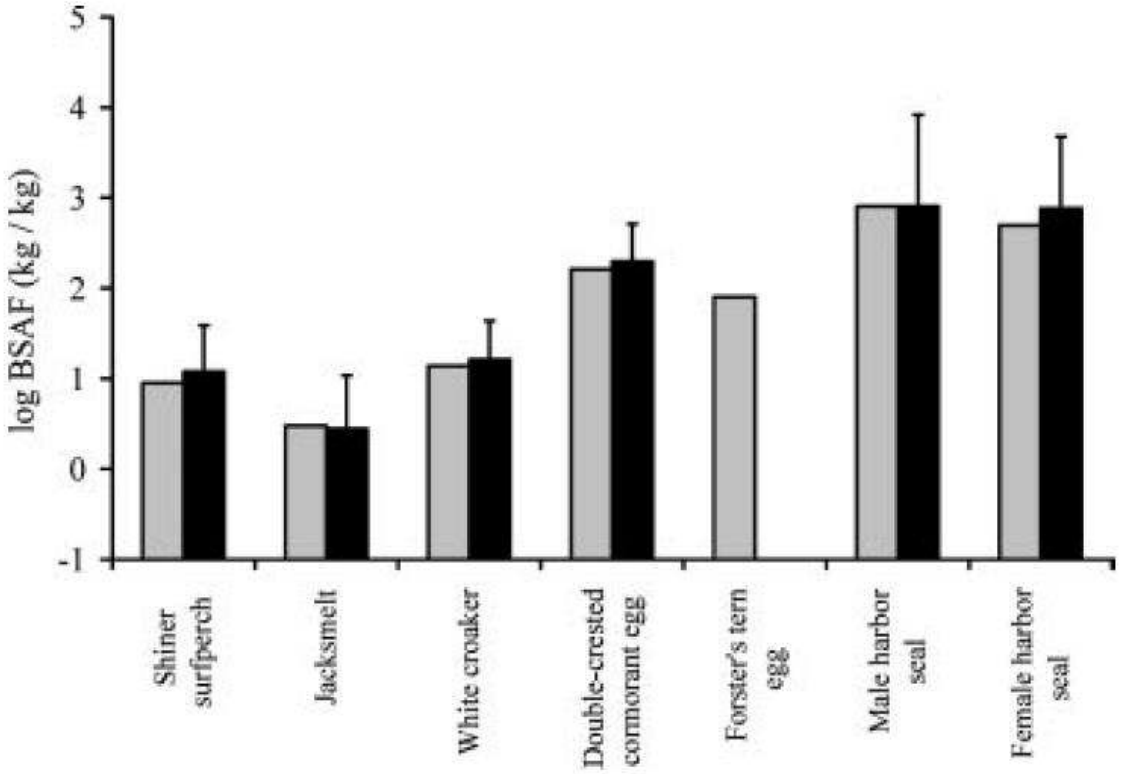


Fig. 4. Model-predicted (gray columns) and observed (black columns) mean biota–sediment bioaccumulation factors (BSAFs in kg dry sediment/kg wet wt organism) of total polychlorinated biphenyls ($\sum$PCBs) in several species in San Francisco Bay, California, USA. Error bars represent 95% confidence intervals.

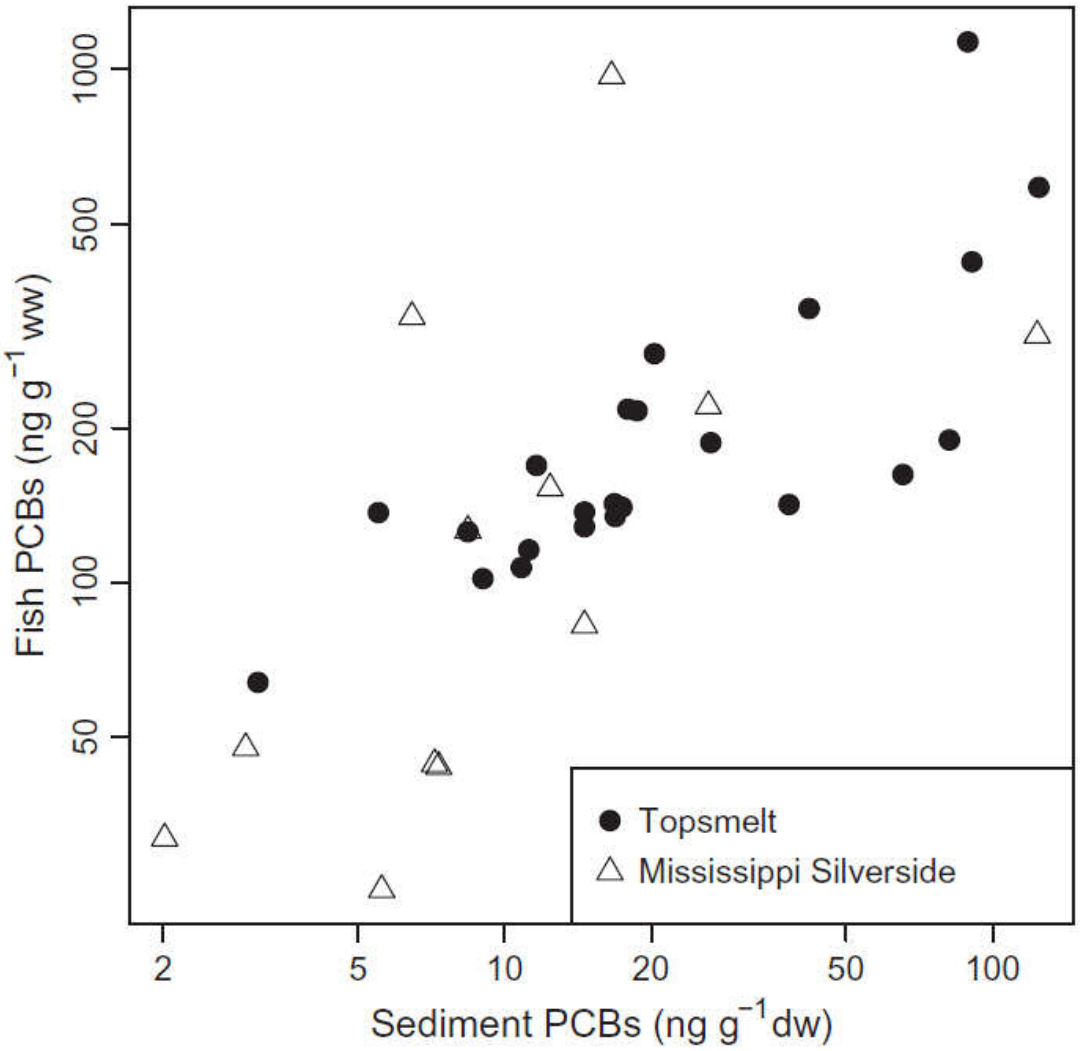
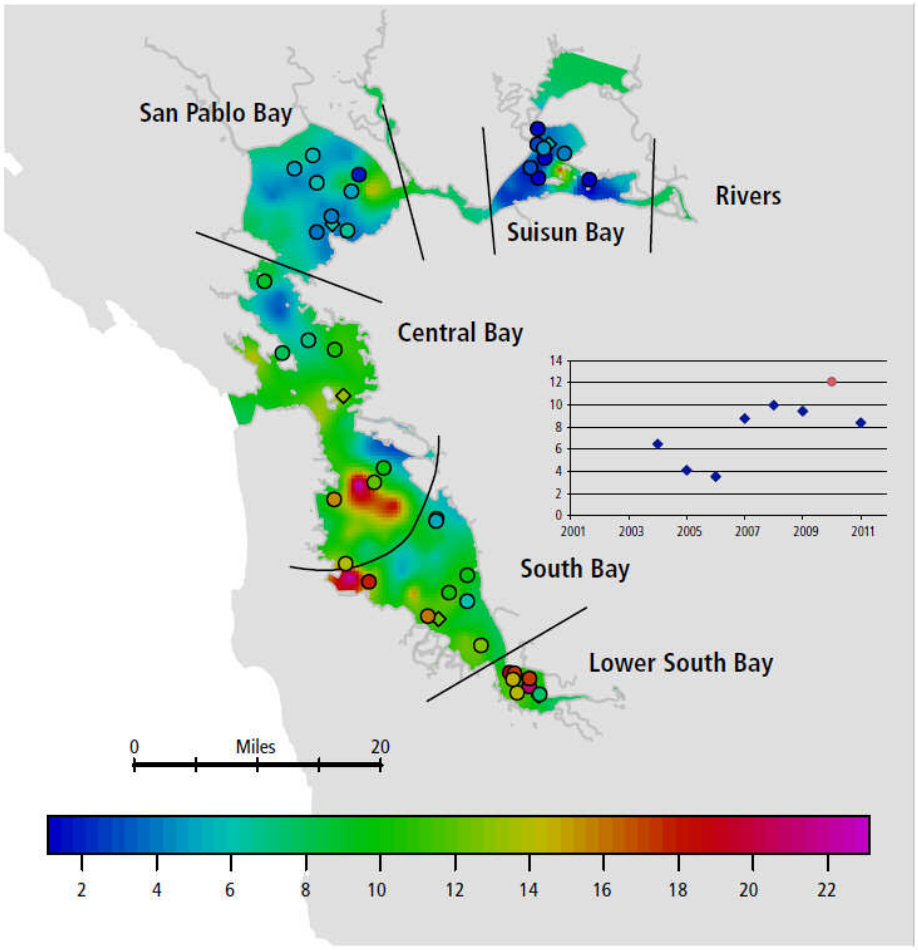
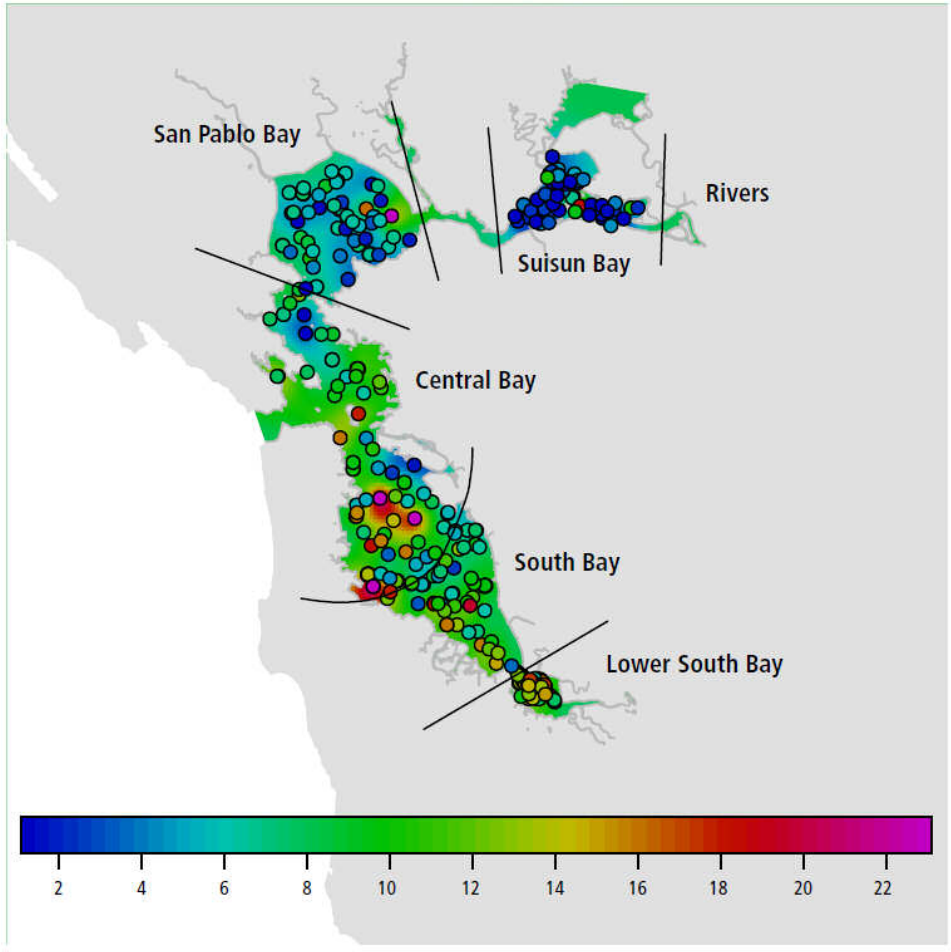


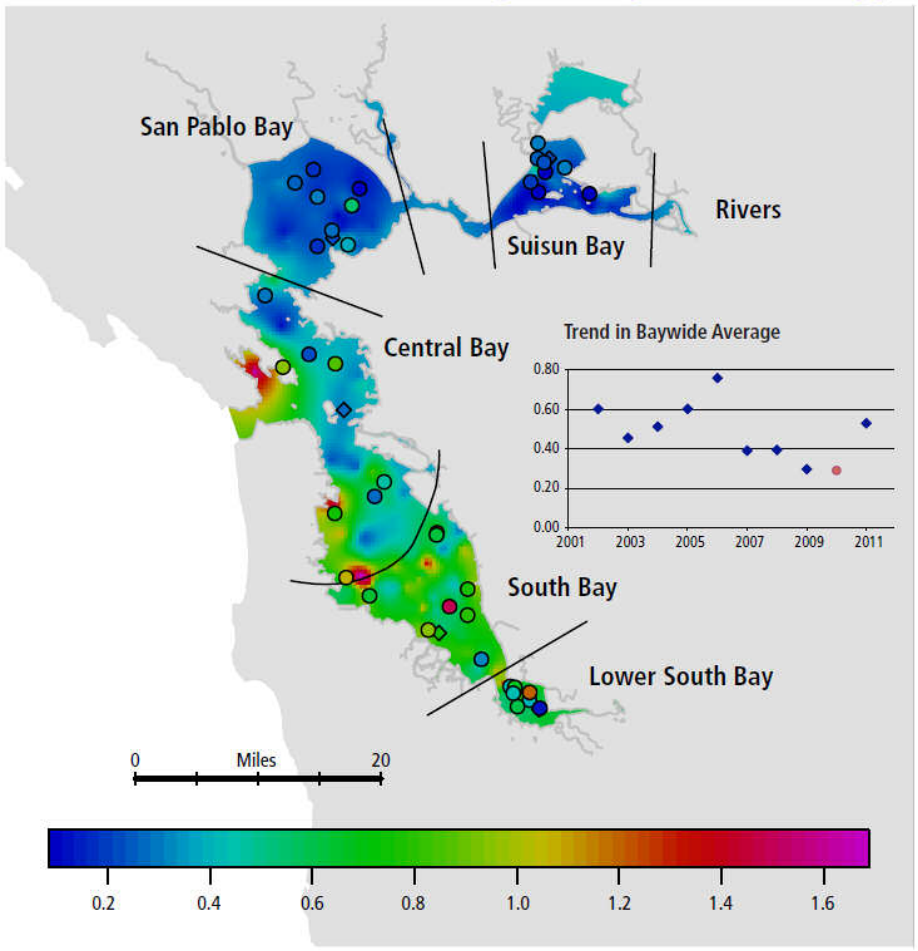
Fig. 3. Relationship between sediment and fish PCB concentrations (Σ40 congeners). *Note*: log scale.

Sum of PCBs in Sediment (ppb)

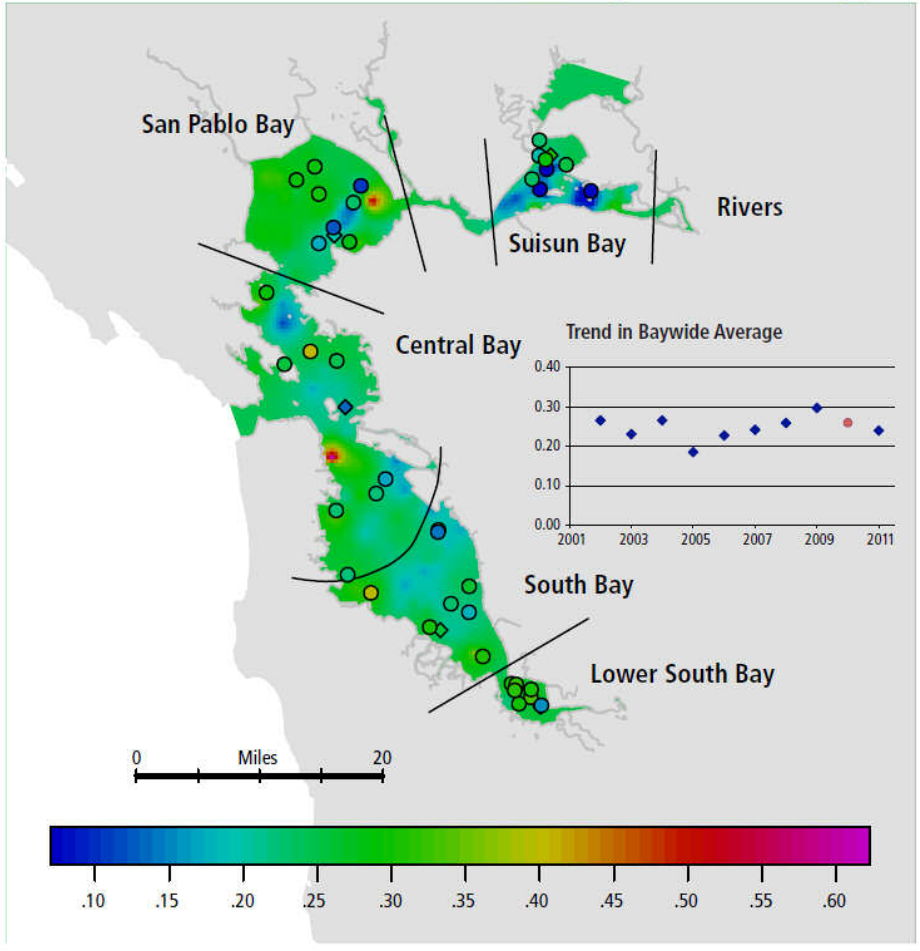


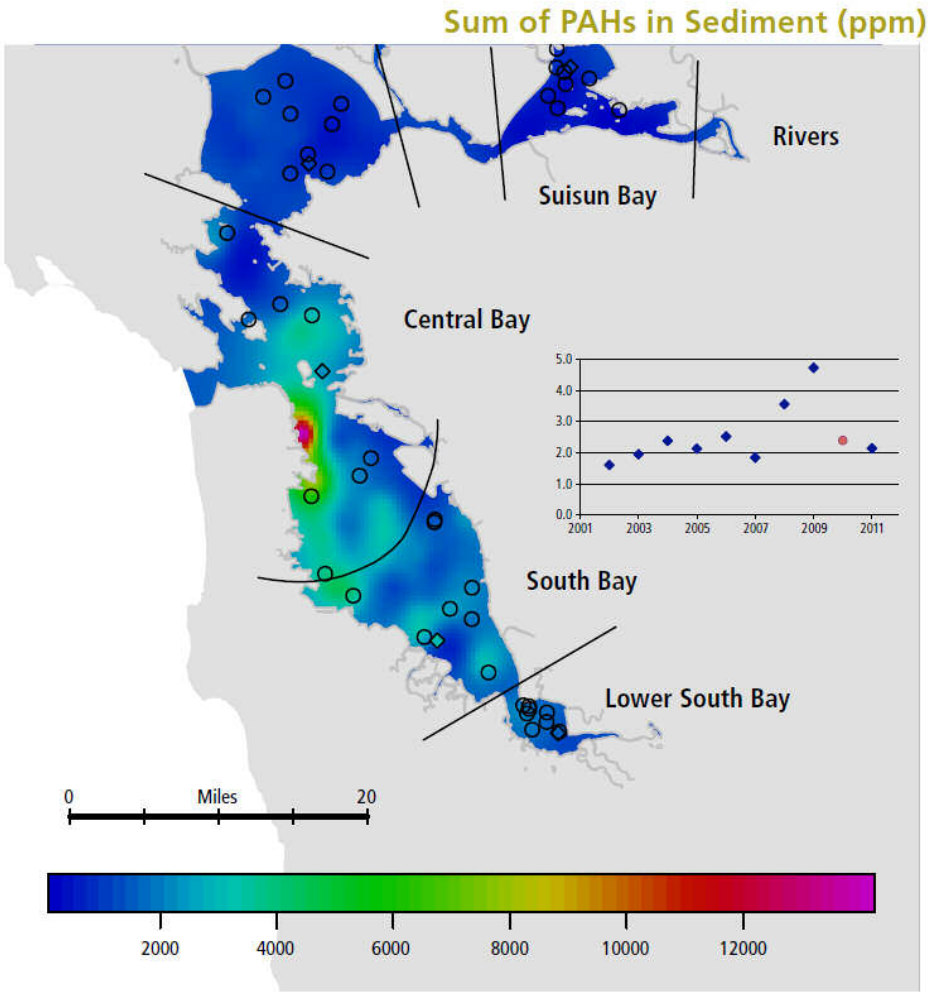


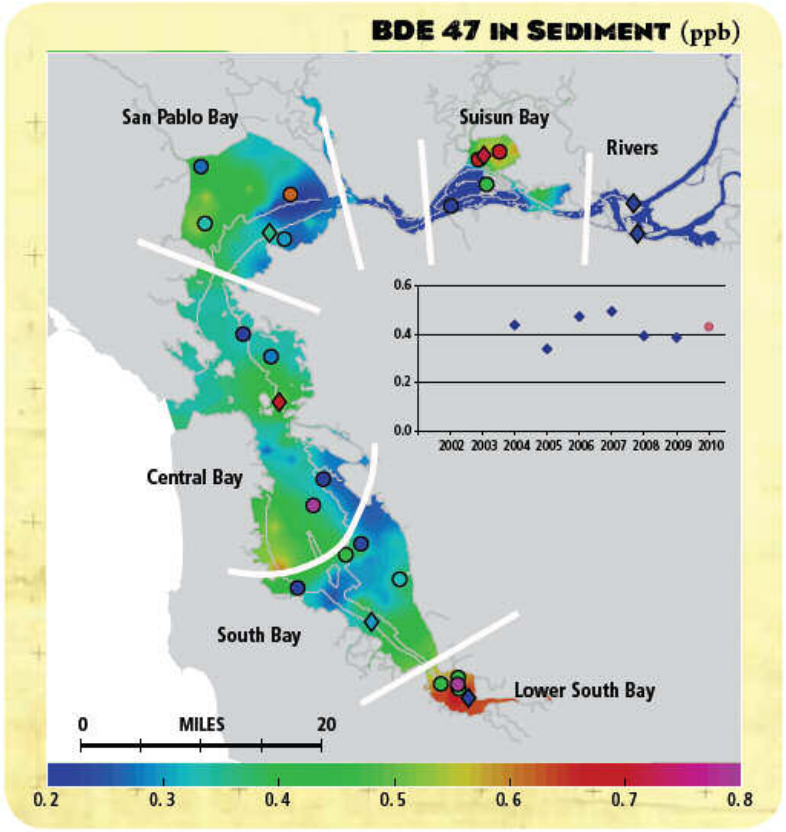
Methylmercury in Sediment (ppb)



Mercury in Sediment (ppm)



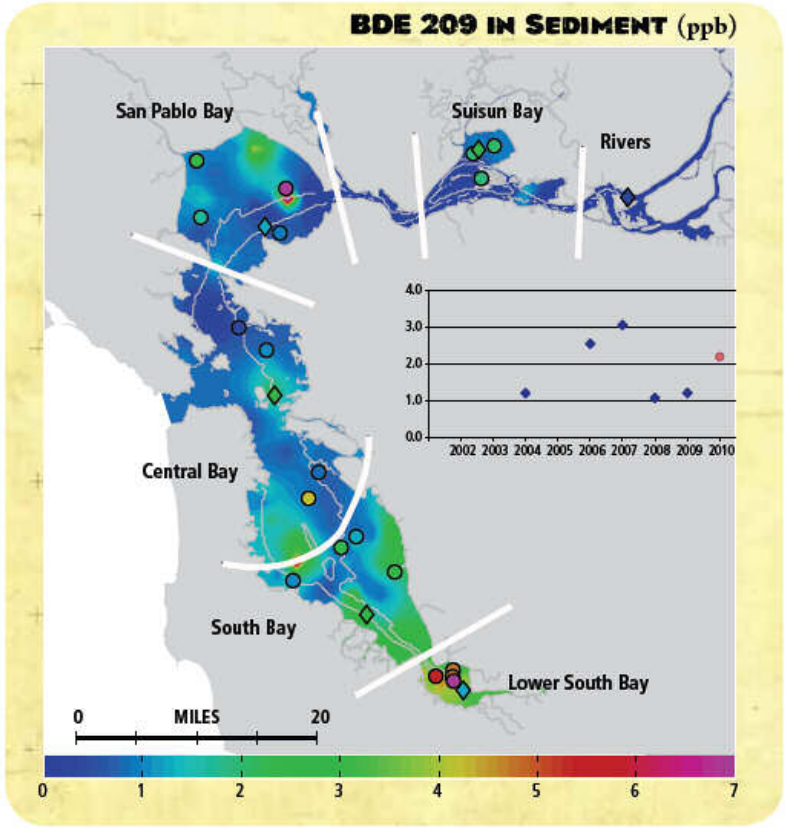

Sum of PAHs in Sediment (ppm)
Rivers
Suisun Bay
Central Bay
South Bay
Lower South Bay
5.0
4.0
3.0
2.0
1.0
0.0
2001
2003
2005
2007
2009
2011
0
Miles
20
2000
4000
6000
8000
10000
12000



In contrast to the results obtained from water monitoring, long-term average dry season concentrations of BDE 47 in sediment have been highest in Lower South Bay (0.70 ppb). Circles and diamonds represent results from a first year of wet-season sampling in 2010. The spatial pattern observed in the wet season of 2010 was consistent with the general pattern observed in dry season monitoring from 2002-2009. Three samples with relatively high concentrations were observed in northern Suisun Bay, a region that has been consistently elevated in past sampling. The Bay-wide average for the 2010 wet season (0.43 ppb) was similar to the long-term average for the dry season (0.42 ppm) and to annual dry season averages observed in all prior years (2004-2009). The Bay-wide average has shown little fluctuation over the seven-year period, ranging from a low of 0.34 in 2005 to a high of 0.49 in 2007.

Footnote: BDE 47 is one of the most abundant PBDEs and was consistently quantified by the lab. Contour plot based on 282 RMP data points from 2004–2009. Data from 2002 are available but were inconsistent with data for the other years. The maximum concentration, by far, was 3.8 ppb in Lower South Bay in 2005. Trend plot shows annual Bay-wide averages. Colored symbols on map show results for samples collected during the wet season (February) in 2010. Circles represent random sites. Diamonds represent historic fixed stations. Concentrations presented on a dry weight basis.

BDE 209 (also known as decabromodiphenyl ether) represents the one remaining class of PBDEs that can still be used in California. Similar to BDE 47 in sediment, long-term average dry season concentrations of BDE 209 from 2004–2009 were highest in Lower South Bay (4.8 ppb). Circles and diamonds represent results from a first year of wet-season sampling in 2010. The spatial pattern observed in the wet season of 2010 was consistent with the general pattern seen in dry season monitoring from 2002-2009, with the highest concentrations (including samples at 16 ppb in Lower South Bay and 8.4 ppb in San Pablo Bay) occurring in areas previously shown to have relatively high concentrations. The average for the 2010 wet season (2.2 ppb) was similar to the long-term average for the dry season (1.8 ppb) and in the middle of the range of annual dry season averages from 2004-2009.

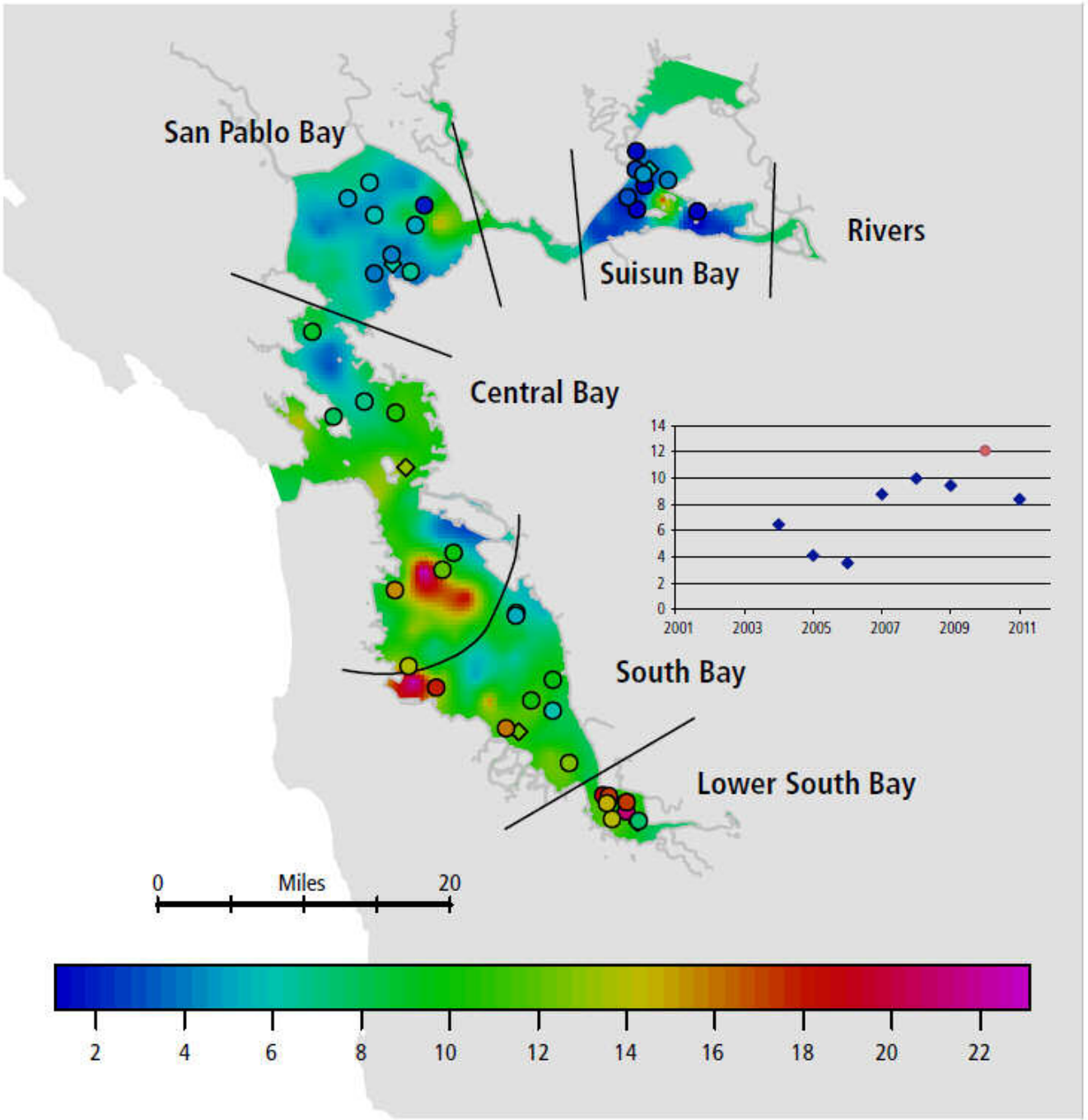


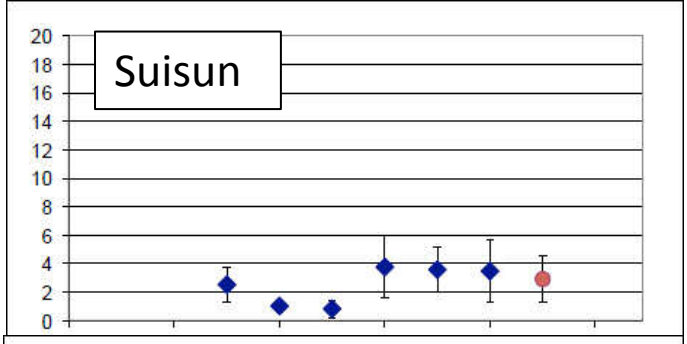
Footnote: BDE 209 shown as an index of the "deca" PBDE mixture. Contour plot based on 282 RMP data points from 2004, 2006, 2007, 2008, and 2009. The maximum concentration by far was 52 ppb in San Pablo Bay in 2007 (the next highest concentration was 19 ppb in South Bay in 2006). Trend plot shows annual Bay-wide averages. Colored symbols on map show results for samples collected during the wet season (February) in 2010. Circles represent random sites. Diamonds represent historic fixed stations. Red circle on trend plot indicates a wet season sample; other samples were dry season. Concentrations presented on a dry weight basis.

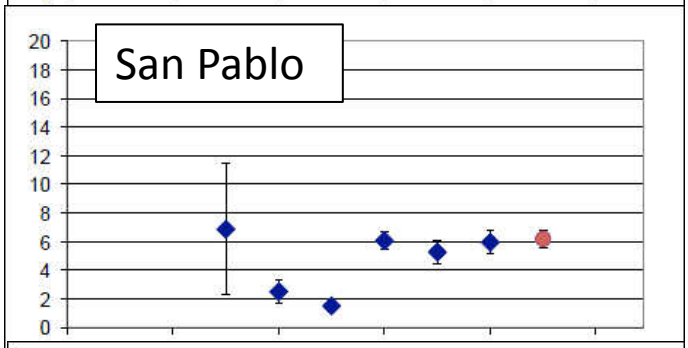
Hypotheses

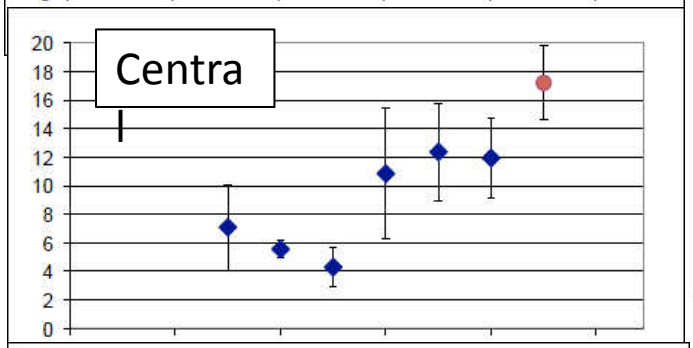
- ~~QA issue~~
- Influx of cleaner sediment
- Tributary inputs driven by high flow
- Spill
- Erosion of contaminated sediment

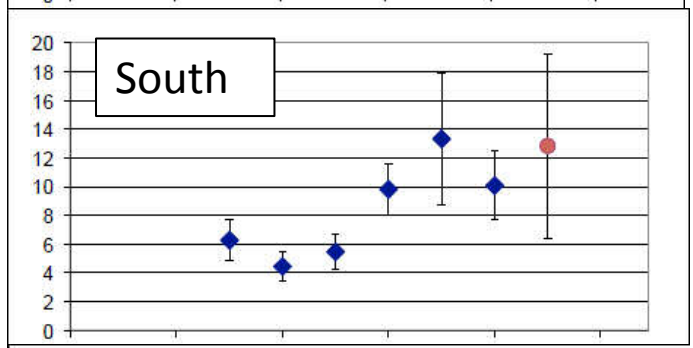
- Bottom Line: Step changes appear to be occurring

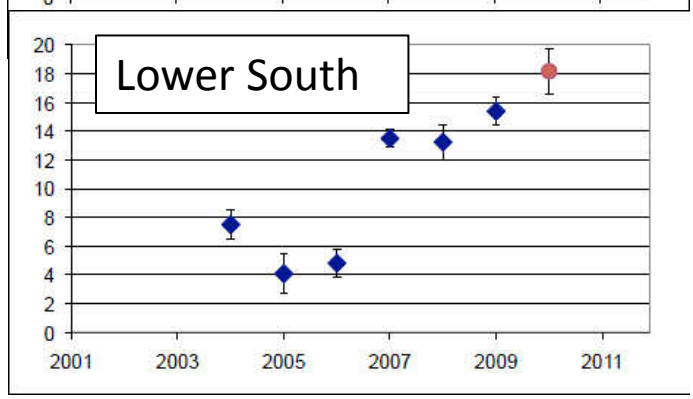

Sum of PCBs in Sediment (ppb)
San Pablo Bay
Suisun Bay
Rivers
Central Bay
South Bay
Lower South Bay
14
12
10
8
6
4
2
0
2001
2003
2005
2007
2009
2011
0
Miles
20
2
4
6
8
10
12
14
16
18
20
22

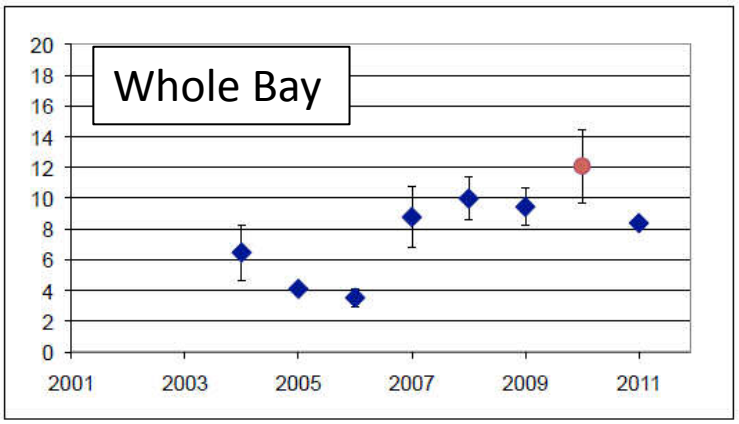

Suisun
20
18
16
14
12
10
8
6
4
2
0


San Pablo
20
18
16
14
12
10
8
6
4
2
0

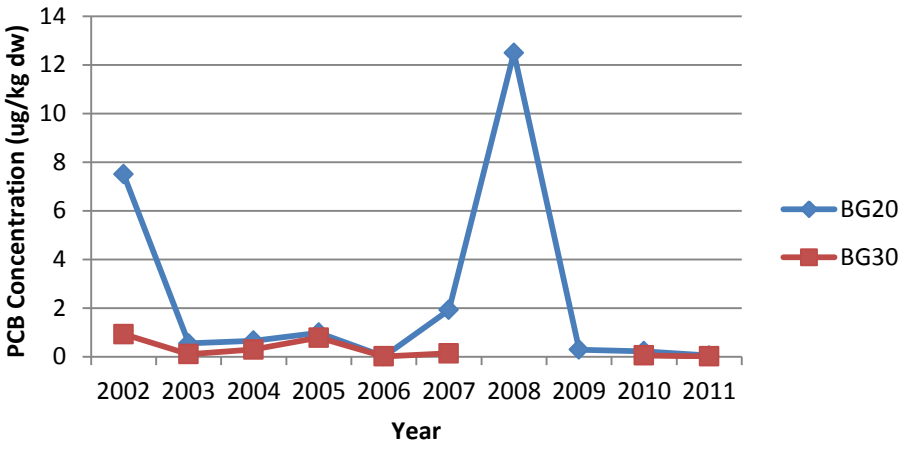

Centra
20
18
16
14
12
10
8
6
4
2
0


South
20
18
16
14
12
10
8
6
4
2
0

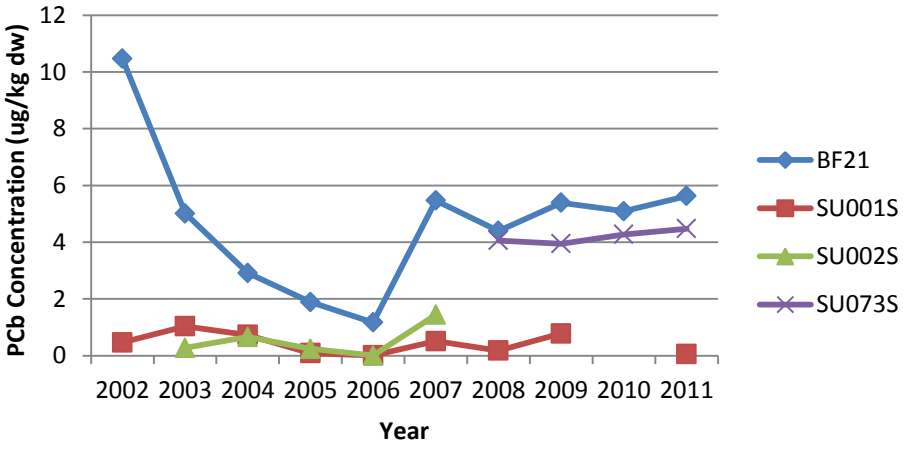

Lower South
20
18
16
14
12
10
8
6
4
2
0
2001
2003
2005
2007
2009
2011


Whole Bay
20
18
16
14
12
10
8
6
4
2
0
2001
2003
2005
2007
2009
2011

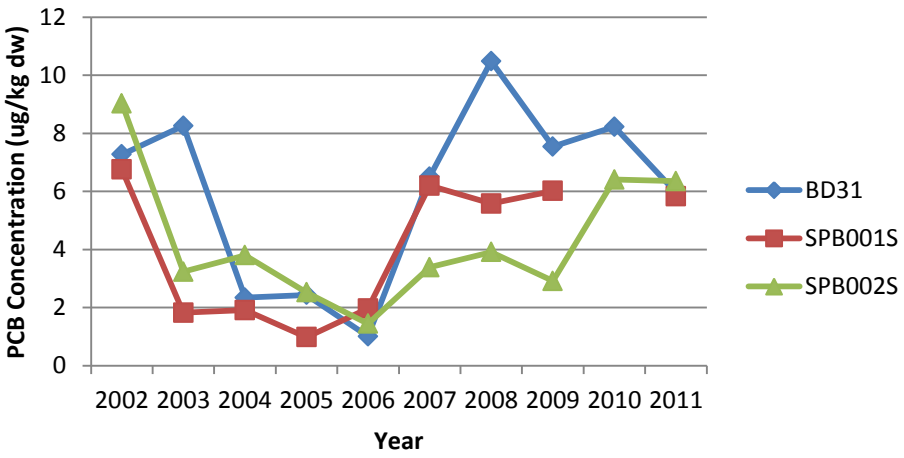
Rivers



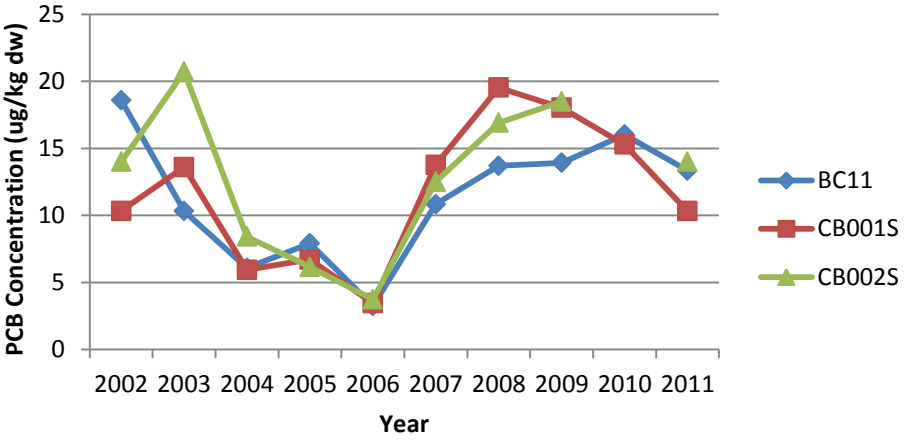
Suisun Bay



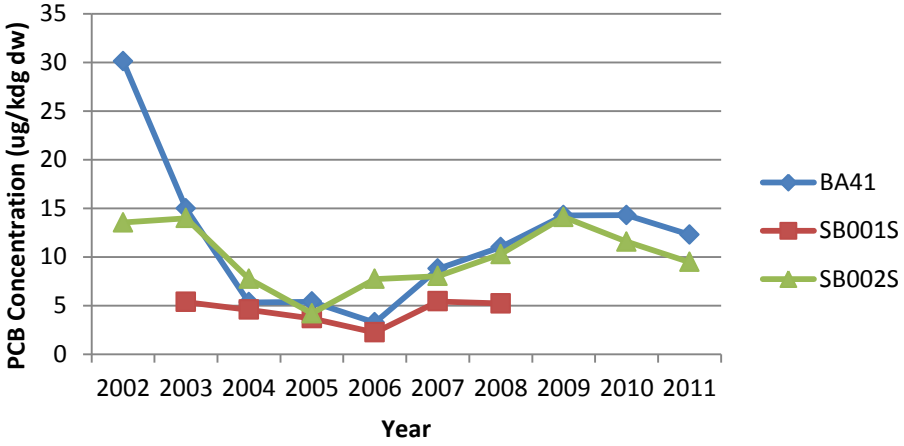
San Pablo Bay



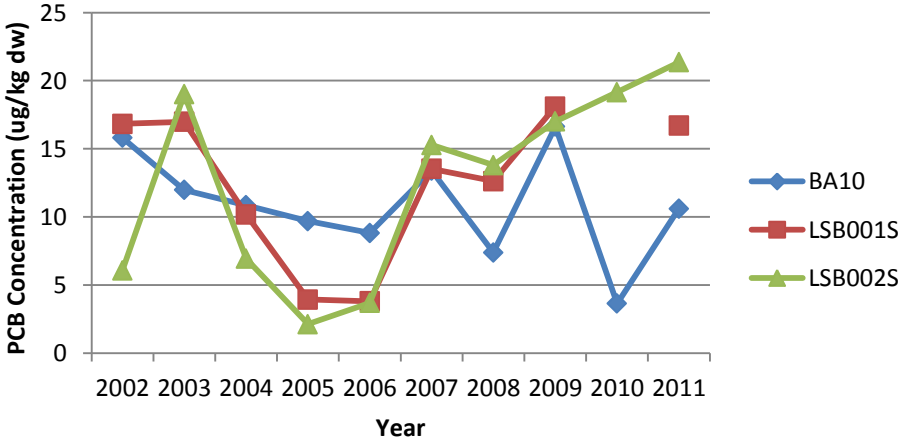
Central Bay



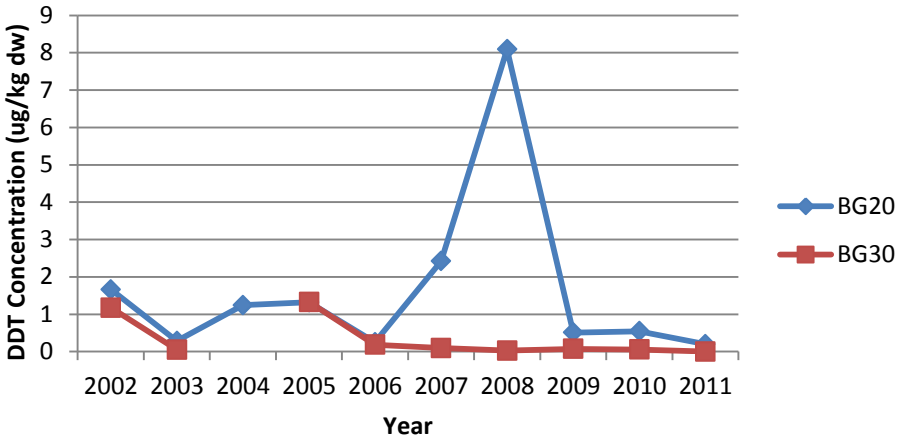
South Bay



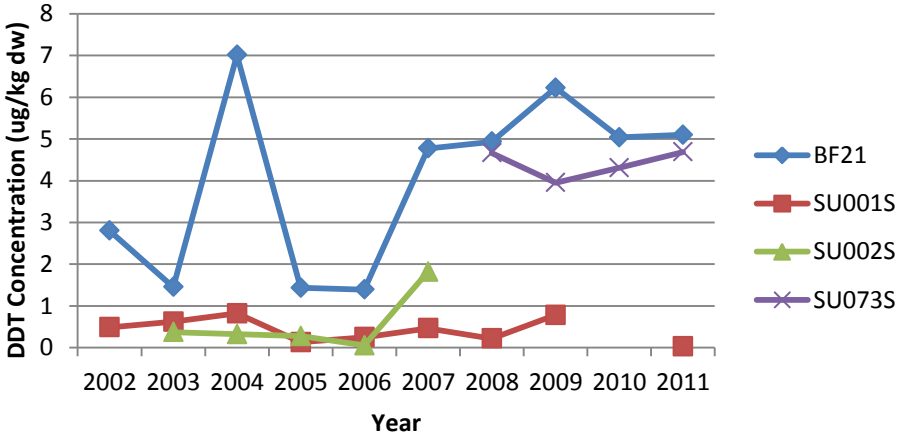
Lower South Bay



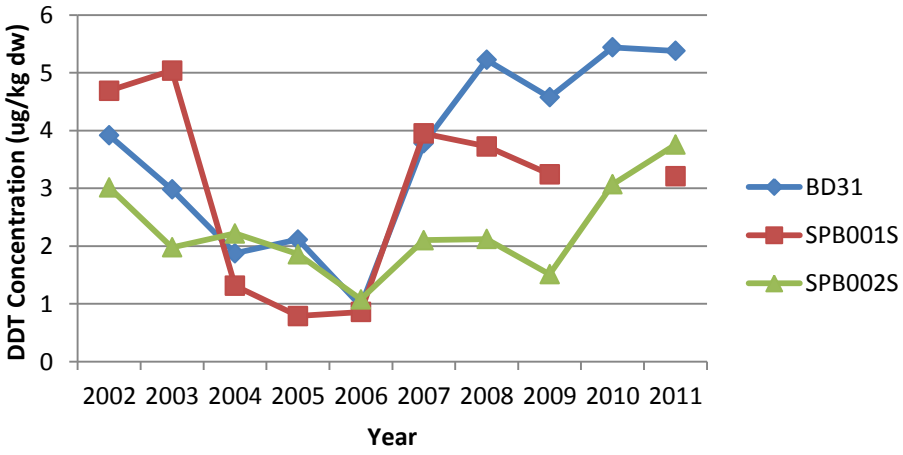
Rivers



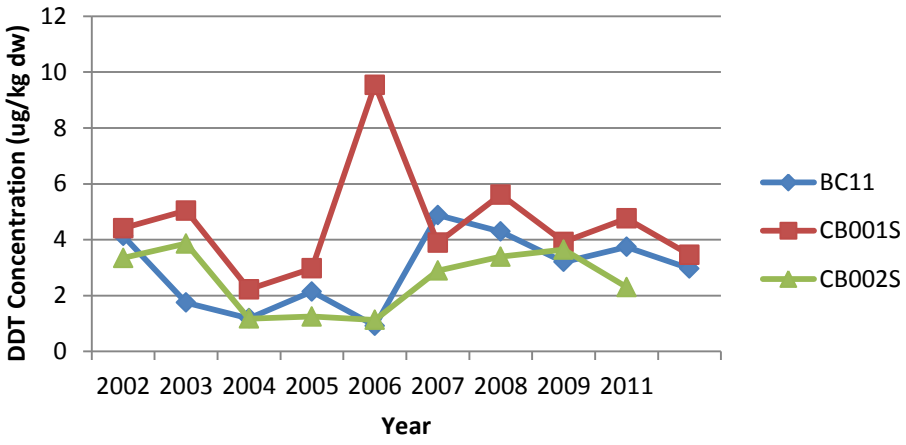
Suisun Bay



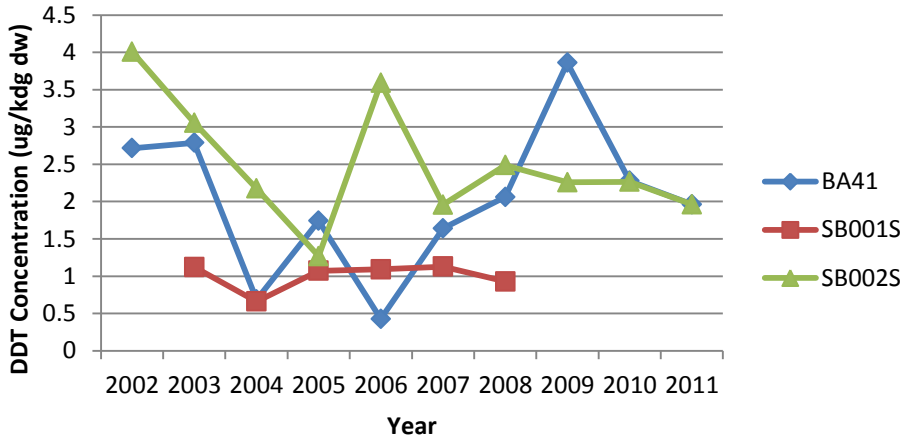
San Pablo Bay



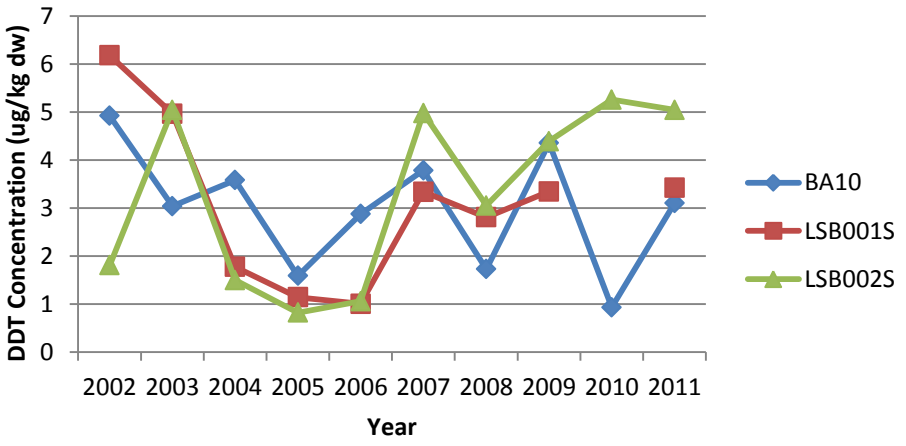
Central Bay



South Bay



Lower South Bay

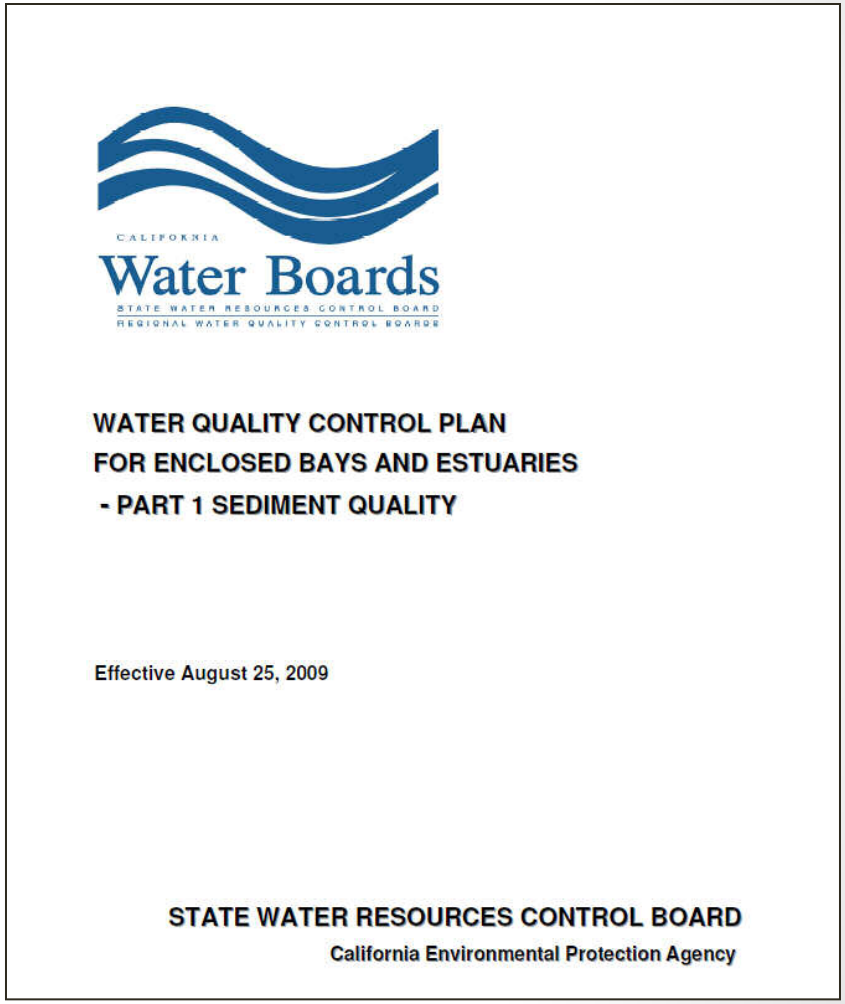


Applying Sediment Quality Objective Assessment Protocols to San Francisco Bay Samples

Using multiple lines of evidence to assess direct exposure of toxic pollutants to San Francisco Bay benthic communities

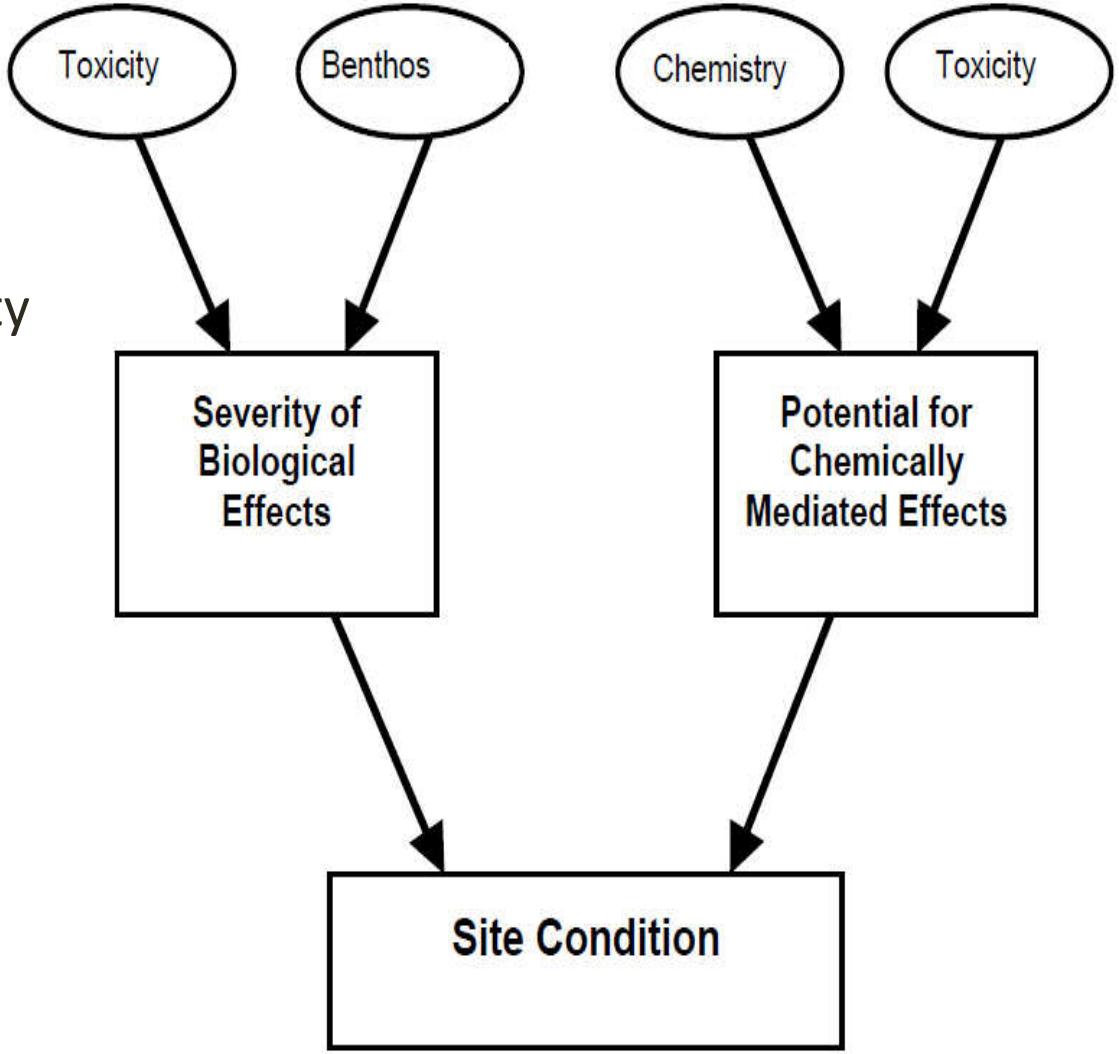
Background on SQOs

- 2003: State Board initiated a program to develop SQOs
- 2009: “Water Quality Control Plan for Enclosed Bays and Estuaries” adopted



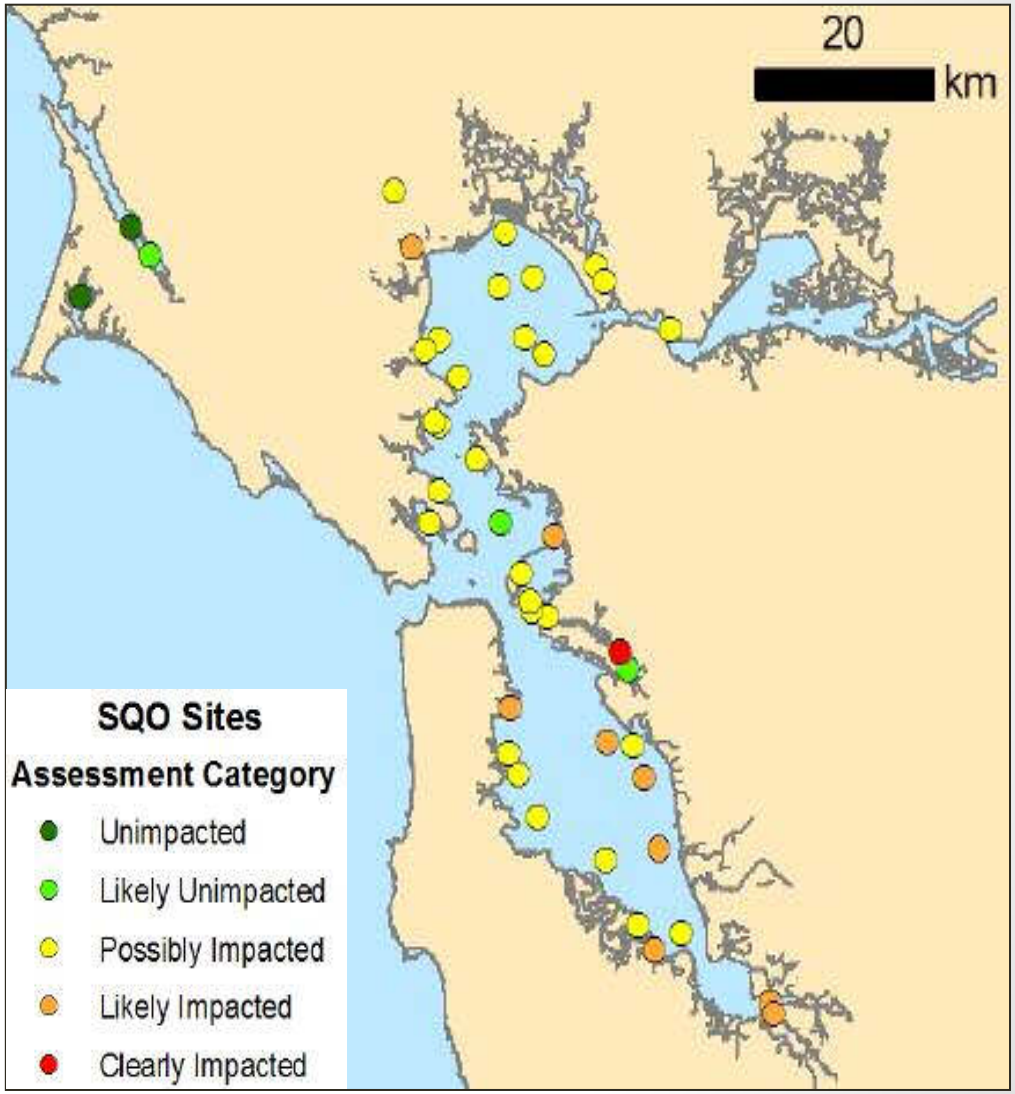
Multiple Lines of Evidence

- Multiple lines of evidence
  - Sediment Chemistry (2)
  - Sediment Toxicity (2)
  - Benthic Infauna Community Composition (4)
- Six categories for a station assessment
  - ✓Unimpacted
  - ✓Likely Unimpacted
  - ✓Possibly Impacted
  - ✓Likely Impacted
  - ✓Clearly Impacted
  - ✓Inconclusive

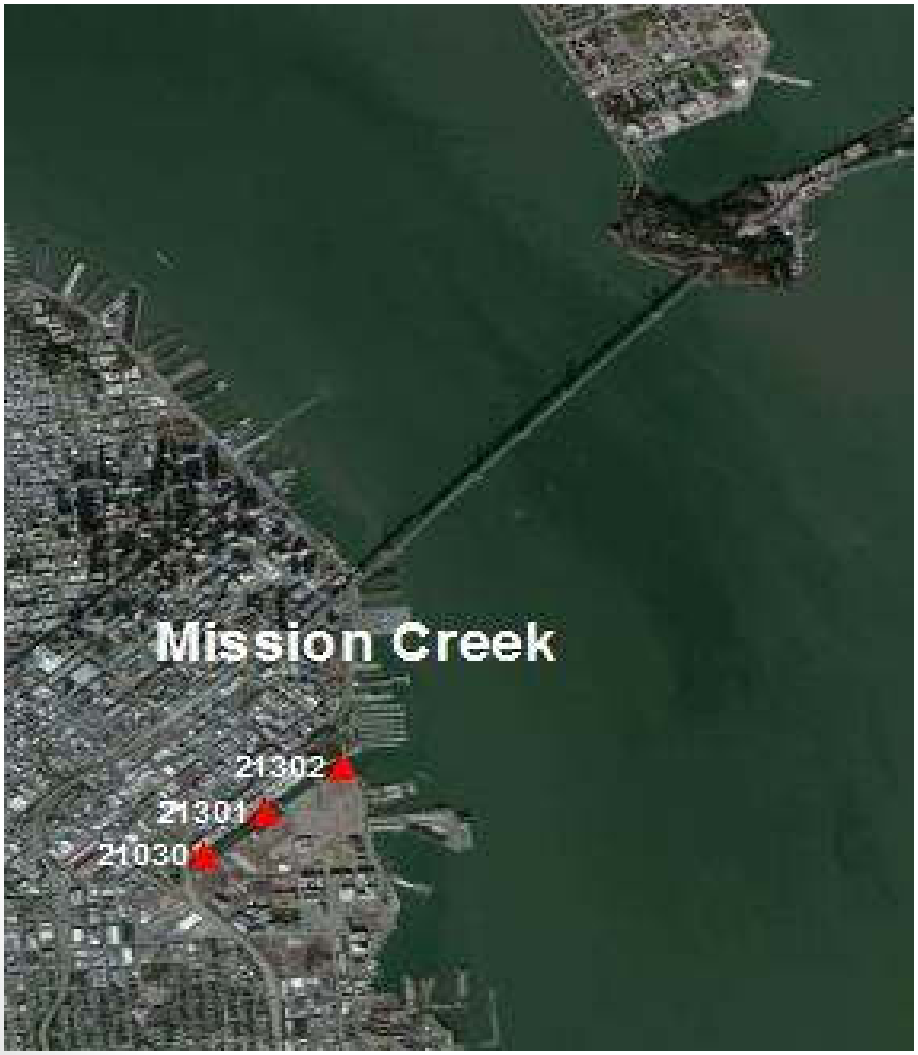


SQO Assessment in San Francisco Bay

- 2011 Hotspot Special Study
  - Revisited 2 of 8 former 1997 BPTCP sites
  - Sampled Mission Creek and San Leandro Creek
- Part of Annual S&T
  - Started in 2009
  - Summarizing 2011 and 2012 results



Hotspot Study Locations



Preliminary Results

Mission Creek (Site 1)			
Chemistry	*Toxicity*	*Benthos*	*Station Assessment*
High Exposure	High Toxicity	Moderate Disturbance	**Clearly Impacted**
Mission Creek (mid-gradient)			
Chemistry	*Toxicity*	*Benthos*	*Station Assessment*
High Exposure	High Toxicity	Moderate Disturbance	**Clearly Impacted**
Mission Creek (end-gradient)			
Chemistry	*Toxicity*	*Benthos*	*Station Assessment*
Moderate Exposure	Moderate Toxicity	Moderate Disturbance	**Likely Impacted**

San Leandro (Site 1)			
Chemistry	*Toxicity*	*Benthos*	*Station Assessment*
High Exposure	Moderate Toxicity	Moderate Disturbance	**Clearly Impacted**
San Leandro (mid-gradient)			
Chemistry	*Toxicity*	*Benthos*	*Station Assessment*
Moderate Exposure	Moderate Toxicity	Moderate Disturbance	**Likely Impacted**
San Leandro (end-gradient)			
Chemistry	*Toxicity*	*Benthos*	*Station Assessment*
Moderate Exposure	Moderate Toxicity	Moderate Disturbance	**Likely Impacted**

Contaminants above the ERM

Mission Creek

- ✓Mercury
- ✓Chlordanes
- ✓PCBs
- ✓Lead
- ✓Zinc
- ✓HPAHs

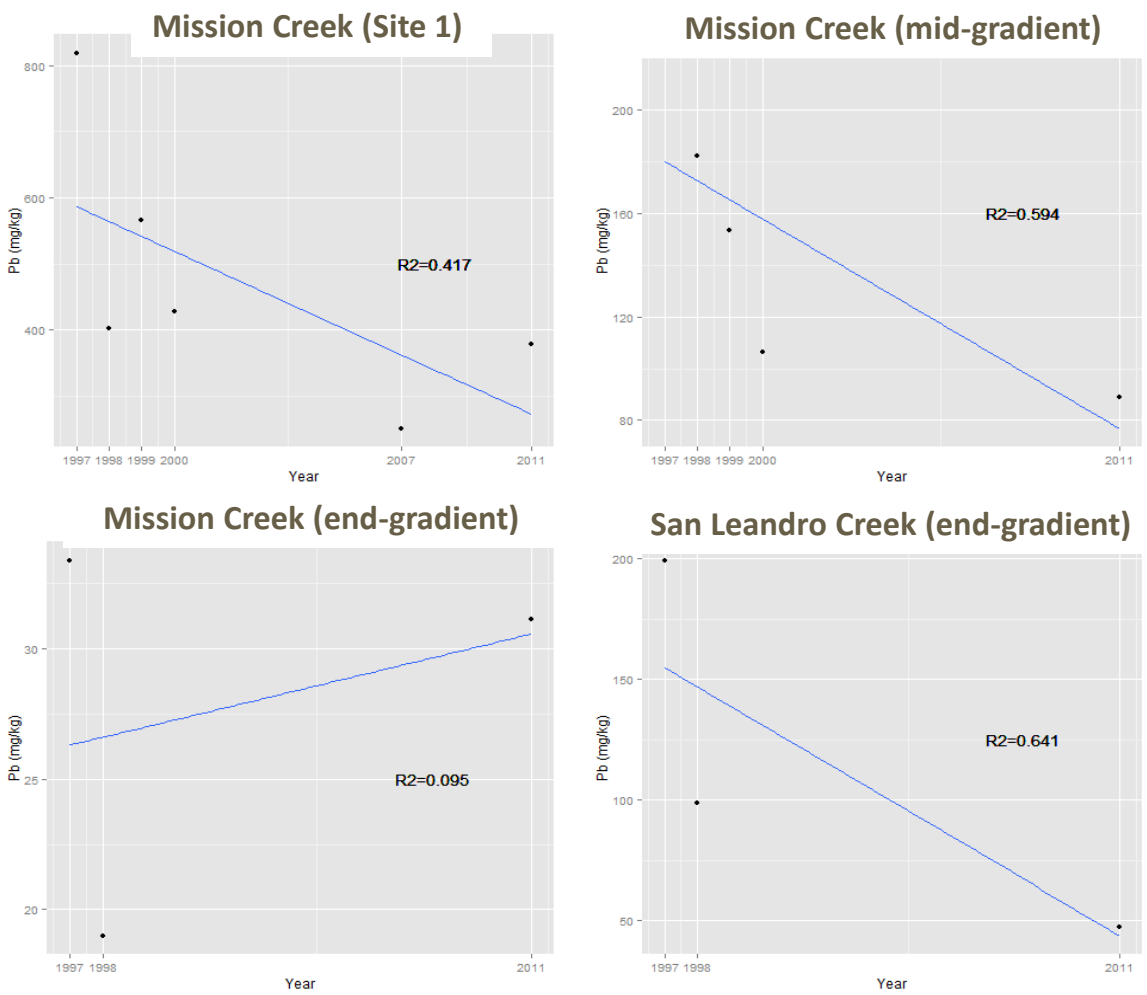
San Leandro Creek

- ✓Mercury
- ✓Chlordanes
- ✓DDEs

Historical Trends

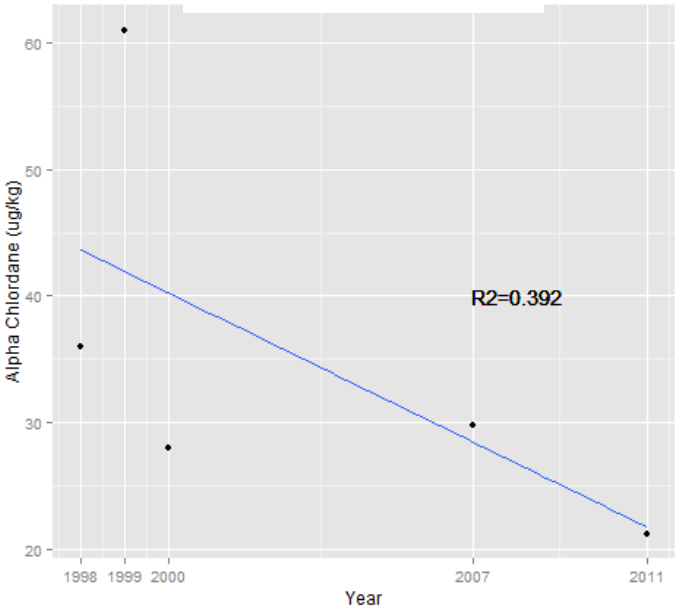
- Amphipod % survival and RBI values exhibited no trend over time
- Chlordanes and Pb were the only two contaminants with a decreasing trend over time

Lead:

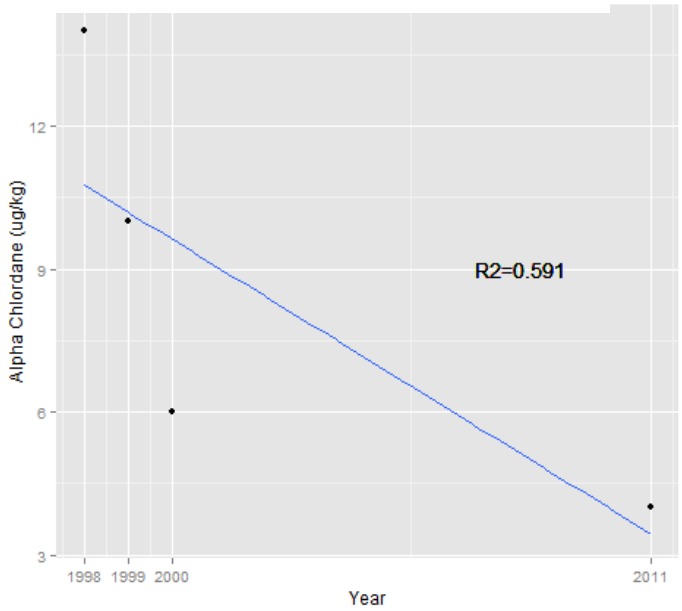


Alpha Chlordane

Mission Creek (Site 1)

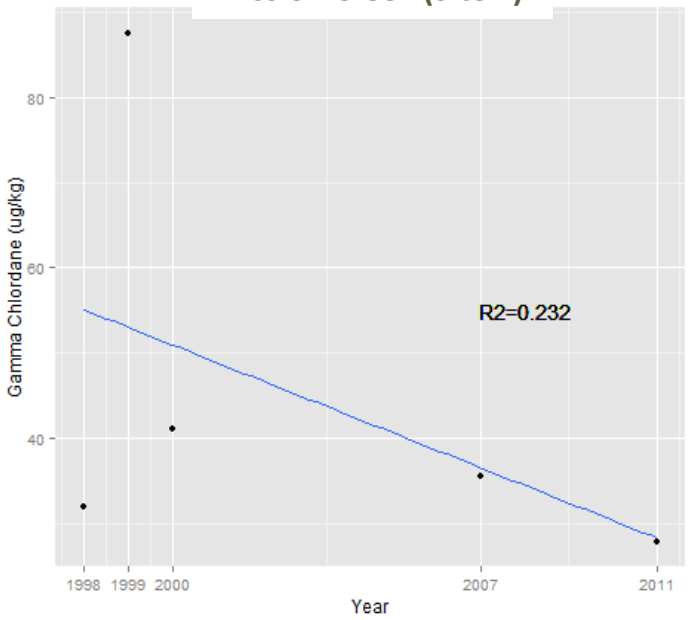


Mission Creek (mid-gradient)

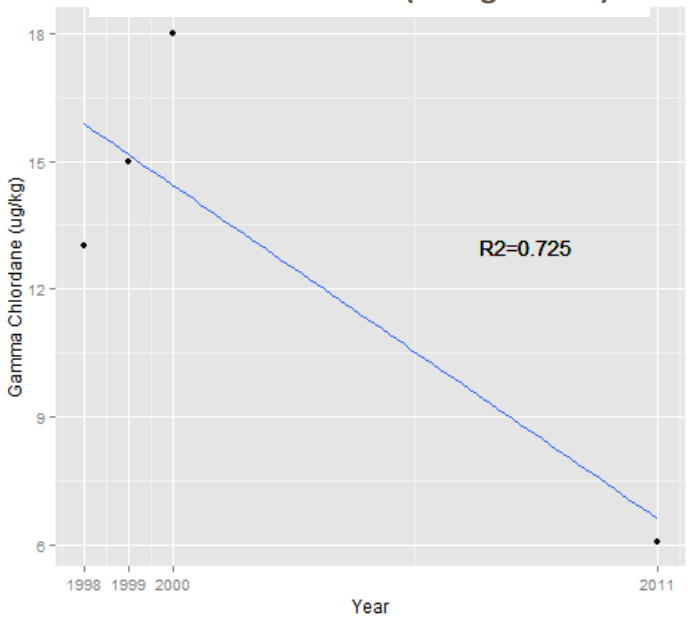


Gamma Chlordane

Mission Creek (Site 1)



San Leandro Creek (mid-gradient)

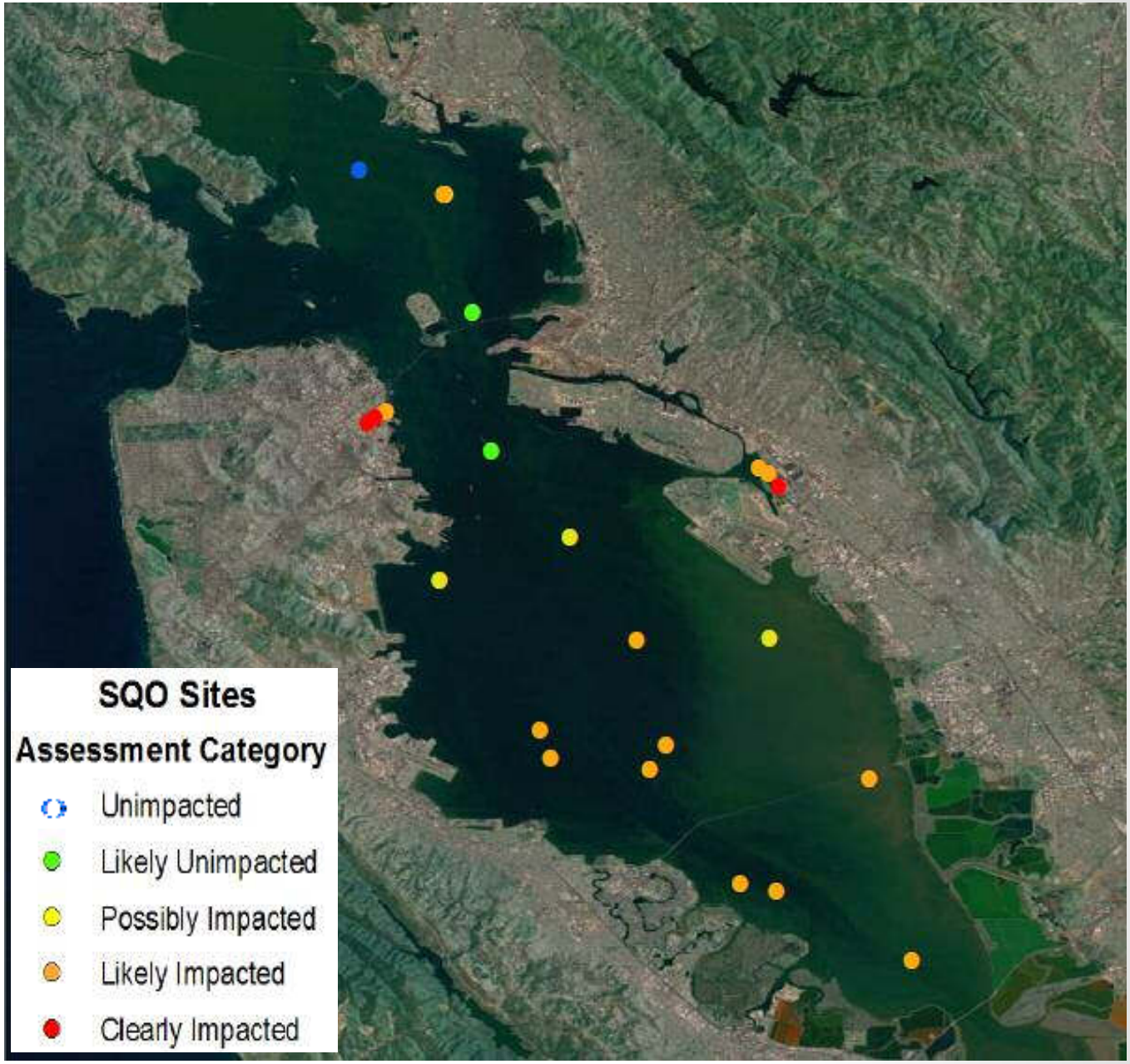


2011 and 2012 S&T Preliminary Results

SQOs were completed for 22 S&T Sediment sites
in 2011 and 2012

Region	Clearly Impacted	Likely Impacted	Possibly Impacted	Likely Unimpacted	Unimpacted
San Pablo Bay*		1	7	2	
Central Bay		3	3	3	1
South Bay		9	1		
Lower South Bay*		6	4		

Contamination in the Open Bay versus Creek Channels



Preliminary Conclusions

- Mission Creek and San Leandro Creek remain impacted
- The majority of the Bay is “Possibly Impacted” or “Likely Impacted” with widespread moderate toxicity
- Pollutant impact greater within creek channels than in open bay sites
- Difficulty with completing SQOs :
  - cause of moderate toxicity unknown.

Moderate Toxicity in Sediments

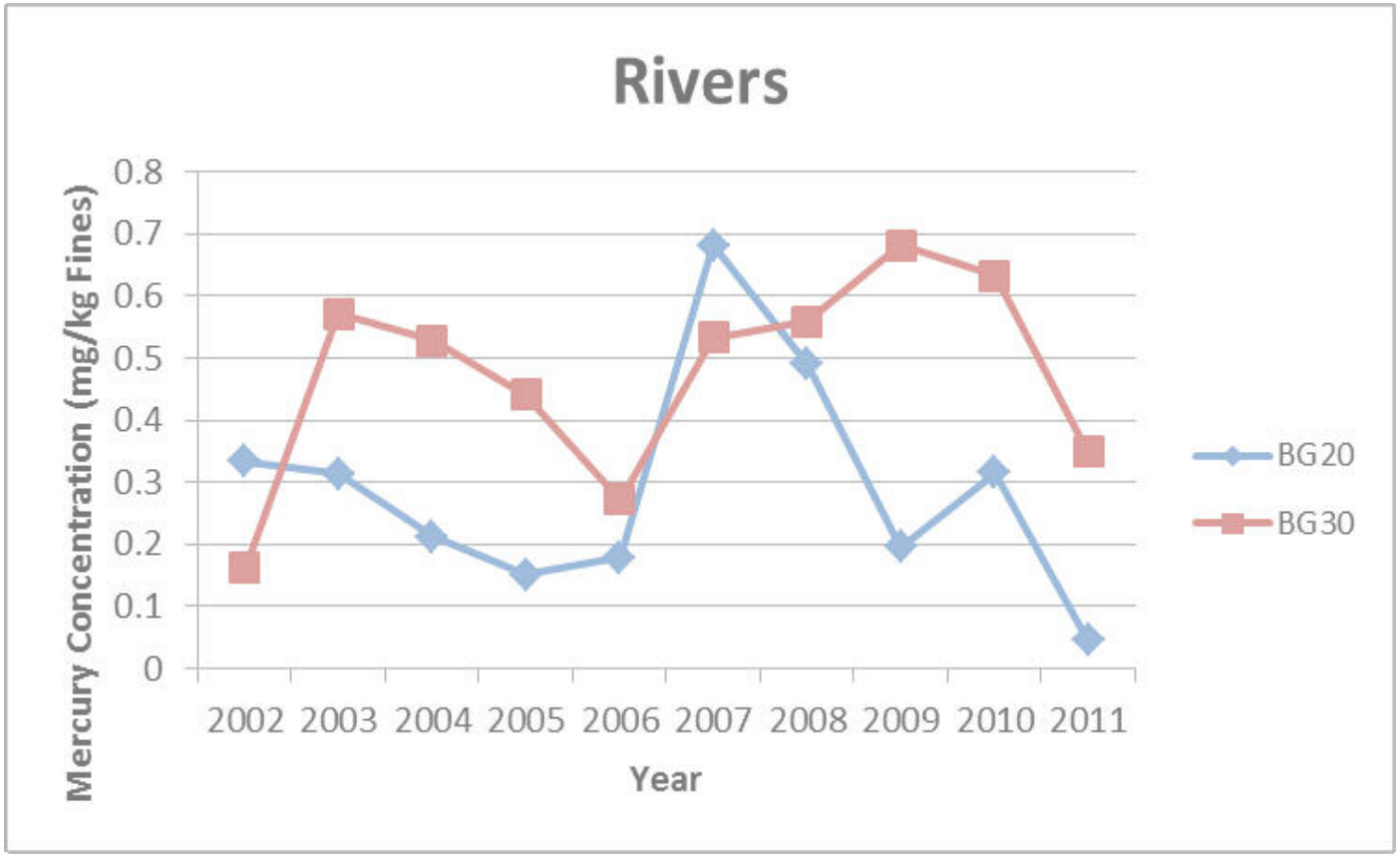
Presentation to TRC – March 5, 2013

Meg Sedlak

Goal of Sediment Analyses

- Answering Management Questions:
  - Q2 Concentrations and masses (spatial distribution)
  - Q4 Trends
  - Q5 Forecasting/ Modeling
- Sediment S&T Monitoring:
  - Alternate years; alternate seasons (wet/dry)
    - 2014 – Dry (47); 2016 – Wet (27); 2018 – Dry (47) etc.
  - Chemistry, Toxicity, and Benthic Assessments

Sediment Chemistry



Ambient Sediment Concentrations

SAN FRANCISCO ESTUARY INSTITUTE
REGION-WIDE SCIENCE FOR ECOSYSTEM MANAGEMENT

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Home :: Regional Monitoring Program :: RMP Data :: Dredged Material Testing Thresholds for San Francisco Bay Area Sediments

Dredged Material Testing Thresholds for San Francisco Bay Area Sediments

This page presents sediment chemistry thresholds for seven different contaminant classes, used by the Dredged Material Management Office (DMMO) for determining when bioaccumulation testing will typically be required for dredged material proposed to be discharged at unconfined open water disposal sites in San Francisco Bay. These same thresholds are also used by DMMO to determine when additional analysis of the post-dredge sediment surface ("residual" or "z-layer" sediments) may be warranted. The June 9, 2011, Essential Fish Habitat Agreement between USACE, USEPA, and NMFS established the approach used to determine the testing thresholds for San Francisco Bay sediments.

The individual chemical thresholds presented in the table below are of two types:

1. Thresholds for **mercury, total PCBs, and total PAHs** are based on San Francisco Bay ambient sediment concentrations determined via the Regional Monitoring Program (RMP), and are recalculated and updated each year. Similar calculations are used to update TMDL in-Bay dredged material disposal limits for mercury and total PCBs each year. (Details on how these ambient-based thresholds are calculated are provided below.)
2. Thresholds for **total DDTs, total chlordane, Dieldrin, and dioxins/furans** are based on similar values in use in other parts of the country and generally remain the same year-to-year.

Dredged Material Testing Thresholds Effective in Calendar Year 2013

	Mercury[a] (mg/kg dw)	Total PCBs (µg/kg dw)	Total PAHs (µg/kg dw)	Total DDTs (µg/kg dw)	Total Chlordane (µg/kg dw)	Dieldrin (µg/kg dw)	Dioxins/ Furans (pg/g dw)
Bioaccumulation Trigger	0.34	17	4,400	50	37	1.9	10
TMDL Limit	0.469	28.7	--	--	--	--	--
Basis	b	b	b	c	c	d	e

a. DMMO no longer requires bioaccumulation testing for mercury above the BT. See Amendment to EFH consultation.
b. Threshold based on San Francisco Bay ambient sediment concentrations, as describe further below.
c. Published bioaccumulation trigger for Puget Sound marine sediments.
d. Published marine SL value from the Pacific Northwest Sediment Evaluation Framework.
e. Toxicity Equivalency Quotient (TEQ) based on WHO 1998 Toxicity Equivalency Factors (TEFs). Value is consistent with the published Puget Sound limit for unconfined aquatic disposal, and is ½ the established limit for placement at the Hamilton Wetlands Restoration Project site.

SUMMARY OF RMP AMBIENT SEDIMENT CALCULATIONS FOR USE IN

SEARCH

MORE INFO

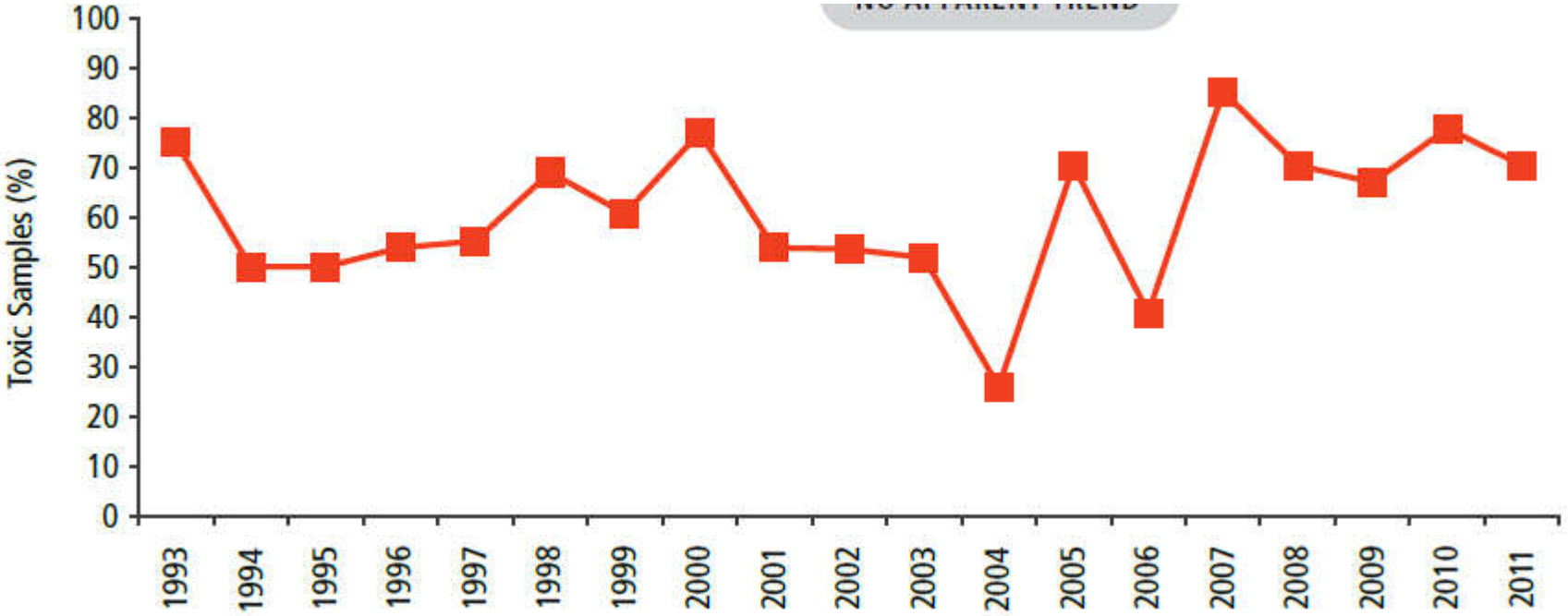
- What is the RMP?
- Committees, Workgroups, and Strategy Teams
- Status & Trends Monitoring
- Pilot & Special Studies
- RMP Projects
- RMP Data
  - USGS Monthly Water Quality Data
  - Changes to the RMP
  - Contaminant Data Display & Download
  - RMP Target Analyte List
  - Reportable Analytes
  - Sample Area Weights
  - Dredged Material Testing Thresholds for San Francisco Bay Area Sediments
  - Copper Site Specific Objective 3-year Rolling Averages
- Annual Reports and Publications
- Annual Meetings
- Glossary

RMP SPOTLIGHT

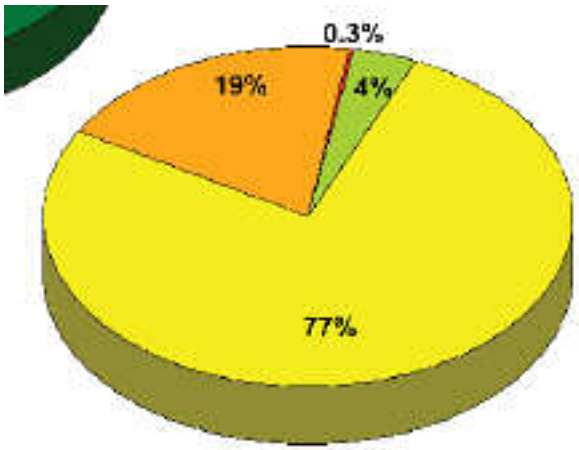
2012 Regional Monitoring Program Update

RMP Estuary Issue FLAME RETARDANTS IN SAN FRANCISCO BAY

Persistent Moderate Toxicity



Majority of Bay Possibly Impacted



San Francisco Bay
1020 km^2

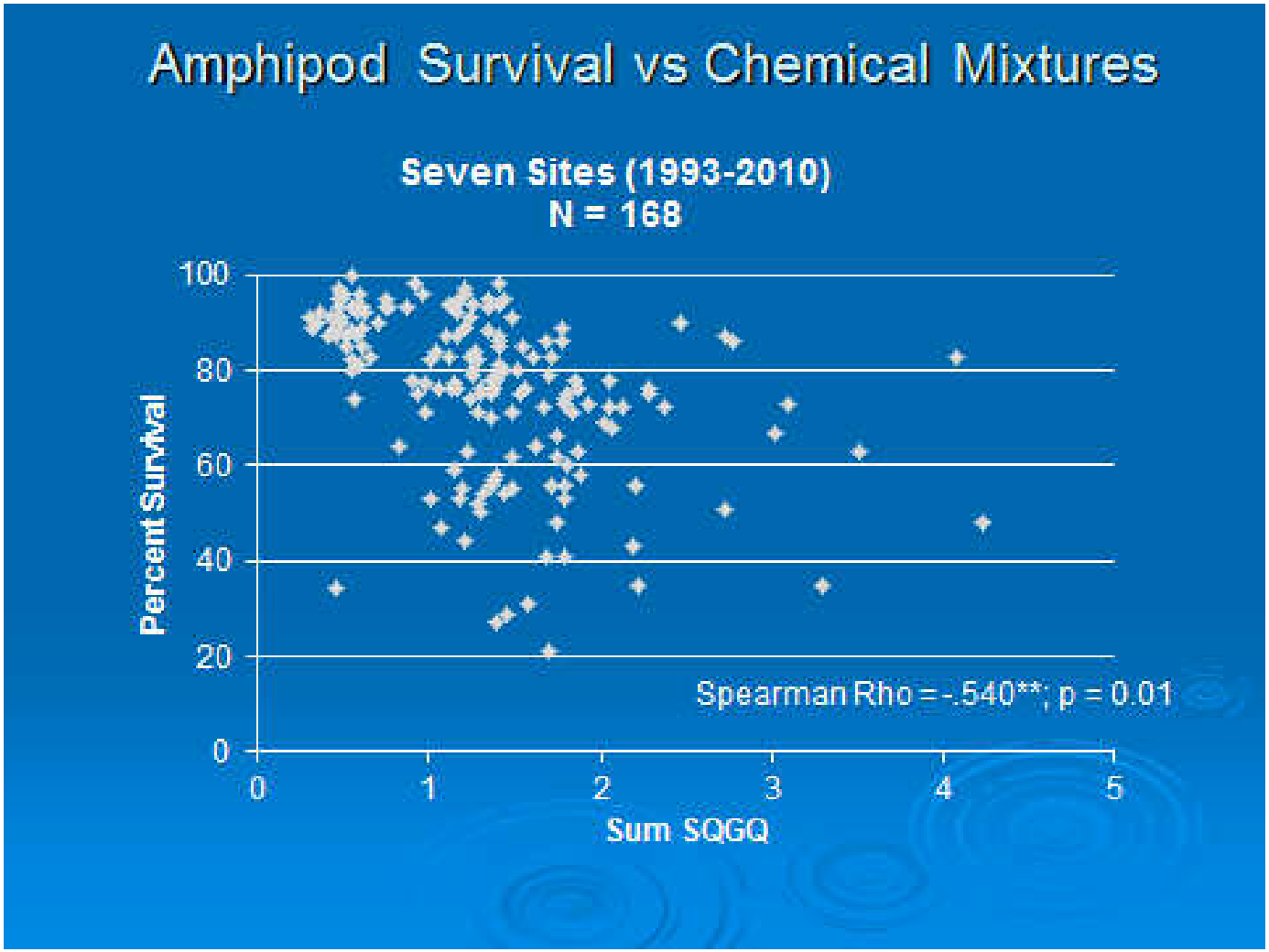
- Unimpacted
- Likely Unimpacted
- Possibly Impacted
- Likely Impacted
- Clearly Impacted
- Inconclusive

• Possibly Impacted - Contamination at the site may be causing adverse impacts to aquatic life in the sediment, but the level of impact is either small or is uncertain because of disagreement among LOEs.

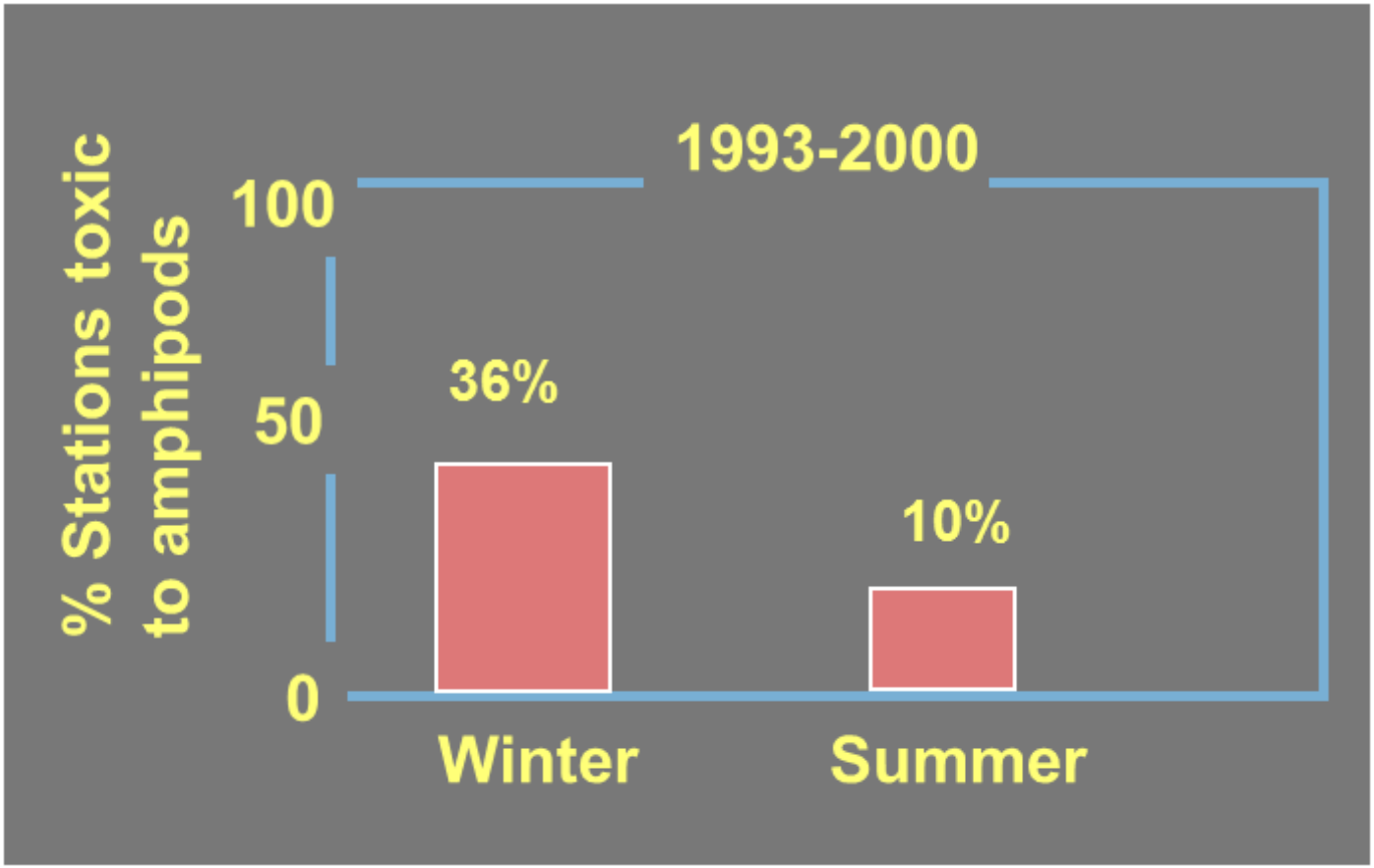
2012 Moderate Toxicity Workshop

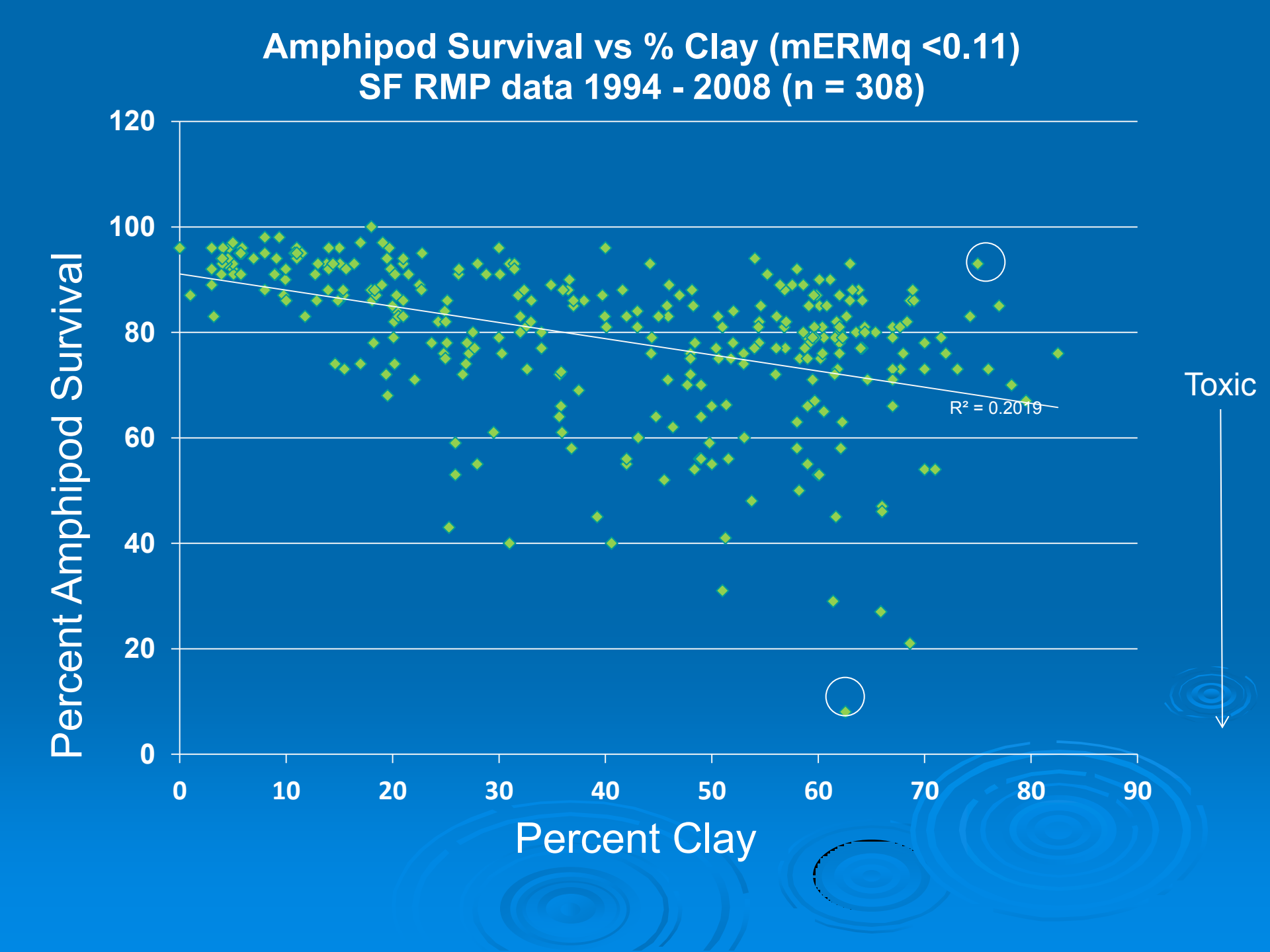
- Goal: To develop hypotheses to determine what is cause of moderate toxicity to amphipods in the Bay

Weak Correlation to Chemistry



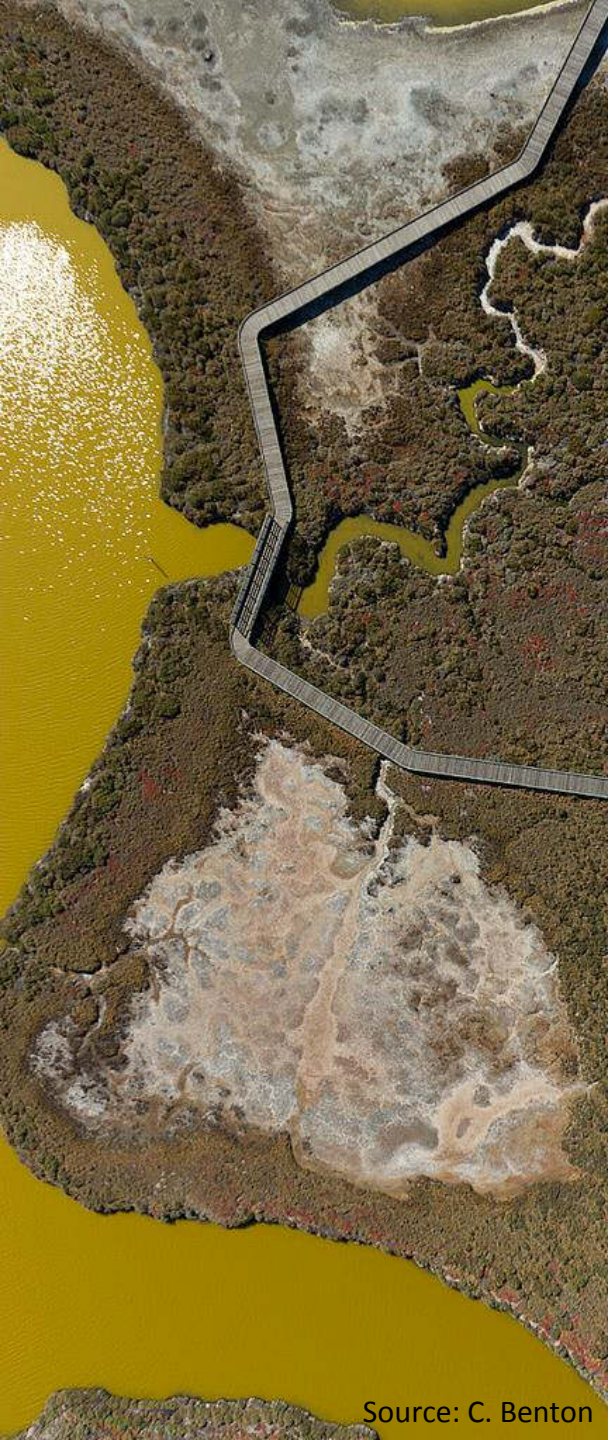
Seasonal Element




Amphipod Survival vs % Clay (mERMq <0.11)
SF RMP data 1994 - 2008 (n = 308)
Percent Amphipod Survival
120
100
80
60
40
20
0
0
10
20
30
40
50
60
70
80
90
Percent Clay
R² = 0.2019
Toxic

Outcomes from Workshop

- Number of hypotheses:
  - Evaluate grainsize/ grain shape
  - Evaluate condition of amphipods (lipid content as a proxy)
  - Conduct statistically rigorous data mining exercise (chemicals, seasonality, particle size, year, predators, comparison to SCCWRP and interactions)
- Develop proposals for EEWG for 2014
- In interim consider putting sediment toxicity and benthic characterization on hold for 2014 to fund possible projects
  - $50K Toxicity and $60K Benthos



TRC update: Nutrients

- Status update: CM model
- Status update: Loading study
- Status update: Moored sensor
- Discussion: RMP oversight of Nutrient Work

David Senn and Emily Novick
March 5 2013

CM Study Update

- Status:
  - Targeting early April for a draft to RMP and technical team
- Process
  - Simultaneous review by RMP and technical team
  - Final technical team meeting: early May
  - Revised version: June/July
- Structure
  - 1 page Synopsis
  - 10 page executive summary (+ figures)
  - Longer supporting document

CM outline

- Synopsis
- Executive Summary
- Introduction
- Background
- Problem statement
  - If SFB had nutrient problems, what would they look like?
- Conceptual Model Overview
- Hydrodynamics
- Nutrients
- Primary Production
- Dissolved Oxygen
- Phytoplankton community composition
- Future Scenarios
- Recommendations

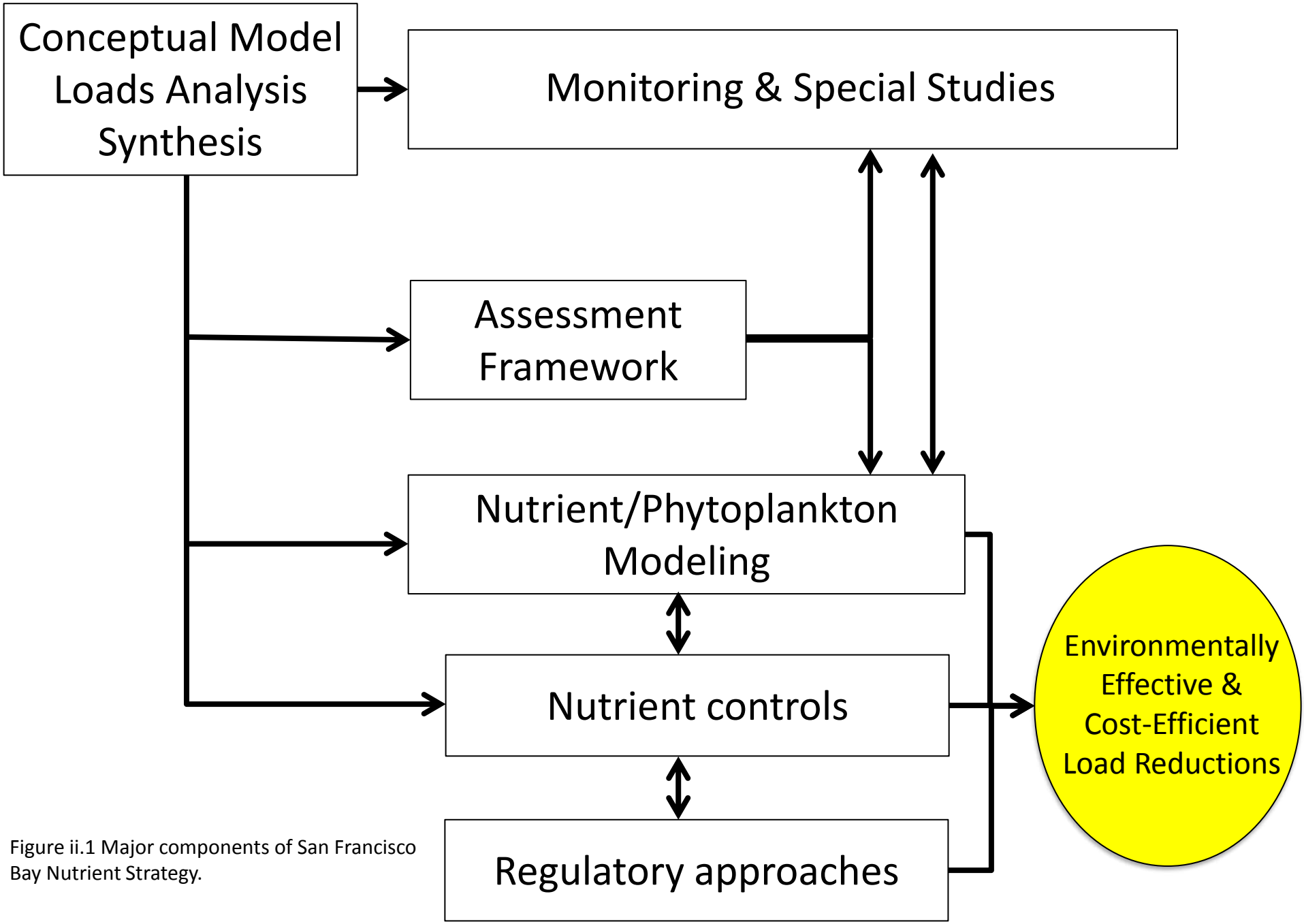


Figure ii.1 Major components of San Francisco Bay Nutrient Strategy.

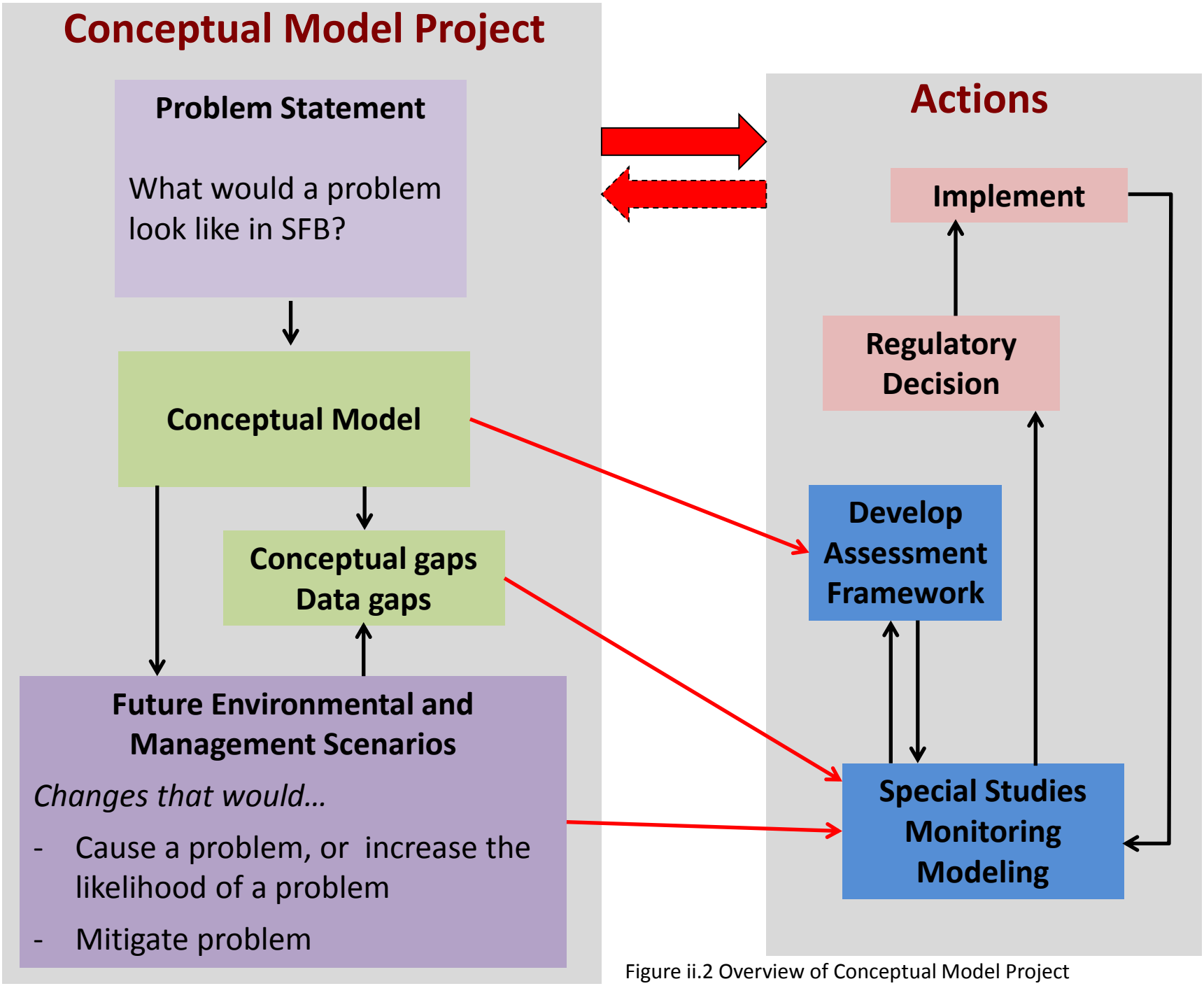
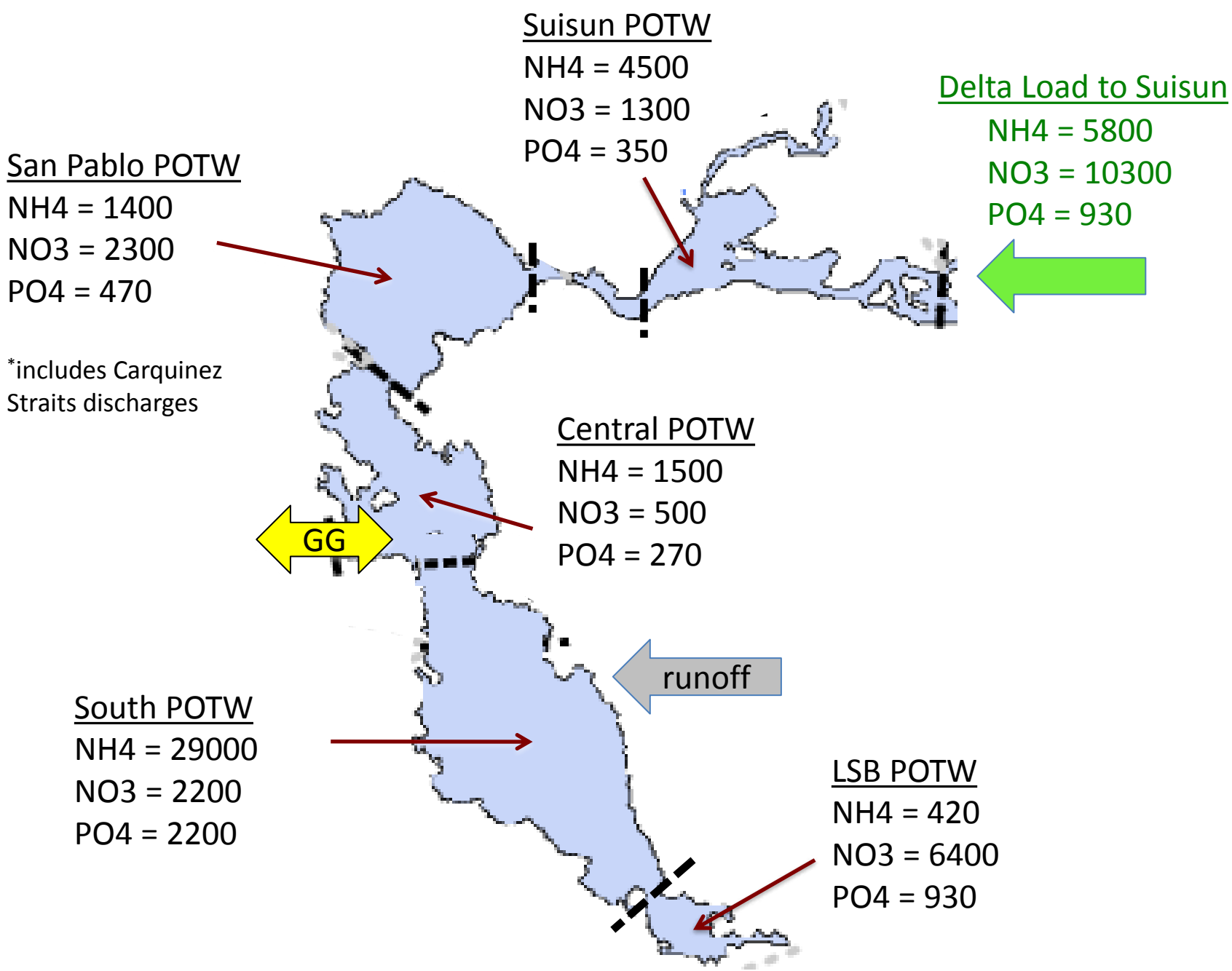


Figure ii.2 Overview of Conceptual Model Project

Loading Study Update

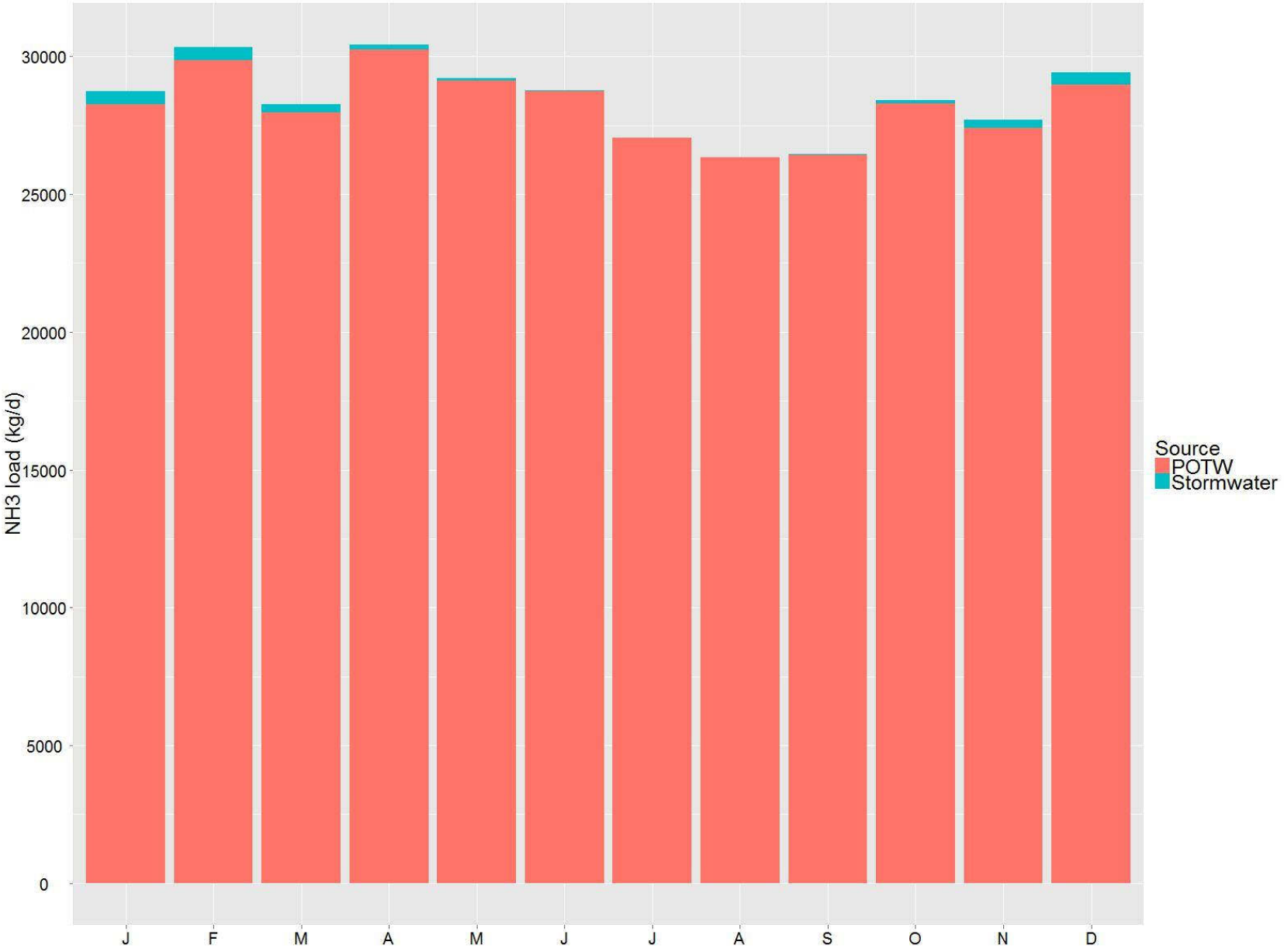
- Status:
  - On-schedule for draft report end of March

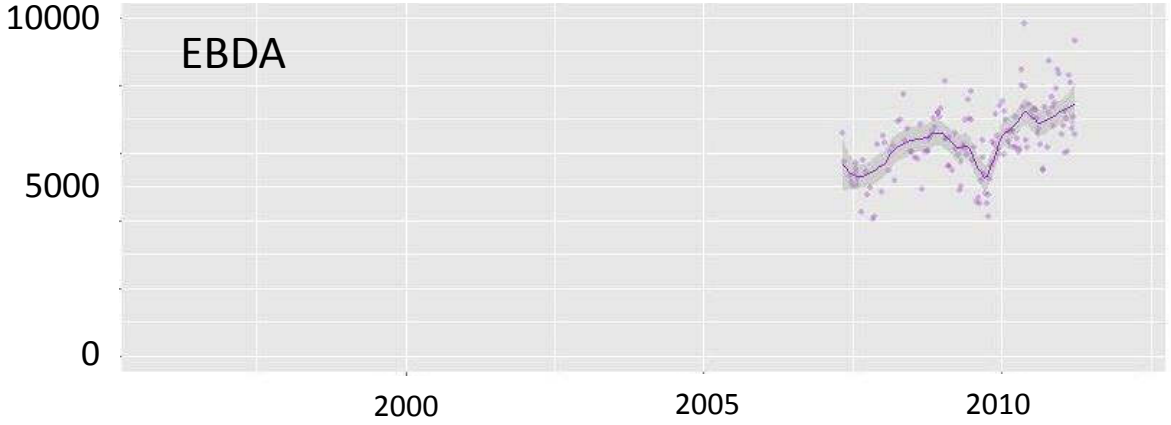
- Approach:
  - "Current" loads (POTWs) – 2006-2011 vs. 2012 (13267)
    - Develop best hybrid estimates
    - Missing analytes vs. small sample size
  - Seasonal variations in loads (POTWs, stormwater, Delta)
  - Loading time series: Suisun, South Bay, LSB
    - primarily POTWs and Delta

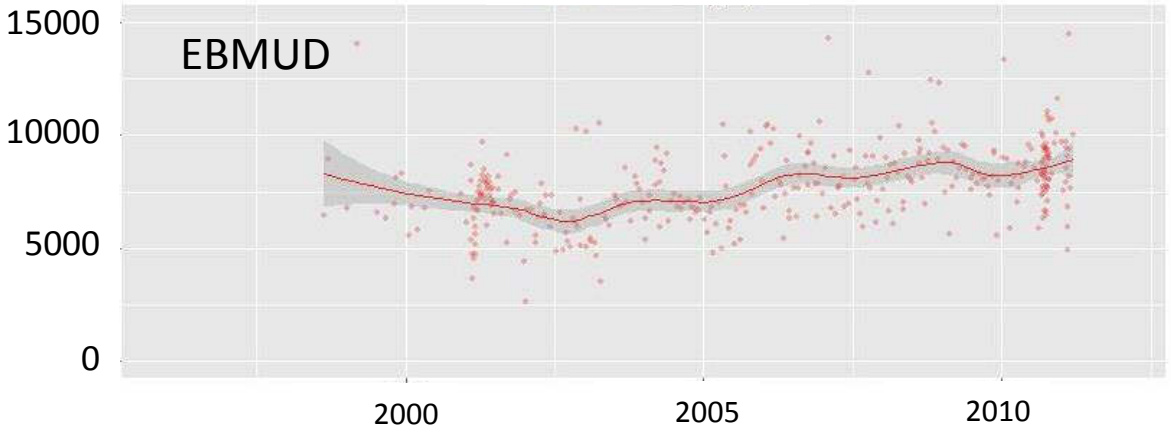

Suisun POTW
NH4 = 4500
NO3 = 1300
PO4 = 350
Delta Load to Suisun
NH4 = 5800
NO3 = 10300
PO4 = 930
San Pablo POTW
NH4 = 1400
NO3 = 2300
PO4 = 470
*includes Carquinez Straits discharges
Central POTW
NH4 = 1500
NO3 = 500
PO4 = 270
GG
runoff
South POTW
NH4 = 29000
NO3 = 2200
PO4 = 2200
LSB POTW
NH4 = 420
NO3 = 6400
PO4 = 930

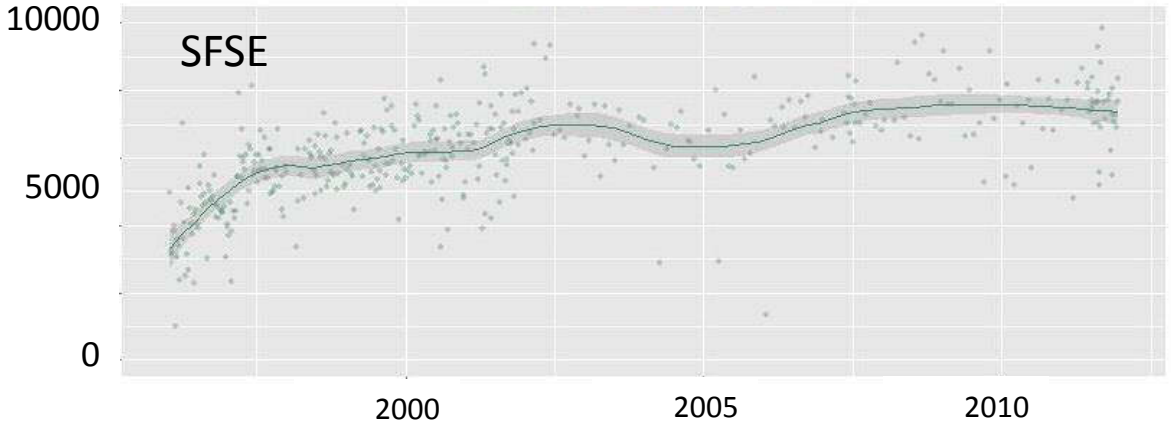
Units = kg d^{-1}

NH4 Loads to South Bay









NH_4^+ loads to South Bay (kg d^{-1})

EBDA + EBMUD + SFSE =
~ 75% of load

Goals of Moored Sensor Pilot Program

- Developing nutrient monitoring program's capacity for utilizing moored sensor approaches
  - Field maintenance
  - Calibration frequency
  - Data communication, QA/QC and visualization
- Inform future years of sensor program
  - Ideal spatial distribution of sensors
  - Which parameters are most critical and most feasible to measure
- Preliminary scientific investigation
  - nutrient and DO budgets
  - bloom time and spatial scales

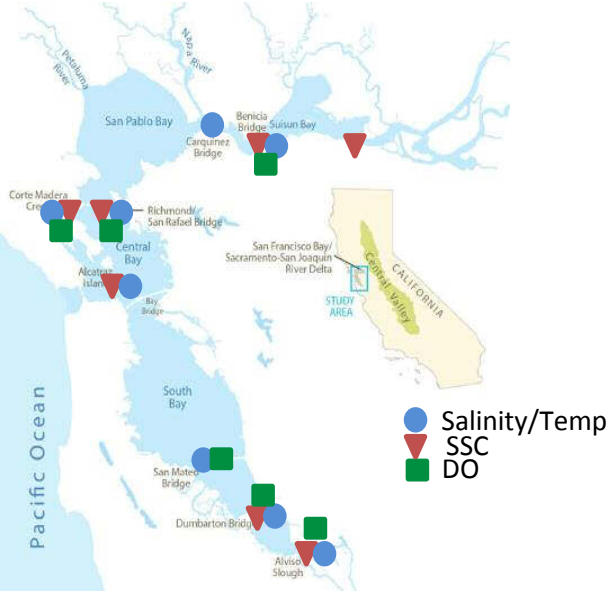
Pilot Program Equipment

- Originally, SFEI had planned to purchase a single, more expensive unit
  - pH, DO, CTD, chl-a, CDOM, turbidity, NO3

- However, meetings with local experts have encouraged exploring other options

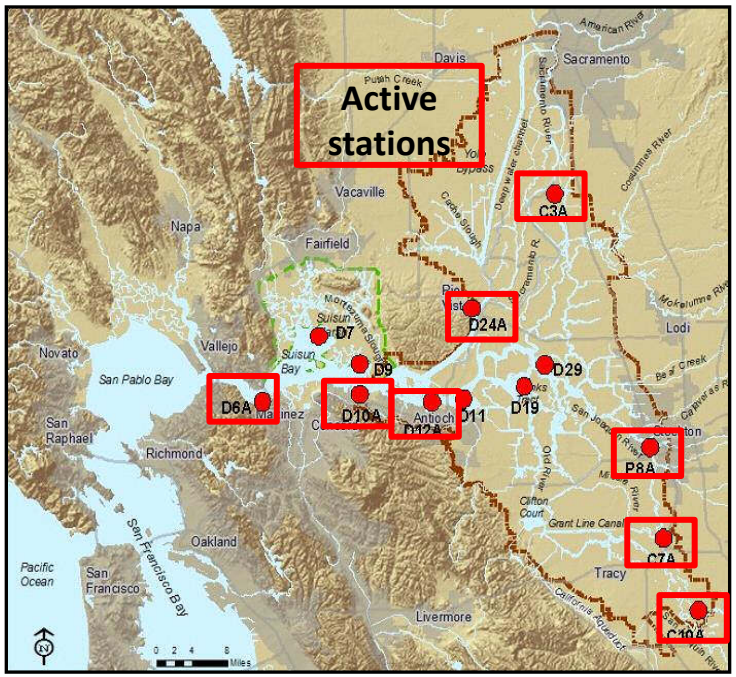
Existing moored sensor stations

USGS (Schoellhamer group)



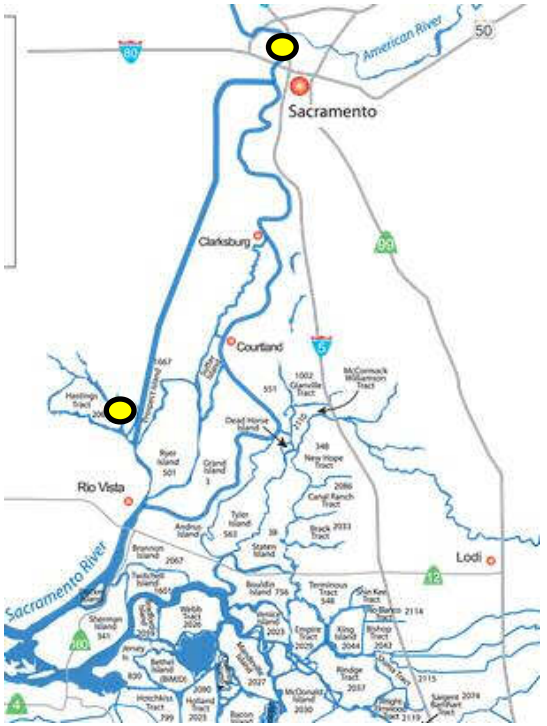
DO
Salinity
Turbidity
pH
Temp
Depth

DWR



DO
Salinity
Turbidity
pH
Temp
Depth
Chl-a

USGS (Pellerin group)



DO
Salinity
Turbidity
pH
Temp
Depth
Chl-a
NO3, PO4, DOC

Pilot Program Equipment

- SFEI plans to purchase:
  - 2 YSI EXO-2 sondes (pH, CTD, DO, CDOM, turbidity, chl-a, blue-green)
  - 1 SUNA-2 NO3 sensor
  - Campbell scientific datalogger to merge and communicate datastreams

- Rationale:
  - Purchasing duplicate sondes will reduce down-time in first year
  - Duplicate sondes will periodically be deployed simultaneously (inform spatial distribution, and next steps)
  - Less expensive: Some money remains for sensor maintenance in first year, purchasing additional sensors or applying towards future years
  - Investing in similar technology that is already deployed elsewhere in the Bay expands partnership possibilities (maintenance, data comparisons, data management/visualization tools)
  - External datalogger promote greater flexibility in adding additional sensors in the future

Criteria for Selection

Equipment	Cost	Quantity	Total Cost
YSI EXO-2 + sensors -pH, conductivity/temp, optical DO, turbidity, total algae, FDOM	$15525	2	$31050
SUNA-2 NO3 sensor	$22800	1	$22800
Campbell Scientific external datalogger	$1465	1	$1465
Cables, battery pack	$800	1	$800
USGS labor for wiring datalogger, setting up communication/visualization (estimation)	$5000		$5000
TOTAL			$61115

Remaining questions

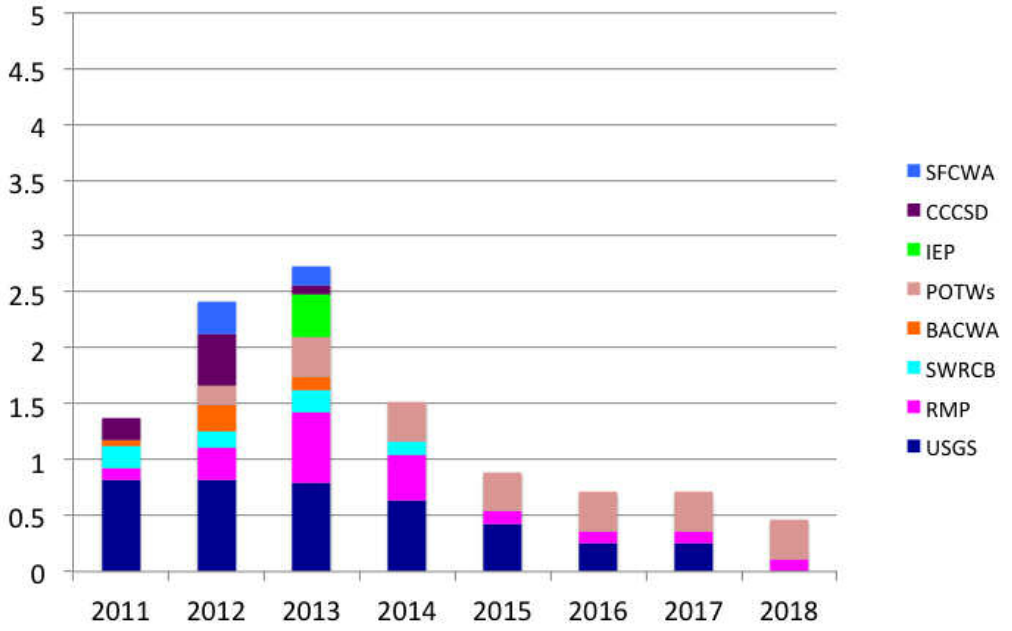
- How to communicate/visualize the data?
  - USGS-Sac has experience wiring this configuration into datalogger, communicating and visualizing data
- Field maintenance/calibration check procedures for Chl and NO3 sensors
  - Will likely use NO3 standard and chl grab samples
- Reliability of in-situ chl measurements – how to account for interference of turbidity, FDOM
  - USGS-Sac planning study

RMP Nutrient Oversight

- What will be the RMP's role in on-going nutrient work?

- Should we form an RMP Nutrient Workgroup?
  - What is its role relative to the NNE SAG, and other bodies?
    - Monitoring program
    - Modeling
    - Input on current/future reports

Program Funding



Forecasted Program Costs