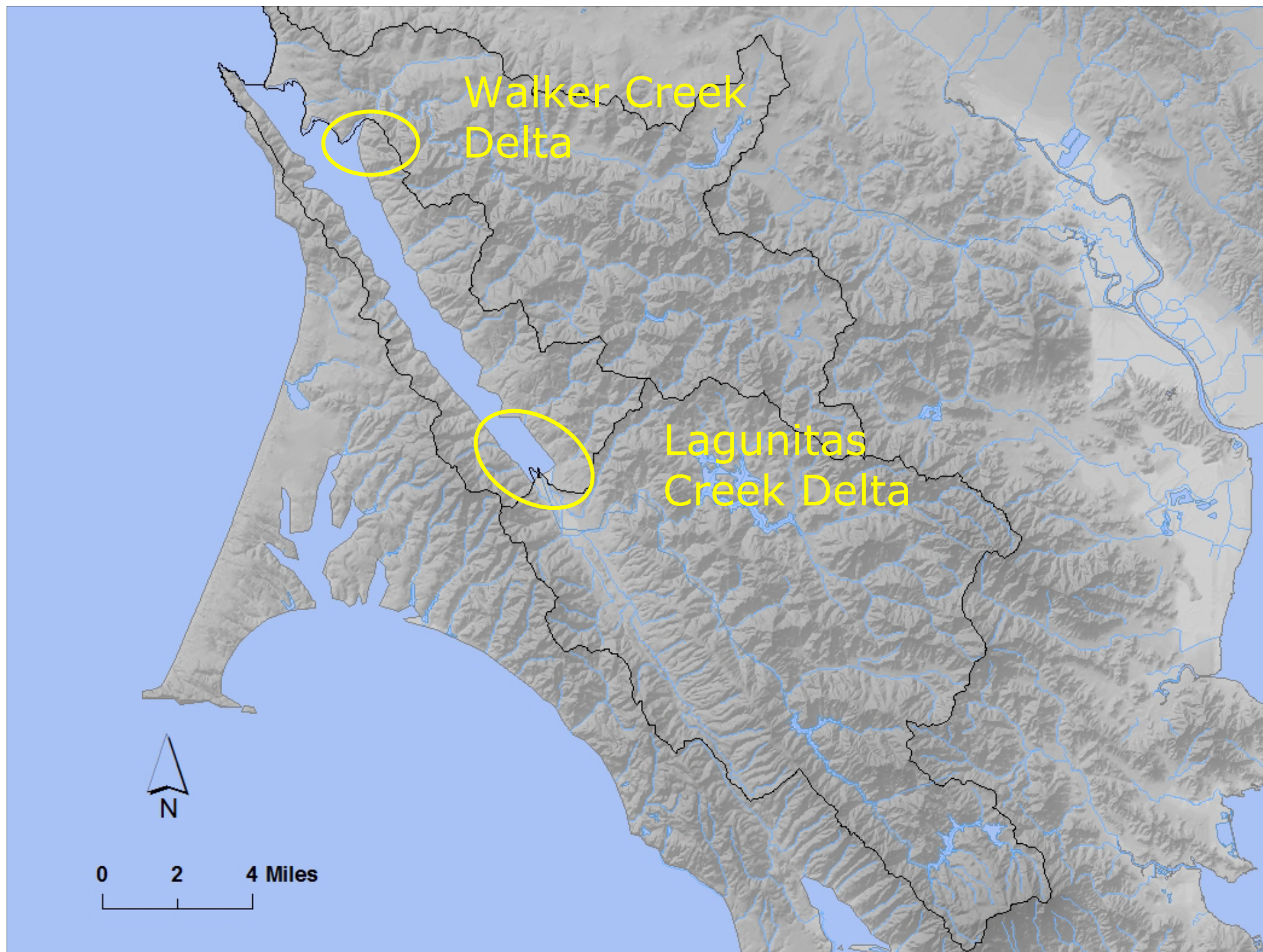


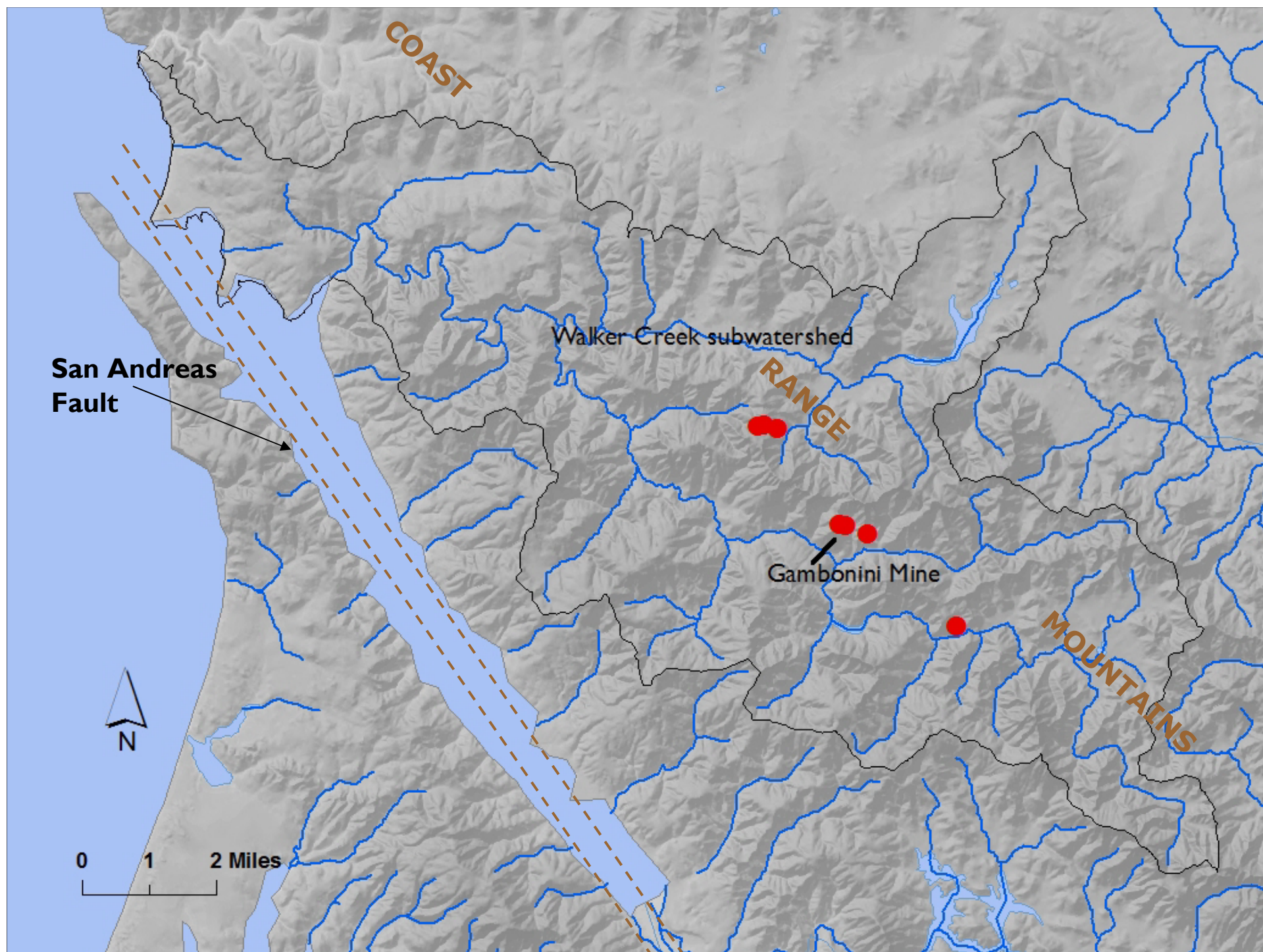


Assessing Impairment of Tomales Bay due to Mercury

**Kat Ridolfi, SFEI
RMP Annual Mercury Meeting
January 27, 2010**

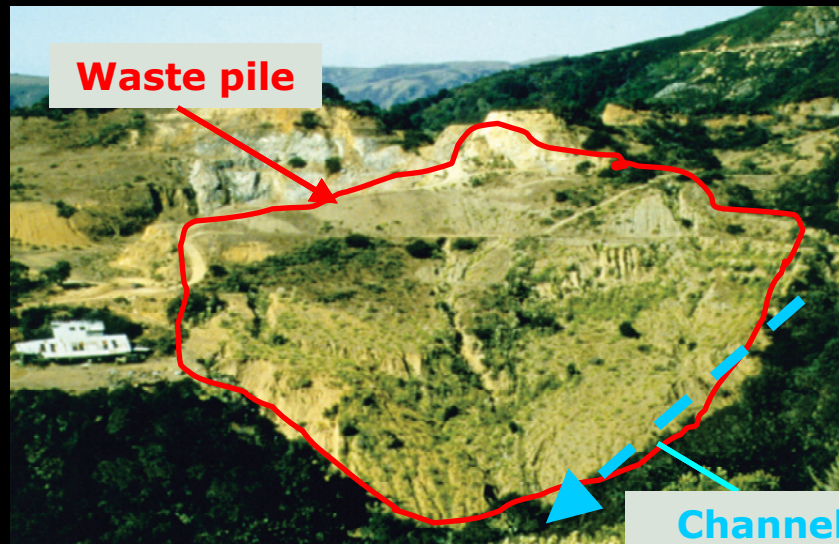






Mercury mining

Pre-remediation



Post-remediation (1999)



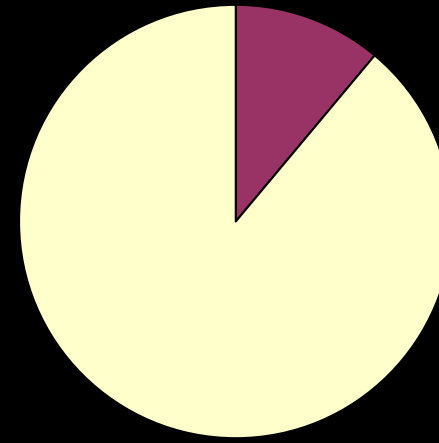
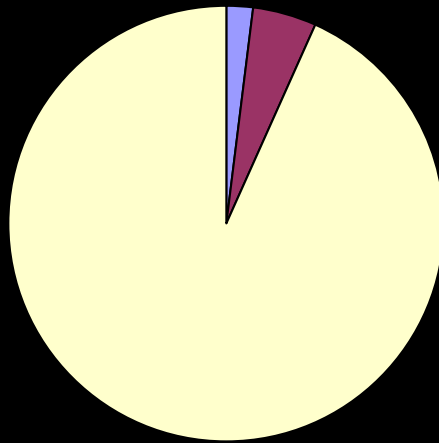
300,000m³ contaminated tailings pile

Avg THg concentration=320 ug/g

Source Analysis

Low: 21kg/year

High: 90 kg/year



■ Atmospheric Deposition¹ ■ Background² ■ Mining³

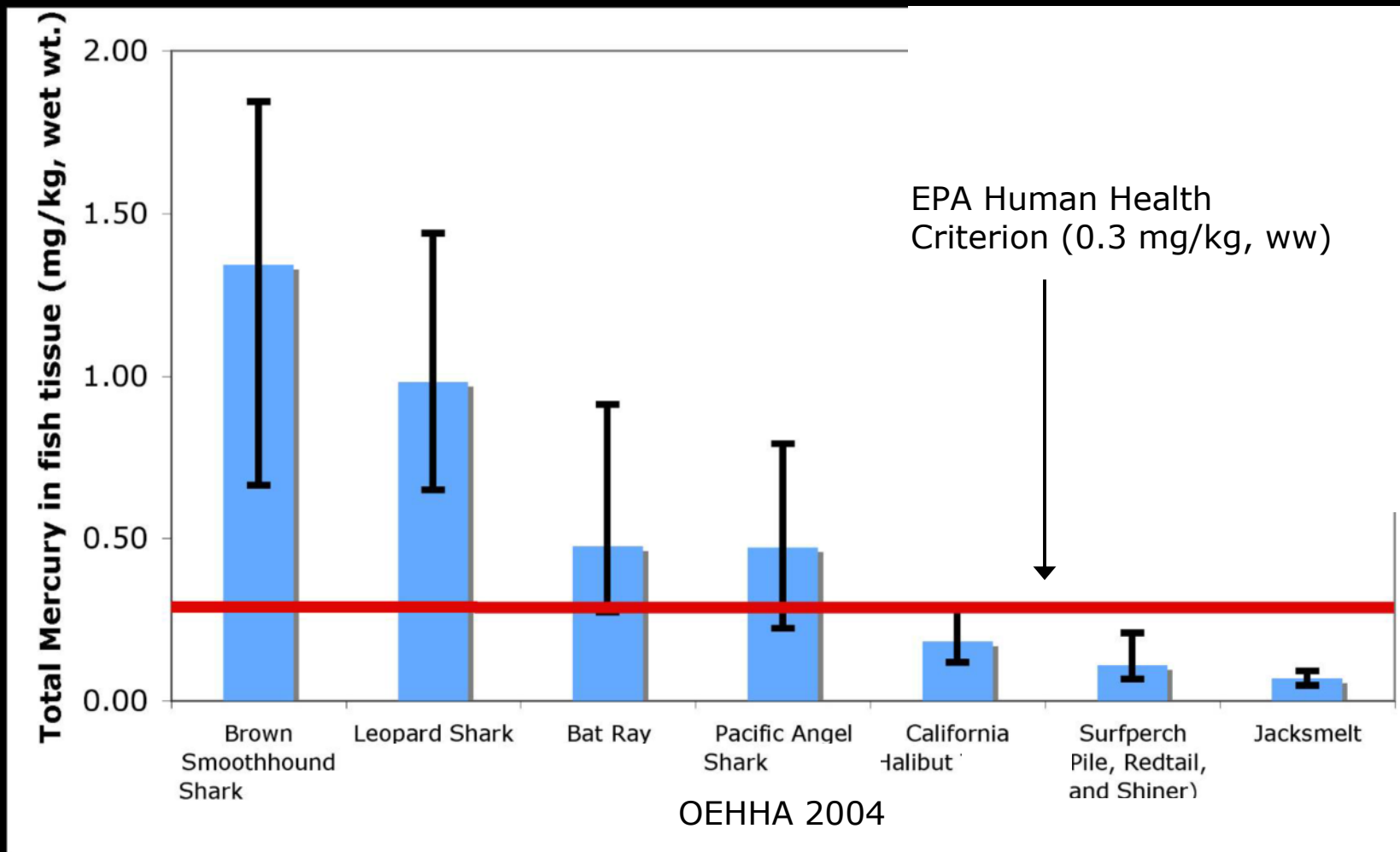
Groundwater contributions not included.

1 Tsai and Hoenicke 2001

2 Marshall 2006

3 Johnson, et al. 2009

Hg in Sport Fish






SFEI's Scope

- Evaluation of numeric targets to protect wildlife
- Sampling to fill data gaps
- Impairment assessment, focus on wildlife (incomplete)

Numeric targets summary for piscivorous wildlife

Target (ug/g, ww)	0.05	0.17
Species protected	Belted kingfisher	Black- crowned night heron
Fish size	5-15 cm	>15 cm

Data Gaps

Sediment	Water	Small Fish	Sport Fish	Invertebrates	Resident Wildlife	Lagunitas Delta
•THg •MeHg	•THg •MeHg		•THg	•THg		

Research Questions and Hypotheses

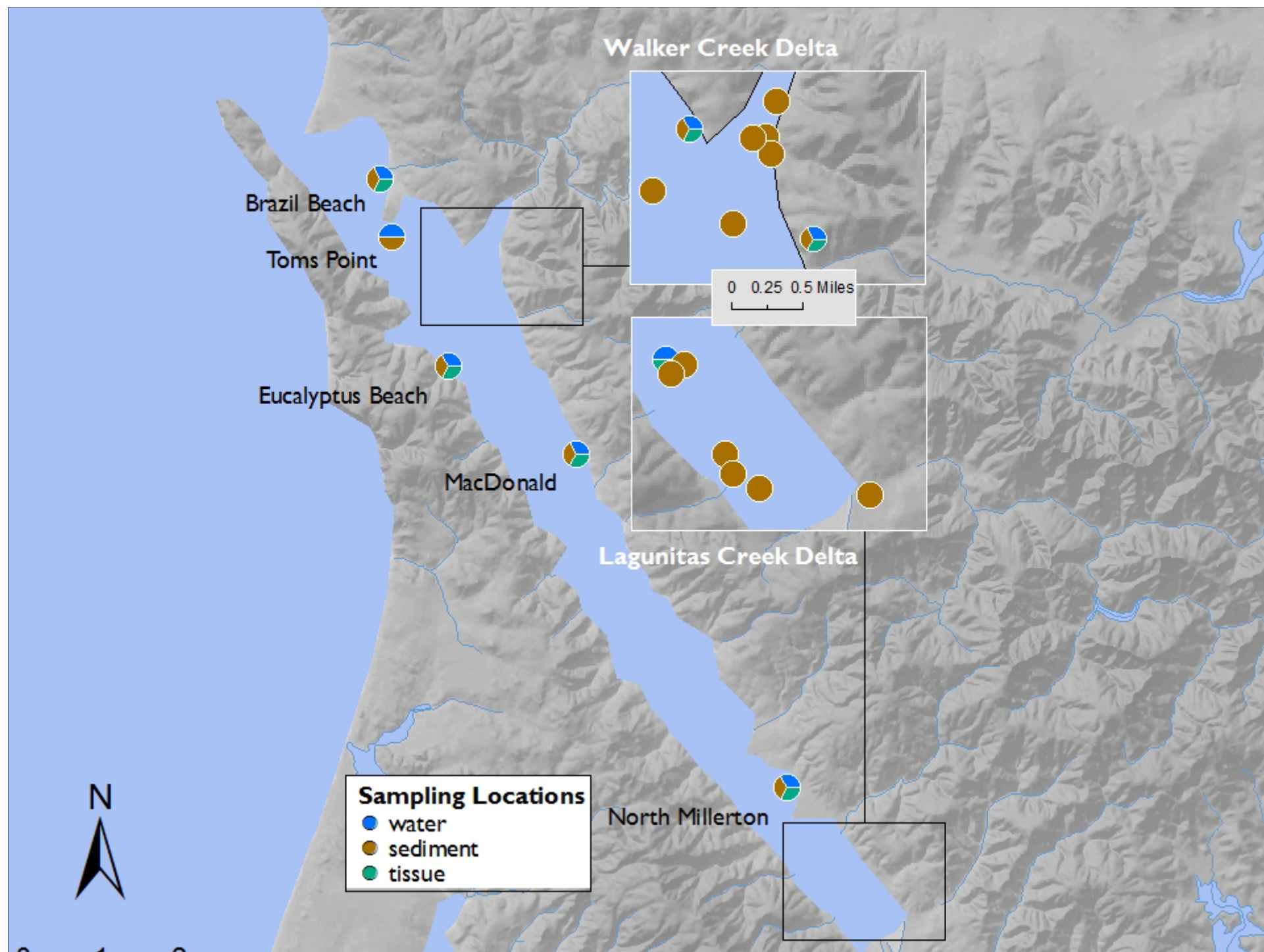
- **Question 1:** What are the gradients and patterns of total and methylmercury?
 - H1: Hg is higher in Walker Creek delta than Lagunitas delta or other sites
 - H2: MeHg is higher in tidal marsh than mudflats or sandy substrate
 - H3: Erosion of mine-contaminated sediments is still occurring

Research Questions and Hypotheses

- **Question 2:** Is mercury from mining sediments entering the food chain of Tomales Bay?

H1: There are correlations of Hg among water, sediment, and fish

H2: Hg concentrations in fish tissue exceed the wildlife target



Fish collected by otter trawl



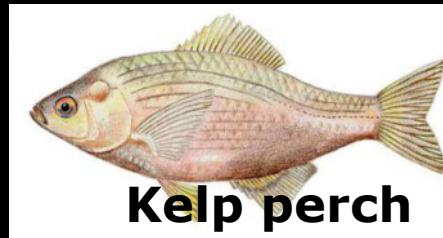
Staghorn sculpin



Shiner perch



Jacksmelt



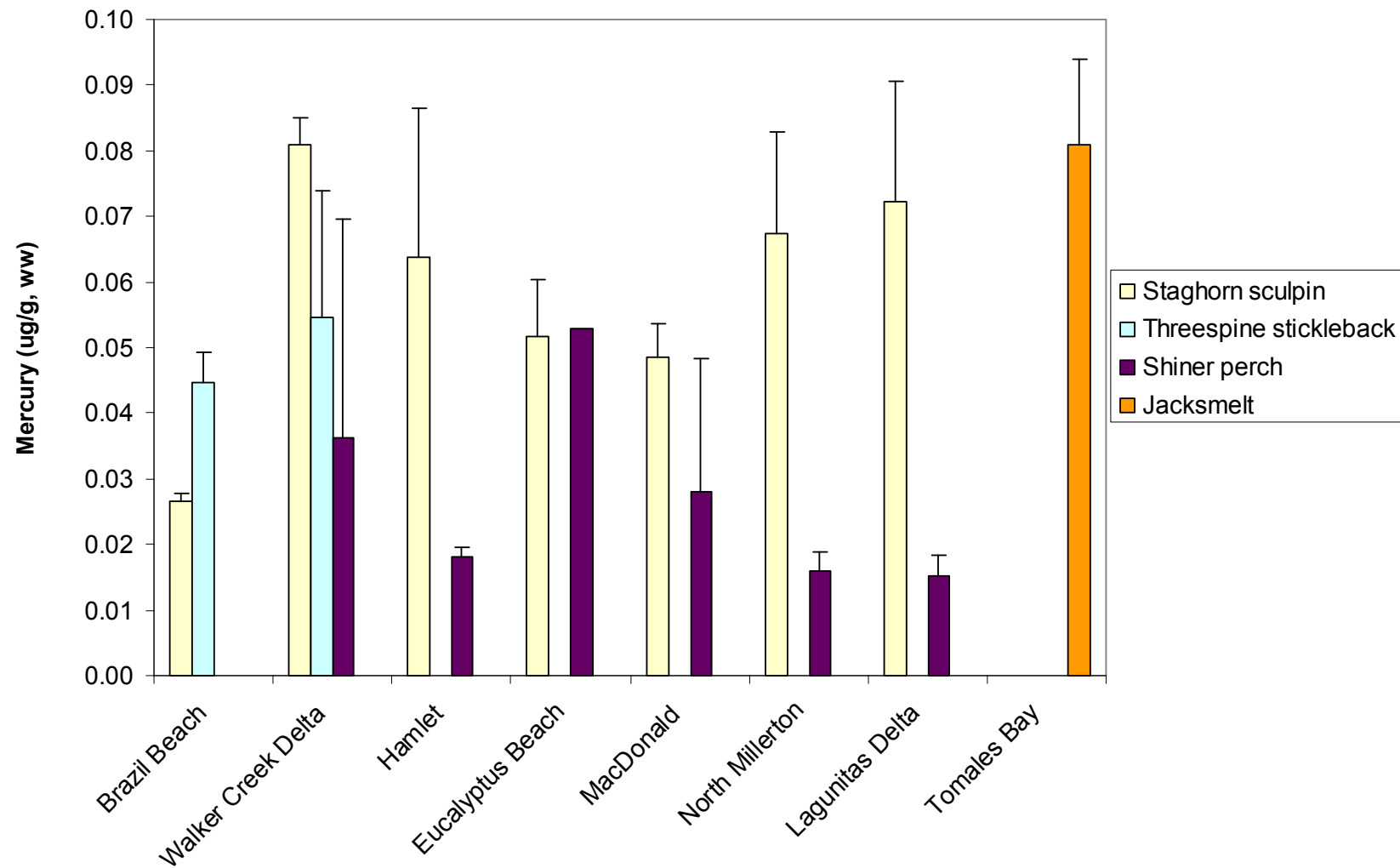
Kelp perch



Speckled sanddab



**Three-spined
stickleback**



• **No statistical significance between sites**

Fish Data by Size Class

Size Class	Target	Mean Hg (ug/g)	Exceedance of target
5-15 cm	0.05	0.047	48%
>15 cm	0.17	0.08	0%

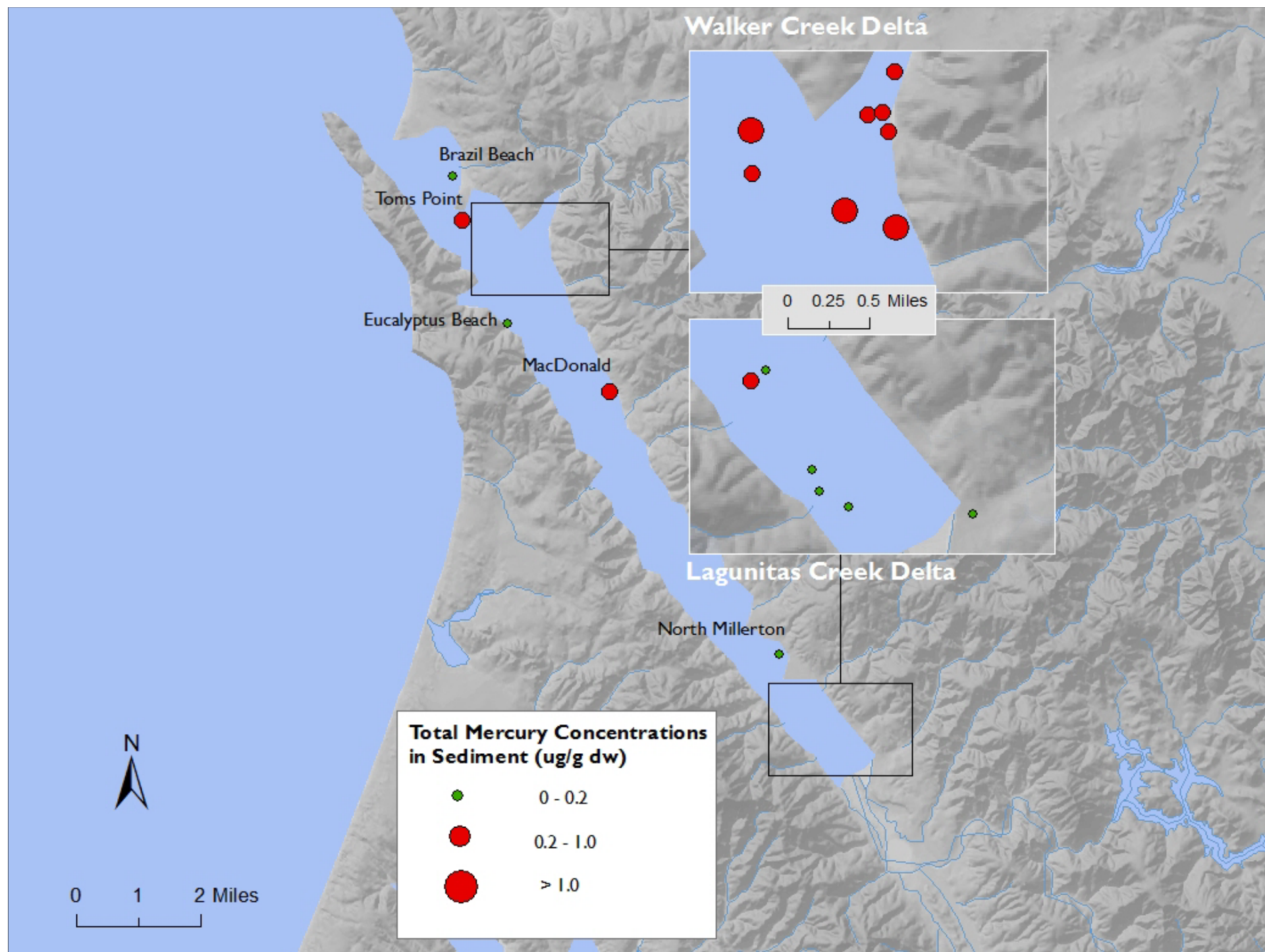
Preliminary Topsmelt Data

- November 2009
- 4 composites
- Mean length=70.5mm
- Mean Hg=0.12 ug/g, ww

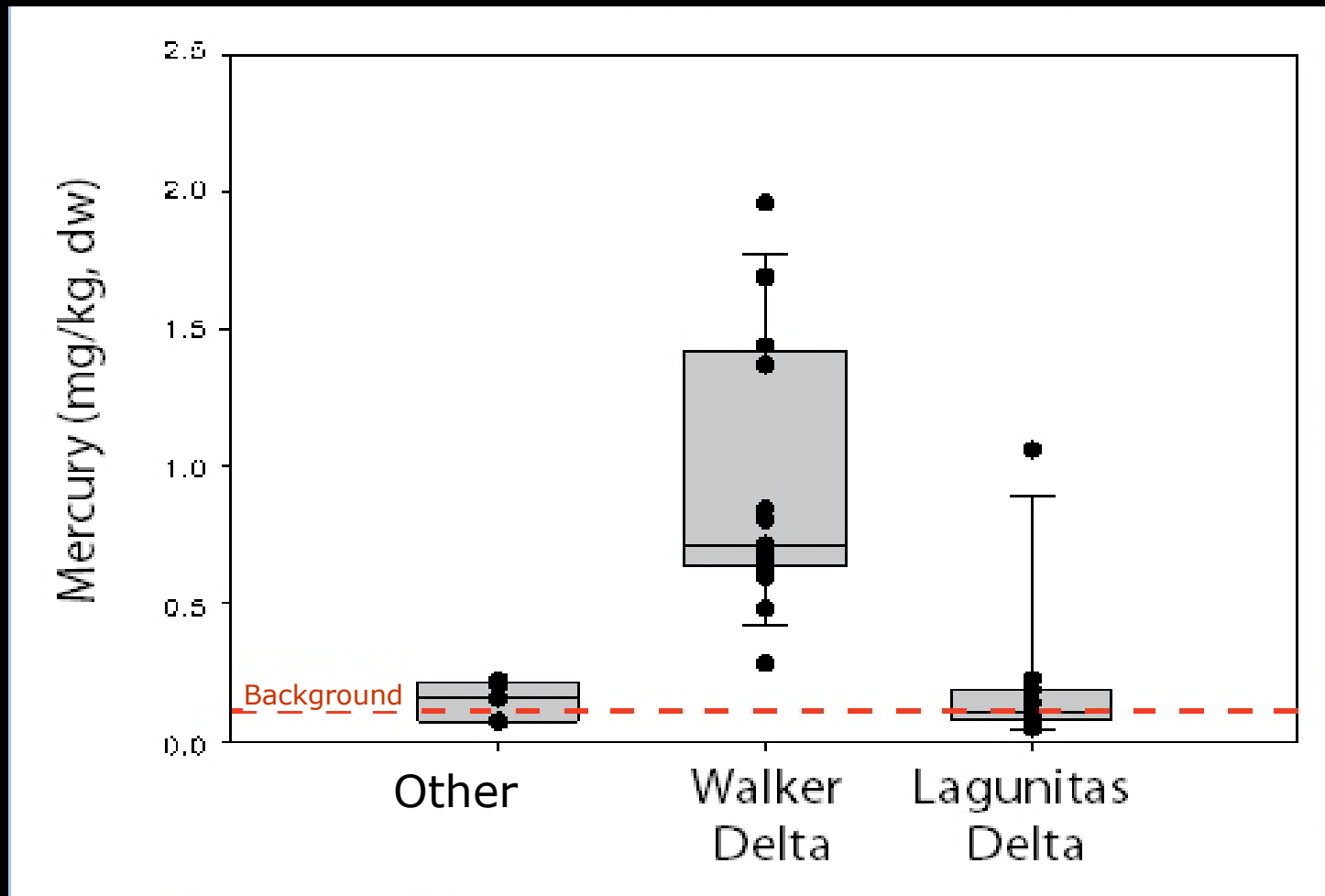


Museum Specimens— Preliminary Data

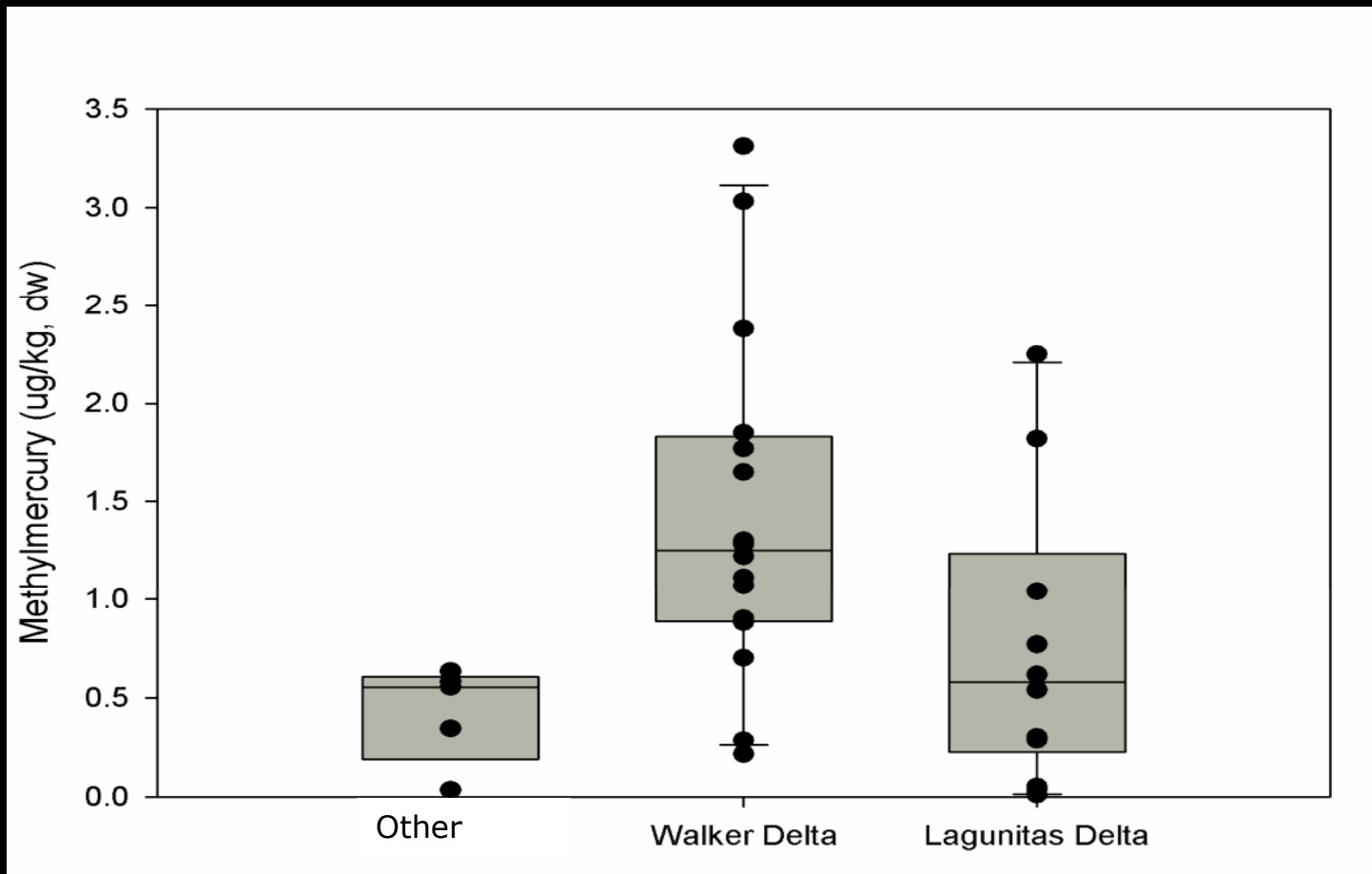
Location	Years collected	Species (n)	Mean Length (mm)	Mean Hg (ug/g, ww)	2009 Mean Hg (ug/g,ww)
Tidal portions of Walker and unnamed Creeks	1953-1960	Staghorn sculpin (12)	67.4	0.15	0.06
Tidal portions of Walker	1954-1955	Topsmelt (6)	63.1	0.12	0.12



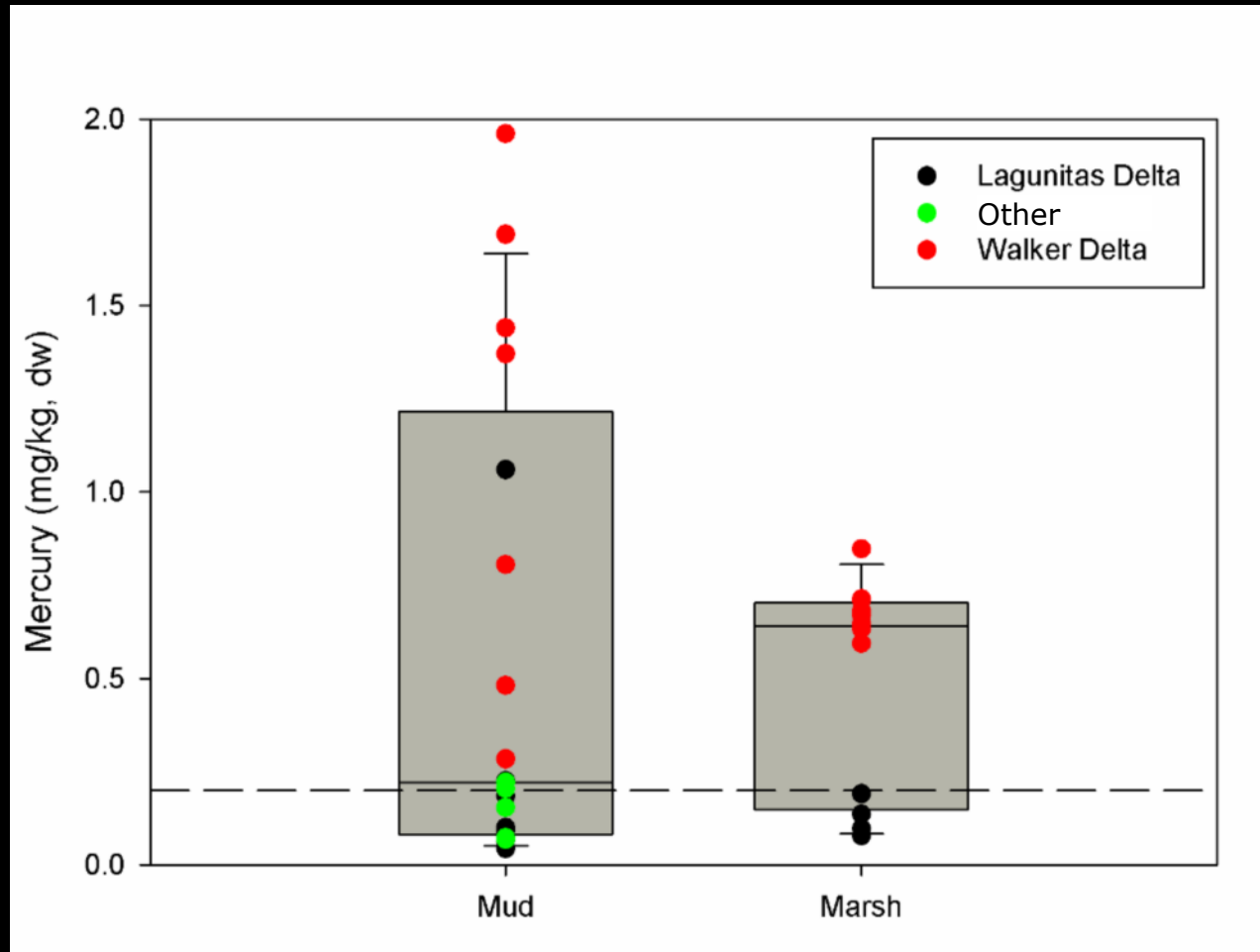
- THg in Sediment is statistically higher in Walker Creek compared to other sites
- Previously reported range: 0.05-3.1 mg/kg (Johnson, et al. 2009)



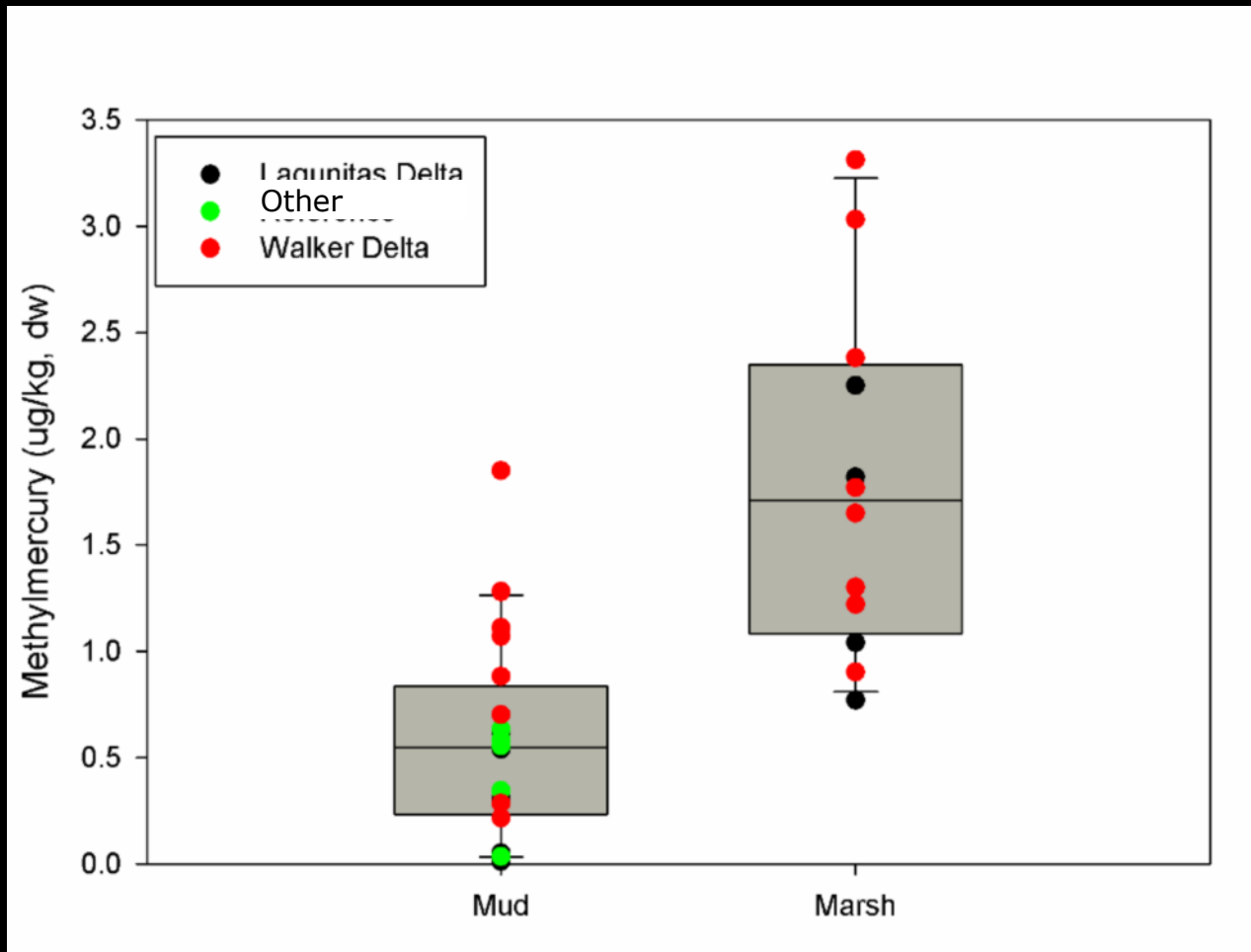
- MeHg in sediment in the Walker delta is statistically higher than other sites
- Previously reported range 0.2-11.4 ng/g in Walker delta (Johnson, et al. 2009)



No statistical difference in Total Hg concentrations in mudflat vs. marsh sites



Marsh MeHg concentrations are statistically higher than mudflat sites



DGT Results

Legend

- 0 - 9.30
- 9.31 - 11.80
- 11.81 - 18.30



0 1 2 Miles

Walker Delta

Hamlet

Eucalyptus Beach

Lagunitas Delta



Research Questions and Hypotheses

- **Question 1:** What are the gradients and patterns of total and methylmercury?

H1: Hg is higher in Walker Creek delta than Lagunitas delta or other sites **YES**

H2: MeHg is higher in tidal marsh than mudflats or sandy soil **YES**

H3: Erosion of mine-contaminated sediments is still occurring **YES**

Research Questions and Hypotheses

- **Question 2:** Is mercury from mining sediments entering the food chain of Tomales Bay?

H1: There are correlations of Hg **NO** among water, sediment, and fish

H2: Hg concentrations in fish tissue exceed the wildlife target

YES, IN 48% OF FISH 5-15CM

LARGER FISH DO NOT EXCEED TARGET



Data gaps

- Impact of mercury on resident tidal marsh wildlife and prey

Conclusions

- Historic mining remains the largest source of mercury
- Evidence of declining trend in sediment
- Impairment due to mercury associated with vegetated marshes

Thanks

- SFEI reviewers, field, and data management staff

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Questions....

