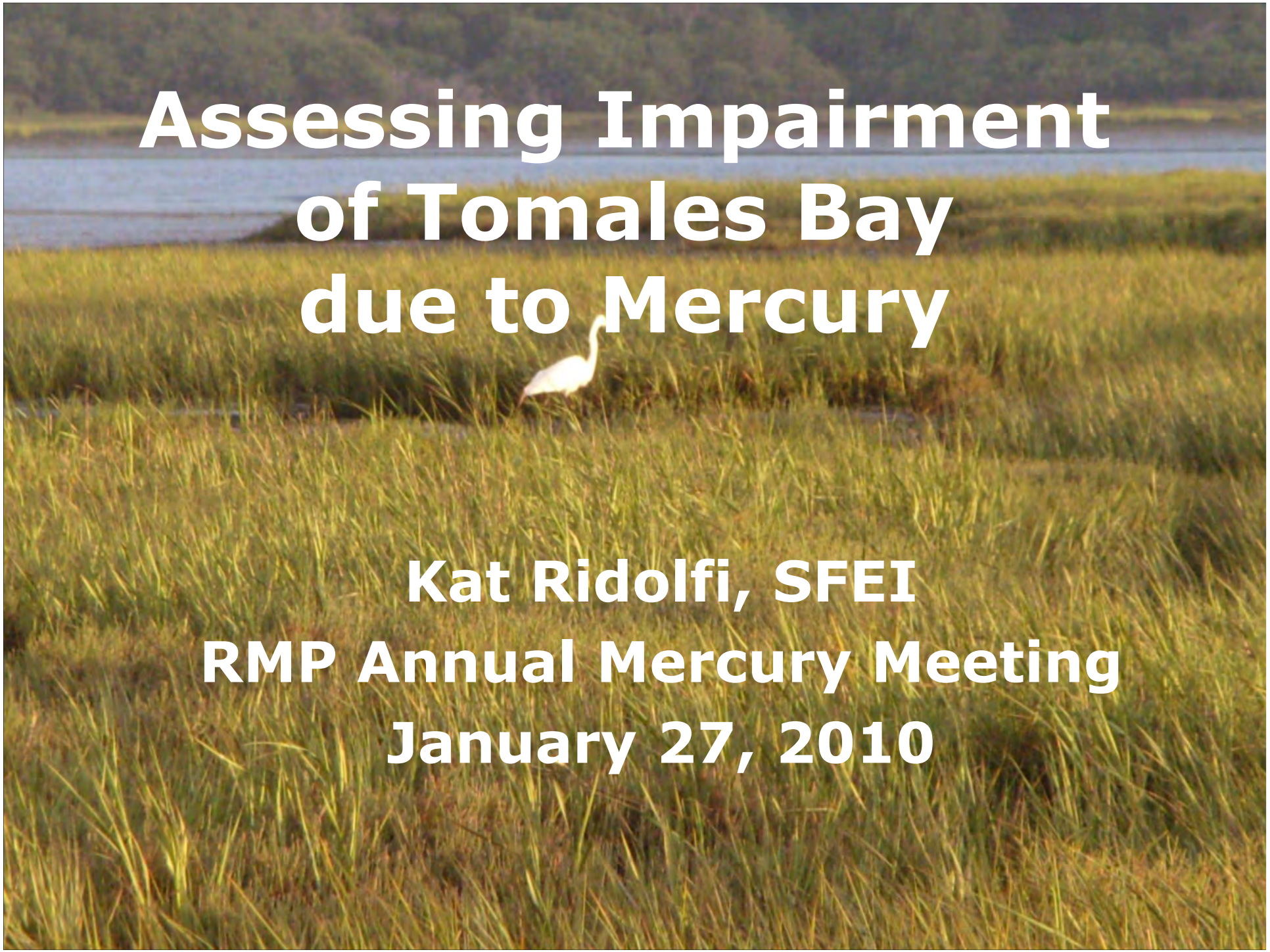


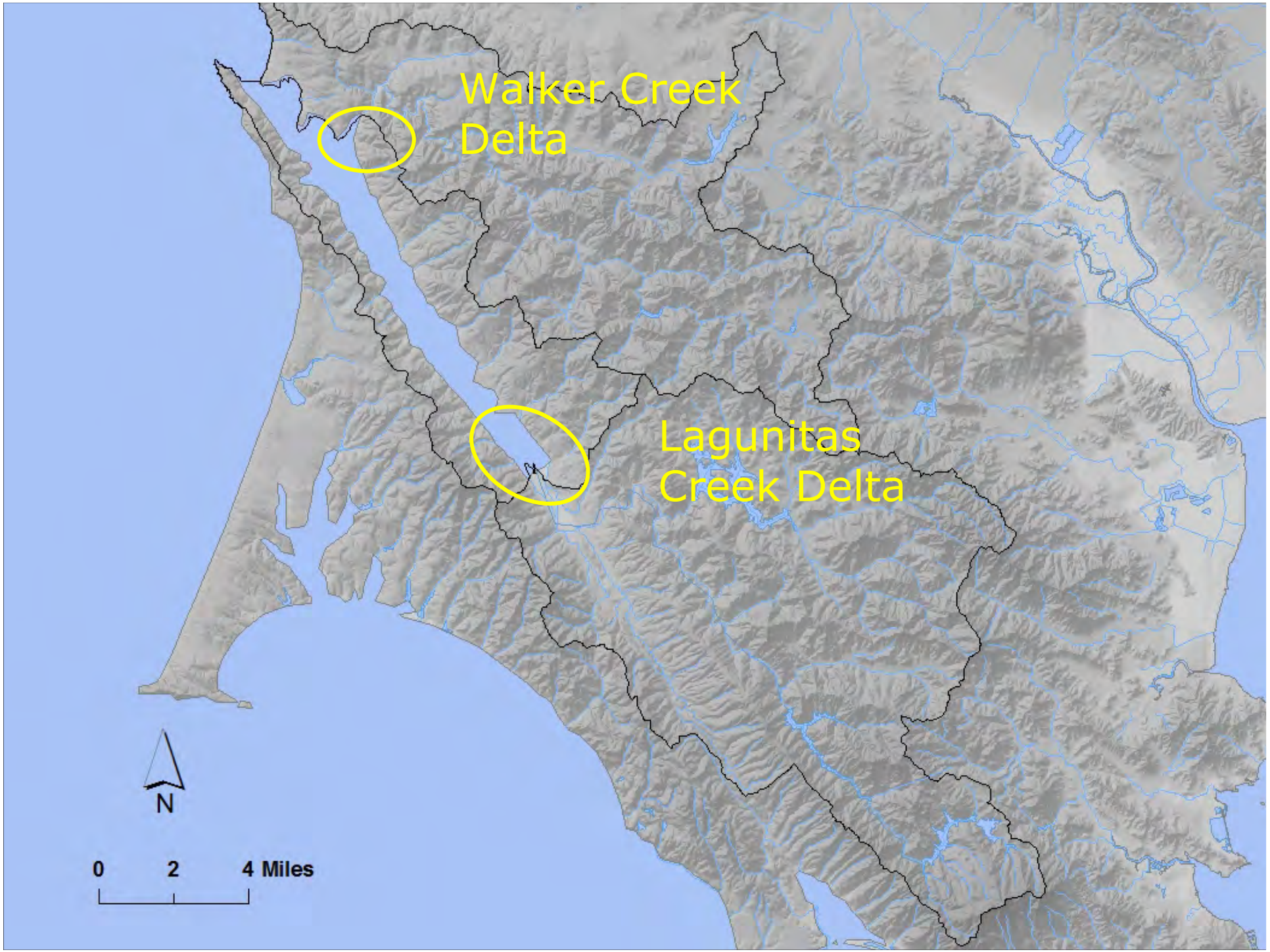
Assessing Impairment of Tomales Bay due to Mercury

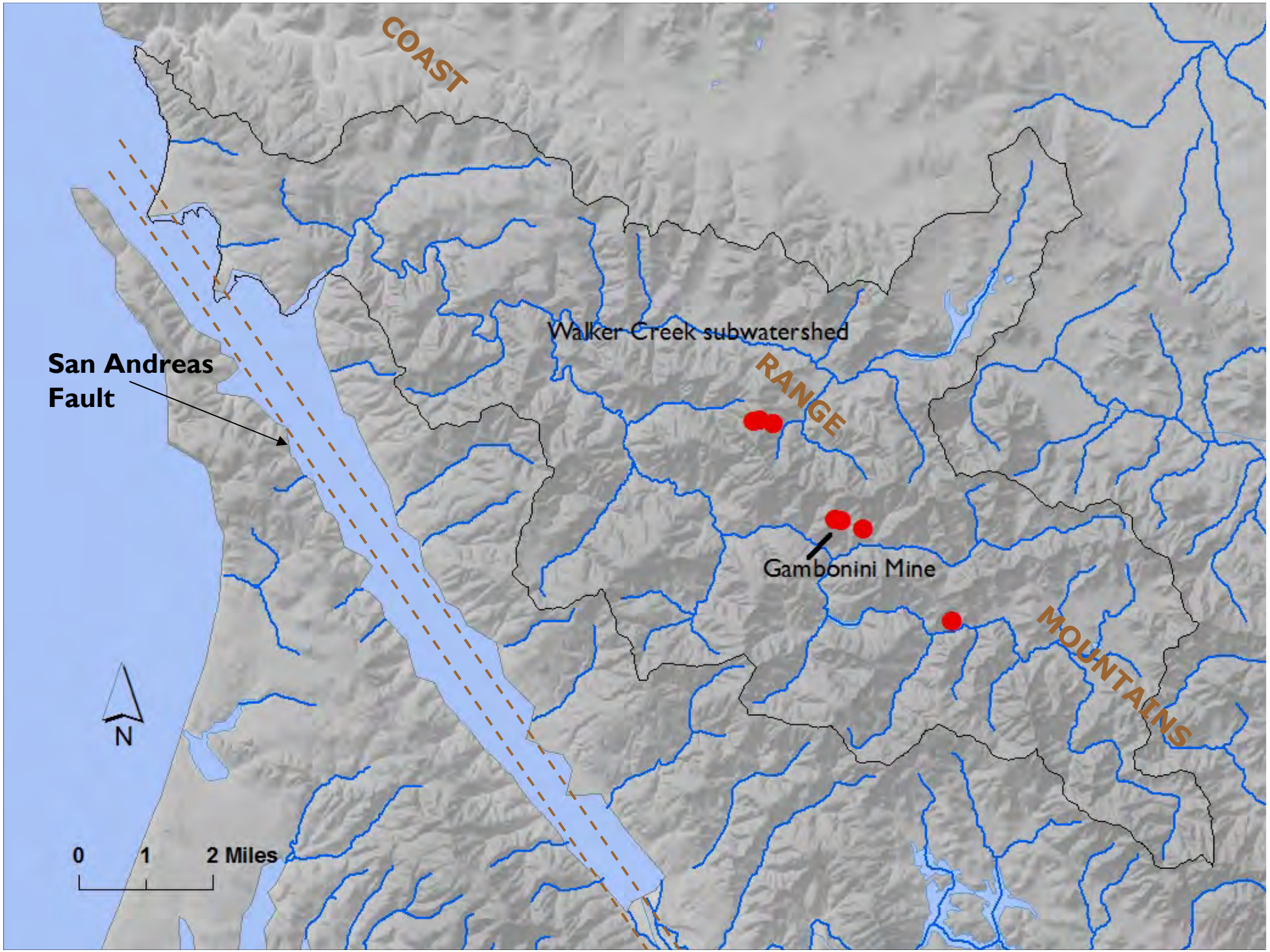
Kat Ridolfi, SFEI

RMP Annual Mercury Meeting

January 27, 2010

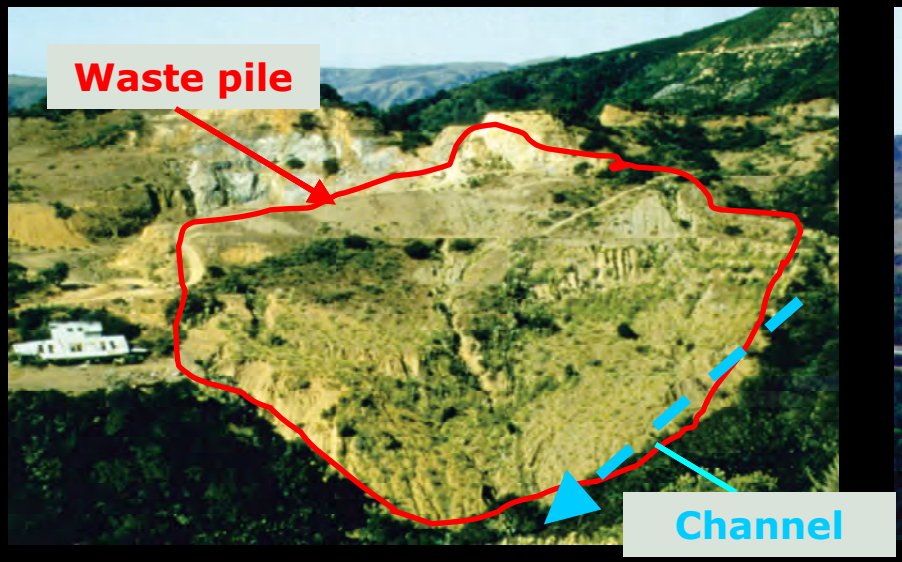

RMP Meeting
Walker Creek subwatershed
Lagunitas Creek subwatershed
N
0 1.5 3 Miles


Walker Creek
Delta
Lagunitas
Creek Delta
N
0
2
4 Miles


COAST
Walker Creek subwatershed
San Andreas
Fault
RANGE
Gambonini Mine
MOUNTAINS
N
0
1
2 Miles

Mercury mining

Pre-remediation



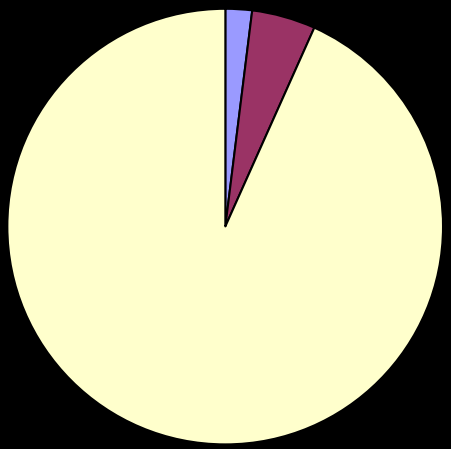
Post-remediation (1999)

300,000m^3 contaminated tailings pile

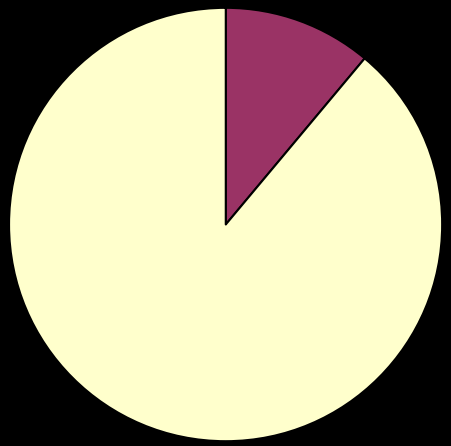
Avg THg concentration=320 ug/g

Source Analysis

Low: 21kg/year



High:90 kg/year



Atmospheric Deposition[1] Background[2] Mining[3]

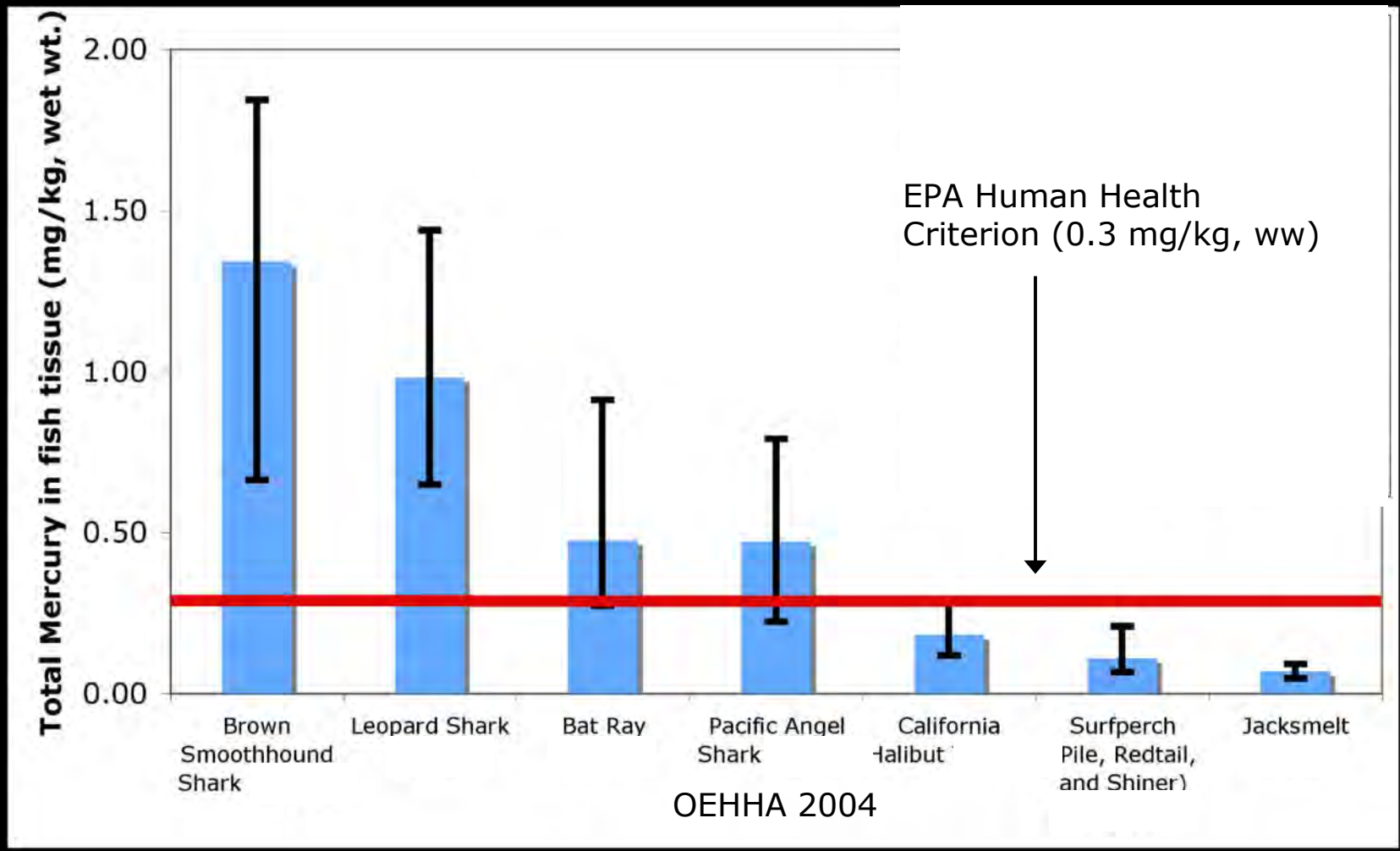
Groundwater contributions not included.

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	Inver-tebrates	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

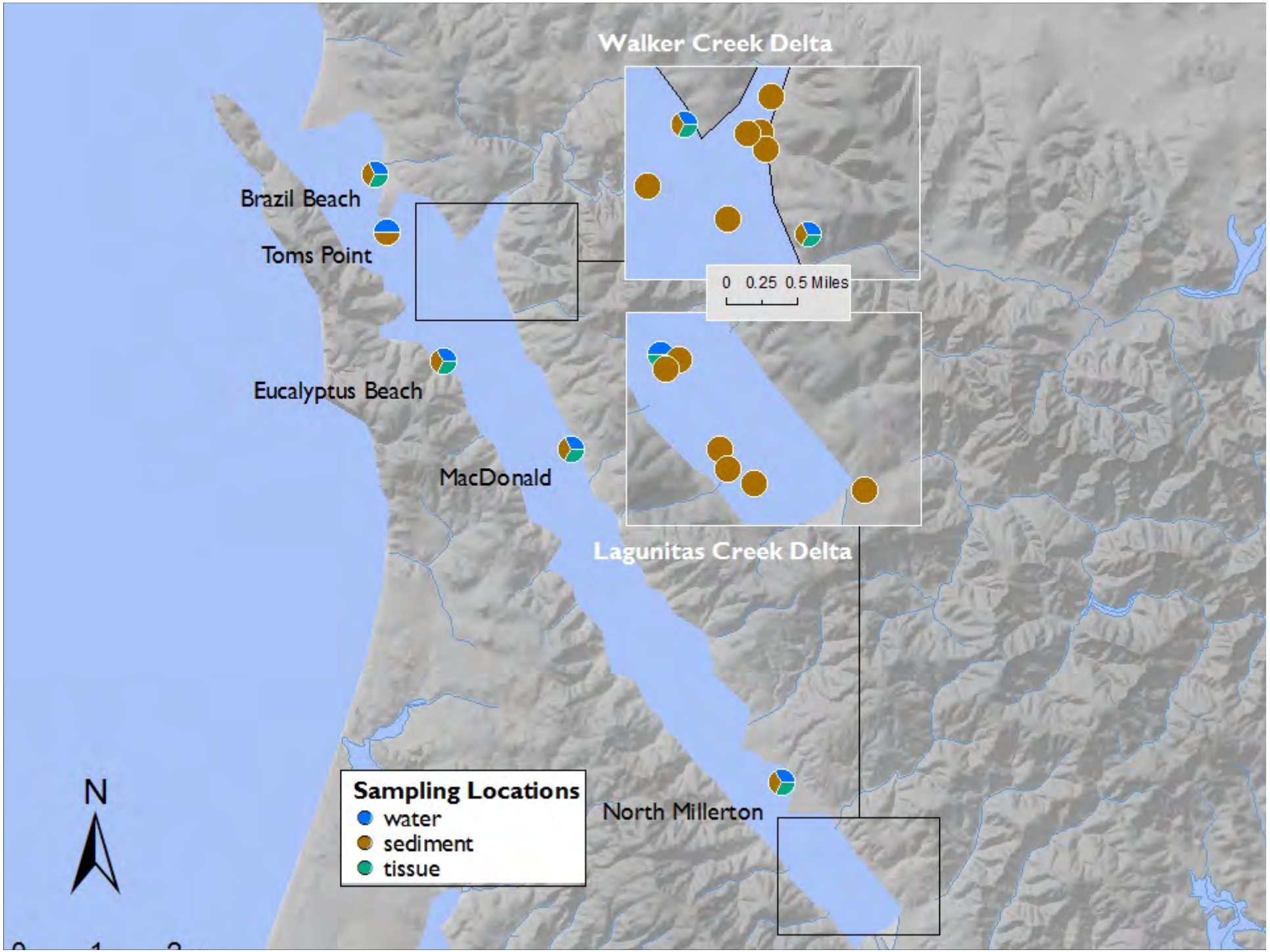
  H3: Erosion of mine-contaminated sediments is still occurring

Research Questions and Hypotheses

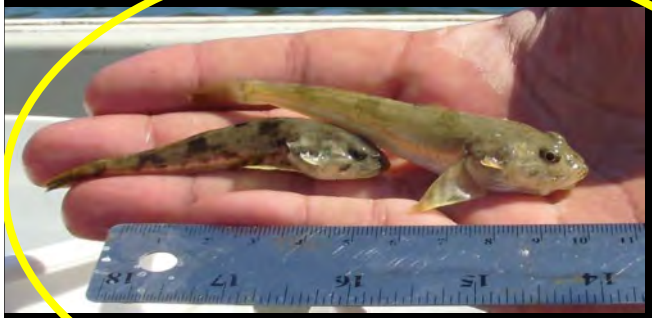
- **Question 2:** Is mercury from mining sediments entering the food chain of Tomales Bay?

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

  H2: Hg concentrations in fish tissue exceed the wildlife target


Walker Creek Delta
Brazil Beach
Toms Point
0 0.25 0.5 Miles
Eucalyptus Beach
MacDonald
Lagunitas Creek Delta
North Millerton
Sampling Locations
water
sediment
tissue
N

Fish collected by otter trawl



Staghorn sculpin

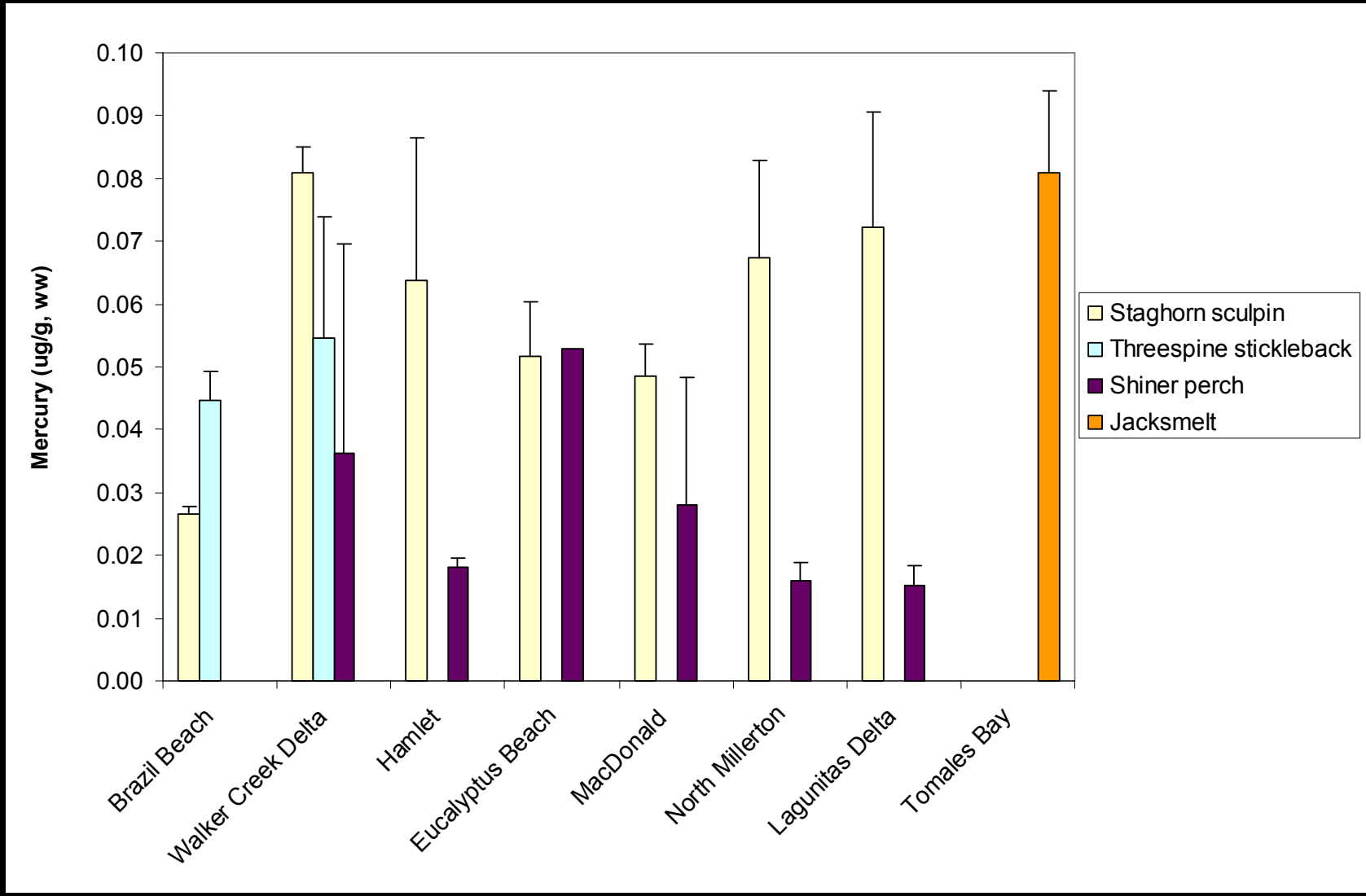
Shiner perch

Jacksmelt

Kelp perch

Speckled sanddab

Three-spined stickleback



- **No statistical significance between sites**

Fish Data by Size Class

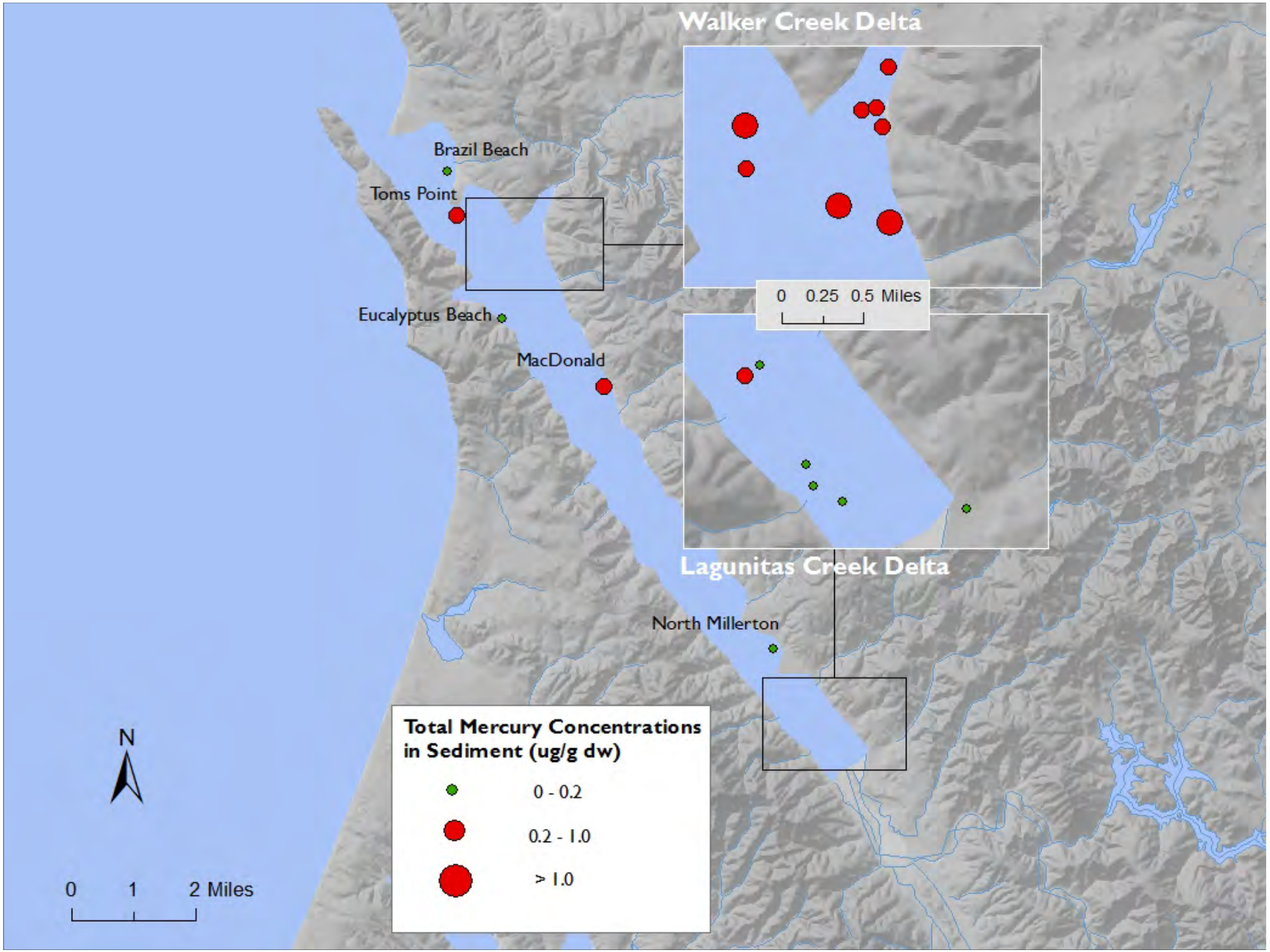
Size Class	Target	Mean Hg (ug/g)	Exceedance of target
5-15 cm	0.05	0.047	48%
>15 cm	0.17	0.08	0%

Preliminary Topsmelt Data

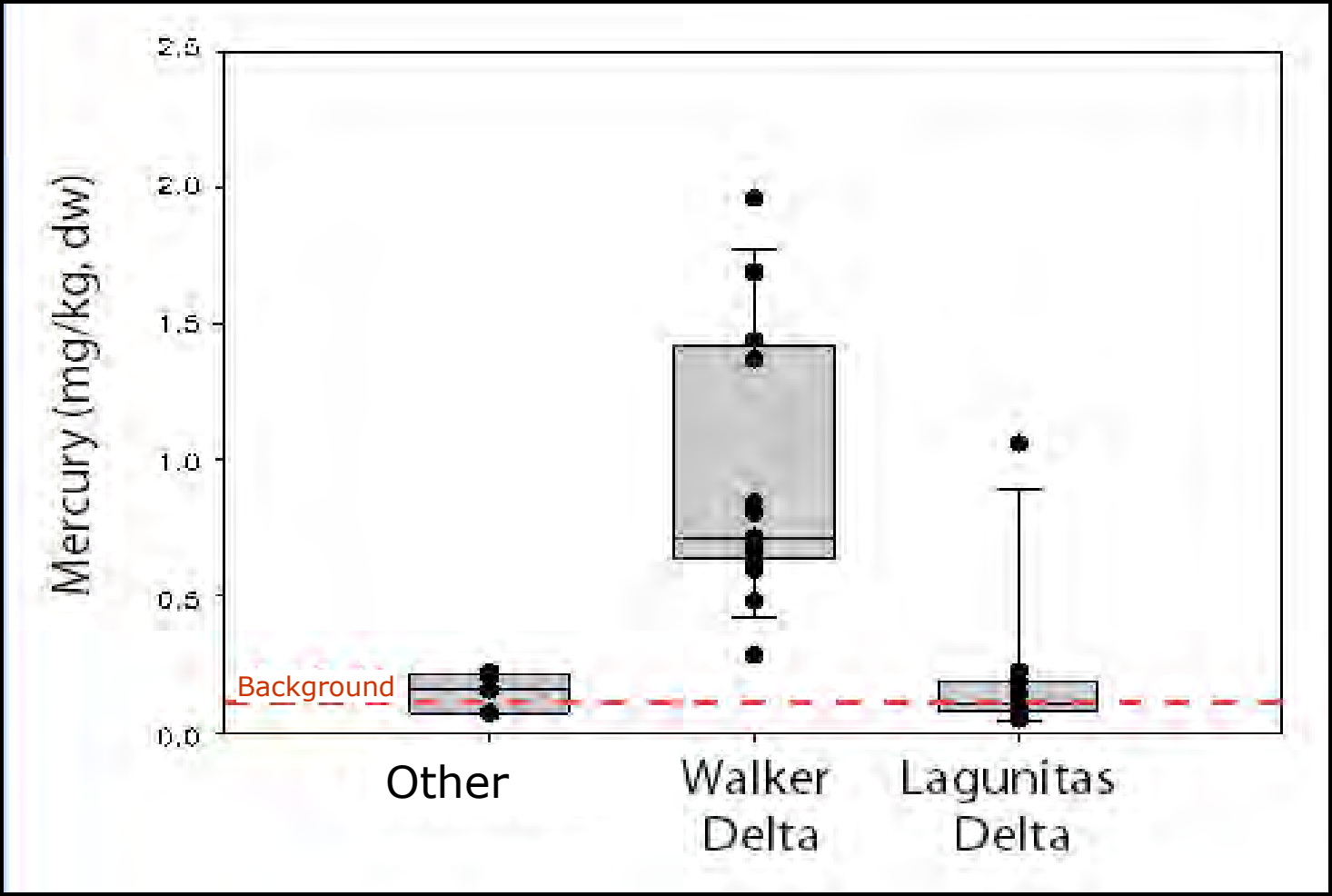
- November 2009
- 4 composites
- Mean length=70.5mm
- Mean Hg=0.12 ug/g, ww

Museum Specimens—Preliminary Data

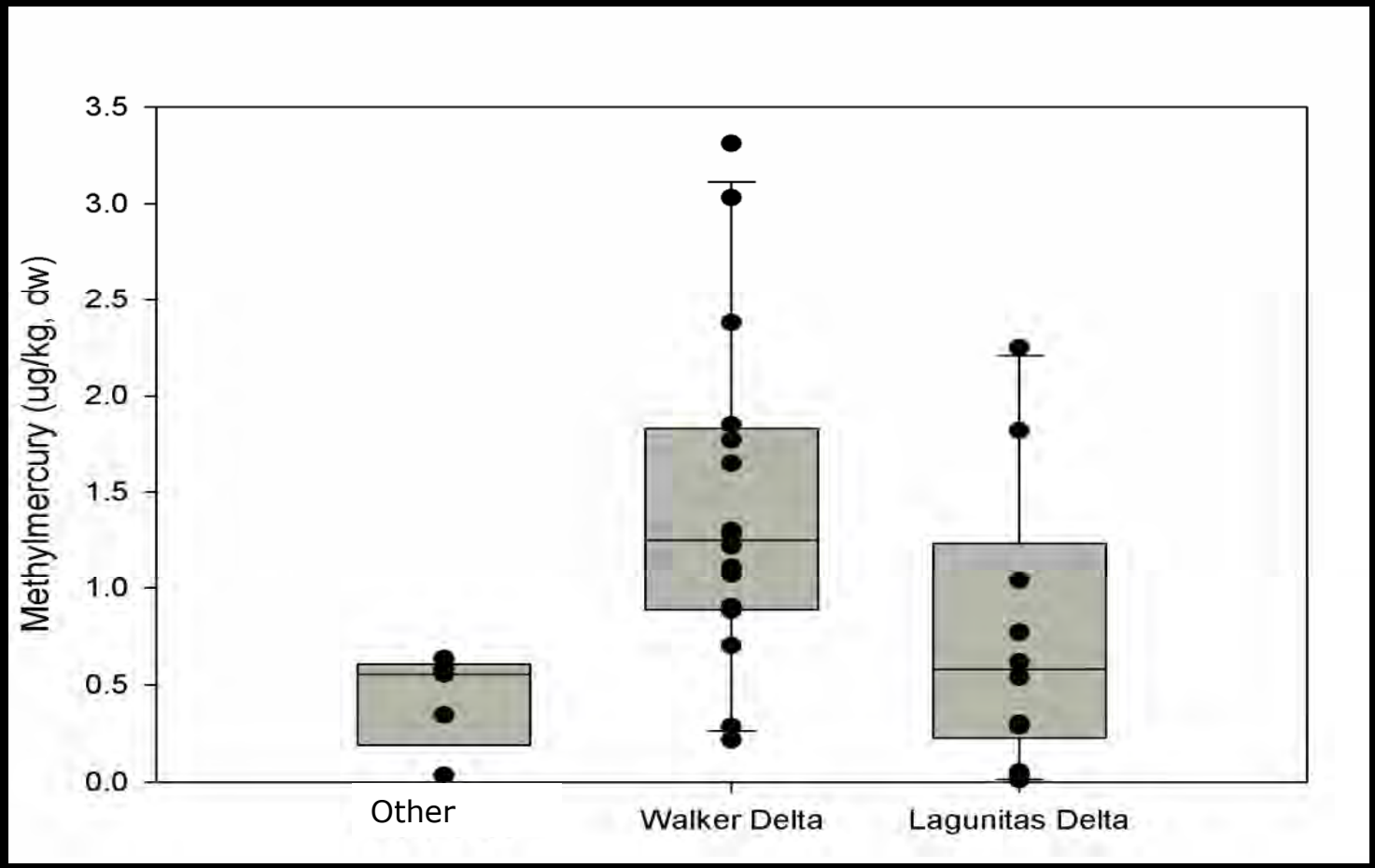
Location	Years collected	Species (n)	Mean Length (mm)	Mean Hg (ug/g, ww)	2009 Mean Hg (ug/g,ww)
Tidal portions of Walker and unnamed Creeks	1953-1960	Staghorn sculpin (12)	67.4	0.15	0.06
Tidal portions of Walker	1954-1955	Topsmelt (6)	63.1	0.12	0.12


Walker Creek Delta
Brazil Beach
Toms Point
Eucalyptus Beach
MacDonald
0 0.25 0.5 Miles
Lagunitas Creek Delta
North Millerton
N
0 1 2 Miles
Total Mercury Concentrations in Sediment (ug/g dw)
0 - 0.2
0.2 - 1.0
> 1.0

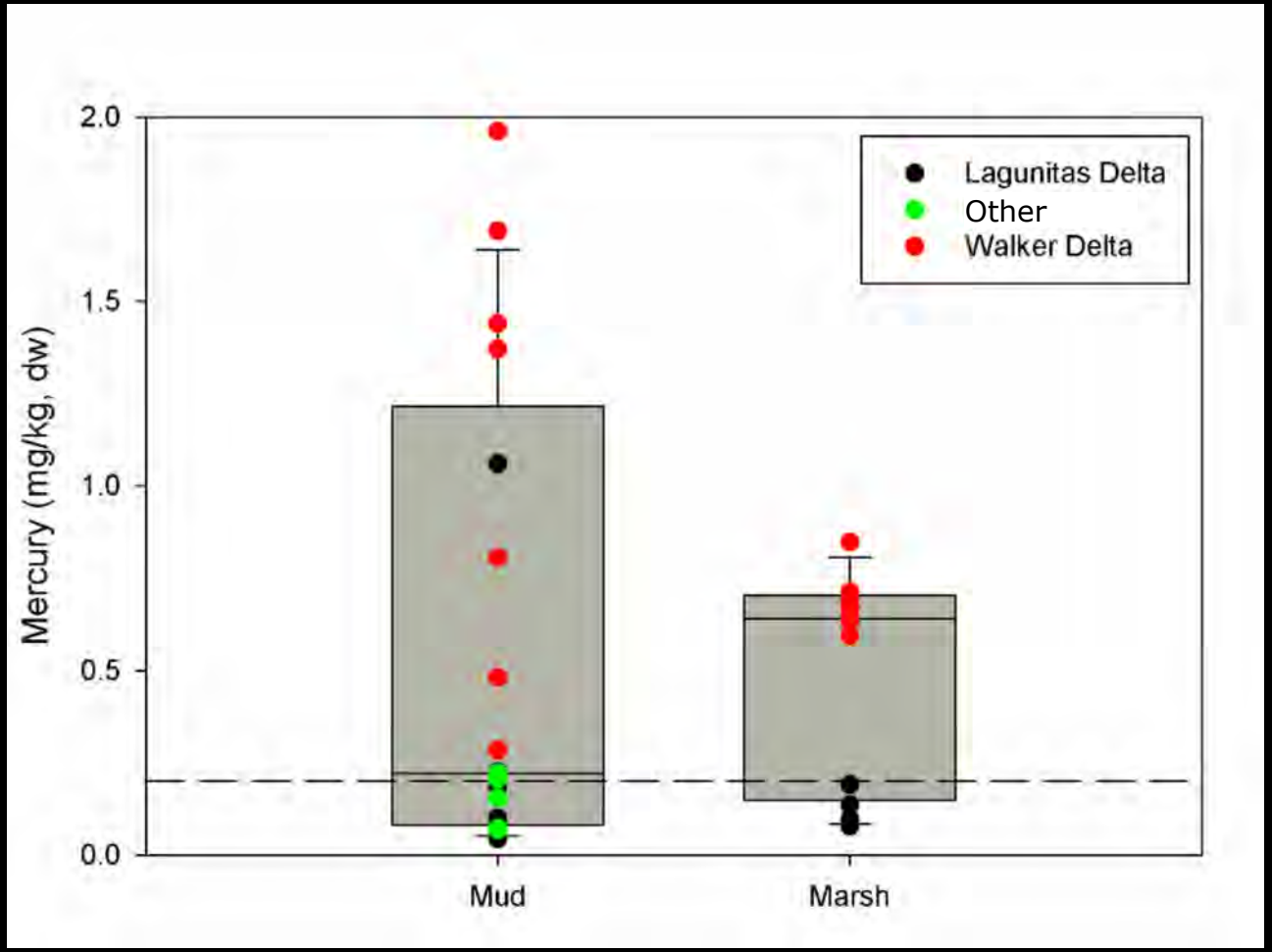
- THg in Sediment is statistically higher in Walker Creek compared to other sites
- Previously reported range: 0.05-3.1 mg/kg (Johnson, et al. 2009)



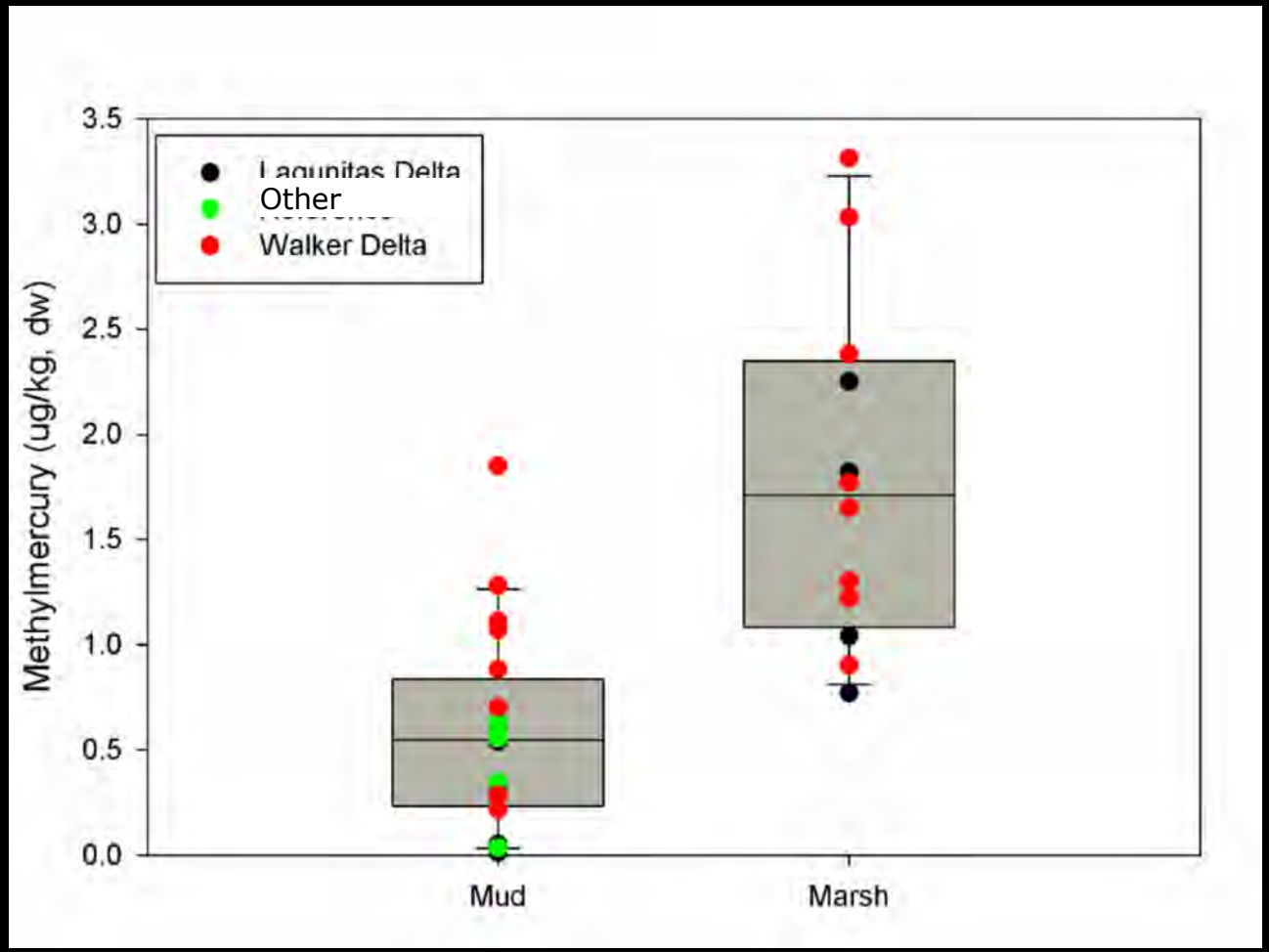
- MeHg in sediment in the Walker delta is statistically higher than other sites
- Previously reported range 0.2-11.4 ng/g in Walker delta (Johnson, et al. 2009)



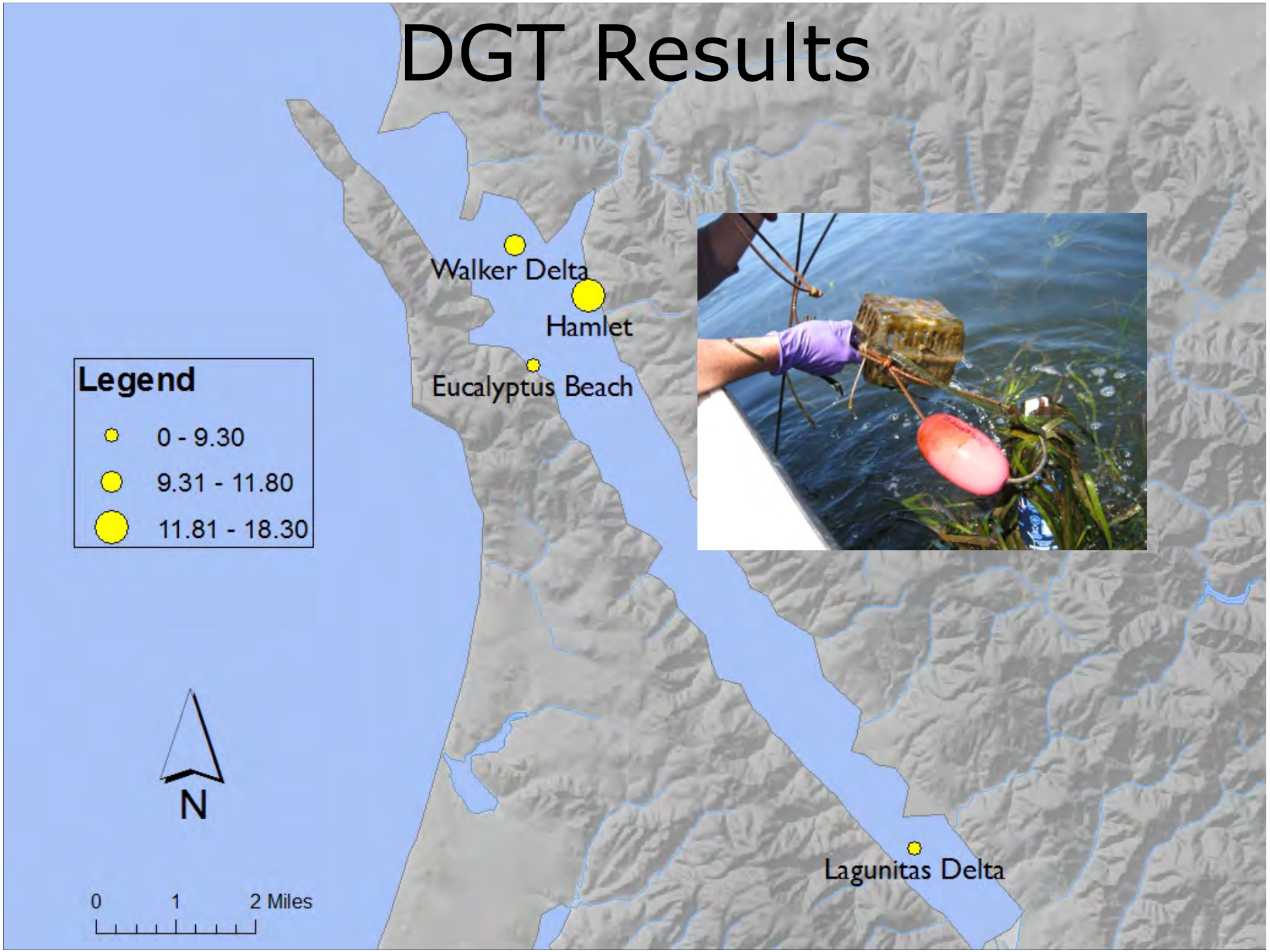
No statistical difference in Total Hg concentrations in mudflat vs. marsh sites



Marsh MeHg concentrations are statistically higher than mudflat sites



DGT Results


Walker Delta
Hamlet
Eucalyptus Beach
Lagunitas Delta
Legend
0 - 9.30
9.31 - 11.80
11.81 - 18.30
N
0
1
2 Miles

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 among water, sediment, and fish **NO**

  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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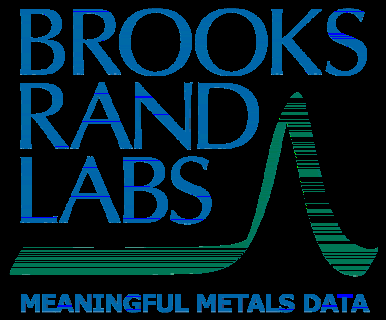
  - Rachel Allen
  - Amy Franz
  - John Ross
  - Sarah Lowe
  - Cristina Grosso
- Labs



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  - Tom Moore
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Questions....