Methylmercury Patterns Revealed by Monitoring Small Fish

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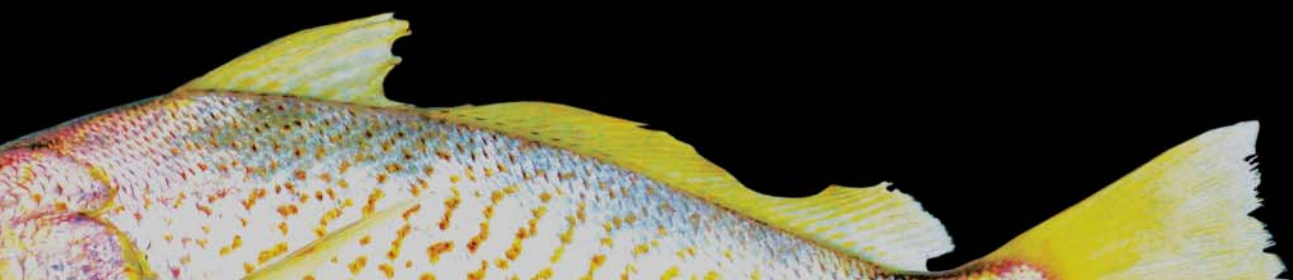


RMP ANNUAL MEETING 2006

Exposure and Effects Pilot Study Small Fish Project Goals

- Monitor food-web mercury at fine spatial and temporal scales
- Assess regional trends in bioaccumulation of Hg related to wetland restoration
- Collect prey fish appropriate for wildlife risk evaluations
  - TMDL has small fish targets but there are limited data from Bay

Sampling Design

- 8 sites along San Francisco Bay margin
  - Wetland restorations vs. extant marshes
- Benthic and pelagic species at each site
  - Variation in habitats or food-webs
  - Topsmelt, Mississippi (inland) silversides
  - Arrow, cheekspot, and Shimofuri goby
- Bay goby in deep water
  - IEP Bay Study collaboration

External Coordination

- This Project: margin of South, Central, and North Bay
- CBDA Fish Mercury Project: Delta to North Bay, more freshwater focus
- South Bay Salt Pond Hg Project: marshes, ponds, and sloughs
- CBDA Bird Mercury Project: forage fish
- Petaluma Mercury Project: marsh fish
- Produce data set as comparable as possible across region by sampling same species

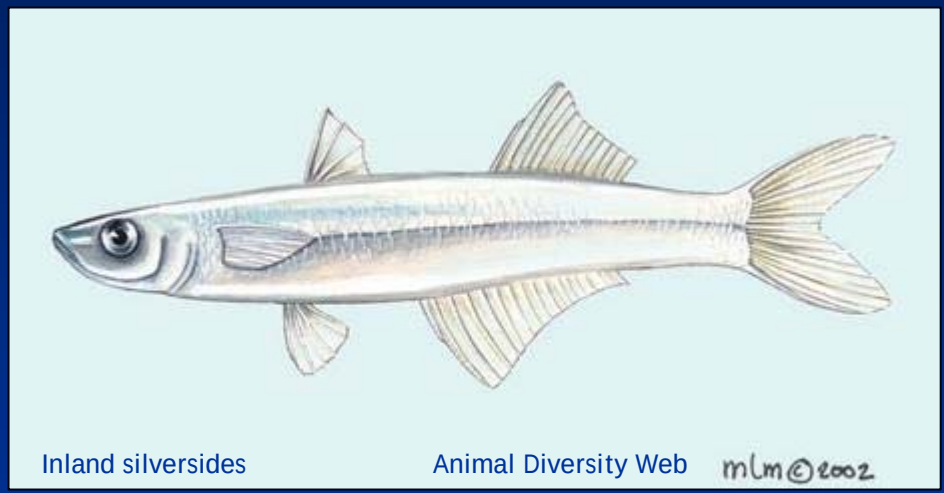
Compositing Design

- 5-10 individuals per composite
- 4 composites per species per site to allow statistical comparison
- Used size limits to reduce influence of any length:Hg relationships

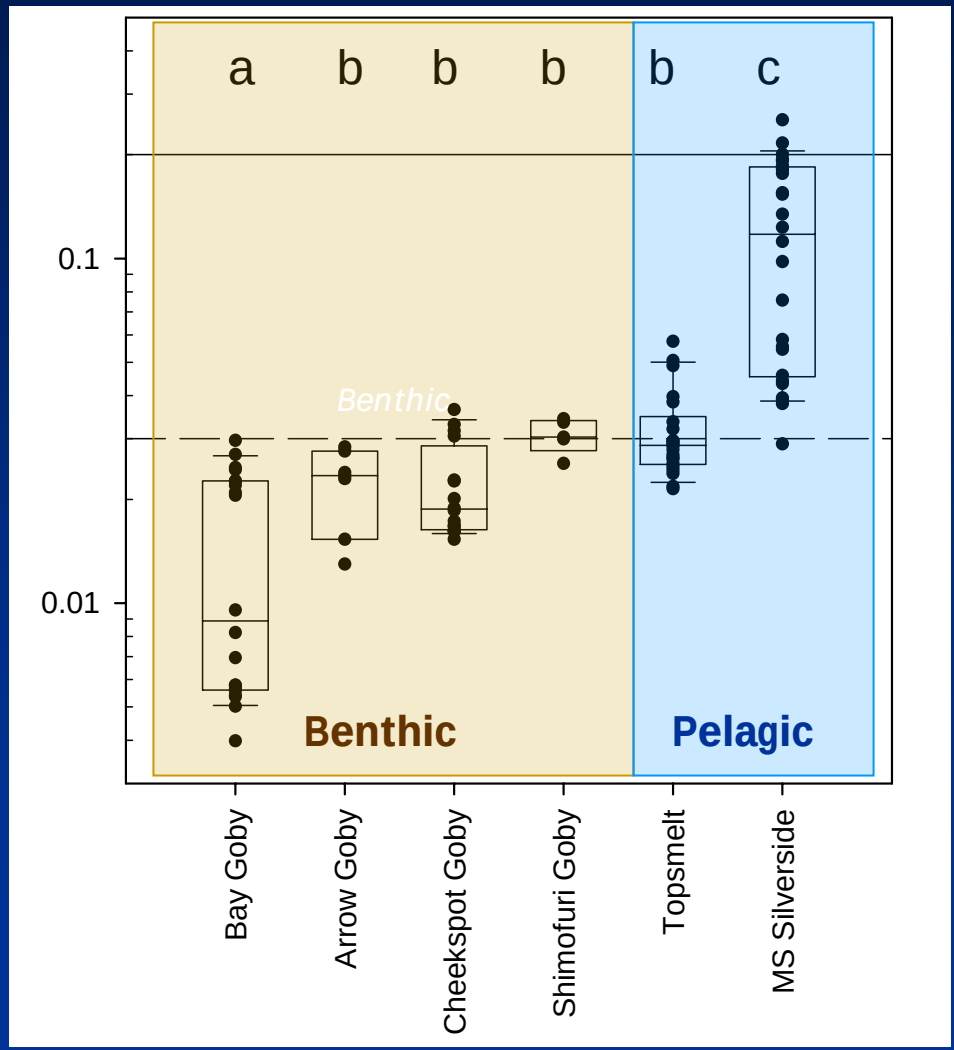
2005 Sampling Locations

Results

- 97 Composite samples analyzed
- 12 locations
- 6 Species
- Good QA
  - 94% recovery of spiked samples
  - 5% relative standard deviation of triplicate samples

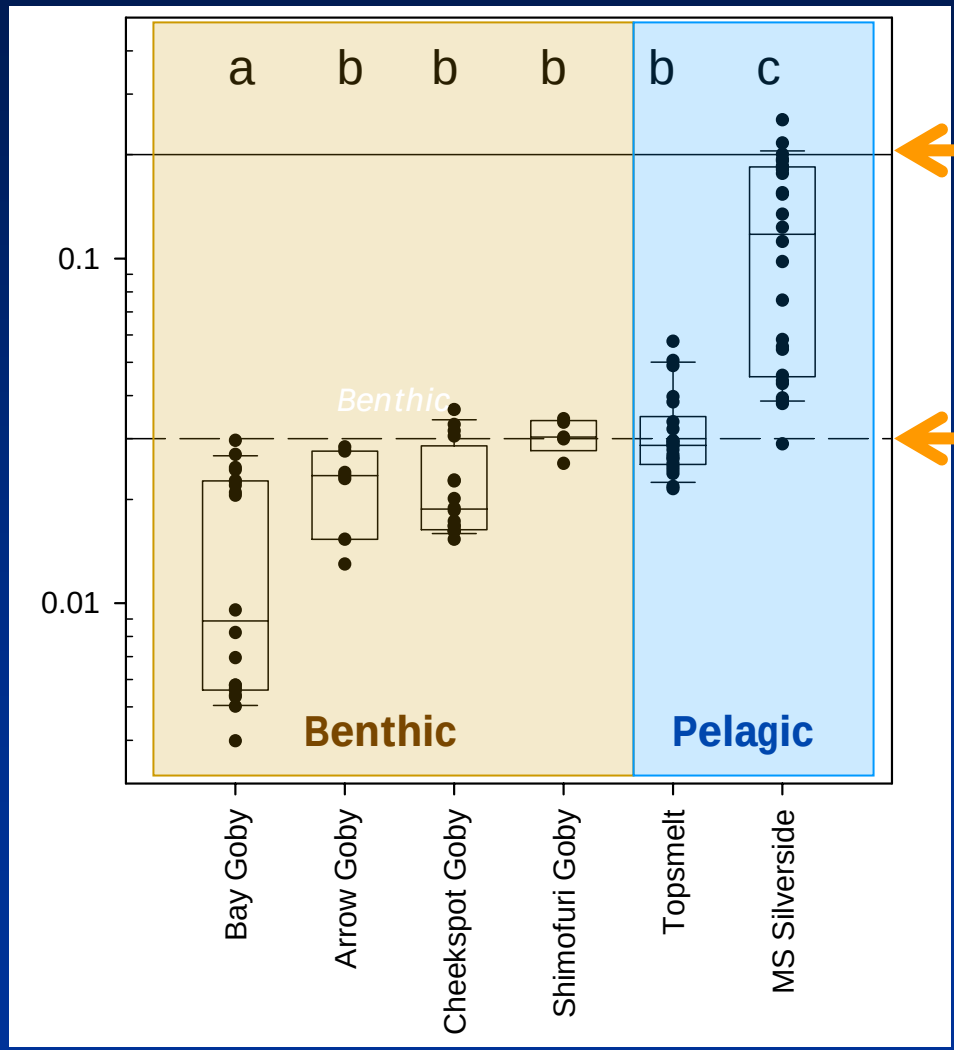


Patterns among Species



Letters indicate results of ANOVA followed by Student-Newman-Keuls test

Patterns among Species

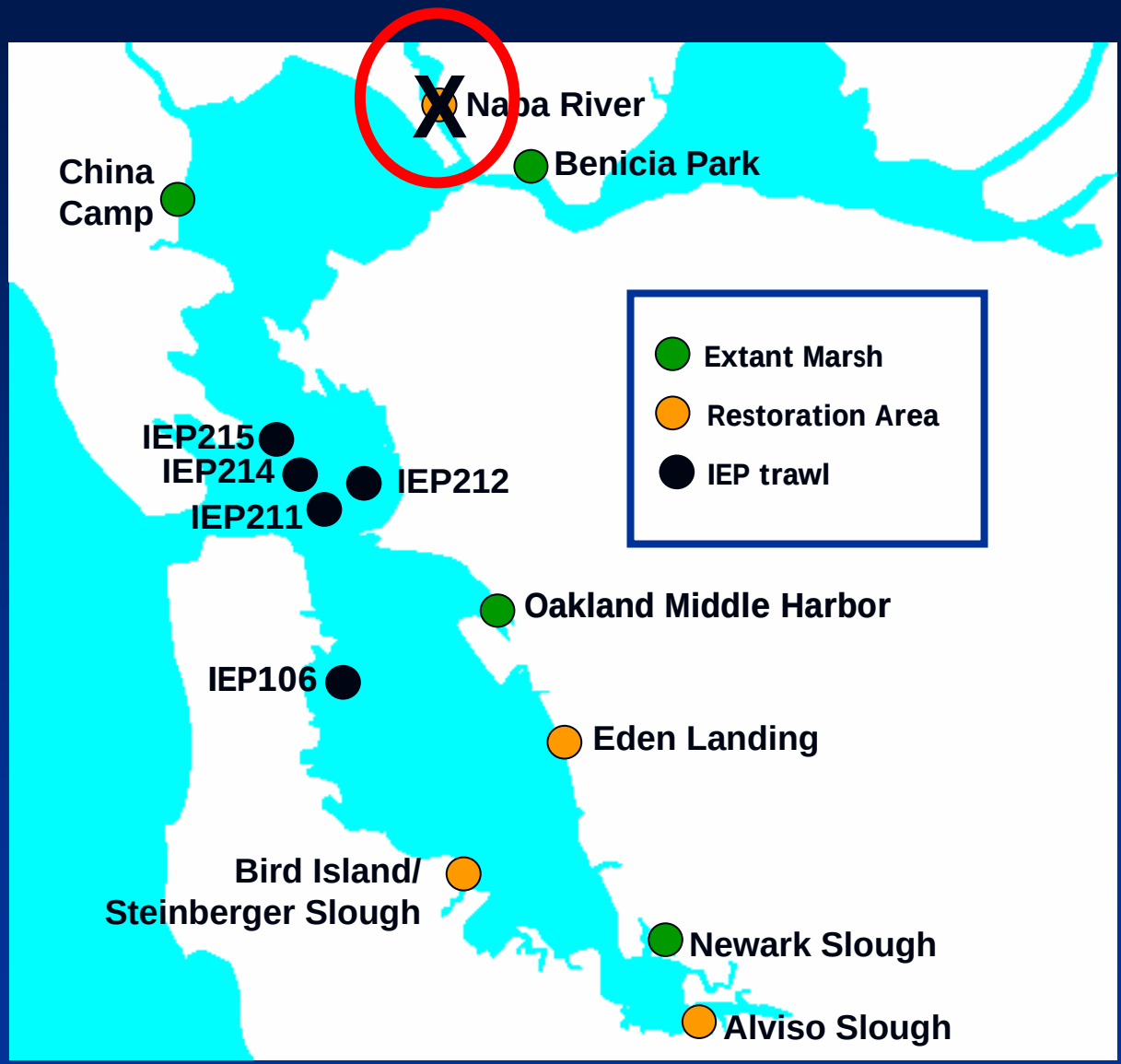


Effects threshold for fish (Beckvar et al. 2003)

TMDL Target for prey fish to protect piscivorous wildlife

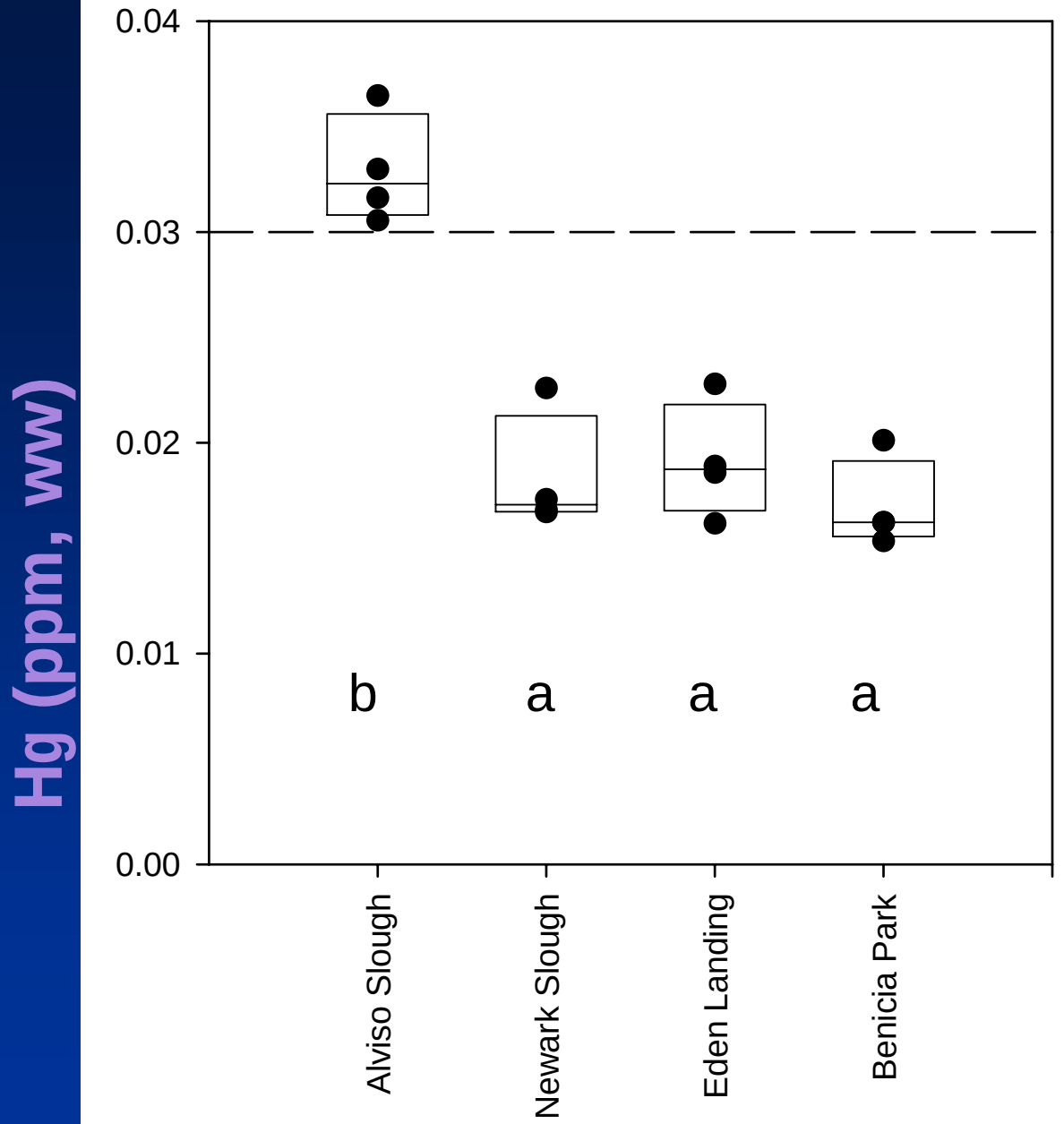
Letters indicate results of ANOVA followed by Student-Newman-Keuls test

Spatial Patterns



Cheekspot Goby

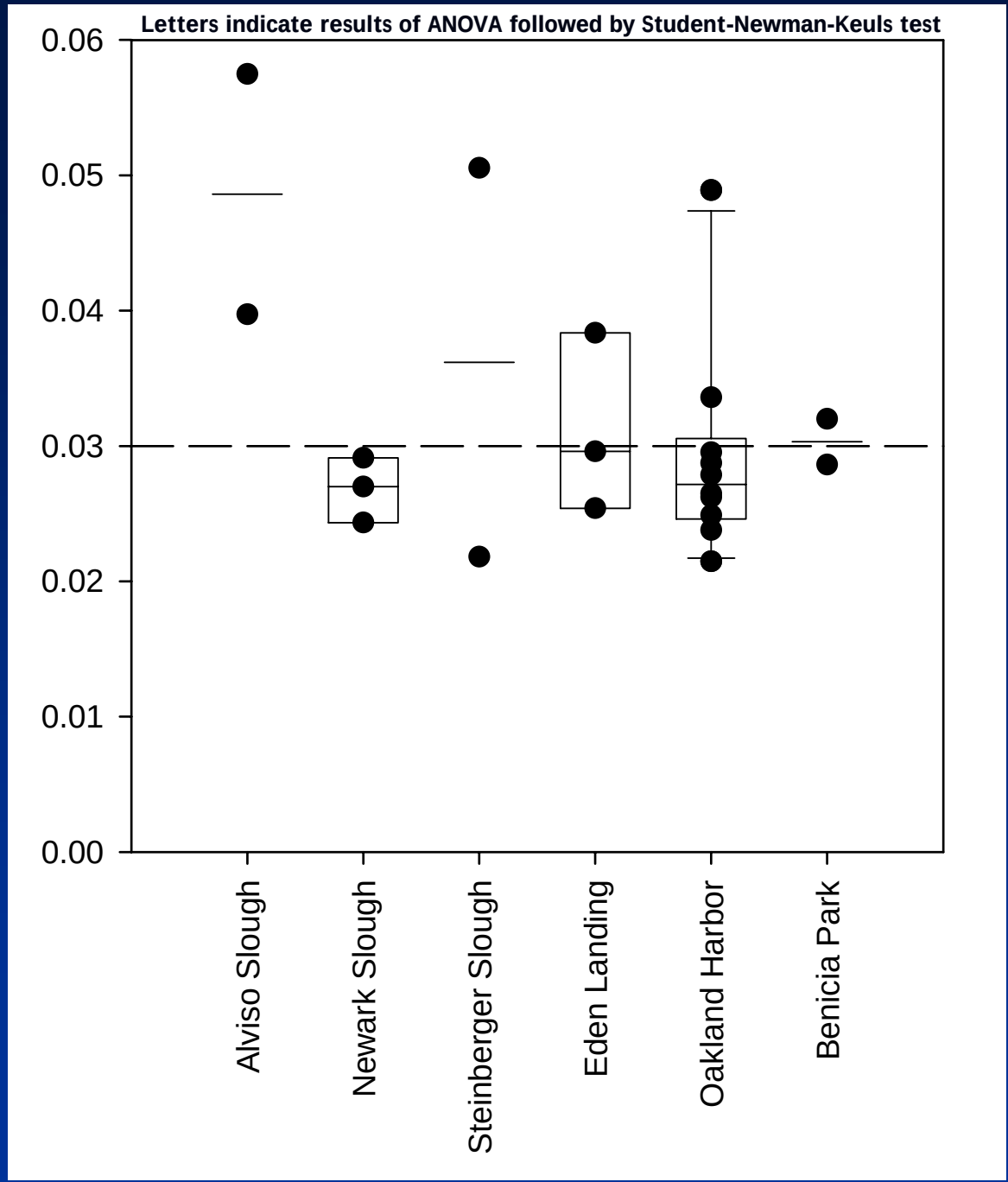
- Higher Hg in Alviso Slough
- Above TMDL target in Alviso Slough



Letters indicate results of ANOVA followed by Student-Newman-Keuls test

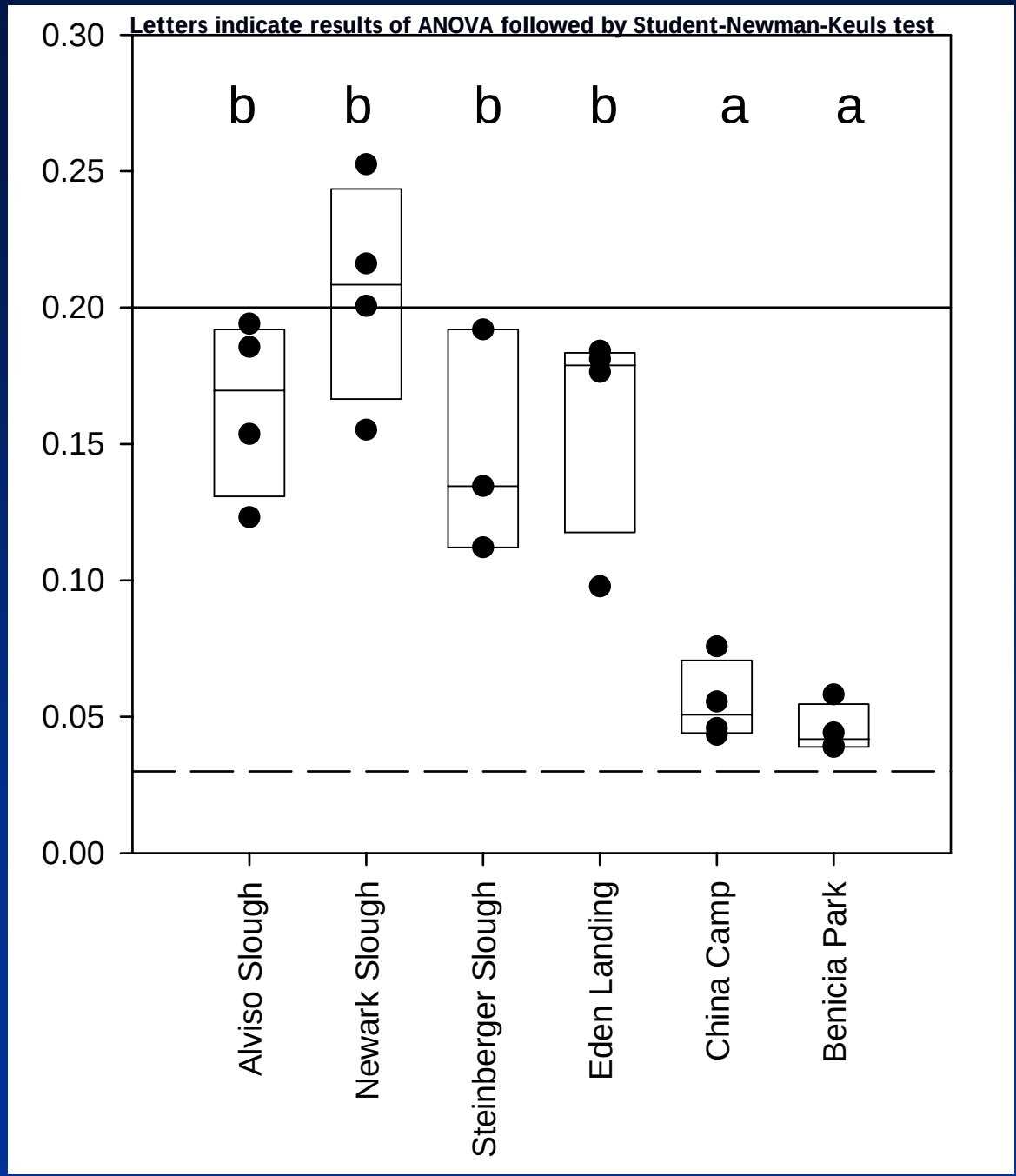
Topsmelt

- No spatial pattern



Mississippi Silverside

- Hg higher in Central and South Bay
- Above TMDL target



Summary of Results

- Variation among species
  - Mississippi Silverside > Topsmelt and gobies on bay margin > Bay Goby
- Spatial patterns
  - Alviso Slough elevated in cheekspot goby
  - South Bay elevated in Mississippi silversides

Exposure and Effects Pilot Study Small Fish Project Goals

- ☑ Monitor food-web mercury at fine spatial and temporal scales
- ☑ Assess regional trends in bioaccumulation of Hg related to wetland restoration
  - Long term annual monitoring on multiple stations would allow trend detection
- ☑ Collect prey fish appropriate for wildlife risk evaluations
  - TMDL has small fish targets but there are limited data from Bay

Comparison to Wildlife Risk Thresholds

Threshold	Endpoint	# Above	% Above
0.030	TMDL Target for wildlife (1)	37	41%
0.200	Fish growth, reproduction, development, behavior (2)	3	3%
0.130*	NOAEL for small sized piscivorous birds (3)	72	80%
1.440*	LOAEL for medium sized piscivorous birds (3)	1	1%

*** Tissue concentration dry weight**

Source
1. Johnson and Looker 2004
2. Beckvar et al. 2006
3. Calculated from BTAG Toxicity Reference Values

Plans for 2006 and Beyond

- Funded at 40K level through 2008
- Technical Review Committee has approved some organics analyses
- Same general sampling design
- Add stations to focus on spatial pattern
- Add species to improve conceptual model

CBDA BIOSENTINEL MERCURY MONITORING PROGRAM

FIRST YEAR DRAFT DATA REPORT

COVERING SAMPLING CONDUCTED AUGUST 2005 – FEBRUARY 2006

June 6, 2006

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UCDAVIS

Why Biosentinels?

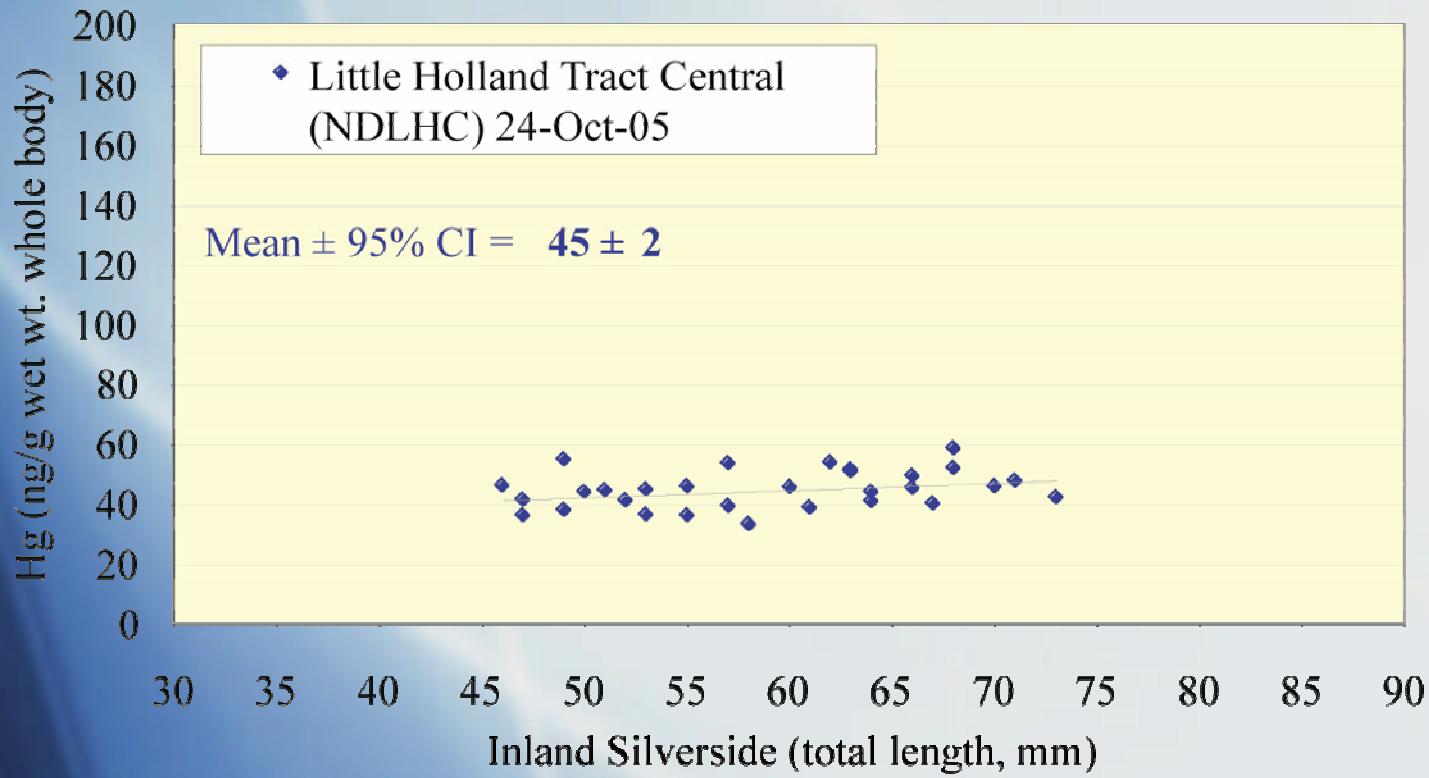
Biosentinel Mercury Monitoring

Using small, young fish as localized, time-sensitive measures of methylmercury exposure

- **Interannual trends and variability**
- **Within-year seasonal trends**
- **Spatial patterns on a fine scale**

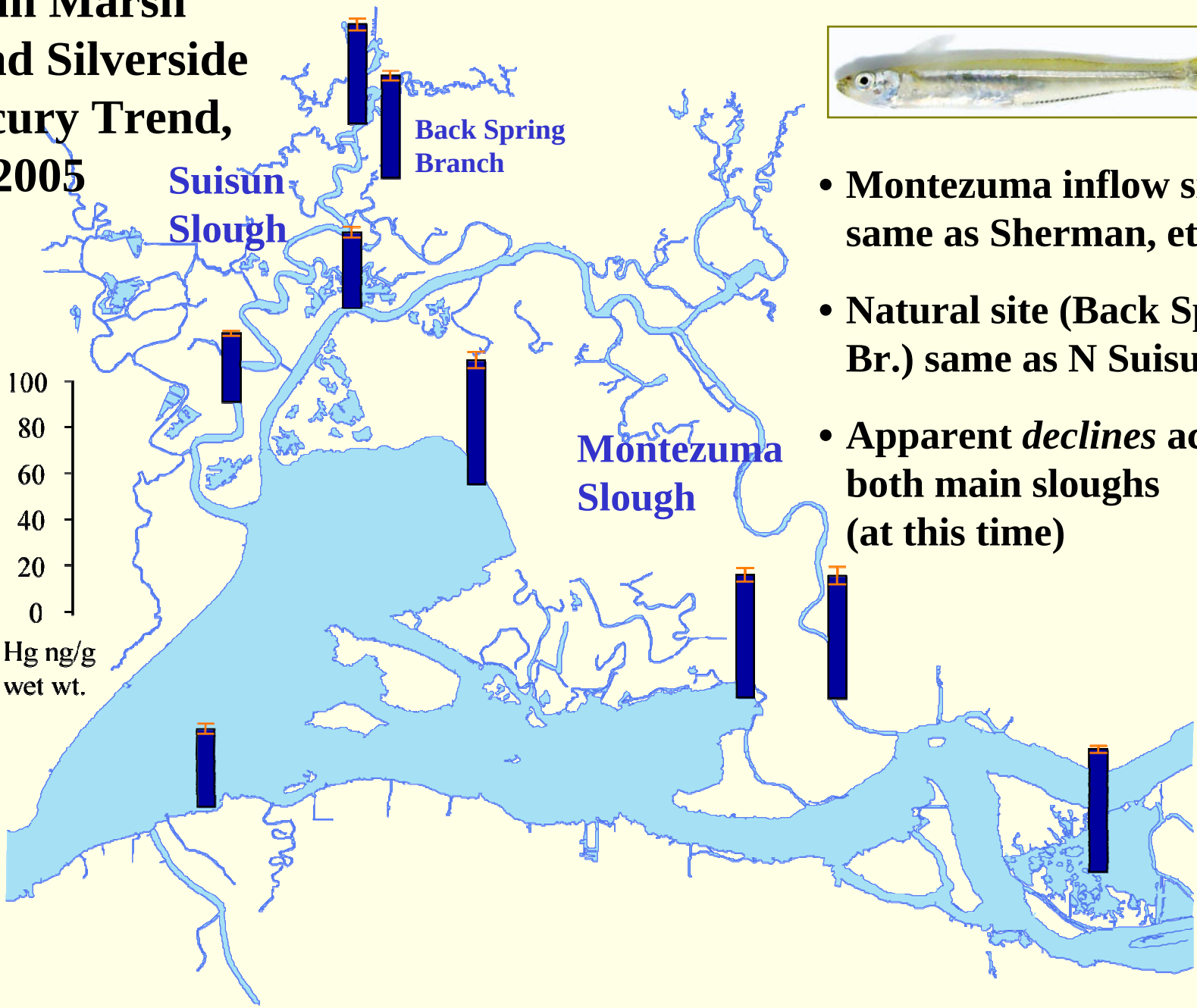
UC Davis High-Rep Individual Fish Analyses

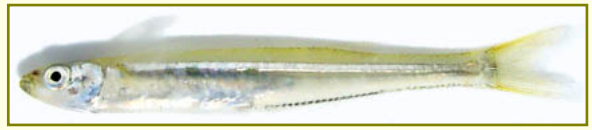
Ideally: consistent Hg over size range, distinctive from other sites and times



Mean Hg ± 95% C.I.

Suisun Marsh Inland Silverside Mercury Trend, Fall 2005

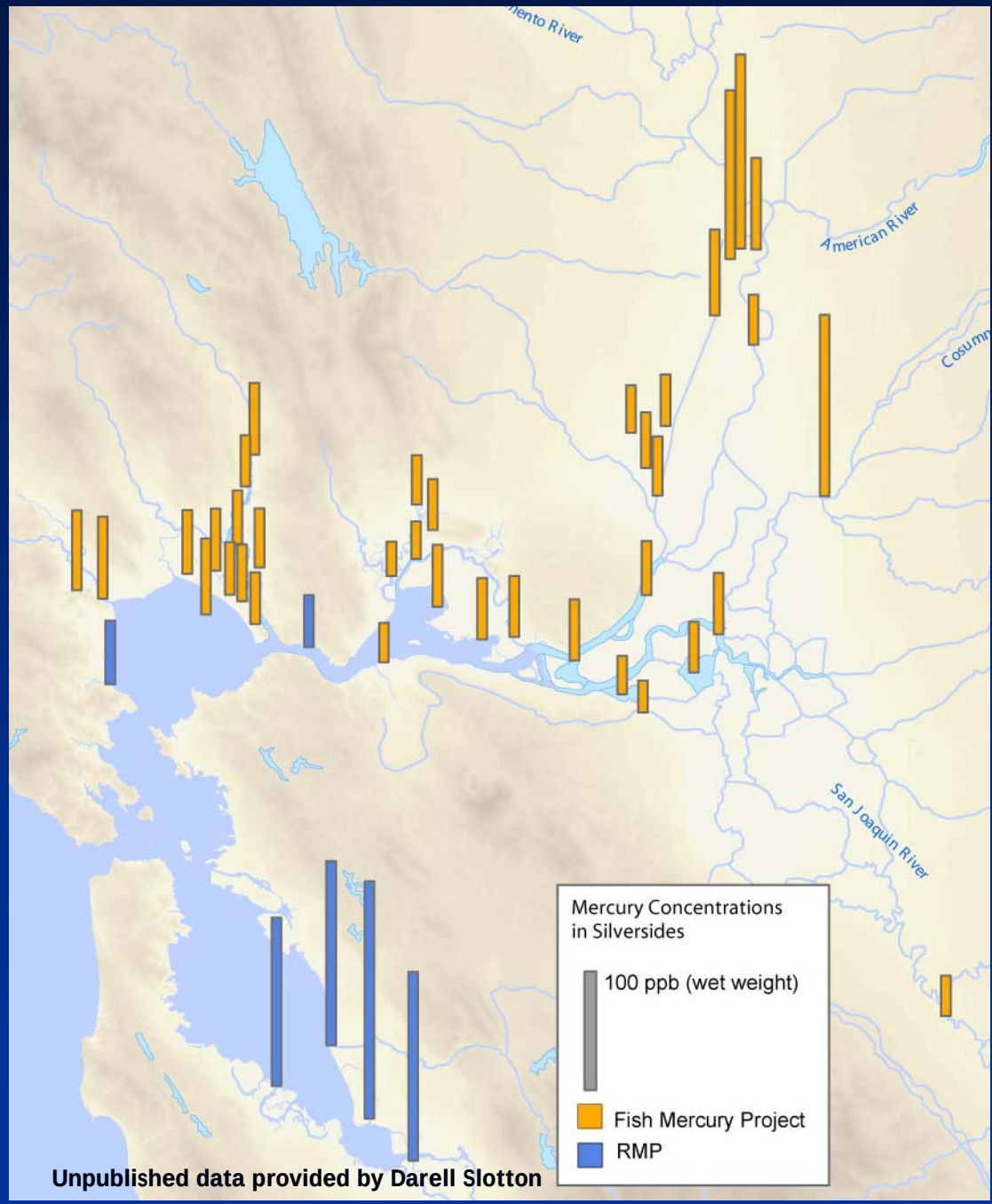


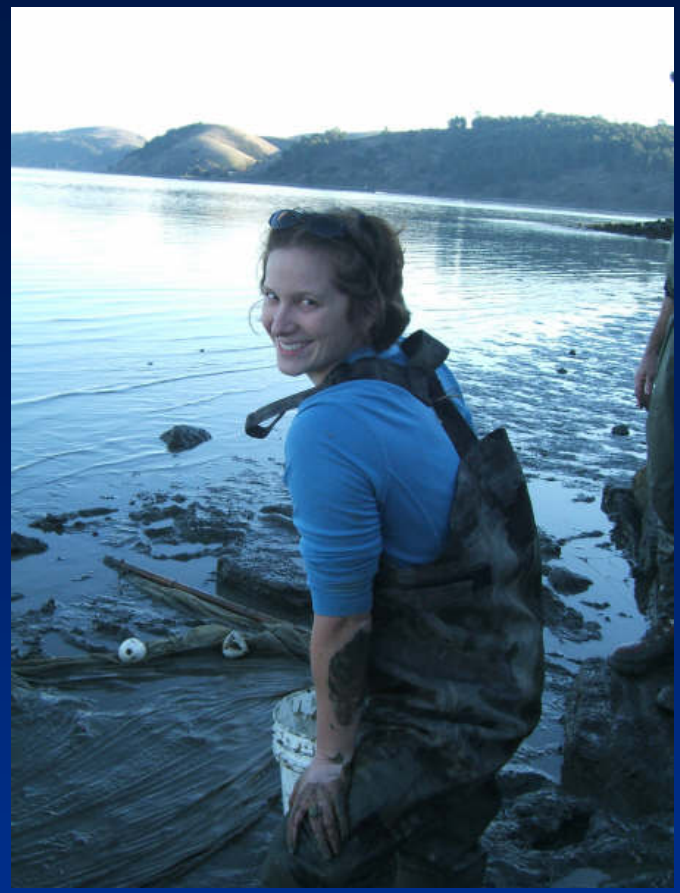


- Montezuma inflow site same as Sherman, etc.
- Natural site (Back Spring Br.) same as N Suisun Sl.
- Apparent *declines* across both main sloughs (at this time)

Mississippi Silverside

- Combined FMP and RMP data
- Highest concentrations in South Bay fish





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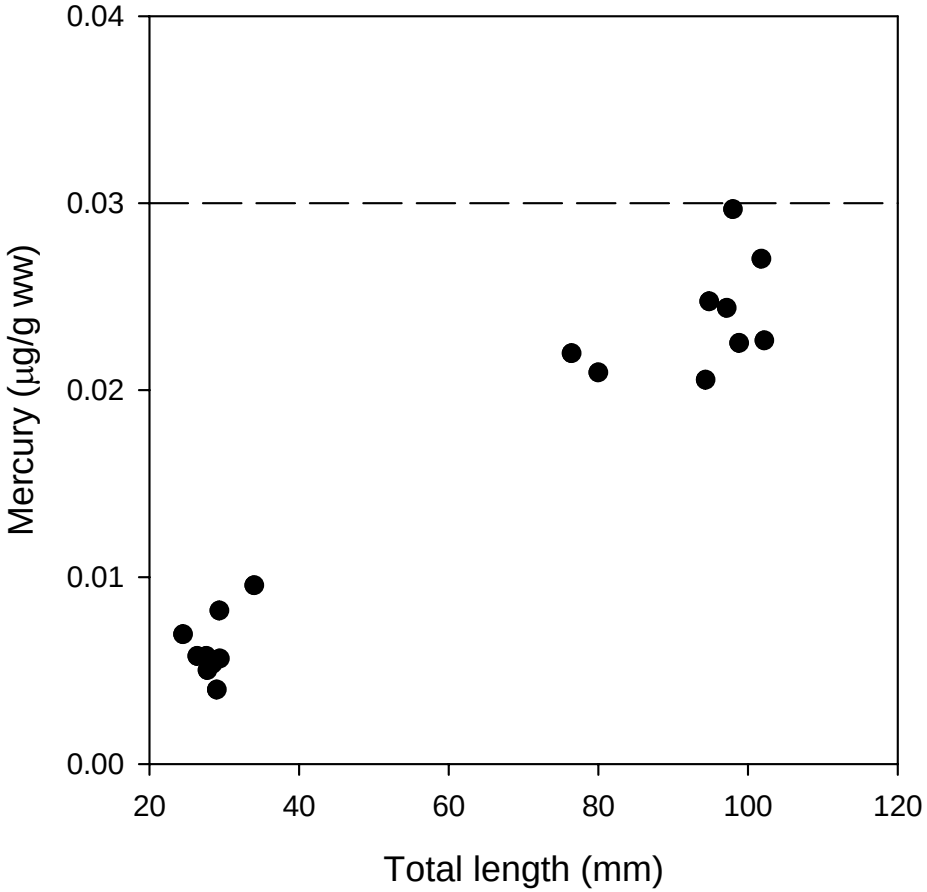
SF Bay National Wildlife Refuge
California State Parks
CA Department Fish & Game
Interagency Ecological Program

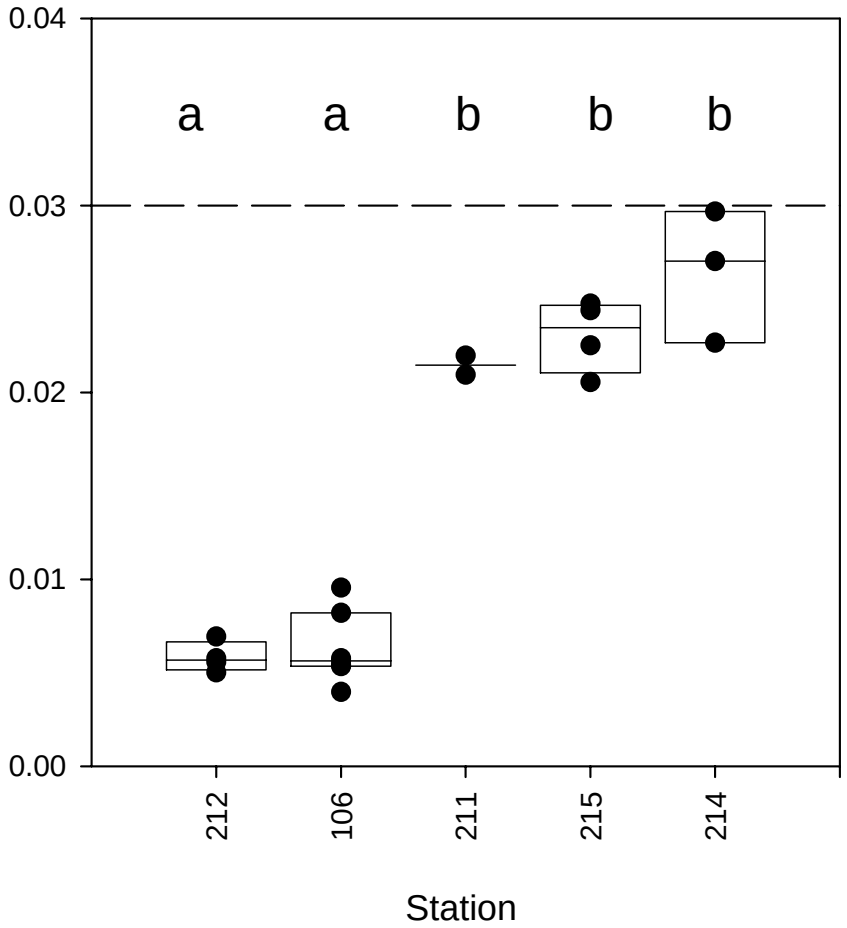
More Info:
www.sfei.org/cmr/fishmercury/

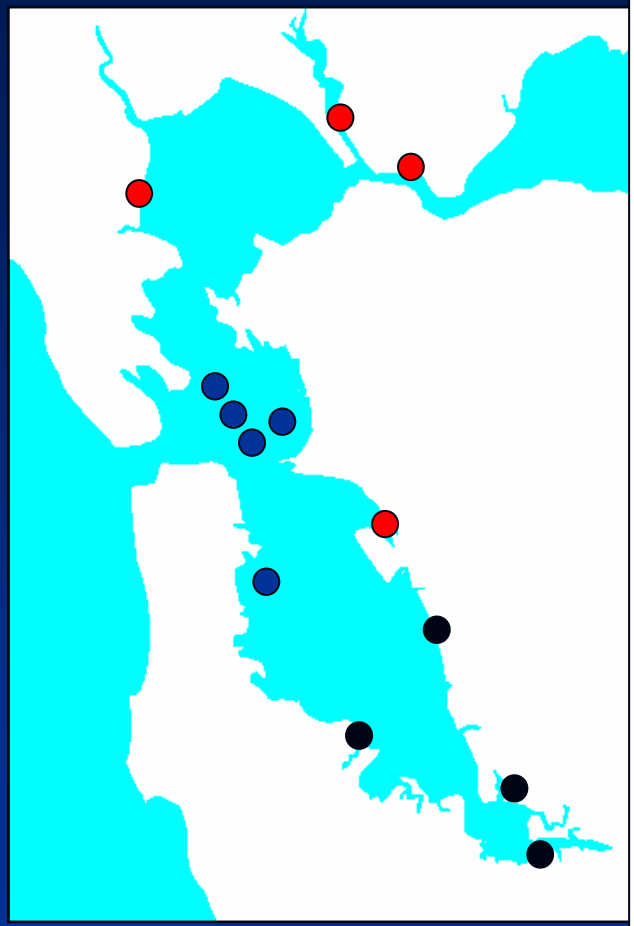
Small Fish Hg Project

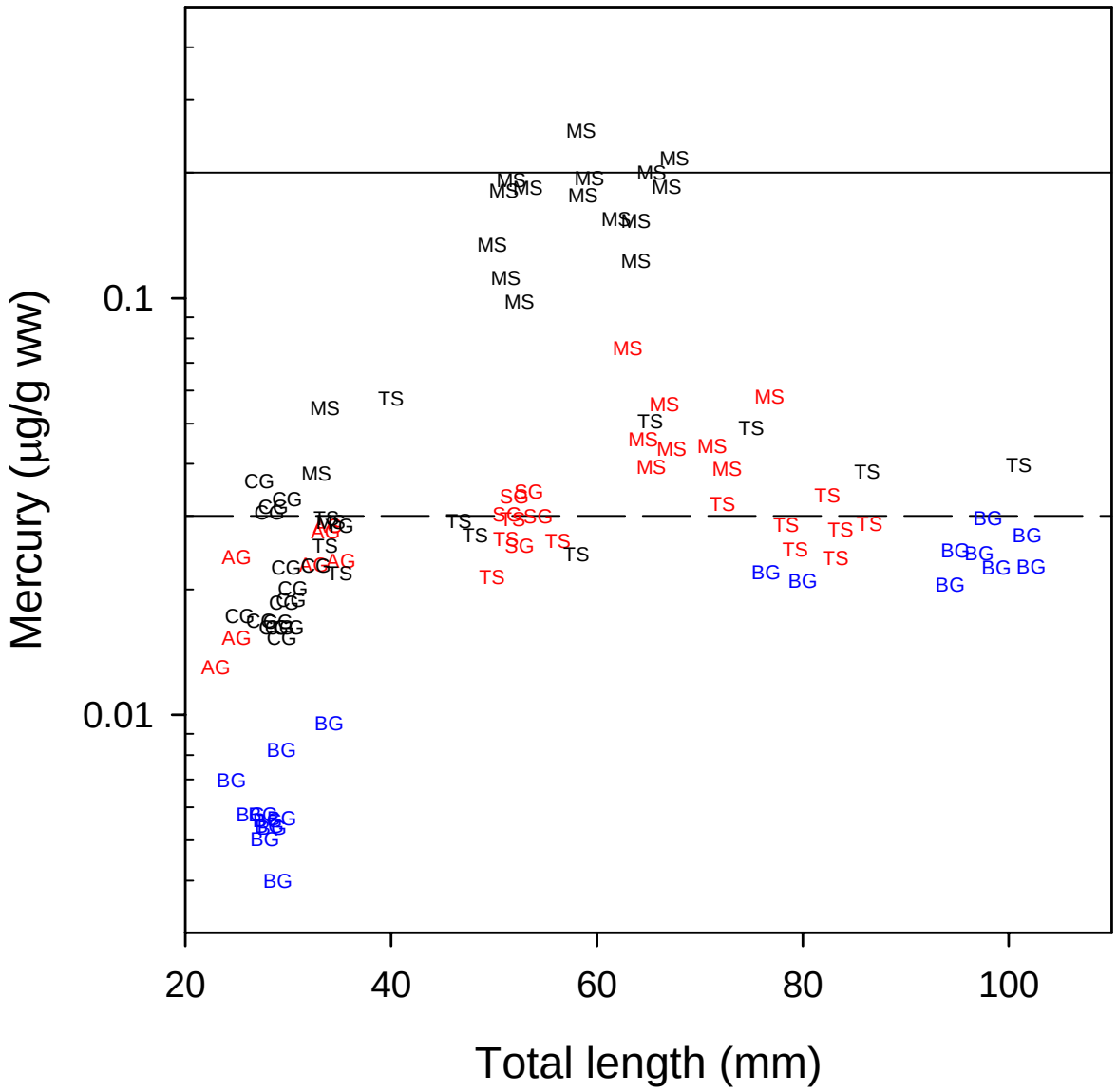
Station	Salinity	Topsmelt	Silverside	Bay Goby	Cheekspot Goby	Arrow Goby	Shimofuri Goby
Alviso Slough	23		4		4		
China Camp	26		4			3	4
Newark Slough	27	2	4		4		
Eden Landing	29	1	4		4		
Birds Island	29	2	3		4		
Oakland Harbor	32	4				4	
IEP Treasure Island				4			
IEP Candlestick				4			

- Bay goby
- Spatial pattern confounded by fish size
- Try to limit size range








Mercury (µg/g ww)
0.1
0.01
20
40
60
80
100
Total length (mm)