Mercury concentrations and isotopes in San Francisco Bay forage fish

Ben Greenfield, Kat Ridolfi, Katie Harrold
SFEI

Gretchen Gehrke, Joel Blum
University of Michigan

Darell Slotton, Shaun Ayers
University of California - Davis
RMP Mercury Strategy Questions

1. Where is mercury entering the Bay food web?
2. What processes, sources, and pathways contribute disproportionately to food web accumulation?
RMP Mercury Strategy Questions

1. Where and when is mercury entering the Bay food web?

2. What processes, sources, and pathways contribute disproportionately to food web accumulation?
General approach

Sources

Historic mining

WWTP

Air deposition

Spatial

Temporal

Small fish

Symbols courtesy of the Integration and Application Network University of Maryland - CES http://ian.umces.edu/symbols/
General approach

**Sources**
- Historic mining
- Air deposition
- Spatial sampling: Stratified random sampling
- Temporal sampling:
  - Seasonal sampling
  - Long term sampling

Symbols courtesy of the Integration and Application Network, University of Maryland - CES
http://ian.umces.edu/symbols/
General approach

Sources
- Targeted sampling
- Mercury isotopes
- Diffusive gradient in thinfilm

Temporal
- Seasonal sampling
- Long term sampling

Spatial
- Stratified random sampling
Initial results

• Spatial – Fish Hg and isotopes
• Sources – What kinds of sites have high vs. low fish Hg?
• Temporal – Seasonal trends
Spatial patterns

Means of Comps ± SE

Silverside
Spatial patterns

Hg (ng/g wet weight, whole body)

- Silverside Hg (mean ± SE)
  - South Bay
  - Suisun Bay
  - San Pablo Bay
  - Central SF Bay

Sites:
- 01OTH
- 05OTH
- KIRKE
- WWTP-2
- BENPK
- WWTP-3
- 03OTH
- 306WE
- 06OTH
- CHINA
- 04OTH
- 66OTH
- 64OTH
- 62OTH
- 93OTH
- EDENL
- 29BIR
- NEWSL
- 18PAB-A
- ALVSL
- 4ALVS
- COYSL

Hg levels vary across different locations and sites.
Sources?

Silverside

Means of Comps ± SE

Hg ng/g wet wt.

WWTP

Hg Mine (New Almaden)

(WWTP)
Silverside

WWTP

Legacy, Industrial

Means of Comps ± SE

Hg ng/g wet wt.

Sources?
Prickly Sculpin Regional Mercury

![Graph showing mercury levels in various locations.]

- **Merced River**
- **Tuolumne River**
- **Clear Creek**
- **Sac R. Hamilton City**
- **Sac R. RM44**

Sculpin Hg (error bar = 95% C.I.)
Prickly Sculpin Regional Mercury

Hg mine (Bella Oaks) Napa river

Merced River

Tuolumne River

Clear Creek

Sac R. Hamilton City

Sac R. RM44

Hg (ng/g wet weight, whole body)

Sculpin Hg (error bar = 95% C.I.)
Mercury isotopes - goals

- Evaluate potential use of Hg isotopes as source and process tracers
  - Similar isotope systems: N, C, S
- Determine Hg isotopic composition of multiple Hg sources in the drainage basin
- Mine tailings
- Municipal waste water
- Marine (Atmospheric deposition)
- Determine spatial distribution of Hg isotopic compositions in sediments and fish
- Investigate possible sources to Bay sediments and fish
Mercury isotopes - results

• The isotope results are highly preliminary and have therefore been removed from the web-distribution of this presentation
• If you would like more information on the mercury isotope project, please contact the primary author, Gretchen Gehrke (gegehrke@umich.edu)
Seasonal trend evaluation

Seasonal Arrow Goby Mercury Concentrations At Martin Luther King Regional Shoreline

THg (µg g⁻¹ wet weight)
Seasonal trend evaluation

Seasonal Arrow Goby Mercury Concentrations At Martin Luther King Regional Shoreline

Peak late summer
Arrow goby results – a closer look

- March
- April
- June
- July
- Sept
- Oct
- Dec

Length (mm)

Mercury (ppm wet)

- Arrow goby results
- A closer look

Graph showing the relationship between length (mm) and mercury (ppm wet) for different months.
Results suggest MeHg pulse in fish diet
Preliminary interpretations

1. Where and when is mercury entering the Bay food web?
   - A regional gradient – peak in Lower South Bay
   - Late summer peak for mudflat fish?

2. What processes, sources, and pathways contribute disproportionately to food web accumulation?
   - Wastewater treatment plants dilution?
   - Historic mining Hg source signal?
Potential management implications

1. Greater focus on Lower South Bay warranted
   - E.g., South Bay Mercury Project

2. Historic mines important
   - E.g., Guadalupe River Hg TMDL

3. Shallow WWTP discharge potentially lower concern
   - Future data will tell...