

Using Biosentinels to Assess Mercury Risk in Wetland Restoration Projects



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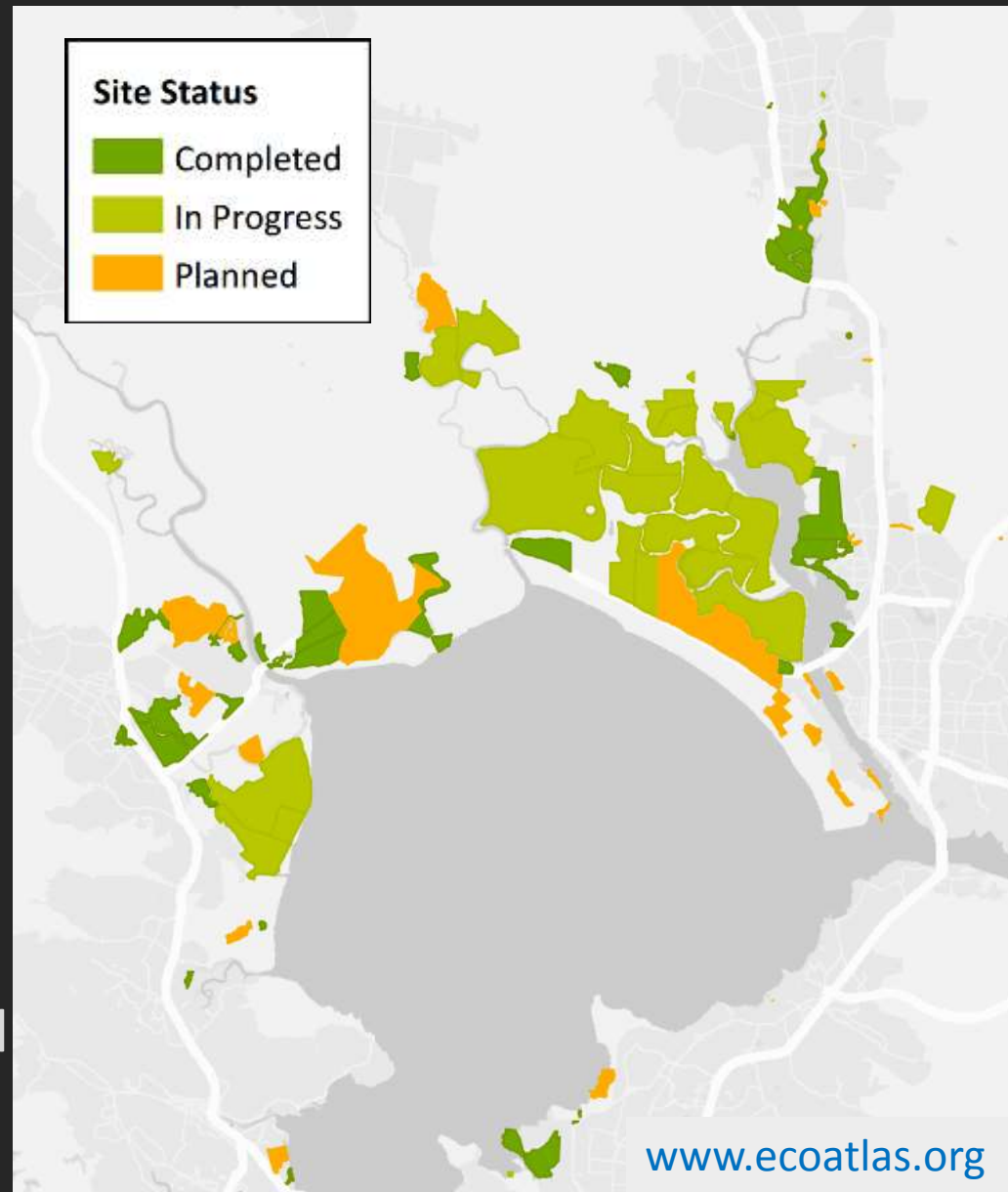
Monitoring Approach

Why wetland restoration projects?

- Potential sites of high methylation
- Many restoration projects in the Bay
- Monitoring required by permits

Why biosentinels?

- Link to beneficial uses
- Interpret results as effects
- Relevant spatial and temporal scales



Science Advisory Group and Stakeholders

Jim Wiener	University of Wisconsin, La Crosse
Dave Evers	Biodiversity Research Institute
Harry Ohlendorf	CH2M Hill
Kathy Hieb	CDFW
Bruce Herbold	Independent Consultant

Stakeholders: Regional Water Board, BCDC, USACE, USGS, CDFW, USFW and others

Management Questions

1. What is the **current potential for impairment** of beneficial uses due to methylmercury in each major habitat of interest in the North Bay intertidal habitat restoration projects?
2. How do the status and trends in impairment due to methylmercury in one project **compare to status and trends** in impairment in other project and non-project wetlands **in the region**?
3. How will the status of impairment due to methylmercury in each major habitat of interest **change over a timescale of years** in response to the project?
4. Will tidal marsh restoration introduce a problematic amount of methylmercury **into the Bay**?

Species sampled

Fish

Mississippi Silversides (MISI)

Long jawed Mudsucker (LOMU)

Staghorn Sculpin (STSC)

Shimofuri Goby (SHGO)

Three-spined Stickleback (THST)

Rainwater Killifish (RAKI)

Topsmelt (TOSM)

Pacific Herring (PAHE)

Yellowfin Goby (YEGO)

Birds

Song Sparrow (SOSP)



Sites Sampled



Date and Length effects

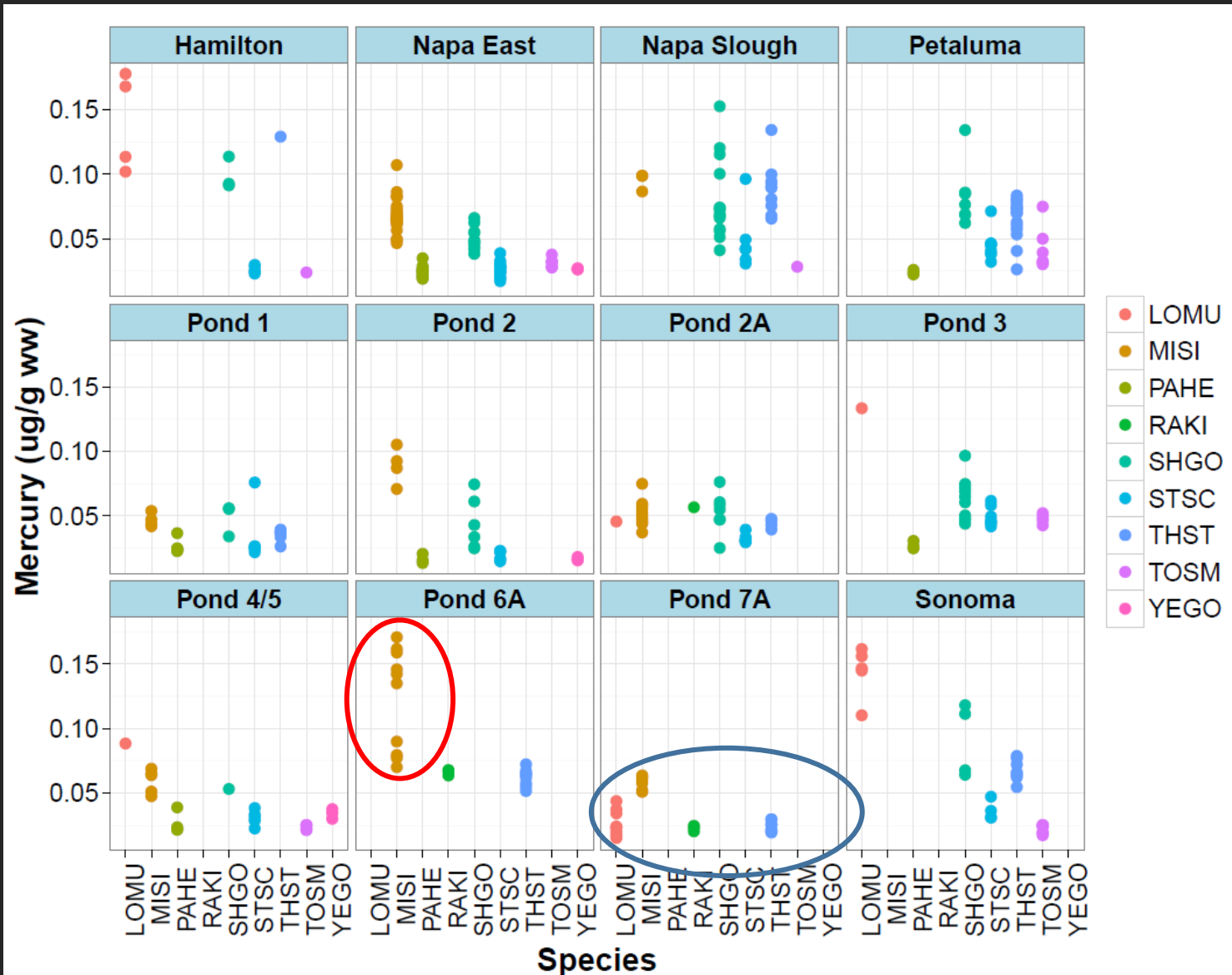
Seasonal effects

- Narrow sampling window (April-June)
- Sample during period of highest risk
- Sampled twice per season at two sites

Fish size effects

- Narrow size ranges
- Size standardized Hg concentrations for silversides

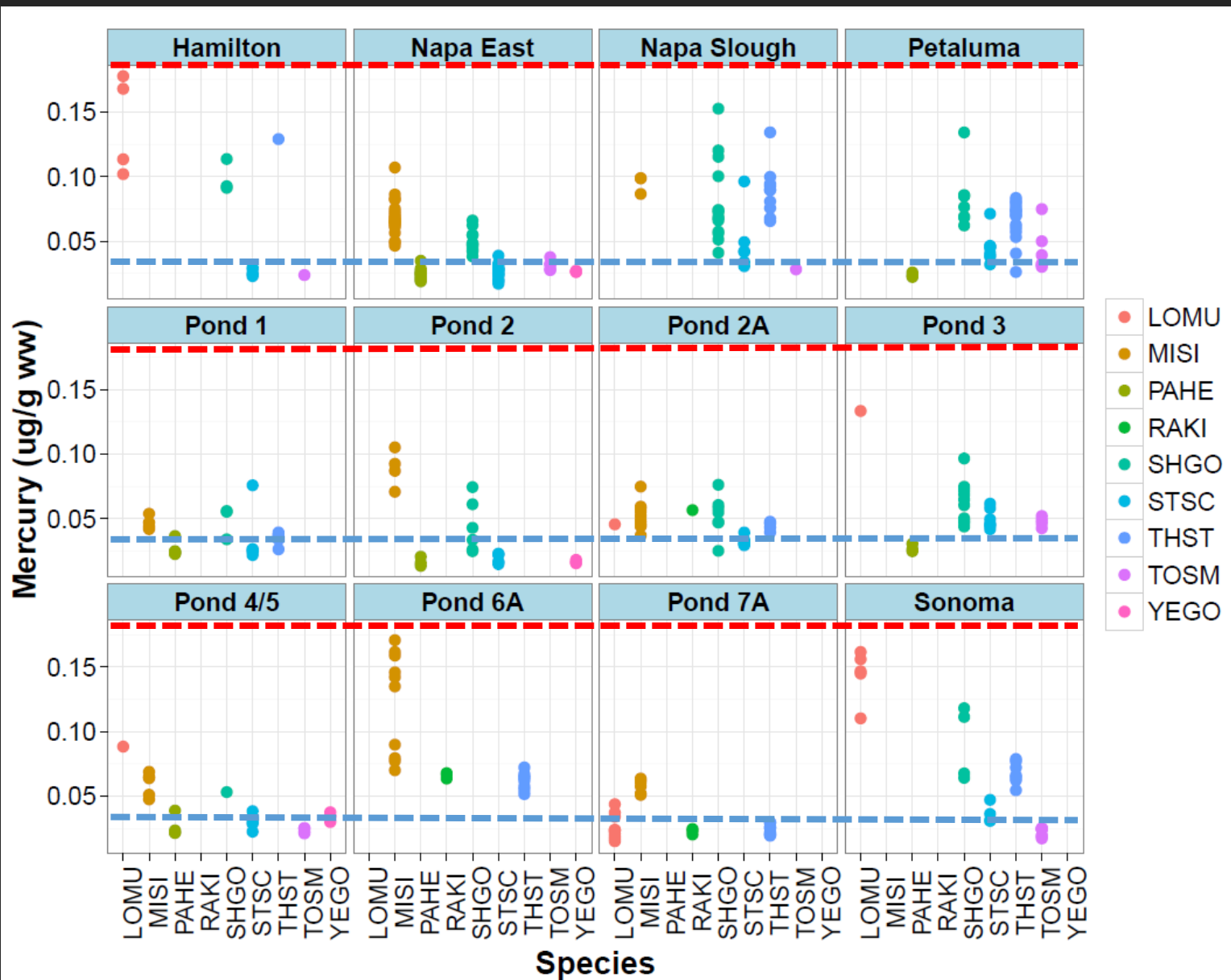
Variation in Methylmercury Exposure



Management Question 1

What is the **current potential for impairment** of beneficial uses due to methylmercury in each major habitat of interest in the North Bay intertidal habitat restoration projects?

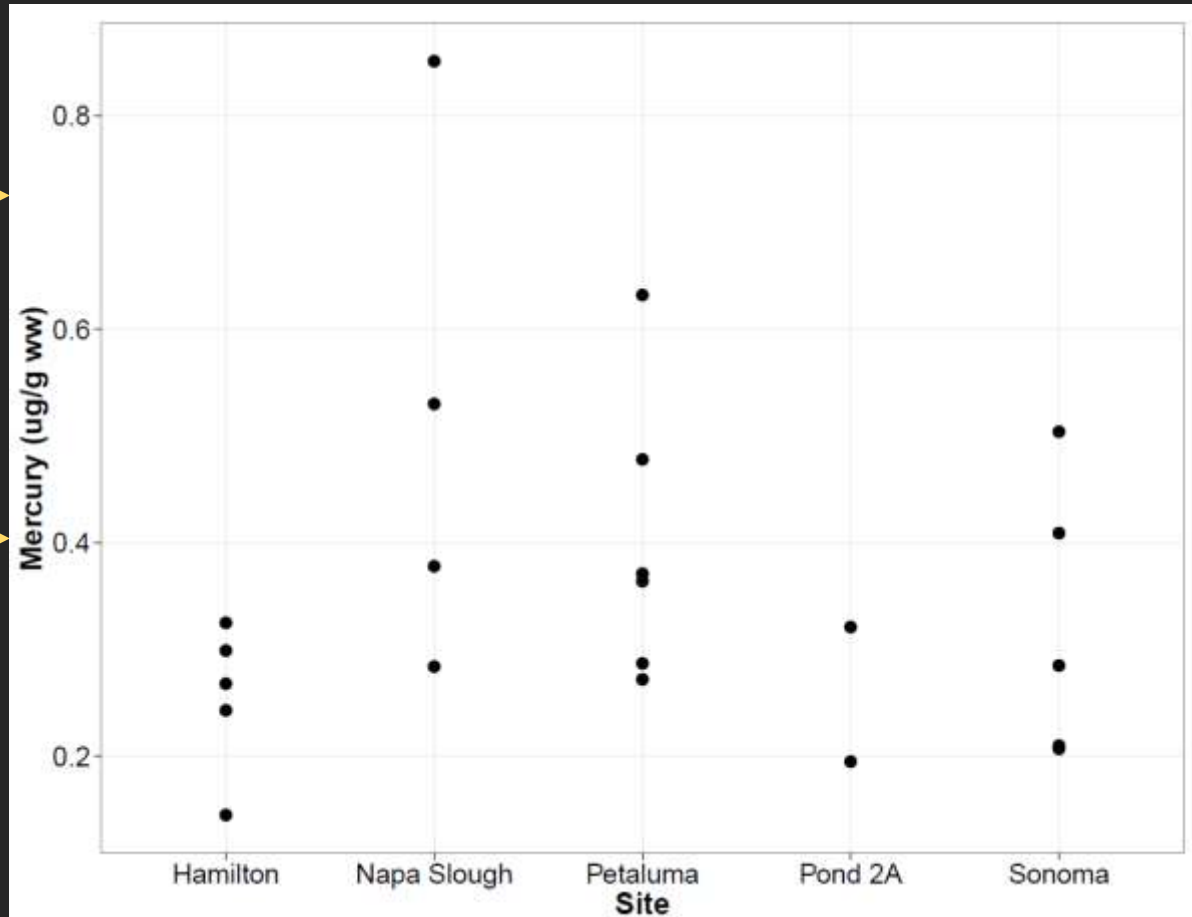
Methylmercury Risk to Fish and Piscivores



Methylmercury Risk to Marsh Songbirds

10% reduction
In breeding success

5% reduction
In breeding success



Species Comparisons

Highest Concentrations

Mississippi Silverside

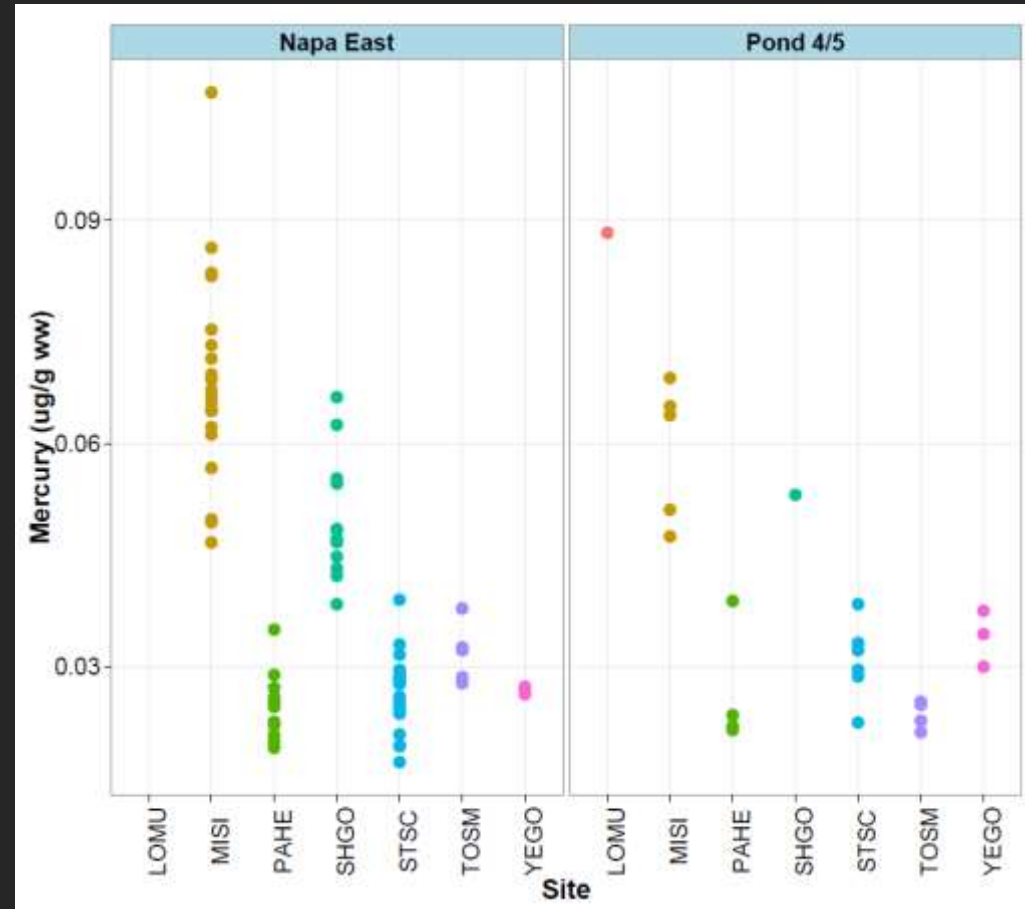
Shimofuri Goby

Longjaw Mudsucker

Lowest Concentrations

Pacific Herring

Topsmelt



Management Question 1

What is the **current potential for impairment** of beneficial uses due to methylmercury in each major habitat of interest in the North Bay intertidal habitat restoration projects?

- *No impairment of prey fish*
- *Potential impairment for piscivores and marsh songbirds*
- *Impairment risk depends on prey species and foraging location.*
- *Mercury risk may be offset by other benefits of restoration*

Management Question 2

How do the status and trends in impairment due to methylmercury at this project **compare to status and trends** in impairment in other project and non-project wetlands **in the region?**

Site Types

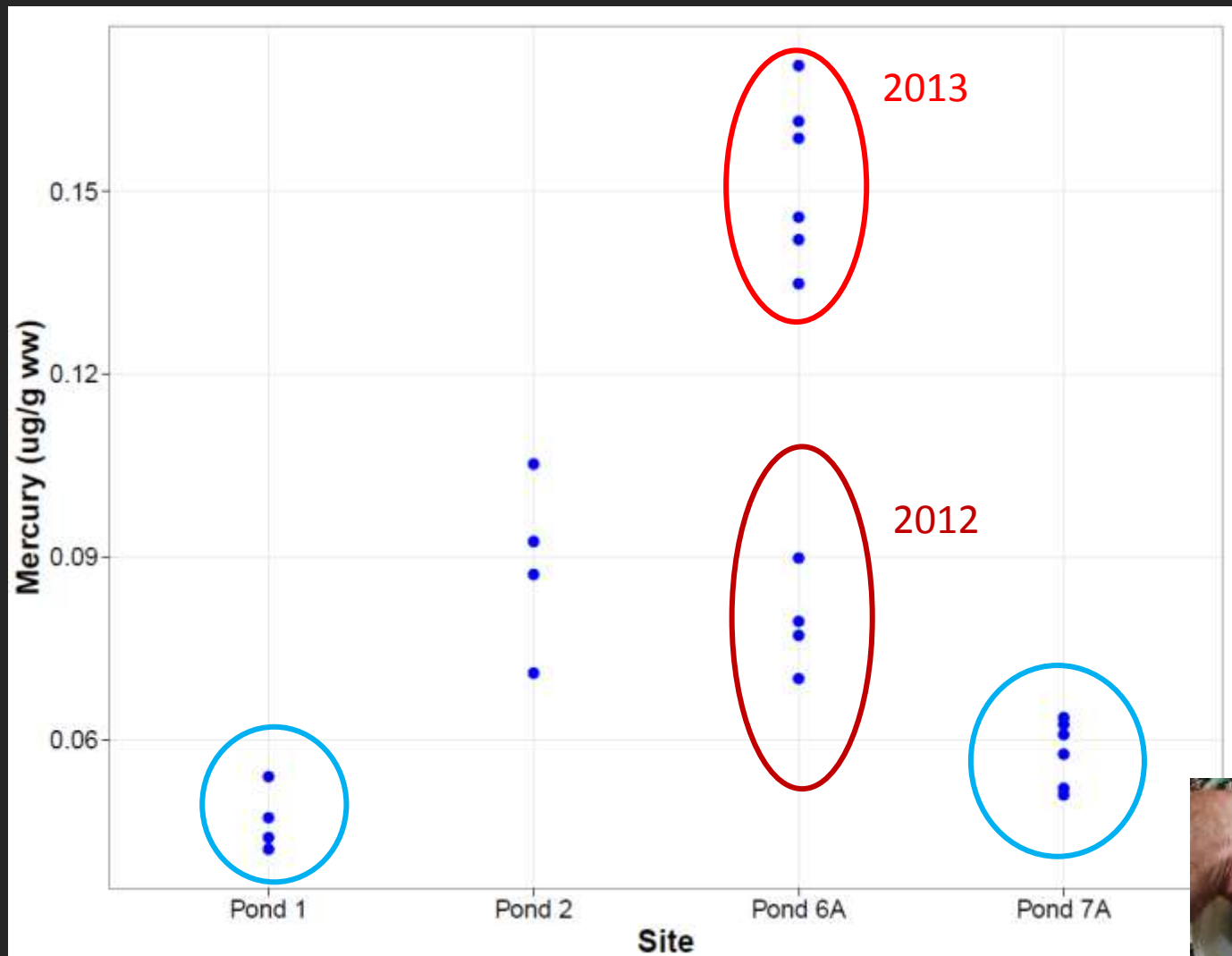


Non-tidal Managed Pond
(Pond 2)

Vegetated Tidal Marsh
(Pond 2A)

Breached Pond
(Pond 3)

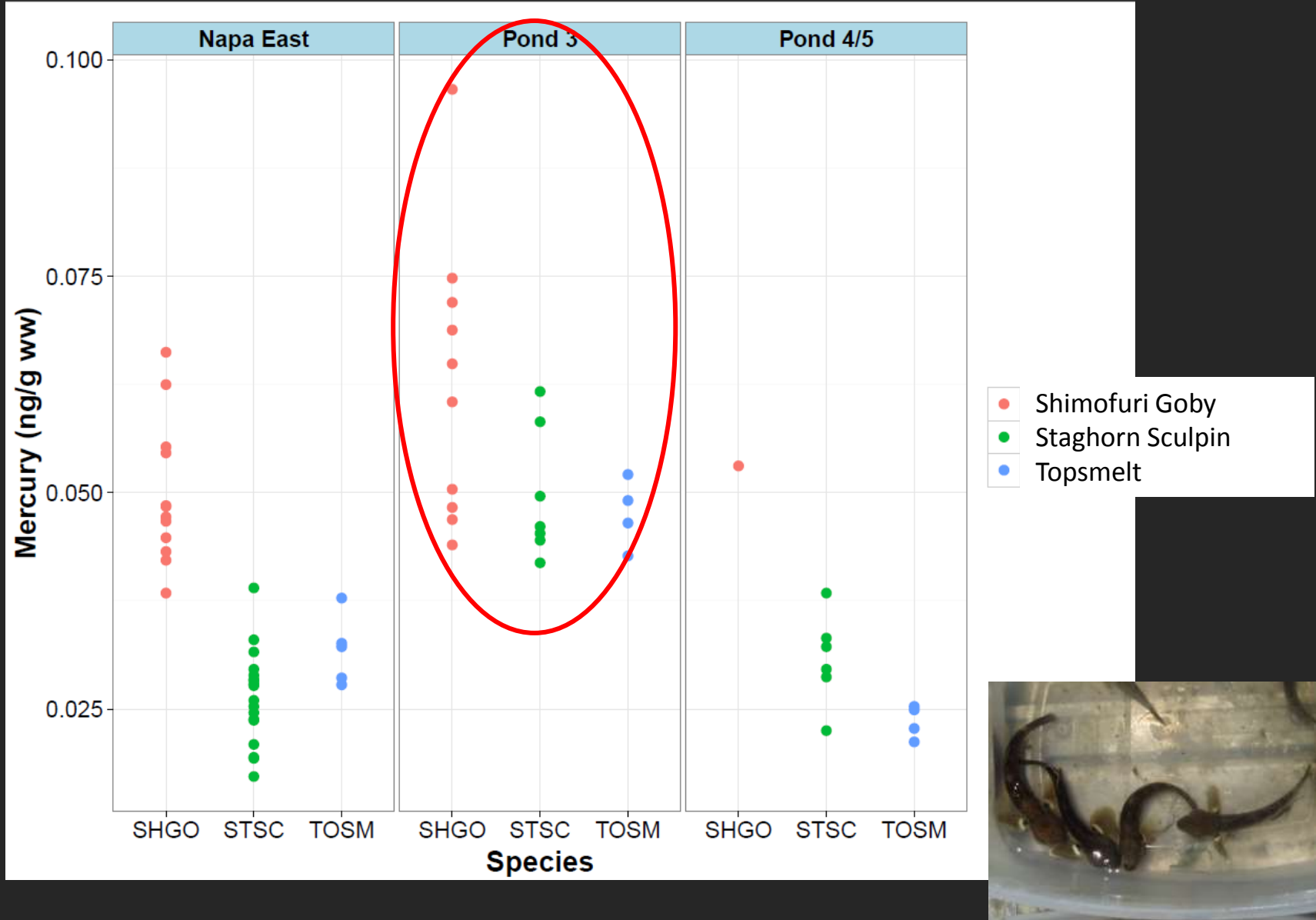
Non-tidal Managed Ponds



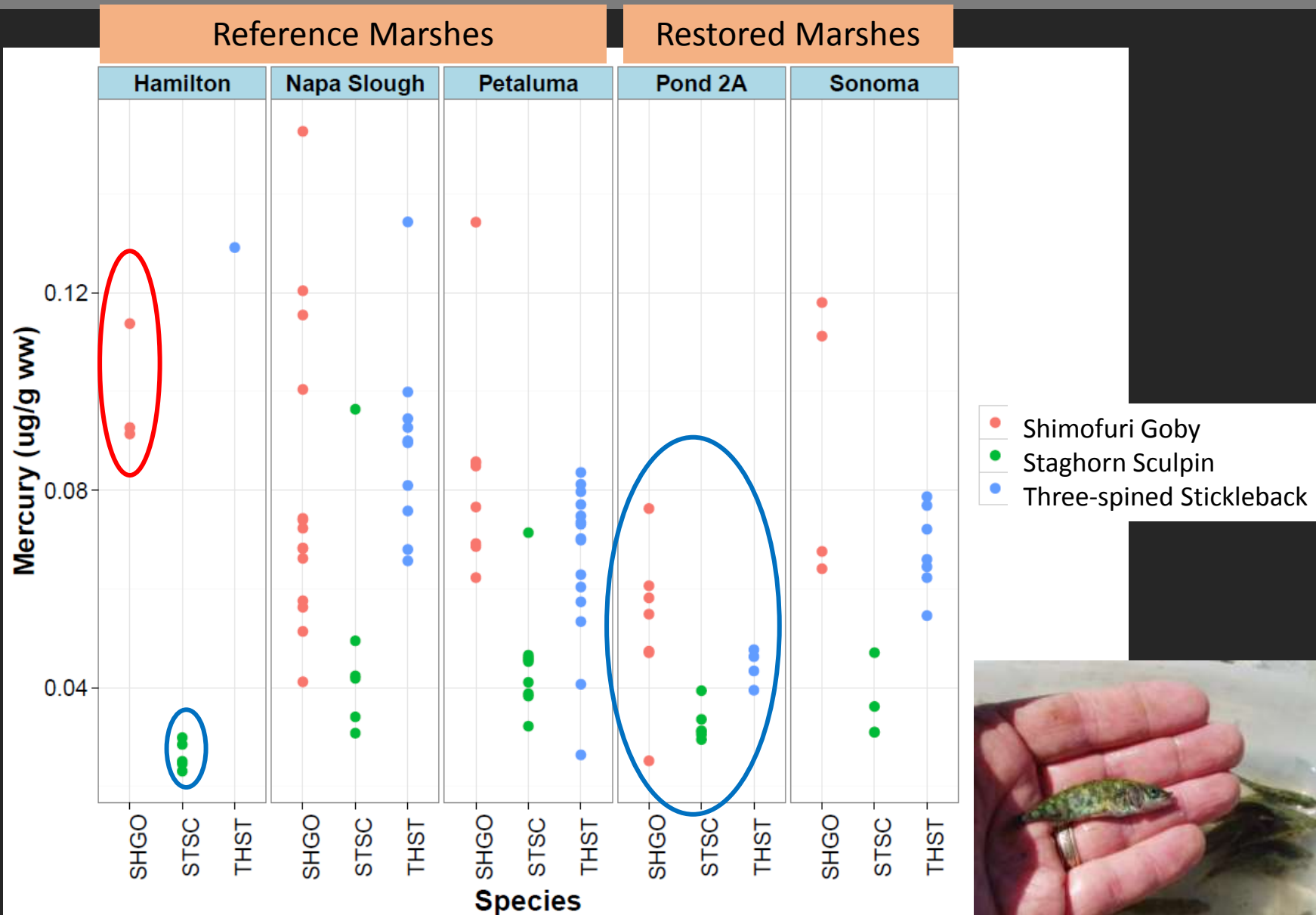
Mississippi Silversides



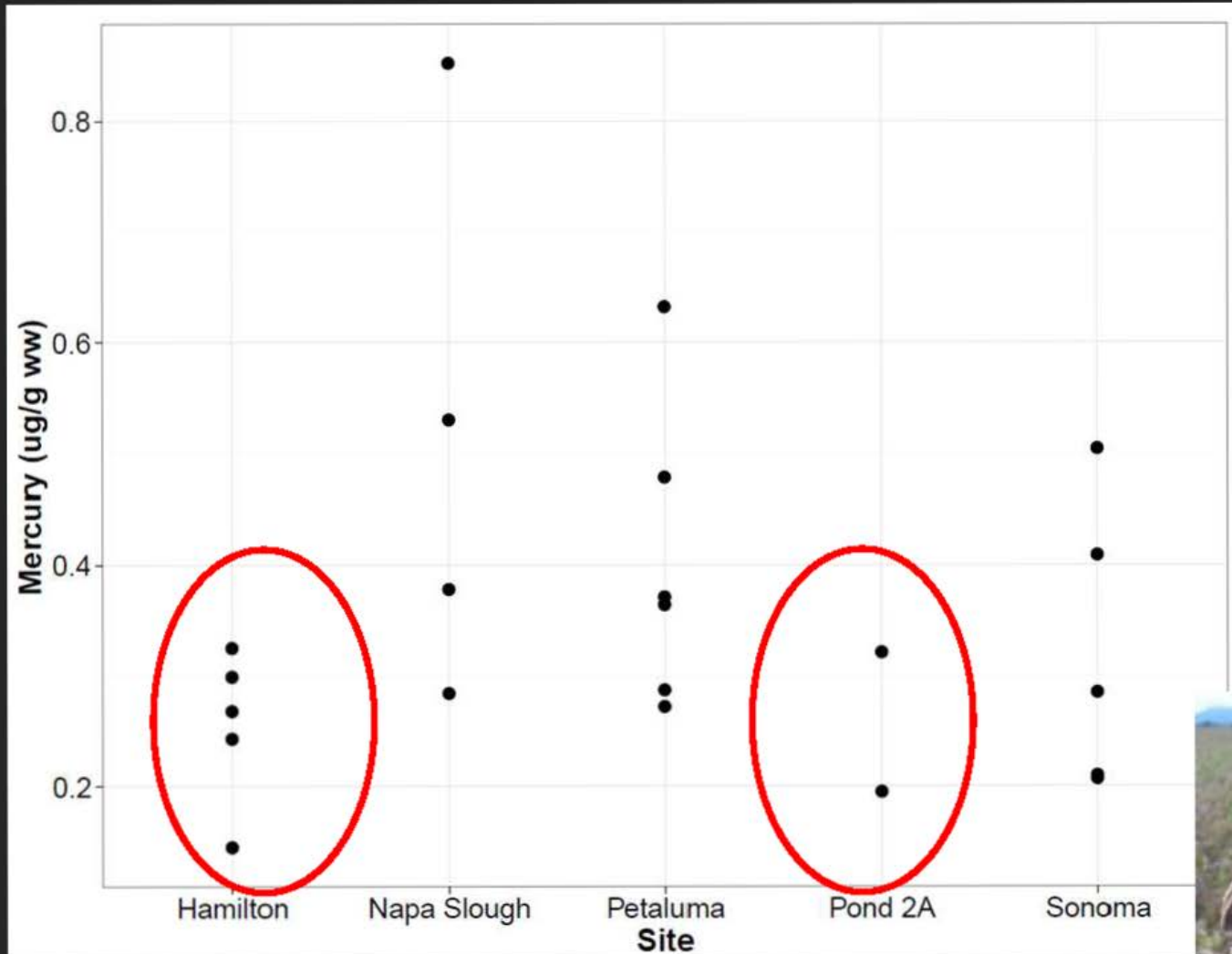
Breached Ponds



Vegetated Marsh (Channels and Ponds)



Vegetated Marsh (Marsh Plain)



Song Sparrow



Management Question 2

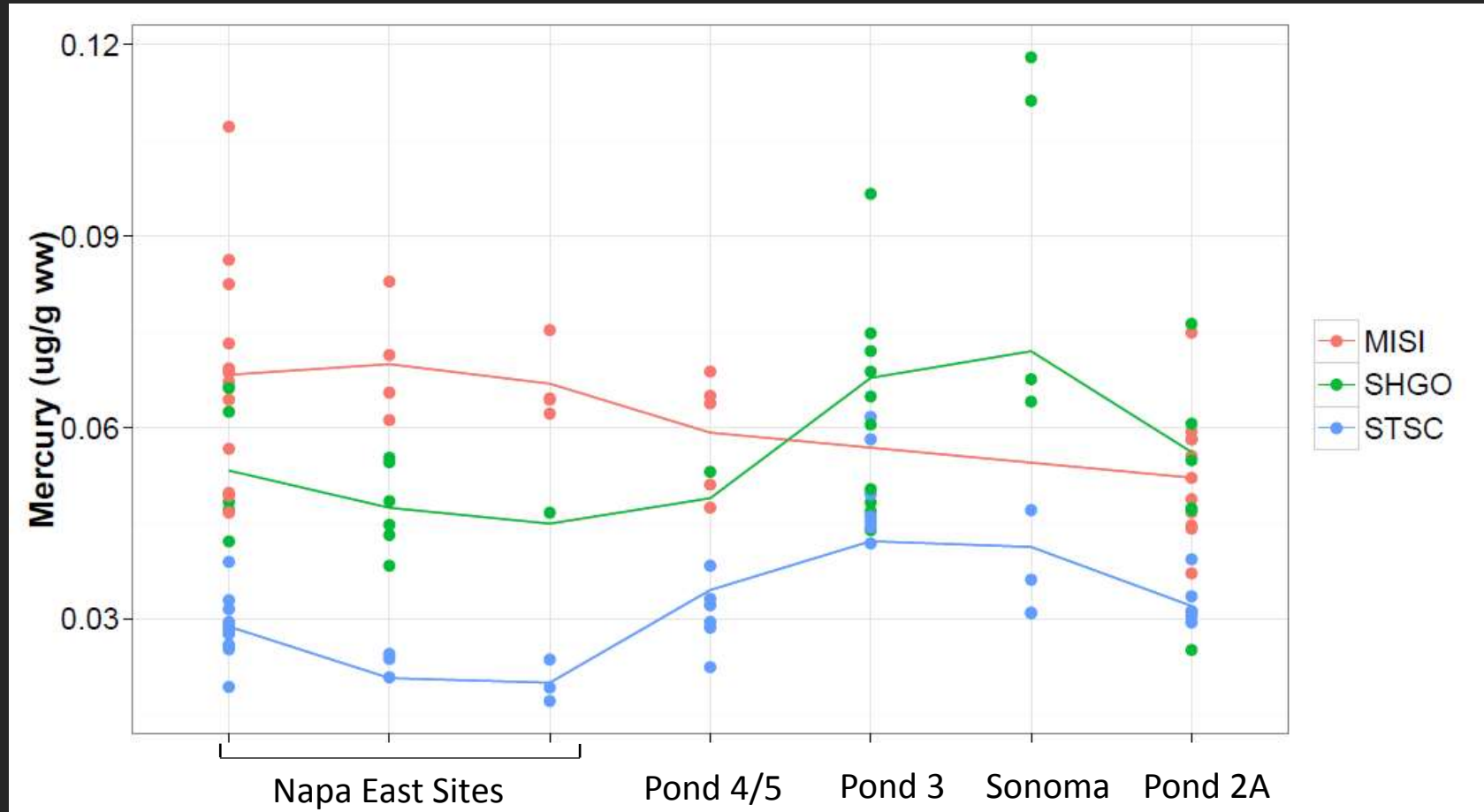
How do the status and trends in impairment due to methylmercury at this project **compare to status and trends** in impairment in other project and non-project wetlands **in the region?**

- *Mercury risk differed by site.*
- *Managed ponds had both the lowest and highest Hg concentrations.*
- *Restored marsh sites are no higher than reference marsh sites*
- *Pond 7A and Pond 2A are low, Pond 6A is high.*

Management Question 3

How will the status of impairment due to methylmercury in each major habitat of interest **change over a timescale of years** in response to the project?

No Trend in Mercury Risk by Restoration Age



Breached in 2010

Breached in 1995

Increasing restoration age

Management Question 3

How will the status of impairment due to methylmercury in each major habitat of interest **change over a timescale of years** in response to the project?

- *No trend in Hg with restoration age*
- *Baseline for future monitoring*

Answering Management Questions

4. Will tidal marsh restoration introduce a problematic amount of methylmercury **into the Bay**?

- *Need alternative methods to determine this.*
- *Discussed at the RMP Methylmercury Forum*
(http://www.sfei.org/calendar_events/4326)

Conclusions

- Multi-species biosentinel monitoring is a cost effective way to answering mgmt. questions
- Coordinated regional monitoring allows spatial and temporal comparisons
- Managed ponds may represent the best opportunity to reduce Hg impairment but further research is needed.
- Input from Science Advisory Group and Stakeholders was key.

Acknowledgements

- State Coastal Conservancy
- Science Advisory Group and Stakeholders
- Field and lab assistants
(UC Davis, SFEI, Texas A&M University)

Questions?

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North Bay Mercury Biosentinel Project

- **Goal:** Evaluate mercury impairment across restoration projects using biosentinel monitoring
- **Geographic Scope:** San Pablo Bay
- **Sampling Period:** 2012-2014
- **Funding:** State Coastal Conservancy



Monitoring Approach

- Monitoring should explicitly focus on the condition of identified **beneficial uses** or aquatic functions of interest to the managers or regulators
- Monitoring results should directly **inform project management** actions or design decisions
- To the extent possible, project **data should be comparable** from one time to another, from one project to another, and to ambient data.
- The **precision and accuracy** of the data should meet the **decision criteria** of the agencies for which the data are being collected.

Monitoring Approach

- Establish **thresholds** or **ambient concentrations** for comparison.
- When there are alternative monitoring methods to adequately answer a management or regulatory question, the **least expensive alternative method** that has the spatial and temporal precision to answer management questions is preferable.
- **Compliance monitoring** and **research** are related but different scientific activities.

Data Management and Availability

CEDEN
CALIFORNIA ENVIRONMENTAL DATA EXCHANGE NETWORK

Find Data | Submit Data | About CEDEN

Map | Satellite

RESULT CATEGORY: ☐ Water Quality ☐ Toxicity ☐ Tissue ☐ Residue ☐ Habitat

☐ Turn on automatic station mapping

Click Map Stations at any time to show currently selected stations on the map.

START OVER **MAP STATIONS** **HELP**

Missing Coordinates Info

Region Type Selection:

SELECT COUNTRIES Do not limit search by Counties

SELECT PROGRAMS Do not limit search by Programs

SELECT PROJECTS Do not limit search by Projects

SELECT PARAMETER GROUPS Do not limit search by Parameter Groups

SELECT PARAMETERS Do not limit search by Parameters

SELECT STATIONS Do not limit search by Stations

Missing Coordinates Info

SELECT MATRICES Do not limit search by Matrices

Search Text:

Available date range: Jan 01, 1950 to Dec 31, 2013

From: To: Clear Dates

Share Controlled Vocabulary
Share Data Availability
Share Station Location
Share QA/Limit

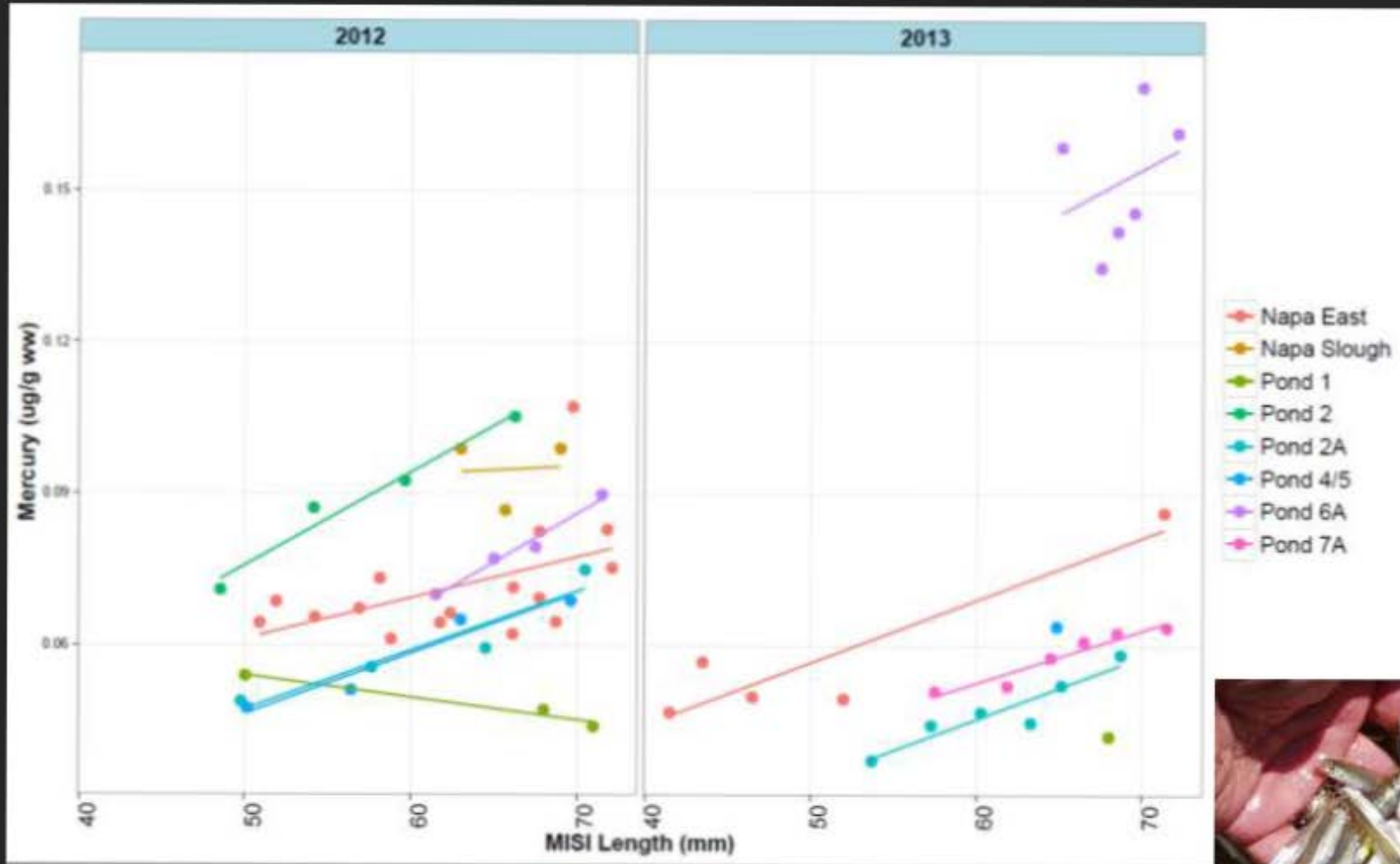
RETRIEVE DATA

Report Count: 249735

Who is this site best viewed with? Firefox? Please contact us for help or to report issues.

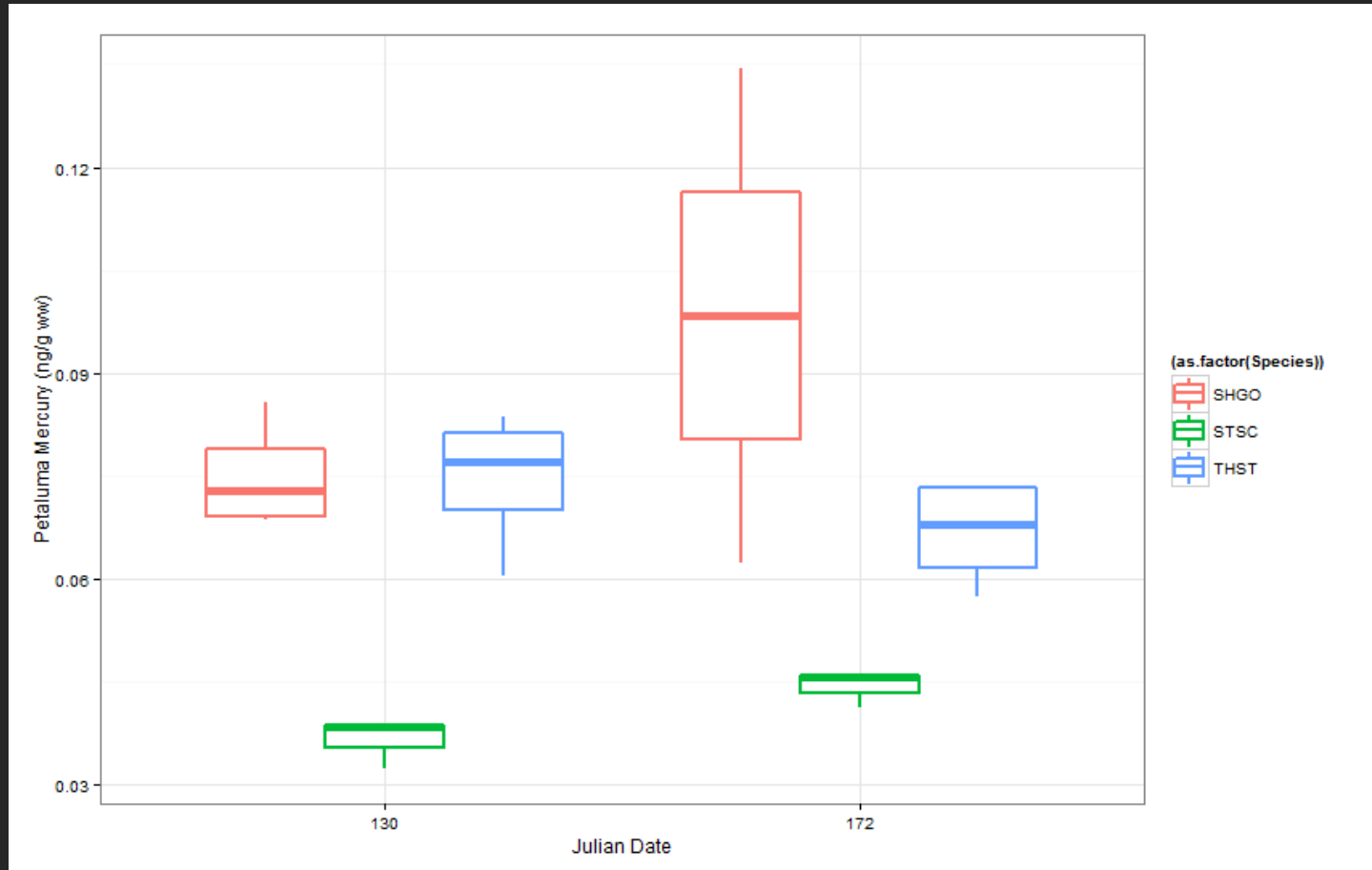
<http://www.ceden.org>

Fish Length Effects: Mississippi Silversides



Sample Date Effects

[REPLACE!]



Monitoring Approach

Indicate mercury exposure

- In a particular habitat or habitats
- In a particular part of the food web
- Over a particular spatial area
- Over a particular temporal period
- Integrate over appropriate spatial and temporal scales
- Exposure can be interpreted in terms of effects
- Identify problems or opportunities to be investigated by further research

Science Advisory Group Recommendations

- Monitoring should be designed to **answer stakeholder questions**.
- Prioritize sampling across **multiple habitats** using a palate of biosentinels over seasonal sampling.
- Sampling should be done **when ecological risk is the highest** (coinciding with timing of breeding for species of interest).
- **Secondary biosentinels** should be sampled in addition to primary species when possible.
- Let the **conditions on the ground** dictate which biosentinels to sample

Field sampling

Primary Biosentinel Targets

- Mississippi Silversides
- Longjaw mudsuckers
- Song Sparrows



Sites Sampled



Comparisons with other datasets

- Comparisons are difficult, many confounding factors
- Broadly similar results to other datasets
- Lower than some South Bay and Delta sites