

High Mercury in South Florida Wetlands: Role of Fish Trophic Position and Redistribution by Wading Birds



Ben Gu, South Florida Water Management District
Paul Julian, Florida Department of Environmental Protection



Greater Everglades Ecosystem Restoration
April 17-20, 2017 Coral Springs, Florida USA

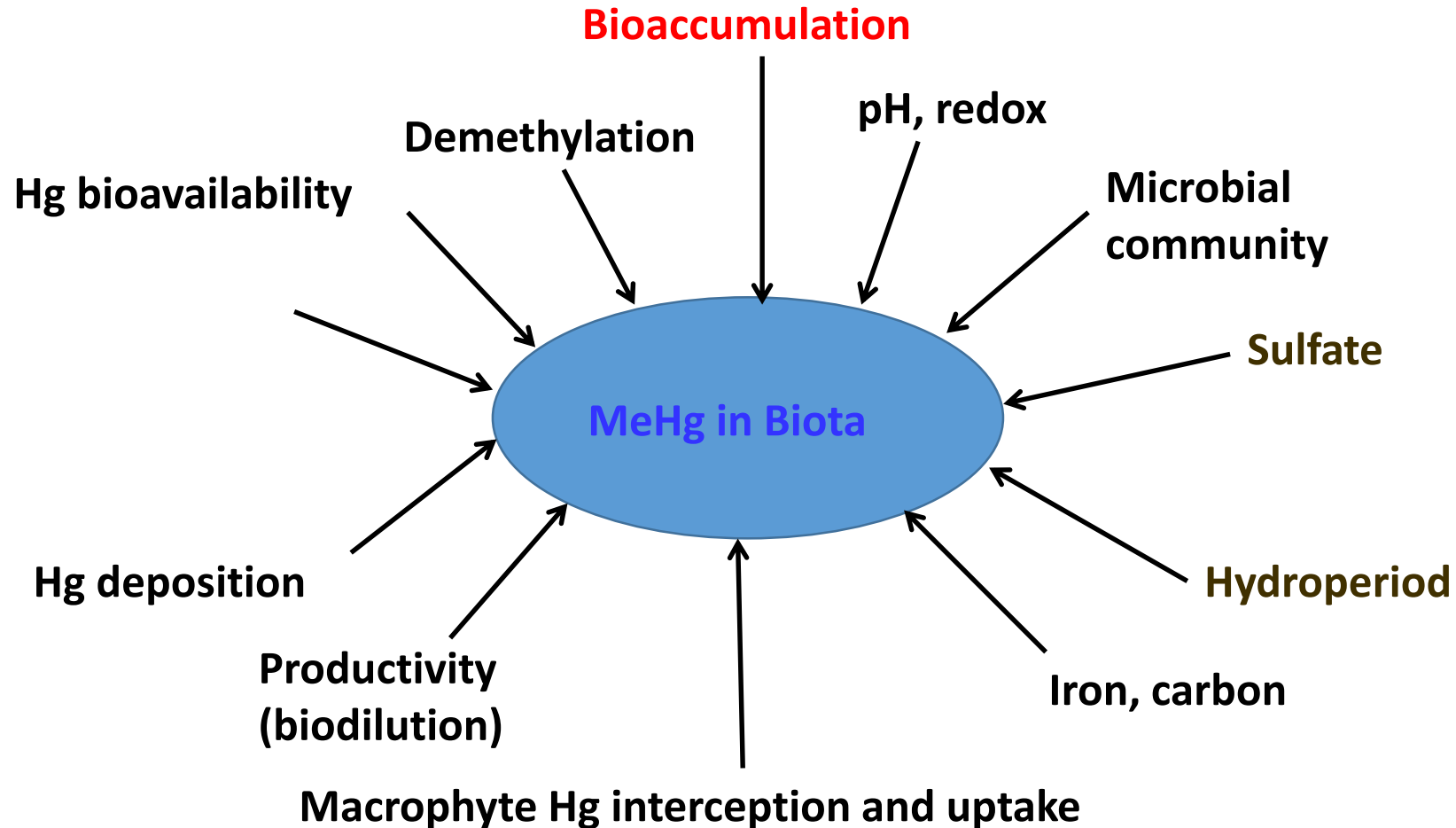
Why Do We Monitor Mercury in Everglades ?



- Elevated Hg concentrations in fish and other biota have been observed in the Everglades since the 1970s.
- Harmful health effects from high Hg concentrations have been observed in Everglades biota that have a semi-aquatic diet, including wading birds, alligators and Florida panthers.



Factors Affecting Mercury Levels in Biota



(Produced by DB Environmental)

Objectives

Present evidence on

- How fish trophic position influences mercury accumulation.
- If wading bird guano could be an important source of mercury to the Everglades marshes.



Fish Trophic Position and Mercury Level: Sources of Data

Mercury Data:

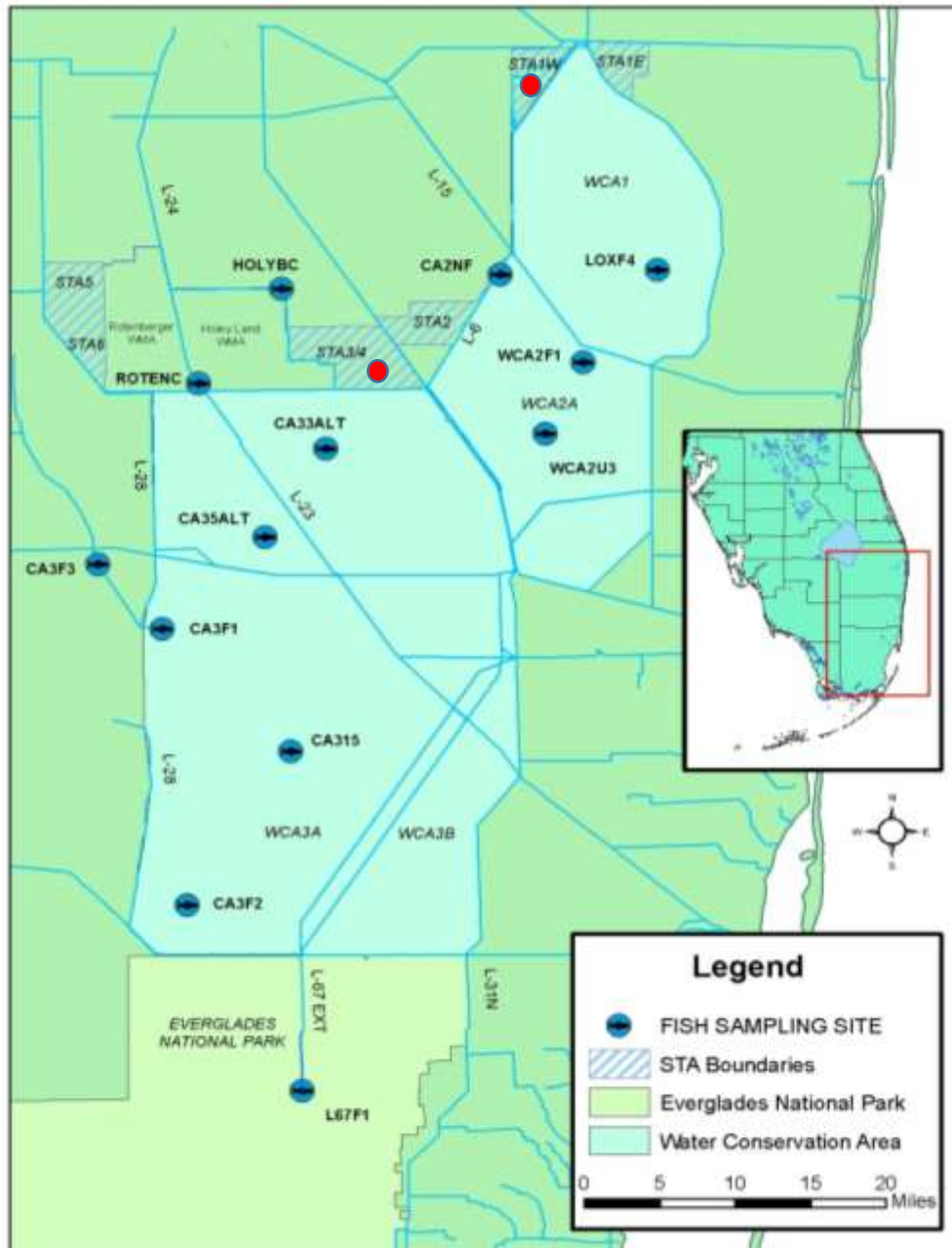
- SFWMD mercury monitoring program

Stable Isotope Data:

- USGS Food web study (1994-1998)
http://sofia.usgs.gov/exchange/kendall_isotope/kendallisotope.html
- District data using archived fish samples (2006-2008)

Sulfate Data:

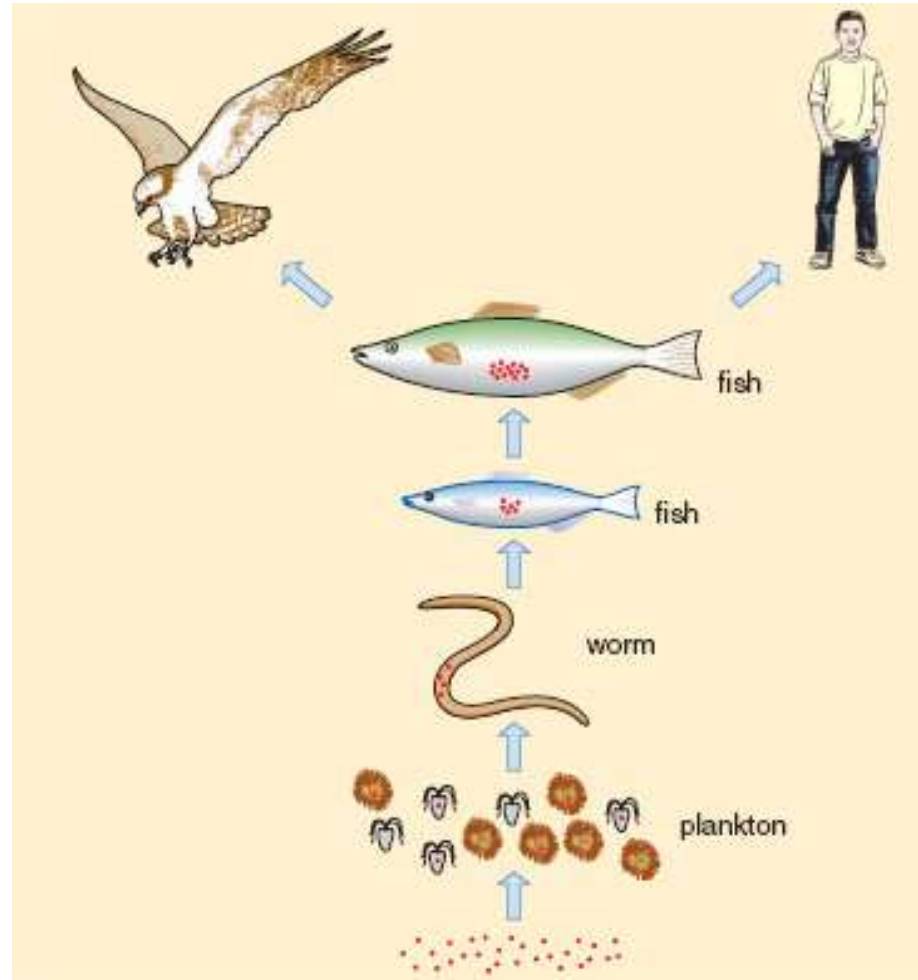
- SFWMD DBHYDRO database



Fish Hg Collection Sites

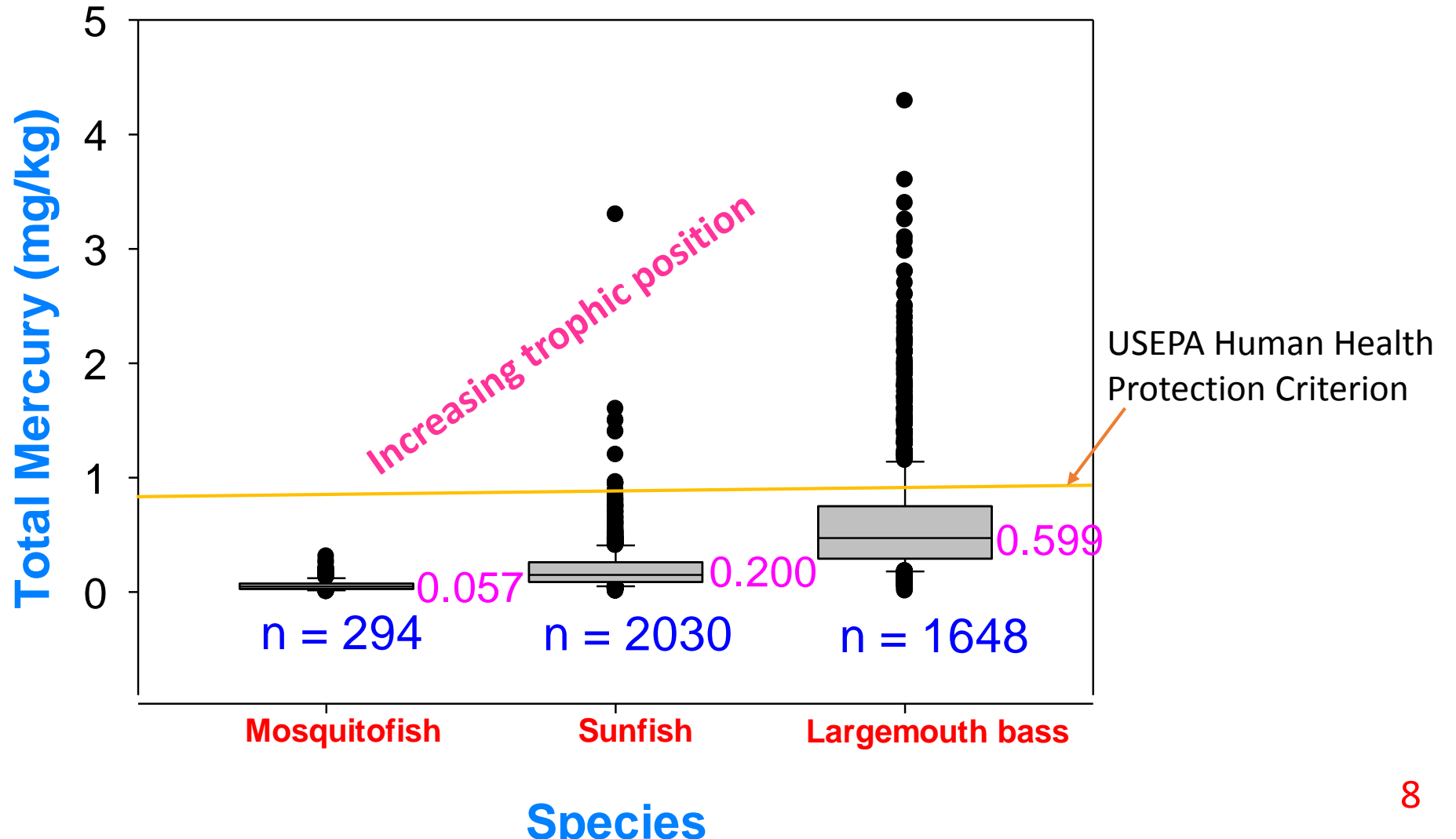
- The fish Hg monitoring network in Everglades Protection Area was initiated during 1998. Collection is done on three fish once a year.
- These monitoring stations represent both canal and marsh habitat types.
- Three sites from two Stormwater Treatment Areas were also included in this study.

High Mercury in Biota: Role of Fish Trophic Position

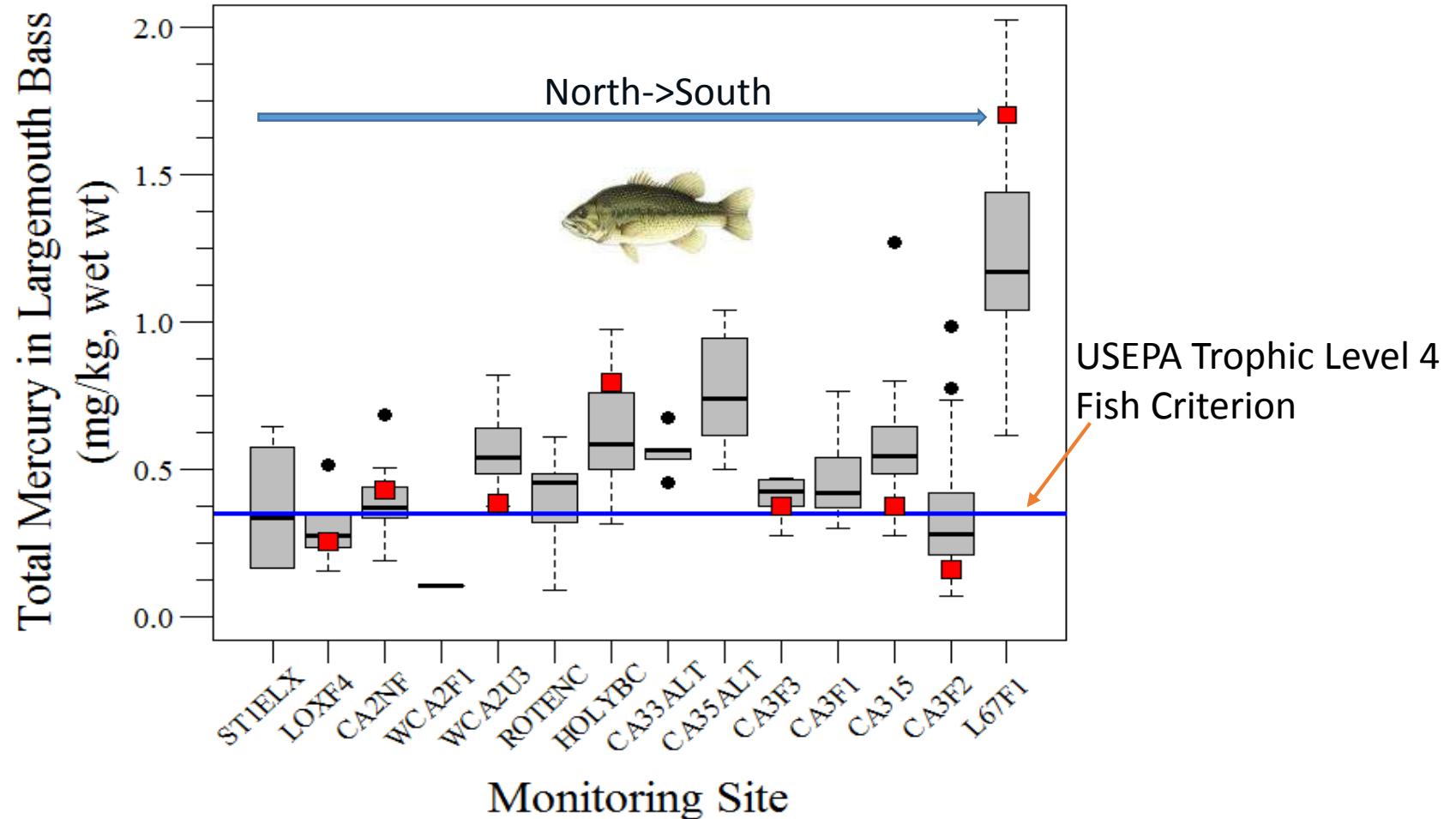


- Contaminants in consumers increase along food chain
- Real world trophic transfers are more complex

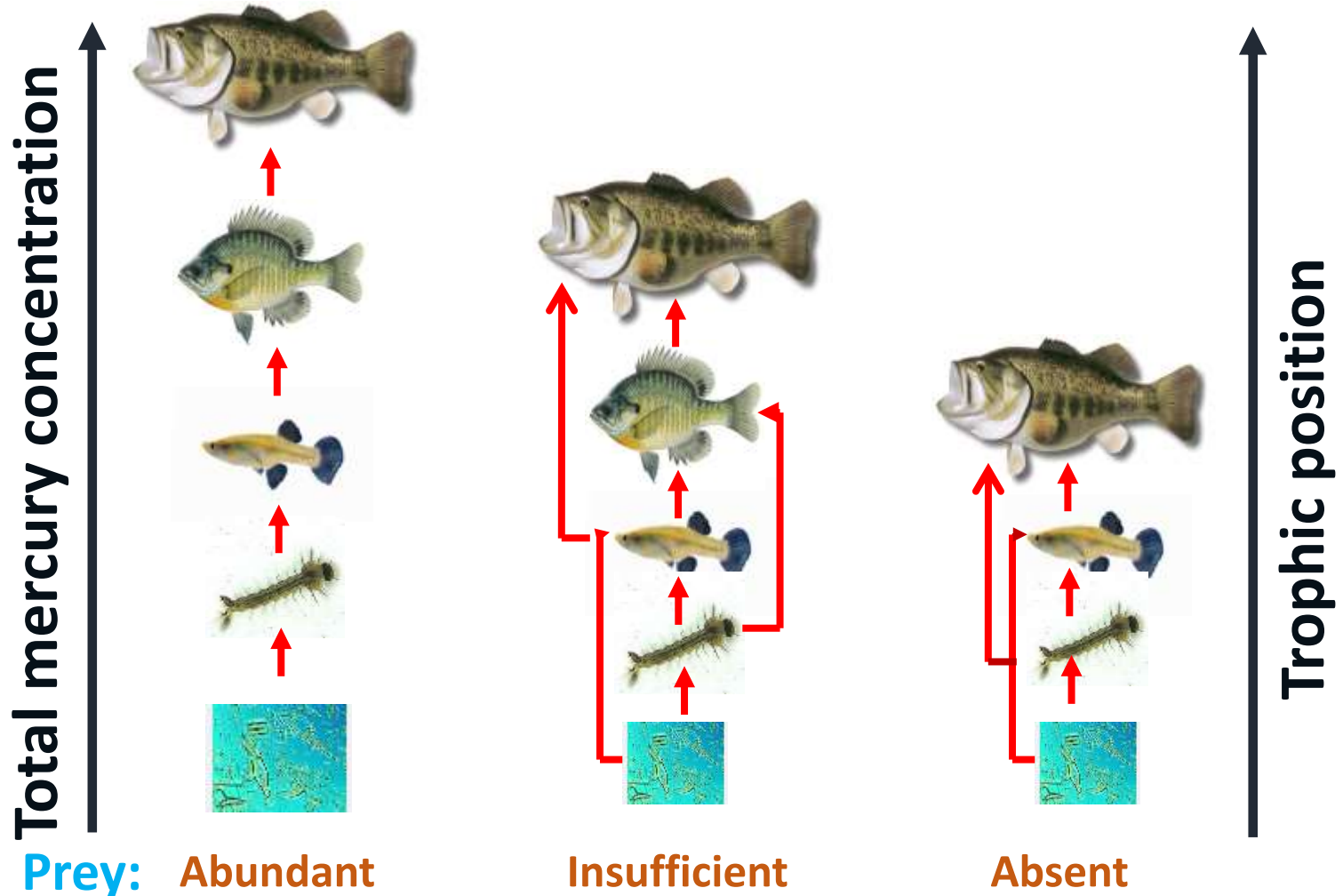
Variations of Total Mercury in Three Major Fish from the Everglades



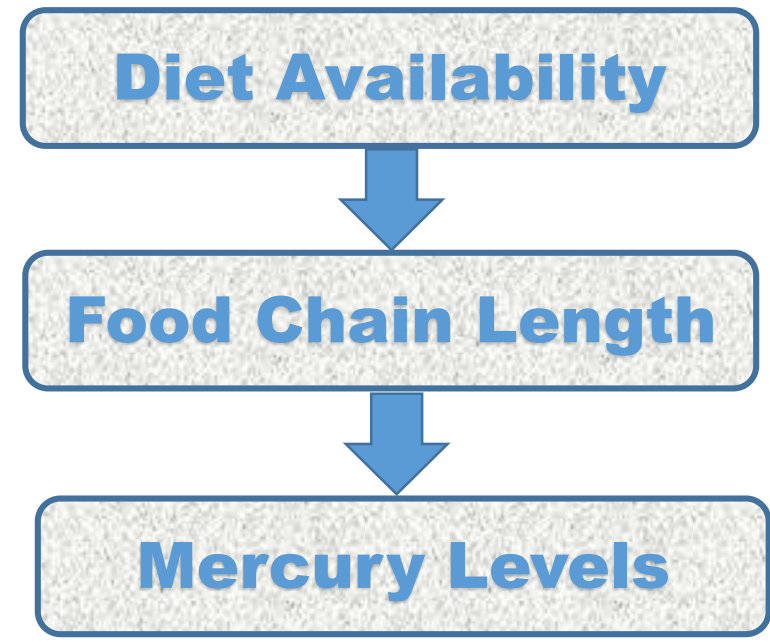
Total Mercury in Largemouth Bass across Everglades Protection Areas



Food Chain Structure and Mercury Level in Largemouth Bass



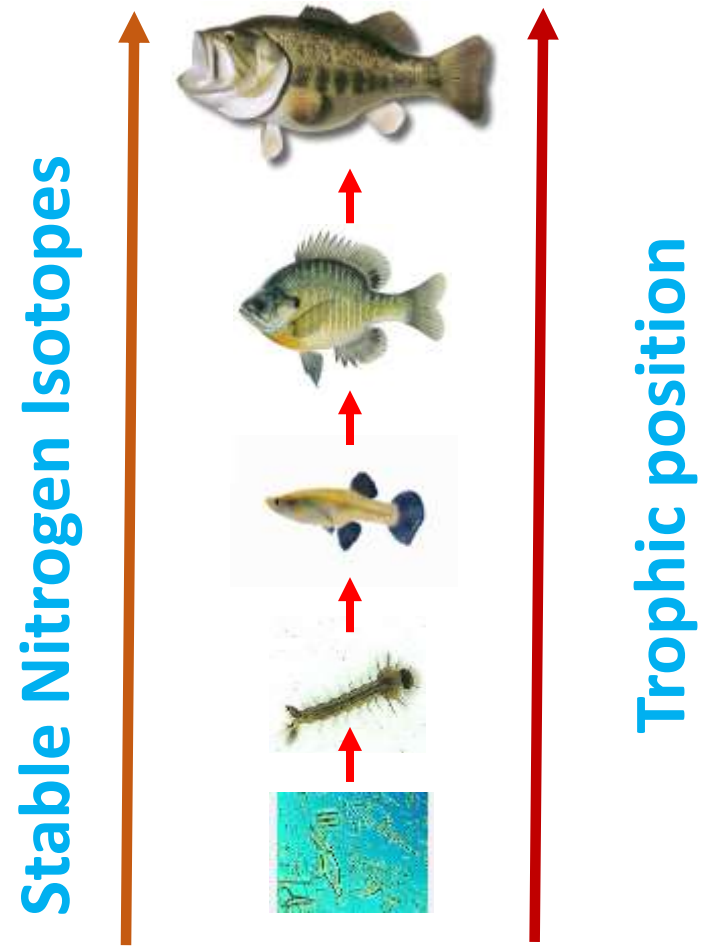
Consumer Trophic Position:



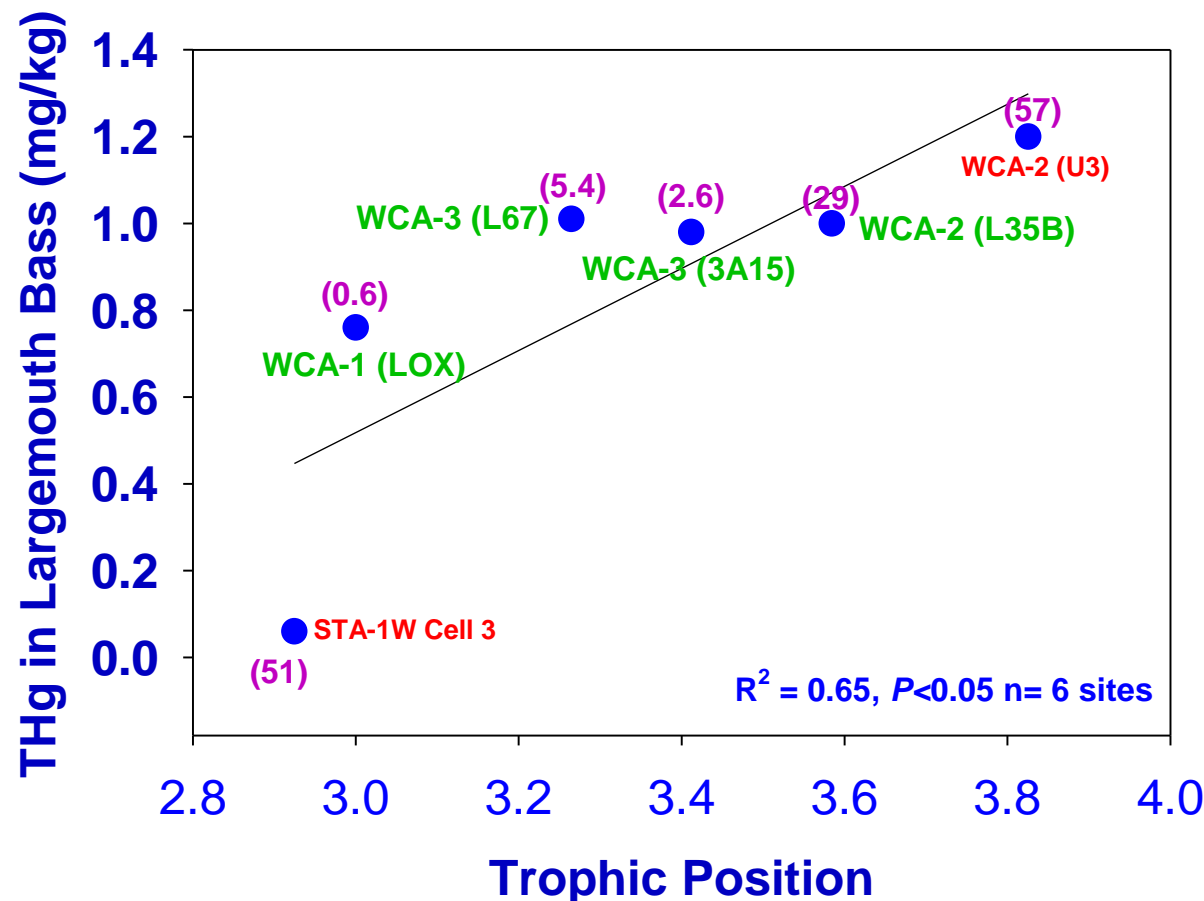
How to Measure Consumer's Trophic Position: Stable Nitrogen Isotope Technique

- Stable nitrogen isotope composition ($\delta^{15}\text{N}$) in biota increases consistently along food chain
- Consumer's trophic position can be estimated with $\delta^{15}\text{N}$ as a trophic indicator

<p>^{14}N 14.00307 99.63%</p>	<p>^{15}N 15.0001 0.37%</p>
Stable	Stable

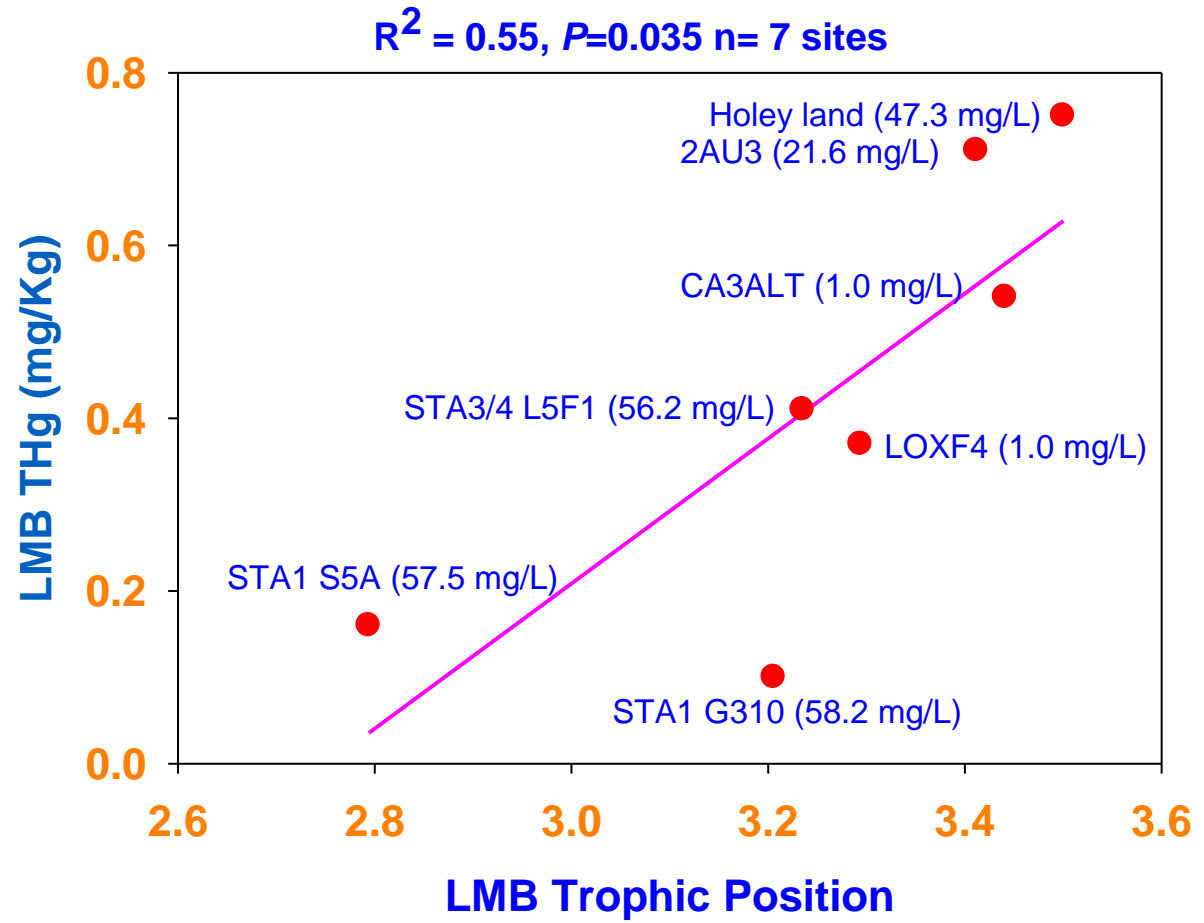


Largemouth Bass Trophic Position, Total Mercury and Surface Water Sulfate Levels (USGS data:1996-1998)



- A full trophic level difference
- Linear correlation between trophic position and THg
- High sulfate associated with low and high trophic position & THg
- Both trophic position & THg in STA1-W Cell 3 are far below the regression line

Largemouth Bass Trophic Position, Total Mercury and Surface Water Sulfate Levels (SFWMD data: 2006-2008)



- A full trophic level difference
- Linear correlation between trophic position and THg
- High sulfate associated with low and high trophic position & THg

High Mercury in Biota: The Role of Wading Birds Redistribution



Tree islands

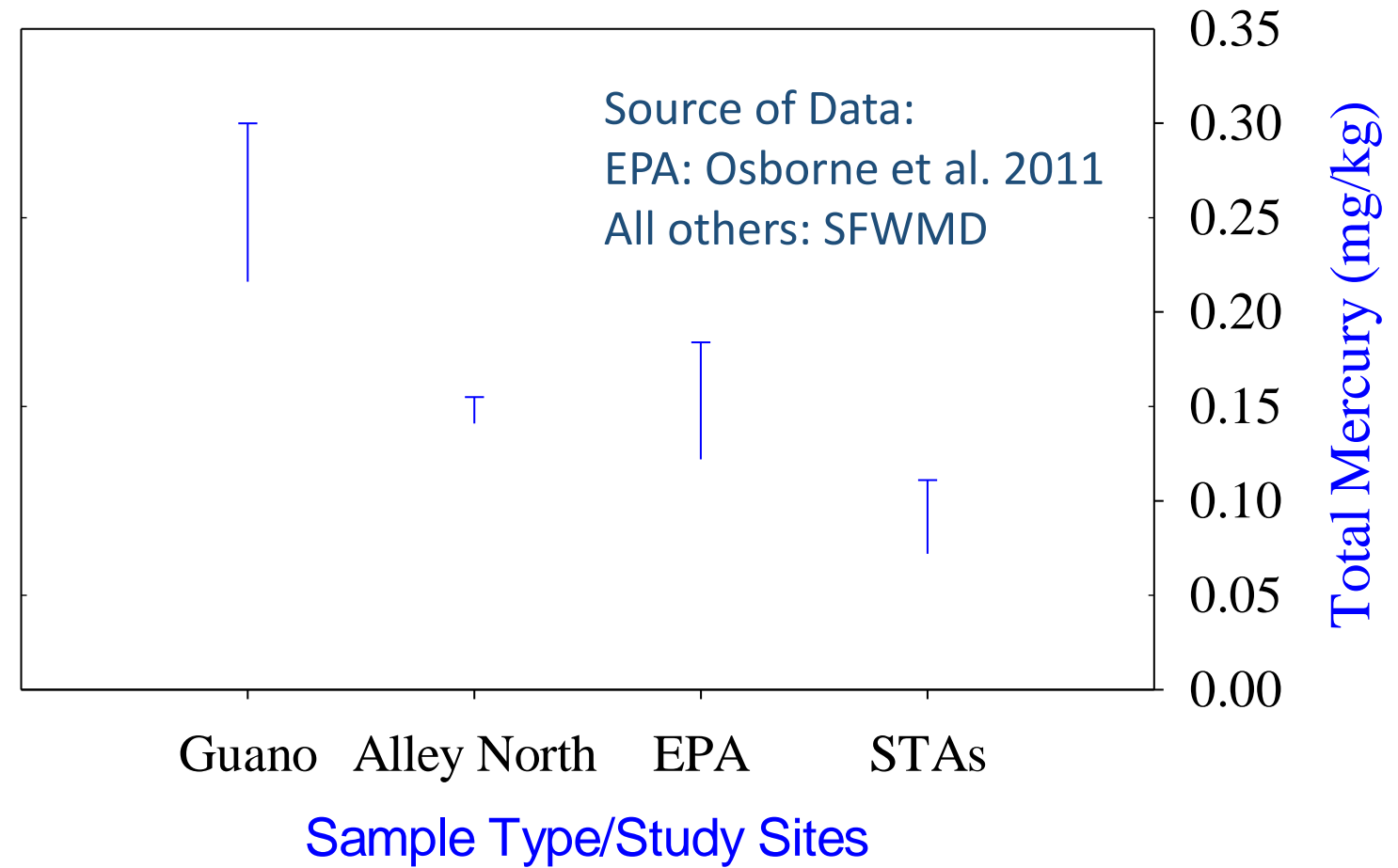
- High lands in the Everglades marsh.
- Homes to many wildlife including wading birds.
- Known as nutrient hotspots, how about mercury?

Wading Bird Guano is high in....

- Uric acid Phosphoric acid
- Oxalic and carbonic acids
- Heavy metals including Hg

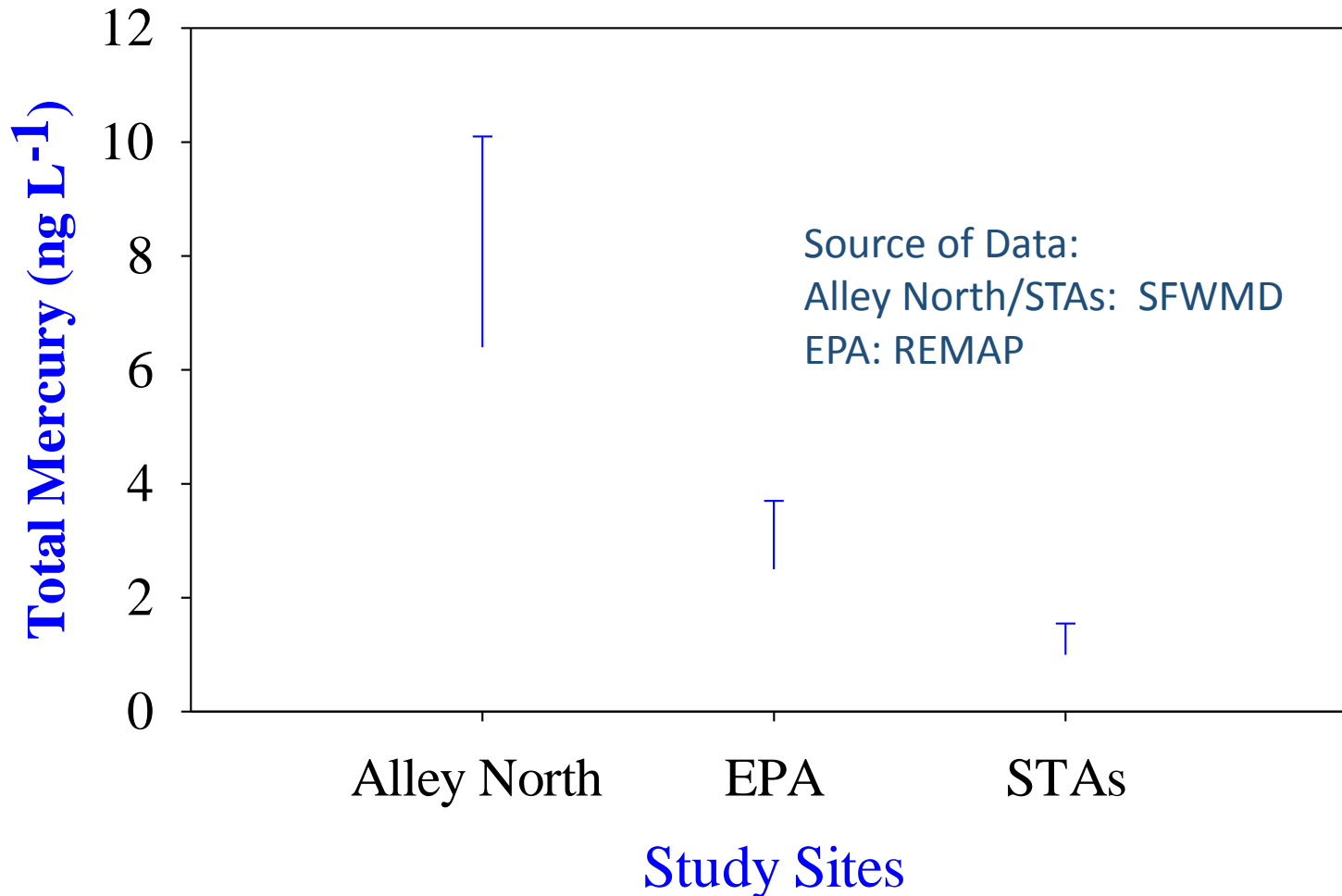


Mercury Levels in Bird Guano and Soil



Location of Tree Island Alley North

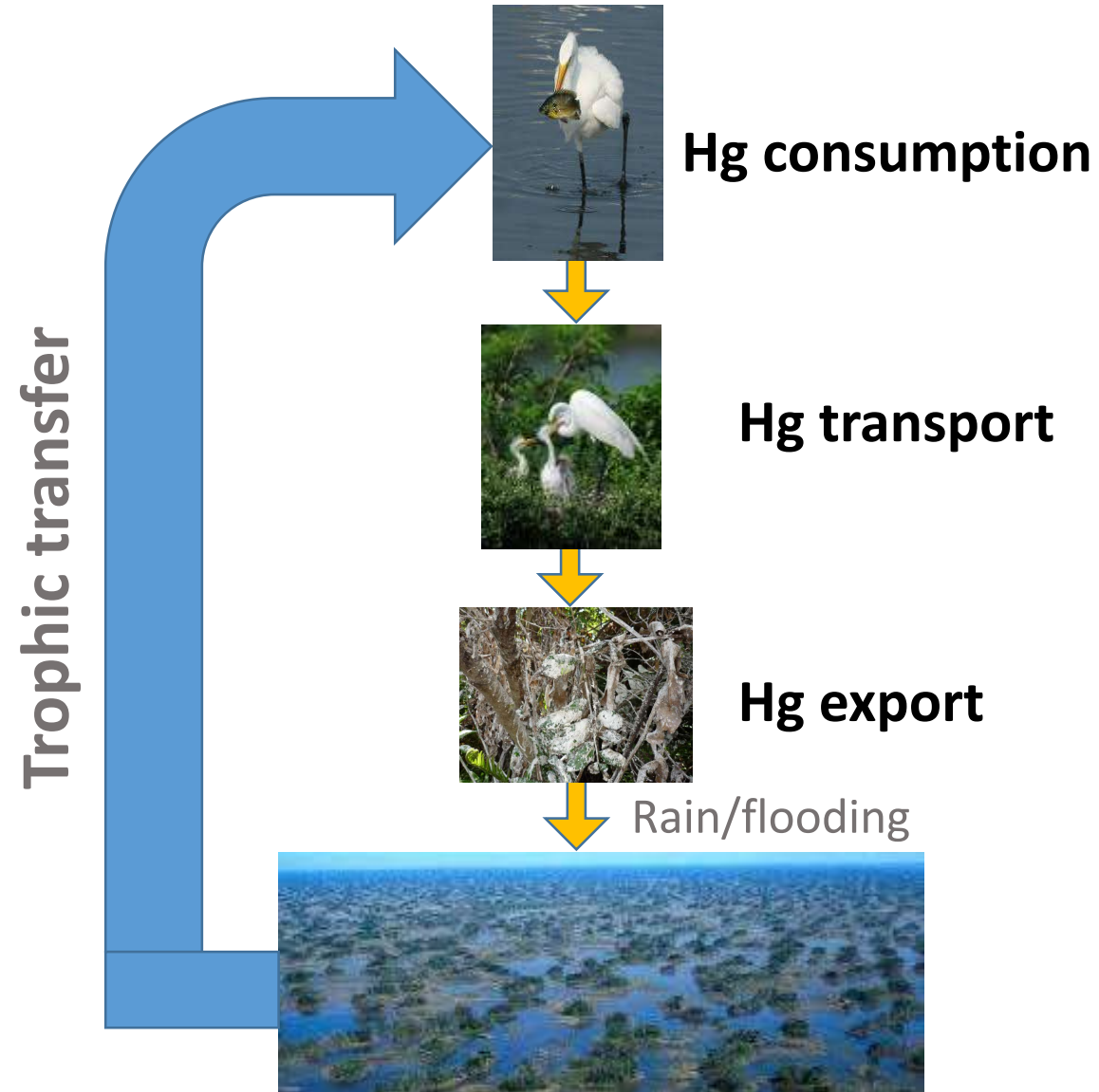
Mercury in Everglades Marsh Water



Alley North Marsh

- Two transects (n=24 sites)
- Maximum=24 ng/L
- High THg levels were often found closer to tree island

Mercury Redistribution by Wading Birds



CONCLUSIONS

- There is strong evidence that mercury variation in bass is linked to fish trophic position.
- Rookery islands are potential sources of high mercury in marsh water.
- Fish trophic position and redistribution of mercury by wading birds are suggested as important mechanisms for the formation of mercury hotspots in the Everglades.

THANK YOU!!!



Any QUESTIONS???