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Mercury Monitoring in Texas Waters of the Gulf of Mexico

University of Houston Clear Lake


https://i.ytimg.com/vi/9jVxQvVh424/maxresdefault.jpg

A CONCURRENT STUDY WITH THE NATIONAL COASTAL CONDITION ASSESSMENT

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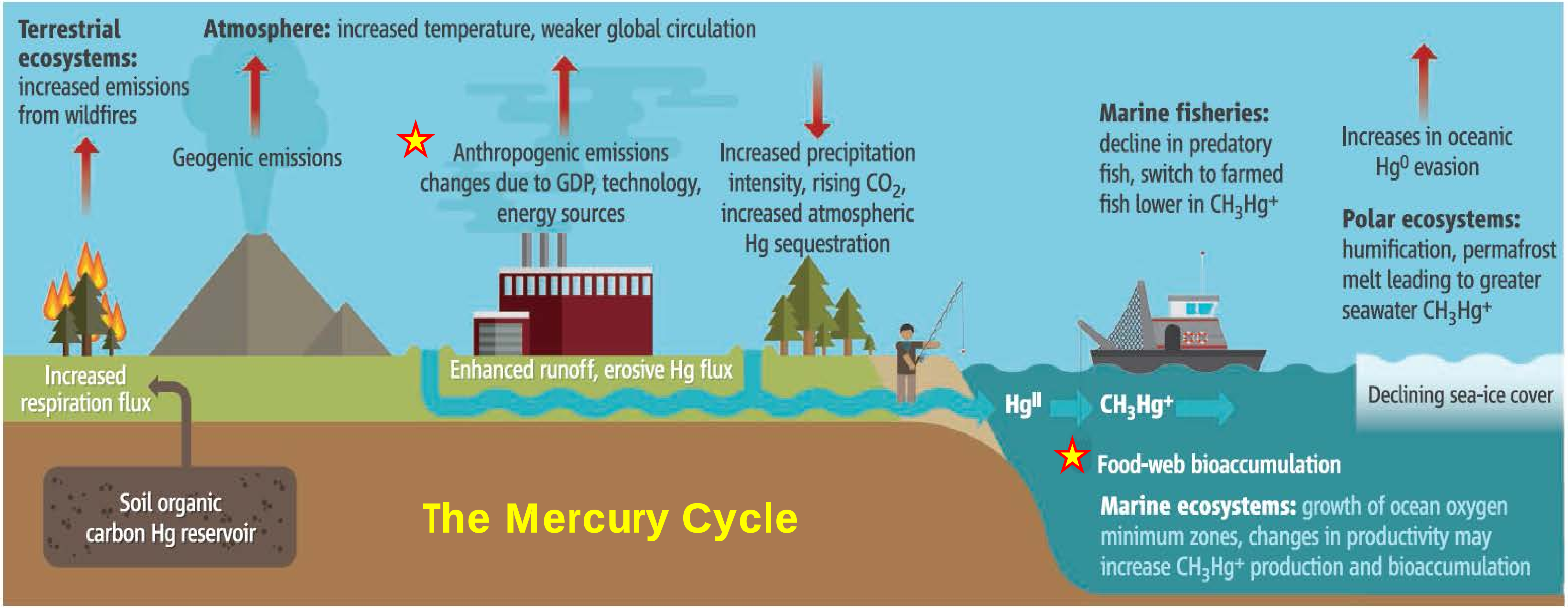
Introduction

- No known biological function
- High bioaccumulation potential and also biomagnifies (Marburger 2004)

Photo Credit: Rowlatt 2013, http://www.bbc.com/news/magazine-25130770

Introduction

- Can pass to humans where it can cause nerve damage or convulsions (Loftus 2000)
- FDA sets a fish mercury action level of 1mg/kg (FDA 1979)
- EPA recommends a daily mercury intake of no more than 0.0001 mg/kg daily (U.S. EPA 2008)



How mercury cycles through the environment. Global change interacts directly and indirectly with mercury cycling. Numerous physical, chemical, and anthropogenic drivers will affect future mercury conditions in the atmosphere, terrestrial systems, and oceans.

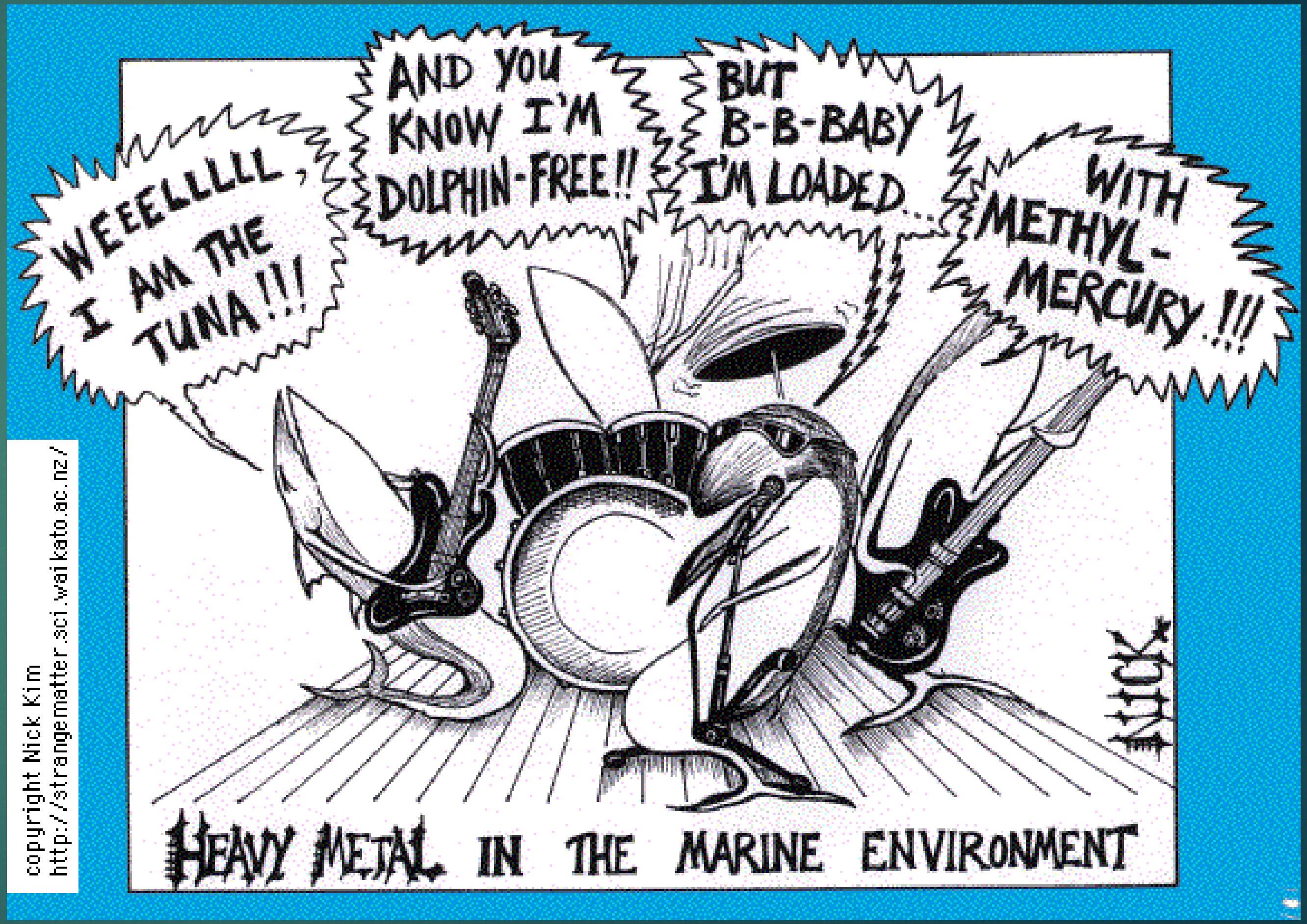
(Krabbenhoft 2013)

Introduction: Mercury in Galveston Bay

- **1973-1980** EPA spends millions on upgrades to water treatment facilities (Youngblood 2010)
- **1994** Still no routine testing of seafood or risk assessment (Youngblood 2010)
- **2001** Texas Natural Resource Conservation Commission re-organization into Texas Commission on Environmental Quality (Youngblood 2010)

Significance

- "Interagency Working Group on Methylmercury" called for a review of historical data and trends (Marburger 2004)
- Texas mercury exceeds USEPA standards 19% of the time (Harvey 2008)



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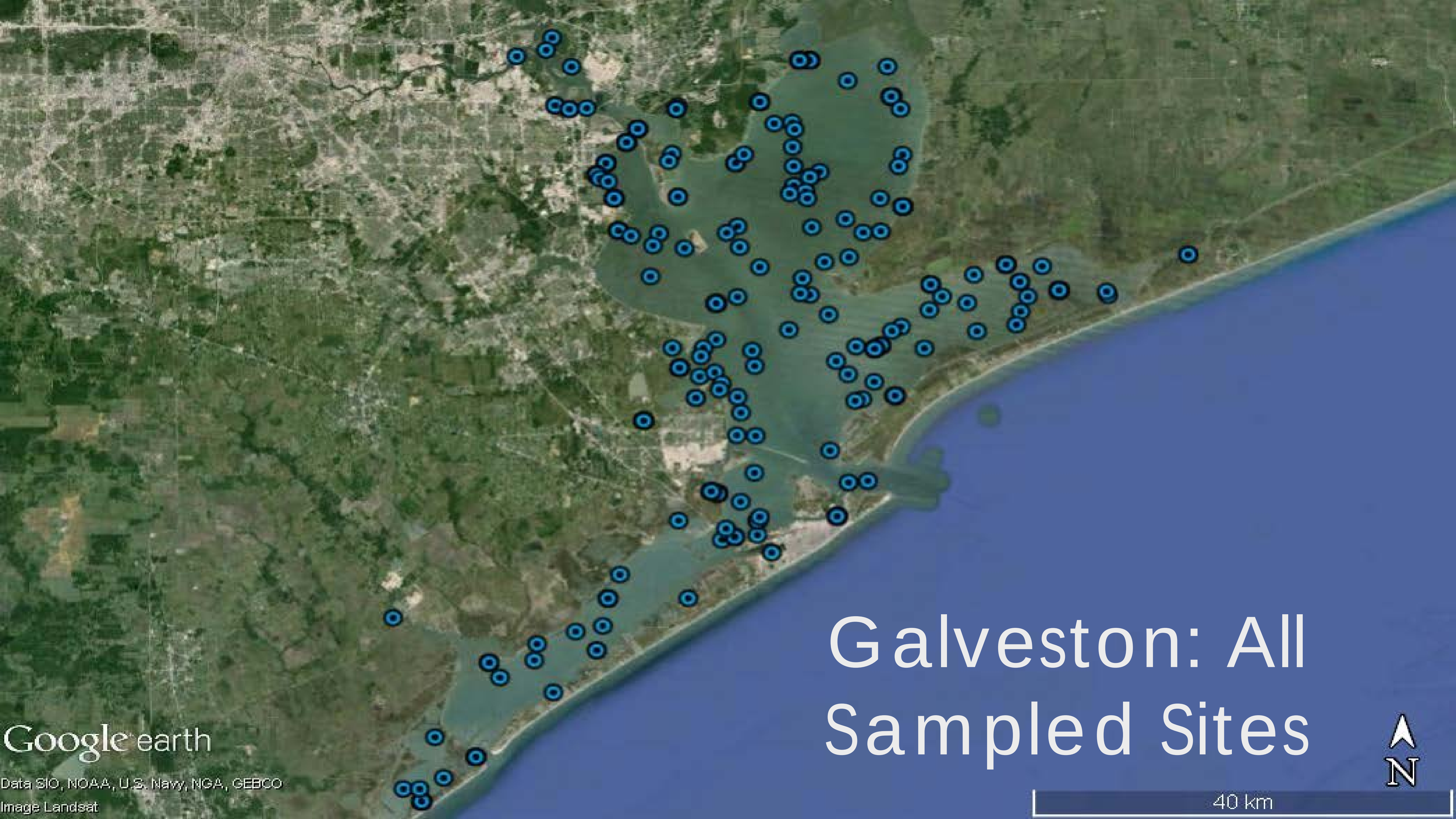
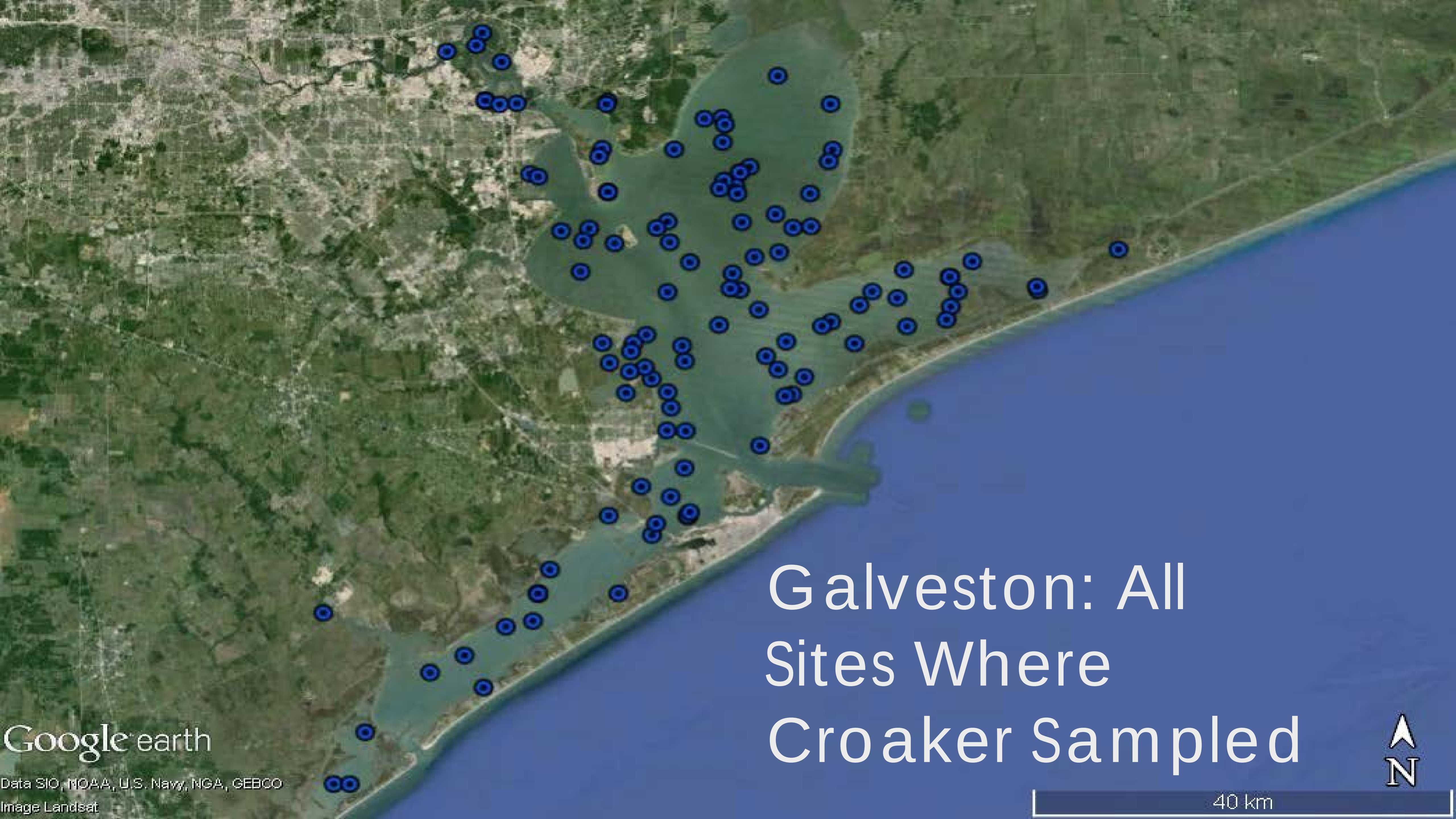
Objectives

- Assemble a database of verifiable, quality, reproducible data
- Determine trends from 1970 to 2015 in levels of mercury in Galveston Bay with a focus on Atlantic Croaker (*Micropogonias undulatus*)
- Compare Galveston Bay croaker mercury levels to other bay systems in Texas

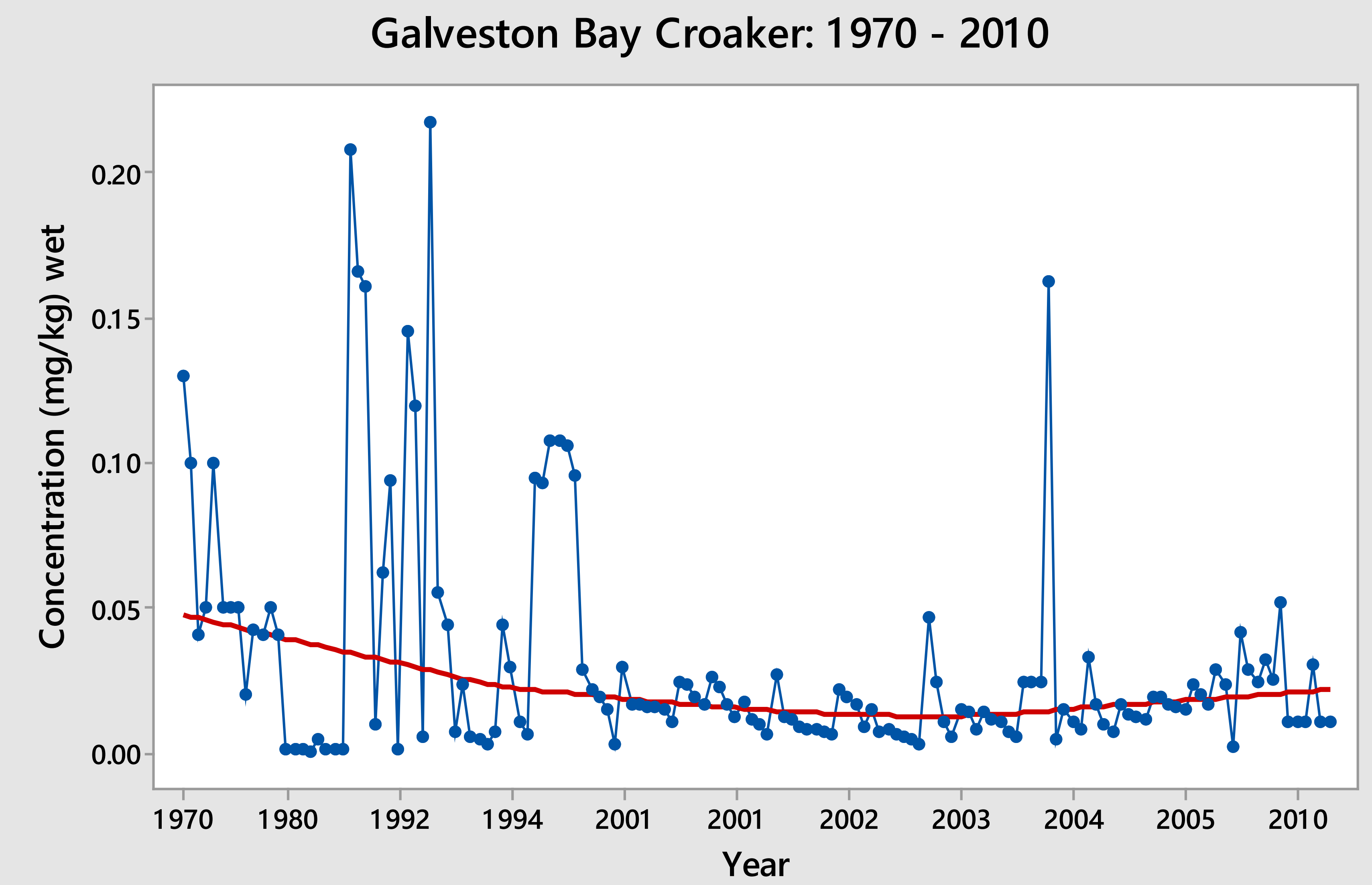
Methods

- Target species: Atlantic Croaker (*Micropogonias undulatus*)
- Database include: National Coastal Condition Assessment, Department of State Health Services, Environmental Monitoring and Assessment Program
- Data grouped by bay systems then analyzed using Kruskal-Wallis and Mann-Kendall nonparametric tests
- All data evaluated using a statistical package in Minitab


Galveston: All Sampled Sites
Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat
N
40 km


Galveston: All Sites Where Croaker Sampled
Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat
40 km
N

Results



P < 0.0254476 at alpha = 0.05 there is a downward trend

Daily Consumption Limit

EPA daily level = 0.0001 mg/kg[1]

ASTDR daily level = 0.0003 mg/kg[1]

Commercial Limit

EPA standard = 0.30 mg/kg[1]

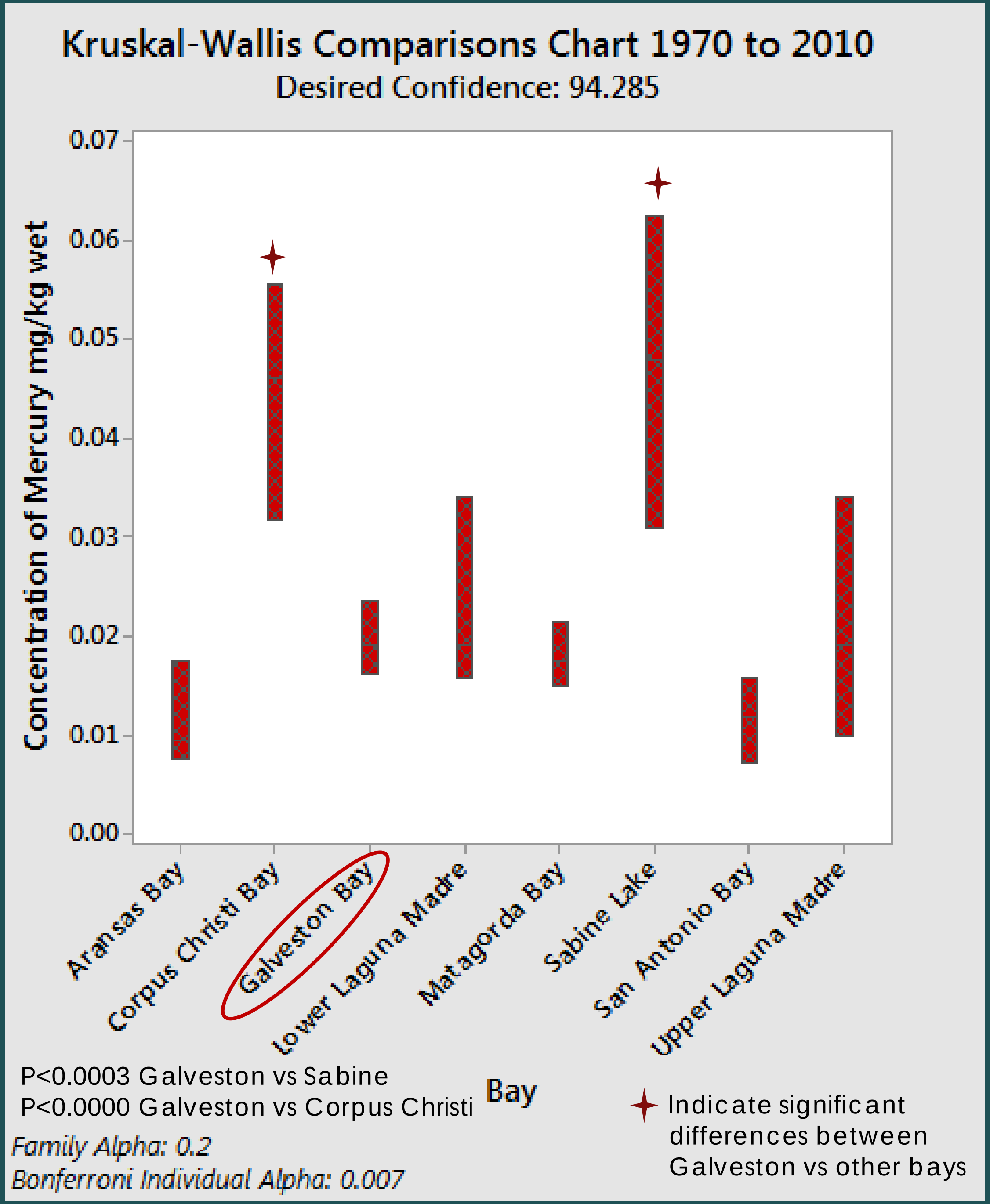
TDH standard = 0.70 mg/kg[1]

FDA action level = 1.00 mg/kg[1]

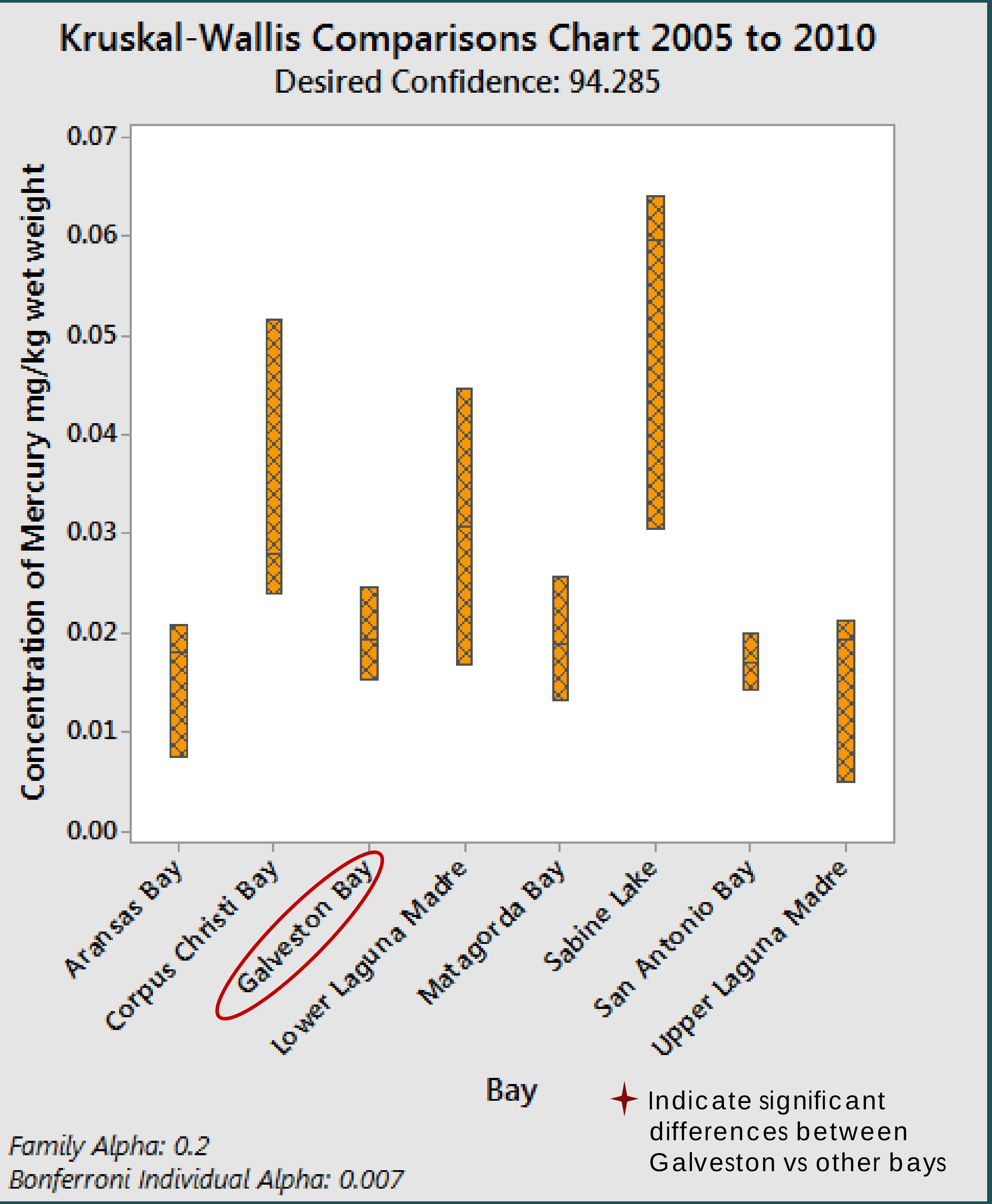
Marine Fish Toxicity Level

Marine Fish TRL = 0.31 mg/kg[1]

1. U.S. EPA 2008, U.S. FDA 1979, GASP 2004, Bowersox 2015, TDSHS 2015



Kruskal-Wallis Comparisons Chart 1970 to 2010
Desired Confidence: 94.285
Concentration of Mercury mg/kg wet
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
Aransas Bay
Corpus Christi Bay
Galveston Bay
Lower Laguna Madre
Matagorda Bay
Sabine Lake
San Antonio Bay
Upper Laguna Madre
Bay
P<0.0003 Galveston vs Sabine
P<0.0000 Galveston vs Corpus Christi
Indicate significant differences between Galveston vs other bays
Family Alpha: 0.2
Bonferroni Individual Alpha: 0.007



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Summary

- Creation of a database of all available verifiable, quality, reproducible mercury in fish tissue data
- Although highly variable, most mercury in A. Croaker muscle tissue has been generally declining over time
- Galveston Bay mercury in croaker does not significantly differ from most other bay systems

Conclusions/Implications

- Regulations have an impact based on trends in overall mercury
- Mercury may be increasing not from direct loading but from historical deposits (Harris 2007)
- Methods for cleaning or removing historical mercury deposits
- Necessity for continued mercury monitoring

Future Studies

- Sample tissue collected as part of the May to August 2015 National Coastal Assessment project in Texas bays
- Compare current data to 50-year trends from 1985 to 2015 in levels of mercury in game fish in Texas bays
- Continue to collect and compile data sources: Texas Commission on Environmental Quality, Regional Environmental Monitoring and Assessment (REMAP)

Photo Credit: Caren Brinkema

Acknowledgements

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References

Bowersox, M., Siwinski, P., Diamond, J., John, F., & Hunt, L. (2015). Development of Fish Tissue Screening Values for the Protection of Piscivorous Ecological Receptors. Tetra Tech Inc., 400 Red Brook Blvd, Suite 200, Owings Mills, MD 21117: USEPA Region 6, 1445 Ross Ave., Dallas TX 75202.

GHASP. (2004). Mercury in Galveston and Houston Fish. airalliancehouston.org/wp-content/uploads/GHASP_Mercury.pdf

Harris, R. C., Rudd, J. W., Amyot, M., Babiarz, C. L., Beaty, K. G., Blanchfield, P. J., . . . Graydon, J. A. (2007). Whole-ecosystem study shows rapid fish-mercury response to changes in mercury deposition. *Proceedings of the National Academy of Sciences, 104*(42), 16586-16591.

Harvey, J., Harwell, L., & Summers, J. K. (2008). Contaminant concentrations in whole-body fish and shellfish from US estuaries. Environmental monitoring and assessment, 137(1-3), 403-412.

Krabbenhoft, D. P. (2013). Global Change and Mercury. *Science, 341*(6153), 1457-1458 doi: 10.1126/science.1242838

Loftus, W. F. (2000). *Accumulation and fate of Mercury in an Everglades Aquatic Food Web. (Doctor of Philosophy), Florida International University, Miami. Florida.*

Marburger, J. H. I. W. G. o. M. (2004). Methylmercury in the Gulf of Mexico: State of Knowledge and Research Needs. Washington, D.C. 20502: Executive Office of the President National Science and Technology.

TDSHS. (2015). Characterization of Potential Adverse Health Effects Associated with Consuming Fish from Houston Ship Channel. Harris County, Texas: Texas Department of State Health Services, Division for Regulatory Services.

U.S. EPA January 2008. Integrated Risk Information System. Methylmercury (MeHg) (CASRN 22967-92-6) http://www.epa.gov/iris/subst/0073.htm [Accessed January 11 2016]

U.S. FDA 1979. Fish, Shellfish, Crustaceans and other Aquatic Animals - Fresh, Frozen or Processed - Methyl Mercury (CPG Sec 540.600) http://www.fda.gov/ICECI/ComplianceManuals/CompliancePolicyGuidanceManual/ucm074510.htm [Accessed January 12 2016]

Youngblood, K. A. (2010). *Fouling the Water: An Environmental History of Galveston Bay.* (Doctor of Philosophy), University of Houston, Houston.

Questions?