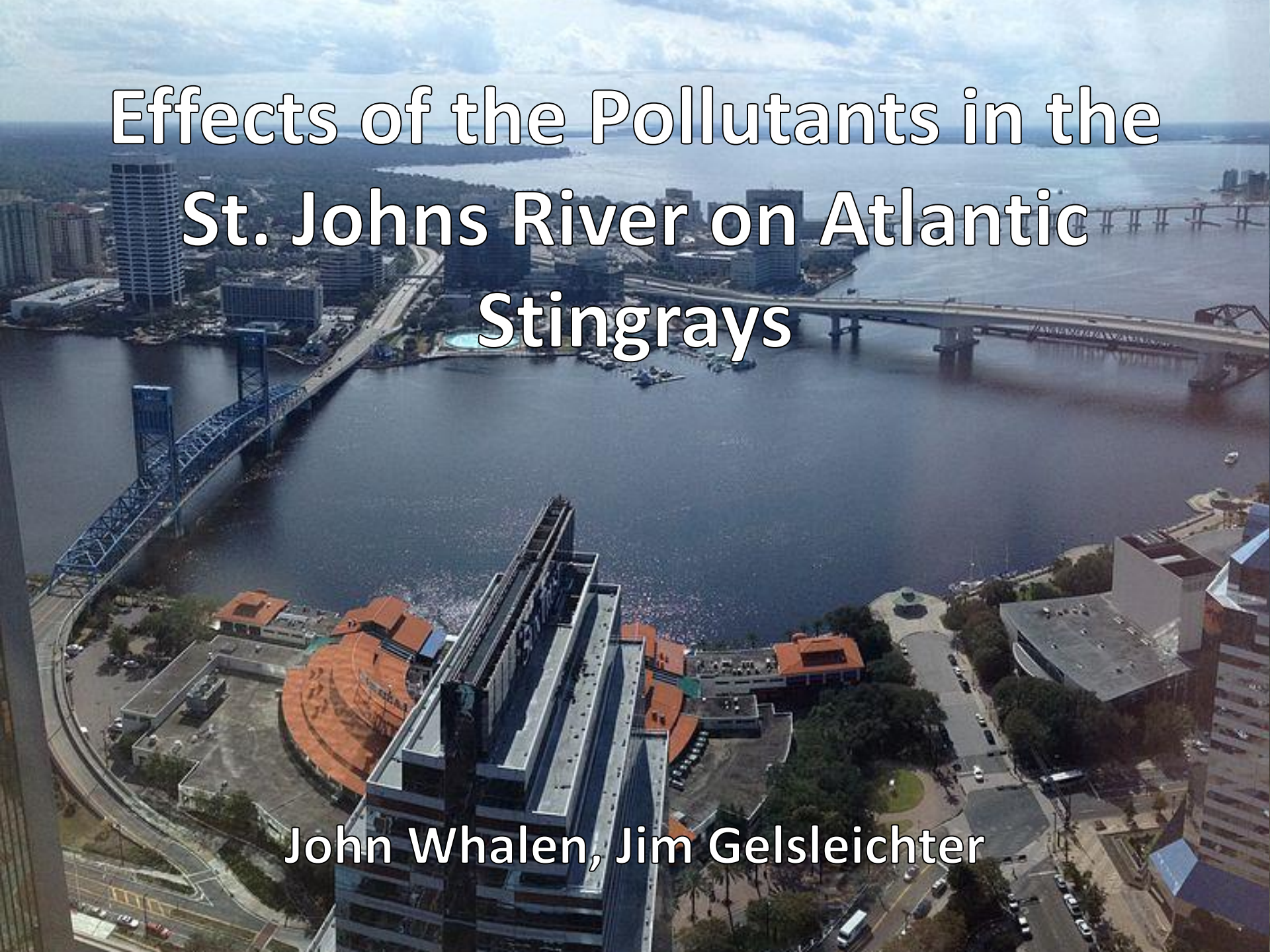
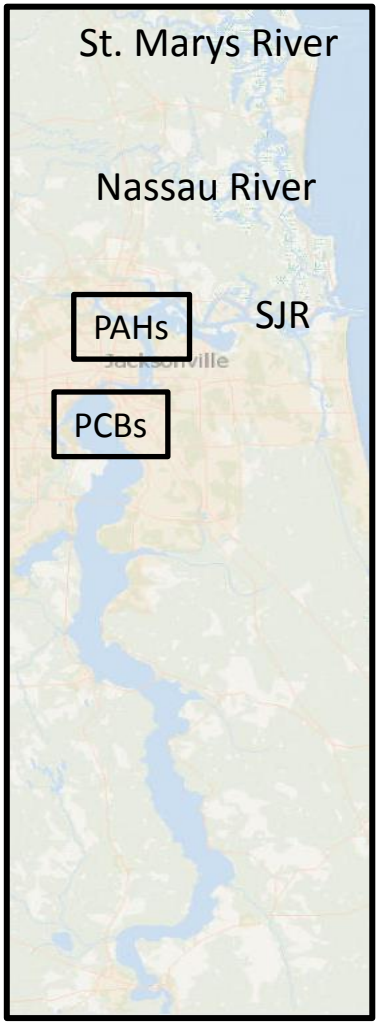


Effects of the Pollutants in the St. Johns River on Atlantic Stingrays

John Whalen, Jim Gelsleichter

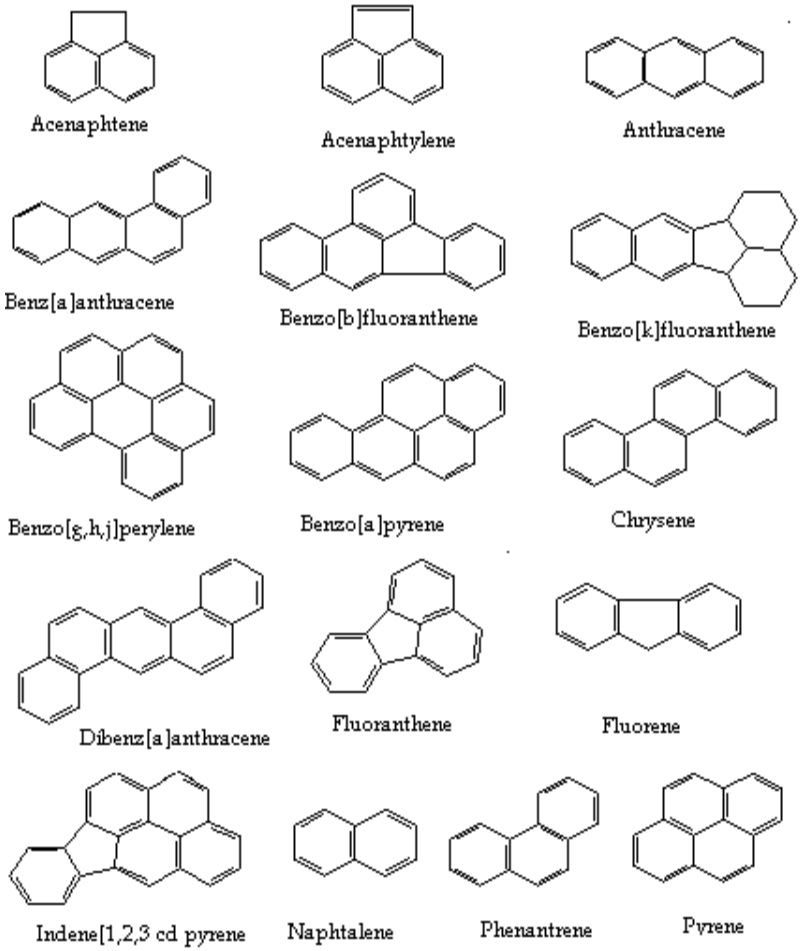
St. Johns River

- The St. Johns River (SJR) is an important resource for northeast Florida.
  - There is a history of industry along the river that has been a source of pollutants, specifically polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs).
- Past studies have detected levels of PAHs and PCBs in the sediment that exceed the sediment quality thresholds for biological effects [Cooksey; SJR].



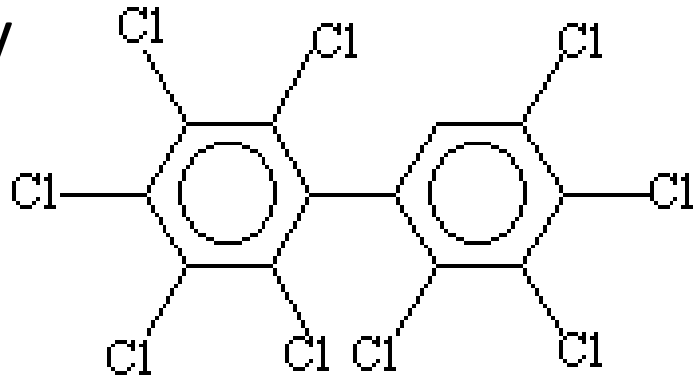
Polycyclic Aromatic Hydrocarbons (PAHs)

- Most toxic component of oil-related products
- In 1991 Pepper Industries' creosote tanks leaked near Talleyrand
- High contamination of low molecular weight PAHs in Rice creek (2002)
  - Naphthalene
  - Anthracene



Polychlorinated Biphenyls (PCBs)

- Synthetic chemicals used in industry until they were banned in the 1970's
- PCB spill in early 1980s during a fire at the American Electric Company
  - 800 ppb
- Rice Creek ~780 ppb
- Trout River ~325 ppb
- Probable effect level (PEL) 200 ppb



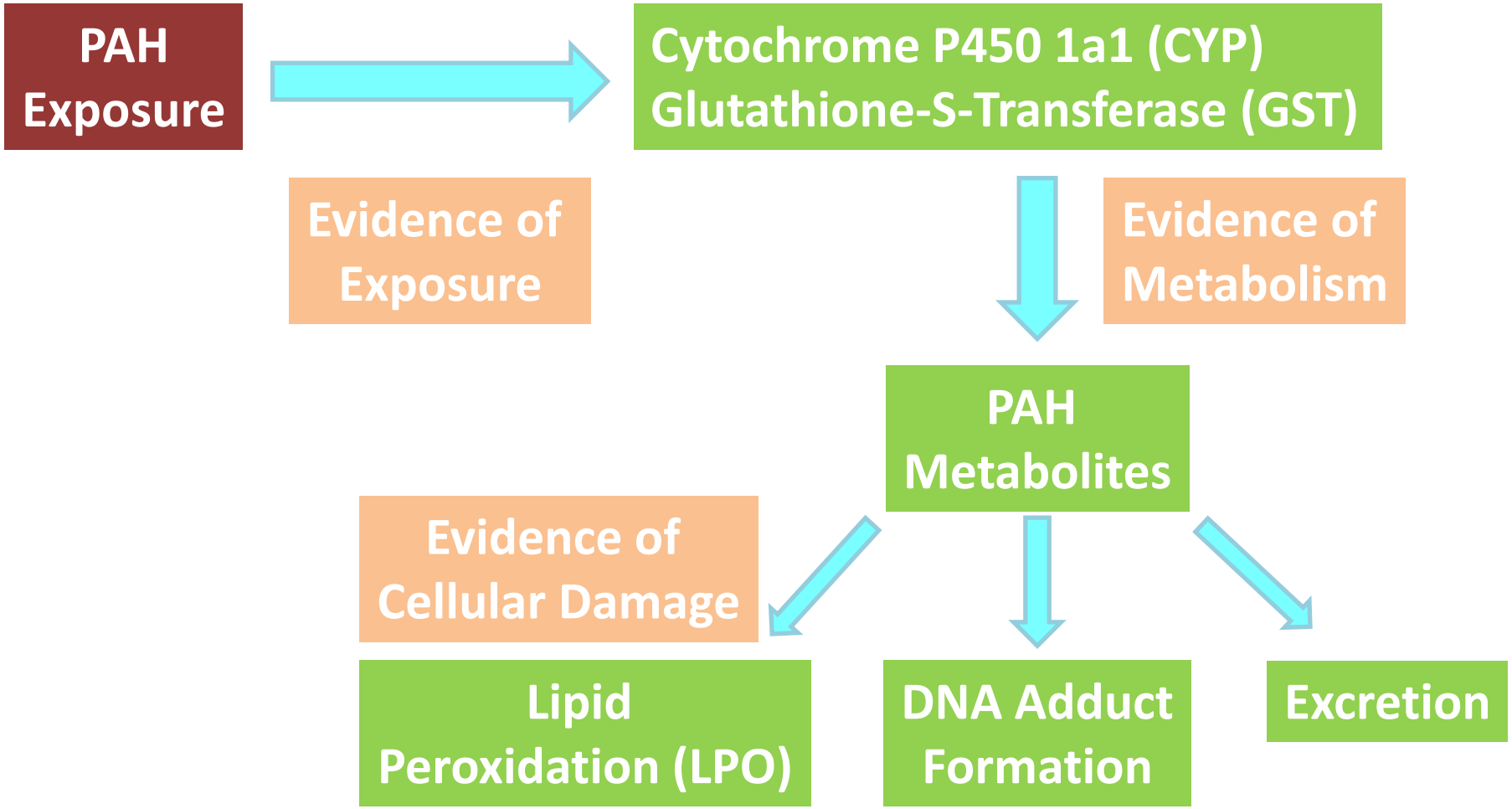
Exposure

- Exposure to both PAHs and PCBs is demonstrated to cause an array of negative health effects (Whitehead et al., 2012; Aas et al., 2000)
- PAHs
  - Toxicopathic lesions, including neoplasms (Meyers et al., 2008)
- PCBs
  - Can alter endocrine and immune function (Gelsleichter et al., 2006)
- Possible population level effects due to reduced growth, reproduction, and immune health

Biomarker

Toxicological biomarkers are quantifiable indicators of exposure to environmental contaminants, i.e. PAHs and PCBs.

Responses to Exposure



Study Organism

- Atlantic stingray (*Dasyatis sabina*)
- Indicator species
  - Interacts with sediments
  - Relatively high position on the food chain
  - Minimal movement patterns

Goal

The goal of this study was to evaluate the potential health effects of PCBs and PAHs on the Atlantic stingray in the St. Johns River.

To accomplish this goal, our objectives were to measure and compare PAH and PCB biomarker levels of Atlantic stingrays collected from known contaminated sites in the SJR and reference sites.

Research Questions

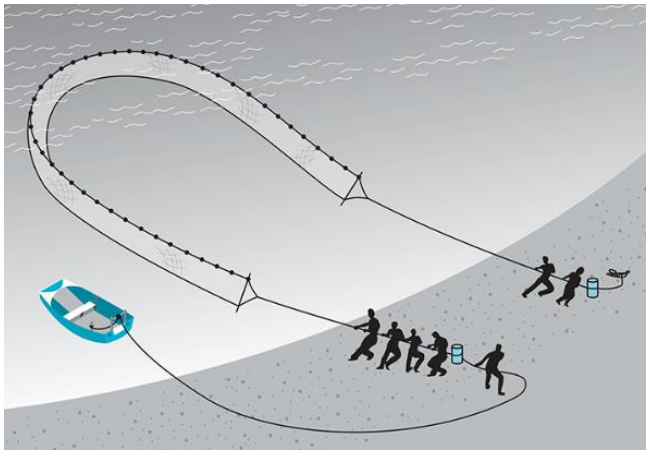
1. Are biomarker levels in the St. Johns River higher than those in the Nassau River and St. Marys River?
2. Are there high biomarker levels in close proximity to known contaminated sites?

Materials & Methods

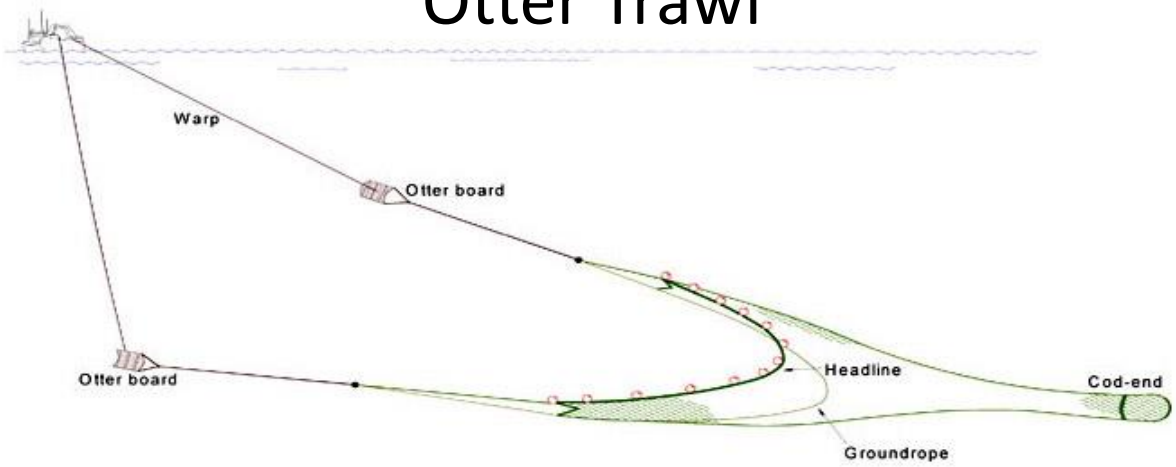
Data Collection

- Individuals collected began in December, 2014

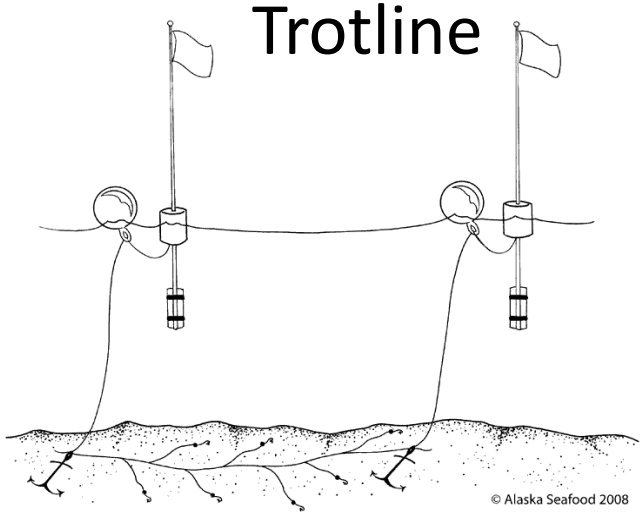
Seine Net



Otter Trawl

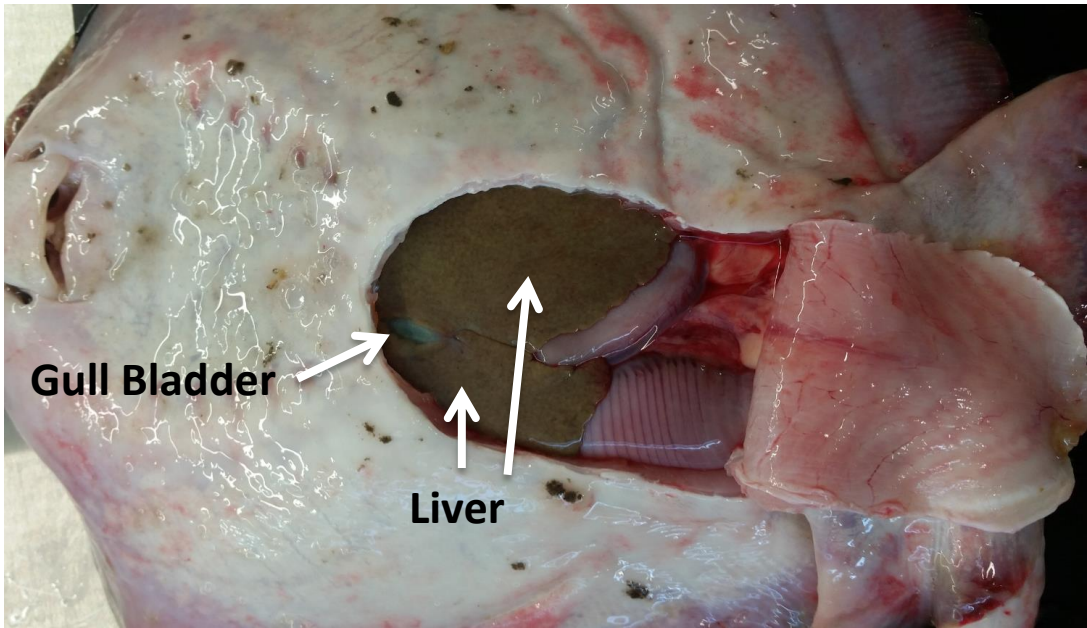


Trotline



Assays

- Stingrays were euthanized for liver and bile collection
- Liver
  - An ethoxyresorufin-o-deethylase (EROD) assay was used to measure CYP activity
  - A Gultatione-S-Transferase Assay Kit was used to measure GST activity
  - A Lipid Peroxidation Assay Kit was used to quantify LPO
- Bile
  - Analyzed for Fluoresence Aromatic Coumpounds (FACs)
    - Naphthalene
    - Pyrene
    - Benzo(a)Pyrene



Data Analysis

- Standard deviations were used to determine relative biomarker levels
  - Negligible (White): < 1 SD below the mean
  - Low (Green): between 1 SD below the mean and 1 SD above the mean
  - Moderate (Yellow): 1-2 SD above the mean
  - High (Red): > 2 above the mean
- Bartlett's Test and Student's t-test were used to determine if biomarker levels were significantly different between the SJR and the reference sites

Results

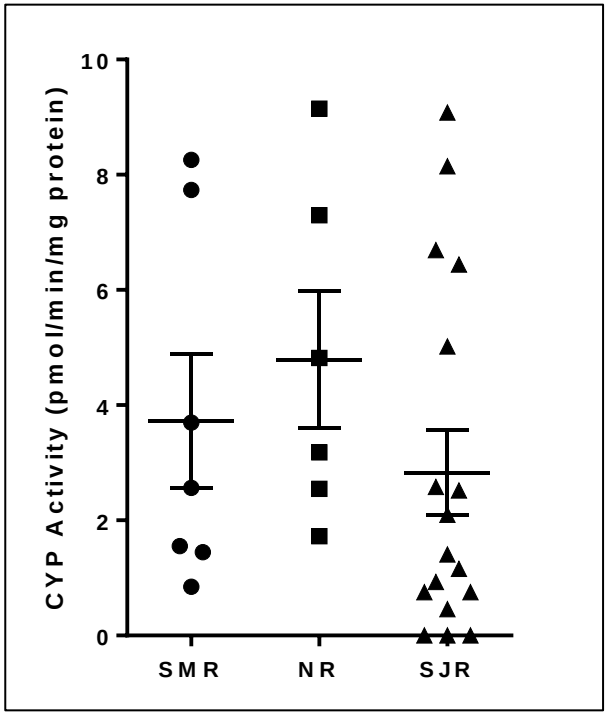
- Each biomarker had individuals with high levels except for CYP
- The PAH metabolite biomarkers did not have any negligible levels

Research Questions

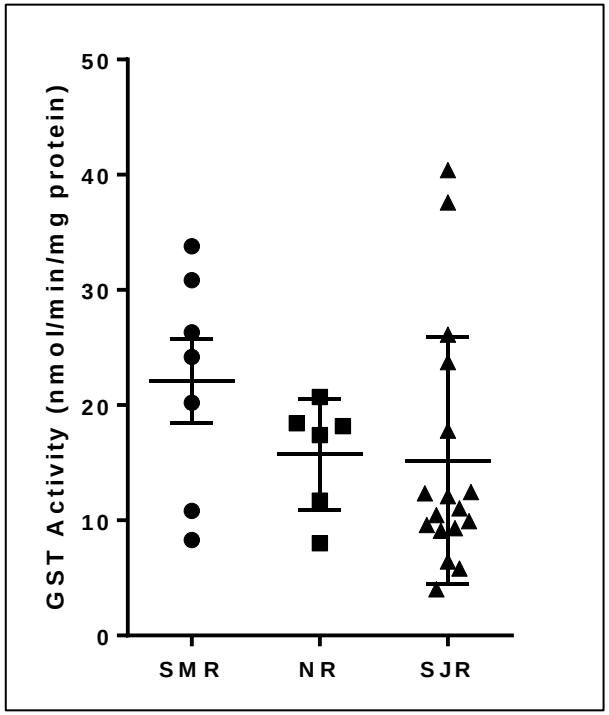
1. Are biomarker levels in the St. Johns River higher than those in the Nassau River and St. Marys River?
2. Are there high biomarker levels in close proximity to known contaminated sites?

Biometabolizing Enzymes

CYP

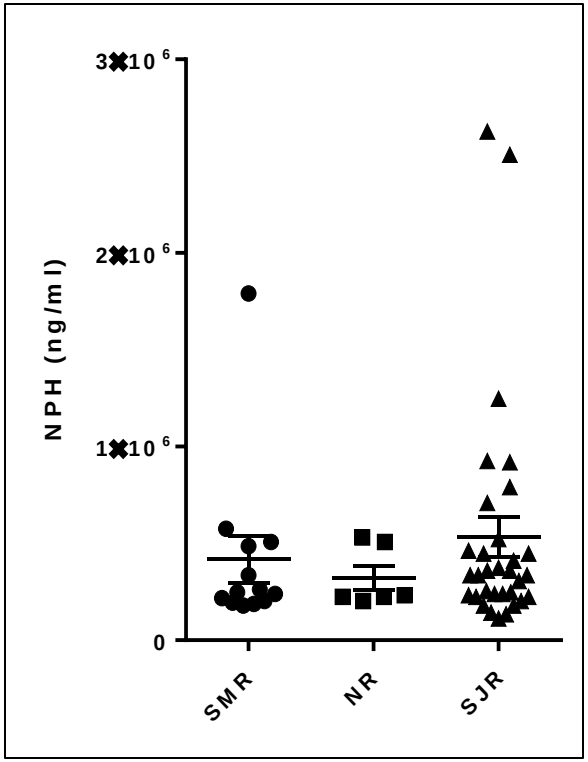


GST

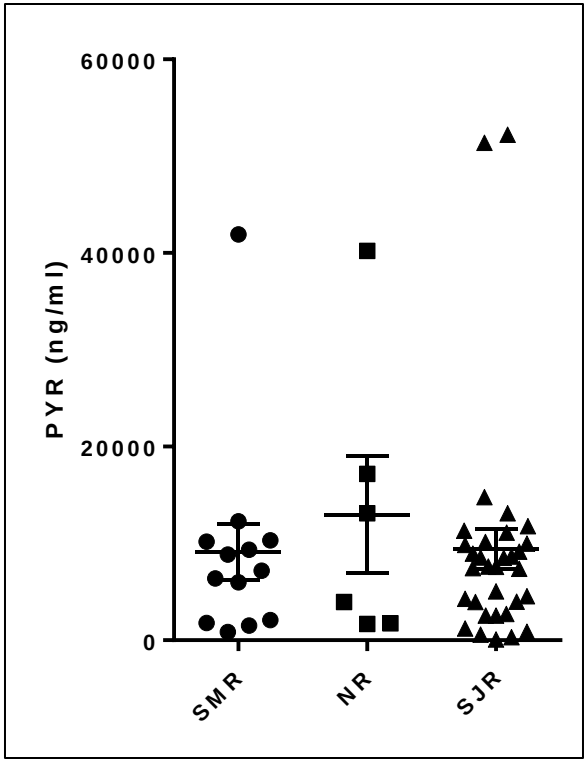


PAH Metabolites (Biliary FACs)

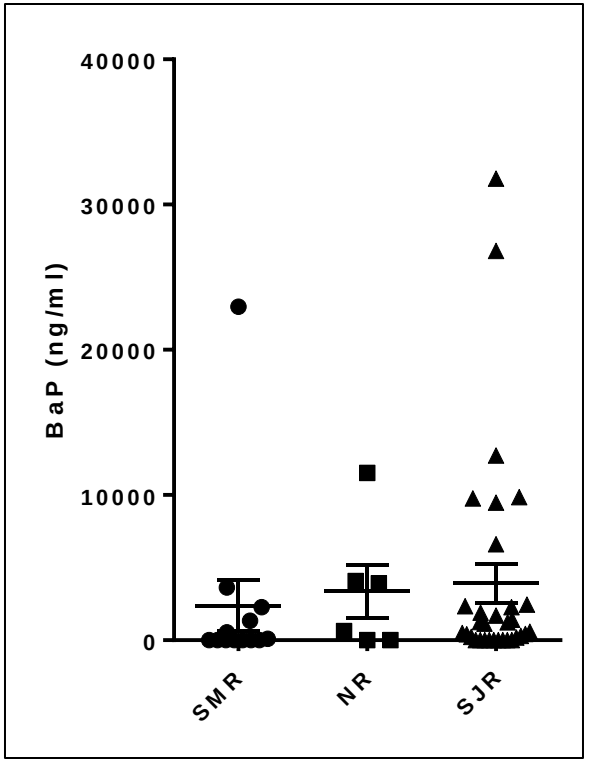
NPH



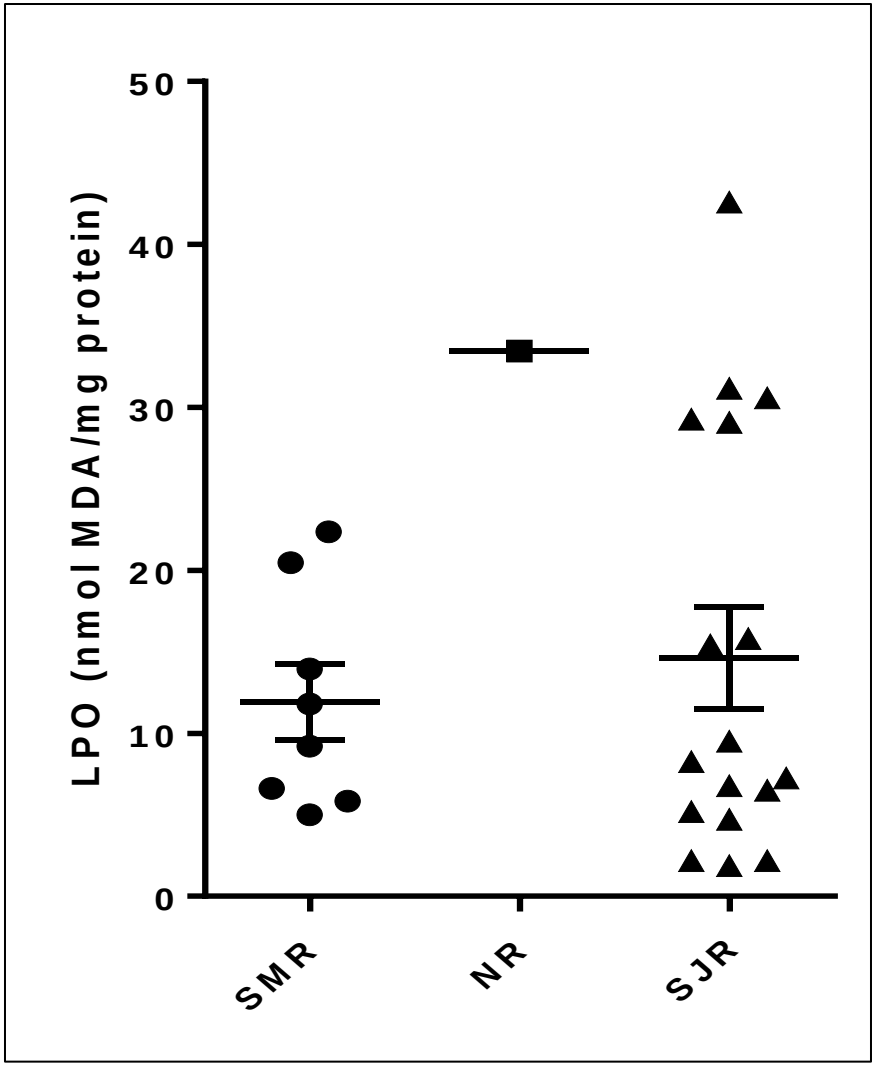
PYR



BaP



Lipid Peroxidation



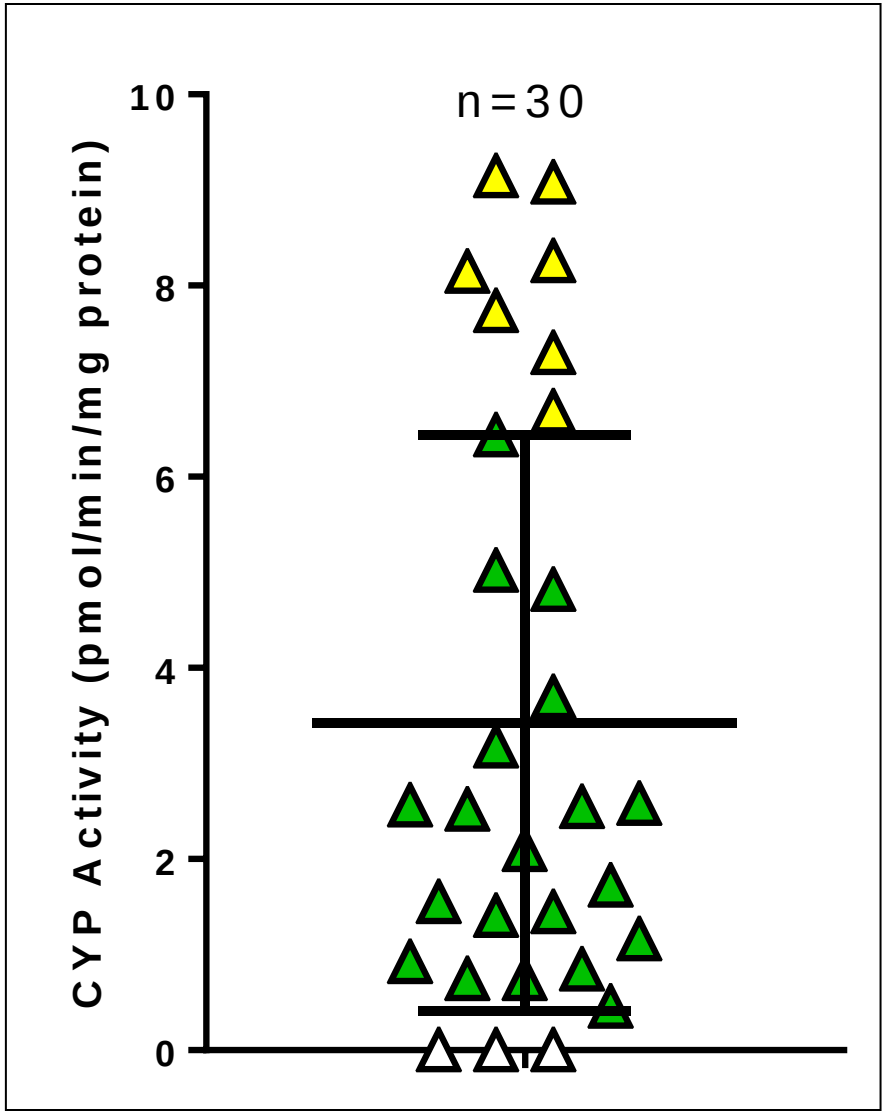
Research Questions

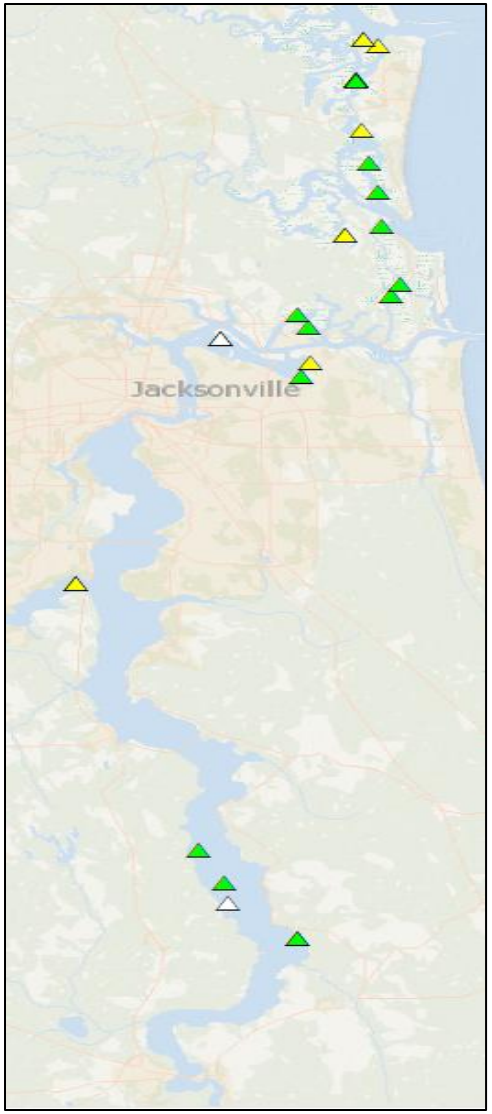
1. Are biomarker levels in the St. Johns River higher than those in the Nassau River and St. Marys River?
   - Not significantly higher
2. Are there high biomarker levels in close proximity to known contaminated sites?

Research Questions

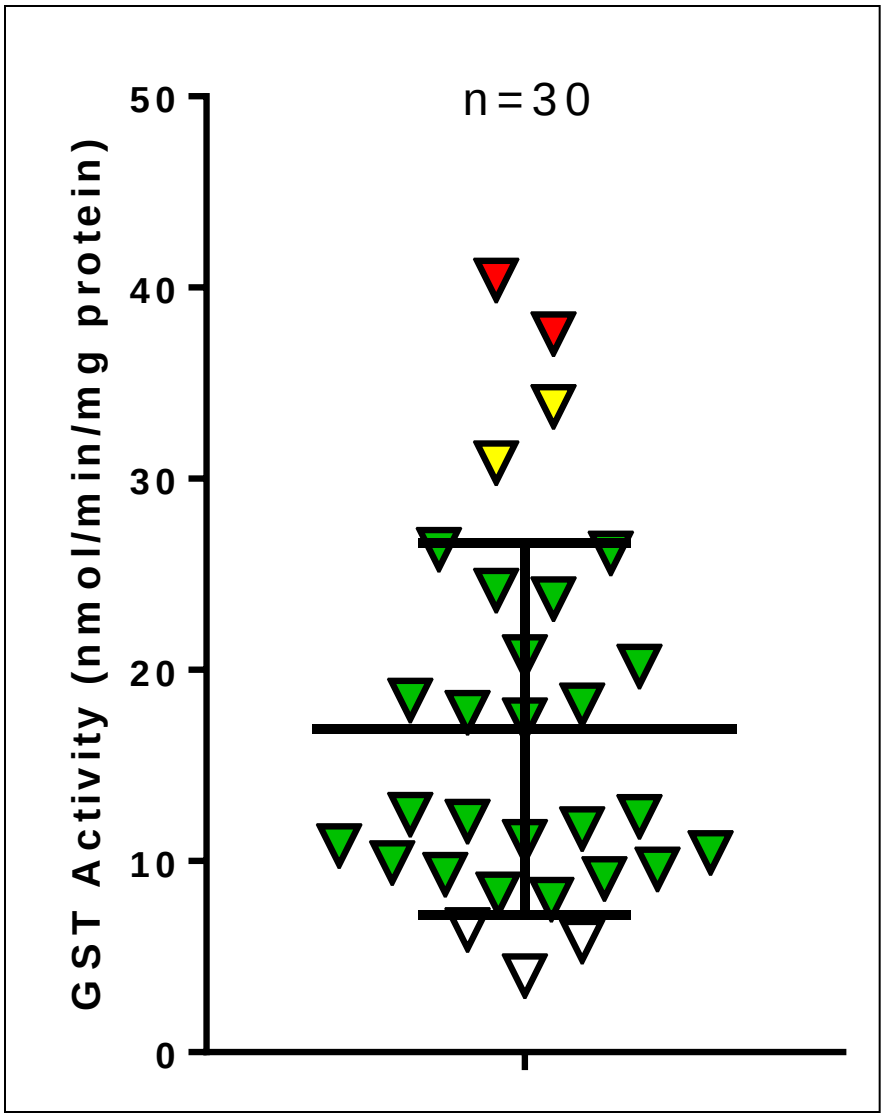
1. Are biomarker levels in the St. Johns River higher than those in the Nassau River and St. Marys River?
   - Not significantly higher
2. Are there high biomarker levels in close proximity to known contaminated sites?

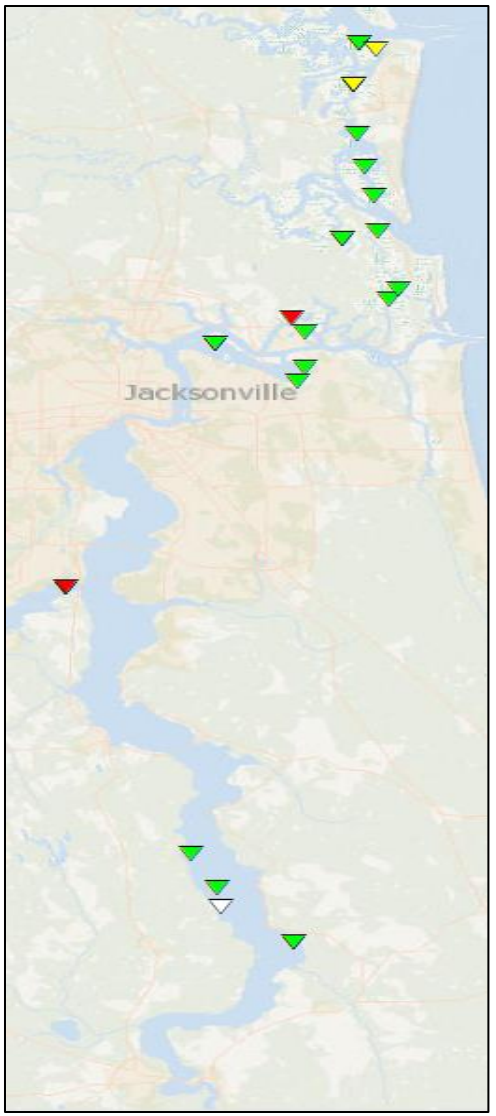
CYP



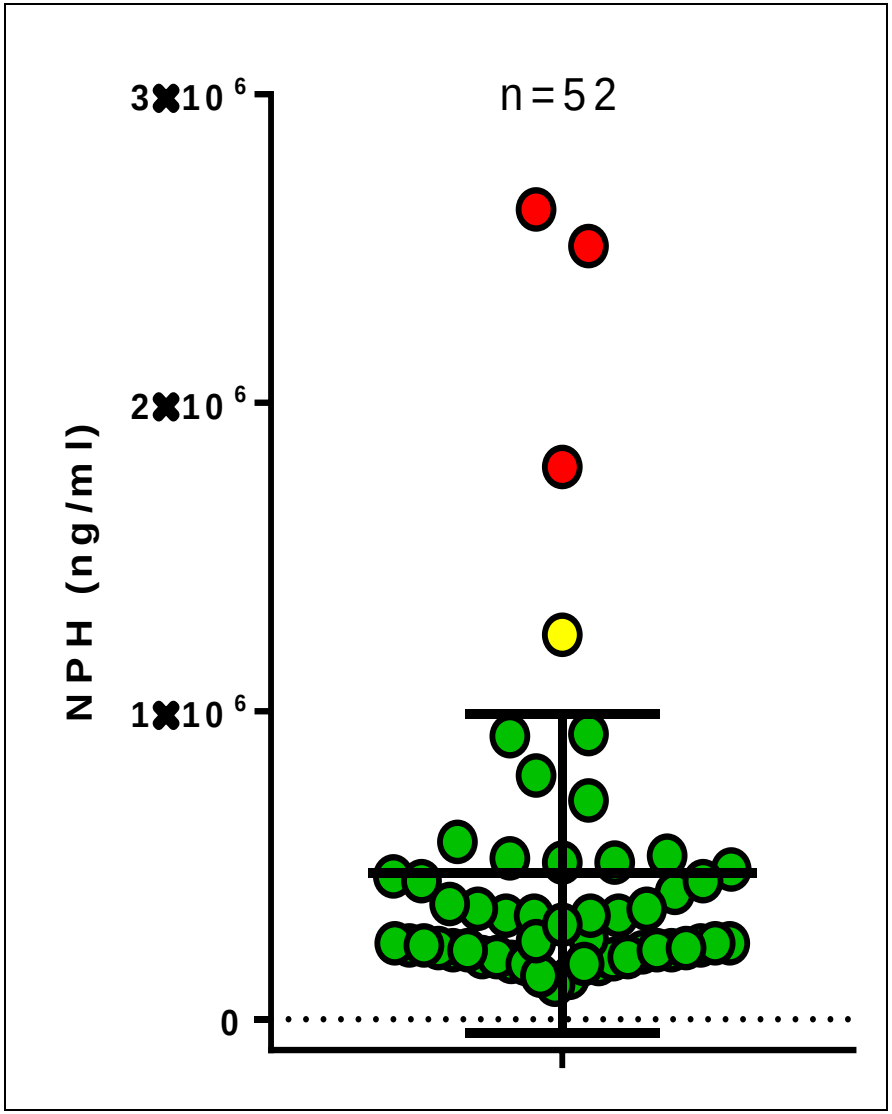


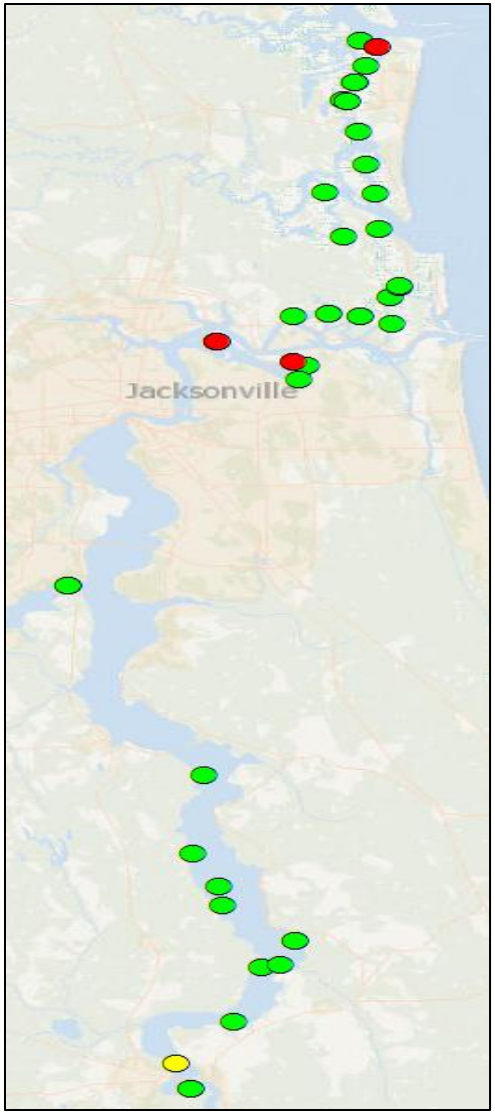
GST


n=30
GST Activity (nmol/min/mg protein)
50
40
30
20
10
0

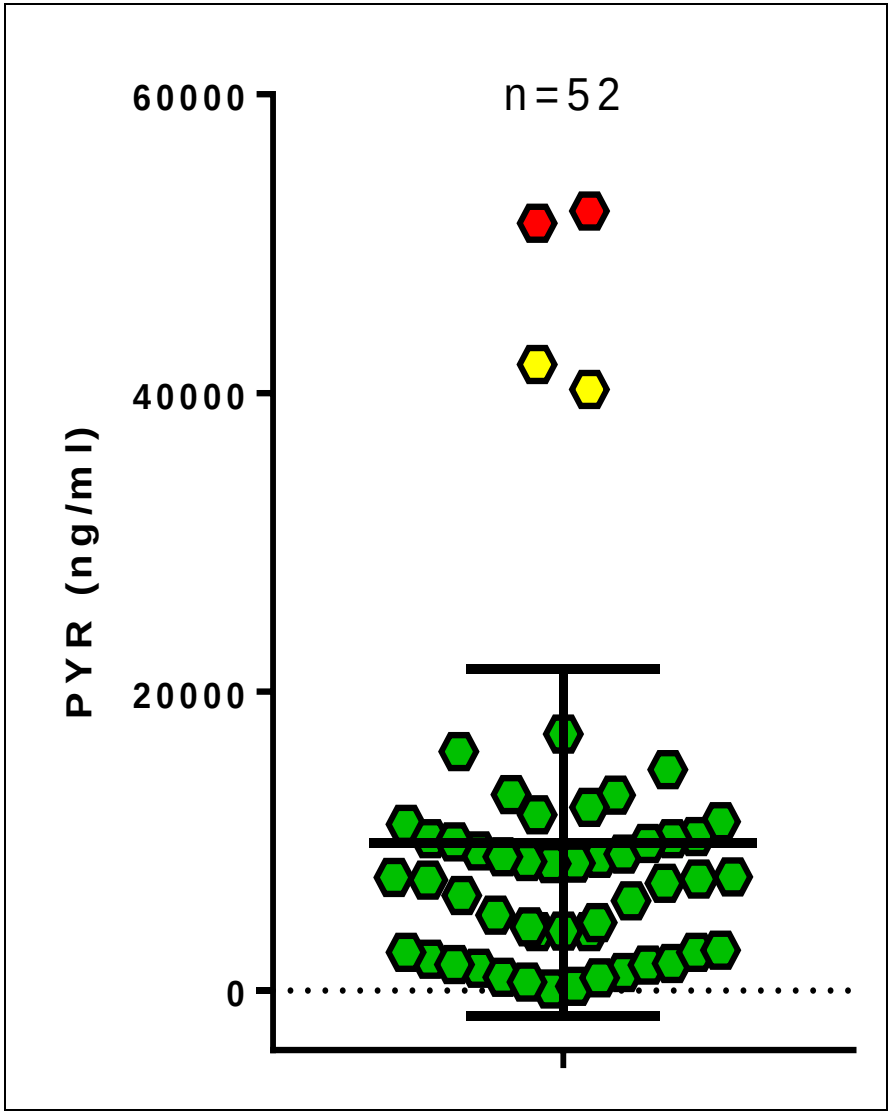

Jacksonville

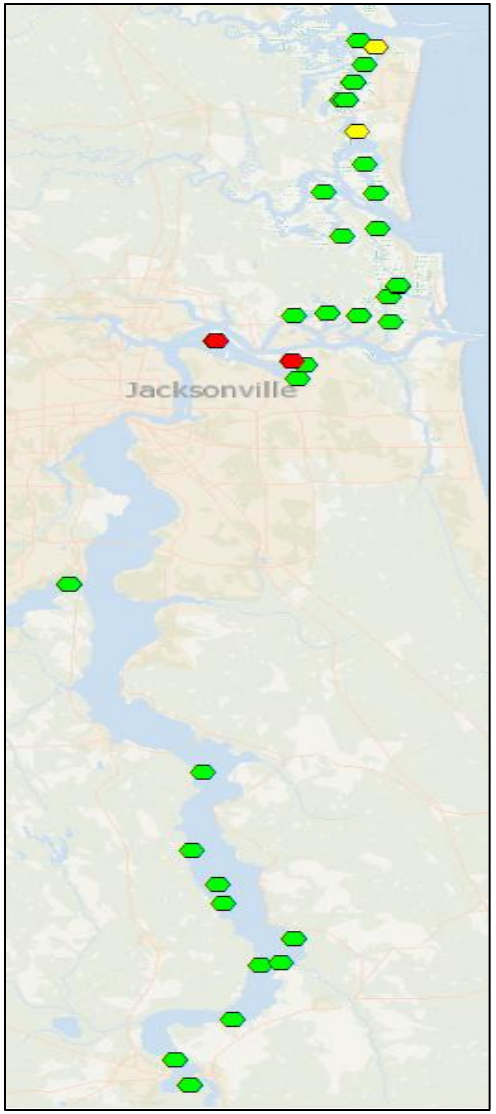
NPH



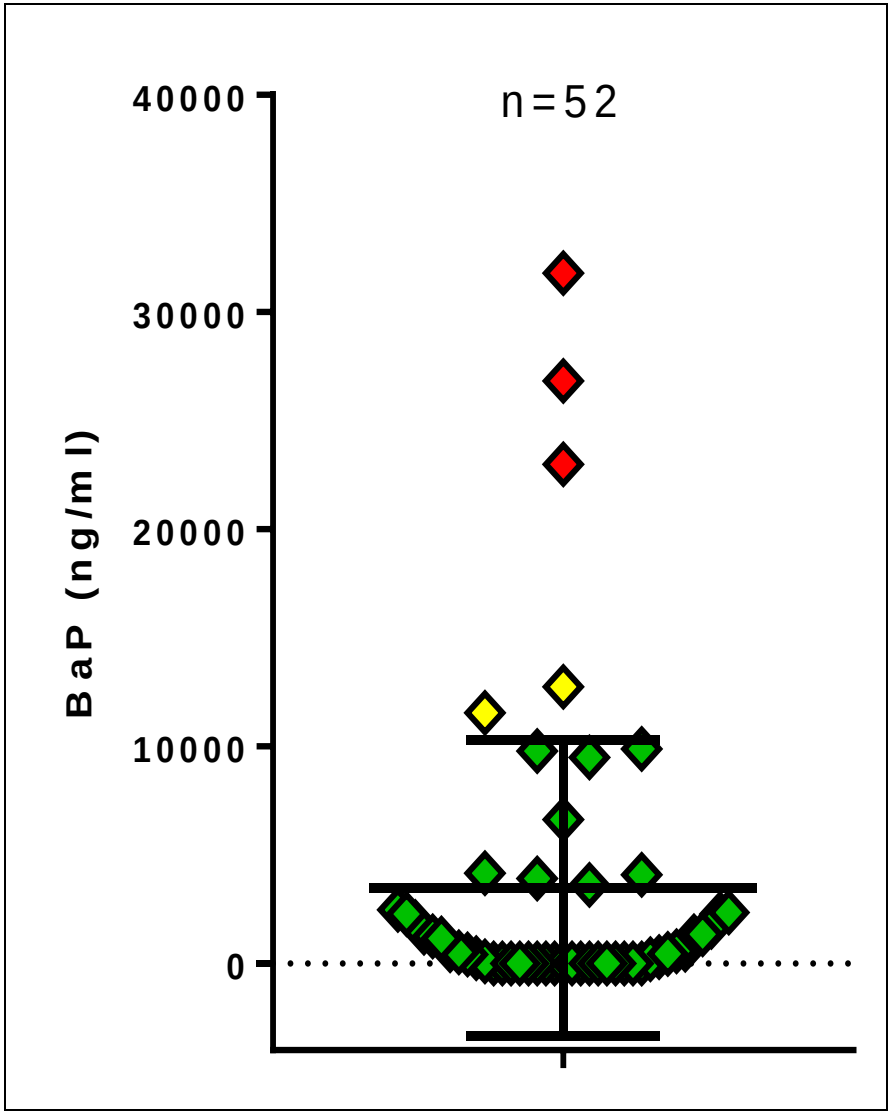


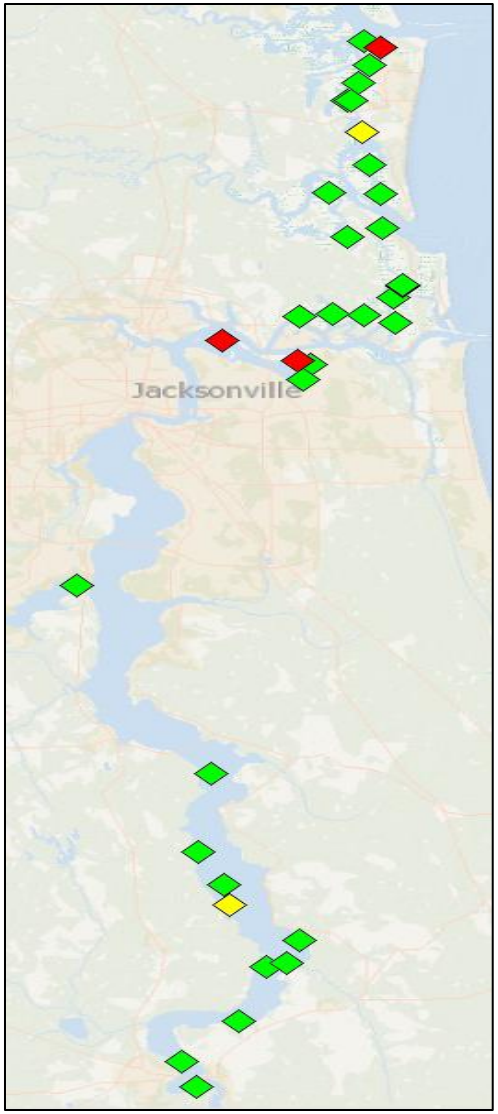
PYR



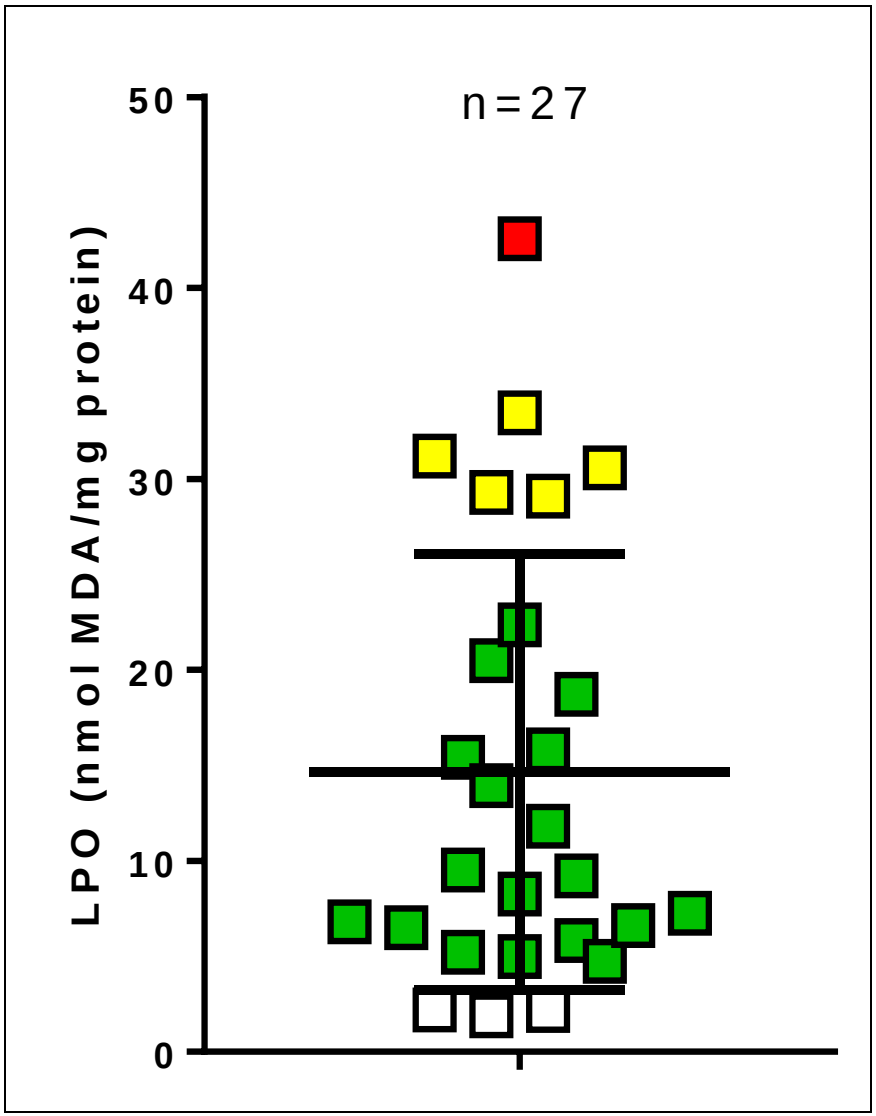


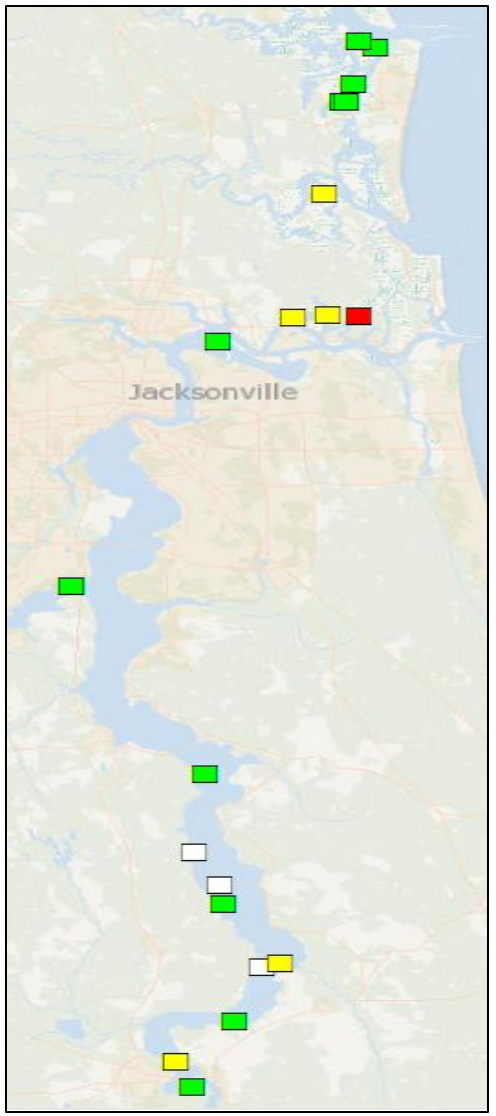
BaP





LPO





Research Questions

1. Are biomarker levels in the St. Johns River higher than those in the Nassau River and St. Marys River?
   - Not significantly higher
2. Are there high biomarker levels in close proximity to known contaminated sites?
   - Need more data

Conclusions

- Preliminary data indicates that pollutant biomarker levels in SJR stingrays were not significantly higher than individuals from reference locations
- However, the appearance of high levels of biomarkers in individuals caught in close proximity to known contaminated areas suggests continuous exposure

Significance

- First study to examine pollutant mediated effects of exposure in populations of Atlantic stingrays residing in the SJR using multiple biomarkers
- Relative biomarker levels are indicators of ecosystem health
- Further dredging of the SJR can resuspend and redistribute pollutants
  - Important to gather baseline pre-dredge biomarker levels to determine the effects of dredging on stingrays and the health of the SJR

Future Directions

- Greater sample size
  - Specifically in the known contaminated sites
- Expand study beyond Northeast Florida
  - Construction phase of the Savannah Harbor Expansion Project began in January, 2015
  - Possible model of environmental impact on dredging in the SJR

Acknowledgements

We would like to thank the UNF Coastal Biology Program for partially funding this research, my lab mates, and everyone at the Florida Fish and Wildlife Conservation Commission for collecting stingrays.

Russel Brodie
Hannah Hart
Samantha Ehnert
Justin
Ryan Ford
Chris Solomon
Matt
Julia
Amy
Carrissa