Florida's Marine Fisheries-Independent Monitoring (FIM) Program
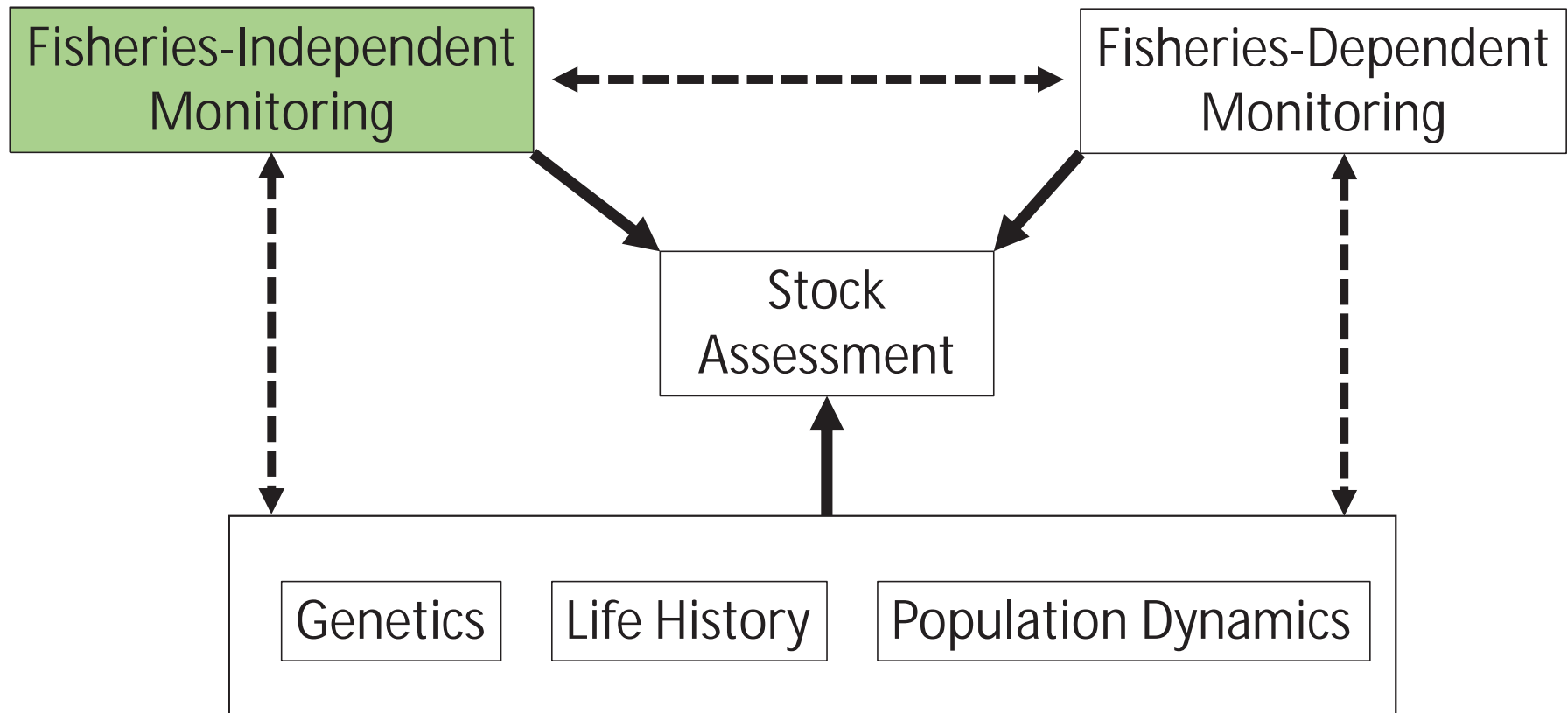
Florida Forage Fish Research Program

Data Workshop

May 24, 2023
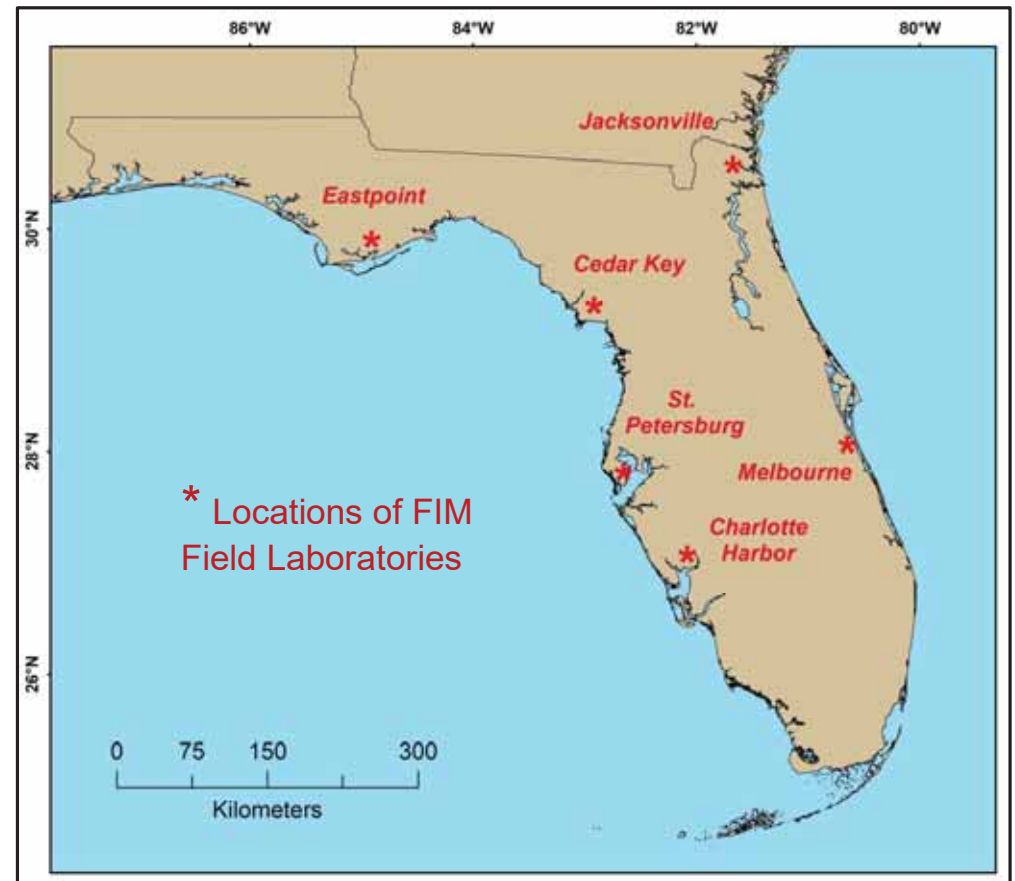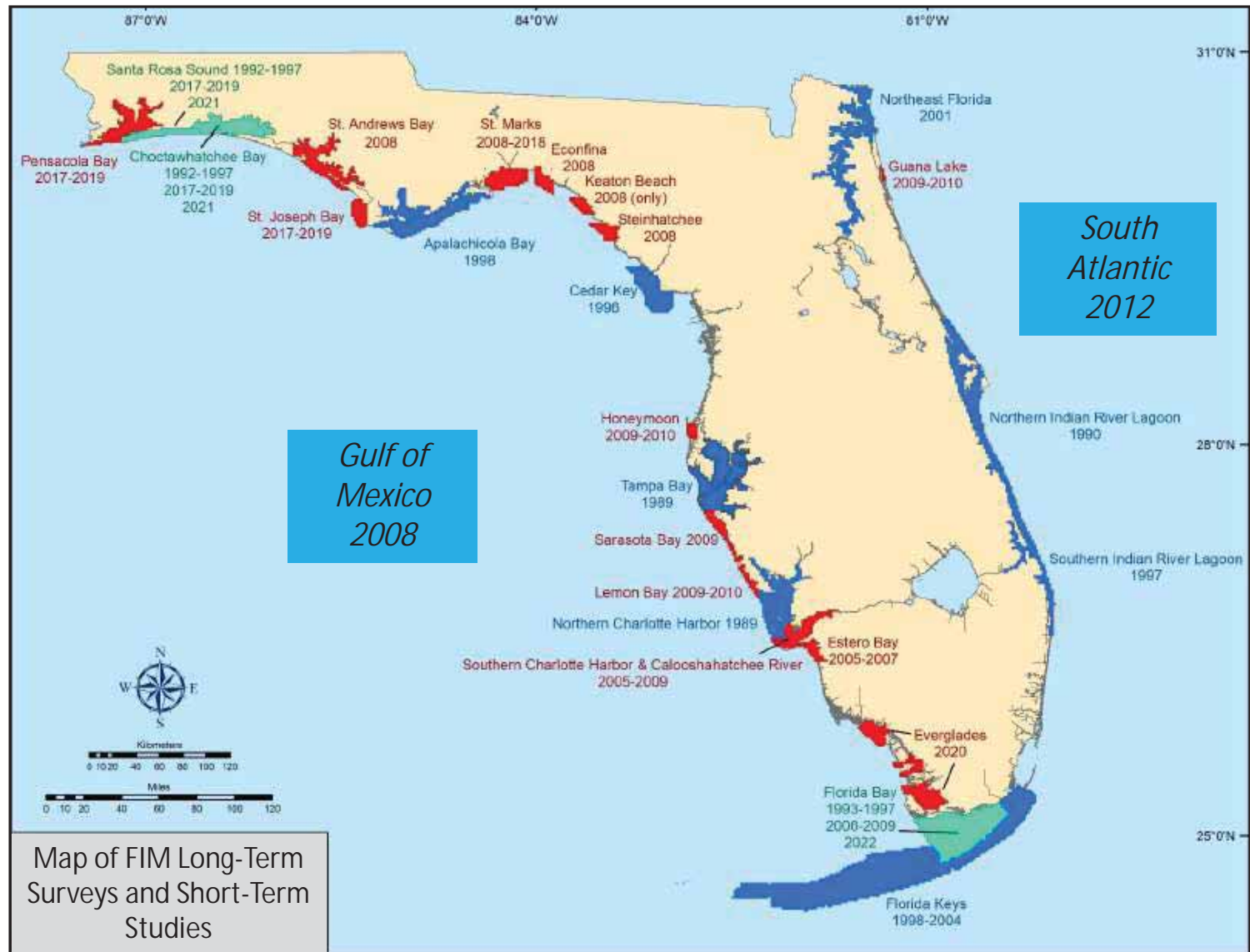
Marine Fisheries Research at FWC-FWRI

What is the FIM Program?

- Statewide program within the **Fish and Wildlife Research Institute**

- Provide fisheries-independent *data* and *analysis* to fishery managers

- Information critical to assessment and management – both state and federal

* Locations of FIM Field Laboratories

Where We Sample

Map of FIM Long-Term Surveys and Short-Term Studies

Objectives of Florida's FIM Program

- The FIM program has been designed to:
    - Support single-species assessment and management
    - Support multi-species, ecosystem-based modeling and management
    - Address emerging issues
- Ideally, data are fully representative of population / stock being assessed or managed
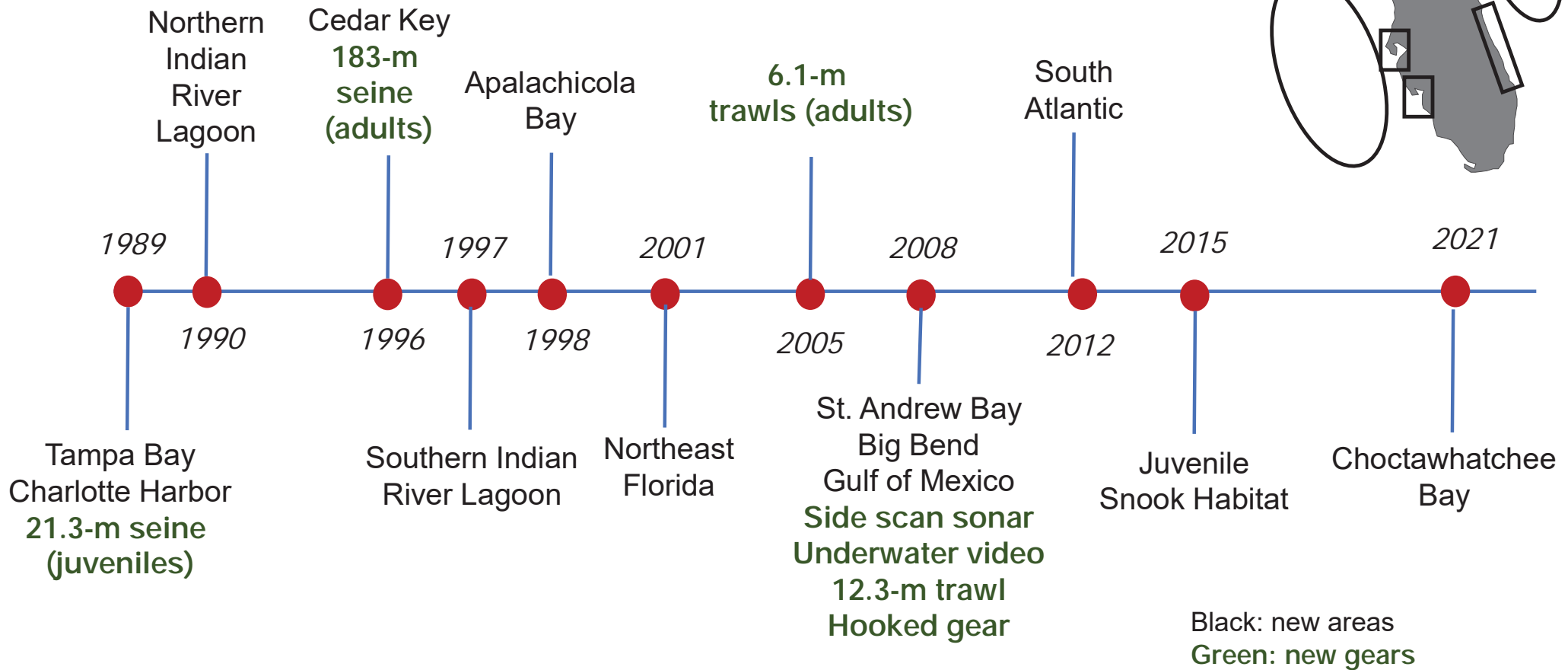- This requires a multi-species, multi-gear, multi-habitat approach
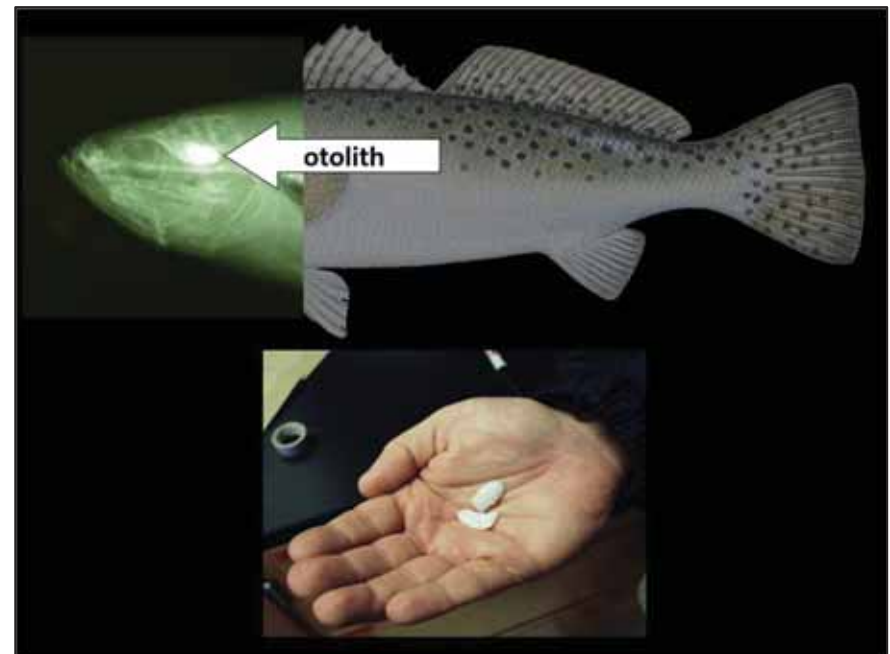
Standard Florida FIM Sampling Gear

Inshore   Offshore

Timeline – Core FIM

Key Attributes of FIM Surveys / Data

- Highly-standardized

- Statistical sampling design

- Long-term consistency

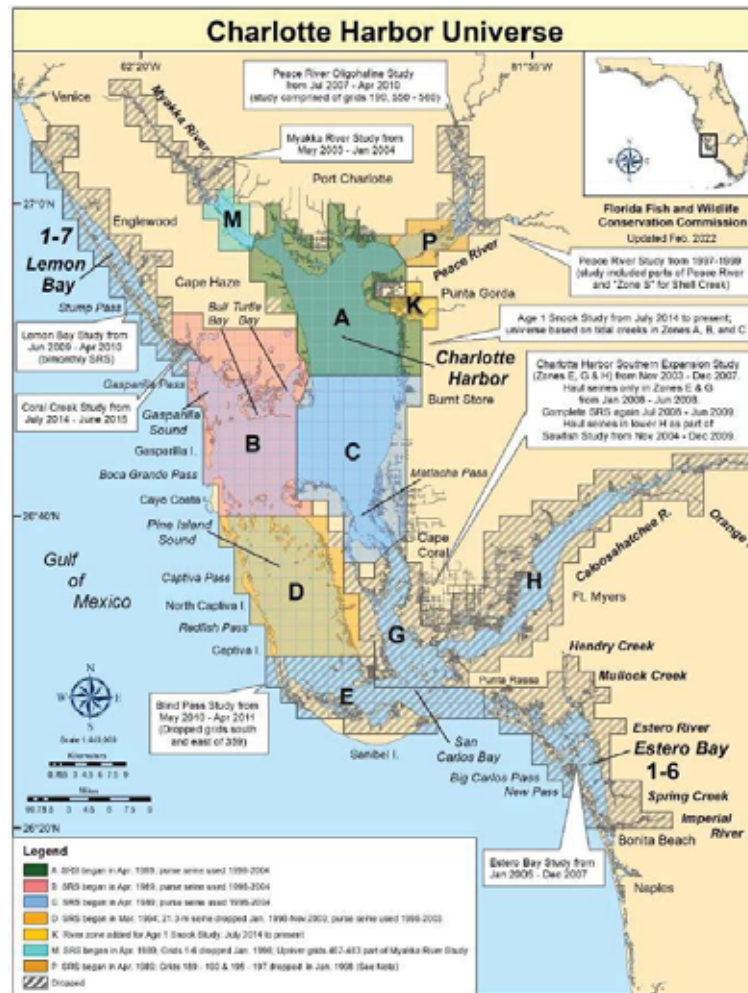- Broad temporal and spatial coverage

Survey Standardization

- Ensures identical methods used:
  - Multiple labs / research teams
  - From year to year

- Requires:
  - Gear specifications
  - Detailed procedures
  - Extensive training
  - Periodic evaluation – annual meetings, staff exchanges etc.
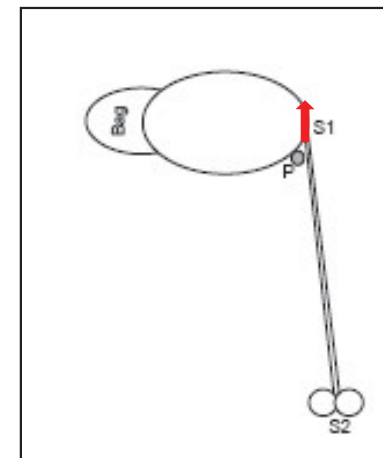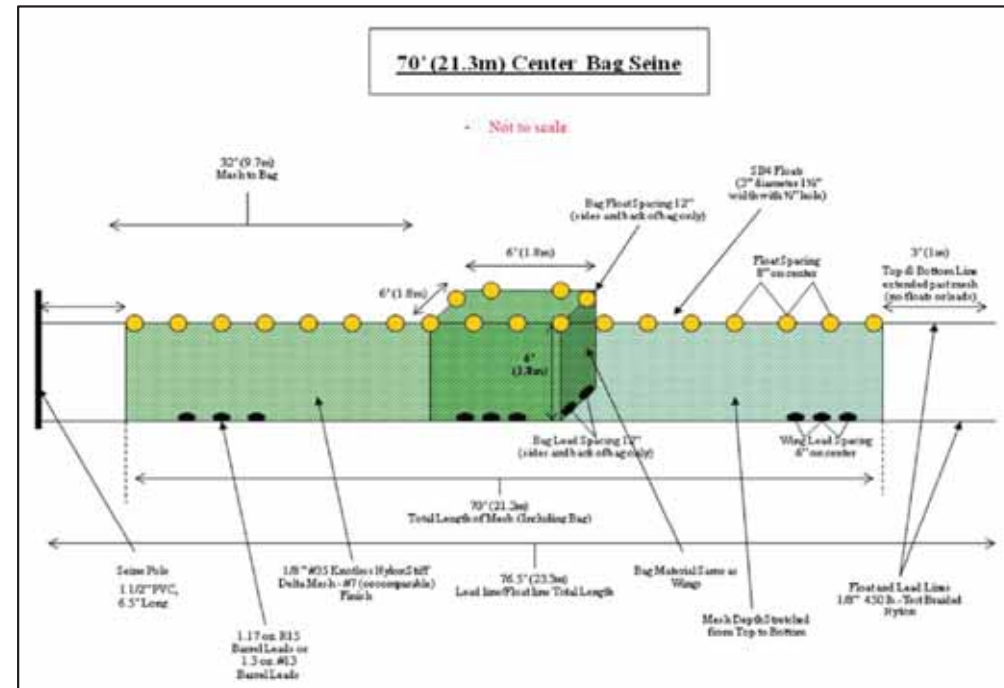
Statistical Sampling Design

- Usually stratified random

- Divides heterogenous environment into homogenous strata

- Stratification via space, sometimes habitat

- Ensures spatial distribution of effort
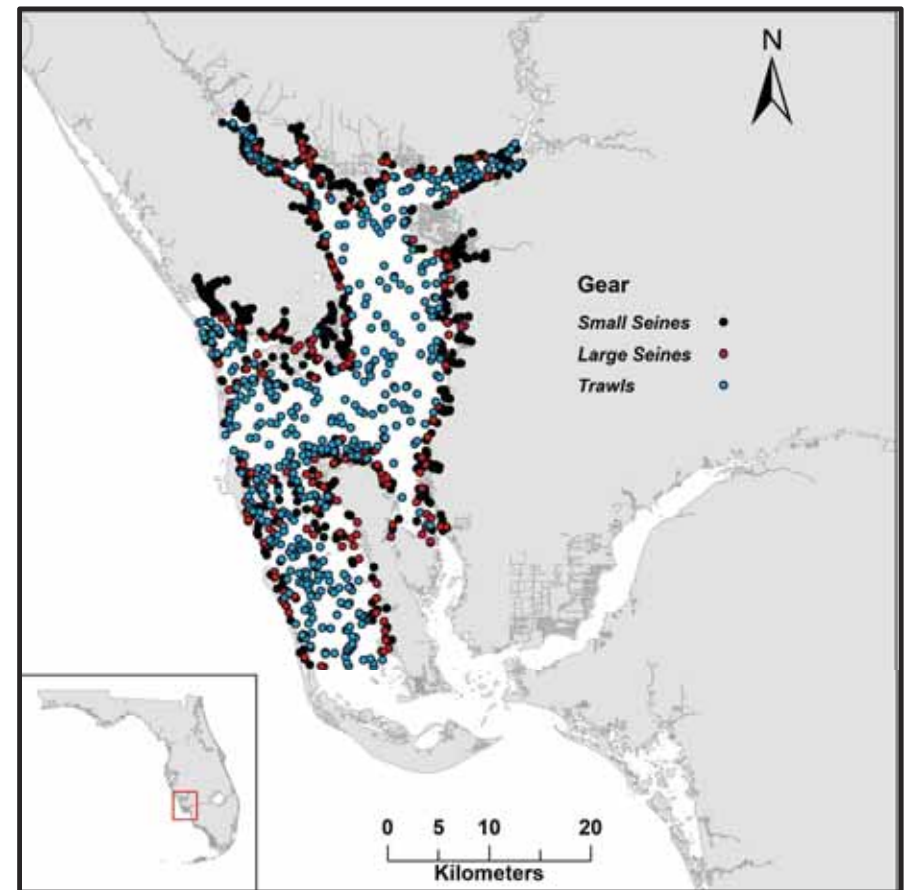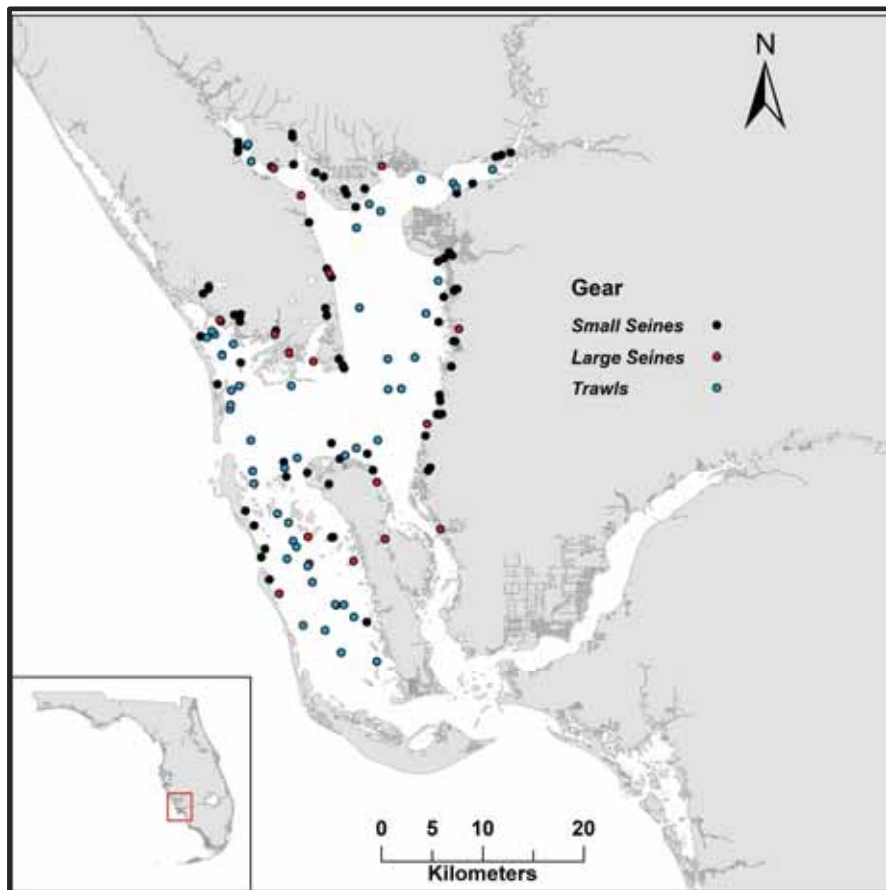

With or without SAV

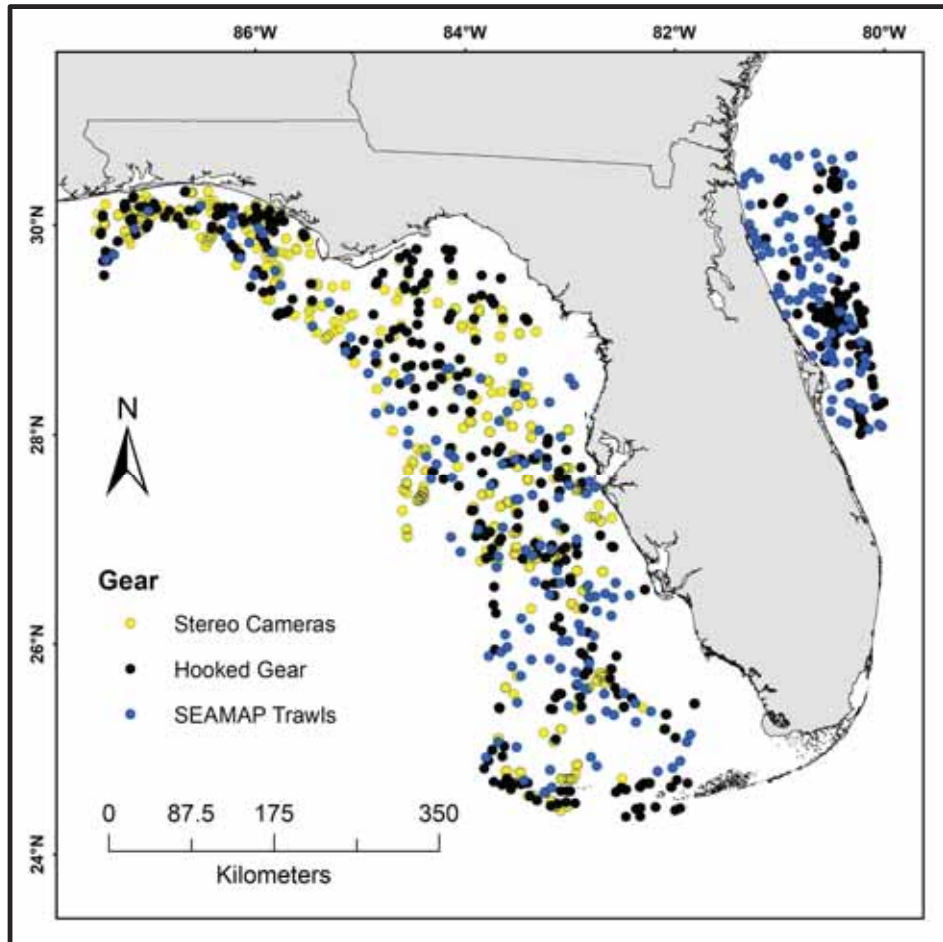With or without overhanging vegetation

Natural or artificial reefs

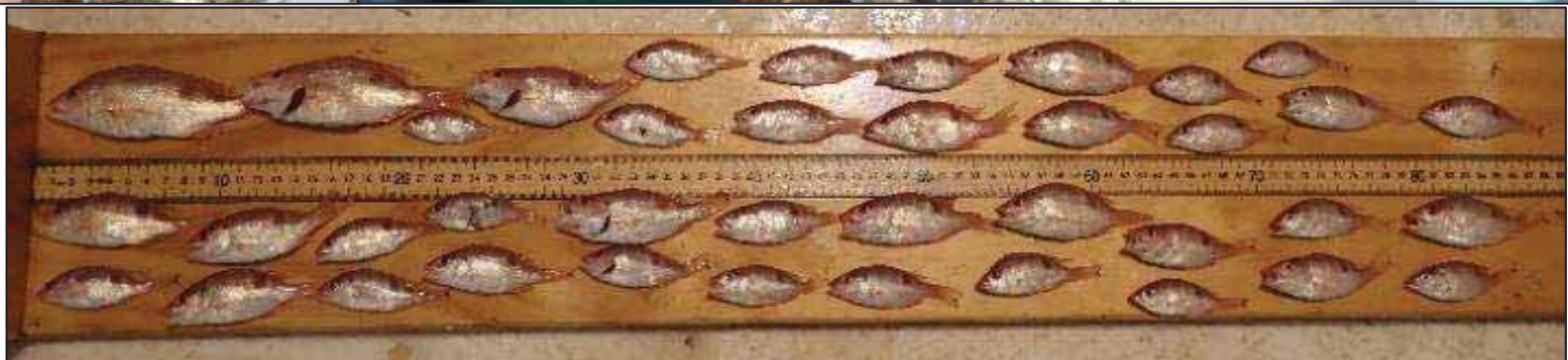# Broad Temporal and Spatial Coverage – Inshore

Broad Temporal and Spatial Coverage – Offshore
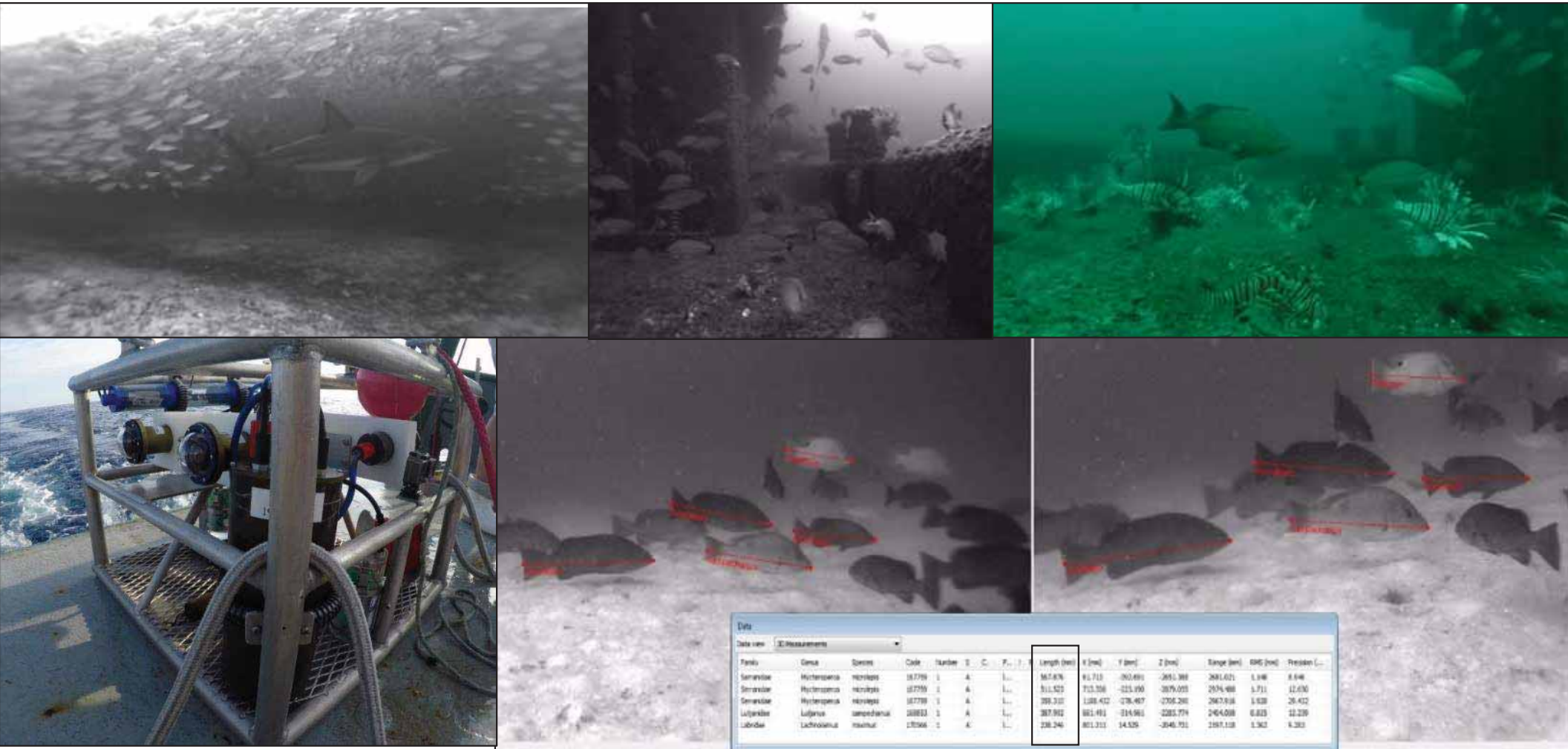
Data Collected – Abundance and Size Composition

- Not just managed species

Data Collected – Abundance and Size Composition
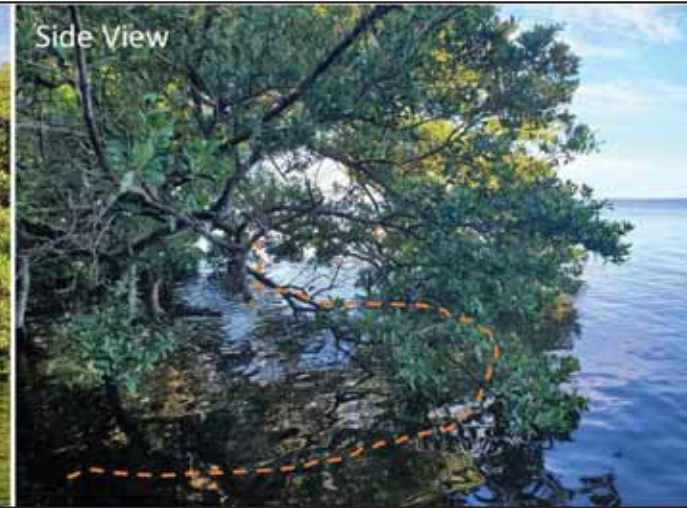
Data Collected – Water Quality

- Temperature
- Salinity
- Dissolved Oxygen
- pH
- Integrated + profiles

Data Collected – Microhabitat

- Substrate cover / composition
- Biota cover / composition
- Inundation / vegetative cover
- Substrate relief

Data Collected – Landscape Scale Habitat Assessment

- Randomized, 'small-scale' habitat mapping of natural and artificial reefs with side scan sonar

- Necessary to direct reef fish sampling effort

- Approximately 8,000 km^2 mapped – largest mapping effort in Gulf
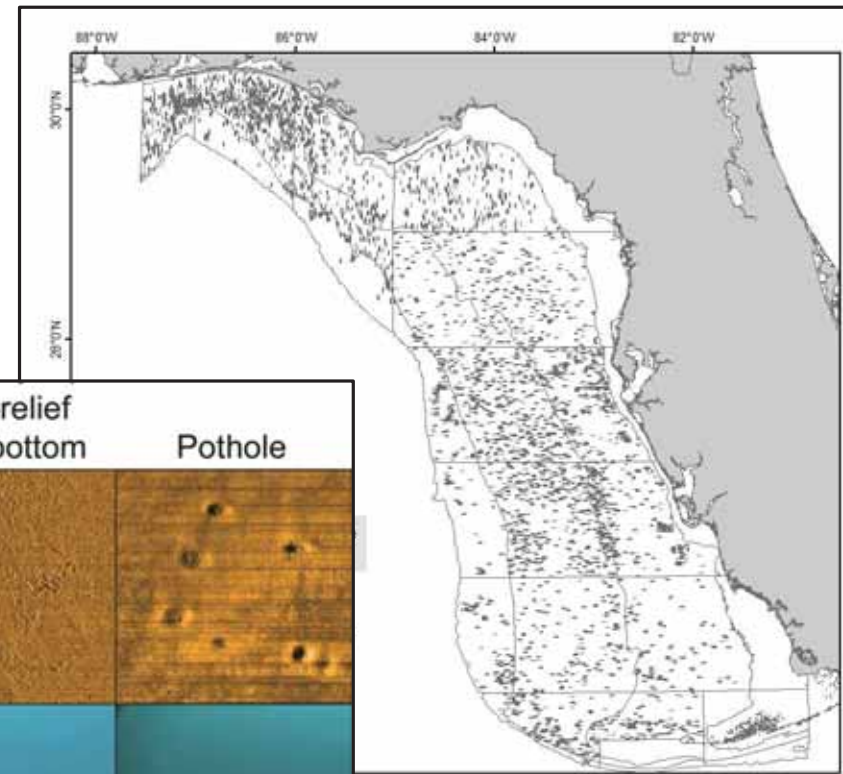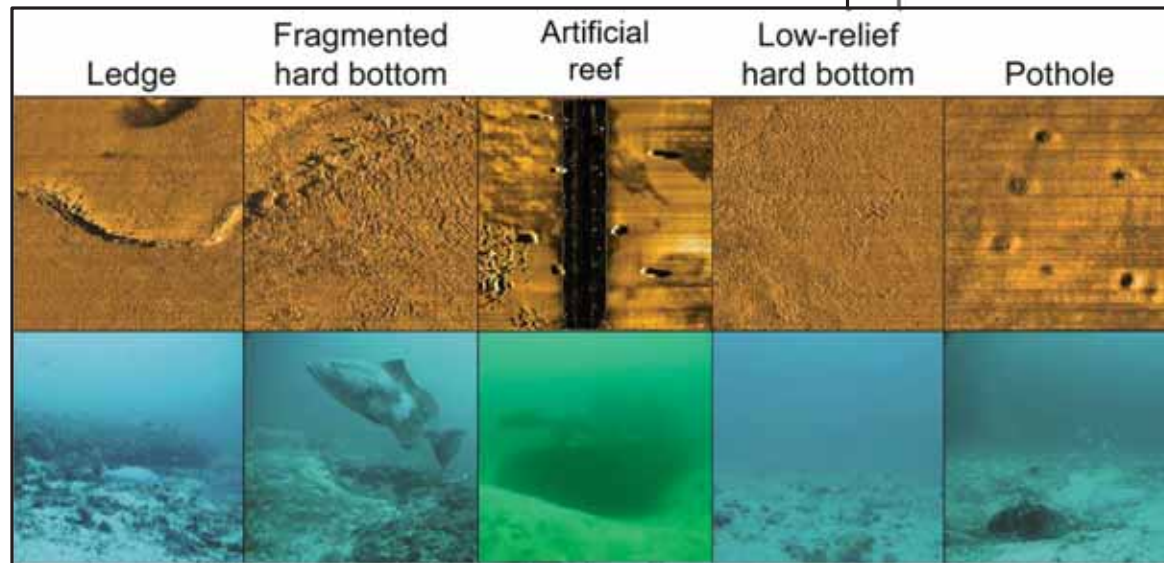
Data Collected – Standard Life History
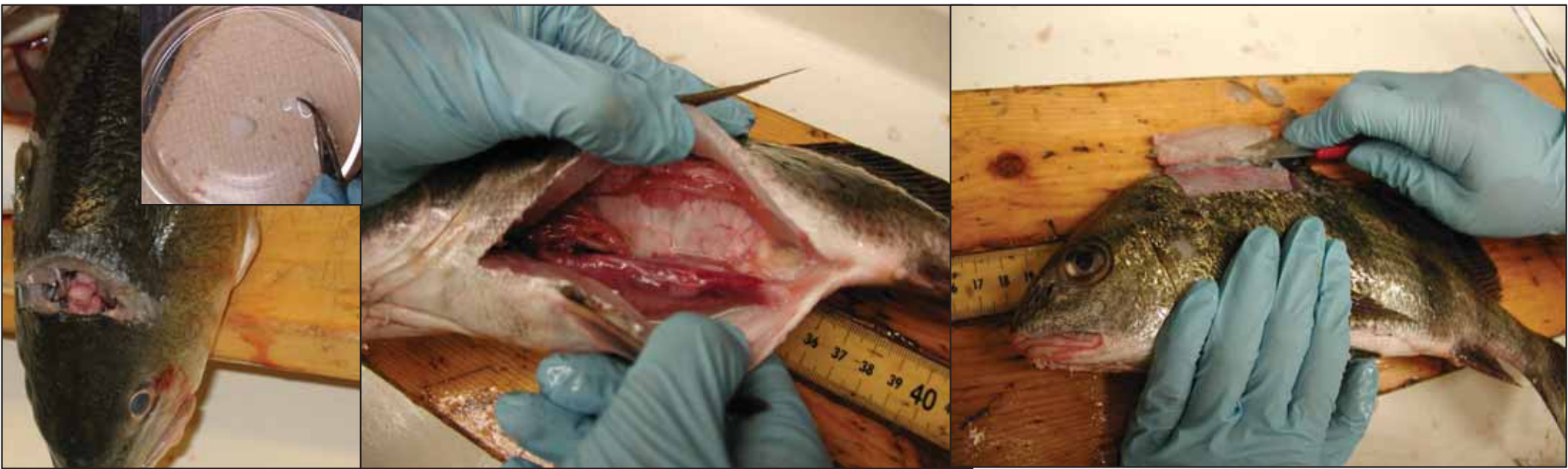
- Age/growth
- Reproduction
- Mercury

Data Collected – Trophodynamics

- One of the largest trophodynamics databases in the GOM
- Over 40,000 stomach samples processed to date
- Fullness, abundance/volume of prey

Data Collected – Active Acoustics
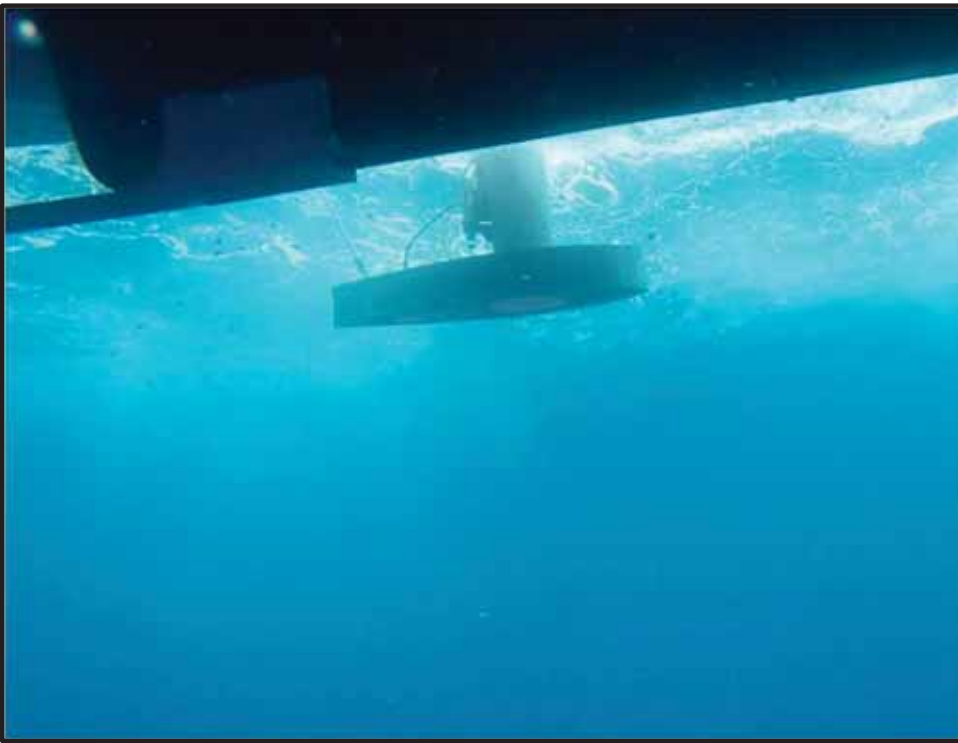
- Acoustics data at subset of S-BRUV sites (N ~ several hundred in 2023)
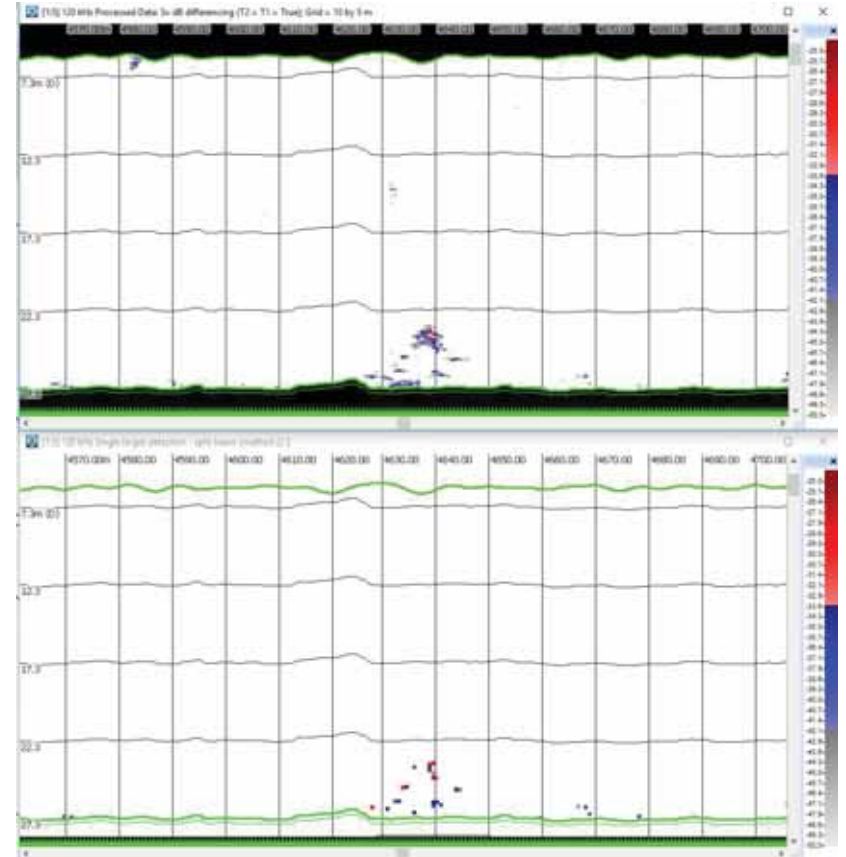
Data Use – Inputs to Stock Assessments
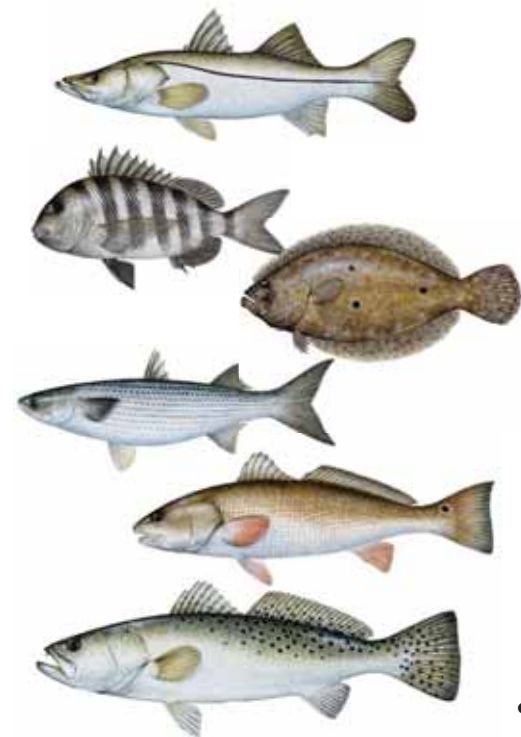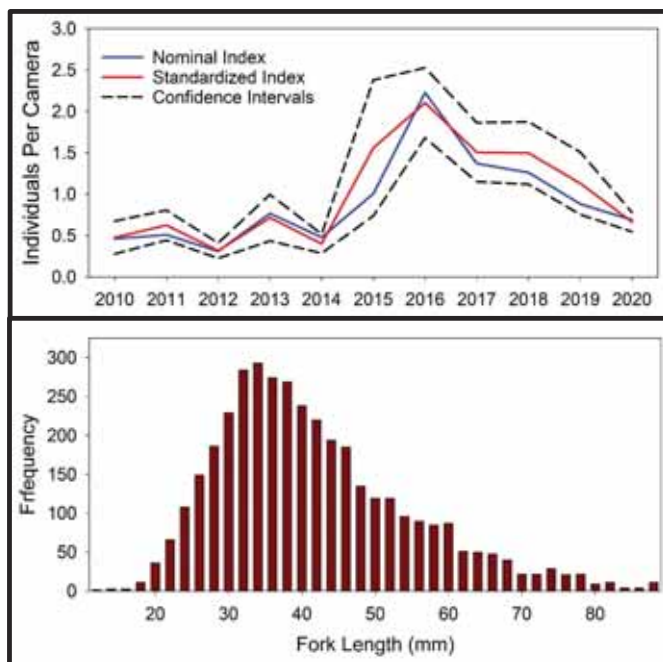
- Abundance indices
- Size/age composition (selectivity)
- Reproduction (sex ratio, maturity)
- Stock identification

State
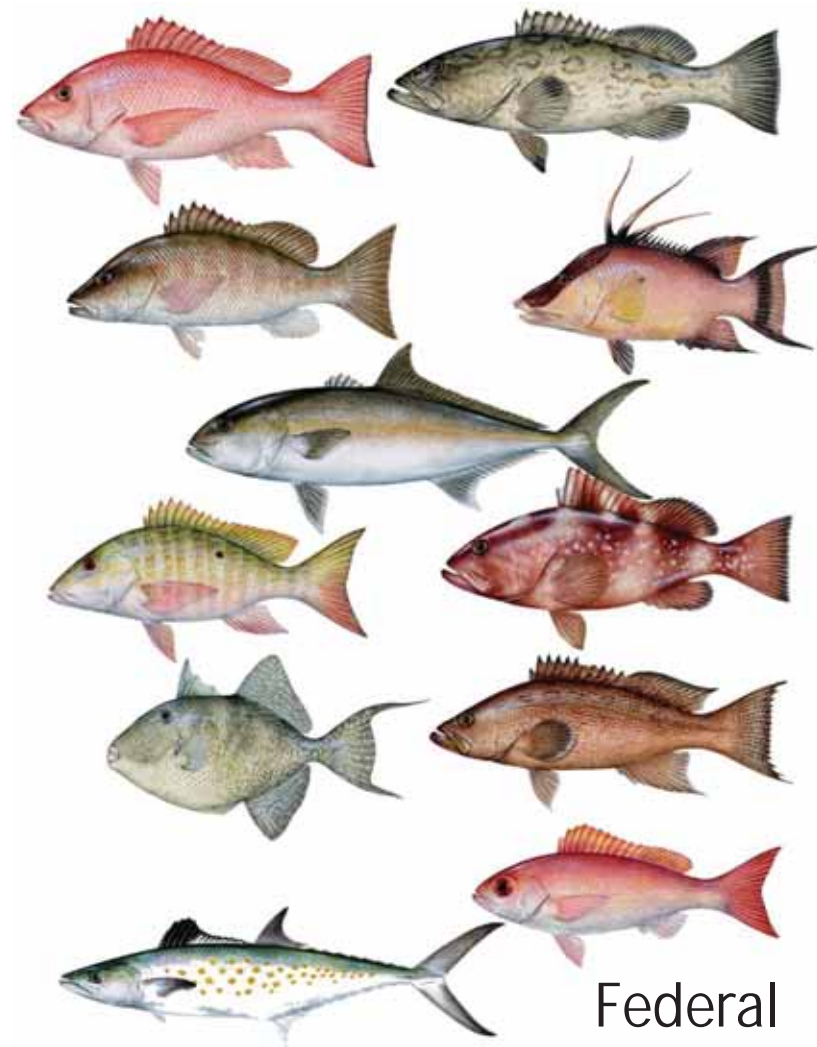
Federal

Data Use – Potential Impacts of Red Tide

- Insight from long-term data into change in abundance
- Model-estimated mortality for Gag, Red Grouper
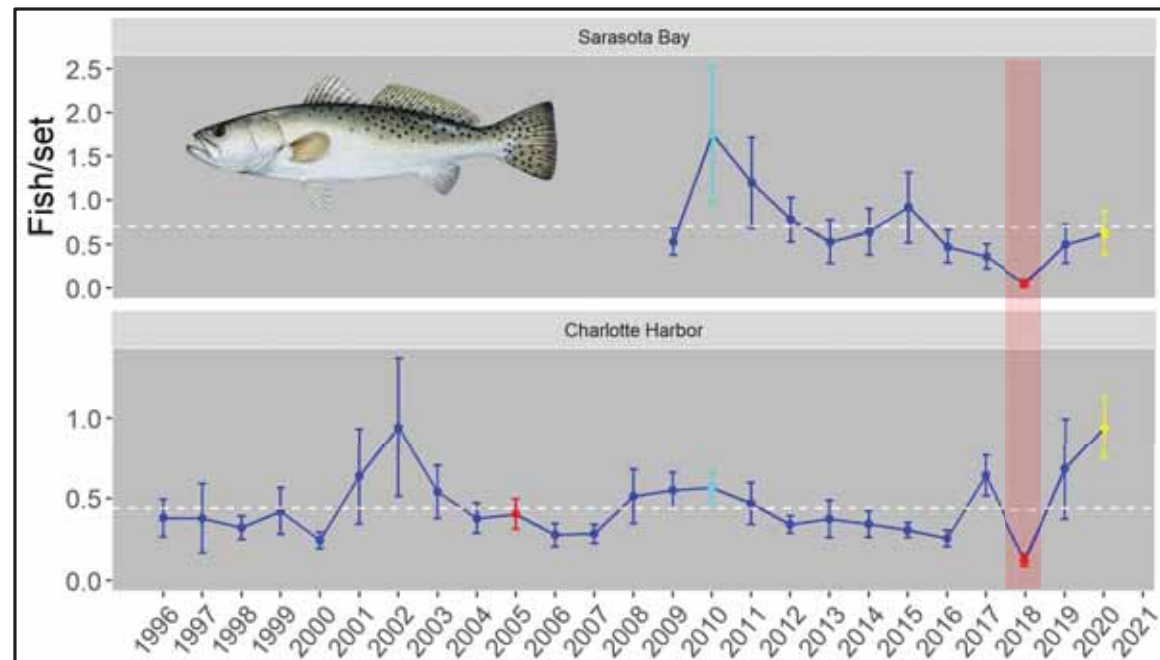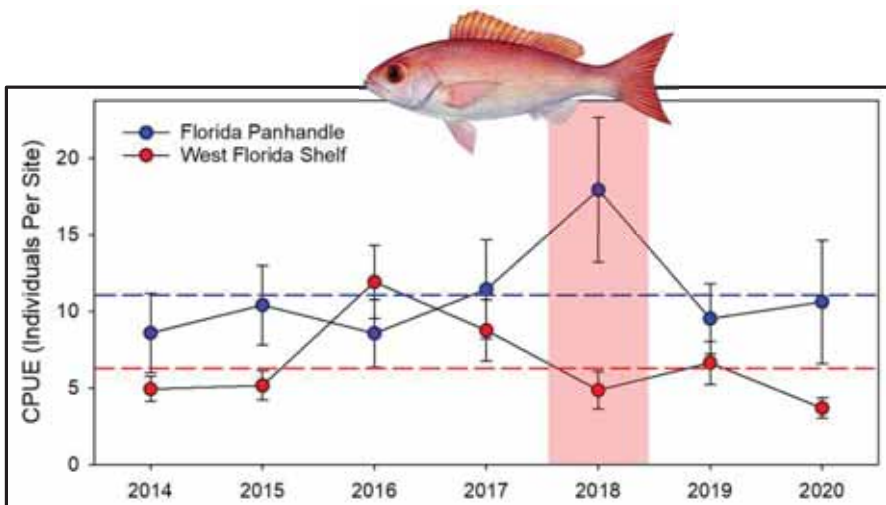
Data Use – Cold Event

- Severe cold event in January 2010

- FIM monitoring data documented decline and recovery of Common Snook in several estuaries
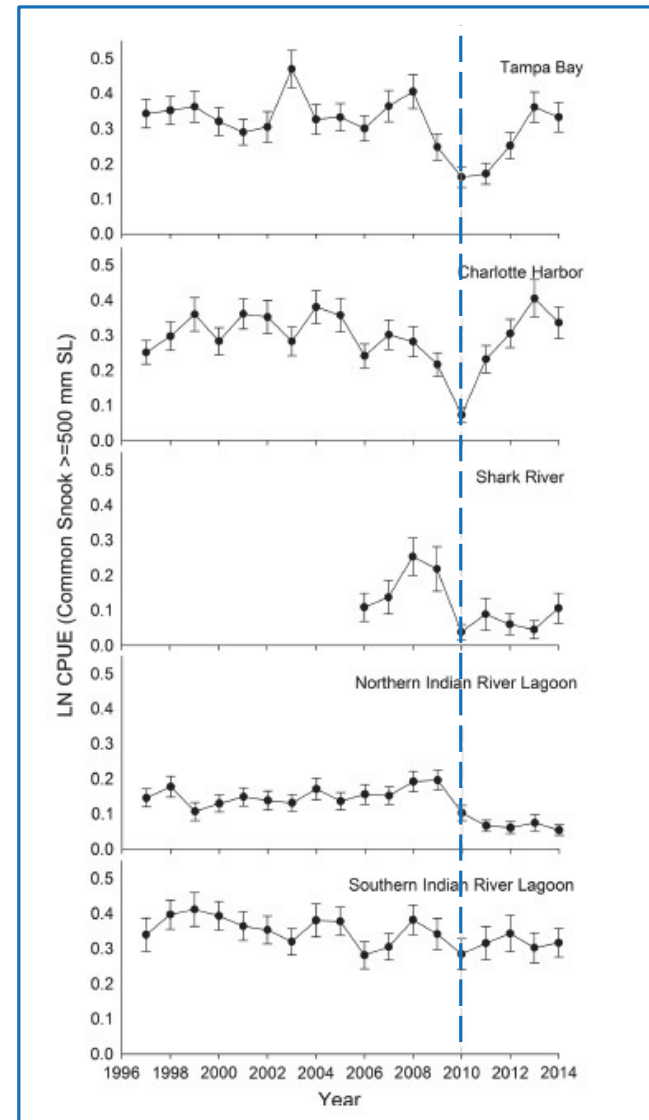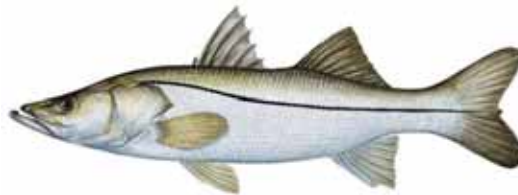
Data Use – Expanding Species Distribution
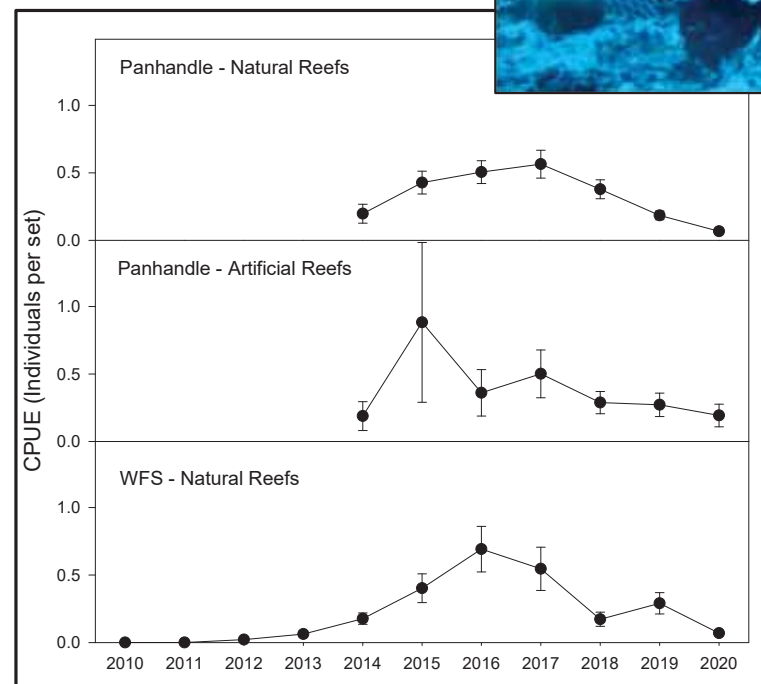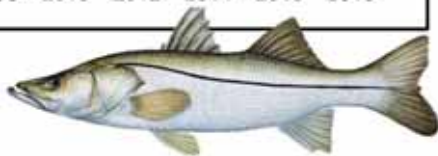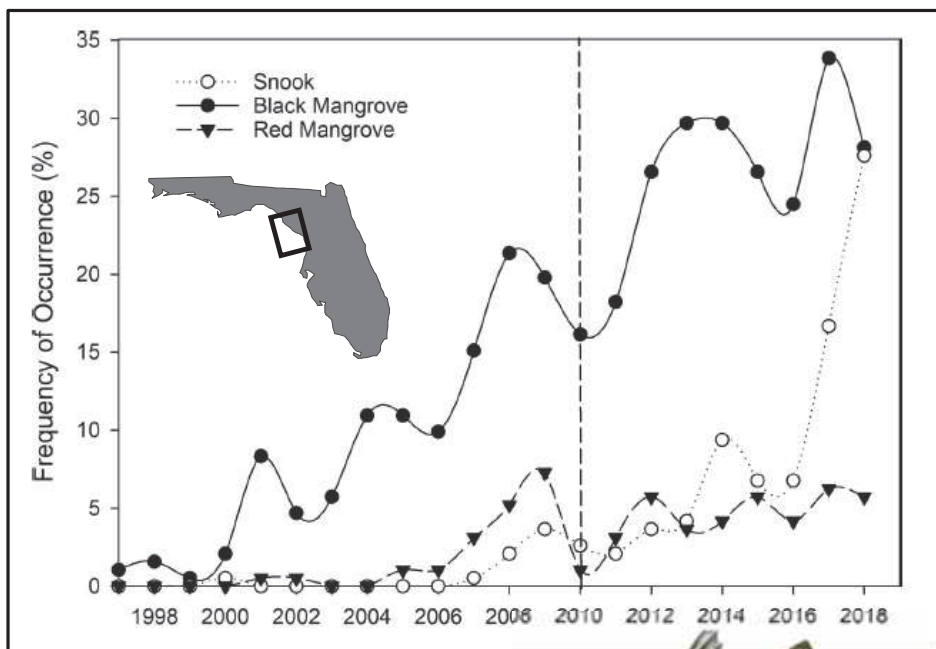
Publishing FIM Data

- FIM and partners have published >420 peer-reviewed manuscripts and counting!
  - >20 pubs in 2022
  - Lately, average >20/year

- FFRP puts high priority on publications

FIM's Database Formats

- FIM Inshore:
  - SQL Server
  - Other formats (SAS, CSV) are possible but require more processing time
- Offshore
  - SQL Server, MS Access
  - Other formats (SAS, CSV) are possible but require more processing time
  - Some data with partners (GSMFC, NMFS)
- Wetlab / Biological Samples (Culls)
  - SQL Server
  - Diet, SEAMAP, and Mercury in MS Access
- Length-Weight
  - SQL Server, can be provided as CSV
- *In the process of migrating all data to SQL databases*
- *Wish-list goal: All data served over the internet for researchers to query*

Metadata

- Tables, columns and relationships documented (diagrams available)

- Calculations (effort, length extrapolations, splitter expansions) explained

- Code lists integral to the data

- Methods detailed in procedure manuals and various manuscripts

- Idiosyncrasies explained

- *Continuing to add, and improve, metadata*

FWRI's 2023 FFRP Research Priorities

Survey data, diet data, applied science, and web-based/data access projects

Inshore/Offshore Connectivity

- Identify spatio-temporal relationships in abundance of forage fish between estuarine and coastal/offshore populations
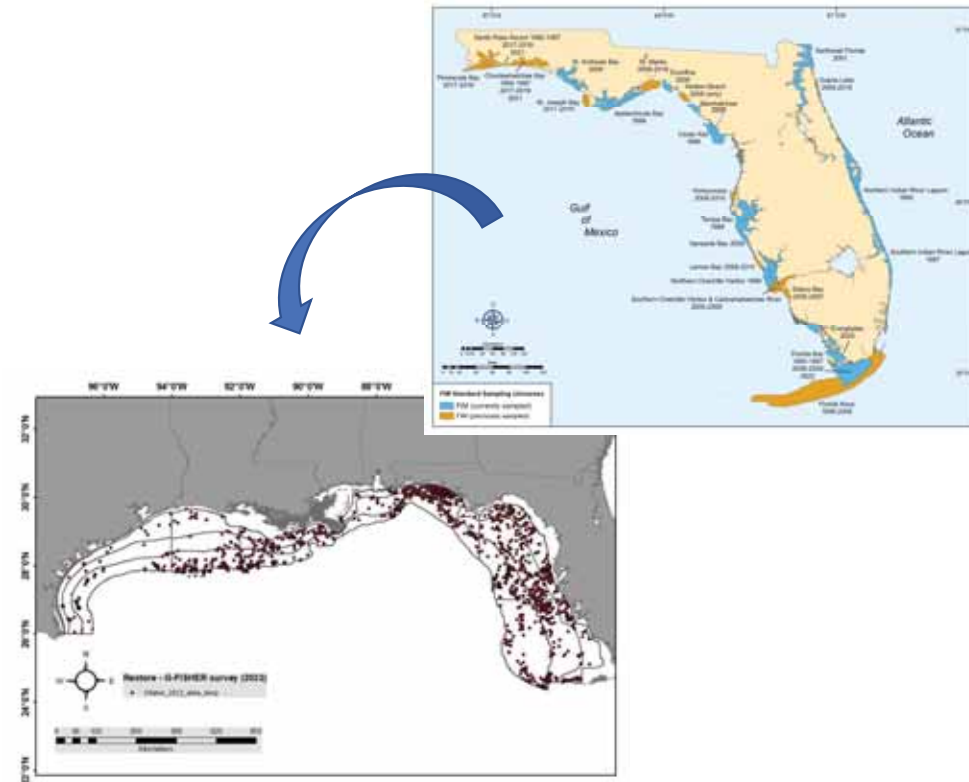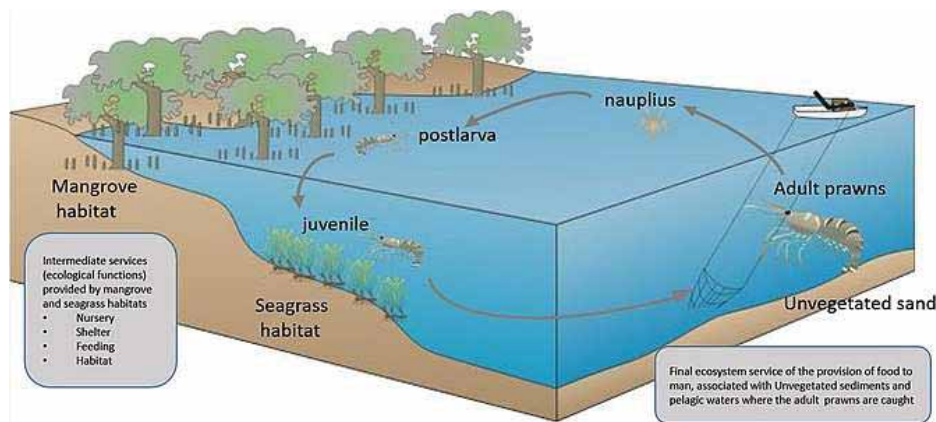
Survey data

Forage Fish & Reef Fish

- Identify variation in reef fish abundance and/or assemblage structure in relation to forage fish abundance from underwater video surveys

Survey data

Perturbance Impacts (And Recovery!)

- Chronic vs. acute environmental drivers of abundance
  - Red tide, storms, droughts, Lake Okeechobee discharges, septic tanks
  - Climate change effects on species distributions/community dynamics
    - Previous fellow: Kira Allen, UCF "Freshwater drought and sea level rise effects on forage fish and the associated food web in Apalachicola Bay, Florida"

- Correlations between forage fish communities and habitat "quality"
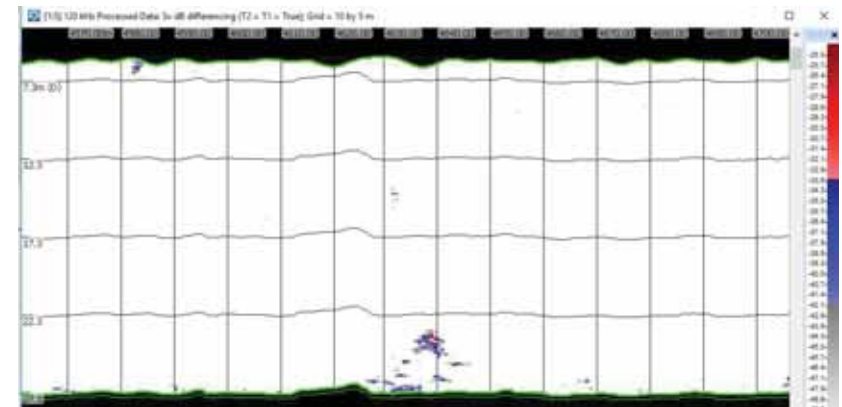 - Habitat change effects, IRL "regime shift"?

- Spatially explicit temporal models relating perturbance to inshore/offshore datasets

Survey data, diet data

Biomass Size Spectra as Indicators of Ecosystem Status

Unperturbed ecosystem — theoretical slope = -1.0

Perturbed ecosystem — steeper slope — A — B

Log Abundance — Log Weight Class
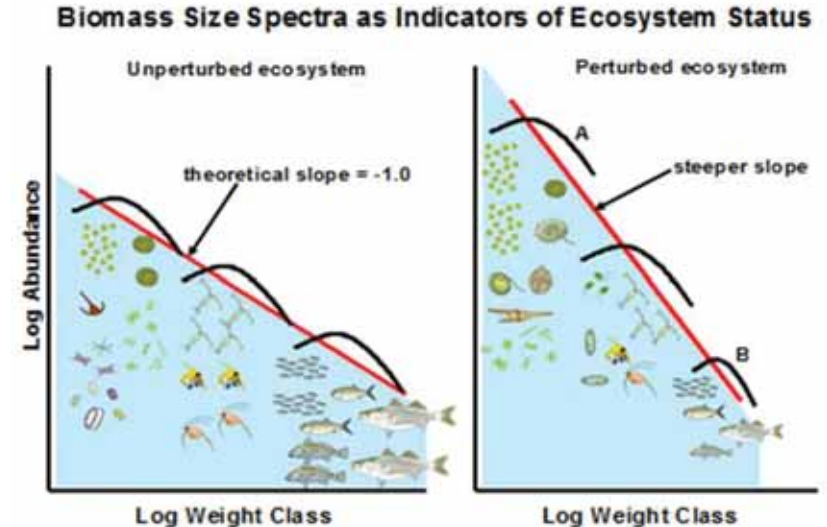
Houde Fisheries Research Lab Conceptual Model

Freshwater Flow Impacts

- Investigate the role of freshwater flow from various Tampa Bay watershed rivers in structuring fish communities
  - Revisit salinity relationships/functions for various species
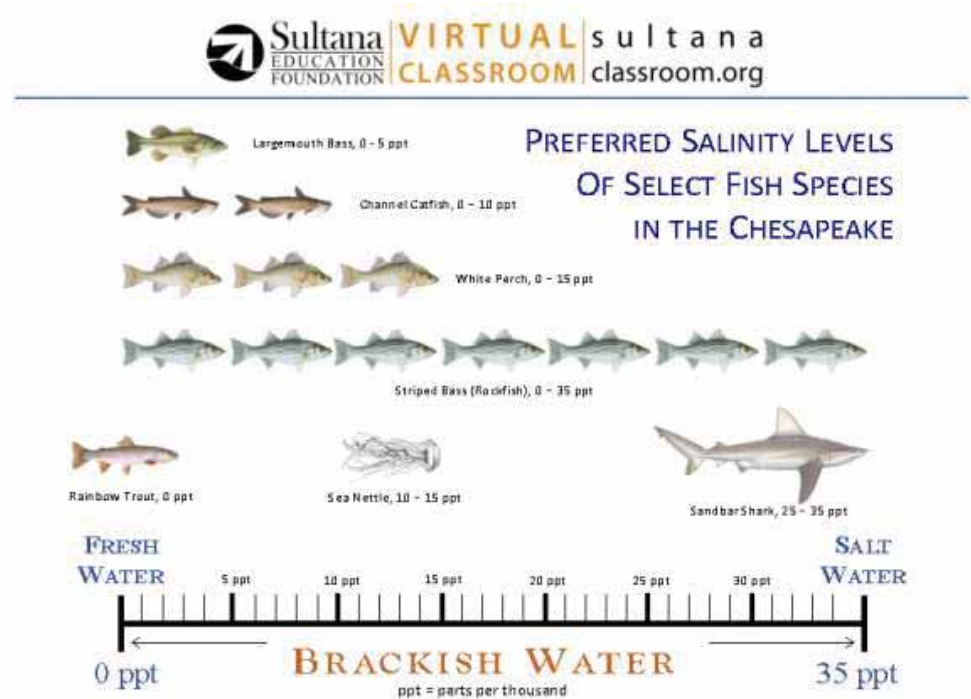
- Fellow Dakota Lewis, UF (forecasting future of Florida Bay estuarine fish communities)

Survey data, applied science

Habitat Preference

- Multivariate analyses of habitat preference including variables like:
  - Water velocity
  - Water depth
  - Vegetation
  - Salinity
  - Temperature
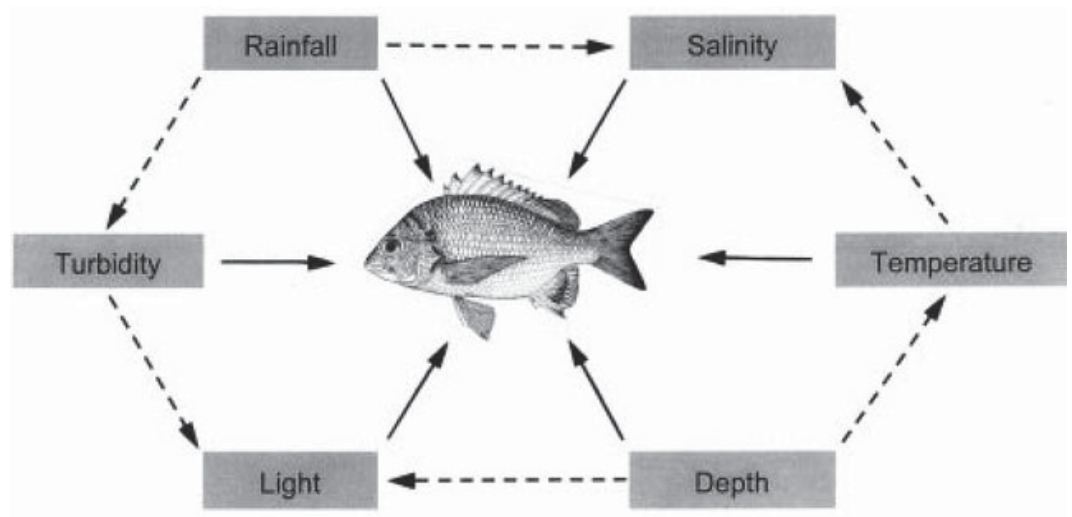 - Substrate
  - Food/prey availability

Figure 4. Physical factors influencing the occurrence, distribution and movements of fish in tropical and subtropical estuaries (after Blaber, 1997). Solid arrows indicate direct influences on fishes; broken arrows denote indirect influences.

Survey data

Molecular Tools for Biodiversity?

- Investigate ability to use molecular techniques to detect fish species or eggs
  - Compare to FIM catch data, known habitat use, or spawning patterns

- Previous fellow:
  - Emily Farrell, UCF (eDNA in the IRL; dissertation also has state-wide data)
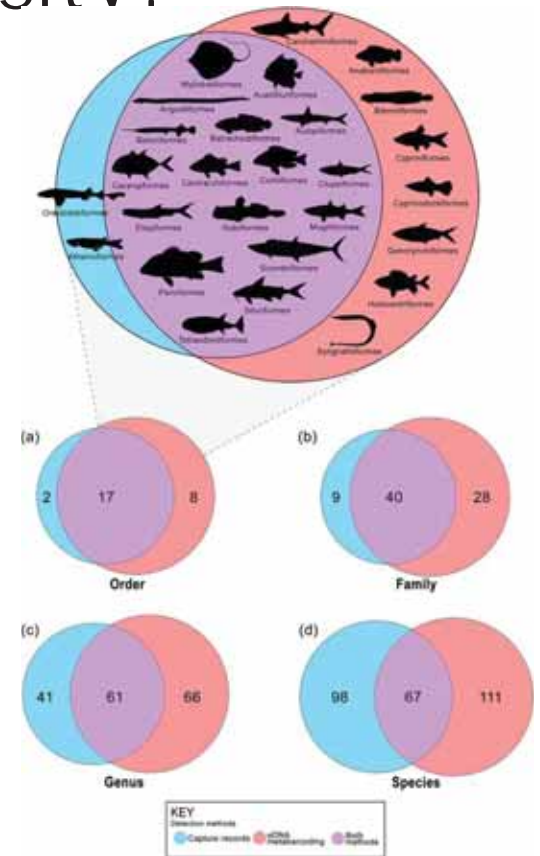
Assessing a megadiverse but poorly known community of fishes in a tropical mangrove estuary through environmental DNA (eDNA) metabarcoding

Danial Hariz Zainal Abidin, Siti Azizah Mohd. Nor, Sébastien Lavoué, Masazurah A. Rahim & Noor Adelyna Mohammed Akib

Scientific Reports 12, Article number: 16346 (2022) | Cite this article

Survey data, applied science

Sampling Intensity Needs to Describe Biodiversity or Abundance

- In comparison to FIM catch data, investigate the ability of statistical models to predict how many samples would be needed to capture diversity and abundance in a system with various habitat types, or the ability to extrapolate abundance data
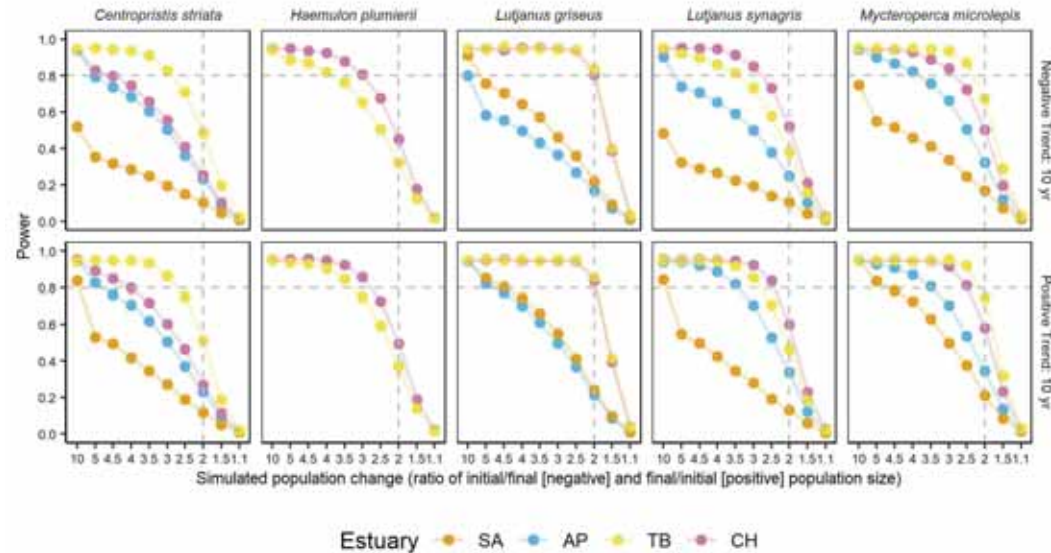
Survey data

Schrandt et al., 2021

Forage Fish Community Structure
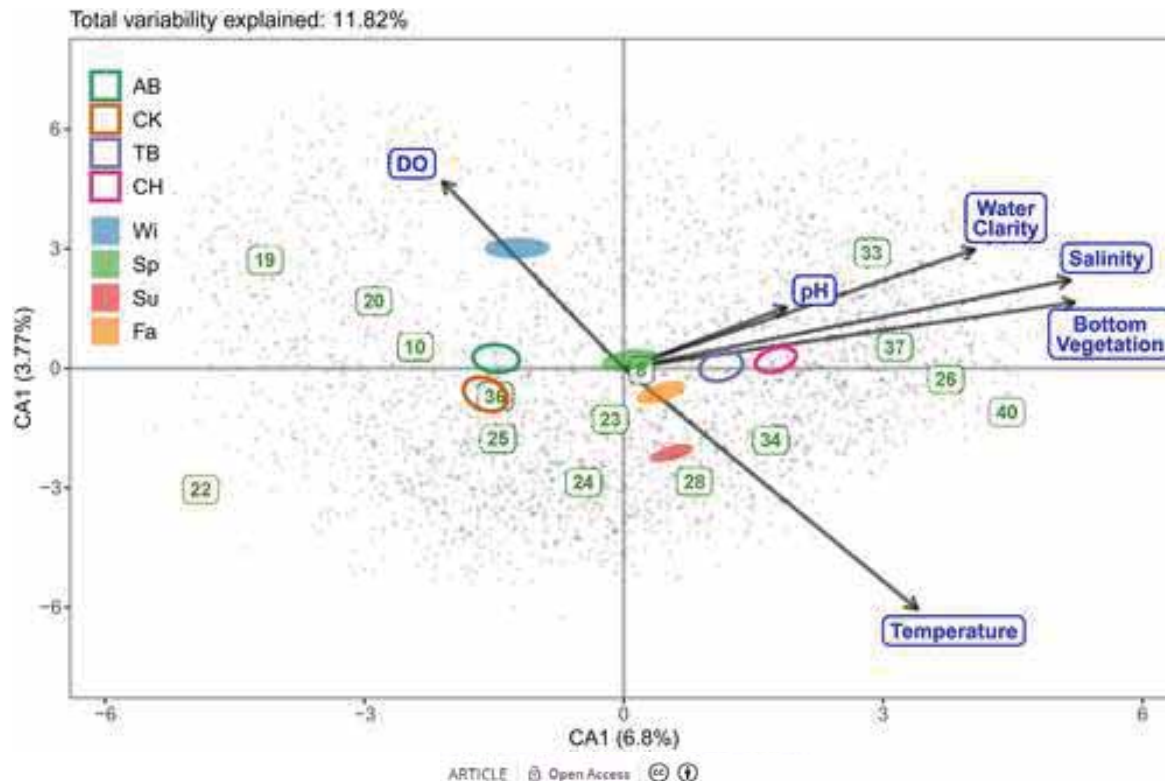
- Identify regional spatio-temporal variation in species composition among Florida's estuaries – which, where, when, and why?

Previous fellow: Community dynamics of estuarine forage fishes are associated with a latitudinal basal resource regime

Survey data

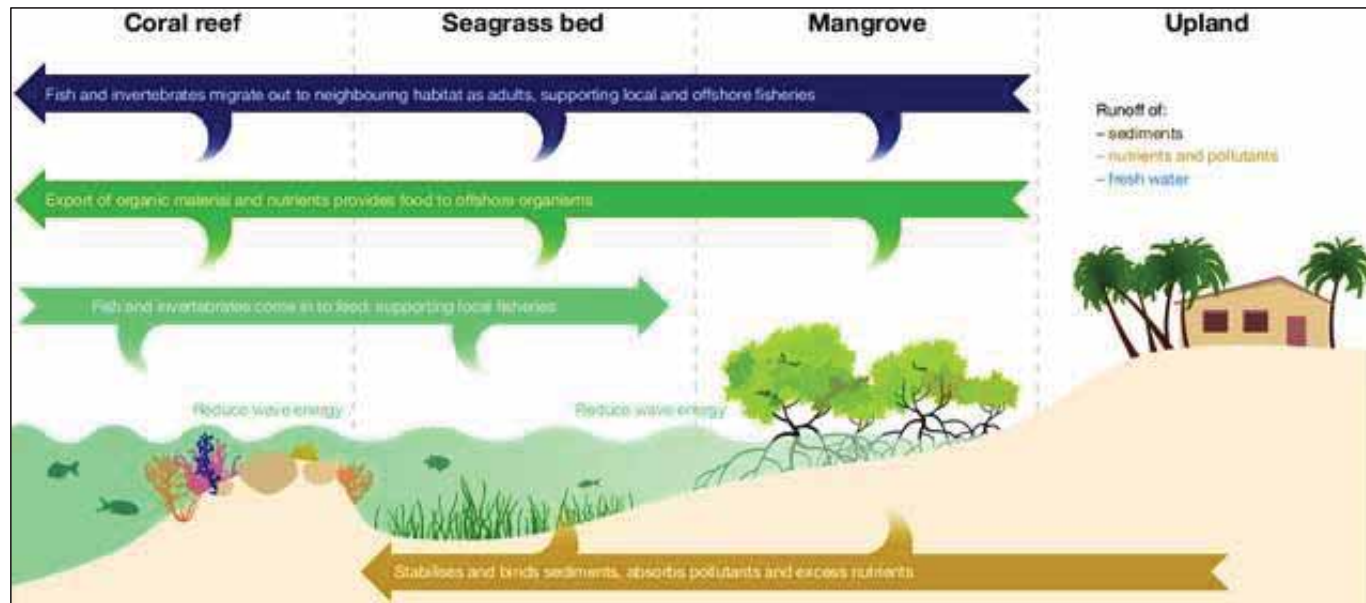# Inshore/Offshore Connectivity with Diet Data

- Investigate energy transfer from estuaries to offshore predators

Thomas, 2017

Survey data, diet data

Temporal Diet Shifts

- Investigate seasonal and annual changes in diet of predators and potential correlations to FIM catch data of forage species
- Spatiotemporal patterns in offshore forage fish diets (Tomtates, Pinfish)

Ontogenetic and Long-Term Diet Shifts of a Generalist Juvenile Predatory Fish in an Urban Estuary Undergoing Dramatic Changes in Habitat Availability

Brittany J. Hall-Scharf*
Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, 100 8th Avenue Southeast, St. Petersburg, Florida 33701, USA; and College of Marine Science, University of South Florida, 140 7th Street South, St. Petersburg, Florida 33701, USA

Theodore S. Switzer
Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, 100 8th Avenue Southeast, St. Petersburg, Florida 33701, USA

Christopher D. Stallings
College of Marine Science, University of South Florida, 140 7th Street South, St. Petersburg, Florida 33701, USA
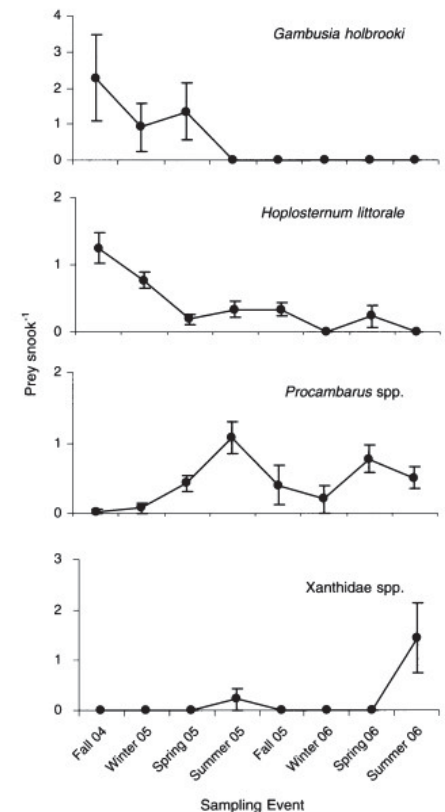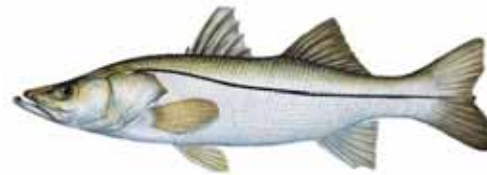
Diet data, survey data

Fig. 4 Abundance (±SE) of the four most numerous prey taxa collected from stomachs of *C. undecimalis* (common snook) in Peace River, Florida (fall 2004–summer 2006)

Posthurricane Recovery of Riverine Fauna Reflected in the Diet of an Apex Predator
Author(s): Philip W. Stevens, David A. Blewett, Thomas R. Champeau and Christopher J. Stafford
Source: *Estuaries and Coasts*, Vol. 33, No. 1 (JANUARY 2010), pp. 59–66
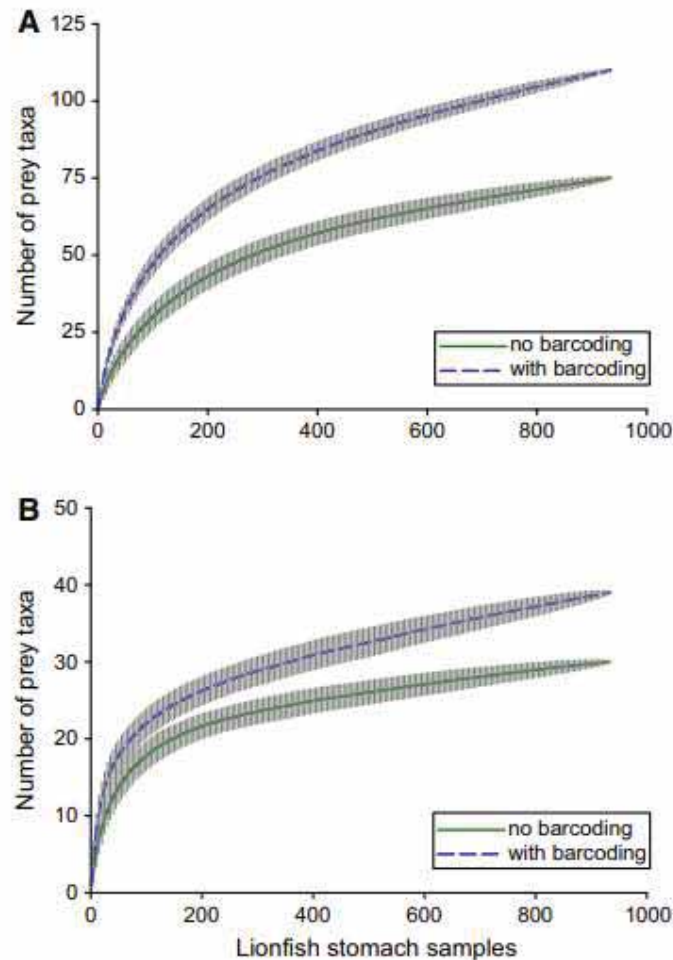
Biodiversity Indicators

- Investigate the potential to use diet as benthic diversity indicators

Diet data

Molecular Tools in Diet Studies

- Comparison of diets assessed visually with current methods as compared to those same contents when barcoded (or other molecular markers?)
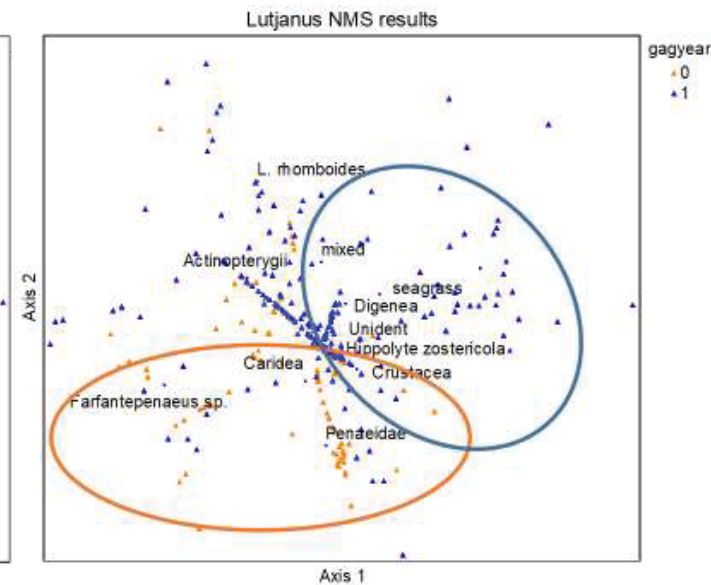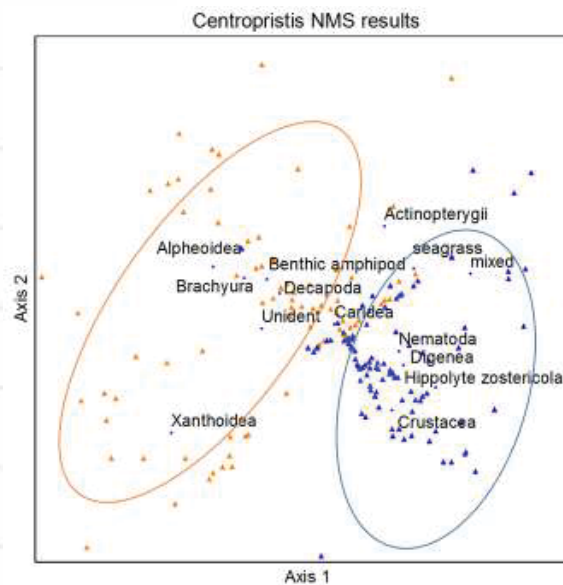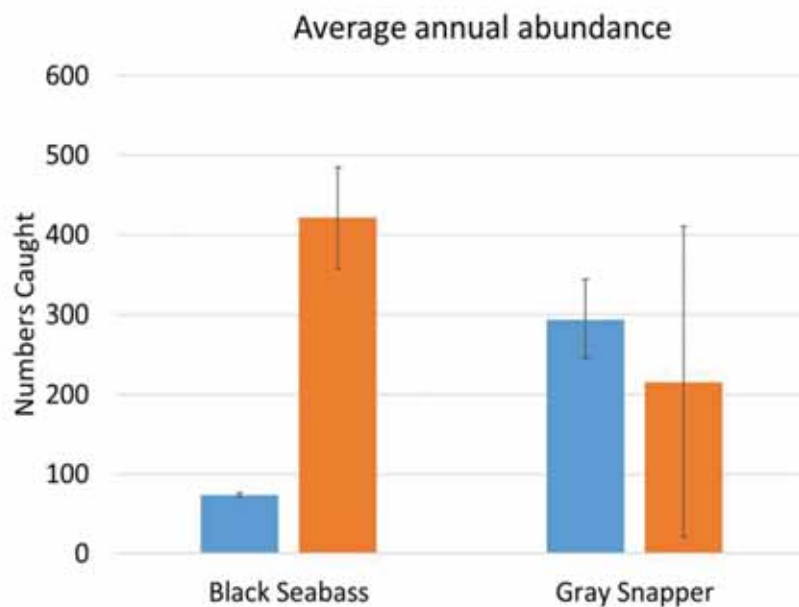
Diet data

Dahl et al., 2017

Fig. 4 Species accumulation curves of red lionfish (*P. volitans*) prey taxa identified during this study. **a** Cumulative number of unique prey identified to species or lowest taxonomic level of identification, and **b** fish families and invertebrate infraorders, as a function of number of lionfish sampled and analyzed with visual gut content analysis (*solid line*) or visual identification plus DNA barcoding (*dashed line*). Every 5th 95% confidence interval is plotted to allow comparison of curves between visual identification and DNA barcoding methods

Coupling Ecological & Trophic Data

- Predator-predator effects and competition
- Prey availability vs. presence in diet(s)
- Continued ecosystem modeling efforts state-wide

Survey data, diet data

Projects Providing Access to FWRI-FIM Data

https://bids.github.io/dats/posts/2018-11-19-data-repos.html

- Data publication and open access

- Web-based interface tools
  - GIS mapping for diet data of predators, habitat preference, overlap of prey/predator

- Develop process to deliver (annually) data and metadata to repository
  - Code/tech transfer with FWRI
  - R package for querying FIM data from repository

Web-based/data access

Funders and Collaborators