

Fish Bioacoustic Activity in Everglades National Park: *Processing and Scaling for Effective Restoration and Management*

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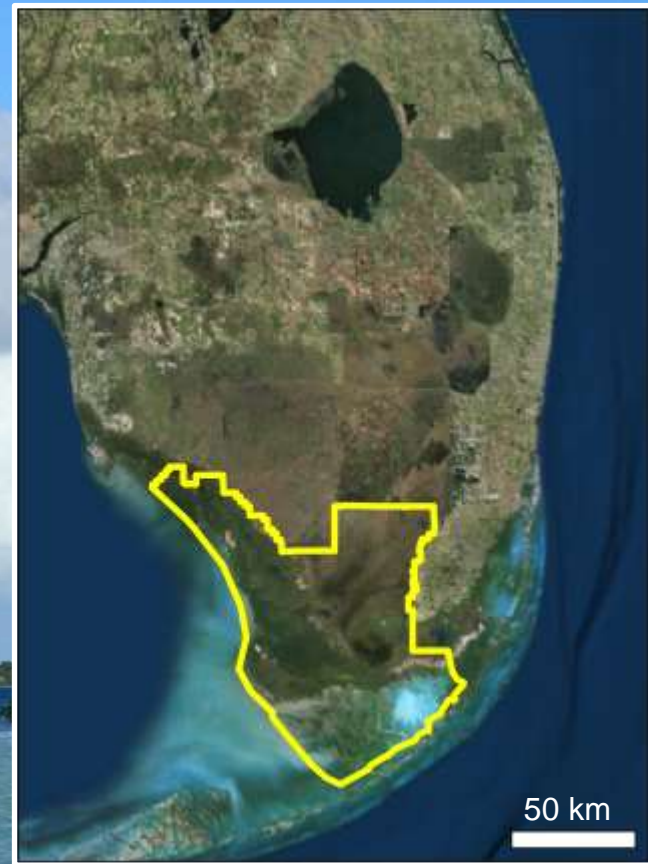
Introduction

- How does water management from Lake Okeechobee impact fish populations in Florida Bay?

- Species diversity
- Abundance
- Condition/health

- In evaluating Everglades restoration success, changes in behavior may precede population increases or decreases

- Opportunity for passive acoustic monitoring to evaluate changes in fish ecology



Introduction

- Many fish produce sounds in reproductive or territorial contexts
- Of the ~177 fish species found in Florida Bay (Roessler, 1970; Tabb and Manning, 1961):
 - 55 species produce sounds or have sonic mechanisms
 - at least 30 more likely produce sounds
- Through recording of sounds, we can identify patterns of fish occurrence and behavior
 - Spawning activity
 - Seasonal movement
 - Community assembly

Objectives



1) Examine calling patterns of two focal fish species within Florida Bay: Gulf toadfish and spotted seatrout

2) Evaluate how changes in water conditions impact fish acoustic behavior and ecology

3) Evaluate spatial and temporal variability in fish calling across Florida Bay

Methods: Study Sites



Methods: Data Collection

- Recording Dates:

Duck Key: August 5-6, 2014; December 3-4, 2015, November 14-15, 2016

Little Madeira: September 7-9, 2016

Joe Bay: December 3-4, 2015; September 7-9, 2016

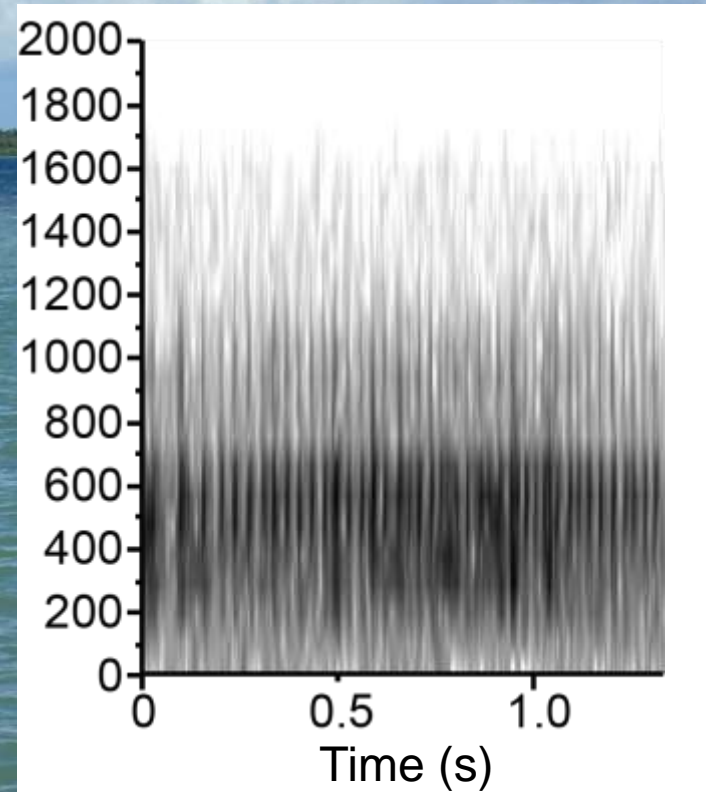
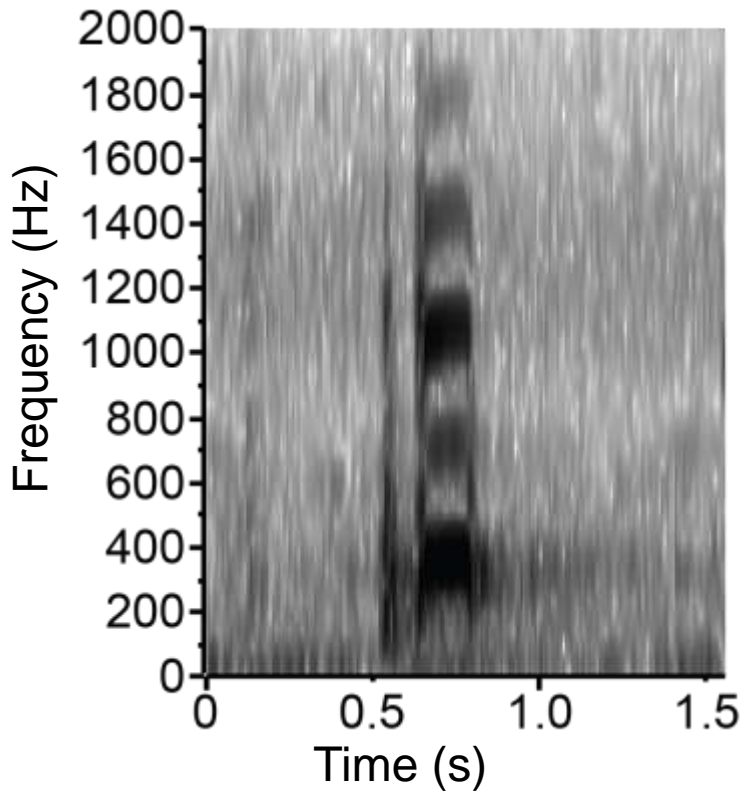
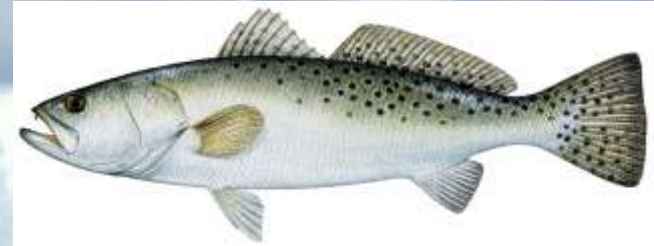
- Analyzed first 10 minutes of sound from each hour
- Environmental data (salinity, temperature, precipitation) downloaded from NPS Marine Monitoring Network (ndbc.noaa.gov)
- Limited-scale temporal and spatial comparisons

Methods: Focal Species

Gulf toadfish
(*Opsanus beta*)



Spotted seatrout
(*Cynoscion nebulosus*)

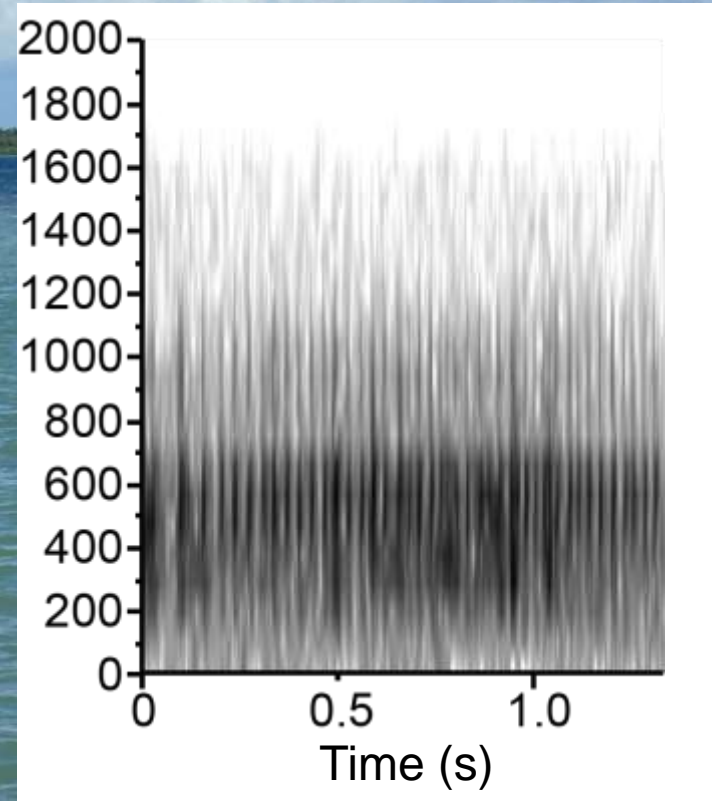
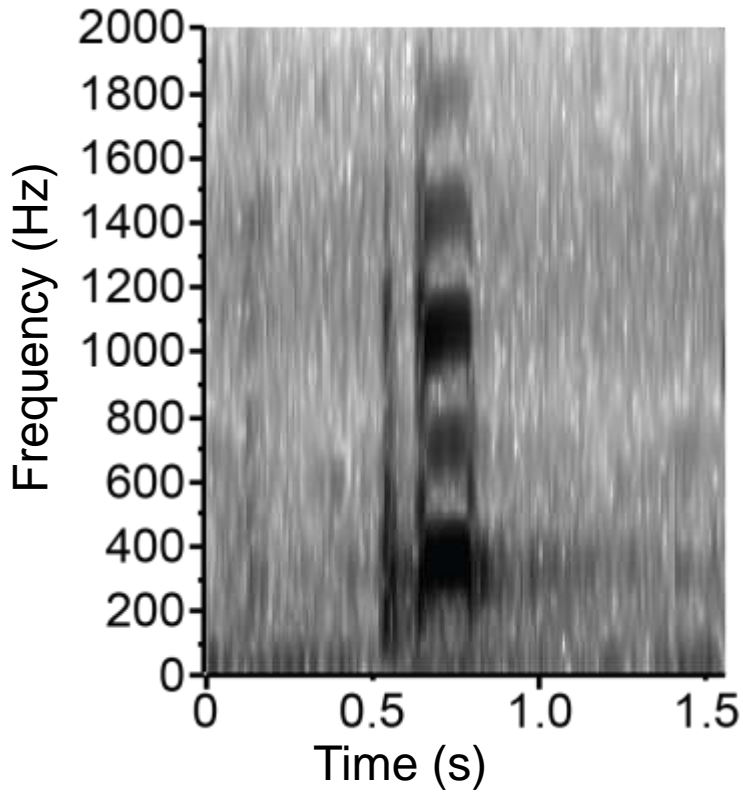


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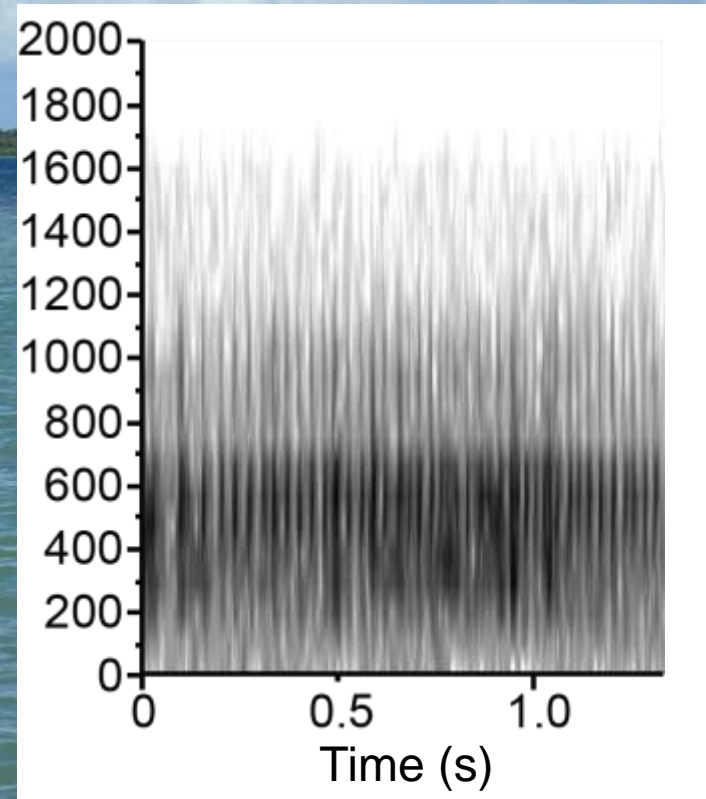
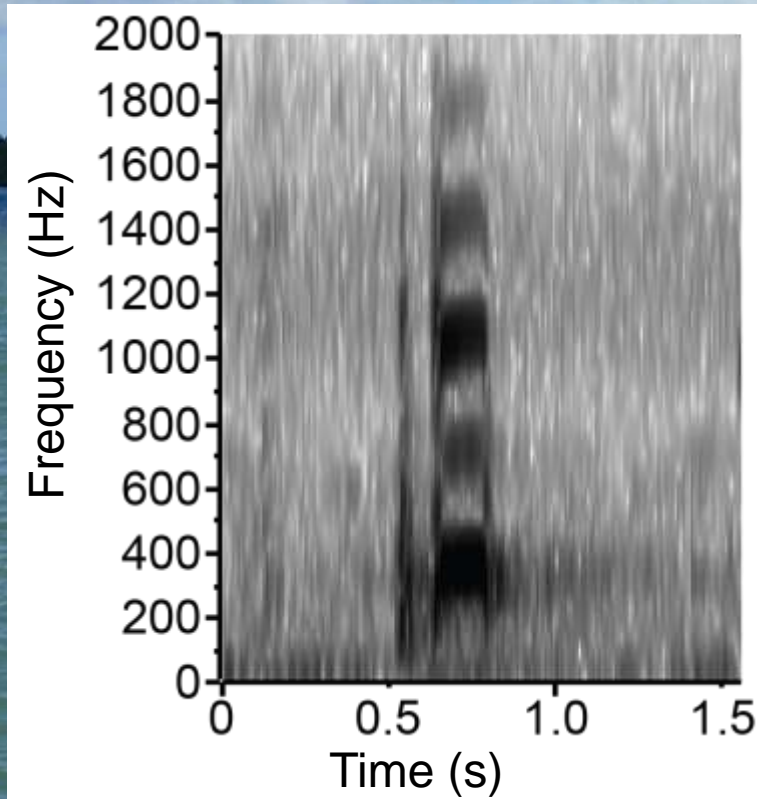
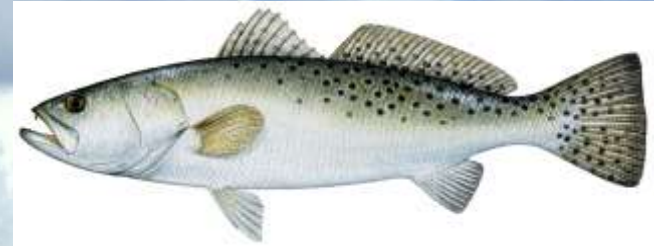


Methods: Focal Species

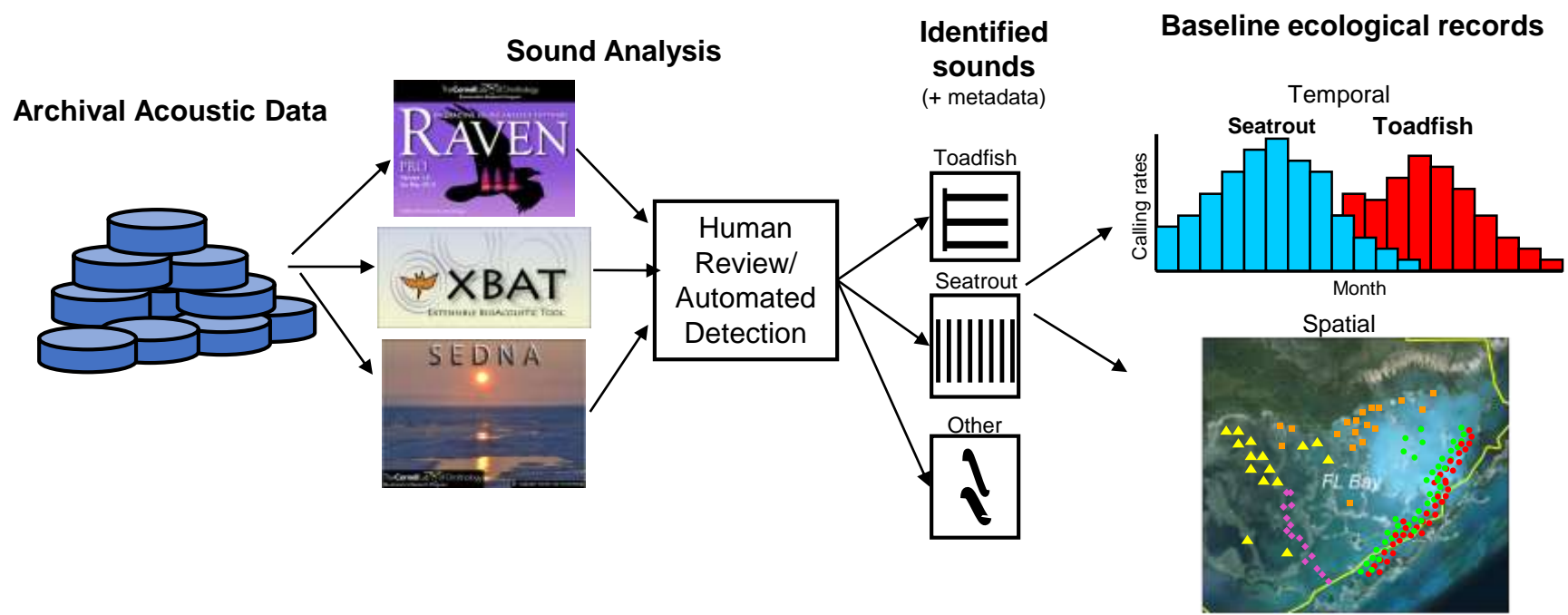
Gulf toadfish
(*Opsanus beta*)



Spotted seatrout
(*Cynoscion nebulosus*)



Methods: Acoustic Analysis



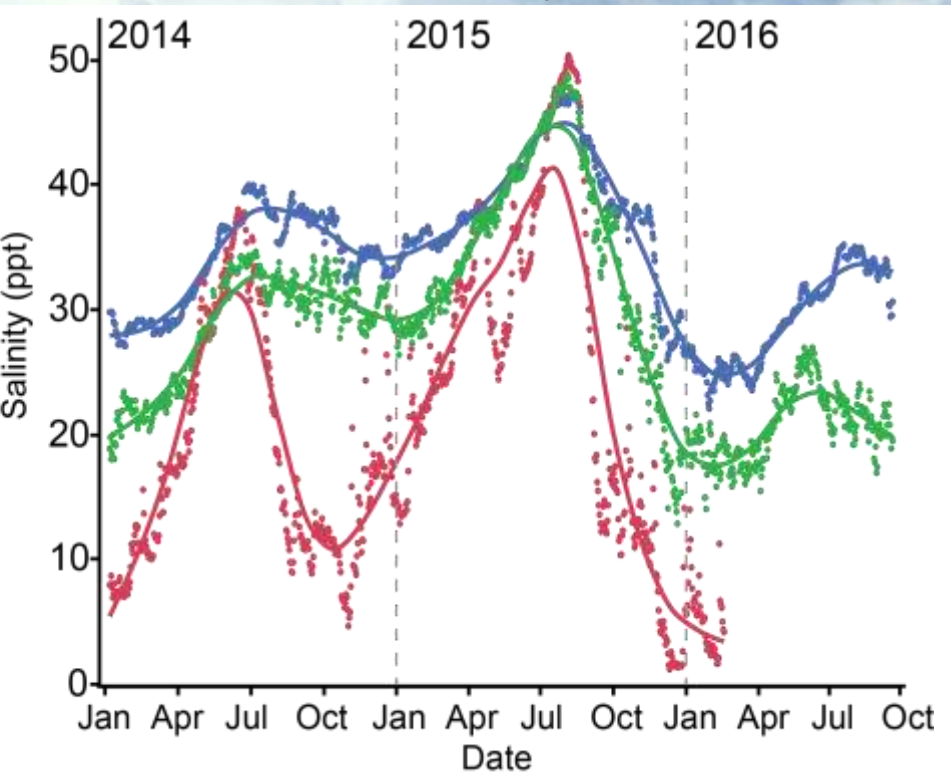
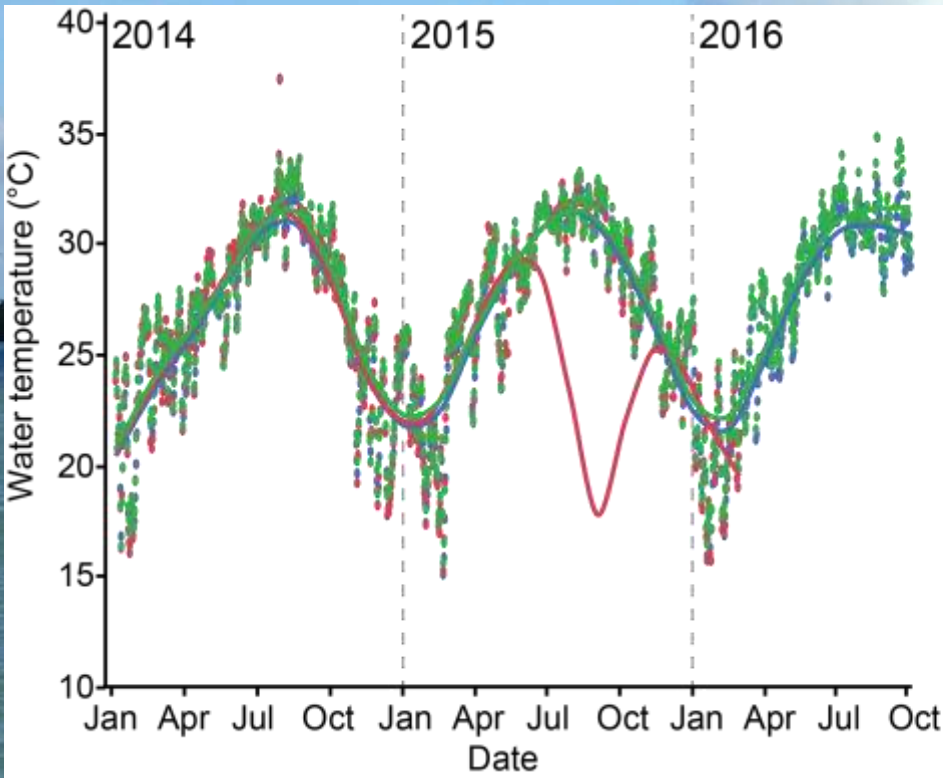
Time-stamp and sensor location of sounds of interest becomes the foundation for understanding spatial and temporal occurrence patterns

Results: Environmental Data

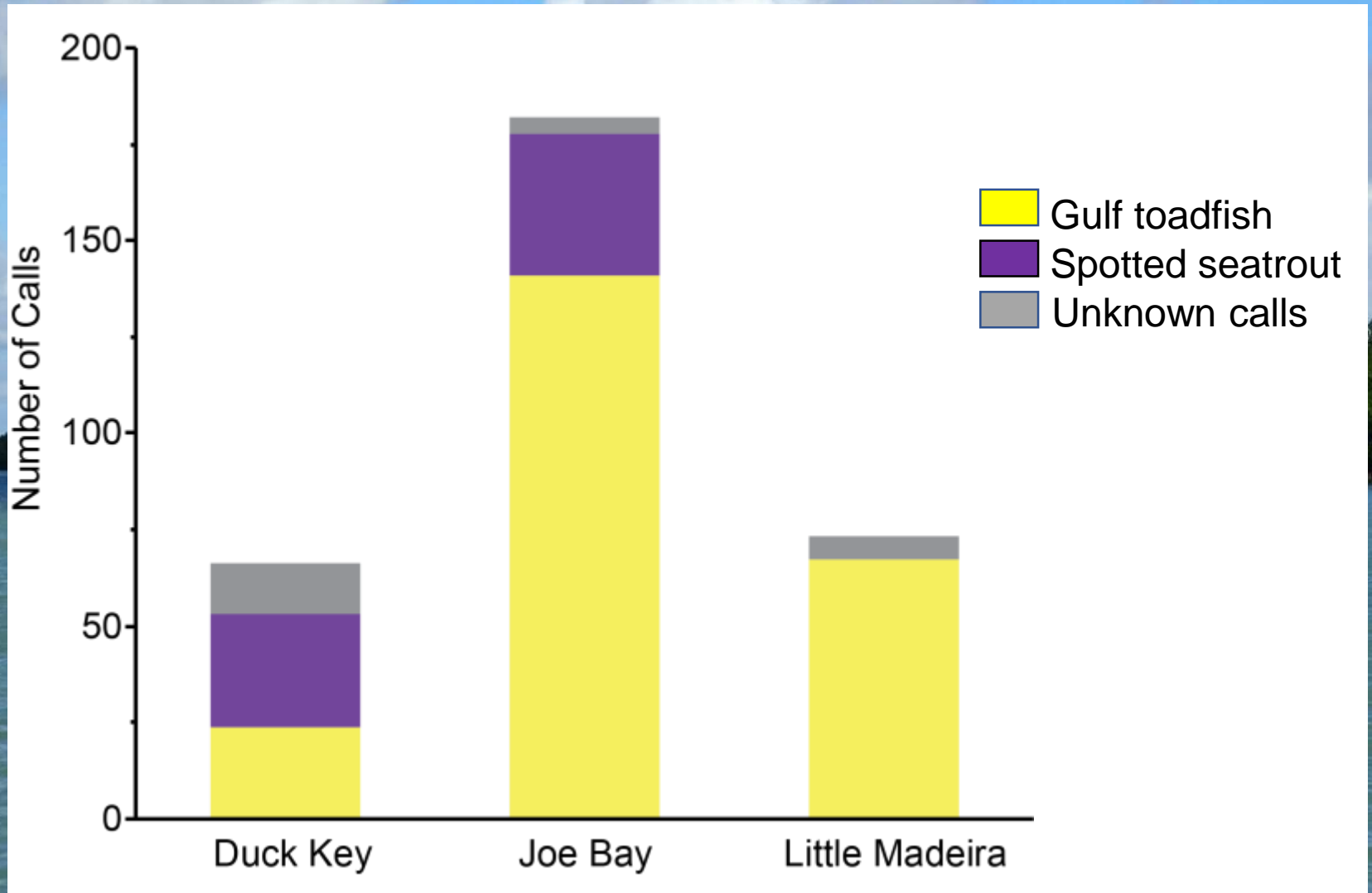
- Duck Key
- Joe Bay/TC
- Little Madeira

Temperature

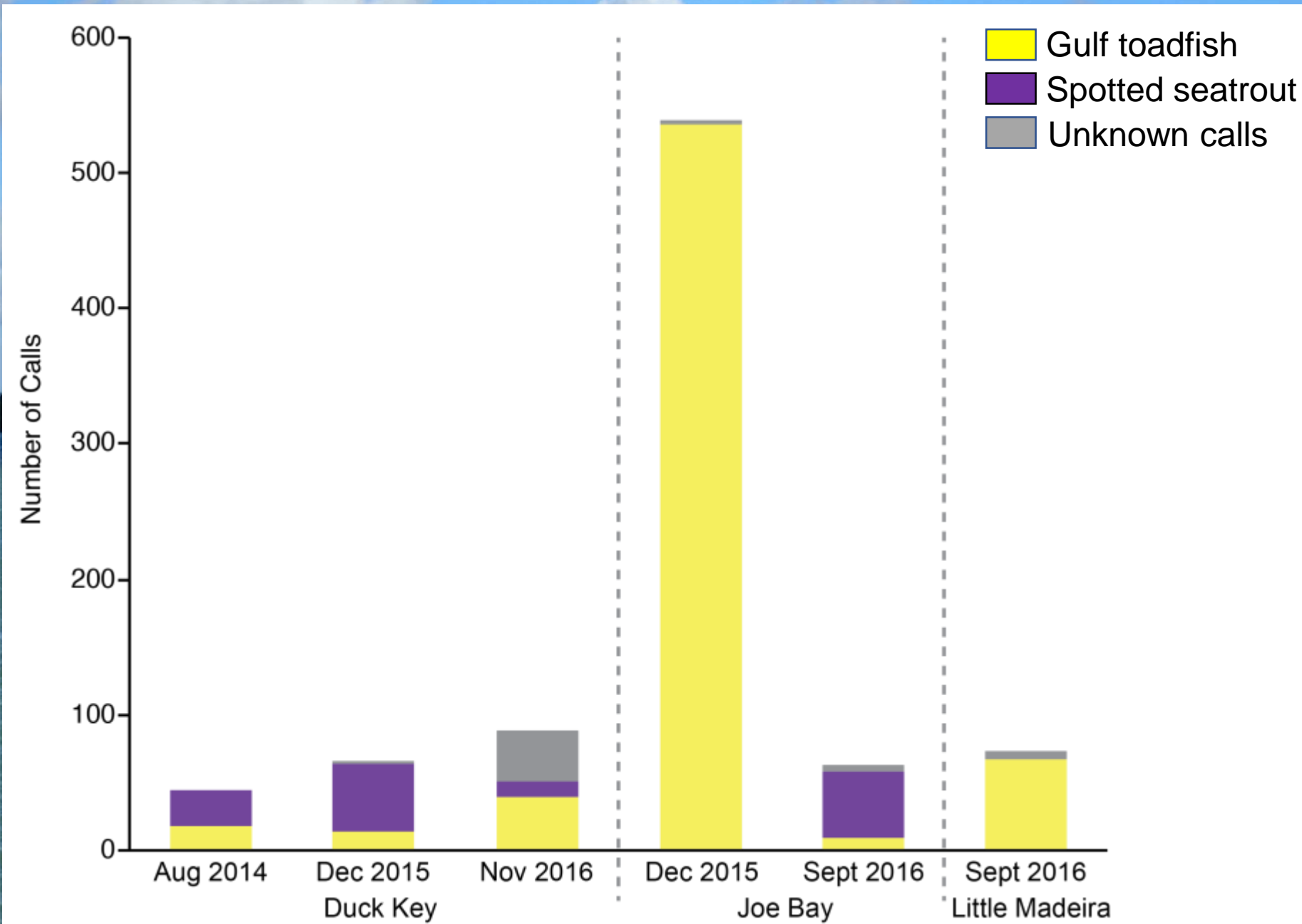
Salinity



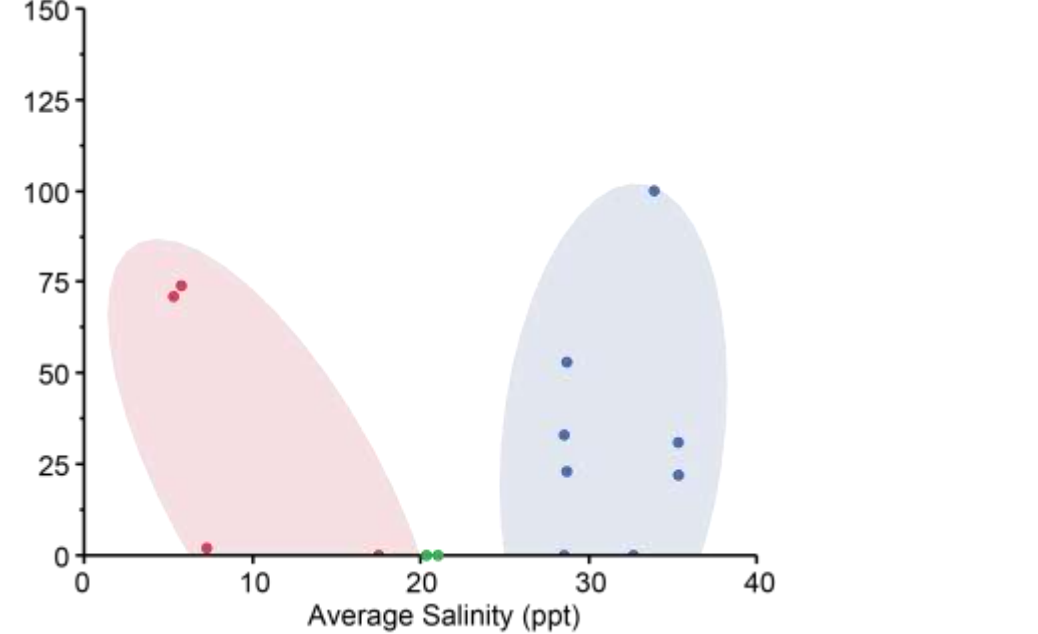
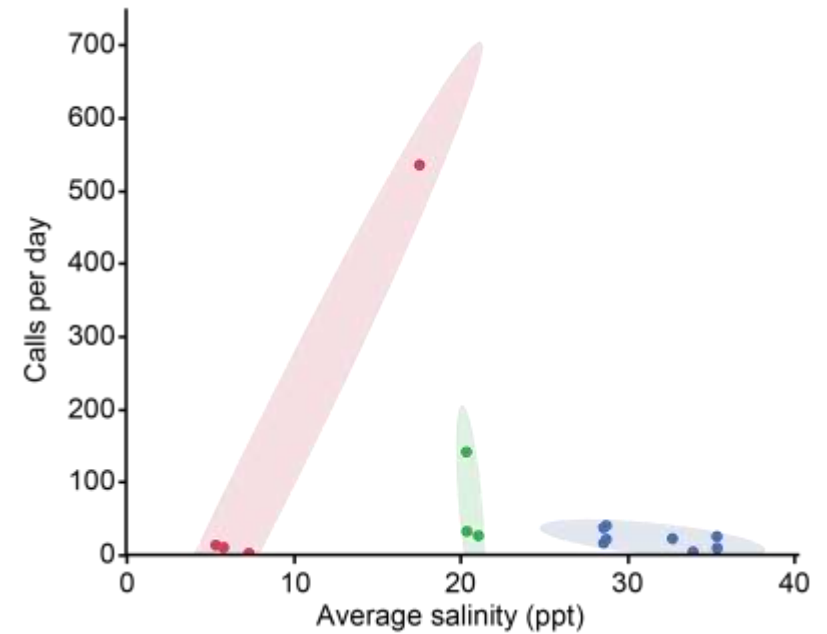
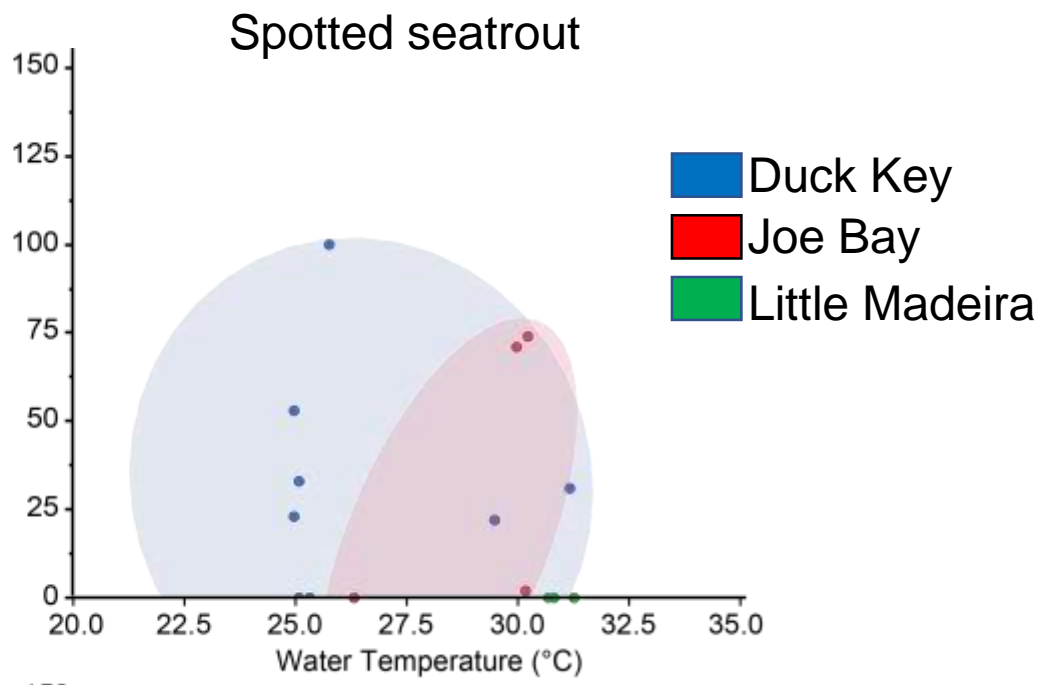
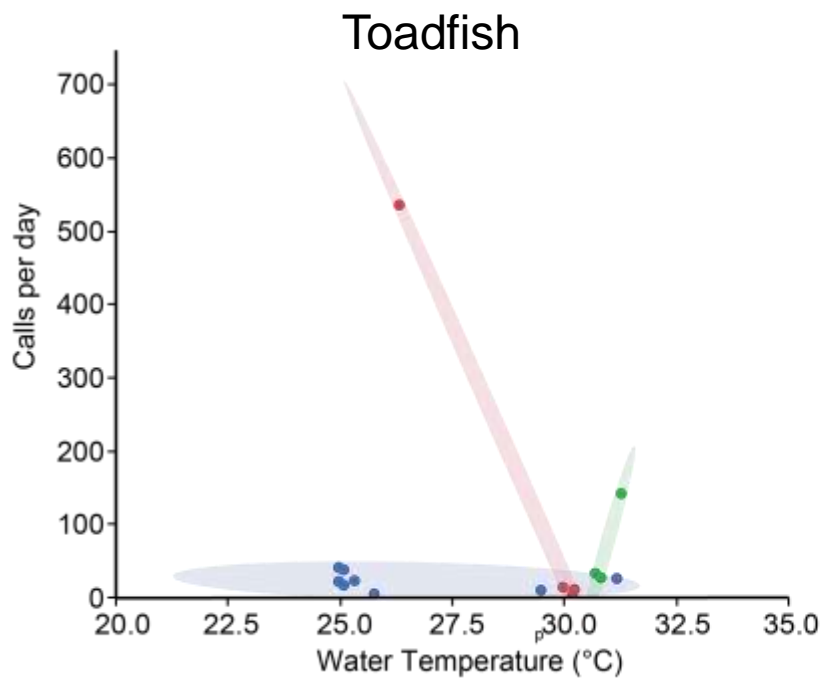
Results: Total calls per site



Results: Temporal Changes

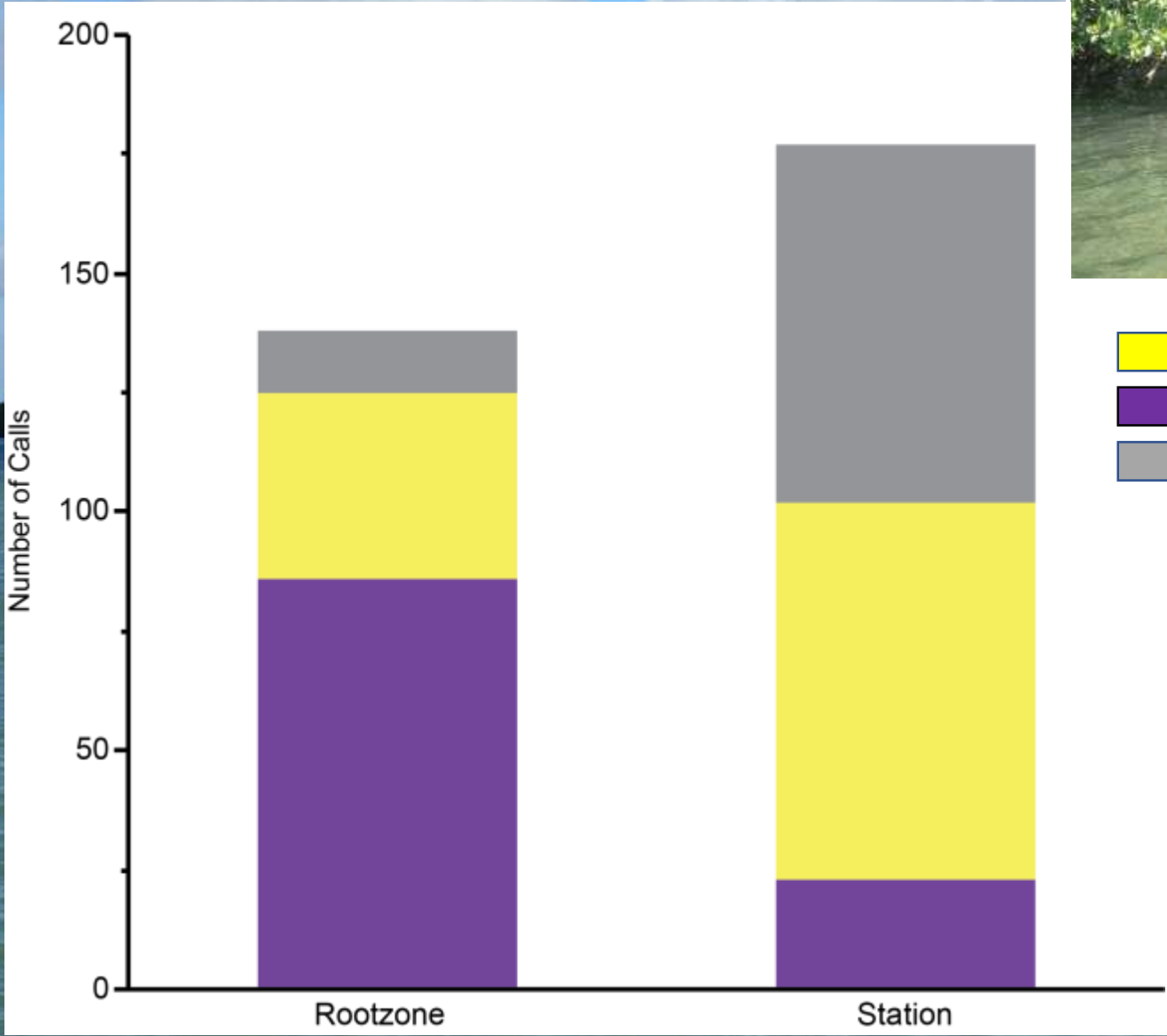





Results: Fish Calling vs. Water Properties



Results: Mixed hard bottom versus mangroves

(Duck Key, Nov. 14-15, 2016)



-  Gulf toadfish
-  Spotted seatrout
-  Unknown calls

Summary

- Lots of acoustic activity of focal fish species
- Fishes responded differently to changes in temperature and salinity at different locations
 - heterogeneous response of fishes with different water conditions in FL Bay

Next Steps

- Making data publically available (e.g., macaulaylibrary.org)
- Increase temporal resolution
- Increase spatial coverage
- Increase number of species analyzed
 - identify which species produce which sounds
 - develop automated approaches
- Examine changes in behavior of Joe Bay fishes relative to fishing activity



Acknowledgements



Collaborators

- Megan McKenna (NPS)
- Christopher Garsha (NPS/Colorado State Univ.)
- Samantha Bietsch (Colorado State Univ.)
- NPS Natural Sounds and Night Skies Division

Funding

- South Florida Natural Resources Center, Everglades National Park

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