Using Autonomous Underwater Gliders to Map Fish in the Eastern Gulf of Mexico

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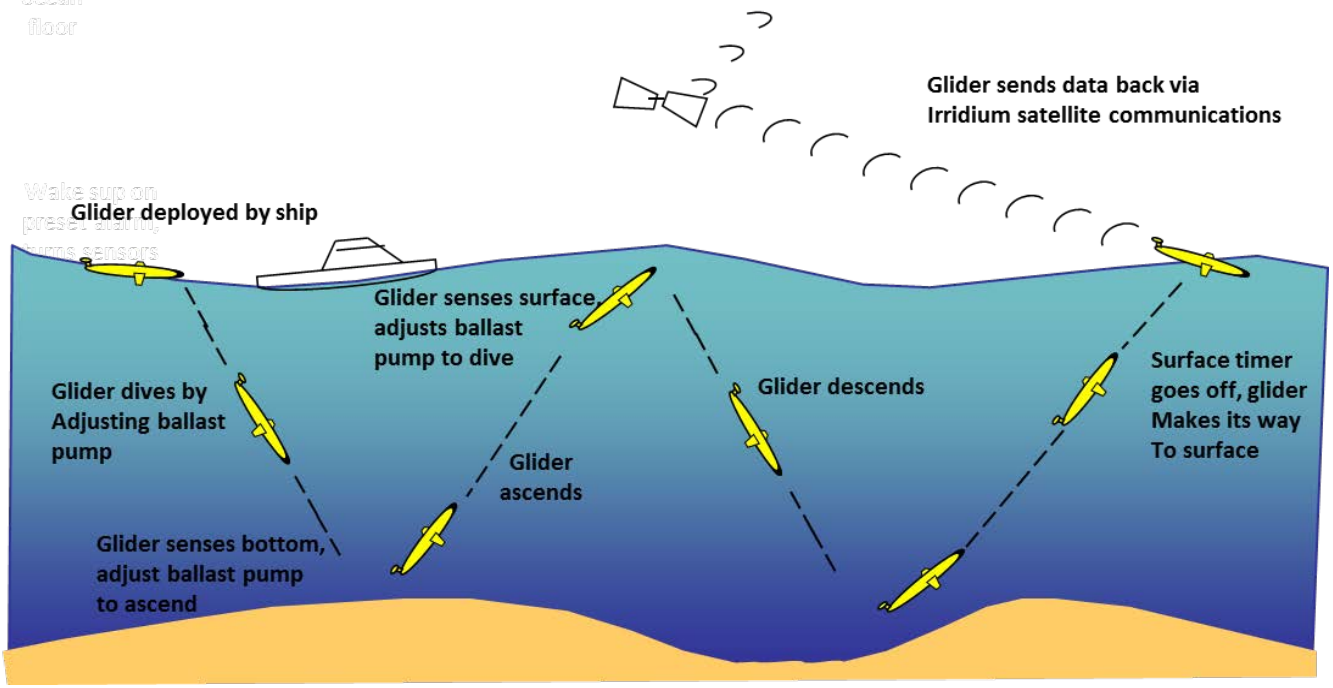
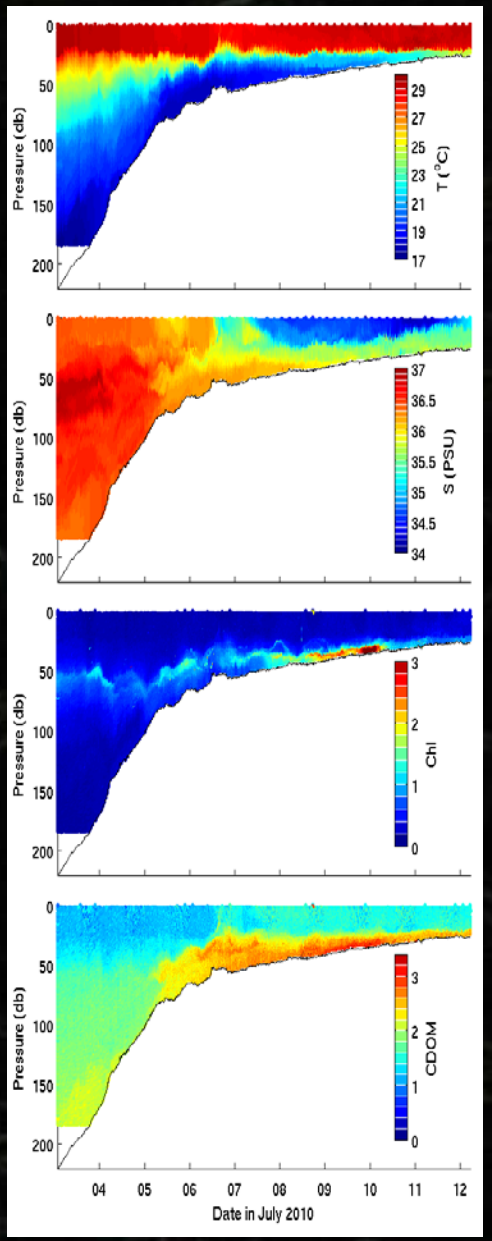
Underwater Gliders

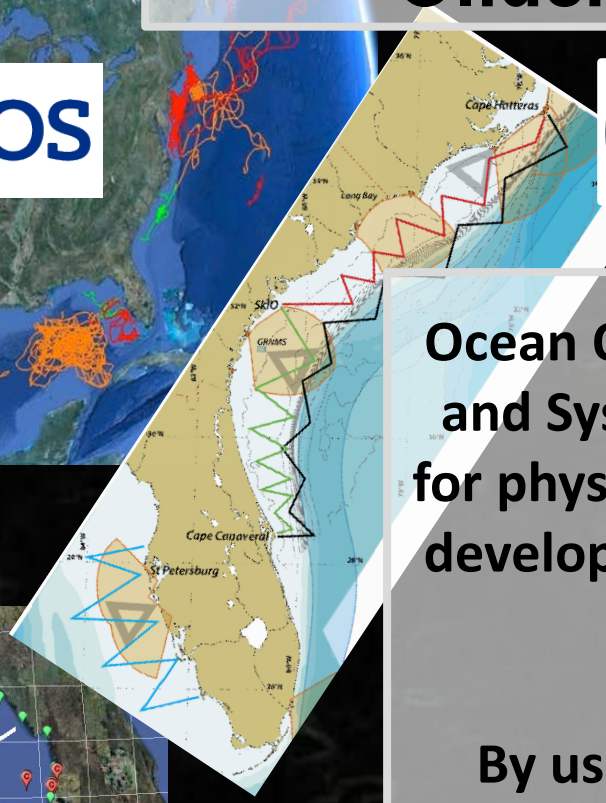
Underwater gliders are autonomous vehicles that profile vertically by controlling buoyancy and move horizontally on wings.

Russ Davis





IOOS / GCOOS / SECOORA Glider Planning



SECOORA
Southeast Coastal Ocean Observing Regional Association

Ocean Observing Technologies and Systems were developed for physics, but are increasingly developing biological products and insight.

By using observing system infrastructure, can we gain insight valuable to stock assessment?

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Can We Use Gliders to Collect Data Helpful to Stock Assessment Managers?

Integration and analysis of 3 acoustic technologies to map and assess fish populations with gliders

- Passive Acoustic Recorders
- Tag Telemetry Receivers
- Echosounders

In addition to CTD, FL, DO

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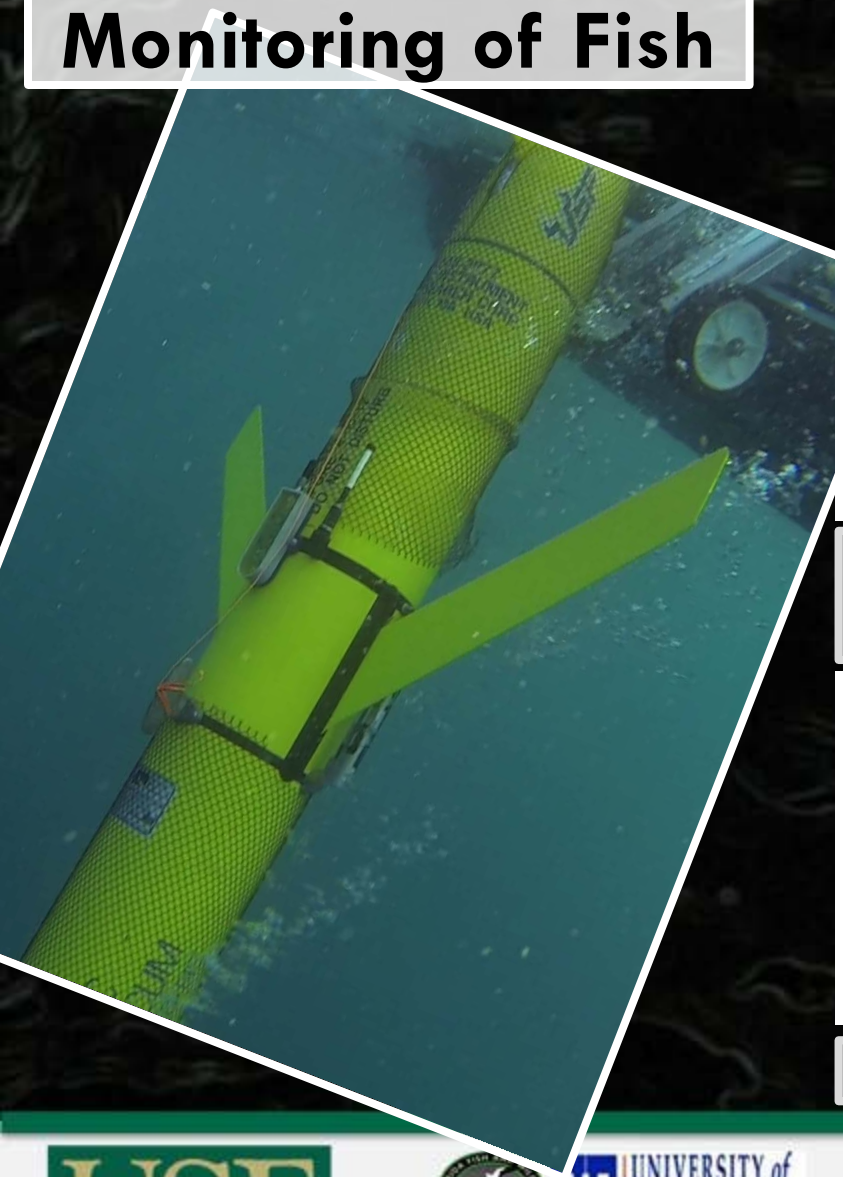
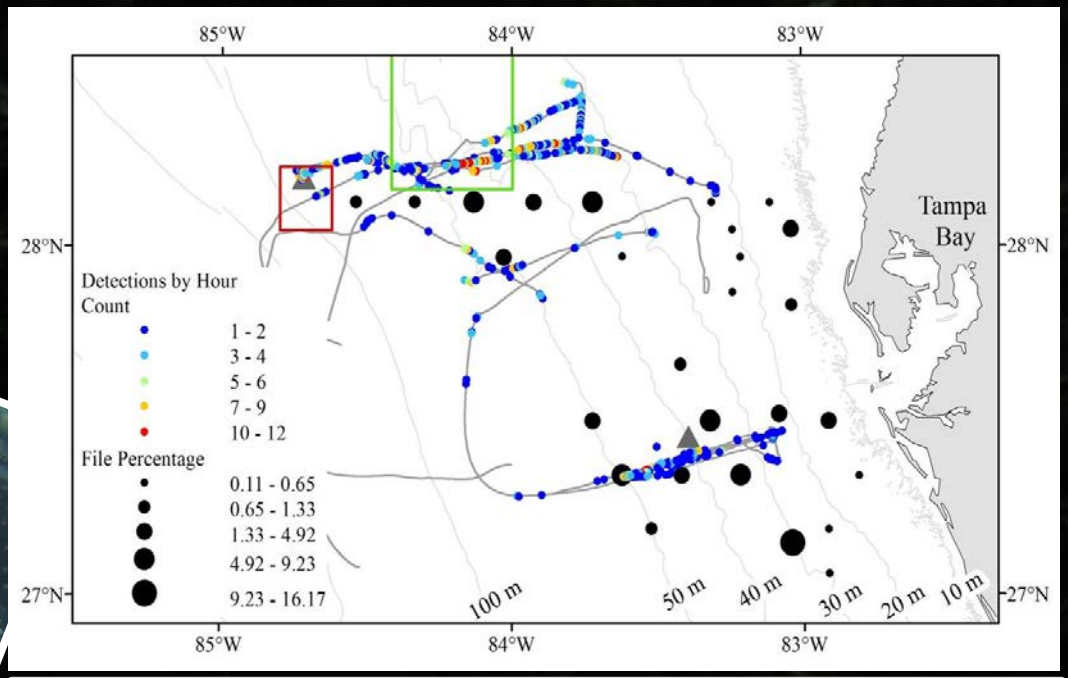
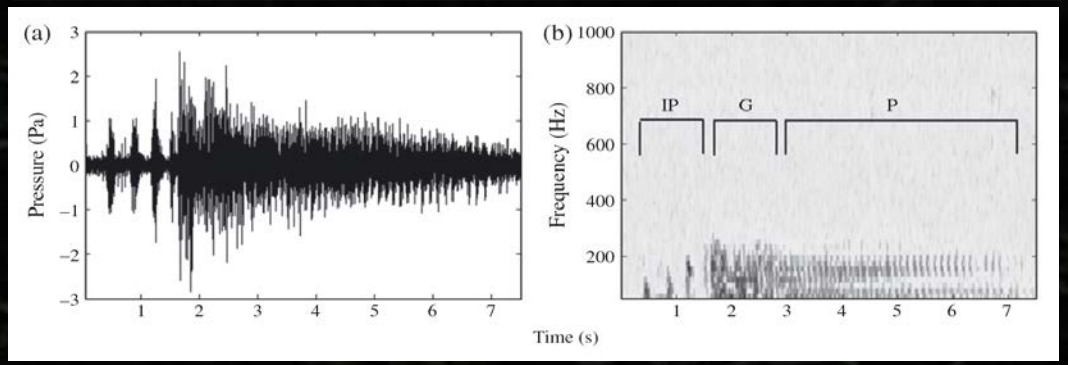
Passive Acoustic Monitoring of Fish





Past Red Grouper Passive Acoustic Monitoring Counts (Wall, et al 2014)



Waveform and spectrogram of Red Grouper

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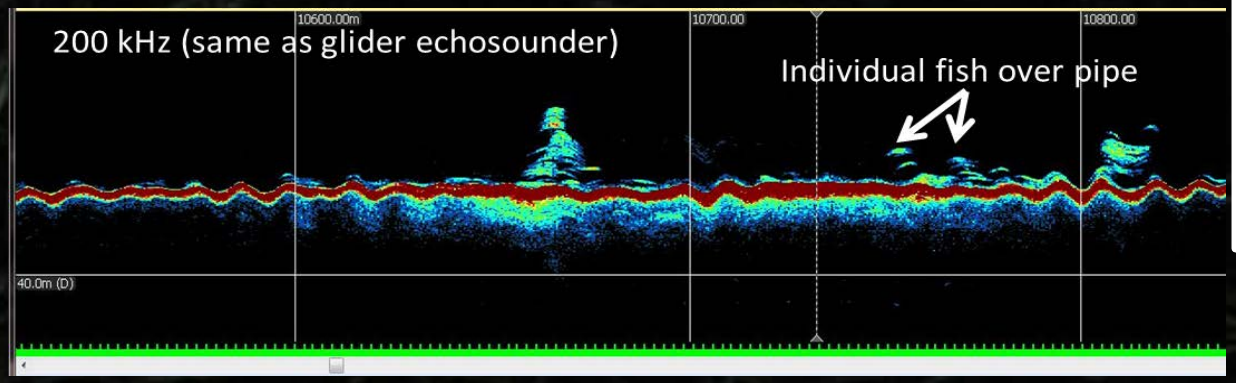
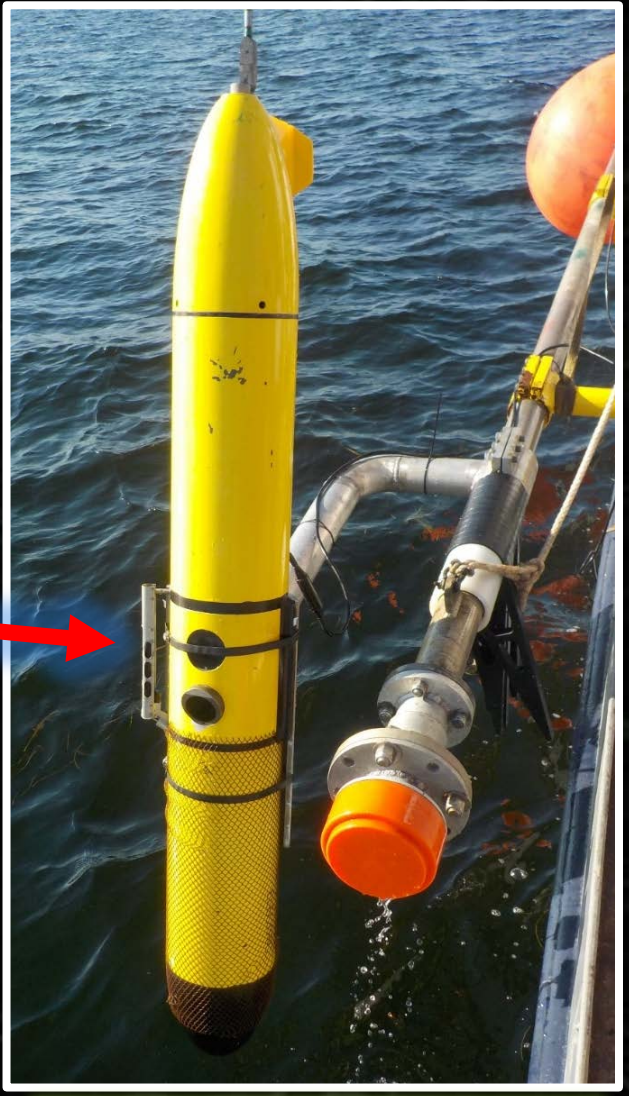
Acoustic Tag Telemetry of Fish

Vemco VMT Attached Externally to Glider Hull for Tag detections

Echosounders on Gliders for Biomass Estimation

ASL Environmental Services Acoustic Zooplankton Fish Profiler (AZFP) 200kHz Echosounder integrated into a Webb Research Slocum Glider for calibrated biomass estimations.





GLIDER ON A STICK©

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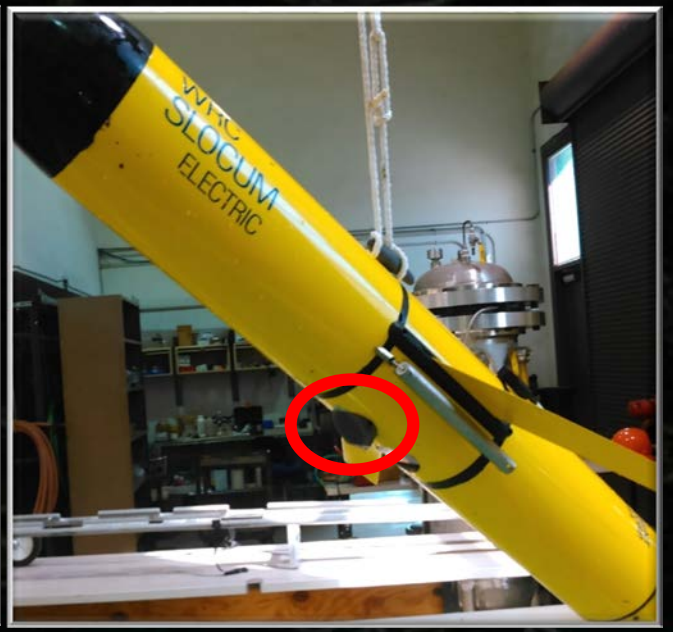
METHODS

- Define a test range in GoM using existing multibeam bathymetry, past video surveys, and local fisheries knowledge (between ~30-55m isobaths).
- Tag target fish.
- Deploy stationary telemetry receivers and passive acoustic recorder moorings.
- Deploy underwater glider seasonally to traverse the within and beyond the test range 4x over a year.



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Test Region

Fish Tagging Zone

Offshore Glider Waypoint (~60m)

Gulfstream Natural Gas pipeline

Inshore Glider Waypoint (~30m)

120

120

300

60

60

Clearwater

St Petersburg

Braden

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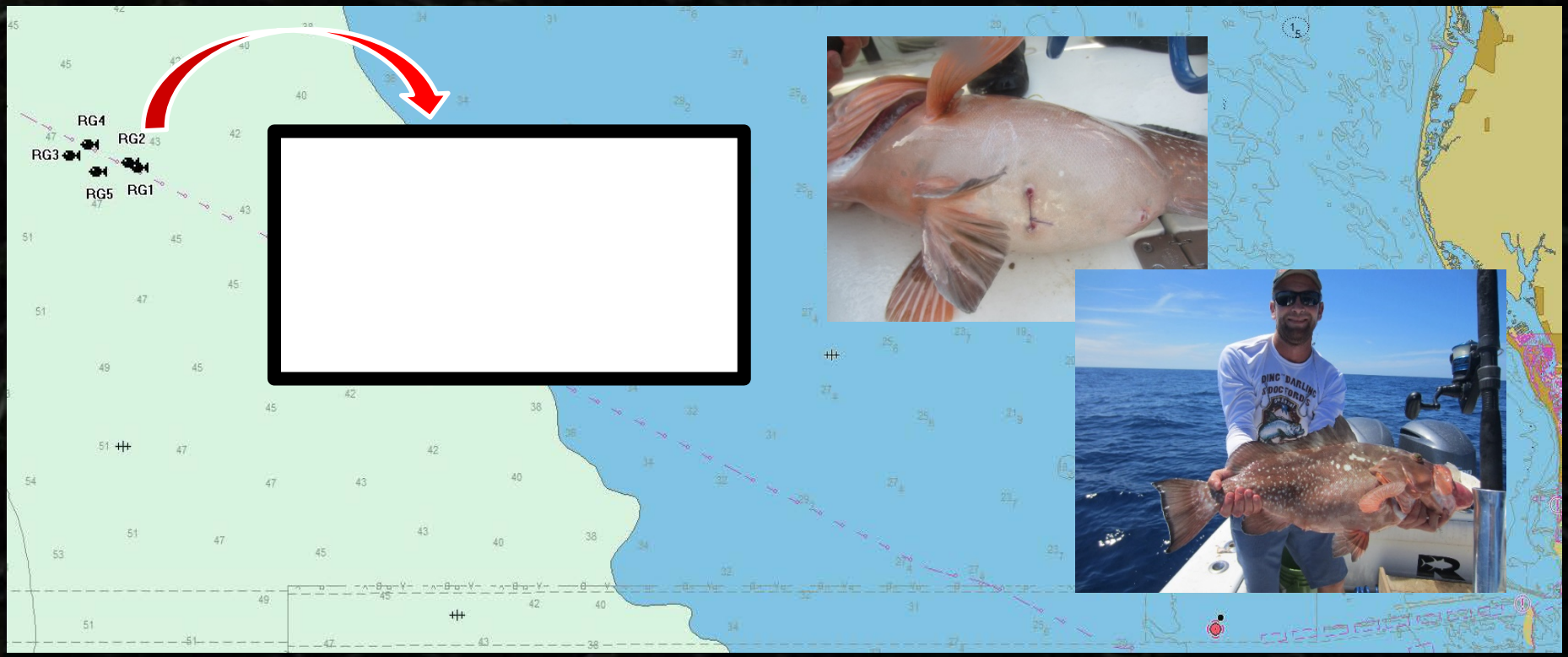
Tagging

- 61 fish (Red Grouper (27) and Red Snapper (34)) tagged at 9 sites near the GSNG Pipeline in ~45m water depth between April 2016 and May 2017
- Each station has a moored Vemco VR2AR receiver and LHI DSG-ST recorder.



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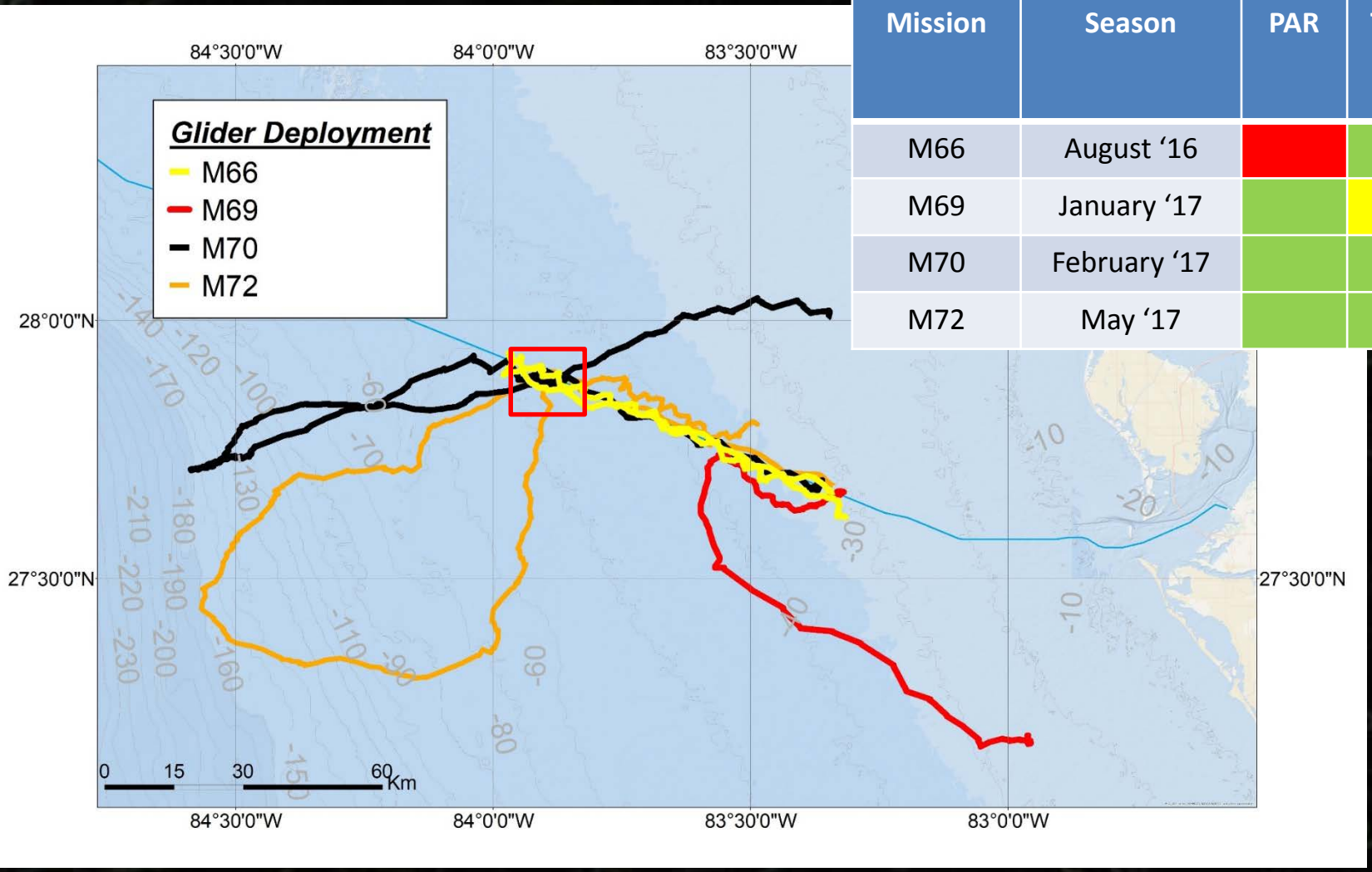
Glider Operations – Preliminary Results



Mission	Season	PAR	Tags	WCA
M66	August '16			
M69	January '17			
M70	February '17			
M72	May '17			

Passive Acoustic Recordings of Red Grouper

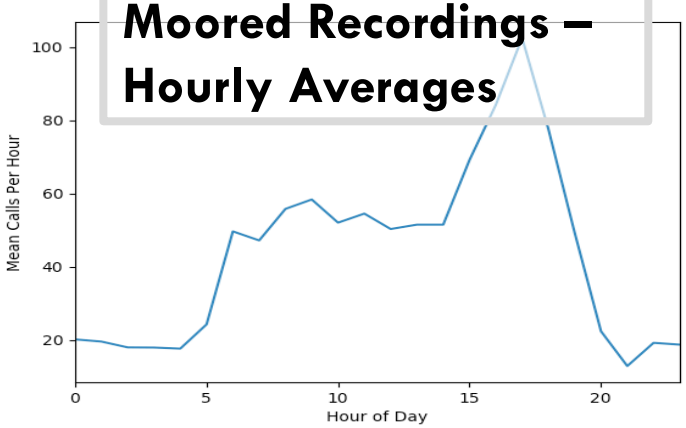
Preliminary Results

Minutes of Recordings	Glider DSG	Remora
Aug 2016	Failed	NA
Jan 2017	2866	3656
Feb/Mar 2017	3133	3329
May 2017	3390	3896

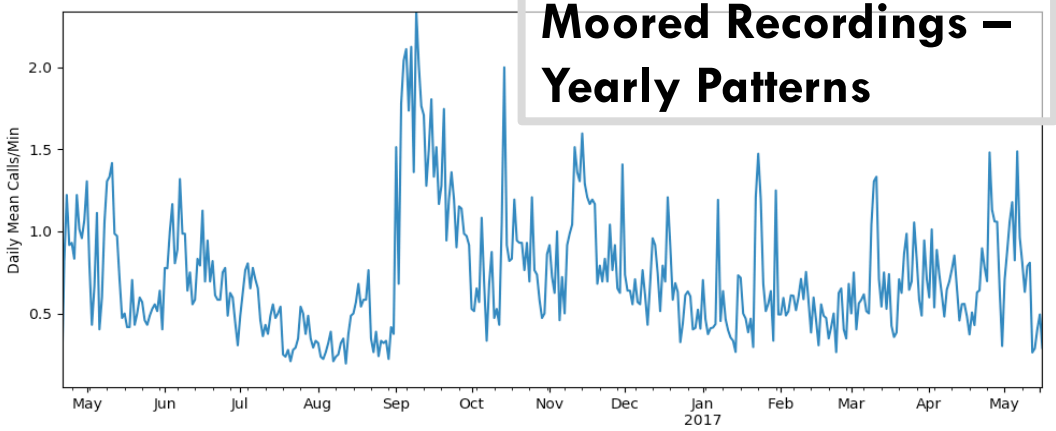
Passive acoustic recordings at 5-9 sites since April 2016, ongoing

Geo-Located Sounds / Minute

Moored Recordings – Hourly Averages



Moored Recordings – Yearly Patterns



Tag Telemetry of Red Grouper / Red Snapper

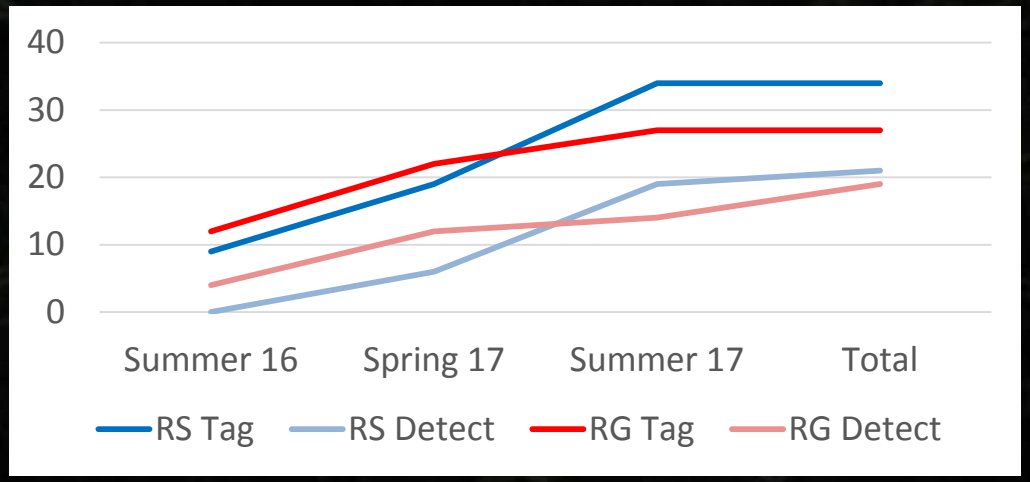
Preliminary Results

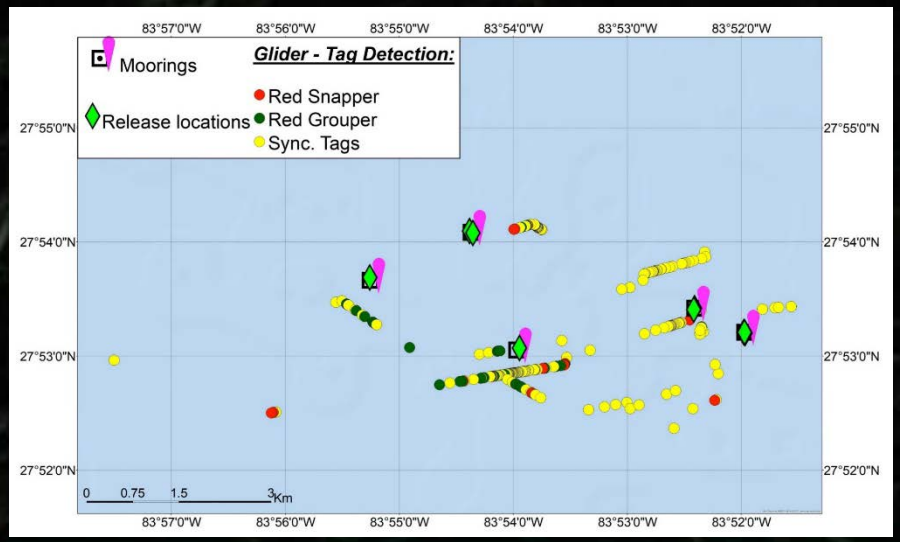
61 fish tagged….

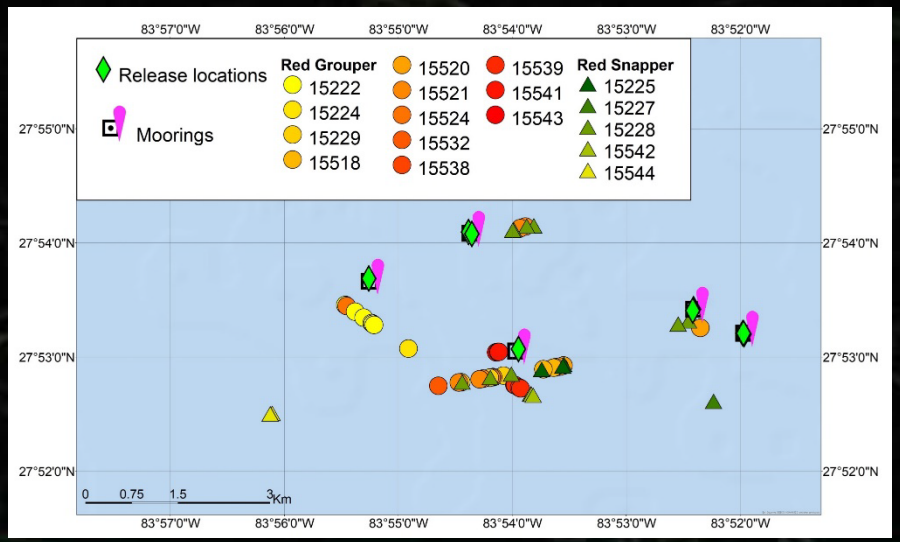
- **29 Red Grouper**
- **34 Red Snapper**

Glider Based Detections Over a Year of Deployments….

- **70% of Red Grouper**
- **62% of Red Snapper**







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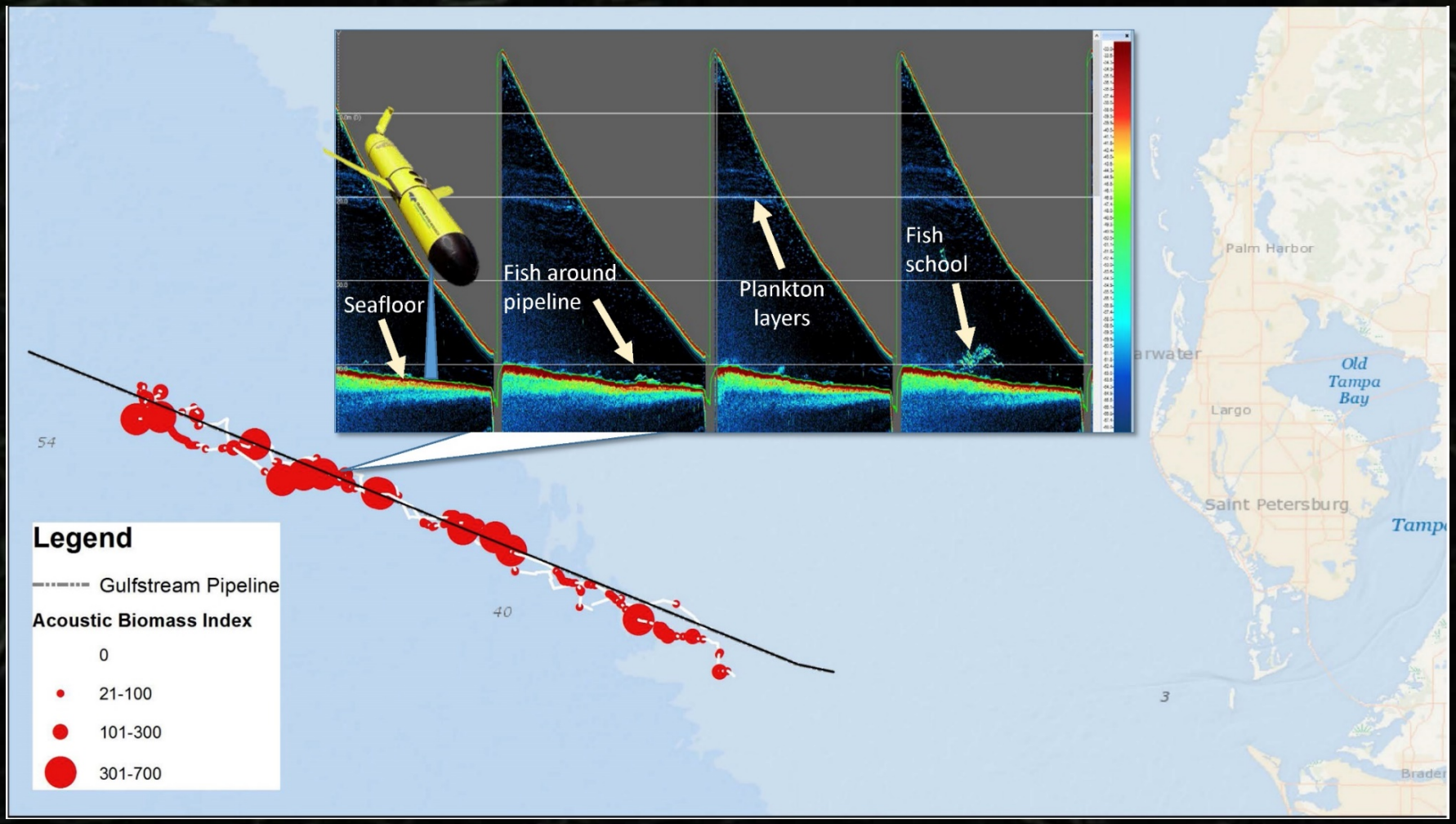
Echosounder Acoustic Biomass Mapping

Preliminary Results



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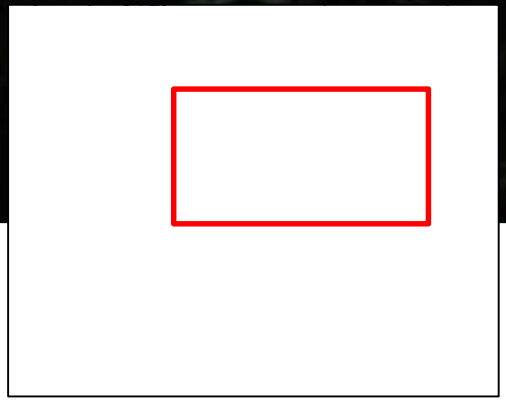
Combining Data Sets

Preliminary Results - Mission 72, May 2017

Passive Acoustic Recordings of Red Grouper

Combining Data Sets

Preliminary Results - Mission 72, May 2017



Passive Acoustic Recordings of Red Grouper + Echosounder Biomass….

Combining Data Sets

Preliminary Results - Mission 72, May 2017

Tag Telemetry Pings…
Snapper = Squares
Circles = Grouper

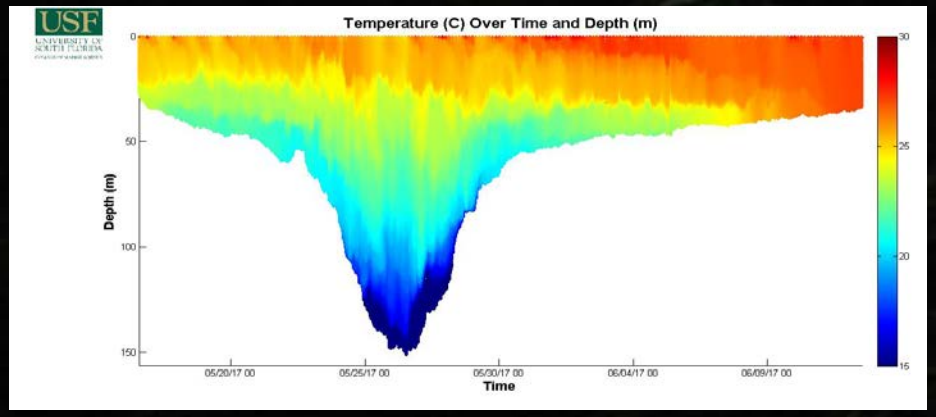
Combining Data Sets

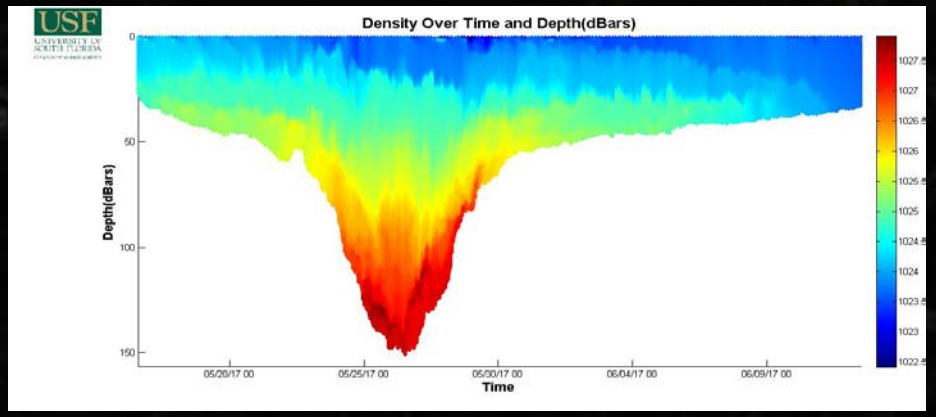
Preliminary Results - Mission 72, May 2017

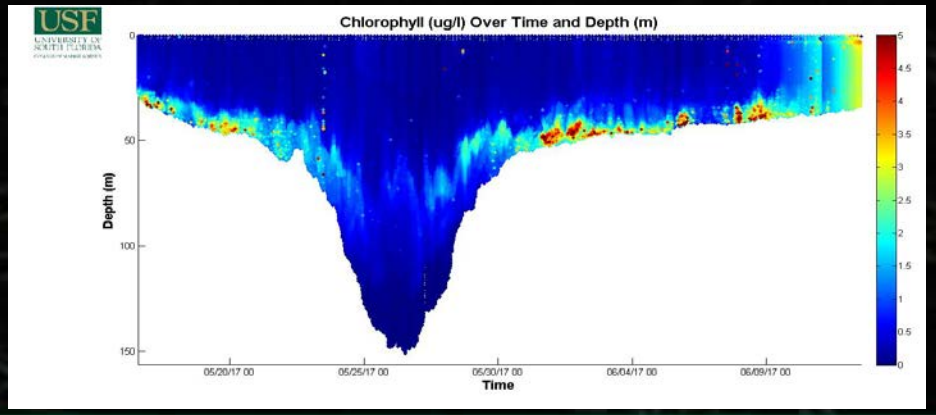
Tag Telemetry Pings…
+ Passive Acoustic Recordings
+ Echosounder Biomass

Combining Data Sets

Preliminary Results - Mission 72, May 2017







Tag Telemetry Pings…
+ Passive Acoustic Recordings
+ Echosounder Biomass
+ Temperature, Salinity, Density, Currents, Fluorescence (Chl, CDOM, etc), Dissolved Oxygen…

Data Distribution

- Real Time Glider Data to IOOS National Glider DAC then to GTS / NGDC
- Displayed on GCOOS and / or SECOORA Data Portals
- Post Deployment Data Shared with iTAG
- Archival at GRIIDC

IOOS

GULF OF MEXICO COASTAL OCEAN OBSERVING SYSTEM
GCOOS

SECOORA
Southeast Coastal Ocean Observing Regional Association

Integrated Tracking of Aquatic Animals in the GOM
iTAG

GRIIDC

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What Can Data Collected Help Understand?

- How do the glider and fixed receiver detections compare?
- How do the spatial distributions from the three data sources (tagged fish, fish sounds, fish mapped using the echosounder) compare?
- Do red grouper / snapper exhibit site fidelity or migration?
- Does red grouper /snapper distribution vary temporally?
- Can cost correlations across spatial and temporal scales be compared?
- Can variations in distribution correspond to environmental data? (ChlA, Dissolved Oxygen, Temperature, Circulation)

Thank You

Acknowledgements

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