39th Annual Meeting of the

Florida Chapter of the

American Fisheries Society

April 3rd –5th, 2019

FFA Leadership Camp

Haines City, Florida

The Florida Chapter of the American Fisheries Society

Chapter Officers

President: Nick Trippel, FWC
President-Elect: Bob Heagey, FWC
Past President: Jeff Hill, UF
Secretary-Treasurer: Kevin Johnson, FWC

Major Contributors for our Annual Meeting

Webmaster: Eric Sawyers, FWC
Newsletter Editor: Scott Bisping, FWC
Raffle Co-Chairs: Amanda Croteau & Chelsey Crandall, UF
Student Travel Awards: Chuck Cichra, UF
Roger Rottmann Memorial Scholarships: Chuck Cichra, UF
Rich Cailteux Award: Eric Nagid, FWC
Membership Database Manager: Larry Connor, FWC (retired)

Special thanks to

Symposium participants & all presenters

All moderators & judges

39th Annual Meeting of the Florida Chapter American Fisheries Society
April 3-5, 2019

FFA Leadership Camp, Haines City, Florida

Wednesday, April 3rd

11:00am – 6:00pm	Registration
1:00pm – 1:10pm	Welcome and Announcements
1:10pm – 3:40pm	Contributed Papers
3:50pm – 5:10pm	**Symposium: Technology- the Catch in Fisheries**
5:10pm – 7:00pm	Poster Setup
6:00pm – 7:00pm	Dinner
7:00pm – 8:00pm	**Formal Poster Session**
	Followed by BONFIRE SOCIAL

Thursday, April 4th

7:00am – 8:10am	Breakfast
7:00am – 6:00pm	Registration
8:10am – 8:15am	Announcements and Welcome
8:15am – 12:00pm	**Symposium: *Technology- the Catch in Fisheries***
12:00pm – 1:15pm	Lunch
12:10pm – 1:10pm	Optional Workshop: New Technology for Fisheries
1:15pm – 5:00pm	**Symposium: *Technology- the Catch in Fisheries***
5:00pm – 6:00pm	Student Subunit Meeting
6:00pm – 7:00pm	Dinner
7:00pm – 8:00pm	**Chapter Business Meeting & Award Presentations**
	Student Awards: *Travel and Roger Rottmann Scholarship*
	Professional Awards: *Rich Cailteux Award*
	Followed by the RAFFLE, AUCTION & BONFIRE SOCIAL

Friday, April 5th

7:00am – 8:10am	Breakfast
7:00am – 9:00am	Registration
8:10am – 8:15am	Announcements
8:15am – 12:05pm	Contributed Papers
12:05pm – 1:00pm	**Lunch & Awards presentation:**
	Best Papers/Best Posters
	Power Tie
	Lampshade Awards

Day-By-Day Agenda – 39th Annual Meeting, 2019 - Florida Chapter American Fisheries Society

Wednesday, April 3rd
11:00am – 6:00pm **Registration**
1:00pm – 1:10pm **Welcome – Nick Trippel, Chapter President**

Contributed Papers 1 **Moderator:** Nick Trippel, FWC

1:10pm – Meade, M., T. Laberge, D. Carballosa, T. Desporte, Y. Fioyale, and S. Sierra. The use of traditional and contemporary methods for surveying fish fauna in South Florida inland waters

1:30pm – Dluzniewski, T., A. Stanfill, E. Johnson, and L. Simonton. Investigating Drivers of Winter Shifts in Fish Abundance in the Homosassa River System

1:50pm – Hatcher, H., A. Strickland, and S. Bisping. Preserving a Potential State Record Fish

2:10pm – Break

Contributed Papers 2 **Moderator:** Drew Dutterer, FWC
2:20pm – *Schulz, K., P. Stevens, J. Hill, A. Trotter, J. Ritch, J. Patterson, and Q. Tuckett. Exploring Fisheries Aspects of Large-Scale Habitat Restoration in Tampa Bay

2:40pm – Jones, S., B. Thompson, and D. Nelson. Estimating the population change from vegetation expansion at Lake Griffin, FL

3:00pm – Trotter, A., J. Ritch, J. Carroll, D. Westmark, K. Cook, and K. Rynerson. Analysis of reproductive hormones as an indicator of skipped reproduction in a protandric hermaphrodite, Common Snook (*Centropomus undecimalis*)

3:20pm – *Lipscomb, T., A. Wood, S. Ramee, M. DiMaggio. Characterization of Larval Digestive System Ontogeny in *Gymnocorymbus ternetzi*: Progress Toward Feeding Optimization

3:40pm – Break

Symposium – *Technology- the Catch in Fisheries*
Moderator: Eric Weather, FWC
3:50pm – *Ilich, A., J. Brizzolara, S. Grasty, J. Gray, M. Hommeyer, C. Lembke, S. Locker, A. Silverman, T. Switzer, A. Vivlamore, and S. Murawski. Mapping Benthic Habitat and Estimating Reef Fish Abundance using Towed Underwater Video and Multibeam Acoustics on the West Florida Shelf

*Student Presentation, Presenter

4:10pm – Moncrief-Cox, H., J. Carlson, G. Norris, M. Wealti, B. Deacy and E. Scott-Denton. Development of video electronic monitoring systems to monitor smalltooth sawfish (*Pristis pectinata)* interactions in the shrimp trawl fisheries of the southeastern United States, with application to other protected species and large bycatch

4:30pm – Moncrief-Cox, H., S. Gulak, A. Mathers, M. Enzenauer, and J. Carlson. Improving Observer Programs through Incorporation of a Data Transfer Application on Tablet Computers

4:50pm – *Vecchio, J.L, and E.B. Peebles. Fish eye-lens isotopes as indicators of larval distribution on the West Florida Shelf

6:00pm – 7:00pm **Dinner**
7:00pm – 8:00pm **Formal Poster Session** (Beverages and snacks in the poster area)
Followed by BONFIRE SOCIAL

*Student Presentation, Presenter

Poster Session (7:00pm – 8:00pm)
(In alphabetical order by presenting author)

Anderson, C., T. Lange, D. Richard, G. DelPizzo, B. Fontaine, A. Bernhardt, T. Tuten and J. O'Connor. Satellites, Sondes, and Shallow Water Fishes: A Habitat Restoration Evaluation

Asp, E., Q. M. Tuckett, L. Lapham, and J. E. Hill. Invasion Potential of Common Pomacentrids in the Marine Aquarium Trade

Barbara, B., K. Flaherty-Walia, A. Collins, and D. Jones. Comparing Goliath Grouper presence to reef fish community structure: An assessment of artificial reefs in the eastern Gulf of Mexico

Crandall, C. and K. Lorenzen. Citizen science, participatory research, public engagement in the process of science… what exactly are we doing and what should we call it?

*Eggenberger, C., R. Santos, T. Frankovich, C. Madden, J. Nelson, and J. Rehage. Habitat preference and resource use of Common Snook (*Centropomus undecimalis*) in altered coastal Everglades lakes

*Espriella, M. and V. Lecours Using Geographic Object-Based Image Analysis to Characterize Oyster Reefs: A feasibility Study

*Kircher, L., D. Frazier, J. Young, and J. Baldwin. Does High Discharge Cause Movement from Snook Spawning Aggregations?

*Lapham, L.[1], Q. Tuckett[1], and J. Hill. Risk-Based Approach to Evaluate Alligator Gar Atractosteus spatula Aquaculture in Florida

*Lewis, J.P., J.H. Tarnecki, S.B. Garner, D. D. Chagaris, and W. F. Patterson III. Changes in reef fish community structure following the *Deepwater Horizon* Oil Spill

Lindelien, S., A. Dutterer and C. Anderson. Developing a Non-lethal Aging Method Using Largemouth Bass Dorsal Spines Collected in Florida

Marbury, A. Seasonal Use and Residence Time of Morones in Silver Glen Springs, FL

*Moreno M. and W. Pine. Using living data to inform restoration and monitoring: An example from Lone Cabbage Reef

Neidig, C., M. Lee, J. Gill, W. Derr, W. Wolf, M. Hickey, G. Cuddihy, G. Sato, and D. Roberts. Electronic Monitoring - Emerging Technology and Platform for Science in the Gulf of Mexico Commercial Reef Fish Fishery

O'Connor,J., C. Anderson, and T. Tuten. Distribution and Status of Blackbanded Sunfish *Enneacanthus chaetodon* in Florida

*Student Presentation, Presenter

Ritch, J., A. Trotter, and P. Stevens. Using Geomorphic Proximity as a Tool to Better Understand Fish Habitat Use in Coastal Rivers

*Schwartz, M. The Effects of Nutrient Reduction on the Water Quality and Largemouth Bass *Micropterus salmoides* Population in Lake Alice, Gainesville, Florida

*Sowaske G., S. Woolley, T. Lipscomb, and M. DiMaggio. Evaluating Larviculture Protocols for Pelagic Spawning Marine Ornamental Species

Steward, C. Creating an effective poster

Viadero N., J.A. Massie, R. O. Santos, and J. S. Rehage. Bass in the Coast: Patterns of Seasonal Habitat Use by Florida Largemouth Bass in the Upper Shark River, Everglades National Park

*Vecchio, JL, CD Stallings, JS Curtis, AA Wallace, and EB Peebles. The δ^{15}N in teleost muscle and liver tissue varies predictably and can be used as an indicator of site fidelity

Wall, K., S. Lowerre-Barbieri, J. Bickford, H. Menendez, and S. Walters-Burnsed. Red Snapper (*Lutjanus campechanus*) and Red Grouper (*Epinephelus morio)* movement in the eastern Gulf of Mexico

*Weeks, K. and R. Tharp. Stomach Content Analysis of *Cichlasoma urophthalmus* (Mayan Cichlid) in the Tampa Bay Watershed

*Student Presentation, Presenter

Day-By-Day Agenda - 39th Annual Meeting, 2019 - Florida Chapter American Fisheries Society

Thursday, April 4th

7:00am – 8:10am **Breakfast**
7:00am – 6:00pm **Registration**
8:10am – 8:15am **Welcome – Bob Heagey, Chapter President-Elect, Program Chair**

Symposium: *Technology- the Catch in Fisheries*

Moderator: Brent Winner, FWC

8:15am – Switzer, T., S.F. Keenan, S.L. Parks, E. Weather, S. Stahl, A. Knapp, J. Davis, B. Pittinger, A. Tyler-Jedlund, N. Roman, R. Munnelly, J. Herting, T. VanDoornik, C. Michael, J. Petty, and R.F. Heagey. Incorporating technology to improve the utility of fishery-independent survey data: ongoing efforts by the state of Florida

8:35am – Weather, E., R. T. Munnelly, T.S. Switzer, and S.F. Keenan. The incorporation of hydroacoustics into reef fish video surveys in the eastern Gulf of Mexico

8:55am – Davis, J., T. Switzer, S. Keenan, and A. Knapp. Not all low-relief habitats are created equal: insights into the varied quality of reef habitats in the eastern Gulf of Mexico

9:15am – Parks, S.L., T. Switzer, K. Thompson, S. Keenan, H. Christiansen, B. Pittinger, A. Tyler-Jedlund, N. Roman, J. Herting, R. Maloney, C. Michael, and R. Munnelly. Length estimation of reef fishes from stereo-baited remote underwater video (S-BRUV) arrays in the eastern Gulf of Mexico: Adapting to evolving technologies without sacrificing science

9:35am – Break

Symposium: *Technology- the Catch in Fisheries*

Moderator: Alexis Trotter, FWC

9:50am – Neidig, C., D. Roberts, M. Lee, J. Steinwachs, T. Taccardi, R. Ryterman, D. Law, B. Hilbrunner, and S. Hayes. Electronic Monitoring - Emerging Technology and Platform for Science in the Gulf of Mexico Commercial Reef Fish Fishery - Pilot Investigations - Underwater Camera and Digital Ruler

10:10am – Weidner, T., D. Gandy, S. Parks, and T. Switzer. Evaluating sampling bias in estimates of size composition of four managed reef fishes as determined from underwater stereo-video surveys.

10:30am – Bradshaw, C.B. and S. Brown. Taking a swipe at updating commercial fisheries reporting

10:50am – Break

*Student Presentation, Presenter

Symposium: *Technology- the Catch in Fisheries*

Moderator: Jeff Hill, UF

11:00am – Garner, S.B. and W.F. Patterson. Comparing video-based methods for collecting reef fish length measurements with micro remotely operated vehicles

11:20am – Dutterer, D. Trophy bass telemetry—cracking the riddle of Kingsley Lake

11:40am – Thompson, B. and N. Feltz. Evaluation of tools used to assess delayed mortality for Florida Largemouth Bass in summer fishing tournaments

12:00pm – 1:15 Lunch and optional workshop –"Autonomous Data Collection" Michael Higgs Higgs Hydrographic Tech

Thursday PM

Symposium: *Technology- the Catch in Fisheries*

Moderator: Brent McKenna, FAU

1:15pm – Flaherty-Walia, K.E., B.J. Williams, B. Barbara, B.L. Winner, T.S. Switzer, S.F. Keenan, P.W. Stevens, and T.C. MacDonald. Fish communities associated with hard bottom habitats in Tampa Bay; new methodology for an undersampled habitat

1:35pm – Winner, B., T.S. Switzer, C.H. Purtlebaugh, J. P. Davis and S.F. Keenan. Utility of a habitat-based, fisheries-independent hooked-gear survey for characterizing reef fish populations in the eastern Gulf of Mexico: Are All Anglers 'Created' Equal?

1:55pm – Purtlebaugh, C.H. and J. Polasik. Range expansion and movement of Common Snook, *Centropomus undecimalis*, in the Cedar Keys area, Florida

2:15pm – Break

Symposium: *Technology- the Catch in Fisheries*

Moderator: Chelsey Crandall, UF

2:30pm – Roberts, D., C. Neidig, M. Lee, J. Steinwachs, T. Taccardi, and R. Schloesser. Exploratory Use of Electronic Monitoring to Spatially Characterize Distribution and Catch of Targeted Reef Fish and Bycatch along the West Florida Shelf

2:50pm – Johnson, K. and C. Bodine. Remote Sensing Technology in Support of Freshwater Fisheries Monitoring, Management, and Research

3:10pm – Stevens, P.W., G.R. Poulakis, D.A. Blewett, A.A. Trotter, and J.L. Ritch. Identification, protection, and restoration of fish nursery habitats: spatial considerations and use of technology

*Student Presentation, Presenter

3:30pm – E.V. Camp, K. Lorenzen, and R. Arhens. Effects of artificial reefs on recreational fisheries: what we don't know might hurt us

3:50pm – Break

Symposium: *Technology- the Catch in Fisheries*

Moderator: Bob Heagey, FWC

4:05pm – *Bowers, B. and S. Kajiura. The Migratory Range of Blacktip Sharks, *Carcharhinus limbatus*, in the Western Atlantic

4:25pm – *Vasbinder,K., C. Ainsworth, G. Zapfe, R. Weisberg, and Y. Liu. Larval Vertical Migration Patterns and Their Impact on Larval Dispersal in the Gulf of Mexico

4:45pm – Symposium Wrap-up/Discussion

5:00pm - Announcements – Bob Heagey
5:00pm – 6:00pm **Student Subunit Meeting** (all students please attend)
6:00pm – 7:00pm **Dinner**
7:00pm – 8:00pm **Chapter Business Meeting & Awards** – everyone please attend!
Student Awards (*Travel and Roger Rottmann Scholarship*)
Professional Awards (*Rich Cailteux)*
Followed by RAFFLE, AUCTION & bonfire social

*Student Presentation, Presenter

Day-By-Day Agenda – 39th Annual Meeting, 2019 - Florida Chapter American Fisheries Society

Friday, April 5th

7:00am – 8:10am **Breakfast**
7:00am – 9:00am **Registration**
8:10am – 8:15am **Announcements**

Contributed Papers 4 **Moderator:** Earl Lundy, FWC

8:15am – Rubec, P., C. Santi, X. Chen, and Y. Ghile. Predicting Spatial Distributions and Population Numbers of Species Life Stages with Simulated Water Withdrawals from the Lower Peace River-Charlotte Harbor System, Florida

8:35am – DiMaggio, M., T. Lipscomb, Q. Tuckett, A. Wood, S. Ramee, J. Patterson, and C. Watson. Evaluation of Culture Protocols for two Florida Native Ornamental Species: Elassoma gilberti and Pteronotropis *metallicus*

8:55am –*Durland Donahou, A., Q. Tuckett, J. Laich, and J. Hill. Predation as Potential Biotic Resistance to African Clawed Frog *Xenopus laevis* Invasions

9:15am – Hill, J., Q. Tuckett, and C. Watson
The Courts Rule on the Lacey Act: What Does This Mean for Non-Native Species Management?

9:35am –Recks, M. What to Do When the Science Doesn't "Say Anything" – Making Management Decisions and Addressing User Conflicts in Data Poor Fisheries

9:55am – Crandall, C., N. Morales, J. Hazell, and K. Lorenzen. Public meetings: who are we hearing from?

10:15am – Break

Contributed Papers 5 **Moderator:** Lauren Kircher, FAU

10:25am – Lundy, E. and P. Schueller. Developing Models Correlating Water Temperatures With Air Temperatures and Limnological Characteristics

10:45am– Asp, E., M. DiMaggio, A. Durland Donahou, M. Hauville, J. Hill, L. Lapham, K. Lawson, T. Lipscomb, K. Lohr, J. Patterson, A. Pilnick, S. Ramee, K. Schulz, G. Sowaske, S. Thomas, Q. Tuckett, and R. Yanong. Traits and trait change in 48 of the world's most highly-domesticated fishes

11:05am – Gandy, D., R. Gorecki, T. MacDonald, and K. Thompson. Essential nursery habitat of an iconic estuarine-dependent sportfish in Apalachicola Bay, FL using regression trees and spatial hot spot analysis.

11:25am – Norberg, M.J. , M. Recks, and K. Shipley. Incorporating stakeholder desires into Florida's marine fisheries management

11:45am - Nelson, D., B. Thompson, and N. Morales. Categorizing Lake Harris user groups and their opinions of hydrilla and hydrilla management

12:05pm – 1:00pm **Lunch & Awards Presentation**

Jack Dequine Best Student Paper
Best Professional Oral Presentation
Best Poster Presentation – Student & Professional
Power Tie & Lampshade awards

*Student Presentation, Presenter

Abstracts for the 39th Annual Meeting of the
Florida Chapter of the American Fisheries Society

Anderson, C.[1], T. Lange[2], D. Richard[2], G. DelPizzo[2], B. Fontaine[3], A. Bernhardt[3], T. Tuten[1] and J. O'Connor[1]
Poster Presentation
[1] Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, 7386 NW 71st Street, Gainesville, Florida 32653
[2] Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, 601 West Woodward Avenue, Eustis, Florida 32726
[3] Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, 525 Community College Parkway SE, Palm Bay, FL 32909
christopher.anderson@myfwc.com

Satellites, Sondes, and Shallow Water Fishes: A Habitat Restoration Evaluation

Water level stabilization and excessive growth of invasive aquatic plants have contributed to an accelerated rate of lake succession in East Lake Tohopekaliga (ELT). A lake drawdown and subsequent habitat restoration will commence on October 1, 2019. Restoration of the littoral zone habitat will be conducted by controlling monocultures of invasive emergent vegetation via herbicide treatment and prescribed burning. Additionally, woody vegetation, tussocks and associated organic material will be mechanically removed from the littoral zone. The objective of this study is to evaluate the short and long-term impacts to shallow water (≤ 0.61m) fish communities, water quality (e.g., diel dissolved oxygen regimes) and habitat structure/composition (e.g., aquatic vegetation density and depth of organic sediment) across a gradient of habitat restoration and enhancement actions. Pre-restoration sampling was conducted in 2016, 2018, and will be completed in 2019. Post-restoration sampling will be conducted for at least 2 years following the completion of restoration activities in 2020. Gears used in this study include mini-fyke nets, dissolved oxygen logging sondes, and sediment cores, which sample the shallow water fish community, dissolved oxygen regimes, and thickness of the organic sediment, respectively. Qualitative assessments of aquatic vegetation density and species composition are also completed at each site. Whole-lake submersed and emergent vegetation maps for ELT have been made for the pre-treatment condition via EcoSound and EcoSat surveys (BioBase, Minneapolis, MN), respectively. Post-treatment maps for both vegetation types will be made upon completion of the restoration. Data collected will be utilized in a variety of spatial and temporal analyses evaluating the effects of the restoration on the limnological properties of ELT. Understanding the effects that different restoration actions have on those properties will provide managers with an idea of how future restorative efforts may influence the ecology of littoral habitats in lakes.

Asp, E.[1], M. DiMaggio[1], A. Durland Donahou[1], M. Hauville[1], J. Hill[1], L. Lapham[1], K. Lawson[1], T. Lipscomb[1], K. Lohr[2], J. Patterson[2], A. Pilnick[2], S. Ramee[1], K. Schulz[1], G. Sowaske[1], S. Thomas[2], Q. Tuckett[1], and R. Yanong[1]
Contributed Paper
[1]University of Florida, Tropical Aquaculture Laboratory, School of Forest Resources and Conservation, 1408 24th Street SE, Ruskin, FL 33570
[2]University of Florida, School of Forest Resources and Conservation, 6650 Dickman Rd, Apollo Beach, FL 33572
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Traits and trait change in 48 of the world's most highly-domesticated fishes
Trait change due to domestication in hatchery settings is thought to be widespread. Evidence shows that these changes can manifest in as short as a single generation and may be pervasive. Given available data, trait change should be evident at the species level for the world's most highly-domesticated fish species – those species that have been in captivity for generations and have been subjected to selective breeding. Trait data was collected from the literature for 19 traits for fish in the wild. We also collected data from hatchery settings for a subset of traits. We focused on those traits expected to be affected by life in captivity, including oocyte size, degree days for incubation, initial larval size, age and size at sexual maturity, absolute fecundity, and larval duration. Our objectives were to 1) characterize the traits of highly-domesticated species and 2) examine variation in change from wild to domesticated among both species and traits. The group of highly-domesticated species is dominated by those used for food and ornamental purposes. Initial findings indicate that domestication can be detected, even at this coarse level.

Asp, E.[1], Q. M. Tuckett[1], L. Lapham[1], and J. E. Hill[1]
Poster Presentation
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Invasion Potential of Common Pomacentrids in the Marine Aquarium Trade
The demand for marine ornamental fish has led to rising ornamental trade, with a greater volume of exports entering the global market. With increased trade, there is concern that propagule pressures will also increase through the intentional or accidental release of organisms. For marine ornamental fishes such as the highly-invasive Devil Firefish *Pterois miles* and Red Lionfish *P. volitans*, the most likely introduction pathway is through deliberate release by hobbyists which has led to widespread distribution in the Gulf of Mexico and Atlantic Ocean. These two species of lionfish were the only successful marine fish invaders in Florida for decades, until the recent establishment of the Regal Damselfish *Neopomacentrus cyanomos* throughout the Gulf of Mexico, extending north into the Florida panhandle. The most likely introduction pathway for this small damselfish is through global transportation on oil platforms, however, given the recent establishment, impacts are still unknown. Unfortunately, little information was known about these species prior to establishment. However, the successful invasion of *P. miles*, *P. volitans* and *N. cyanomos* along the coast of Florida stressed the need to

proactively, rather than reactively, identify potential invaders prior to establishment. To address this growing concern, this study examined eleven species of pomacentrids imported annually at a volume of over 4 million fish collectively for the aquarium trade, examining *N. cyanomos* and related species of damselfish in more detail to better predict potential impacts. Literature reviews were compiled for each species including information on distribution, biology, control measures, potential Florida distribution, and potential impacts of establishment. Traits were compared among species to identify common potential traits which could affect risk. Information from these biological synopses will be incorporated into risk screening tools in order to aid in decision making and better inform management decisions.

Barbara, B.[1], K. Flaherty-Walia[1], A. Collins[2], and D. Jones[3]
Poster Presentation
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[2]Florida Sea Grant, University of Florida IFAS Extension, Manatee County Government, 1303 17th Street West, Palmetto, Florida 34221
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Comparing Goliath Grouper presence to reef fish community structure: An assessment of artificial reefs in the eastern Gulf of Mexico

Atlantic Goliath Grouper are large, reef-associated predators that display strong site fidelity and, as a result, are vulnerable to overfishing. In the United States, harvest has been prohibited since 1990, and the species has responded favorably to protective measures. Goliath Grouper have an affinity for structurally complex habitat, and as the population recovers, encounters with anglers and divers have increased. These interactions, especially at artificial reefs, have prompted questions from stakeholder groups regarding the relationship between Goliath Grouper abundance and impacts on other targeted reef fish species. Underwater visual surveys (n=170) were conducted seasonally from 2011-2014 on six fixed artificial reef sites along the West Florida Shelf. These sites varied in water depth (3 deep (>20 m); 3 shallow (<20 m)), structural relief, and volume. Relative frequency of reef fish species and counts of Goliath Grouper were recorded at each site during each sampling event. Differences in reef fish community structure were strongly associated with the habitat characteristics of each artificial reef and were primarily driven by water depth. For example, Greater Amberjack and Vermillion Snapper were more prevalent on the deeper sites, while White Grunt were commonly observed on the shallow sites. The high relief sites typically had greater abundances of Goliath Grouper, but no direct evidence was found that Goliath Grouper presence affects the diversity or relative frequency of other reef species at these artificial reef sites. This study provides a description of fish community interactions, seasonal variation, and the value of specific site characteristics on artificial reefs along the West Florida shelf.

*Student Presentation, Presenter

***Bowers, B.[1] and S. Kajiura[1]**
Contributed Paper
[1]Florida Atlantic University, Biological Sciences, 777 Glades Rd. Boca Raton, FL 33431mebowers5@gmail.com

The Migratory Range of Blacktip Sharks, *Carcharhinus limbatus*, in the Western Atlantic

All migratory species initiate their movement in response to some motivational driver. Sharks follow narrow ranges of environmental parameters when migrating large distances. Blacktip sharks, *Carcharhinus limbatus*, migrate south from summer mating grounds in Georgia and the Carolinas when water temperatures drop below 21°C. They overwinter off the coast of southeastern Florida in dense aggregations when sea surface temperatures are below 25°C. As the vernal equinox occurs, they depart from this region and head north again toward Georgia and the Carolinas. Over seventy years ago, Cape Hatteras, NC was identified as a northern boundary for this population. Since then sea surface temperatures have increased 0.85°C. The distribution of many marine species has shifted poleward as oceans have warmed globally. Blacktip sharks have been caught as far north as Delaware Bay, DE but their current migratory pattern remains unknown. This research aims to assess whether shifts in the migratory pattern have occurred due to global climate change. Blacktip sharks were instrumented with acoustic transmitters (n=52) off southeastern Florida. The sharks were passively tracked along the Atlantic Seaboard through collaborative telemetry networks. The migratory pattern and consequent range of 43% (13/30) of all subsequently detected individuals extends from southeastern Florida to Long Island, NY and 27% (8/30) to Delaware. This suggests that a shift in the migratory pattern occurred over the past 70 years. If poleward migratory shifts continue to occur, the seasonal influx of top-level predators, like the blacktip shark, into increasingly higher latitudes may cause cascading effects through the trophic levels of ecologically and economically important species. This research will inform stock assessment of the breadth of migratory range exhibited by the blacktip shark in the western Atlantic. Additionally, the results will be an indicator of the resilience of a top marine predator in a rapidly changing system.

Bradshaw, C.B. and S. Brown
Symposium Paper
FWC FWRI, 100 8th Ave SE, St. Petersburg, FL 33705
Chris.Bradshaw@myfwc.com

Taking a swipe at updating commercial fisheries reporting

Commercial fishers have reported commercial catch via Marine Fisheries Trip Tickets since 1984. This started with paper trip tickets and has progressed to electronic reporting on a desktop application. The majority of landings are reported electronically even though just over 50% of saltwater dealers report with paper trip tickets. We are developing web based reporting, a mobile application to initiate a trip ticket, and a magnetically encoded fisher license cards. We are currently testing this technology with commercial dealers throughout Florida.

E.V. Camp[1], K. Lorenzen[1], and R. Arhens[1]
Symposium Paper
[1] School of Forest Resources and Conservation, Fisheries and Aquatic Sciences Program, University of Florida, 7922 Northwest 71st Street, Gainesville, Florida 32606
edvcamp@ufl.edu

Effects of artificial reefs on recreational fisheries: what we don't know might hurt us

Artificial reefs are increasingly deployed in marine waters to enhancing recreational fishing opportunities and also enhance or restore reef fish populations. Reefs almost certainly alter rates affecting fish populations, fishers and how they interact, such that the net effects to broader fisheries management objectives are not always clear. This may lead to unintended consequences of artificial reefs and may limit their use as an otherwise powerful engagement tool with stakeholders. To provide better understanding of the likely and unlikely outcomes of artificial reef implementation, we develop an integrated socioecological model representing a red snapper in Northwest Florida that has been increasingly enhanced via artificial reefs. The model demonstrates that *both* overall socioeconomic *and* conservation benefits derived from implementing artificial reefs are only possible under relatively specific and narrow assumptions regarding fish and fishers. Under more generally assumptions, artificial reefs may well increase overall fishing related mortality on key reef species, such as red snapper. It is possible that artificial reefs could eventually contribute to shorter harvest seasons for this popular fishery, which would have undesired effects on the nearby coastal communities. These results highlight the importance of understanding spatial dynamics of fish populations and anglers, and also highlight the possibility of using models as engagement tools to help developed shared understanding between managers and fishers.

Crandall[1], C. and K. Lorenzen[1]
Poster Presentation
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Citizen science, participatory research, public engagement in the process of science… what exactly are we doing and what should we call it?

There is no consensus definition for "citizen science". Some call any effort involving citizen volunteers citizen science; others consider a more strict definition, and use broad terms such as "public participation in scientific research" (PPSR) to subsume citizen science, community-based monitoring, participatory action research, crowdsourcing, and other collaborative efforts. One thing that is agreed upon is the importance of defining the terms we use in each field. Engaging the public in research is becoming increasingly popular in fisheries science. However, there remains no clear delineation of what involvement constitutes citizen science. As calls for alternative and supplemental ways to collect fisheries data grow, it is important to clarify terminology and differentiate among approaches to engaging the public in the process of science and in collecting and supplying data for fisheries management. In this study, we review current approaches to characterizing citizen science and participatory research. In addition, we review different objectives that may be reached through a citizen science approach and what those goals mean in terms of program design, target volunteers, and outcomes. The objective is to first move toward a consistent terminology when discussing public involvement in fisheries

research, and second to identify when citizen science is most effectively applied in the context of fisheries research.

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Public meetings: who are we hearing from?
Public meetings are a common way for agencies to gain input from members of the public. However, it is likely that the input obtained in these formats is not representative of the views of stakeholders as a whole. This study uses responses from an online survey of recreational anglers in southwest Florida to compare individuals had never participated in management ("nonparticipants," n=109) with those who had recently attended public meetings ("participants," n=85). Results show that those who participated in public meetings were significantly less satisfied with management overall and felt themselves to be more knowledgeable with regard to the management process and the science behind management decisions. In addition, participants had been fishing for longer and had fished in Florida for longer and were less likely to fish from shore when compared to nonparticipants. Gender differences were also evident, with women representing 24% of nonparticipants but only 15% of participants. Overall, this suggests that anglers who provide input at public meetings may be different from those who do not participate, and that public meetings may be obtaining input from more avid anglers who are less satisfied with management.

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Not all low-relief habitats are created equal: insights into the varied quality of reef habitats in the eastern Gulf of Mexico
Since 2010, the state of Florida has utilized side scan sonar to identify and classify reef habitats to direct reef fish survey effort, and a total of 34 distinct habitat types have been identified to date. Of these, low-relief hard bottom (LRHB), defined as flat (<0.2m of relief) areas of hard bottom generally colonized by benthic biota, comprises the majority of habitat identified. Of a mapped footprint of 6,374.4 km^2, a total of 52.4 km^2 of LRHB has been identified. Although LRHB represents the most commonly identified reef habitat type throughout the eastern Gulf of Mexico, questions remain as to the importance of this habitat type to managed reef fishes.

Accordingly, we analyzed data on habitat and associated reef fish assemblages from 1,387 deployments of stereo baited remote underwater videos (S-BRUV) arrays on sites classified as LRHB from 2014 to 2017. An examination of habitat data observed during video analyses indicated that LRHB classified sites often exhibited varying habitat complexity, and in some instances substrate relief exceeding 0.2m was observed. Results from multivariate analyses on fish communities suggested that habitats classified as LRHB were comprised of a continuum of habitat types of varying quality that in turn supported different reef fish assemblages. Analyses suggested that some reef fish species such as Gray Snapper, Scamp and Lionfishes were more abundant on observed higher-relief habitats, while Gray Triggerfish, Red Grouper and Lane Snapper did not demonstrate a clear habitat preference. The prevalence of LRHB, coupled with the abundance of reef fishes associated with these habitats, indicates this habitat type is important to several managed reef fishes. With movement toward a habitat-specific survey design, additional efforts may be necessary to determine if LRHB can be further partitioned into varying levels of vertical relief and account for an important source of survey variability.

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Evaluation of Culture Protocols for two Florida Native Ornamental Species: *Elassoma gilberti* and *Pteronotropis metallicus*

Freshwater fishes comprise the majority of the volume in the ornamental trade with approximately 90% of the species and varieties captively produced through aquaculture. Commercial production of North American freshwater species for ornamental markets has generally occurred on a small scale. While a significant number of native species have been cultured in captivity, empirical evidence to support management decisions and production goals is limited. Fundamental information regarding reproduction, larval culture, and production techniques is critical when evaluating a species for commercial propagation and these bottlenecks will ultimately dictate the success of domestication and cultivation efforts. The Gulf Coast Pygmy Sunfish *Elassoma gilberti* and the Metallic Shiner *Pteronotropis metallicus* are small bodied species with bright coloration, making for attractive aquarium specimens. While both species are excellent candidates for Florida's thriving ornamental aquaculture industry little is currently known with respect to commercial production protocols. Broodstock of both *E. gilberti* and *P. metallicus* were collected from northwest and west-central Florida to establish populations for subsequent experimentation. Fish were held in a recirculating aquaculture system with various spawning media to simulate aquatic vegetation and conditioned for captive reproduction. Both *E. gilberti* and *P. metallicus* volitionally spawned and a suite of applied culture experiments were carried out. Egg incubation environment (static or upwelling), egg disinfectant dose response (formalin, iodine, and hydrogen peroxide), and first feed type (microdiets or *Artemia*) were evaluated for each species. Growth and developmental milestones were documented from cohorts of cultured larvae. Results from these trials will provide important insights into basic culture techniques for these species and serve as a

foundation for commercial production protocols in the aquaculture of these two promising Florida native fishes.

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Investigating Drivers of Winter Shifts in Fish Abundance in the Homosassa River System
Interactions between marine and freshwater fish communities in spring-fed rivers along Florida's Nature Coast are poorly understood and warrant further investigation. In 2013, the Southwest Florida Water Management Districted (SWFWMD) contracted FWCs Division of Freshwater Fisheries Management (DFFM) to conduct a multi-year study evaluating fish communities in five coastal spring-fed rivers. Due to their connectivity with the Gulf of Mexico four exhibited a seasonal shift in fish species composition, depicting an increase in marine species and a decline in freshwater fish species relative abundance during winter months. Of these systems, the influx of marine species was most evident in the Homosassa River system. Catch rates of large-bodied marine fishes in the Homosassa River increased during winter months, while catch rates of freshwater sportfish significantly decreased. Seasonally, freshwater fish abundance decreased 59% between summer and winter months. Marine species such as the Common Snook were found to be twice as abundant during winter months, while Gray Snapper were 30 times more abundant when compared to summer months. Results from previous studies exhibit distinct seasonal differences in fish abundance, however, the timing of the winter influx by marine fishes and the impacts on freshwater fishes native to the system are still unclear. We will investigate seasonal migration, distribution, and habitat use by marine and freshwater fish species using acoustic telemetry, mark recapture, and electrofishing techniques. This study aims to document the importance of maintaining freshwater flow and habitat which in turn provides opportunities for conservation, restoration and enhancement projects in the Homosassa River system. Data collected in this study may benefit other coastal spring-fed rivers similar in ecological nature (e.g., tidally influenced, history of marine species influx, stable year-round temperature, etc.). The Homosassa River system will provide a model for examining other coastal spring-fed river communities around the state of Florida.

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Predation as Potential Biotic Resistance to African Clawed Frog *Xenopus laevis* Invasions

Domestication of organisms for the pet trade can alter life history and behavioral traits, which has implications for invasion success. However, following introduction and return to a wild setting, the process of feralization can affect trait distributions, selecting for wild-type phenotypes. Selection may be particularly strong during the tadpole stage, which is highly susceptible to fish predators. Therefore, introduced African Clawed Frogs *Xenopus laevis* may face a barrier to survival and spread in the form of biotic resistance from fish predators. At the same time, feral individuals may have evolved greater predator defenses. The freshwaters of Florida contain numerous native and non-native predators, such as Bluegill *Lepomis macrochirus*, Walking Catfish *Clarius batrachus*, African Jewelfish *Hemichromis letourneuxi*, Jack Dempsey *Rocio octofasciata*, and Eastern Mosquitofish *Gambusia holbrooki*. I used three frog populations to test vulnerability to Florida fish predators (i.e., the strength of biotic resistance), including 1) a feral population recently discovered in Riverview in a fishless pond, 2) a domesticated population sourced from a local producer, and 3) a wild population sourced from South Africa. Preliminary results indicate that late stage African Clawed Frog tadpoles had variable survival in the presence of African Jewelfish, Bluegill, Eastern Mosquitofish, and Walking Catfish (mean survival ranged from 6% to 48%), with Walking Catfish consuming the fewest tadpoles. No late stage tadpoles survived in the presence of Jack Dempsey and no early stage tadpoles survived in the presence of Eastern Mosquitofish. This indicates potentially strong biotic resistance to African Clawed Frog invasions if fish can access tadpoles. Management agencies can focus control efforts on fishless ponds by stocking native fish predators to control African Clawed Frogs at the tadpole stage.

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Trophy bass telemetry—cracking the riddle of Kingsley Lake

Among Florida waterbodies, Kingsley Lake stands out for two reasons—it is unusually deep for a natural Florida lake, and it is home to an abundance of exceptionally large Florida Bass (Micropterus floridanus). Each year dozens of trophy bass (≥8 lbs) have been reported from

Kingsley to TrophyCatch, the Florida Fish and Wildlife Conservation Commission's citizen-science, trophy-bass conservation program. The lake has produced 15 of the program's Hall-of-Fame bass (≥13 lbs), more than any other of Florida's 7,700 waterbodies. Several of these bass have exceeded 15 lbs, which is quite rare. Our a priori hypothesis is that thermal stratification of the water column offers a cool-water refuge to bass during summer. Bass that maintain body temperatures closer to a thermal optimum through the year may experience faster growth or decreased natural mortality, allowing more individuals in the population to reach trophy size. Our objective is to confront this hypothesis with measured depth and temperature selection patterns of resident Kingsley Lake bass. We implanted 10 bass, ranging in size from 9–13 lbs, with depth- and temperature-sensing acoustic telemetry transmitters. We followed these telemetered bass for 18 months via a Vemco positioning system (VPS), which allowed for near-continuous three-dimensional tracking. This presentation covers study highlights and results to date.

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Habitat preference and resource use of Common Snook (*Centropomus undecimalis*) in altered coastal Everglades lakes.

Habitat selection by organisms can be driven by a number of factors, including the availability of resources. Nutrient enrichment can alter the quality of landscapes, and thus the availability of resources, with implications for consumer movement and habitat use. In coastal ecosystems, eutrophication can affect the production and distribution of resources, and thus the behaviors and space use of consumers. Understanding how these impacts may be altering animal habitat selection mechanisms and resource use is critical to both management and restoration efforts. Coastal lakes in the Everglades have experienced major changes including higher salinities and nutrient concentrations relative to pre-drainage conditions. These changes in water quality have caused state shifts from SAV-dominated to phytoplankton-dominated primary production in some coastal lakes. In this project, we couple acoustic telemetry methods and stable isotope analyses (SIA) to examine the habitat preference and resource use of Common Snook (*Centropomus undecimalis*) across two neighboring estuarine lake systems of varying trophic state (eutrophic vs. mesotrophic), located in Florida Bay (Florida, USA).

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Using Geographic Object-Based Image Analysis to Characterize Oyster Reefs: A feasibility Study

In Florida, eastern oyster (*Crassostrea virginica*) reefs are important economically and provide a range of essential ecosystem services (*e.g.*, pollutant filtration, shoreline erosion control). However, these services and fisheries are threatened, as there has been an estimated 66% decline in eastern oyster reef area along the Big Bend Coast of Florida since 1982. This decline along a vastly undeveloped coastline presents an opportunity to study the spatial and temporal dynamics of a system without excessive human-induced change. However, sampling oyster reefs is often costly in terms of financial, human, and time resources. Here we present preliminary results on the use of Geographic Object-Based Image Analysis (GEOBIA) to monitor oyster reefs remotely. While standing on an intertidal reef, a hand-held camera was used to capture imagery that was then mosaicked and used to produce a high-resolution digital terrain model. GEOBIA was used to extract live oyster counts and densities from the ortho-mosaic. GEOBIA first segments images by regrouping multiple adjacent pixels into distinct objects based on similarities between spectral, topographic and structural pixel characteristics. Each object was then summarized based on its spectral, topographical and structural components, which informed the classification of all objects into one of four classes: live oyster, dead oyster, surrounding reef elements, and shadow. These results serve as preliminary analysis and will be used to inform a study that will use GEOBIA to classify imagery collected using an unmanned aerial system (UAS). UAS provide a relatively inexpensive method to collect data on intertidal reefs at a very high spatial resolution. The potential of UAS imagery to produce accurate live oyster counts presents a relatively expedient and inexpensive monitoring technique that has the capability of assessing the status of reefs in Florida and elsewhere.

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Fish communities associated with hard bottom habitats in Tampa Bay; new methodology for an undersampled habitat

Hard bottom habitats such as corals, sponges, limestone ledges and artificial reefs are known to support diverse fish communities in offshore areas of the Gulf of Mexico. Less is known about inshore hard bottom habitats in Tampa Bay due to the limitations of traditional fisheries gear (nets). This study was designed to determine the distribution of hard bottom habitats in Tampa Bay, the fish species that are using these habitats, the temporal and spatial use of these

habitats by fish and how fish use these hard bottom habitats in comparison to other habitats within Tampa Bay. Using baited remote underwater video surveys and timed-drop hook-and-line sampling based on current sampling of offshore reefs, we collected data on species composition and abundance for natural and artificial hard bottom habitats within Tampa Bay. Species that have not been or are rarely collected in fisheries-independent monitoring efforts within Tampa Bay were documented. Information on hard bottom habitat use was collected for a variety of economically important species, including reef fish that aren't typically considered estuarine dependent (i.e., Red Grouper). These results suggest that Tampa Bay hard bottom habitats likely function as an extension of nearshore hard bottom habitats and support unique fish assemblages within the estuary. In addition, these habitats probably serve as a nursery for emigrating estuarine-dependent reef fish as they move to shallow nearshore reefs farther offshore (e.g., Gag, Gray Snapper). Hooked gear sampling allowed us to obtain accurate lengths on many of these key estuarine dependent reef fish species and provided data on species that are commonly captured by the recreational fishery. This research will help resource managers prioritize habitat conservation and artificial reef enhancement throughout Tampa Bay and surrounding waters and serve as a model for other estuarine systems along the Florida coast.

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Essential nursery habitat of an iconic estuarine-dependent sportfish in Apalachicola Bay, FL using regression trees and spatial hot spot analysis.

Gulf of Mexico (GoM) estuaries function as critical nurseries for many recreationally-important fishes, providing essential foraging grounds, refuge from predators, and physicochemical conditions needed for growth and survival. Red Drum is an important estuarine-dependent sport fish in the GoM that exhibits extreme plasticity in preferred nursery habitat throughout its range. Although prior studies have documented the importance of seagrasses, salt marshes, and oligohaline backwater areas as important nurseries for Red Drum, little is known about microhabitat use and the factors that influence nursery quality in Apalachicola Bay. We used long-term fisheries-independent data (1999 - 2017) to identify essential nursery habitat via a spatially-explicit hot spot analysis, used classification and regression trees (CART) to model the environmental conditions that affect nursery quality, and determined how habitat use and suitability shifted as Red Drum grew rapidly during their first-year of life. Nursery hot spots primarily occurred near shallow backwater environments including small tidal creeks and fringing marshes. But the distribution of hot spots varied with size, becoming more dispersed as YOYs transitioned to age-1 fish. Salinity overall was one of the best predictors of occurrence in CART models but also varied with size. Mesohaline waters best predicted the occurrence of YOY Red Drum, while polyhaline waters best predicted older fish transitioning to age-1s. Our study provides identification of optimal Red Drum nursery habitat in Apalachicola Bay that will be essential to regional management under future environmental and restoration scenarios.

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Comparing video-based methods for collecting reef fish length measurements with micro remotely operated vehicles

We tested the efficacy of two different video-based methods (i.e., a red laser scaler or stereocameras) for collecting length data from reef-fish communities with micro-remotely operated vehicles. A pool experiment was conducted to compare length estimates of paper fish of known length (i.e., 288, 552, or 890 mm FL) at different distances (1, 2, 3, or 5 m) and rotation levels (0, 5, 10, 15, 20, 25, 30, 35, or 40° from perpendicular) obtained with a traditional laser scaler (75 mm beam separation) versus two sets of stereocameras, with each pair having either a 406 or 762 mm separation distance. A field experiment also was conducted at reef sites in the northern Gulf of Mexico to test stereocamera accuracy under typical ROV operating conditions. In the pool experiment, estimation errors were consistently below the 5% error threshold at distances ≤3 m and at ≤10° rotation for all three methods. However, the stereocameras with 406 mm separation distance produced fish length estimates with <5% error at all distances up to 20° rotation while the stereocameras with 762 mm separation did not exceed 5% at nearly all distance or rotation treatments. Fish length did not significantly affect estimation error. Field measurements of an object of known length exceeded the 5% error threshold in only 4 of 55 (7.3%) cases. Our data show that ROV-mounted stereocameras can increase the number of viable fish length estimates several-fold compared to traditional laser scalers, but that wider camera separation distances are necessary to collect accurate length estimates from fishes at >20° rotation from perpendicular.

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The Courts Rule on the Lacey Act: What Does This Mean for Non-Native Species Management?

Recent court rulings have determined that the U.S. Fish and Wildlife Service (USFWS) lacks the authority to prohibit interstate transport of injurious wildlife under the Lacey Act. The District Court ruling also recognized that non-native species may be considered injurious to some states or regions and not to others. Although many states have done considerable work in non-native species management, states are now incentivized to evaluate their current regulatory framework in light of the recent rulings. We specifically recommend that states (1) adopt risk analysis methods to support non-native species decision making, (2) evaluate risks of current federal injurious wildlife species and add them to state prohibited lists if warranted, (3) evaluate risks of future federal injurious wildlife species listings in the same manner, (4)

strengthen and create partnerships to improve non-native species management, especially across political boundaries, and (5) work closely with American Fisheries Society scientists to draw on their expertise for input, review, and training. We further remind state agencies that the USFWS can still federally prosecute interstate violations of state non-native species regulations under Title 16 of the Lacey Act (wildlife trafficking provisions) if enforcement assistance is needed.

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Preserving a Potential State Record Fish

Landing a state record fish is a once-in-a-lifetime achievement for any angler. However, to be recognized, an angler must certify their catch with an FWC biologist. Biologists are often unable to immediately respond, resulting in a delay (up to 48 hours) before the catch can be certified. Over time, fish can lose weight in several ways including regurgitation, defecation, and water loss. We will evaluate fish weight loss based on preservation method for several species collected by boat electrofishing, including: Bluegill *Lepomis macrochirus*, Black Crappie *Pomoxis nigromaculatus*, Largemouth Bass *Micropterus salmoides*, and Flathead Catfish *Pylodictis olivaris*. Weight loss was compared between fish preserved in a live well with aeration, in a cooler on ice, in a cooler with ice bath, and frozen in a deep freezer. Weights of individual fish were recorded immediately after catch and at specified time intervals up to 48 hours post catch. Values were converted to represent percent change in weight relative to initial weight. Analysis utilized analysis of variance (ANOVA), repeated measures analysis of variance, and Tukey post-hoc honest significant difference test to detect significant variation between preservation methods with respect to percent change in weight. Preliminary results for Flathead catfish indicate significant differences in percent change in weight between preservation methods at 24 (ANOVA, $F=153.39$, $P<0.01$) and 48 (ANOVA, $F=62.89$, $P<0.01$) hours post capture. Flathead Catfish preserved in a live well with aeration exhibited the greatest weight loss for both 24 and 48 hour time periods while fish preserved in an ice bath gained weight over both 24 and 48 hour periods. We plan to evaluate additional species in the spring and summer of 2019. Results could be used to revise FWC suggested fish preservation methods and better inform anglers wishing to preserve potential state record fish.

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Mapping Benthic Habitat and Estimating Reef Fish Abundance using Towed Underwater Video and Multibeam Acoustics on the West Florida Shelf

Traditionally, benthic habitat maps have been created manually. However, scientists are increasingly developing quantitative methods to create habitat maps in a more objective, automated, and reproducible way. Additionally, there has been increased interest in utilizing modern technologies such as high definition video to provide relevant information to support fisheries management decisions in habitats that are either too sensitive (e.g. Marine Protected Areas or Habitat Areas of Particular Concern) or too difficult (e.g. high relief rocky reefs) to sample with more traditional extractive gear types such as bottom trawling.For this study, high resolution multibeam bathymetry and co-registered backscatter data were collected on the West Florida Shelf. Towed underwater video transects were conducted to provide ground truth benthic habitat observations, and to determine fish densities over different habitat types. Full coverage benthic habitat maps were created by georeferencing habitat observations from the towed video, and then using these observations to train a supervised classification model that predicts benthic habitat to the entire study area based on the acoustic signatures of the bathymetry and backscatter data. Concurrently, fish densities over different habitat types were determined from the towed video transects for selected species and extrapolated across the mapped area to generate an estimate of the total abundance of each species within the entire study area. This information can be useful to fisheries managers for assessing fish abundance, determining sampling and survey design, and for identifying essential fish habitat. This research is meant to demonstrate how utilizing multibeam echosounders and towed underwater video can provide complementary information to traditional data sources to improve the efficiency of fisheries management and to inform marine spatial planning and ecosystem based approaches to management.

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Remote Sensing Technology in Support of Freshwater Fisheries Monitoring, Management, and Research

The Freshwater Fisheries Long Term Monitoring (LTM) Program of the Florida Fish and Wildlife Conservation Commission (FWC) began in 2006 with the intent to obtain standardized data that

could be used by managers to determine trends in sportfish abundance, species composition, mortality, growth, size structure, and utilization by anglers for Florida's important freshwater fisheries. The LTM Program has 29 lakes and 11 rivers that are sampled annually for these metrics. With this program in place, there was a growing need to develop efficient methods for collecting habitat information in these lakes and rivers so that habitat quality and quantity could be monitored over time. Managers and researchers in FWC also thought that collecting habitat information could help explain changes in sportfish or fish community data and could help to inform or focus research and management actions. Therefore, our objective was to develop sampling protocols that would provide lake-wide estimates of percent area covered and percent volume infested with submersed and emergent vegetation in lakes and maps of continuous habitat in rivers that are part of the LTM Program. After investigating different techniques used for sampling aquatic vegetation in lakes and habitat features in rivers, we determined that two methods of remote sensing fit our objective. These include hydroacoustic sensing for mapping in-lake submersed vegetation and riverine habitat and the interpretation of satellite imagery for mapping in-lake emergent vegetation. With sampling protocols developed, annual mapping efforts for lakes take place during the peak growing season and began in the summer of 2015; while mapping efforts for rivers began in 2017 and occur during bank-full conditions with 3 to 4 rivers mapped every year.

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Estimating the population change from vegetation expansion at Lake Griffin, FL

Lake Griffin was a renowned bass fishery in Florida prior to 1970. Numerous factors contributed to the decline of the bass fishery at Lake Griffin and by the early 80's, the loss of expansive emergent and almost all submersed vegetation reduced the population and angler effort to a fraction of historical levels. However, restoration activities and nutrient reduction slowly resulted in improved water clarity and by 2011, submersed vegetation began to expand (up to 30% coverage). The improved water quality and habitat has resulted in an increasing trend in bass recruitment, relative abundance for bass and angler catch rates. In fact, angler catch rates for bass at Lake Griffin (0.81 bass per hour) are among the highest for all waterbodies sampled by the FWC. Often, bass fisheries in Florida that demonstrate a rapid change in abundance and angling success benefit from hydrilla. Although hydrilla is present at Lake Griffin, much of the submersed vegetation and best fishing areas are dominated by natives. Although the electrofishing catch rates showed an increasing trend as vegetation increased, the expanding offshore vegetation likely reduced vulnerability to the gear and therefore, may not have accurately represented the continued increase in the population. To further document the magnitude of change to the bass abundance at Lake Griffin, researchers are repeating a population estimate using the same techniques conducted in 2011. In the fall of 2018, 300 bass were tagged with high reward tags and a year-round creel survey began, which aims to estimate the number of bass caught by anglers and the proportion of bass caught by anglers. Information from this study demonstrates how critical native submersed vegetation is for a bass fishery and

can be used by mangers to work with stakeholders that contend hydrilla is necessary to produce a high-quality bass fishery.

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Does High Discharge Cause Movement from Snook Spawning Aggregations?
Water managers control Lake Okeechobee water levels by scheduling discharges to the St. Lucie and Caloosahatchee estuaries. The majority of these discharges occur during Florida's rainy season, coinciding with the protracted spawning season of the common snook (*Centropomus undecimalis*). Common snook support a popular recreational fishery in Florida that contributes to the state's economy. Anglers believe that snook are attracted to areas of high flow. While discharges can carry in new sources of prey, it can also carry algal blooms, suspended sediments, and polluted water. Snook will travel to avoid stressors like cold temperatures. Discharges occurring during their spawning season may cause snook to move away from their aggregations and lead to lower spawning success and recruitment. Passive acoustic telemetry measured movement in 280 tagged snook from 2008-2014 (FWC). Snook were tracked over the course of four high discharge events (>2,000 cubic feet per second). Flow in St. Lucie was extracted from dbHydro an open-source online environmental database from South Florida Water Management District. St. Lucie was divided into North Fork, South Fork, Estuary, River, and Inlet and fish were assigned one of these regions for each day they were detected based on their detections throughout the day. Examining the number of fish in each region to the flow occurring at the same time, will allow spatial and temporal comparison of fish movement from the spawning aggregation during high discharge events in St. Lucie estuary. This research should inform management of common snook as well as determine if water management should be altered to promote more successful reproduction of an important recreational species.

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Risk-Based Approach to Evaluate Alligator Gar Atractosteus spatula Aquaculture in Florida
Alligator Gar Atractosteus spatula is imperiled throughout much of its native range, being rare or extirpated in 6 of 14 U.S. states. It is of conservation concern in its small portion of the Florida Panhandle where it is native. Few data exist for Alligator Gar in Florida; therefore, the Florida Fish and Wildlife Conservation Commission implemented a harvest closure in 2006,

making it illegal to take or possess Alligator Gar without a permit. FWC will issue permits for scientific research and management efforts. There is interest in Florida to culture Alligator Gar for food and out-of-state sales as ornamentals; activities currently not permitted. Although Alligator Gar is imperiled, there is concern for invasiveness if regulations are changed to allow for commercial aquaculture in Florida. Before making decision concerning commercial aquaculture, it is prudent to evaluate the risk of establishment and impact. Risk of invasiveness will be assessed through an extensive literature review and biological synopsis, risk screens, and a stakeholder-inclusive qualitative risk assessment. The biological synopsis will provide considerable information on the species biology and potential invasiveness. Fish Invasiveness Screening Kit (FISK) assessments will provide a preliminary risk estimate. A stakeholder panel will consist of experts in state and federal agencies, academia, or other organizations and will further evaluate invasiveness risk. Research and management recommendations arising from risk-based process will be available to agencies and industry to support decision making regarding permitting, restricting, or prohibiting aquaculture of Alligator Gar.

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Changes in reef fish community structure following the *Deepwater Horizon* Oil Spill
Large-scale disturbances in marine ecosystems can alter food web structure with both acute and long-term consequences. Here, we report the results of a time-series that captured the effects of the Deepwater Horizon oil spill (DWH) on fish community and trophic structure on northern Gulf of Mexico reefs. Immediately following DWH, we observed a significant change in community structure and significantly lower species richness. Declines in species richness did not persist, and long-term changes in community structure, though significant, appear within the range of natural variation. However, initial changes in community structure driven by widespread declines across a range of trophic guilds were not followed by equally ubiquitous recoveries. Densities of small demersal invertivores, small demersal browsers, generalist carnivores, and piscivores remained low with little indication of recovery up to 7 years following the DWH. Although these declines occurred prior to the arrival of the invasive lionfish (*Pterois* sp.), the lack of recovery among small demersal browsers and invertivores suggests lionfish predation may be affecting recovery. However, the cause of persistently low densities of generalist carnivores and piscivores, such as snappers, groupers, and jacks, likely reflects a combination of factors and warrants further exploration considering the ecological and economic importance of these fishes.

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Developing a Non-lethal Aging Method Using Largemouth Bass Dorsal Spines Collected in Florida

Non-lethal aging techniques for Largemouth Bass (LMB) would be an invaluable tool for LMB management and conservation in Florida, particularly for trophy LMB (≥ 3.63 kg). Various fin structures (e.g., dorsal spines, pectoral rays, anal spines, etc.) were recently evaluated for their utility in aging LMB in Florida. Dorsal spines III–V had the highest precision and accuracy of age estimates relative to sagittal otolith derived ages amongst all evaluated fin structures. They were also the easiest to remove and read. Utilizing these structures could reduce or eliminate mortality during age sampling and enable age determination of angler-caught LMB (e.g., during tournaments or TrophyCatch submissions). Future assessments will involve a survival experiment to evaluate acute lethality of dorsal spine removal as well as comparisons of dorsal spine derived ages amongst five waterbodies with different growth rates (i.e., Stick Marsh/Farm 13, Fellsmere Reservoir, Lake Griffin, Apalachicola River, and Escambia River marsh). The process of aging dorsal spines requires substantial practice, understanding the potential imprecisions associated with these fin structures (e.g., misinterpretation of the first annulus, identifying false annuli/checks, and edge compaction of annuli), and adequate equipment for viewing, measuring, and projecting structure sections. Recently, the dorsal spine aging techniques have been integrated into tagging, growth, and mortality studies in collaboration with other Florida Fish and Wildlife Conservation Commission (FWC) biologists throughout the state. Ultimately, a training workshop for removal, processing, and aging techniques will provide FWC personnel with the tools needed to effectively and accurately apply these techniques in future studies.

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Characterization of Larval Digestive System Ontogeny in *Gymnocorymbus ternetzi*: Progress Toward Feeding Optimization

Freshwater ornamental fish production is often hampered by survival and growth bottlenecks associated with larval nutrition. Near ubiquitous use of live feeds during early life stages for the intensive culture of these fishes persists, as apparent physiological limitations preclude the use of manufactured microparticulate diets. In general, freshwater ornamental larvae are fed newly-hatched *Artemia franciscana* nauplii, which is characterized by inconsistent availability and high cost. Representative fishes of the family Characidae, and particularly tetras, appear to require live feeds for larval propagation. However, pragmatic characterization of early digestive

ontogeny for ornamental Characids that may be used to formulate physiology-based rearing protocols is deficient. This study evaluates the reliance of Black Tetra *Gymnocorymbus ternetzi* on *Artemia* during early larval stages. Initially, three commercially available microparticulate diets were compared to *Artemia* (*n* = 6) as feed items for the first 10 days of exogenous feeding, with growth and survival being primary indicators of success. Subsequently, larvae fed exclusively *Artemia* were sampled at 2 day intervals to 24 dph to histologically evaluate gastrointestinal development, as well as characterize the ontogeny of three critical digestive enzymes (bile-salt dependent lipase, trypsin, and pepsin). In agreement with anecdotal accounts, limited survival was observed with microparticulate diets relative to *Artemia* (6.9 ± 2.1% and 20.8 ± 7.3%, respectively), although growth was similar across treatments. Maturation of the stomach, characterized by the appearance of gastric glands and a pyloric sphincter, did not occur until 22 dph. Trypsin and lipase activity were detectable from 2 dph and increased over the course of the study. Pepsin was not detectable until 22 dph, after which a sharp increase in enzyme activity was observed. These results will contribute to the development of appropriate feeding and weaning protocols for the production of *G. ternetzi*.

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Developing Models Correlating Water Temperatures With Air Temperatures and Limnological Characteristics

The discussion of climate change from a natural resource manager's perspective has shifted from forestalling climate change to preparing for, adapting to, and mitigating the overall effects of climate change. However, how do managers prepare for a problem if they do not know the magnitude of its effects? The effects of climate change and concurrent water temperature change on Florida ichthyofaunal communities are largely speculative. We sought to develop a series of models correlating water temperatures with air temperatures and lake characteristics. These models can be used for predictions of climate change effects and invasive species expansion, as well as modeling short-term effects such as temperature-induced mortality events. We chose 49 lakes and reservoirs throughout the state of Florida as monitoring sites with lakes selected based on size, trophic state, and location. Data loggers gathered hourly water temperature data over a two-year period. National Weather Service monitoring stations and other publicly available provided local air temperatures. We modeled the relationship between lake water temperature and area air temperatures and additional factors with multiple linear regressions, examining winter and summer as they represent thermal minima and maxima.

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Seasonal Use and Residence Time of Morones in Silver Glen Springs, FL

Striped Bass (Morone saxatilis) and Sunshine Bass (M. chrysops x M. saxatilis) have been stocked into the St. Johns River since the 1970's, creating a recreational fishery. These Morones species can generally be caught throughout the river and its tributaries in cooler months, but due to high water temperatures during the summer they are confined to cool-water refuges. While restricted to thermal refuge, fish have little, if any, available forage especially when confined to mostly barren spring boils. Biologists have identified Silver Glen Springs (SGS) as one of the largest summer aggregations of Morones in the St. Johns River system. Annual snorkel surveys at SGS have shown declining health and condition factors throughout this period, lasting upwards of 6 months. To further study the temporal and spatial movements of individual *Morone* spp., a pilot telemetry study was initiated in May 2018. A total of 10 fish (1 Striped Bass, 9 Sunshines) from SGS were internally tagged with an acoustic transmitter (Vemco, V9) and 5 receivers (Vemco, VR2W) were deployed throughout the spring run and outflow to Lake George. Results suggest a surprising level of movement in and out of SGS during summer residency, expressed as runs further down the spring run and short (1-2 day) treks into Lake George. As summer progressed however, many fish left the system and never returned, suggesting either mortality or emigration to an alternative thermal refuge. Future efforts will focus on expanding both the sample size and receiver array throughout the Middle St. Johns River.

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The use of traditional and contemporary methods for surveying fish fauna in South Florida inland waters

Traditional methods of surveying fish populations include manual methods such as seining or electrofishing. In recent years, new methods of detecting species using molecular techniques have been developed to complement traditional surveying methods. The use of eDNA (environmental DNA) has become a commonplace method used by many research institutions and environmental agencies. The method has particularly been useful in determining the presence of elusive species including invasive non-natives as well as imperiled endemics. We report here the use of electrofishing and eDNA surveys to detect fish species in South Florida inland waters. Specifically, traditional surveys were conducted in conjunction with water sample collection and identification using species-specific DNA probes. Sites surveyed mainly included the canals and urban watersheds of Miami. At each site, water quality parameters including DO, pH, TDS, conductivity, and temperature were measured before each survey. A

Smith-Root APEX electrofisher™ was used for traditional surveys following standard protocols (EPA-RBP) and a Smith Root ANDe™ eDNA sampling system was used to collect water samples for molecular analyses. Our target species for eDNA surveys were the invasive bullseye snakehead, *Channus marulius*, and the Asiatic weatherfish, *Misgurnus anguillicaudatus*. Many native and invasive species were detected at the sites surveyed. Survey site descriptions, water conditions, and species observed will be detailed.

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Development of video electronic monitoring systems to monitor smalltooth sawfish (*Pristis pectinata)* interactions in the shrimp trawl fisheries of the southeastern United States, with application to other protected species and large bycatch

NOAA Fisheries began placing at-sea observers on commercial shrimping (*Penaeida* and *Sicyonia brevirostris*) vessels in the early 1990s in the southeastern region of the United States (US) to identify and minimize the impacts of shrimp trawling on federally managed species. Recent analysis of bycatch data relative to smalltooth sawfish, *Pristis pectinata*, a federally-listed endangered species, indicated a high level of uncertainty in the estimated take. Due to costs associated with observer coverage, and given the rare event of capturing a smalltooth sawfish, increasing observer coverage to refine take estimates of this species is not considered practical. We explored the use of electronic monitoring (EM) to provide a valid alternative to increased observer coverage for the purpose of documenting fishery interactions with smalltooth sawfish. This system was additionally used to document interactions with other protected species and large teleost and elasmobranch bycatch (>1.0 kg). While no smalltooth sawfish were observed, the catch and safe release of a loggerhead sea turtle, *Caretta caretta*, was documented in the try net by both the EM system and observer. The EM system was used to record commercial shrimp vessel operations during six trips, encompassing 1,733 hours of video over 94 sea days, with a certified fishery observer also being present for the full duration of each trip. Catch composition documented by the EM reviewer was compared to observer data. Overall, 20 tows contained a total of 33 bycatch items in the observer sample that met criteria of being over 1.0 kg. Of these catch items, 87.9% were also detected by the EM reviewer compared to observer data. Detection rates for elasmobranchs were higher in comparison to teleosts, at 95.8%. Pairwise comparison of EM video to data collected by on-board observers (animals >1.0 kg in size) lead us to conclude that EM would be an effective tool for detecting protected resources and larger fauna interactions in the Gulf of Mexico shrimp trawl fishery.

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Improving Observer Programs through Incorporation of a Data Transfer Application on Tablet Computers

To reduce the time and resources needed between data collection and data entry for a fisheries observer program, developments of applications that facilitate the exchange of observer data between a remote version of the database contained on a mobile device and the central database are needed. NOAA Fisheries Service's Panama City Laboratory is undergoing program improvement by incorporating tablets into the data collection process. Advantages of this are expected to include fewer personnel hours focused on data entry, better data processing, and improved validation capabilities, with an overall reduction in cost. By having observers directly input biological data into a tablet, time (and costs) of data transcription from paper form to electronic are reduced, along with opportunities for recording error. Preliminary development and testing of a tablet application found screens did not load rapidly when the observer toggled among them, screen glare and interference from water and biological materials inhibited data entry, and the Iridium network for data transfer was insufficient. In addition to addressing those concerns, the application has been modified to include expanded data validation to remove input errors, integrated photography capabilities for transferring images to the tablet wirelessly, and barcode scanning to advance sample processing methods. Observers are now able to quickly access manuals and species identification guides straight from the tablet's home screen, reducing spatial needs on small vessels, while allowing coordinators to keep these documents updated regularly through remote access software. The developed application further allows for encrypted uploading of data, removing the need to ship hard data through mail services. This eliminates chances of data loss or delay through mishandling, while also protecting confidential information. A third phase of this project is currently under development to address concerns before full implementation can occur, with improvements continually being made throughout the field testing process.

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Using living data to inform restoration and monitoring: An example from Lone Cabbage Reef

"Living" data, data that are continuously collected from field programs or automated sensors, can provide critical information for informing ongoing restoration and monitoring programs in aquatic ecosystems. For example, these data can help inform whether water quality sensors are recording useable data and at what frequency field crews should service the sensors to

ensure their functionality. This reduces the likelihood of sensor failure and missing data observations. However, continuous data can be difficult to manage for several reasons including (1) high volume of observations, (2) limited time to enter, QA/QC, and summarize data during busy field seasons, (3) limited training/experience by biologists in working with large datasets (4) inconsistent methods of surveying. Here we demonstrate a case history of a living data lifecycle for the Lone Cabbage reef oyster restoration project near Cedar Key, Florida using open source widely available, free or low-cost software. We demonstrate how data are collected by field teams on oyster populations and recorded on paper data sheets, as well as water quality data from an array of autonomous sensors are rapidly, compiled, QA/QC'ed, and analyzed to provide prompt feedback to ongoing monitoring programs. These efforts are designed to inform ongoing monitoring programs to improve data quality, reduce cost, and improve restoration actions by assessing system response and adaptively informing ongoing restoration and monitoring efforts. By accelerating the speed of learning of what does and doesn't work, we hope to improve the effectiveness of the Lone Cabbage Reef and to influence other restoration efforts to do the same.

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Electronic Monitoring - Emerging Technology and Platform for Science in the Gulf of Mexico Commercial Reef Fish Fishery

The application of Electronic Monitoring has been shown to be an effective tool to meet a variety of fisheries monitoring objectives in the Gulf of Mexico (GOM). Mote Marine Laboratory EM projects respond to a direct request from the U.S. GOM commercial fishing industry to document their increasing bycatch of sharks and other non-target species in the snapper grouper fishery. In turn, MML working with Saltwater Inc. are continually evolving to implement technological developments of new and improved EM camera-based systems and software for improving the collection of scientific data. Based on review data and fisher feedback, Mote is striving to improve the limitations of EM systems for documenting bycatch, particularly "cut-offs", including large sharks, in this fishery. Testing is underway for capturing high quality (HD) images of underwater catch and release events that onboard cameras are not able to document. Pilot test to initialize EM underwater hardware testing involve partnering with charter-for-hire vessels prior for possible future implementation as well as a precursor to application on commercial bottom longline and vertical line vessels. The underwater camera systems integrated with existing equipment can resolve species identification issues and improve observations of the release disposition of bycatch. Additionally, integration of a Saltwater Inc. software "digital ruler" tool to collect length measurements is being tested. The ruler is calibrated to measure the pixels in a video image of a fish, and from that calculate a length measurement without requiring onboard equipment beyond the "standard" EM system.

Image measurements use a custom algorithm to estimate the linear length of the fish, these are equivalent to a measurement taken by an observer.

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Electronic Monitoring - Emerging Technology and Platform for Science in the Gulf of Mexico Commercial Reef Fish Fishery

Mote Marine Laboratory has partnered with the commercial snapper grouper industry, technical equipment vendors, government agencies, and other stakeholders to apply and evaluate Electronic Monitoring (EM) technology on commercial bottom longline and vertical line bandit vessels for future commercial fleet-wide implementation in the GOM. This GOM fishery targets 42 species using horizontal bottom longline and vertical line “bandit” vessels, about 330 vessels account for 90% of the landed catch. Because observer programs can only monitor about 1% of these vessels, EM presents itself as an unbiased monitoring tool to observe and permanently document fishing effort and retained and discarded catch, with potential to be a valuable fisheries-dependent tool for the capture of critical at-sea data for management. The EM equipment and software technology in this project are evolving, and are being adapted to improve documentation onboard the vessels and in the lab review process. Testing is underway for integrating fish measurements during video review and evaluating onboard underwater cameras to document bycatch cut-offs. Analyzed data, including trip duration, catch per unit effort, fish handling, gear type, catch and discard species composition, disposition, incidental catch documentation, interactions with sharks, marine mammals, and sea turtles, hotspots, and spatio-temporal distributions are exported for subsequent inclusion in fisheries databases. Through collaborative efforts, EM trip data is being correlated with other vessel fishery-dependent information to augment available datasets and provide linkage information for industry, Councils and NOAA Fisheries. Implementation of EM in this fishery will improve collection and quality of data to address shortfalls in the availability of reliable, timely and accurate characterization, effort and quantification of catch, bycatch and discards of priority species for use by fisheries management. In addition, it will provide information for the development of bycatch reduction strategies in the GOM snapper grouper fishery.

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Categorizing Lake Harris user groups and their opinions of hydrilla and hydrilla management

Hydrilla has expanded throughout the Harris Chain and in the summer of 2018, vegetation surveys identified greater than 4,000 acres of hydrilla at Lake Harris. The invasive plant management section spent over 4 million dollars treating hydrilla at Lake Harris alone, and the herbicide treatment in April of 2018 created immediate controversy with anglers, lakefront home owners, boaters and concerned members of the public. There is a critical and urgent need for aquatic plant and fisheries managers to better understand who the stakeholders are at Lake Harris and their opinions of hydrilla management at Lake Harris. Basic knowledge of the primary users at Lake Harris becomes important to ensure all groups are properly represented as managers aim to make informed plant management decisions. In December 2018, we initiated a study design that utilizes a year-round roving creel survey with additional access point surveys to estimate the annual effort of all user groups at Lake Harris. We also designed a survey that will be used to compare opinions of hydrilla and hydrilla management among user groups at Lake Harris. Further, during this survey, we are soliciting contact information from those participating in the survey which should provide a robust and representative stakeholder contact list. In the first four months of the study, results from over 300 surveys have shown interesting differences among users regarding their opinion of hydrilla and hydrilla management.

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Incorporating stakeholder desires into Florida's marine fisheries management

Stakeholder input is an important component in fisheries management. Traditional approaches to fisheries management focused primarily on managing species to achieve a biological goal and have failed to recognize the importance of stakeholder involvement in the management process. This has often led to disconnects between user groups and managers, resulting in distrust as well as perceptions that government agencies enact new regulations without considering diverse stakeholder values. Recognizing that effective fisheries management is a continuum between biologist, managers, and the public, the Florida Fish and Wildlife Conservation Commission (FWC) has strived to bridge these disconnects by implementing new public feedback opportunities in an effort to cultivate stakeholder involvement in marine fisheries management. This presentation will highlight some of the technological tools and

strategies FWC's Division of Marine Fisheries Management has promoted in recent years to dispel misperception that stakeholder participation does not matter.

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Distribution and Status of Blackbanded Sunfish *Enneacanthus chaetodon* in Florida
Blackbanded Sunfish *Enneacanthus chaetodon* is a small sunfish species that occupies heavily vegetated, acidic bodies of water. Historical records suggest that Blackbanded Sunfish are rare in Florida, however, available data are insufficient to evaluate their current distribution and status. We have conducted targeted surveys for Blackbanded Sunfish across their known range in the Florida since 2014. Wetland characteristics such as water depth, vegetation density and substrate composition varied greatly across the sampling area, therefore we utilized multiple sampling methods to most effectively sample each site. Sampling methods included seining, boat electrofishing, dip netting, and mini-fyke netting. 55 sites were surveyed between 19 Jun 2014 and 31 Oct 2018, including 11 of 15 known historical locations. 39 fish species were collected across all sites. The most commonly detected species include Eastern Mosquitofish *Gambusia holbrookii* (52 sites), Golden Topminnow *Fundulus chrysotus* (43 sites), and Warmouth *Lepomis gulosus* (40 sites). Blackbanded Sunfish were collected at 5 sites, of which, 1 was a known historical location. Warmouth, Golden Topminnow, Pygmy Killifish *Leptolucania ommata*, Lined Topminnow *Fundulus lineolatus*, and Bluespotted Sunfish *Enneacanthus gloriosus* were the only species collected at all 5 sites where Blackbanded Sunfish were collected. Sampling is ongoing and future effort will be taken to sample the 4 additional historical locations, and unsampled suitable habitat within the current known range.

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Length estimation of reef fishes from stereo-baited remote underwater video (S-BRUV) arrays in the eastern Gulf of Mexico: Adapting to evolving technologies without sacrificing science
The use of underwater video arrays for monitoring reef fish assemblages *in-situ* has increased significantly in recent years as technologies improve and costs decline. Video surveys not only allow for habitat characterization and identification and enumeration of observed fishes, but the incorporation of stereo imagery provides accurate size composition data without having to extract fish from their environment. Since 2008, the state of Florida - Fish & Wildlife Research Institute (FWRI) has utilized stereo-baited remote underwater video (S-BRUV) arrays to monitor reef fish populations within the eastern Gulf of Mexico, analyzing approximately one thousand

videos per year for habitat and biology, and collecting over twenty-eight thousand length measurements since 2010. Although the utilization of stereo imaging technology can provide essential data on the size composition of managed reef fishes, it comes with a unique set of challenges, most notably the rapid pace of advancements in both technology and software capabilities. As these stereo imaging technologies evolve, maintaining a cost- effective, accurate, and comparable time series of data requires careful consideration and extensive calibration of sampling and analytical methods. We will review the history of FWRI's stereo imaging technology, the process of producing accurate reef fish measurements, and continuing efforts to generate a cohesive, long-term dataset that can be used in tandem with other video surveys in the region. Relevant case studies will be presented demonstrating the utility of these data for assessment and management purposes, highlighting insights gained in dealing with these evolving technologies.

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Range expansion and movement of Common Snook, *Centropomus undecimalis*, in the Cedar Keys area, Florida

The Common Snook, *Centropomus undecimalis*, is an ecologically and economically important species commonly found throughout south Florida. It is thought that the species' true northern range is limited by the 15°C winter isotherm that they are typically found south of the 28°N latitudinal line in the Gulf of Mexico. We present an overview of a recent range expansion of Common Snook into the Cedar Keys area of Florida (29° 8′ 44″ N). Common Snook first appeared in Cedar Key Fisheries Independent Stratified Random Sampling in the year 2000 (N=1), and catches have been exponentially increasing since 2007, with 231 individuals caught in 2018. We have also captured YOY Snook in both directed and SRS sampling, suggesting reproduction occurred in the area. In addition to SRS data, we present updated results from an ongoing telemetry project in the Cedar Keys area. A total of 42 Common Snook were tagged with Vemco V13 and V16 acoustic tags since October 2016. Our goal for this project was to analyze site fidelity and determine where Common Snook seek refuge during winter months. Preliminary results suggested high site fidelity in the Cedar Keys area during spring, summer, and early fall months. Fish then moved into the Lower Suwannee River as temperatures decreased in the late fall and early winter months. Information gathered from this project, paired with catch data from SRS sampling, will help us understand the life history dynamics of this northern population and range expansion of Common Snook.

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What to Do When the Science Doesn't "Say Anything" – Making Management Decisions and Addressing User Conflicts in Data Poor Fisheries

Abstract: When facing difficult or contentious management decisions, stakeholders and decision-makers often ask, "What does the science say?" However, as saltwater fishing effort continues to grow in Florida, species that faced little pressure before, now support growing fisheries. Fishermen are raising concerns about species for which robust, long-term data collection is lacking. This puts fishery managers in the position of trying to discern whether an issue raised by fishery participants represents a true conservation issue with limited science to support or refute fisher concerns. These situations are further exacerbated by user conflicts that polarize stakeholders with competing values. Because funding for fisheries research will always be limited, these situations will continue to arise. This presentation will highlight a series of case studies ranging from tropical ornamental species to sharks where management decisions made without the benefit of adequate standardized scientific research gained public support and furthered conservation of saltwater species. We will provide examples where short-term data sets, citizen science, and fisher expertise informed these contentious management decisions and emphasize the importance of communication between researchers and managers about data needs and information availability.

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Using Geomorphic Proximity as a Tool to Better Understand Fish Habitat Use in Coastal Rivers

There has been increasing awareness that morphological features within a landscape may be driving habitat use by fishes as much as commonly assessed metrics such as shoreline and bottom type; however, this sort of morphological data is often lacking in datasets. Our objective was to explore the importance of geomorphology in assessments of fish habitat by categorizing rivers in Tampa Bay and the Indian River Lagoon by geomorphic type (mainstem, backwater, creek, bends, and canal) and then overlaying the categorized river data with fisheries catch data in GIS. The datasets used in the analyses were from three different projects (2007-2017) that used stratified random electrofishing to better understand the use of rivers by Common Snook, a euryhaline species that uses a wide range of habitats including upper reaches of rivers. The primary goals of each project varied and each project assessed habitat at different scales. Preliminary analyses suggest that Common Snook utilize specific geomorphic features at different life stages. Young-of-the-year used backwater areas (e.g., bayou, slough), expanding throughout all available habitat as they grew, and larger adults focused on specific

geomorphological features such as river bends. Although one dataset provided highly detailed descriptions of habitat associations, the spatial resolution of the analysis was limited by the absence of individual catch locations and by transect length (300m). This broad scale allowed for a transect to overlap multiple geomorphic features and decreased our ability to incorporate geomorphology into the analysis. The results of this study suggest that geomorphic proximity may be a useful tool in refining descriptions of habitat use; however, special attention should be placed on the scale of sampling to allow for increased precision.

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Exploratory Use of Electronic Monitoring to Spatially Characterize Distribution and Catch of Targeted Reef Fish and Bycatch along the West Florida Shelf

Commercial bottom longline fishing vessel preliminary catch per unit effort (CPUE), spatial distribution, habitat associations, seasonality, species diversity and vessel efficiency are characterized for the West Florida Shelf (WFS) for a 27-month period from summer 2016 through fall, 2018. Approximately 25,000 annotation records sampled from over 1,900 separate set-haul-events (SHE) from 112 trips made by five longline vessels, fishing an area of 84,000 square kilometers, were reviewed. More than 120 species were annotated from videography, including 15 shark species. Red grouper, *Epinephelus morio*, was the primary target species and it supports the bulk of the fishery (62.57%), followed by red snapper, *Lutjanus campechanus* (10.17%), and Yellowedge grouper, *Epinephelus flavolimbatus* (4.28%). Targeted fishing location distributions were highly clustered (Ripley's K function; Average Nearest Neighbor Analysis, z-score: 17.12, p-value, 0.000), as was grid-based SHE CPUE (Getis-Ord, z-score: 23.68, p-value, 0.0000). Grid-based SHE CPUE was also spatially auto correlated (Global Moran I, z-score 97.26, p-value 0.0000). Location density analysis indicated varying fishing location intensity across the global fishing area. Centroid-squared Euclidean neighbor analysis indicated five dominant local cluster groups within the global fishing area. Fish species diversity was analyzed within cluster groups. Mean fish species richness was 66.8, ranging from 49 to 88 species. Mean Shannon-Weaver Index was 1.77, ranging from 1.01 to 2.32. Individual species specific CPUE and SHE CPUE (response variables) were modeled using generalized linear models, with respect to categorical variables (season and vessel), and continuous variables (dominant sediment type and water depth). Model strategies are discussed.

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Predicting Spatial Distributions and Population Numbers of Species Life Stages with Simulated Water Withdrawals from the Lower Peace River-Charlotte Harbor System, Florida

The Southwest Florida Water Management District is reevaluating adopted Minimum Flows for the Lower Peace River, the largest source of freshwater inflow to Charlotte Harbor. To support the reevaluation, we use habitat suitability modeling (HSM) to seasonally predict spatial distributions and population numbers of estuarine species life stages due to changes in inflows in the Lower Peace River, Lower Shell Creek and upper Charlotte Harbor, Florida. Average seasonal salinity and temperature grids from 2007-2014 derived from a hydrodynamic model differed between Baseline (i.e., flows not affected by water withdrawals) and reduced freshwater inflow conditions that could occur in association with currently proposed Minimum Flows. Seasonal dissolved oxygen, and single depth, and bottom type grids derived from Fisheries Independent Monitoring (FIM) data collected from 1996-2013 were held constant between the two scenarios. Seasonal HSMs were applied to 32 fish and invertebrate species life stages with affinities for low or moderate salinities. Salinity was the most significant factor in the models for most species life stages. The seasonal HSM maps produced were very similar between Baseline and Minimum Flows for each species life stage. Most seasonal estimates of population numbers under Minimum Flows were less than the estimates for the Baseline condition indicating impacts on population numbers associated with flow reductions. Reductions in population numbers under Minimum Flows ranged from 1 to 21% with 10 out of 31 seasonal comparisons exceeding 10% and 8 others exceeding 5% loss. The project illustrates the application of HSM to support water management. It compares effects on population numbers of water management scenarios for selected species life stages of fishes and Blue Crab in a major west Florida river-estuarine system.

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Exploring Fisheries Aspects of Large-Scale Habitat Restoration in Tampa Bay

Tampa Bay is a coastal restoration success story. In recent decades numerous entities have worked to restore historically impacted wetlands. This has recreated hundreds of acres of

estuarine habitat lost to disturbance. It is assumed that fish community structure and commercially/recreationally important sportfish will benefit from these major restoration activities. Specifically, these restored areas should offer nursery habitat for sportfish such as common snook *Centropomus undecimalis*) and red drum (S*ciaenops ocellatus*). Also, the areas should provide habitat that allows for a diverse prey base, within the range of expectations for coastal wetlands, that can provide for community resilience and a consistent source of prey production. However, few data exist to support these assumptions. Quarterly randomized sampling with 9.1-m and 40-m seines was used to characterize the fish communities at three restored, three impacted, and three natural sites on the eastern shore of Tampa Bay. Routine habitat data were collected for each net pull. A subset of captured juvenile common snook was retained for laboratory processing (body condition, growth, and daily otolith aging). Preliminary results indicate juvenile common snook have faster growth at restored sites compared to natural or impacted locations. Also, shoreline restoration led to increased spatial heterogeneity, providing a mosaic of vegetation and habitat characteristics, leading to increased fish diversity. These results may be used to guide resource managers on the effectiveness of specific habitat restoration practices and tailor restoration design to specific fisheries goals

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The Effects of Nutrient Reduction on the Water Quality and Largemouth Bass *Micropterus salmoides* Population in Lake Alice, Gainesville, Florida

Phosphorus and nitrogen are widely considered the limiting nutrients in lake systems. Prior to 1994, Lake Alice, Gainesville, Florida received treated effluent from a wastewater treatment facility. In October 1994, a new wastewater reclamation plant was opened, and the treated effluent was rerouted, no longer contributing excess nutrients to the lake. Lake Alice is home to an unfished population of Largemouth Bass *Micropterus salmoides.* This study examines how the water quality and the Largemouth Bass population has responded to the reduction in nutrients due to the removal of treated wastewater effluent. Water chemistry and Largemouth Bass Data collected by UF's Introduction to Fisheries science class was analyzed for the years surrounding the removal of effluent and examined for relationships between effluent presence, absence, and bass population parameters. Years following the removal of treated effluent to the lake showed significant increase in Secchi depths, and reductions in Total Phosphorus (TP), Total Nitrogen (TN), and chlorophyll (CHL) as well as a reduction in Proportional Size Distribution (PSD) of Largemouth Bass. However, after evaluating long term data, the changes seen in the Largemouth Bass population during the study period are small oscillations in a larger trend and were not related to the effluent removal event. Utilizing long-term monitoring programs, instead of studies from northern lakes, to drive management decisions for Florida's lakes, will improve lake management practices to protect and preserve these unique freshwater systems.

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Evaluating Larviculture Protocols for Pelagic Spawning Marine Ornamental Species

The marine aquarium hobby has grown considerably in recent decades to become a multi-billion-dollar industry. Less than 10% of commercially available marine species are cultured, while the rest are wild-caught. The global marine aquarium industry is working to improve culture practices to reduce population strain from harvest on imperiled ecosystems. Species that spawn demersally dominate the aquaculture market due to the availability of established rearing protocols, and high relative parental care and larval survival. Pelagic spawning species usually provide no parental care and the newly hatched larvae have a small mouth gape that limits their diet to copepod nauplii and other small zooplankton or phytoplankton. Challenges associated with these characteristics need to be addressed for production of pelagic species to become commercially viable. Species such as the Pacific Blue Tang (*Paracanthurus hepatus*), Melanurus Wrasse (*Halichoeres melanurus*), and Yellow Wrasse (*Halichoeres chrysus*) are of particular interest because of their popularity in the marine aquarium trade and lack of established rearing methods. The proposed research focuses on manipulation of various environmental and nutritional parameters during early larviculture for these three species. These investigations will better define protocols which yield increased survival and growth and can then be transferred to commercial producers. Research will focus on optimizing parameters such as tank size, live feeds and larval stocking densities and algal species and densities used for greenwater larviculture. Preliminary results suggest inclusion of the microalgae *Tisochrysis lutea* during early larviculture of the Melanurus Wrasse aids in prey capture whereas the addition of the diatom *Chaetoceros muelleri* negatively impacts larval survival. Results from these investigations will help to shape future production protocols.

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Identification, protection, and restoration of fish nursery habitats: spatial considerations and use of technology

Protection of fish habitats along developing coastlines of Florida is needed to achieve the goal of ecosystem management. Ecologists widely recognize that habitat mosaics (e.g., vegetated shorelines, oyster reefs, open water) exist within a broader nursery context (e.g., a river mouth) to support the early life stages of estuarine-dependent fishes. However, realities of coastal zone management often require information on fish habitat use at a fine scale. For example, as

individual parcels within a landscape are permitted for development, managers require data on fish use at the scale of these parcels (meters to hectares) to effectively comment on potential impacts and assess opportunities for habitat protection. Likewise, as habitat restoration plans are drafted to create new fish nurseries, or specific habitat types, information must be conveyed to project engineers at even finer scales (meters to centimeters) relative to factors such as marsh elevation, tidal flooding frequency, and connectivity of water bodies. Modern research techniques that have become widely used by fish ecologists such as otolith microchemistry and telemetry have the potential to allow for assessment of fish habitat at these finer scales. Our objective is to highlight studies that have tested the use of these technologies, at these scales, using examples from Florida estuaries. In some cases, new findings may challenge existing ecological concepts such as those that define the nursery itself. These concepts can be refined to incorporate new data, which regularly occurs as science evolves. Productive collaboration among scientists and managers will be needed to provide for conceptual models that work at these different spatial scales, recognizing both broad concepts of nursery habitat and dynamic nursery substructure (e.g., hotspots within a nursery) that may warrant added layers of protection.

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Creating an effective poster

A poster can be an effective way to present your research. Posters are handy if you are not comfortable speaking at the podium and they allow you more personal engagement with interested colleagues. But there are effective posters and less-effective posters. What makes the difference? It's all about presentation – the information you choose to present and how you present it. Does your layout lead the reader logically through the information? Do your color choices make your information easy to read? How much information should you include? How can your poster be eye-catching without being busy? Most of the answers lie in thinking less about the work you are presenting and more about the audience. This poster will illustrate some of the common do's and don'ts and give participants a chance to consider why some common poster-presentation mistakes are mistakes.

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Incorporating technology to improve the utility of fishery-independent survey data: ongoing efforts by the state of Florida

Abstract: Fishery-independent surveys and the data they provide have long been essential to traditional single-species stock assessment, primarily through the development of indices of relative abundance that describe the long-term status and trends of managed fish populations. Nevertheless, recent advancements in stock assessment methodologies, along with the need to improve ecosystem-based assessment and management capabilities, have correspondingly increased the requirements of survey data well beyond estimates of relative abundance. To meet these and other emerging needs, fishery-independent monitoring programs are increasingly incorporating new technologies to augment existing surveys and, in many instances, implement entirely new surveys. Over the past decade, the state of Florida's Fish and Wildlife Research Institute has integrated several technologies into offshore research and monitoring activities to address a variety of research questions. Side scan sonar is used to locate and characterize reef habitats to direct sampling efforts and quantify reef habitat availability. Stereo baited remote underwater video (S-BRUV) arrays produce non-extractive estimates of abundance and size composition of reef fishes while also facilitating analyses of the species- and size-selectivity of various other capture gears. Fisheries acoustics provide valuable insight into the catchability of S-BRUV surveys and, coupled with net measurement sensors, groundfish trawl surveys. Several case studies will be presented highlighting how each technology was applied to address a specific research question as well as the ancillary benefits provided. Future efforts will also be discussed to highlight the challenges and important considerations for implementing new technologies into long-term fishery-independent surveys.

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Evaluation of tools used to assess delayed mortality for Florida Largemouth Bass in summer fishing tournaments

Managers and anglers have expressed concerns about the fate of tournament-caught bass after release. Net pens used in other studies may elevate mortality by further confinement and may not allow for a long enough observation period to estimate delayed mortality. In this study, we simulated a bass tournament in the summer at Lake Dora to compare the delayed mortality for

three treatments. One treatment involved tracking 50 released bass with radio transmitters (affixed to their dart tag). We assumed this treatment represented a non-biased estimate of delayed mortality (as fish were not confined) from this experiment and any tested enclosures could be validated if estimates were not significantly different than the telemetry results. The first enclosure treatment was a 14,000-gallon pool (32' x 16' x 52") that was set up on the shore of Lake Dora, and the second enclosure treatment was two cages (20' x 6' x 6') placed 30 feet from shore and constructed from PVC and chain-link fencing. Bass were collected for the simulated tournament via electrofishing and stress was induced equally (e.g., dart tagging, livewell conditions, weigh-in) to fish used for each treatment (N=50 for each treatment). The two enclosure types were checked for mortalities through eight days post-tournament and bass released with radio transmitters were tracked in Lake Dora for 20 days. Mortalities for both enclosures occurred from day 3–6, whereas mortalities from radio-tagged bass occurred from day 2–8. Results from a Kaplan-Meier survival model revealed that survival through eight days for the telemetry fish (0.90 (0.82–0.99, 95% CI)) was not significantly different (p = 0.04) compared to the cage fish (0.83 (0.73–0.94)) but was significantly higher (p = 0.31) than the pool fish (0.70 (0.58–0.84)). These results show that the cages may represent a relatively unbiased estimate of delayed mortality from a summer bass tournament and that an eight-day set likely captures most of the delayed mortality. This study provides biologists with a tool that can easily be set and checked at tournament sites to obtain a representative range and average estimate of delayed mortality from bass tournaments throughout Florida.

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Analysis of reproductive hormones as an indicator of skipped reproduction in a protandric hermaphrodite, Common Snook (*Centropomus undecimalis*)

Recent research has demonstrated that a portion of the Common Snook population spends the majority of its annual cycle in the freshwater reaches of coastal rivers and can be found in abundance in these habitats during all seasons. These results suggest that some Common Snook may skip spawning events as conditions within the river (e.g. salinity) would not support successful reproduction. Two acoustic tracking studies have estimated skipped reproduction in Common Snook populations and suggest that either 1). smaller fish may delay maturation and skip spawning as a trade-off to feeding and optimizing growth or 2). first year females may have insufficient energy stores to allow for migration and spawning. Both studies, however, lacked associated biological sampling to confirm skipped reproduction or to elucidate the mechanisms behind it. Our objective is to describe reproductive development and estimate skipped reproduction in the rivers and estuaries of Tampa Bay, Florida using comprehensive analysis of reproductive dynamics, including histological examination of ovaries and testes, reproductive hormones levels, fish condition, and hepatosomatic and mesenteric fat indices of energetics. 273 females and 210 males were analyzed for serum hormone levels of 17β-estradiol and 11-ketotestosterone, respectively. Hormone values matched well with the known spawning

season, gonadal development stage, and catch location. In every month, some Common Snook exhibited baseline levels of hormones and undeveloped gonads. During the peak spawning months, 19% of fish had baseline hormone levels, suggesting skipped reproduction. Fish with baseline levels were predominately female (73%) and were significantly smaller than those with positive hormone levels (t-test; $p<0.05$). The results suggest that skipped reproduction in Common Snook occurs primarily in smaller females. Further analysis of both histology and energetics should confirm whether these are, in fact, first year females with insufficient energy reserves following sex reversal.

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Bass in the Coast: Patterns of Seasonal Habitat Use by Florida Largemouth Bass in the Upper Shark River, Everglades National Park

Recreational angling for species such as Florida Largemouth Bass (*Micropterus salmoides floridanus*) significantly contributes to Florida's economy, especially throughout the Everglades. The resilience of these recreational fisheries relies on healthy fish populations and on maintaining favorable environmental conditions in the ecosystems that support them. However, our understanding of how biotic and abiotic factors interact to produce these conditions remains limited. Previous work has shown that bass move out of headwater marshes into deeper perennial habitats in the main channels of the Shark River as upstream marshes dry down seasonally, but the precise timing and drivers of these movements and extent of the habitat use in the estuary remain poorly understood. In this study, we used acoustic telemetry to track the drivers, timing, and extent of habitat shifts from marshes to mangrove habitats for bass in relation to seasonal stage fluctuations. We correlated these movements with data on water levels, flow, and recession rates across multiple years with varying hydrological conditions. An increased understanding of how bass utilize and move between different habitats can help inform water management decisions and ongoing restoration efforts in the Everglades, and the link between these and socio-economic valuable recreational fisheries.

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Red Snapper (*Lutjanus campechanus*) and Red Grouper (*Epinephelus morio)* movement in the eastern Gulf of Mexico

Red Snapper (*Lutjanus campechanus*) and Red Grouper (*Epinephelus morio)* are two important commercial and recreational fisheries in the Gulf of Mexico. While these two species commonly

cohabit, much remains unknown about their potential spatial and temporal interactions. Using acoustic telemetry, we were able to monitor the survivorship and movement of 60 individual fishes (30 of each species) on natural hardbottom adjacent to the Gulf Steam Pipeline off the coast of Tampa Bay, Florida. Each fish was internally implanted with pressure sensing acoustic tags and monitored using nine Vemco VR2-AR receivers moored at release locations (average depth: 50m). Both species exhibited barotrauma at these depths but had high post-release survivorship, with 96% of both species detected on multiple dates post release. Both species also exhibited high site fidelity with 95% of individuals solely detected on the receiver at their release site and more than 75% detected for 100 days or more. Site fidelity did not differ with spawning seasonality for either species, suggesting these fish do not differentiate spawning habitat and their normal foraging areas. Red Snapper utilized more of the water column compared to Red Grouper, particularly at night. The ability to track movements of these species over relatively long time periods has important implications for management by providing means to assess natural and discard mortality, responses to disturbance events, and the distribution of their life cycles over space and time.

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Larval Vertical Migration Patterns and Their Impact on Larval Dispersal in the Gulf of Mexico
The Gulf of Mexico is home to some of the most economically valuable commercial and recreational fisheries in the United States. Understanding vertical migration patterns of larvae can aid in exploring ways to protect fish populations. Developing predictions of the depths at which larvae are found in the water column provides a clearer picture of how these larvae are traveling within the Gulf of Mexico. In order to predict ontogenetic shifts in the vertical distribution of larvae, Generalized Additive Models (GAM) were built to predict the concentration of larvae present at depth for a range of age classes and taxa of major commercial and recreational fishes in the Gulf of Mexico based on a suite of environmental variables. Each taxa showed a different pattern of vertical migration by age. The models were built using a training data set, and a testing data set was used to make predictions and calculate Pearson's correlation coefficients for each taxa and age class. These depth at age predictions can be used in collaboration with hydrodynamic and ecosystem models, and are currently being utilized in conjunction with circulation data from the hydrodynamic model WFCOM, with the aim of developing larval trajectories and identifying larval source and sink areas for a range of fish taxa.

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Fish eye-lens isotopes as indicators of larval distribution on the West Florida Shelf

While adult and juvenile reef-fish habitats on the West Florida Shelf (WFS) have been well studied, spawning and larval locations remain poorly understood. The isotopic values (δ^{13}C and δ^{15}N) of the inner-most fish eye-lens layer (core) reflect the trophic level and location of the fish during the earliest weeks of life. Here we use the locations, areas, and overlaps of standard ellipses for fish eye-lens cores within δ^{13}C and δ^{15}N bivariate isotope space to infer spawning and larval location patterns on the WFS of four reef-fish species.). PERMANOVA results ($F = 8.42$, $p < 0.001$) indicated significant differences in larval distribution among species. We found that the means of both δ^{13}C and δ^{15}N was unique for each species. The Red Grouper larval standard ellipse area was smallest (2.76‰) and mean δ^{13}C and δ^{15}N values were lowest (-19.22 ± 0.17 and 6.75 ± 0.11 respectively). In contrast, Black Seabass ellipse area was largest (5.58‰) and mean δ^{13}C and δ^{15}N values were highest (-18.54 ± 0.2 and 8.20 ± 0.2 respectively Together these data suggest a range of larval distributions and locations for reef-fish species on the WFS. In future, this technique may be combined with data from other analyses, such as fish egg DNA barcoding and larval-transport modeling, to better understand spawning and larval habitat requirements for a wide variety of reef-fish species.

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The δ^{15}N in teleost muscle and liver tissue varies predictably and can be used as an indicator of site fidelity

We investigated the δ^{15}N offset between two tissue types, skeletal muscle (relatively slow turnover rate) and liver (relatively fast turnover rate; $\delta^{15}N_{M-L}$), as an indicator of marine fish site fidelity at a timescale of weeks-to-months. We calculated $\delta^{15}N_{M-L}$ from twelve published studies of captive marine teleost species that were in isotopic equilibrium with their experimental diets. Equilibrium $\delta^{15}N_{M-L}$ was 1.67 ± 0.14 (mean ± SE) with a 95% confidence interval of 1.37–1.97‰. Variation around the mean equilibrium $\delta^{15}N_{M-L}$ value did not correlate with size, trophic level, tail aspect ratio, or water temperature. We used the 95% confidence interval for $\delta^{15}N_{M-L}$ as a baseline for comparing the $\delta^{15}N_{M-L}$ values from eight wild-caught fish species comprising a range of expected site fidelity behaviors (including consuming migratory vs. stationary prey), captured from Florida, USA continental-shelf waters. The $\delta^{15}N_{M-L}$ values from five species were not different from the equilibrium-offset value, reflecting a lack of isoscape-scale movements by these predatory species and their prey during recent months, consistent with the literature. In contrast, the mean $\delta^{15}N_{M-L}$ values for three other species were all lower than the equilibrium offset value, indicating either these predatory species or their prey had recently moved along

the $\delta^{15}N$ gradient. All species with $\delta^{15}N_{M\text{-}L}$ values lower than equilibrium are generalist predators that consume mixed diets of migratory forage fishes and benthos. As a method, $\delta^{15}N_{M\text{-}L}$ appears to be useful for identifying short-term movements of marine teleosts or their prey and has the potential for widespread application.

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The incorporation of hydroacoustics into reef fish video surveys in the eastern Gulf of Mexico

The Florida Fish and Wildlife Research Institute (FWRI) conducts a stratified random video survey to determining relative abundance of reef fish in the eastern Gulf of Mexico. As part of a collaborative survey with the National Marine Fisheries Service, FWRI has collected and processed thousands of videos that have provided habitat-specific, relative abundance data for numerous species occupying a variety of reef habitats. While these data are useful in determining temporal trends, estimates of absolute abundance remain a high priority for fisheries managers and ecosystem modelers. Further site-specific information regarding the total volume of water sampled along with a precise estimate of fish density at sampling sites is needed to derive estimates of absolute abundance. Accordingly, the FWRI survey is utilizing hydroacoustic technology in concert with video data. Hydroacoustics can mitigate visibility and field-of-view limitations associated with video-based sampling and provide a spatially-explicit characterization of abundance and biomass. A Simrad EK80 multi-frequency split-beam sonar is used to collect backscatter data around habitat-specific camera deployments. Broad-scale and fine-scale surveys are conducted to investigate changes in biomass distribution relative to gear deployment as well as the temporal impacts of attraction relative to the baited camera array. Mean volume backscatter (Sv) and single-target (TS) estimates will be used to calculate total fish density associated with several natural and artificial habitats. In addition to the split-beam sonar water column survey, a Kongsberg M3 multi-beam sonar is incorporated into the acoustic array to conduct high-resolution seafloor mapping at each site. These data will be used to provide further insight into the characteristics of sampled habitats and aid in the development of a more comprehensive habitat classification across all organizations involved in the cooperative Gulf of Mexico reef-fish survey.

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Stomach Content Analysis of *Cichlasoma urophthalmus* (Mayan Cichlid) in the Tampa Bay Watershed

Throughout their native range in Central America, Mayan Cichlids (*Cichlasoma urophthalmus*) have been documented to have a generalist diet consisting of mainly fishes and invertebrates, as well as plant material. In the Everglades ecosystem, invasive populations of Mayan Cichlids also displayed an omnivorous diet. Little is known about the ecology of invasive Mayan Cichlids in the fresh and brackish water habitats in the Tampa Bay watershed. During the summer and fall of 2018, adult and juvenile Mayan Cichlids were collected via hook-and-line with artificial lures or with cast nets in the Hillsborough River and Little Manatee River. Fish were fixed in 10% formalin, dissected, and stomach contents were sorted and preserved in 70% ethanol. After sorting, stomach contents were identified to the lowest taxonomic level possible and an Index of Relative Importance (IRI) was calculated for each taxon. To date, the highest IRI values calculated for stomach contents of Mayan Cichlids collected in the Tampa Bay watershed were associated with gastropod mollusks. Future work will include additional field collections from more sites and a larger number of fish collected per site. It is hoped that sufficient samples will be collected of both juvenile and adult Mayan Cichlids that any ontogenetic shifts in their trophic ecology in the Tampa Bay watershed will be identified.

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Evaluating sampling bias in estimates of size composition of four managed reef fishes as determined from underwater stereo-video surveys

The use of stereo baited remote underwater video (S-BRUV) arrays to assess reef fish populations in the Gulf of Mexico has increased in recent years as a critical fisheries-independent survey tool. Video surveys allow for the *in situ* characterization of reef microhabitats while providing a minimally invasive approach to quantifying the abundance of reef fishes. The incorporation of stereo imagery into these surveys also provides precise and relatively unbiased size composition data compared to other gear types that are inherently size selective (e.g. traps and hooked gear). Since 2008, the Florida Fish and Wildlife Research Institute (FWRI) in conjunction with the National Marine Fisheries Service (NMFS) has monitored reef fish populations in the eastern Gulf of Mexico using S-BRUV arrays. Standard protocols involve recording measurements of managed reef fishes from a single screen shot where the greatest number of measurements could be made for that species (a.k.a., MaxN method). However, the validity of this method in providing an accurate representation of reef fish size structure has not been well tested. This study compared the size composition of four

managed reef species (Red Snapper, Red Grouper, Gag and Greater Amberjack) using the MaxN method to measurements recorded for all individuals present across the entire 20-minute video for each S-BRUV (a.k.a., EveryN method). Preliminary results suggest significant differences in the size distributions between the two methods (k-s test, $p \leq 0.05$) for Red Snapper, Red Grouper, and Greater Amberjack while no differences were detected for Gag. Where differences were observed, the MaxN method generally under sampled smaller size classes compared with the EveryN method. Results from this study may help improve the accuracy of S-BRUV based size composition data used in stock assessments by uncovering potential biases in data processing methodologies.

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Utility of a habitat-based, fisheries-independent hooked-gear survey for characterizing reef fish populations in the eastern Gulf of Mexico: Are All Anglers 'Created' Equal?

In recent years, there has been a dramatic increase in the use of underwater video surveys throughout the southeastern United States to assess the distribution, abundance, and size-composition of managed reef fishes. One important limitation of video surveys is that video cannot provide site-specific life history data (i.e., age, sex, reproductive condition). To address this limitation, the state of Florida has developed a complementary survey using standardized active fishing methods (Repetitive Timed Drop method, RTD), although concerns remain regarding potential variability among anglers and how that might influence catch data. We analyzed data from several habitat-based reef fish surveys (2012–2017) to assess catch variability in association with angler experience among other factors. During this study period, 67 offshore research cruises were conducted that sampled 898 habitat-specific sites; representing 22 different habitat types including artificial and natural reef habitats. These studies demonstrated the utility of the RTD method in providing robust catch and effort data for a suite of species while also facilitating population demographics studies (*e.g.,* age, reproduction, genetics). A total of 5,249 specimens were caught, with 93 taxa represented. Sampling was conducted by 88 different anglers, including 35 commercial/charter fishermen and 53 scientists. We evaluated variability of reef fish catch rates relative to angler type, habitat, year, region, and physiographic parameters and found that most of the variability in the catch was explained by hook size, year, habitat, and region. Catch rates among angler types were not significantly different between commercial (2.0 fish/site) and scientific anglers (1.9 fish/site). Our analyses suggest that the RTD method is a viable standardized sampling technique that can provide abundance and life history data for a suite of reef fish species inhabiting the West Florida Shelf, and that these estimates are not significantly influenced by an angler effect.

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