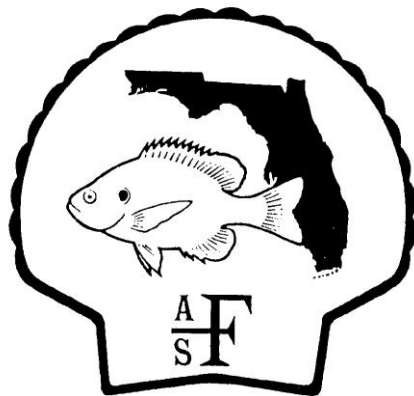


**38th Annual Meeting of the
Florida Chapter of the
American Fisheries Society**

April 11th –13th, 2018

**FFA Leadership Camp
Haines City, Florida**



The Florida Chapter of the American Fisheries Society

Chapter Officers

President: Jeff Hill, UF

President-Elect: Nick Trippel, FWC

Past President: Andy Strickland, FWC

Secretary-Treasurer: Kevin Johnson, FWC

Major Contributors for our Annual Meeting

Webmaster: Eric Sawyers, FWC

Newsletter Editor: Jessica Feltz, FWC

Raffle Co-Chairs: Alan Collins (retired), NOAA & Andy Strickland, FWC

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

**38th Annual Meeting of the Florida Chapter American Fisheries Society
April 11-13, 2018**

FFA Leadership Camp, Haines City, Florida

Wednesday, April 11th

11:00am – 6:00pm Registration
1:00pm – 1:10pm Welcome and Announcements
1:10pm – 3:40pm Contributed Papers
3:50pm – 5:10pm **Symposium: Improving Communication and Collaboration 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 12th

7:00am – 8:10am Breakfast
7:00am – 6:00pm Registration
8:10am – 8:15am Announcements and Welcome
8:15am – 12:00pm **Symposium: Improving Communication and Collaboration in Fisheries**
12:00pm – 1:15pm Lunch
12:10pm – 1:10pm Optional Workshop: Science Outreach-Engagement Through Film
1:15pm – 5:00pm **Symposium: Improving Communication and Collaboration 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 13th

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 – 38th Annual Meeting, 2018 - Florida Chapter American Fisheries Society

Wednesday, April 11th

11:00am – 6:00pm

Registration

1:00pm – 1:10pm

Welcome – Jeff Hill, Chapter President

Contributed Papers 1

Moderator: Jeff Hill, UF

1:10pm – *Sriwanayos, P., K. Subramaniam, N. K. Stilwell, K. Imnoi, J. Polchana, S. Kanchanakhan, and T. B. Waltzek. Phylogenetic characterization of Ranaviruses detected in fish and amphibians in Thailand

1:30pm – *Lindeliën, S., and D. Parkyn. An assessment of fin rays and fin spines for use in non-lethal aging of Largemouth Bass *Micropterus salmoides* in Florida

1:50pm – Camp, E. V., and B. T. van Poorten. Buffet-style management: increasing satisfaction and participation of diverse anglers

2:10pm – Break

Contributed Papers 2

Moderator: Savanna Barry, UF

2:20pm – Schloesser, R., P. Caldentey, N. Brennan, C. Peterson, and K. Leber. Hatchery-reared juvenile Snook as ecological probes for habitat quality

2:40pm – Ritch, J., A. Trotter, J. Carroll, D. Westmark, K. Cook, and K. Rynerson. Abundance and distribution of Common Snook *Centropomus undecimalis* in the coastal rivers of Tampa Bay

3:00pm – Chagaris, D. Incorporating manager input into ecosystem modeling efforts for the Gulf of Mexico

3:20pm – *Malinowski, C. R., F. C. Coleman, and C. C. Koenig. High mercury levels in the Atlantic Goliath Grouper *Epinephelus itajara*: a critically endangered species being reconsidered for a fishery in the southeastern United States

3:40pm – Break

Symposium – Improving communication and collaboration in fisheries

Moderator: Joy Hazell, UF

3:50pm – McBride, R. Designing an effective presentation

4:10pm – Nabors, A. Selecting your communication strategy

4:30pm – Hill, J. Who is at fault for poor communication and why is it you? Social media edition

4:50pm – Vecchio, J., and Misiewicz, A. Converting fisheries research into engaging classroom activities

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., A. Stanfill, and B. Poudier. Effects of a Lake Renovation on the Fish Community in Edward Medard Reservoir

*Bowers, B., and S. Kajiura. The migratory pattern and consequent extent of range of the western Atlantic blacktip shark, *Carcharhinus limbatus*

Crandall, C., M. Monroe, S. Barry, J. Dutka-Gianelli, B. Fitzgerald, and K. Lorenzen. How to bait the hook: Understanding citizen scientists' motivations to participate

*Croteau, A., If you restore it, will they come? Colonization of Robinson Preserve after habitat restoration

*Durland Donahou, A., Q. Tuckett, and J. E. Hill. Predicting distributions of non-native freshwater fish: A role for climate indicators

*Faletti, M. E., and C. D. Stallings. Life through the eyes of a Hogfish: Investigating Hogfish *Lachnolaimus maximus* movement and habitat connectivity using eye-lens stable isotopes

*Garner, S. B., W. F. Patterson III, and C. E. Porch. Cooperative research onboard charterboats to evaluate hook performance, selectivity, and management alternatives for red snapper in the northern Gulf of Mexico

*Gervasi, C., and J. S. Rehage. Impacts of coastal marine protected area on Grey Snapper *Lutjanus griseus* biology, behavior, and movement in Florida Bay

*Greenspan, J., J. E. Hill, Q. Tuckett, M. Hoyer, and C. Cichra. Habitat factors affecting establishment success of the non-native Blue Tilapia *Oreochromis aureus* in Florida lakes (USA)

*Hartfiel, M., G Bielmyer-Fraser, B. Franks, and N. Goldberg. Physiological stress response of sharks captured in a unique recreational fishery

Hyle, R., and J. Holder. Post-flood piscivory by a semelparous anadromous planktivore; diets of spawning American Shad from the St. Johns River, Florida

*Kircher, L., M. Bristol, J. Noble, J. Young, M. Ajemian, and J. Baldwin. Retroactive range testing in a dynamic estuary to further investigate snook movement through telemetry

*Lehmensiek, M., and M. K. Lorenzen. Understanding occupational displacement of people who fish commercially

*Massie, J., N. Viadero, and J. Rehage. Hurricane driven movements of Common Snook *Centropomus undecimalis* in the Florida coastal Everglades

*Student Presentation, Presenter

*Nicholson, C., N. Simon, and H. Yang. Larval survival of Hard Clams *Mercenaria mercenaria* in artificial seawater from different sea salts

Ostroff, J., B. R. Pittinger, S. F. Keenan, and T. S. Switzer. Temporal and habitat-associated dynamics of nearshore reef fish assemblages from a multiyear fixed station survey in the eastern Gulf of Mexico

*Schulz, K., P. Stevens, J. Hill, J. Patterson, and Q. Tuckett. What's a snook's favorite nook? Exploring sportfish use of restored and disturbed sites in Tampa Bay

*Simon, N., and H. Yang. Germplasm cryopreservation techniques in the Eastern Oyster *Crassostrea virginica*

Stallings, C. D., *M. E. Faletti, D. H. Chacin, J. A. Peake, and T. MacDonald. Population dynamics of Pinfish in the eastern Gulf of Mexico (1998-2016)

Trotter, A., J. Ritch, J. Carroll, D. Westmark, K. Cook, and K. Rynerson. Analysis of reproductive hormones as an indicator of skipped reproduction in Common Snook *Centropomus undecimalis*

*Yangqing Z., and H. Yang. Impacts of microplastics in coastal seawaters on filter feeding shellfish metabolism

Day-By-Day Agenda - 36th Annual Meeting, 2016 - Florida Chapter American Fisheries Society**Thursday, April 12th**

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

Symposium: *Improving communication and collaboration in fisheries***Moderator:** Nick Trippel, FWC

8:15am - Nelson, D., A. Strickland, and S. Bisping. Communicating scientific and social data to the fisherman of Lake Jackson

8:35am – Porak, W. Cooperative science with stakeholders and subject matter experts

8:55am – Thompson, B. Accomplishing statewide fisheries research by cooperating with regional biologists

9:15am – Dotson, J. R. The power of communication to create collaborative partnerships: a freshwater fish tale

9:35am – Break**Symposium: *Improving communication and collaboration in fisheries*****Moderator:** Matt Wegener, FWC

9:50am – Foss, K., and J. McCawley. Marine fisheries management in Florida: expert authority to co-management

10:10am – Brodie, R. B., J. J. Solomon, R. Paperno, R. Johnson, J. Hull, and T. S. Switzer. The benefits of stakeholder collaboration to reef fish research and monitoring: a case study on Red Snapper along Florida's Atlantic coast

10:30am – Collins, A. B., R. S. McBride, L. R. Barbieri, and L. Borden. Your fish was how big? Cooperative research collaborations begin with the conversation

10:50am – Break**Symposium: *Improving communication and collaboration in fisheries*****Moderator:** Erin Bohaboy, UF

11:00am – Rehage, J. S., K. E. Flaherty-Walia, C. Gervasi, R. O. Santos, D. Stormer, J. Ley, R. E. Matheson Jr., P. W. Stevens, J. Lorenz, P. Frezza, B. Fitzgerald, and R. E. Boucek. Effects of a 36-year fishing closure and opening of a coastal embayment in the crocodile sanctuary of northeastern Florida Bay on fishes and recreational fisheries

11:40am – Crandall, C., and M. Crandall. Science outreach-engagement through film

12:00pm – 1:15 Lunch and optional workshop –“Science outreach-engagement through film”

*Student Presentation, Presenter

Symposium: *Improving communication and collaboration in fisheries*

Moderator: Geoff Smith, UF

1:15pm – Brown, C. The Florida Fish Kill Hotline: A resource that benefits the public and scientists

1:35pm – Hill, J. E., and Q. M. Tuckett. Collaboration with Florida’s aquaculture industry to reduce the risks of non-native species

1:55pm – Schofield, P. J., The Non-native Fish Action Alliance: Interagency cooperation to tackle non-native fishes

2:15pm – Break

Symposium: *Improving communication and collaboration in fisheries*

Moderator: Kailee Schulz, UF

2:30pm – Lecours, V., and Emma LeClerc. Opportunities and dangers of using maps as means of communication

2:50pm – Sauls, B. FWC’s Fishery Independent Monitoring Program – cooperative research in action

3:10pm – Barry, S., J. Brockmann, and T. Black. Mobilizing citizen scientists to inform management of the data-poor horseshoe crab fishery in Florida

3:30pm – Hazell, J., K. Lorenzen, and C. Crandall. The possibilities, processes, and potential pitfalls of stakeholder engagement in fisheries management

3:50pm – Break

Symposium: *Improving communication and collaboration in fisheries*

Moderator: Jordan Massie, FIU

4:05pm – *Brown, J., E. Johnson, K. Bonvechio, and K. Smith. Long-term stock monitoring through state agency and university collaboration: Recruitment of American eels *Anguilla rostrata* to an estuary in northeast Florida

4:25pm – Strickland, A. I’m about to graduate... I think I want a job with FWC

4:45pm – Symposium Wrap-up/Discussion

5:00pm - Announcements – Nick Trippel

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 – 38th Annual Meeting, 2018 - Florida Chapter American Fisheries SocietyFriday, April 13th

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

Contributed Papers 4**Moderator:** Lauren Kircher, FAU8:15am – Wegener, M. Regulation evaluation of a coastal Largemouth Bass population8:35am – *Smith, G. D Murie. Potential impacts of non-native Pike Killifish on juvenile Common Snook8:55am – Tuckett, Q. M., J. E. Hill, M. T. Kinnison, and Z. T. Wood. Feralization: restoration, rehabilitation, invasion, and the establishment process for domesticated organisms9:15am – *Hasenei, A., R. W. Brill, A. Z. Horodysky, and D. W. Kerstetter. Metabolic physiology and hypoxia tolerance of Lionfish *Pterois* spp. using stop-flow respirometry: Are there physiological limits to inshore invasion?9:35am – *Lyons, T. J., Q. M. Tuckett, and J. E. Hill. Pathway evaluation and risk screen of lionfishes, Subfamily Pteroinae9:55am – Johnson, E., and M. K. Swenarton. Understanding the biology of invasive lionfish in Florida: Collaborative research among scientists, managers, and citizens**10:15am – Break****Contributed Papers 5****Moderator:** Eric Nagid, FWC10:25am – Munnelly, R., B. Pittinger, S. Keenan, and T. Switzer. Grouper potholes on the West Florida Shelf: extent of habitat modification and biological associations10:45am – Knight-Gray, J., K. A. Thompson, P. E. Vick, T. S. Switzer, and A. B. Collins. Spatial and ontogenetic patterns of trophodynamics of Hogfish *Lachnolaimus maximus* in the eastern Gulf of Mexico11:05am – *Mowle, K., and J Gelsleichter. Characterization of vitellogenesis in the Bonnethead Shark *Sphyrna tiburo*11:25am – *Bohaboy, E. C., W. F. Patterson III, and S. L. Cass-Calay. Efficacy of descender devices in reducing discard mortality of Gulf of Mexico hook and line caught reef fish: an acoustic telemetry study11:45am – *Ramee, S. W., T. N. Lipscomb, and M. A. DiMaggio. The potential influence of environmental stress on sex differentiation in two ornamental fishes*Student Presentation, Presenter

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 36th Annual Meeting of the Florida Chapter of the American Fisheries Society

Anderson, C.¹, A. Stanfill², and B. Pouder³

Poster Presentation

¹ Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, Gainesville Fisheries Research Laboratory, 7386 NW 71st Street, Gainesville, Florida 32653

² Florida Fish and Wildlife Conservation Commission, Division of Freshwater Fisheries Management, Lakeland Regional Office, 3900 Drane Field Road, Lakeland, FL 33811

³ Florida Fish and Wildlife Commission, Fish and Wildlife Research Institute, Lakeland Regional Office, 3900 Drane Field Road, Lakeland, FL 33811

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Effects of a Lake Renovation on the Fish Community in Edward Medard Reservoir

Edward Medard Reservoir (EMR) is a 770-acre hypereutrophic reservoir located in Hillsborough County. A large-scale dewatering of EMR was conducted in 2009 by the Southwest Florida Water Management District (SWFWMD) to repair an aging dam. Trends in fisheries data prior to dewatering suggested declines in relative abundance/biomass of sportfish, and increases in relative abundance/biomass of non-native fish (i.e., Nile/Blue Tilapia and Sailfin Catfish). The dewatering event created a unique opportunity, and in collaboration with management partners, we eradicated the entire fish community while the reservoir was at low pool. Upon refill, we stocked hatchery produced sportfish (e.g., Bluegill and Black Crappie) and wild adult Largemouth Bass into EMR. Our objectives were to evaluate the influence of the renovation (i.e., drawdown, fish eradication, and sportfish stocking and relocation) on sportfish and the fish community, respectively, and determine the effectiveness of the eradication of non-native fish and temporal trends in their populations post-renovation. We utilized boat electrofishing to sample EMR following FWC's Freshwater Fisheries LTM standardized sampling protocol in September-October for most years (e.g., 2011 – 2015) except in 2009 when sampling occurred in May (e.g., prior to drawdown that fall). When comparing pre- (i.e., 2009) versus post-renovation (i.e., 2011), we observed substantial changes to the fish community. Decreases in Sailfin Catfish coupled with increases in Shad spp. and Redear Sunfish were the largest contributors to dissimilarity between these years. However, as pre-renovation data were compared to subsequent years (i.e., 2012, 2013, 2014), the fish community gradually reverts to the one observed in 2009 until a substantial increase in Gizzard Shad in 2015. Renovation efforts proved to be successful in suppressing Sailfin Catfish, but Tilapia recovered by 2012. Commercial fishing for Tilapia was opened in 2013 and our data indicate it likely shifted the size structure of the population towards smaller individuals.

Barry, S.¹, H. Jane Brockmann², and T. Black³

Symposium Paper

¹University of Florida IFAS Nature Coast Biological Station, Cedar Key, FL

²Department of Biology, University of Florida, Gainesville, FL

³Florida Fish and Wildlife Conservation Commission, Cedar Key, FL

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Mobilizing Citizen Scientists to Inform Management of the Data-Poor Horseshoe Crab Fishery in Florida

Horseshoe crabs are a key component of coastal ecosystems and their population status is well documented along most of the United States East Coast. Horseshoe crabs take 10 years to reach maturity

*Student Presentation, Presenter

and have a complex life history and are thus particularly sensitive to over-exploitation. However, little is known about the status of Florida horseshoe crab populations despite ongoing exploitation by the marine-life trade, eel-bait fishery, and entrapment in power plant intakes. To address this concern, we initiated a citizen science effort to conduct standardized spawning and mark-recapture surveys that will generate long-term population data to be used by fisheries managers. This citizen science effort blends research, extension, and fisheries management into a holistic program that provides high quality data to managers, offers opportunities for environmental stewardship and engagement to volunteers, and has the ability to answer basic research questions about horseshoe crab breeding ecology. Like many citizen science efforts, the program is cost effective yet poses unique challenges such as assuring quality of data and retaining volunteers. In spring (March-April) and fall (September-October) 2015-2016, breeding and mark-recapture surveys were conducted by trained citizens during peak breeding times in Cedar Key, FL. After this initial pilot testing phase, the program was expanded to include three additional locations in Florida's Nature Coast region in 2017. Training resources and program logistics were refined using lessons learned during the pilot-testing phase. In 2018, the Florida Horseshoe Crab Watch citizen science initiative is rapidly expanding to beaches statewide and is experiencing marked success due in part to strong multi-agency partnerships and highly engaged volunteers.

***Bohaboy, E. C.¹, W. F. Patterson III¹, and S. L. Cass-Calay²**

Contributed Paper

¹ Fisheries and Aquatic Sciences, University of Florida, Gainesville, FL

² NOAA Fisheries – Southeast Fisheries Science Center, Miami, FL

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Efficacy of Descender Devices in Reducing Discard Mortality of Gulf of Mexico Hook and Line Caught Reef Fish: an Acoustic Telemetry Study

Gulf of Mexico recreational fishers discard the majority of catch of several overfished reef fish species including red snapper (*Lutjanus campechanus*) and gray triggerfish (*Balistes capriscus*). Discarded fish may suffer immediate or delayed mortality, contributing to wasted harvest and increasingly stringent management regulations to rebuild these overfished stocks. In this study, we examined the behavior and fates of acoustic transmitter tagged red snapper ($n = 60$) and gray triggerfish ($n = 24$) following catch and release within a 15 km² array of acoustic receivers at 30 m depth in the northern Gulf of Mexico. This unique dataset contains spatially and temporally fine-scale movement and depth information on tagged fish for up to 11 months following release. Red snapper released at depth with a descender device were more likely to survive than surface-released fish; however, gray triggerfish experienced higher mortality rates when released via descender device. Predation by highly mobile predators accounted for the majority of discard mortality (86% of red snapper and 100% of gray triggerfish). Fate and movement data will soon be available from approximately 80 additional acoustically tagged red snapper from greater water depth (50 m), which will add important information on the effect of increased pressure-related trauma and handling on discard mortality. Preliminary results from this study suggest that descender devices lower discard mortality in red snapper, but additional data and planned simulation analyses will provide more definitive information as to the conservation benefit of descender device usage in the Gulf of Mexico reef fish fishery.

*Student Presentation, Presenter

***Bowers, B.¹ and S. Kajiura¹**

Poster Presentation

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The migratory pattern and consequent extent of range of the western Atlantic blacktip shark, *Carcharhinus limbatus*

Migration occurs across all animal taxa from lower invertebrates to mammals. The commonality between all migratory species is some motivational driver that affects their movement. Sharks follow narrow ranges of environmental parameters when migrating over large distances. Blacktip sharks, *Carcharhinus limbatus*, migrate south from their 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. At the same time as the vernal equinox, they depart from this region and head north again toward Georgia and the Carolinas. Seventy years ago, only rare strays traveled north of Cape Hatteras, NC. Since that time, sea surface temperatures have increased 0.85°C. Many marine species have shifted poleward as oceans have warmed globally. The overarching goals of this research are to assess whether shifts in the migratory pattern of the blacktip shark in the western Atlantic have occurred and if these changes are due to global climate change. Blacktip sharks were passively tracked using acoustic telemetry. Preliminary acoustic telemetry data reveal that the migratory range of the blacktip shark in the western Atlantic extends from southeastern Florida to Long Island, NY. These data suggest poleward shifts in the migratory pattern of the blacktip shark have occurred over the past seven decades. 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.

Brodie, R.B.¹, J.J. Solomon¹, R. Paperno², R. Johnson³, J. Hull⁴ and T.S. Switzer⁵

Symposium Paper

¹Florida Fish and Wildlife Conservation Commission (FWC), 2800 University Blvd. N., Jacksonville, FL 32211

²FWC, 1220 Prospect Ave, Suite 285, Melbourne FL 32901

³Jodie Lynn Charters, 804 Shore Drive, St. Augustine, FL 32086

⁴Hulls Seafood, Inc., 111 West Granada Blvd., Ormond Beach, FL 32174

⁵FWC, 100 8th Ave. SE, St. Petersburg, FL 33701

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The Benefits of Stakeholder Collaboration to Reef Fish Research and Monitoring: A Case Study on Red Snapper Along Florida's Atlantic Coast

The assessment and management of economically-important reef fishes is often highly controversial. Often there is a disconnect between the perception of stakeholders based on their experiences on the water and the results obtained from the synthesis of data from scientific surveys. This disconnect results in a general stakeholder mistrust of survey data that is often difficult to overcome. Our philosophy has long been to engage stakeholders in the scientific process from the outset, especially because recreational and commercial fishers have tremendous knowledge and insight that can greatly improve the success of scientific studies. In this talk, we will highlight our philosophy by focusing on one of our most successful

*Student Presentation, Presenter

case studies: South Atlantic Red Snapper. Following a 2008 assessment that indicated South Atlantic Red Snapper stocks were overfished and undergoing overfishing, an emergency closure was implemented in 2009 that prohibited the harvest of Red Snapper, effectively terminating most fishery-dependent data sources. To address the resultant data gaps, we initiated cooperative efforts with various stakeholder groups, beginning with an industry-initiated Red Snapper tagging program. These initial efforts provided basic information on the distribution and movement of Red Snapper, but more importantly, established effective partnerships with citizen stakeholders. Building upon these partnerships, we embarked on a series of cooperative research studies, with significant industry input, that has yielded new insight into Red Snapper life history and stock status. Importantly, we built opportunities into these studies for stakeholders to document their perception of the fishery. Overall, engaging stakeholders from the outset has led to a successful working relationship and enhanced stakeholder buy-in to the data being provided for assessment. In this talk, we will discuss the benefits and challenges of these collaborative efforts, and provide insight to others seeking to improve stakeholder input to their work.

Brown, C.¹

Symposium Paper

¹ Florida Fish and Wildlife Research Institute, 100 8th Ave SE St. Petersburg, FL 33701

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The Florida Fish Kill Hotline: A resource that benefits the public and scientists

The Florida Fish and Wildlife Conservation Commission's Fish Kill Hotline (FKH) is a mechanism primarily to document and monitor disease and mortality in marine systems throughout the state, though we frequently get reports about freshwater fish kills and numerous other types of incidents. The FKH was established in 1995 and since its inception, we have streamlined reporting, advertised its existence, and promoted it as a resource for the public and partners. Simplifying reporting by adding an online reporting system and developing the FWC Reporter app, has significantly increased the number of reports made by the public. The role of the Fish and Wildlife Health (FWH) group, is to initiate an appropriate response to reports received through the FKH. A typical response may include a fish kill investigation by us or partners, sample collection, diagnostics on specimens shipped to us by the public, forwarding the report to the correct group, or providing information to the public about an event. Engaging stakeholders and improving relationships with federal state and local agencies is a pivotal function of the FKH. We rely on these contacts with local, state, and federal agencies and our strong relationships with stakeholders for information. An increase in the number of reports submitted: diseased fish, fish with lesions, distressed or stranded marine megafauna and endangered species is a quantifiable measure of accomplishment. The success of the FKH has been the result of long term relationships and effective communications among researchers, stakeholders and partner agencies.

***Brown. J.¹, E. Johnson¹, K. Bonvechio², and K. Smith¹**

Symposium Paper

¹ Department of Biology, University of North Florida, 1 UNF Drive, Jacksonville, FL 32225

² Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission, 601 West Woodward Avenue, Eustis, FL 32726

JYBrown88@gmail.com

Long-term stock monitoring through state agency and university collaboration: Recruitment of American eels (*Anguilla rostrata*) to an estuary in northeast Florida

The American Eel (*Anguilla rostrata*) is a catadromous species of ecological and economic importance to the western north Atlantic. Eel populations have been declining throughout their range prompting concerns over population and conservation status. We estimated annual glass eel recruitment (catch-per-unit-effort; CPUE) to assess historic trends in abundance and to examine the relationships between eel recruitment and environmental drivers at various temporal and spatial scales. Glass eels were collected in northeast Florida at a single fixed station at the Guana Dam in the Guana-Tolomato-Matanzas (GTM) National Estuarine Research Reserve on dark flood tides during winter from 2001-2018. Overall, we observed a significant decline in eel CPUE from a period of higher, but variable, abundance in early years (2001-2004) to a sustained period of low abundance from 2005 to present. At a local scale, recruitment was negatively correlated with discharge and water temperature. The relationship between lunar phase and CPUE was variable among years, with increased CPUE associated with new moons in some years, but not in others. At an oceanic scale, CPUE was generally higher in years with increased primary productivity in the Sargasso Sea (Bermuda Atlantic Time-series Study; BATS). Further, we observed a significant relationship between annual CPUE and eel size (total length) in a given year, which may result from faster growth and increased survival in years of high food availability. These results contribute to a growing literature on American eel early life history and recruitment dynamics, and are useful for agencies seeking to more effectively manage this important fishery species. The use of student data collection, faculty led analysis, and state agency management provides an effective example of collaboration in fisheries science. By implementing such strategies, management agencies can efficiently collect valuable long-term data while also facilitating the training of the next generation of fisheries scientists.

Camp. E.V., and B. T. van Poorten

Contributed Paper

¹ School of Forest Resources and Conservation, Fisheries and Aquatic Sciences Program, University of Florida, 7922 NW 71st Street, Gainesville, FL 32606

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Buffet-style management: increasing satisfaction and participation of diverse anglers

Recreational fisheries management strives to achieve a balance between providing satisfying fishing experiences and conserving fish stocks. Achieving both these objectives is difficult because anglers are heterogeneous in their motivations, utility derivation, and behaviors. Trade-offs emerge, such that managing for what one type of angler desires, like high harvest, may make it difficult to achieve another, like high catch rates. So, applying the same management to all waters (“one size fits all”) likely is sub-optimal, but lake-by-lake management is logistically costly. To address this challenge, we developed a landscape management approach that we term buffet-style management. Borrowing from marine spatial planning and modern portfolio management, this concept accounts for landscape-level heterogeneity in both fish populations dynamics and angler human dimensions, and applies a small set (~five) distinct management actions designed to provide a diverse suite of angling opportunities. To test

*Student Presentation, Presenter

this concept, we developed a landscape socioecological model with density dependent growth and survival feedbacks on fish populations and multi-attribute utility models describing dynamic behavior of multiple typologies of anglers. Simulations with this model suggests that, compared to “one-size-fits-all” approaches, buffet-style strategies can achieve greater utility and participation across all angler typologies, with minimal conservation risk to any fish populations. These advantages remained even when we considered imperfect management implementation, such that management actions were not ideally assigned to given waters. While these improvements occur because buffet-style management capitalizes on the open access, multi-objective nature of recreational fisheries, the concept is not without weakness. Stakeholder or agency resistance to change, or “not in my backyard” attitudes could detract from gains. However, we believe the potential to satisfy a greater diversity of anglers, in addition to enhanced opportunities for adaptive and cooperative management, should warrant agency consideration of this new broad management approach.

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Contributed Paper

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Incorporating manager input into ecosystem modeling efforts for the Gulf of Mexico

In the Gulf of Mexico, dozens of ecosystem models have been developed for a variety of applications including fisheries management. However, ecosystem models have rarely been used in actual fisheries management decisions. This is largely due to data limitations, model uncertainties, absence of a formal review process, and the format and timing of model outputs. In order for ecosystem models to be useful for managers, they must provide relevant information at the most appropriate time. Doing so requires careful planning and strong communication between the modeling team and managers. An ongoing study in the Gulf of Mexico seeks to incorporate input from federal and state management agencies into ecosystem modeling efforts. Fisheries managers were included in the project early to help define the questions and facilitate participation in the management process. A scoping workshop was held to identify and prioritize management issues that could benefit from an ecosystem modeling approach. This provided short and long-term management needs that will help to guide future model development. Communication with managers will continue throughout the project in order to refine model outputs and delivery of information. Once models have been developed, we will provide training so that managers may have a better understanding of model dynamics and learn to evaluate scenarios of their own. In conclusion, scientists should solicit input from managers early and often, communicate realistic expectations, provide training when necessary, and have a clear plan for interactions throughout the project’s duration.

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Symposium Paper

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Your fish was *how* big? Cooperative Research Collaborations begin with the Conversation

Cooperative research continues to gain momentum as an efficient and effective method of fisheries data collection. Fisheries stakeholders typically have an unparalleled and intimate knowledge of their fisheries and can provide critical skills and resources that are unavailable to most research faculty. Collaborations between scientists and user groups therefore have the potential to result in better data collection and more informed results than would be possible through a singular entity's effort. The success of these relationships depends upon communication and usually begins with a simple conversation. Cooperative research related to West Florida's reef fisheries have been successful in providing data for assessment and management. We will feature several examples that highlight the benefits, challenges and evolution of relationships with a variety of user groups.

Crandall¹, C., M. Crandall²

Symposium Paper and Workshop

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Science Outreach-Engagement Through Film

Film is a powerful communication tool, and the growing availability and affordability of gear and software makes film an increasingly accessible option to scientists. The aim of this workshop is to share the concepts, skills, and tools that can aid in effectively using this medium. In this first portion, we will focus on communicating through film. We will cover concepts key to creating engaging stories, with an emphasis on moving beyond deficit-model thinking toward a focus on story and character. The ideas covered will be framed in the context of film but are applicable to all forms of science communication. This will feed into the second part of the workshop, which will focus on the tools and techniques of filmmaking, including gear selection, videography, sound recording, and editing.

*Student Presentation, Presenter

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Poster Presentation

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How to bait the hook: understanding citizen scientists' motivations to participate

Citizen science has become a valuable tool for scientists and agencies. However, recruiting and retaining participants can be difficult. Recruitment requires a considerable amount of time and effort, and often high dropout rates necessitate the constant recruitment of new participants. Therefore, critical questions in citizen science program implementation are how to effectively recruit and then retain participants. Previous work has identified a diversity of motivations and barriers to citizen science participation, though there has been little comparison across programs and relatively little research into the motivations of fisheries citizen scientists in particular. This study reviews the citizen science and volunteer literature, synthesizing motivations and ideas across disciplines. These findings were then applied in the development of a questionnaire aimed at determining the most significant motivations and barriers to participation. To date, the survey has been applied to participants in a volunteer angler data program (the Angler Action Program) and to participants in Florida Horseshoe Crab Watch, giving the ability to compare motivations and barriers across programs. Application of the survey to additional program volunteers in future will allow us to elucidate which motivations are consistently important and which differ across projects.

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If You Restore It, Will They Come? Colonization of Robinson Preserve After Habitat Restoration

Florida's coastal habitats have been severely impacted by development. In the past 100 years, Tampa Bay has lost >44% of its mangrove and salt marsh habitat. Robinson Preserve is a 197-hectare preserve, located on the southern shore of Tampa Bay. Originally a coastal wetland, the property was ditched, drained, and used for agriculture. Tidal flow was restored in 2006. While upland and salt marsh vegetation were planted, aquatic flora and fauna were left to colonize from neighboring populations. Robinson Preserve was sampled quarterly from 2007-2013 to evaluate the success of restoration activities. Different species colonized the preserve at different rates based on life-history characteristics. Within the first year following tidal reconnection, 18 fish and 14 invertebrate species had been collected. Although the rate of colonization slowed, at least one new species was documented during each subsequent sampling event. After 7 years of colonization, 85 fish and 105 invertebrate species have been observed. A number of species are ubiquitous, others are seasonal, and some appear to fluctuate based on the presence/absence of specific habitat types, such as macroalgae and seagrass. Numerous commercially or recreationally important species utilize the preserve for juvenile refuge and/or adult foraging (e.g., snook, red drum, and mullet).

*Student Presentation, Presenter

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Symposium Paper

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The Power of Communication to Create Collaborative Partnerships: A Freshwater Fish Tale

The Fish and Wildlife Research Institute (FWRI) Freshwater Fisheries Research Section and the Division of Freshwater Fisheries Management (DFFM) rely heavily upon Sport Fish Restoration (SFR) Federal Aid funding to execute freshwater research and management programs. The SFR allocations for freshwater fisheries research declined from \$2.1 million in 2012 to \$1.3 M in 2015 due to federal sequestration, declining total apportionments for Florida, and a significant decrease in the percentage of SFR allocations designated for freshwater (49% to 41%). These reductions in funding designated for freshwater fisheries research could have deleterious programmatic impacts without innovative solutions that rely on effective communication and teamwork. We worked closely with internal and external management partners to conduct an intensive assessment of our research programs for management decision-making and formed collaborative partnerships to ensure the future success of critical research programs. Between 2013 and 2015 we acquired a recurring legislative budget request for state funding to support four full-time employee positions, developed multiple mutually beneficial collaborative partnerships involving cost-sharing, and secured multiple new grant awards. These partnerships with other FWRI sections (Marine Fisheries Research and Information Science and Management), Division of Habitat and Species Conservation (Aquatic Habitat Conservation and Restoration, Species Conservation Planning, and Invasive Plant Management sections), Division of Freshwater Fisheries Management, Florida LakeWatch, and various Water Management Districts ensured that our research programs were hyper focused on the most critical management issues and improved efficiency in the execution of programs by sharing costs and manpower to meet mutually important goals. By applying an approach of creating collaborative partnerships, the freshwater fisheries research section maintained its core programs, and even expanded and began new research programs to best meet the needs of its management partners. This freshwater fish tale is a testament to the power of communication and teamwork to achieve common goals.

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Predicting Distributions of Non-Native Freshwater Fish: A Role for Climate Indicators

Changing climate, both temperature and precipitation regimes, will potentially influence the ability of non-native tropical freshwater fishes to establish and spread in the southeastern United States. Tools such as CLIMATCH are used to examine and predict the distribution of non-native freshwater fish. However, because these tools use air temperature as a proxy for water temperature, their reliability to predict invasions given a changing climate is uncertain. The purpose of this study was to examine the effectiveness of climate indicators to predict non-native species distributions. A systematic approach was taken to examine the literature to determine which indicators best predict introductions of non-native freshwater fish. The Eco Evidence tool was used to collect and organize the data and then weigh the rigor of the data based on both the amount and quality of support. A series of hypotheses were examined to determine

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which climate indicators had the most support. Out of the fifteen climate indicators tested, eight were supported. The four indicators weighed the highest were maximum and minimum water temperature and average and minimum air temperature. It is recommended that a suite of the top four indicators be tested in species distribution models to predict where non-native species can establish. These high-weighted indicators can be used with appropriate climate forecasting models to better predict establishment and spread under future climate scenarios.

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Life Through the Eyes of a Hogfish: Investigating Hogfish (*Lachnolaimus maximus*) movement and habitat connectivity using eye-lens stable isotopes

Ontogenetic migrations of fishes can lead to depth-specific size distributions across habitats occupied during different life stages. For example, Hogfish (*Lachnolaimus maximus*) in the eastern Gulf of Mexico (eGOM) use seagrass beds as juveniles and reefs as adults. Effective Juvenile Habitat and nurseries have yet to be defined for Hogfish, although seagrass beds of the Big Bend have been hypothesized to serve this role. Offshore movement with age may explain an observed difference in size distributions between shallow versus mid-shelf reefs. However, Hogfish exhibit a separation in size distributions corresponding to SCUBA diving depth limits (30m). Thus, it is unknown whether these distributions are the result of ontogenetic migrations, spearfishing activity with a deepwater refuge, or both. Here, we examine Hogfish movement using stable isotope analysis on eye lenses sampled from individuals across a depth gradient. Eye lens laminae serve as chronological recorders of isotopic values. Since background $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ are spatially predictable in the eGOM, we can estimate the fish's previous locations using measured values from laminae, and recreate their movements. We will use these methods to quantify migration patterns of Hogfish, identify habitat use throughout their life history, and investigate the relative importance of juvenile Hogfish habitat. Improved knowledge about Hogfish ontogenetic migration patterns will help disentangle the relative influences of life history and fishing intensity on population dynamics in the eGOM, as well as identify effective juvenile habitat (i.e., areas of origin) for the eGOM Hogfish population.

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Symposium Paper

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Marine Fisheries Management in Florida: Expert Authority to Co-Management

The Florida Fish and Wildlife Conservation Commission's (FWC) Division of Marine Fisheries Management (DMFM) works with stakeholders to develop management recommendations for Florida's fisheries. This presentation will give examples of how the agency has moved from an expert authority approach to more co-management with stakeholders. To gather information on management ideas and regulatory changes on species, DMFM has held in-person workgroups, advisory boards, and workshops with stakeholders on topics such as marine life, snook, cobia, and scallops. The pros and cons of this and other approaches will be explored relative to what resulted in the most durable management decisions. DMFM has also

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conducted a series of statewide workshops, as well as an online workshop and survey, to gather information on goliath grouper management. A discussion of this process will be presented along with recommendations for effective future stakeholder engagement processes.

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Poster Presentation

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Cooperative research onboard charterboats to evaluate hook performance, selectivity, and management alternatives for red snapper in the northern Gulf of Mexico

Cooperative research provides a unique opportunity for scientists to address issues in fisheries management together with stakeholders. Amendment 27, the circle hook requirement, was thought to have decreased gut-hooking rates for Gulf of Mexico reef fishes, but the effects of circle hooks on catch metrics had not been rigorously tested with controlled experiments. Thus, fishers still question the efficacy of circle hook to decrease release mortality without negatively affecting catch rates. Over the past few years, we have worked with charterboat captains in the northcentral Gulf of Mexico to examine hook performance and selectivity of reef fishes through a combination of fishing experiments and remotely operated vehicle (ROV) surveys. Captains contributed to both the planning and execution of the sampling protocol. Volunteer anglers participated throughout the data collection process, exposing them to ROV-based sampling methods and highlighting the importance of fishery-independent surveys. We compared traumatic hooking frequency and multiple catch metrics among a range of hook sizes commonly used by recreational fishers targeting reef fishes. Red snapper contact selectivity was estimated directly by conditioning hook-specific catches on *in situ* size-distributions observed during ROV surveys conducted prior to fishing. Circle hooks did reduce traumatic hooking rates compared to J hooks (~50%), as intended by the circle hook regulation, without reducing catch rates of target species. Dramatic increases in hook size (2/0 to 15/0) neither shifted selectivity away from small red snapper (~400 mm TL) nor fully selected for larger individuals (> 500 mm TL). Empirical data were used to inform stock assessment simulations to evaluate the impacts of potential hook regulations on stock recovery and long-term yields of red snapper.

***Gervasi, C.L.¹ and J.S. Rehage¹**

Poster Presentation

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Impacts of a Coastal Marine Protected Area on Gray Snapper (*Lutjanus griseus*) Biology, Behavior, and Movement in Florida Bay

In the state of Florida, saltwater recreational fishing adds billions of dollars to the economy annually, so conservation of recreationally fished species is of utmost importance. Research on no-take marine protected areas has shown that they are extremely valuable conservation tools, as they can provide a variety of benefits for fishes. In Florida Bay, a subtropical estuary home to a variety of recreationally important fish species, there is one no-take area known as the Crocodile Sanctuary. This area has been closed to public access since 1980, but little is known about how fish populations have been impacted by the closure. Gray Snapper is one of the top most popular gamefish species in Everglades National Park, and has been chronically overexploited in the region. In addition, the Park has reopened a portion of the Sanctuary to catch-and-release fishing, and the entire closed area may be reopened under future

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management plans. It is therefore an immediate need to understand how the closure of the Crocodile Sanctuary may be affecting Gray Snapper and contributing to its conservation. Research has shown that Snapper are larger and more abundant in the Sanctuary than in adjacent fished areas, but we do not know anything about how the closure has impacted life history characteristics (growth, maturation), behavior (boldness, catchability), or movement (residency). Any changes to Snapper biology, behavior, or movement within the sanctuary could affect the recreational fishery via spillover from the protected area. This research will compare Gray Snapper biology, behavior, and movement between Little Madeira Bay (part of the Sanctuary) and Long Sound, an adjacent fished embayment of similar size and with similar environmental characteristics. Results will show how the Crocodile Sanctuary is contributing to conservation of the Gray Snapper in Florida Bay and possibly provide support for keeping the area closed into the future.

***Greenspan, J.¹, J. E. Hill², Q. Tuckett², M. Hoyer¹, and C. Cichra¹**

Poster Presentation

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Habitat factors affecting establishment success of the non-native Blue Tilapia *Oreochromis aureus* in Florida Lakes (USA)

Documented intentional introductions of Blue Tilapia *Oreochromis aureus* into Florida waters date back to August 1961, and the species (or some hybrid thereof) has spread throughout much of the Florida peninsula. However, density of Blue Tilapia varies greatly across basins and habitats in Florida and some water bodies remain uninvaded. Blue Tilapia is of concern because it reaches high densities in some locations and although largely anecdotal, a variety of negative effects have been attributed to this species, including competition with native organisms for food and/or spawning sites, changes in fish community structure, and loss of vegetation. Its biology has been heavily studied, but little research exists to determine which factors limit/promote successful establishment. The proposed study will use Florida Lakewatch habitat and fish data and distribution data from the FWC Long Term Monitoring Program to identify abiotic and biotic factors contributing to the successful establishment of Blue Tilapia in Florida waters. The results of this study can be used by management to identify areas at risk of future Blue Tilapia spread and contribute to a central theme in invasion biology, prediction of species establishment and spread.

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Poster Presentation

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Physiological Stress Response of Sharks Captured in a Unique Recreational Fishery

Physiological consequences of recreational land-based shark fishing are lacking in current scientific literature for all species. Commercial fishery scientists have used blood analysis to predict post-release mortality to develop models for maintaining a sustainable shark fishery. As a first step in collecting similar data in a unique recreational fishery, sharks will be captured and released from beaches off Eastern Florida (April 2018-December 2018) from Nassau to Palm Beach County using similar rod and reel equipment as

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recreational fishermen. Each shark will have three blood samples taken (~6 mL) at 0, 5, and 10 mins after landing. Blood samples from captured sharks will be analyzed for lactate, glucose, pH, iCa, Na, Cl, K, TCO₂, and pCO₂ by using a portable point-of-care iSTAT. Remaining blood (~4 mL) will be stored on ice and brought back for laboratory analysis. The resulting dataset of stress parameters will be evaluated with respect to determine where a statistical difference may occur in respect to time out of water. Further statistical analysis will consist of evaluating relationships between the quantified stress response with respect to varying species, size class, fight time, temperature, salinity, and DO. If better handling techniques that maximize survivorship are discovered, they should be added to current fishing regulations. This could aid in the conservation of threatened species like sandbar, hammerhead, and tiger sharks. In collaboration with the Jacksonville University Communications Department, a video will be created and disseminated that documents the capture, handling, and release of sharks, the sampling procedure, and results from blood analyses. The results from this study will contribute to understanding of the stress physiology of sharks and may support better sustainability models. If this collaboration is successful, future studies may want to consider similar collaborations to improve communication in/out of the scientific community.

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Contributed Paper

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Metabolic Physiology and Hypoxia Tolerance of Lionfish (*Pterois spp.*) using stop-flow respirometry: Are there physiological limits to inshore invasion?

The Indo-Pacific lionfish (*Pterois* sp.) is now well established in the coastal areas of the western Atlantic Ocean. Because of rapid geographic range expansion, fast individual growth, high fecundity, and high predation rates, this invasive species is broadly considered a significant threat to native fish populations and overall biodiversity. To provide data that could help predict the ability of lionfish to successfully invade inshore temperate estuaries, we used stop-flow respirometry to determine aerobic metabolic scope (the difference between resting and maximum metabolic rates) under normoxic and mildly hypoxic conditions, as well as critical oxygen saturation (S_{crit} , lowest oxygen level as which aerobic metabolism can be maintained) for eight lionfish captured off southeastern Florida. Mean (\pm SD) aerobic scope was 35 ± 5 , 86 ± 13 , and 105 ± 16 mg O₂/kg/h under normoxic conditions and S_{crit} values of $42 \pm 2\%$, $52 \pm 2\%$, and $65 \pm 1\%$ at 20, 25 and 30°C respectively. Preliminary measurements of aerobic scope under mildly hypoxic conditions were 33 ± 5 at 25°C. Aerobic scopes are consistent with the benthic, ambush-predator feeding ecologies of lionfish and far less than those of estuarine piscivores that must actively forage for food. The smaller aerobic-scopes equip lionfish with an energetic advantage when prey items are abundant, reducing digestion time as well as recovery time from burst swimming behavior. Lionfish S_{crit} values revealed much less of a tolerance to hypoxic conditions in comparison to estuarine fishes which will drastically reduce their overall fitness and therefore pose a minimal threat within estuaries that are episodically hypoxic. We intend to incorporate our results into eco-physiological models that will allow predication of the ability of lionfish to invade temperate estuaries and other sensitive ecosystems directly enhancing fisheries management strategies of these invasive species.

*Student Presentation, Presenter

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Symposium Paper

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The Possibilities, Processes and Potential Pitfalls of Stakeholder Engagement in Fisheries Management

Fisheries scientists and managers are increasingly being charged to engage stakeholders in science and management decisions. A well thought out and executed stakeholder engagement plan can lead to more sustainable management actions, systemic changes and build relationships and trust. When scientists and managers aren't given the time, resources and training to create and implement a comprehensive engagement plan there can be negative consequences such as a breakdown in communication, distrust in and a lack of buy-in to scientific results or management decisions. Successful engagement plans include an identification of goals and levels of engagement, stakeholder analysis; engagement processes designed to meet goals and stakeholder needs, adaptability and a closure and evaluation phase. This presentation will use case studies to review best practices and lessons learned from 13 years of stakeholder engagement process development, application and evaluation.

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Symposium Paper

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Who is at fault for poor communication and why is it you? Social Media Edition

How and where people communicate has changed and will continue to do so. The tools driving it are free. What are you waiting for?

Hill, J.E.¹, and Q.M. Tuckett¹

Symposium Paper

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Collaboration With Florida's Aquaculture Industry to Reduce the Risks of Non-native Species

Historically, Florida's aquaculture industry has been a prominent pathway for the introduction of non-native aquatic organisms. Nevertheless, the industry is economically important in Florida and has been the major stakeholder of the University of Florida/IFAS Tropical Aquaculture Laboratory (TAL) since its inception in 1996. The TAL has worked on the controversial issue of the culture and trade in non-native species from its beginning, with a formal program since 2003. Despite some early reservations and concern over the potential for unintended consequences to the industry, the TAL program has gained the trust and support of trade associations and individual producers. The result is a productive collaboration whereby the TAL works with agencies and industry on risk assessment and management (= risk analysis) to support regulatory and non-regulatory decisions on species status and culture. The TAL further provides science on the factors that promote and impede species invasions, develops and tests risk screening and assessment methodology, evaluates risk mitigation practices, and analyzes policy options.

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The program has been successful due to several important factors: (1) history of the TAL in assisting the aquaculture industry with its problems, (2) trust and respect built by TAL aquaculture staff, (3) knowledge that key TAL staff have worked in industry, (4) consistency in our science and messaging, (5) education of the industry, and (6) ongoing, two-way communication. This productive relationship has resulted in evaluation and improvement of industry regulatory compliance and the effectiveness of Best Management Practices, documentation of the scope of non-native species escape, and the risk screening and assessment of numerous species in trade or of interest for trade. The industry now views risk analysis as a valuable tool for decision making and frequently solicits advice and rapid risk screens prior to culturing new species.

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Poster Presentation

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Post-Flood Piscivory by a Semelparous Anadromous Planktivore; Diets of Spawning American Shad from the St. Johns River, Florida

American Shad are an anadromous herring that live in the ocean until they reach sexual maturity when they ascend their natal rivers and spawn in fresh water. American Shad lose up to half of their body weight during spawning; southern populations lose so much energy that they are semelparous. Conventional wisdom has been that American Shad do not feed on the spawning grounds and that the lack of feeding was due to a lack of suitable food. American Shad adults are planktivores and feed extensively on *calanoid* copepods in the ocean and *mysids* in estuaries. Previous studies in the York River, VA and St. Johns River, FL found no more than very small, <0.1g, quantities of small detritus, sand, small copepods and ostracods in the stomachs of American Shad on the spawning grounds. However, anglers in the St. Johns River, FL have recounted shad chasing “shower minnows”. We examined the stomach contents of American Shad subsampled from our spawning grounds monitoring catches in 2009, 2010, 2011, 2012, and 2018. Stomachs in 2009 and 2018 contained large quantities, >20g, of small fish, primarily *Gambusia holbrooki* but also *fundulids*, *cyprinodontids*, and even small *centrarchids* and *clupeids*. Stomach fullness of the fish-eating shad rivalled that of the pre-migration ocean shad in some individuals. Stomach fullness was an order of magnitude lower and no fish were observed in stomachs in 2010 or 2011. The spawning runs in 2009 and 2018 followed prolonged near-record high hurricane rain enhanced wet-season flooding of the upper St. Johns River marshes. The 2010 and 2011 spawning runs followed normal and below normal wet seasons with only brief inundation of the floodplain. American Shad arrive to spawn during the dry season and appear to capitalize on the abundance of floodplain associated prey when the marshes drain down after extended flooding.

*Student Presentation, Presenter

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Contributed Paper

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Understanding the biology of invasive lionfish in Florida: Collaborative research among scientists, managers and citizens

Invasive species are organisms that have been introduced to areas where they do not naturally occur, whose establishment causes injury to recipient ecosystems. One such invader, the Indo-Pacific lionfish (*Pterois volitans/miles*) has rapidly invaded the western Atlantic, Gulf of Mexico and Caribbean Sea with documented negative impacts on native ecosystems. To most effectively manage lionfish and mitigate their effects, a detailed understanding of its life history is required. To better understand the life history of this species, we collaborated with a diverse group of stakeholders including local fishermen and dive captains, non-profit organizations, state agencies to collect lionfish from the offshore waters of northeast Florida. The data were used to develop and validate a length-based, age-structured model for lionfish in the region to estimate growth and population structure. Overall, our model generated biologically realistic parameter values, provided good fits to observed length-frequency data, and was validated using two independent data sources. Our length-based approach may offer a more practical alternative to estimating growth than by tagging or otolith analysis which are time and labor intensive, and can be difficult for tropical species. The main findings of this study were: (1) lionfish exhibited rapid growth with seasonal variation in growth rates, (2) distinct cohorts were clearly identifiable in the length-frequency data suggesting that lionfish recruit over a relatively short period in summer, and (3) the majority of lionfish were less than 2 years old with no lionfish older than 3 years of age, possibly as a result of an ontogenetic shift of older fish to deeper water, which may provide a reservoir of spawning biomass not accessible to spearfishing. Further, working directly with stakeholders allowed for efficient collection of biological samples at a large spatial scale, fostered communication between researchers and fishermen and facilitated knowledge transfer to managers.

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Poster Presentation

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Retroactive range testing in a dynamic estuary to further investigate snook movement through telemetry

Passive acoustic telemetry (PAT) is a widely spreading technology where targeted organisms are implanted with transmitter tags that give off unique ID codes as they pass stationary receivers within the environment. Animals can be tracked over several years, providing data on habitat selection, social interaction, disturbance ecology, and movement ecology, which enhances understanding and management. Passive acoustic receivers used to detect this movement data have a range within which they can detect acoustic tags that fluctuates based on environmental conditions, noise, structure of the site, and other factors. Our study focuses on how common snook (*Centropomus undecimalis*), a tropical euryhaline sportfish, movement is influenced by environmental parameters and focuses on their response to the discharge from Lake Okeechobee. Preliminary results of 200 adult snook tagged with PAT suggest that snook possibly avoid desirable habitat in backwaters of the estuary connected to the outflow canal

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from Lake Okeechobee. In the region closest to the outflow canal, snook appear absent when flow is high seeming to indicate this region is used less due to the outflow canal. The high-volume water discharges in this outflow canal may knock-out code detections from tagged fish so that even though fish are present they are not being detected. Testing of the ranges of detectability is required to solidify the results and be able to provide input on the management of this species and the waterway. Acoustic receivers can have a range of up to 1km, but it is often much less based on environmental factors and site-specific features. In order to support this preliminary data and future results, we will be conducting a long-term range test of the equipment comparing it with environmental conditions and noise in the system to determine the actual range of a receiver under varying parameters within a dynamic estuary.

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Contributed Paper

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Spatial and ontogenetic patterns of trophodynamics of Hogfish, *Lachnolaimus maximus*, in the eastern Gulf of Mexico

Recent stock assessments of Hogfish, *Lachnolaimus maximus*, in the eastern Gulf of Mexico (GOM) indicate that the rate of fishing exploitation may have increased in recent years due to growing interest in recreational hook-and-line fisheries. As such, biological and ecological information for the species, including data on trophodynamics, is needed. Little is known about Hogfish trophodynamics, most likely due to difficulties in describing prey as this fish species is durophagous and primarily feeds by crushing shelled organisms. We developed novel approaches to effectively and efficiently describe the diets of Hogfish collected from multiple surveys across a wide range of sizes throughout the eastern GOM. Results indicate that hogfish experience ontogenetic shifts in diet with increased size and movement offshore. Adults were found to eat higher proportions of molluscs, crabs, and larger shrimp (usually commercially important species) in comparison to smaller, nearshore individuals whose diet was primarily Paguroidea (hermit crabs) and small crustaceans such as amphipods, isopods, and smaller shrimp; however, this is potentially influenced by survey limitations for different life stages. This examination of Hogfish diets represents a critical first step in understanding their unique ecology and trophic interactions, which in turn provides valuable context and laboratory methodologies for current and emerging ecosystem research in the GOM.

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Symposium Paper

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Opportunities and dangers of using maps as means of communication

Maps are often recognized to be an effective means of communication between scientists, decision-makers, and other stakeholders because they present information in a common frame of reference:

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geographical space. However, maps are simplified representations of the real world and are strongly influenced by the many decisions involved in their production. This paper addresses the advantages and disadvantages of using maps to collect, summarize, and disseminate data and information.

First, we introduce map-based data collection as a methodology for substantive stakeholder engagement. The map biography methodology was developed in indigenous research contexts as a means of gathering information about traditional land use and place-based knowledge. We posit that adapting the map biography methodology to suit the context of fisheries stakeholders would yield access to valuable local insight. While the methodology has considerable potential as a way to engage stakeholders, we also present some ethical and practical considerations to its responsible use.

Then, we present examples, in a fisheries context, of how decisions made during map production can influence the way the information is displayed, lead to misrepresentations, and consequently misinform decision-making based on such maps. Particular attention will be given to scale, as it is still unclear how different stakeholders with different backgrounds interpret the concepts of scale, and how methodological, ecological, social, and management scales can be simultaneously taken into account. Mismatches between scales have previously been identified as causes for failures in conservation and management.

Better engagement with the intricacies involved in communicating through maps will help answer the needs of different stakeholders. It is of utmost importance to recognize both the potential and limitations of the spatial methods and data used, to understand the different trade-offs involved in map production, and to remain critical of the outcomes of mapping methodologies.

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Poster Presentation

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Understanding Occupational Displacement of People Who Fish Commercially:

Work is an important part of most people's lives and holds meaning beyond the earning of wages and the securing of a livelihood. For people who fish commercially, identity, attachment, social ties, traditions, and social norms are deeply entwined with the fishing occupation, both on the individual level as well as for communities. In recent decades, many fisheries and especially small-scale fishing operations have been under significant pressure and undergoing large changes due to fishing regulations, market forces, industrialization, and environmental changes. These changes can force fishers to leave the fishing occupation, thus leading to occupational displacement. We define occupational displacement of commercial fishers as the process that forces fishers to either leave the fishing occupation or to make significant changes to their fishing activity (such as moving to a different geographic location, changing the type of fishing they are doing, or fishing illegally). In the context of political and economic forces that shape coastal and riverine communities, contentious allocation of resources between recreational and commercial fishing, and changes in local and global ecosystems, it seems likely that occupational displacement will continue to affect commercial fishers.

We propose to explore this issue by conducting two complementary case studies of occupationally displaced fishers, one in Florida, where the gill net ban displaced around 1500-2000 fishers and their families in 1995/6, and another in Brazil where hydroelectric dams displace riverine communities, some of which rely on fishing.

In this presentation, we will present the theoretical background for this research, the proposed research methods, and share first experiences in exploring this issue. Fisheries management is about the natural resource and the humans that use them. We hope this research will bring a better understanding of the social and psychological consequences of occupational displacement of commercial fishers.

*Student Presentation, Presenter

***Lindelién, S.¹, and D. Parkyn¹**

Contributed Paper

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An assessment of fin rays and fin spines for use in non-lethal aging of Largemouth Bass (*Micropterus salmoides*) in Florida

Non-lethal aging methods using fin structures have been applied to both marine and freshwater fishes for more than 60 years (Cass and Beamish 1983). However, these methods have not been fully explored for Largemouth Bass *Micropterus salmoides* (LMB) in Florida. Verifying these methods would reduce/eliminate mortality during age sampling and enable age-determination of angler-caught LMB (e.g., during tournaments and/or TrophyCatch submissions). LMB were collected from Rodman Reservoir via boat electrofishing from February 2017 to January 2018 (N = 685). Anal, dorsal, pectoral, and pelvic fin rays, dorsal, anal, and pelvic fin spines, as well as sagittal otoliths were removed from each fish. Thus far, cross sections of 688 fin structures/otoliths have been aged. Dorsal spines have provided the most accurate and precise age estimates based on CV and APE relative to other fin structures. Within-reader agreement (i.e., precision; Reader 1) was 96% (CV = 0.96) for otoliths, which was highest among all structures. Between-reader agreement was 94% (CV = 1.2) for otoliths. Within-reader agreement (Reader 1) for fin structures ranged from 56 to 82%, with dorsal spines, pectoral rays, and pelvic rays having percent agreements $\geq 75\%$. Precision of age estimates for all fin structures ranged from $95\% \pm 1$ year to $100\% \pm 1$ year for Reader 1. Percent agreement (i.e., accuracy) between fin structure-based and otolith-based ages ranged from 54 to 78% (CV = 5.7 – 13.7) for Reader 1. Aging imprecisions associated with the fin structures included: misinterpretation of the first annulus leading to an overestimation of young fish in dorsal spines, identifying false annuli/checks, and edge compaction of annuli.

***Lyons, T. J.¹, Q. E. Tuckett¹ and J. E. Hill¹**

Contributed Paper

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Pathway Evaluation and Risk Screen of Lionfishes, Subfamily Pteroinae

Invasive lionfish (*Pterois volitans/P. miles*) are highly successful marine invaders that have generated widespread and severe ecological consequences throughout their invaded range in the tropical western Atlantic. The spread of these species has generated a large body of literature in recent years. However, the occurrence of several additional species of globally traded lionfish has raised concern that they may pose similar risks as potential invaders. Here we (1) characterize the current literature for the invasive lionfish complex and 16 other species of lionfish (subfamily Pteroinae) to determine what is known about these potentially invasive species that lack an invasion history and see how this compares to our knowledge of two known invaders within the same subfamily, (2) evaluate the trade pathways of ornamental lionfish using three independent databases to identify species that are heavily imported and determine the most likely areas of introduction, and (3) apply the Aquatic Species Invasiveness Screening Kit (AS-ISK) as an initial evaluation of invasion risk for the state of Florida. Because this group of fish has prior invasion history in the Atlantic Ocean, Gulf of Mexico, and Mediterranean Sea, a proactive approach

*Student Presentation, Presenter

towards future establishment by screening species that exhibit similar characteristics is a viable tool that can inform future risk assessment.

***Malinowski, C.R.^{1,2}, F.C. Coleman², C.C. Koenig²**

Contributed Paper

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High mercury levels in the Atlantic Goliath Grouper *Epinephelus itajara*: a critically endangered species being reconsidered for a fishery in the southeastern US

Goliath Grouper *Epinephelus Itajara* is currently a protected species in the southeastern U.S. waters of the Atlantic and the Gulf of Mexico and is considered critically endangered throughout its now considerably compressed geographic range. In this study, we evaluate the mercury levels in the tissues of Goliath Grouper in Florida waters – their center of abundance – revealing extraordinarily high levels in the liver and muscle of adult fishes that increase with size and age. The levels far exceed the recommendations for consumption designated by either the U.S. Environmental Protection Agency or the U.S. Food and Drug Administration. So why the concern? After all, there is no fishery extant in the U.S.. There are two issues that we investigate here: (1) the lack of agreement among federal agencies for the level of mercury considered dangerous for human consumption; and (2) the apparent lack of interest in curtailing the sale of fish that exceed this level of consumption. We also question the legitimacy and purpose of opening a fishery for a species of conservation concern, of unknown population recovery status that could pose a serious health risk to potential consumers. We worked closely with various managers and stakeholders to complete this work, which is critical to the upcoming decision of whether or not to reopen the fishery.

***Massie, J.¹, N. Viadero¹, and J. Rehage¹**

Poster Presentation

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Hurricane driven movements of Common Snook (*Centropomus undecimalis*) in the Florida Coastal Everglades

Extreme weather events such as hurricanes have the potential to alter fish distributions and can carry implications for both catchability by anglers and the timing of life history events such as reproduction. In this study we use acoustic telemetry data collected from tagged Common Snook (*Centropomus undecimalis*) in the Shark River Slough of the Florida Coastal Everglades to perform a preliminary investigation on the timing, direction, and magnitude of movements in relation to Hurricane Irma. Downstream movements to potential estuarine spawning sites are then compared to electrofishing catch data of juvenile Snook in order to examine possible recruitment events related to the storm. Common Snook are a tropical species that are targeted by anglers whose participation in a largely catch-and-release fishery makes substantial contributions to the economy of South Florida. 2.5 million Snook are caught each year and these fish are the fourth most targeted species by anglers on the southern Atlantic coast, and third most targeted species in the Gulf of Mexico. The frequency with which disturbances such as hurricanes occur has increased in recent years, a trend that is predicted to continue in the future, and shedding light on the specific responses of recreationally important fish species can help to formulate

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predictions on how fish might respond in the future. Understanding when, where, and why animals move can provide valuable information that allows scientists and natural resource agencies to make informed decisions regarding how best manage fish stocks and maintain angling opportunities in the face of changing conditions.

McBride, R.¹

Symposium Paper

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Designing an Effective Presentation

Do you have a strategy for designing your presentations, and if so, how would you characterize it? In this presentation, I will introduce the assertion-evidence approach, which is well suited to use for a formal seminar. This style was advocated by Michael Alley in his 2003 book: "The Craft of Scientific Presentations: Critical steps to succeed and critical errors to avoid" (<https://www.craftofscientificpresentations.com/>). It is based on the premise that coordinating your words and images on each slide can make your points both more understandable and more memorable. I will also highlight ways: 1) to target your audience and the occasion; 2) to communicate early the subject and its importance; and 3) to structure your talk to engage everyone regardless of their expertise. I make extensive use of Microsoft clip art and smart art features to demonstrate not only their availability, but also best practices in font style and size and use of color and images. Finally, I discuss other presentation styles so that you can consider a portfolio of strategies for designing your next presentation.

***Mowle, K.¹ and J. Gelsleichter¹**

Contributed Paper

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Characterization of vitellogenesis in the bonnethead shark *Sphyrna tiburo*

Vitellogenin (Vtg) is a precursor to yolk-proteins that is known to be produced in the liver under the control of the hormone estradiol (E2) in reproductively active females of most non-mammalian vertebrates. Previous studies have examined Vtg production in a wide variety of fishes, but no studies to date have done so in a placental viviparous elasmobranch. Therefore, the purpose of this study is to examine Vtg production in a viviparous shark species, the yolk-sac placental bonnethead shark *Sphyrna tiburo*. Specifically, this study focuses on determining where Vtg is produced in *S. tiburo*, how reproductive steroid hormones influence Vtg production, and what temporal patterns occur in Vtg levels throughout the species' reproductive cycle. To date, Vtg presence in the plasma has been assessed using immunoblotting; preliminary results have detected Vtg in the plasma of mature females collected during the spring, which is the established time period of follicular development for this species. Preliminary results have also found Vtg production occurring earlier in the year for this species, in the fall and winter. Immunohistochemistry has also been conducted; these assays have confirmed the liver is the site of Vtg synthesis in *S. tiburo*. Preliminary evidence also suggests that E2 and progesterone (P4) play a role in regulating this process, with immunohistochemistry detecting the receptors for both hormones within the liver. High levels of E2 have also been found to correlate with Vtg presence in the plasma, suggesting that E2 stimulates Vtg production for *S. tiburo*. The role that E2 and P4 play in regulating Vtg synthesis will be further assessed by exposing cultures of liver slices to the hormones and measuring Vtg

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production, with the working hypothesis that E2 will stimulate production while P4 may inhibit or slow down the process.

Munnelly, R.¹, B. Pittinger¹, S. Keenan¹, and T. Switzer¹

Contributed Paper

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Grouper potholes on the West Florida Shelf: extent of habitat modification and biological associations

Locally-abundant features on the West Florida Shelf (WFS) are shallow sand depressions commonly referred to as ‘pockmarks’ or ‘potholes’. In WFS waters <90m deep, potholes (PHs) are often excavated by the recreationally and commercially valuable red grouper, *Epinephelus morio*. Potholes attract diverse fish assemblages that include species with fisheries of their own. From 2014–17, Florida’s Fisheries-Independent Monitoring program (FIM) used 445 kHz side-scan sonar to map the seafloor of 38,380 transects 0.1km² in area in waters <90 m deep. The SSS imagery was used to locate and deploy baited stereo-camera arrays at 69 PHs in 17–88m water depth between 2014–16, within WFS National Marine Fisheries Service (NMFS) offshore statistical zones 4–10. On video, 32 PHs were within view of adjacent hardbottom habitat (flat, fragmented, or ledge). Permutational multivariate analysis of variance (PERMANOVA) detected significant differences between fish assemblages at PHs adjacent to hardbottom vs. stand-alone PHs, although relative-abundance indices were similar. Also, the presence of *E. morio* (active PHs) at 6/27 PHs throughout zones 7–10 (Panhandle) vs. 36/42 PHs throughout zones 4–6 (Central WFS) suggested a non-*E. morio* origin of Panhandle PHs. PERMANOVA indicated a significant effect of active status by region, and a significantly higher number of species were associated with active PHs. Pothole densities ranged from 0–360/km², and peaked between the 50–90m isobaths. Mean PH width varied significantly by active status and region. Further, substantial quantities of rock were exposed within excavated PH interiors. At active Panhandle PHs, inactive Panhandle PHs, active Central WFS PHs, and inactive Central WFS PHs, respectively, mean excavated rock ($\pm 95\%$ CIs) covered: 1.1 \pm 1.2, 0.5 \pm 0.7, 9.3 \pm 4.2, and 2.8 \pm 5.7 m², and excavation fouling biota covered: 1.4 \pm 1.2, 4.0 \pm 3.7, 9.1 \pm 3.3, and 5.5 \pm 9.6 m². These results emphasize the importance of the ecosystem-engineering services provided by *E. morio*.

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Symposium Paper

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Selecting Your Communication Strategy

At the FWC, there are many different communications routes available to get the word out about fisheries projects—and sometimes selecting the “right” one can be difficult! This talk discusses the available communication routes, help attendees better understand which one may work best for them, and discuss success stories and lessons learned from leading FWC’s freshwater fisheries communication team.

*Student Presentation, Presenter

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Symposium Paper

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Communicating scientific and social data to the fishermen of Lake Jackson

Lake Jackson, FL is managed using biological and social surveys. The information collected can evaluate changes to the Lake Jackson fishery. In 2013, the Largemouth Bass *Micropterus salmoides* regulation on Lake Jackson, FL changed from a 5 fish bag limit, with an 18-inch minimum (permitting the take of one Largemouth Bass > 22 inches) to a 5 fish bag limit, with a 16-inch maximum (permitting the take of one Largemouth Bass greater than or equal to 16 inches). The change was to allow an increase in angler harvest of smaller Largemouth Bass and in turn have a positive effect on size structure. Biologists have been monitoring if the regulation change had any effect on the Lake Jackson fishery. The results of surveys should be shared with the public so that those who are interested can learn more about the Lake Jackson Largemouth Bass fishery. The objectives of this talk are to discuss effective ways to get fisheries information to the public and increase the knowledge about the Lake Jackson fishery and the effects of harvest of Largemouth Bass. Currently, we are creating a brochure with various information (e.g. background, research results, and cooking recipe) to be available at local tackle shops and to be handed out during creel surveys to begin to get the information back to the public.

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Poster Presentation

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Larval Survival of Hard Clams *Mercenaria mercenaria* in Artificial Seawater from Different Sea Salts

Shellfish aquaculture is heavily reliant on commercial hatchery seed production. To access seawater, almost all hatcheries are located on shorelines, having variable coastal water quality and potential for destruction during severe weather conditions. Therefore, use of artificial seawater may be an alternative approach for inland hatcheries and research laboratories. The goal of this pilot study was to evaluate survival of hard clam larvae in artificial seawater beyond metamorphosis. Four artificial salts were chosen and natural sea water was paralleled as a control. Twenty-four hours after fertilization, D-larvae at (T = 22°C) were aliquoted into five parts and allocated into four types of artificial seawater and natural seawater for culture through the whole swimming larvae stage (19 days) till reaching metamorphosis (i.e. foot and eye development). Water changes were performed every other day, and total larvae number were estimated after being screened and concentrated into a 500-mL volume during water change. Three replicates were performed in this study. Survival was calculated in each group as the percentage of survived larvae out of the total D-larvae estimated at Day 1. Water quality, including pH, dissolved oxygen, temperature, salinity, ammonia, and nitrate concentrations, were measured. The results showed that artificial salt treatment and culture time (days) had significant effects on larval survival ($P < 0.001$). A post hoc Tukey test indicated that compared to natural seawater, artificial seawater from two of four types of sea salts, including Brightwell Aquatics NeoMarine Salt Mix and Crystal Sea[®] Marinemix, produced the similar larval survival. If considering the costs of these three sea salts, Crystal Sea[®] Marinemix would be the choice for making artificial seawater for hard clam larval culture. More trials are needed with larval

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concentration controlled over the span of the swimming larvae stage and measurement of the larval growth rates.

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Poster Presentation

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Temporal and habitat-associated dynamics of nearshore reef fish assemblages from a multiyear fixed station survey in the eastern Gulf of Mexico

When examining temporal trends in reef-fish survey data, it is critical to identify whether observed trends represent actual population level fluctuations rather than alterations to survey design and, if so, adjust analytical methodologies or subset the data accordingly. One approach to verifying observed trends in survey data is to conduct surveys at a set of fixed locations, so that collected data accurately reflect true population trends and are not confounded by spatial variability in habitat sampled. Accordingly, we implemented a fixed-location sampling survey beginning in the spring of 2012. Data from side-scan sonar surveys and concomitant visual surveys were used to identify a series of fixed locations representing multiple, natural reef habitats (i.e., low-relief live bottom, fragmented hard bottom, ledge) in nearshore waters (12-19 m) of the West Florida Shelf. Quarterly sampling was conducted using stationary underwater video camera arrays that quantify the relative abundances of fishes and associated habitat. Analyses using non-parametric, community-based methods provided information on differences in species assemblage structure between habitats, seasonal changes in assemblage structure, and inter-annual abundance trends among different reef habitats for many economically important species. Species assemblage structure differed between all habitat types, and between winter and all other seasons. Assemblages differed over time within habitat types and between habitats. Species largely contributing to differences among habitats and seasons include Gray Snapper (*Lutjanus griseus*), Damselfishes (*Pomacentridae*), Blue Runners (*Caranx crysos*) and Scamp (*Mycteroperca phenax*). Additional environmental data were evaluated as potential drivers of these trends. Data from this program can also be used to aid federal managers in developing and improving stock assessments.

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Symposium Paper

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Cooperative Science with Stakeholders and Subject Matter Experts

Imagine what can be accomplished when we harness the energy, the passion, and the knowledge of other people; working together to achieve a common goal. I will discuss how we created collaborative fisheries research projects with stakeholders and with subject matter experts, and why we think they were successful. A statewide assessment of trophy bass age, growth, survival, and seasonal harvest was achieved by recruiting more than 50 taxidermists across the state to collect otolith samples from Florida Bass >4.54 kg. Communicating results to taxidermists and anglers each year maintained a high interest among cooperating taxidermists. Focused research projects can also be greatly enhanced through partnerships with subject matter experts. I will discuss our partnership with geneticists that provided the expertise to complete statewide genetic studies of Florida Bass, Suwannee Bass, and Shoal Bass. Data collected on Florida Bass from the Richloam Fish Hatchery and from wild populations across the State of

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Florida, allowed us to develop a statewide conservation plan for this species. Expanded partnerships on a regional scale resulted in three national symposia on black bass conservation, a book, and range-wide conservation initiatives for several species of black bass. Various outreach strategies were used to educate anglers and other stakeholders.

***Ramee, S. W.¹, T. N. Lipscomb¹, and M. A. DiMaggio¹**

Contributed Paper

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The potential influence of environmental stress on sex differentiation in two ornamental fishes

There is considerable sexual plasticity among teleosts. In many species, sexual phenotypes may result from a combination of both genetic and environmental sex determination (GSD and ESD), while sexual differentiation can be later influenced by environmental factors. This environmentally dependent plasticity that occurs during the undifferentiated labile period has the potential to result in skewed sex ratios. In several species, the process of environmental sex reversal has been linked to the stress response axis and regulated by the release of the stress hormone cortisol. Sexually dichromic species, such as the Rosy Barb *Pethia conchonius* and Dwarf Gourami *Trichogaster lalius*, make excellent model species for sex differentiation research. They are also commercially important ornamental species, for which alternative masculinization techniques would benefit Florida's ornamental aquaculturists due to the male's more vivid color resulting in greater commercial value. Current research efforts focus on understanding the role and interaction of environmental stressors on sex differentiation in these two species in order to develop potential new masculinization protocols.

A suite of experiments have been conducted during the first 30 days post hatch of these two species. These experiments were designed to elevate endogenous cortisol levels in developing larvae by either directly exposing them to cortisol through their feed or manipulating environmental factors such as stocking density, temperature, or salinity to elicit a natural increase in endogenous cortisol levels. Whole body cortisol levels, survival, growth, and sex ratios of fish in replicate tanks were determined and analyzed for each experimental treatment. To date, experimental treatments have resulted in significant differences in growth, survival, and whole-body cortisol levels in specific treatments, but no differences have yet been found in resulting sex ratios.

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Symposium Paper

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Effects of a 36-year fishing closure and opening of a coastal embayment in the crocodile sanctuary of northeastern Florida Bay on fishes and recreational fisheries

Two large coastal embayments in northeastern Florida Bay (Joe Bay and Little Madeira Bay) have been closed to public access since Everglades National Park (ENP) created the Crocodile Sanctuary in 1980. The 2015 ENP General Management Plan called for the opening of Joe Bay, which is part of the Crocodile Sanctuary, to public, non-motorized access and catch-and-release fishing. This project was designed as a collaborative effort among researchers from agency, academic, and non-profit organizations to examine the effects of the closure on nekton community metrics and recreationally important fish species across three embayments (Little Madeira Bay – closed to fishing, Joe Bay – opened in November 2016, and Long Sound – open to fishing) using fisheries-independent surveys with baited remote underwater video systems (BRUVs) and seines, and a fisheries-dependent angler reporting system. In the first year of fisheries-independent sampling, fish communities differed significantly among basins with Joe Bay having a distinct small prey community with relatively low abundances, and Little Madeira Bay (seines) and Joe Bay (BRUVs) exhibiting the highest abundances of recreational fishes. Trophic groups of fishes appeared stable over time as compared to seine data from 2006-2009, but species-specific differences may indicate associated habitat changes. The angler reporting system had a good response rate, but visitation to the no-motor zone in Joe Bay was low. Two more years of sampling are ahead for this project, so more comprehensive data analyses incorporating hydrological and habitat dependencies are planned. Seine and BRUV fish community data will be compared between gears and across estuaries, and the long-term trends in visitation and angler experiences will be examined. This project will provide useful data for developing a long-term protocol for fisheries monitoring in these embayments into the future and demonstrates the advantage of collaborative research to reach a common goal.

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Contributed Paper

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Abundance and Distribution of Common Snook (*Centropomus undecimalis*) in the Coastal Rivers of Tampa Bay

Common Snook are a euryhaline species that utilizes a wide range of habitats from offshore reefs to the upper reaches of freshwater rivers. To better understand use of rivers by Common Snook, systematic electrofishing surveys were conducted in Tampa Bay rivers and have identified young-of-the-year (YOY), early juveniles, and adults of various sizes and ages. The four major rivers (Manatee, Little Manatee, Alafia, and Hillsborough) were sampled in an effort to describe Common Snook seasonal abundance, distribution,

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life history, and habitat associations within freshwater (<10 ppt) portions of the rivers. Electrofishing occurred during 2014-2017, used a stratified random site selection, and caught 8,689 Common Snook ranging from 27 to 1,024 mm total length (TL). The abundance of YOY Common Snook (<250 mm TL) increased in the fall across all rivers, though YOY were caught in each river year-round. Abundance of the >250mm TL size class varied seasonally, but estuary-wide trends were difficult to describe because the seasonal abundance varied by river. Habitat, hydrology, and location within Tampa Bay (e.g., proximity to spawning sites, amount of floodplain habitat) may affect how Common Snook use each river. Directed electrofishing at known “honey holes” to supplement samples for a reproductive study produced an additional 393 Common Snook, which included the nine largest fish (up to 1,110 mm TL) of all sampling combined. This directed catch data indicates that large Common Snook are not widely distributed throughout the river but aggregate at locations with specific geomorphic features. The broad size range, and the abundance at which different size classes occupy the rivers, suggests that the coastal rivers of Tampa Bay provide important habitat for all life stages of Common Snook.

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FWC’s Fishery Dependent Monitoring Program – Cooperative Research in Action

Fishery dependent monitoring programs collect information directly from recreational anglers, for-hire vessel operators, and commercial fishers and dealers. This information is needed to characterize fish removals attributed to harvesting and discarding, which is an important input into stock assessments. Because biologists in the Marine Fisheries Research, Fishery Dependent Monitoring Program work closely with fishers, they are often the closest link people have to the resource management Agency that impacts their recreation and livelihoods. The nature of this work requires maintaining strong professional relationships with the public and fishing industry, which includes maintaining a neutral stance on management issues. Successful data collection programs depend heavily on the reputation of the Agency collecting the information as fair and unbiased, and this reputation is earned through an adherence to science-based results backed by sound data collection methods. Whenever management decisions are perceived as not transparent and not based on sound science, or data collection methods are called into question, stakeholder buy-in and willingness to cooperate in fisheries dependent data collections is eroded. For this presentation, I will describe several fishery-dependent monitoring projects for marine fisheries in Florida and discuss how we work cooperatively with the public and fishermen to collect this vital information needed to assess and manage important fish stocks in the Gulf of Mexico and South Atlantic regions.

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Hatchery-reared Juvenile Snook as Ecological Probes for Habitat Quality

Nursery habitat for juvenile fish has been lost to coastal development and shoreline hardening, raising concerns about the health of Florida estuaries. To examine the impact of reduced shoreline complexity

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from hardening on fish survival, we used hatchery-reared juvenile Common Snook tagged with passive integrated transponder (PIT) tags as ecological probes. Four habitat types in Phillippi Creek were monitored with marine-adapted PIT tag antenna arrays: seawalls without vegetation, seawalls with vegetation, natural shorelines, and seawall-natural transitional habitats. PIT tagged Snook were released at each monitored site during three replicate releases that occurred in the fall and in the spring. Recapture histories were highly variable among individuals and were influenced by site-specific differences among shorelines. Within each season, mark-recapture models suggest that recapture histories were best explained by short-term differences in survival among the habitats at which individuals were released, and long-term patterns in detectability among habitats. Yet, these patterns differed among seasons, particularly for short-term survival, which was significantly lower for the fall release. Improving survival of hatchery-reared fish immediately after release is a key next step to further the use of hatchery-reared fish as ecological probes to understand fish-habitat associations and the influence of habitat availability on survival.

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The Non-native Fish Action Alliance: Interagency cooperation to tackle non-native fishes

Dozens of species of non-native fishes are present in the freshwaters of Florida, and new species are discovered each year. Maintaining current information on the geographic ranges of all non-native fishes is a daunting task, as many jurisdictions are involved at the state, federal level, and municipal levels. There is a need to coordinate sampling, research and management across jurisdictional boundaries while also providing up-to-date geographic distribution information to publicly-accessible databases. In 2013, US Geological Survey (USGS) and Florida Fish and Wildlife Conservation Commission (FWC) fish biologists began working together informally to build the Florida Non-Native Fish Action Alliance. This group is comprised of many agencies, universities and non-governmental organizations. While our agencies' missions may differ, we recognize the need to work together to tackle the enormous task of documenting and managing non-native fishes in Florida. We regularly hold Fish Slams, where groups of researchers from different organisations come together for two days to sample for non-native fishes in South Florida. These bioblitz-type sampling events allow managers and researchers to become better-informed of shifting distributions and look for new non-native species. We also hold Fish Chats every other year, where researchers working on non-native fishes in Florida come together to discuss current research and other topics of interest to the group.

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What's a snook's favorite nook? Exploring sportfish use of restored and disturbed sites in Tampa Bay

Tampa Bay is considered a success story for coastal restoration. In recent decades numerous agencies, organizations, and individuals have worked to reconnect and restore tidal creeks, mosquito ditches, wetlands, and rock, shell, and sand pits. This has recreated hundreds of acres of estuary habitat historically 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 prime habitat for sportfish such as common snook (*Centropomus undecimalis*) and red drum (*Sciaenops ocellatus*). However, few data exist to support these assumptions. Thus, we recently initiated a study to address this knowledge gap. A survey across major restorations in Tampa Bay was used to inform site selection and establish methods for data collection. A subset of captured juvenile common snook will be retained to collect data on body condition and growth using fat content and otolith aging, respectively. Following fish and associated habitat sampling, conceptual and statistical models will be used to understand the relationship between restored habitat and fish communities. This research will help identify high-quality common snook nursery habitats, quantified objectively by faster growth and higher tissue fat content. These results can be used to guide resource managers on the effectiveness of specific habitat restoration practices and potentially enhance current and future efforts.

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Germplasm Cryopreservation Techniques in the Eastern Oyster, *Crassostrea virginica*

Germplasm preservation is an advantageous technology that would benefit the oyster industry through the preservation of hereditary tissue for genetic improvement and breeding programs. The goal of this study will be to develop effective protocols for germplasm cryopreservation for the Eastern Oyster, *Crassostrea virginica*. Based on the existing protocols, the objectives will be to evaluate the effects of cold shock, cryoprotectants, cooling profile, sugar additions, and thawing rates on sperm viability. Sperm samples will be collected from natural spawn and dissection methods. Sperm quality will be estimated by using flow cytometry and microscopy to determine the plasma membrane integrity and sperm motility. Potential applications of cryopreservation techniques on oysters include preservation of natural populations, specific lines or traits, self-fertilized inbred lines, tetraploid oysters

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Potential Impacts of Non-native Pike Killifish on Juvenile Common Snook

Pike Killifish is an established non-native fish species in Florida that was first documented in south Florida in 1957 and secondarily in Tampa Bay tributaries in 1994. Decreases in small-bodied fish abundances have been linked to the introduction of Pike Killifish in both of these regions. Increases in the range and abundance of Pike Killifish in the Tampa Bay area and overlap in habitat usage has led to concerns about potential predation on, and competition with, early-juvenile Common Snook (≤ 100 mm SL). Several lines of evidence point to minimal or no impacts of Pike Killifish on early-juvenile snook in Tampa Bay tributaries. Predation trials indicate that Pike Killifish are capable of consuming juvenile snook up to 48 mm SL, but no snook remains have been found in the diet analysis of Pike Killifish. There is a small degree of diet overlap between these species, and declines in the abundance of some prey groups has been detected in locations where Pike Killifish and snook co-occur. However, diet overlap of early-juvenile snook from locations with and without Pike Killifish co-occurring remains high and there is no indication of reduced condition or growth of early-juvenile snook in the presence of Pike Killifish.

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Phylogenomic Characterization of Ranaviruses Detected in Fish and Amphibians in Thailand

Ranaviruses are emerging pathogens associated with epizootics in farmed and wild ectothermic vertebrates including fish, amphibians, and reptiles worldwide. In this study, we describe the full genomes of seven ranaviruses, each isolated from one of the following species: Marbled Sleeper Goby (*Oxyeleotris marmorata*); Goldfish (*Carassius auratus*); Guppy (*Poecilia reticulata*); Tiger Frog (*Hoplobatrachus tigerinus*); Asian Grass Frog (*Fejervarya limnocharis*); and two from East Asian Bullfrogs (*H. rugulosus*), in Thailand. The full genomes of the fish and amphibian isolates were sequenced using an Illumina MiSeq sequencer. The nucleotide (nt) sequences of the major capsid protein (MCP) from the Thai isolates compared to a Chinese isolate from Tiger Frog were highly similar (99.8-100% nt identity). Comparison of the seven Thai isolate MCP sequences to other 22 fully sequenced ranaviruses, recovered from Genbank, displayed a lower nt sequence identity ranging from 93.1-98.9%. Phylogenomic analyses based on the concatenated locally collinear blocks alignments obtained from Mauve 2.4 for 29 fully sequenced ranaviruses revealed that these eight Asian isolates, including the Chinese isolate, formed a well-supported monophyletic group referred to as Tiger Frog virus (TFV) clade. Our findings confirm the international movement of TFVs among Asian cultured fish and amphibians. Biosecurity measures should account for the potential movement of TFVs through the live fish and amphibian trade within Southeast Asia and between this region and other world areas.

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Population dynamics of Pinfish in the eastern Gulf of Mexico (1998-2016)

Pinfish (*Lagodon rhomboides*) is a species of forage fish with major importance to both inshore (e.g., seagrass ecosystems) and offshore (e.g., reef ecosystems) food webs in the eastern Gulf of Mexico (eGOM). Pinfish are one of the most abundant species of finfish in eGOM seagrass beds, which they use as juvenile habitat. Florida Fish and Wildlife Research Institute (FWRI) has conducted monthly population monitoring in Charlotte Harbor (CH), Tampa Bay (TB), Cedar Key (Big Bend; BB), and Apalachicola Bay (AP) since 1998. However, we do not understand the dynamics across these systems, nor do we know whether they are in synchrony with each other. Here, we estimate the intra- and inter-annual dynamics in density, biomass, and instantaneous growth rates (IGR) within and among each of four eGOM estuaries from 1998-2016. Intra-annual densities of Pinfish peaked within the same timeframe across all four estuaries, for all years combined. We observed the highest densities in March-April for each estuary, although the magnitude of the peaks differed. Intra-annual biomass of Pinfish also peaked within the same timeframe across all four estuaries, for all years combined, with the highest biomass in April-May. Overall density and biomass were highest in CH, followed by TB, AP, and CK. We analyzed weighted standard length for each month and bay across years to calculate IGR for each estuary. Average IGR for CH, CK, TB was similar for all months/years combined, with AP having much lower IGR. Next steps are to use time series analysis to examine whether the four systems are in synchrony. To identify Pinfish spawning locations, we conducted stable isotope analysis on the eye lens cores from individuals collected in each of the four eGOM estuaries. Eye lens core $\delta^{13}\text{C}$ values (-17.12 ‰ to -21.52 ‰ relative to VPDB) may be indicative of offshore spawning grounds.

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I'm about to graduate...I think I want a job with FWC

Fisheries students have many options for employment after graduation. Continuing education, working in the private sector, or getting a job with a state or federal agency are all viable options. The specific state agency for employment within Florida is the Florida Fish and Wildlife Conservation Commission (FWC). For graduates, the biggest uncertainties include where vacant positions are posted and what supervisors are looking for in a candidate to fill a vacant position. A survey was conducted to gather information from prospective employers within FWC's Fish and Wildlife Research Institute and both Freshwater and Marine Fisheries Management divisions. Surveys were given to personnel at the project leader level or higher. The survey was designed to interpret what skill sets employers were looking for when hiring recent graduates. Inferences were made to interpret differences and similarities among divisions. Results of this presentation focus on information for students to better prepare them for employment after graduation.

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Accomplishing statewide fisheries research by cooperating with regional biologists

Many fisheries research projects focus the objectives and inference to a particular waterbody. However, broadening the scope of the study to a more regional or statewide scale can prove beneficial by increasing the relevance to managers and stakeholders; along with expanding the management application. Conducting a study that spans waterbodies across the state would be labor prohibitive without the collaboration of regional biologists who also provide local knowledge of their resources. I will discuss the benefits and communication challenges of three statewide collaborative research studies with regional fisheries biologists across Florida. These studies include an assessment of Largemouth Bass stocking survival, angler opinions of hybrid striped bass stocking, and evaluating the statewide bass regulation change.

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Analysis of reproductive hormones as an indicator of skipped reproduction in 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 portions 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 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 analysis of ovaries and gonads, analysis of reproductive hormones (17 β -estradiol, 11-ketotestosterone, and testosterone), analysis of fish condition, and hepatosomatic and mesenteric fat indices of energetics. To date, approximately 200 female Common Snook have been analyzed for 17 β -estradiol levels and reproductive stage. Levels of 17 β -estradiol began to increase in March, peaked in May, and then decreased to baseline by September. Hormone levels also matched well with ovarian developmental stage, with the highest levels seen in fish collected from the estuary that had spawning capable oocytes. In every month, some Common Snook exhibited undeveloped ovaries and baseline levels of hormone. During the spawning season, approximately 27% of fish remained at baseline levels suggesting skipped reproduction. Fish with baseline levels were significantly smaller than those with positive hormone levels (t-test; $p < 0.05$). Further analysis of 11-ketotestosterone and testosterone should help elucidate the mechanisms behind skipped reproduction in Common Snook.

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Feralization: restoration, rehabilitation, invasion, and the establishment process for domesticated organisms

The scale and pace of fish, mammal, and plant domestication has reached unprecedented levels, the degree of which varies from the formation of new species to more modest changes occurring over one or more generations or even within a single generation. These domesticated organisms are also accidentally or deliberately introduced into the environment. The outcome of these introductions can ultimately influence the success of restorations, rehabilitation projects, and invasions. Despite the ubiquity of domesticated organisms and their often deliberate release and potential to escape from captivity, there is no unified perspective which examines how domesticated organisms become feral. This is important because the processes determining the degree and pace at which species become feral may be similar among the disparate pathways. Our overall goal is to unite the field of introduced domesticated organisms behind a broader definition of feralization, the establishment process for domesticated organisms. Secondary goals include identifying the key steps or stages of feralization, examining the similarity of the establishment process across introduction pathways, organismal consequences of feralization, and identification of key areas of feralization research. Ultimately, in order to gain wider traction and increase synthesis, a broader view of feralization is needed, one that explicitly takes into account individual and population level responses to rearing environments and examines evolutionary processes and organismal states during and after feralization.

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Converting Fisheries Research into Engaging Classroom Activities

We converted several fisheries monitoring and management tasks into hands-on learning opportunities targeting middle school through college students. Here I highlight three of these projects. First, we repurposed Fisheries Independent Monitoring samples destined for the dumpster into a hands-on lesson in fish identification. This activity included the use of dichotomous keys, fish ID books, and group work to identify commonly captured fishes from Tampa Bay. The activity has been used with many student groups, both during summer and as part of a school curriculum. Second, we used stationary underwater videos in a lesson designed for AP Environmental Science students to learn the correct use of diversity parameters in ecology. Students are able to learn about the vast diversity of fishes on the West Florida Shelf as well taking a hands-on approach to population ecology. The lesson has been used in the classroom for over 5 years. Finally, we created a simulation whereby students enact all parts of fisheries management decision-making to demonstrate many of the difficulties fisheries managers face as they complete their work. Students must work with limited data, balance the needs of several stake-holder groups, and make the best decisions they can. This lesson helps student to understand how challenging it can be to make appropriate fisheries management decisions. Each of these lessons has increased students' exposure and

*Student Presentation, Presenter

knowledge of their immediate environment. Each has also introduced them to the excitement and challenges inherent in fisheries science and fisheries management.

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Regulation Evaluation of a Coastal Largemouth Bass Population

Length-based regulations remain the primary approach to black bass management, however effectiveness can vary depending on angler attitude towards harvesting fish. Voluntary catch and release of legal-sized fish can render length limits useless, while abuse of liberal length limits can lead to overexploitation of sport fish populations. Therefore, it is important to have knowledge of angler attitudes paired with current information on population dynamics to effectively measure success of regulations following implementation. A new statewide 16" maximum length limit necessitates the need to compare population dynamics and angler attitudes pre- and post-regulation because individuals in the Escambia River Marsh rarely attain a size greater than > 16", thus the entire population is susceptible to harvest. Relative abundance from day-time electrofishing samples was used to quantify change in population size between years. A random subsample (20%) were sacrificed for age and growth determination and estimation of total annual mortality. Additionally, access-point creel surveys were conducted to determine angler attitudes towards Largemouth Bass harvest. Angler trends suggest a decrease in freshwater fishing effort and increase in Largemouth Bass harvest rate from 5% in 2015 (pre-regulation change) to 39% in 2017 (post-regulation change). This comprehensive approach of monitoring population dynamics and measuring temporal changes in angler attitudes will continue to provide important information on the impact of the statewide regulation on the Largemouth Bass population in the Escambia River Marsh.

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Impacts of Microplastics in Coastal Seawaters on Filter Feeding Shellfish Metabolism

Worldwide plastic is the major type of ocean litter pollution. Due to its abundance and persistence in the environment, plastic debris is becoming a major concern. Besides the visible large pieces, the small plastic particles with size < 5 mm, which are classified as microplastics by the U.S. National Oceanic & Atmospheric Administration (NOAA), have drawn great attention since a review publication in 2011 because of their persistence in aquatic and marine environment at high levels. As filter feeders living in coastal waters, molluscan shellfish are facing great challenges of microplastic pollution. Since 2011, only a handful of reports have published on the effect of microplastics on commercial shellfish, including: 1) detection of the accumulation of microplastics (types and abundances) in wild and cultured shellfish; 2) capacity of ingest microplastics by shellfish (larval stage); 3) effects of microplastics on shellfish reproduction, such as fecundity, gamete quality and quantity, and larvae development, and 4) influence of microplastics on energy uptake and allocation. The goal of this study is to evaluate the effects of microplastics on the metabolism of aquaculture shellfish species, including oysters, clams and mussels, and the ingestion and removal of microplastics through these shellfish species. This research focuses also include prevention of microplastics entering shellfish body, effective monitor of microplastics

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accumulated in shellfish body, and post-harvest processing methods to reduce or clear out the microplastics rapidly. In addition, we hope to find a species has high ability to ingest microplastics that can be used as a biological prevention species to help solve marine microplastic pollution. Overall, this project aims to provide systematic experimental data to investigate and evaluate the influence of microplastic pollution on shellfish aquaculture and fisheries industry.