### IN THIS ISSUE

<table>
<thead>
<tr>
<th>Category</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>GREETINGS/FISHERIES &amp; AQUATIC SCIENCES UPDATE</td>
<td>1</td>
</tr>
<tr>
<td>STUDENT RESEARCH: ESPRIELLA</td>
<td>2-3</td>
</tr>
<tr>
<td>STUDENT RESEARCH: HARRIS</td>
<td>4-5</td>
</tr>
<tr>
<td>STUDENT RESEARCH: LIPSCOMB</td>
<td>6-7</td>
</tr>
<tr>
<td>STUDENT RESEARCH: PACICCO</td>
<td>8-9</td>
</tr>
<tr>
<td>FAS UPDATES</td>
<td>10-11</td>
</tr>
<tr>
<td>RECENT GRADUATES</td>
<td>12</td>
</tr>
<tr>
<td>SUMMER ACTIVITIES</td>
<td>13</td>
</tr>
<tr>
<td>AWARDS</td>
<td>14</td>
</tr>
<tr>
<td>UPCOMING EVENTS</td>
<td>15</td>
</tr>
<tr>
<td>RECENT PUBLICATIONS</td>
<td>16-20</td>
</tr>
</tbody>
</table>

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**Director’s Letter**  
By Kai Lorenzen, PhD, Associate Director of the Fisheries and Aquatic Sciences Program

**Greetings from the Fisheries and Aquatic Sciences Program!**

Our program is uniquely comprehensive in its coverage of the fisheries and aquatic sciences and in the best of the Land Grant tradition, it brings cutting-edge science to many important applied problems. In this issue, we highlight the work of four of our graduate students who address problems in oyster restoration, control of invasive lionfish, ornamental aquaculture, and fisheries stock assessment.

Michael Espriella is developing new methods for monitoring intertidal oyster reefs using unmanned aircraft systems. His particular focus is on image analysis techniques that will vastly improve the speed and efficiency of oyster reef monitoring while also providing new data on factors that influence reef persistence or decline. This is a great example of the rapid advances in habitat and biological monitoring capacity we have achieved by adding expertise in remote sensing and geospatial sciences to our core Program and ramping up cross-SFRC collaborations with the Geomatics Program.

Holden Harris is assessing the effectiveness of targeted fishing as a method for controlling the abundance of invasive lionfish in the Gulf of Mexico. His research is evaluating the efficacy of novel traps and the impacts of an emerging disease on lionfish populations. In addition, he is using bio-economic models to explore the potential for an economically viable commercial lionfish fishery.

In the aquaculture area, Taylor Lipscomb is delving deep into the digestive physiology of fish larvae to understand their nutritional requirements in a critical developmental period. His research shows that tetra fish larvae can be weaned off live feeds earlier than is currently practiced, potentially resulting in efficiency gains for the ornamental fish industry.

Ashley Pacicco’s research aims to improve our basic knowledge of yellowfin tuna growth and reproductive biology. This work provides vital information for fisheries stock assessment and management. Ashley is an employee of NOAA Fisheries, based at their Panama City lab, and she takes advantage of our flexible online classes and a supervisory committee that includes a senior scientist from the NOAA lab to obtain a research degree without having to leave her duty station. A win-win-win for her, her employer and our program.

iTag (Integrated Tracking of Aquatic Animals in the Gulf of Mexico), a collaborative movement ecology program led by Sue Lowerre-Barbieri (research faculty based at the Florida Fish and Wildlife Research Institute) is another example of a highly productive agency partnership. Check out the iTag website to see how the network revolutionizes our ability to monitor mobile marine organisms.

Please join me in congratulating our recent graduates and the many faculty and students who have been recognized for their outstanding work or tapped for important advisory roles. Finally, take a look at the long list of new publications our program has contributed to the scientific literature over the past months! If you are interested in a listed publication but can’t access it through an institutional subscription, contact the author and they will send it to you for free!

Thanks for your interest in our program and we hope that you enjoy this issue of WaterWorks!

Kai
Student Research Highlight
The graduate students in the Fisheries and Aquatic Sciences program conduct cutting-edge research, from oysters to lionfish. Read on to learn about four exemplary student projects.

MICHAEL ESPRIELLA
Using Unmanned Aircraft Systems to Monitor Intertidal Oyster Reefs

Oyster reefs are declining globally as a result of stressors such as overharvest, disease, coastal development, and alterations to natural freshwater flow. This decline results in a loss of ecosystem services and affects the livelihood of coastal communities that rely on the fishery. Oyster reefs provide habitat for hundreds of other species, filter the surrounding water, and control shoreline erosion. Florida’s Big Bend coastline presents a unique opportunity to study the decline as it is sparsely populated, limiting direct anthropogenic impacts when compared to other high stress areas. Despite the absence of typical human-induced stressors, declines persist in this region making it a key study area.

I was intrigued by oyster reefs and the habitat they provide because the intertidal reefs that line the Big Bend coastline are at the interface of terrestrial and aquatic ecosystems. The tidal nature of the habitat makes it difficult to sample oyster reefs, and sampling methods are often time and cost-intensive. Unmanned aircraft systems (UASs) allow for rapid collection of sub-centimeter resolution imagery of coastal habitats at a low cost.

While UASs provide an efficient mechanism to collect imagery, it is important that the method of analysis is time efficient as well. I am taking a Geographic Object-Based Image Analysis (GEOBIA) approach to quantify reef coverage and assess reef status. GEOBIA is a semi-automated technique that allows for more robust analysis than traditional pixel-based analysis techniques. It is a two-step process: first pixels are segmented into objects based on textural, spectral, and spatial characteristics, then those meaningful objects are classified using a ruleset.

Our current study area is Little Trout Creek, located north of Cedar Key and south of the mouth of the Suwannee River. Overlapping RGB imagery was collected with a UAS and stitched together to generate an orthomosaic and a digital elevation model. The scene contains mudflats, salt marshes, and oyster reefs.
Masking out the water is an essential intermediate step as the spectral similarity between the water and reefs causes misclassifications. After masking out the water using a water index (Red-Blue+Green /Red+Blue+Green) and elevation data, the exposed habitats were segmented and ready for classification. A sample of each habitat was selected from the imagery to derive terrain attributes from the digital elevation model. We conducted a multiscale analysis to determine which attributes at which scale are best suited to differentiate between habitats. Once the attributes were selected, they were used along with the spectral characteristics to classify the habitats. This work is continuing, as I look to improve the classification, especially in areas of sparse oyster coverage, by further exploring the characteristics that define each habitat. The next step is to conduct this analysis at the scale of an individual reef to identify any structures that may contribute to reef success or decline. Identifying spatial characteristics that contribute to reef success can inform management as well as restoration projects that may look to mimic the structure of successful reefs.

![Figure 1](image1.png)

**Figure 1:** Orthomosaic (A), digital elevation model (B), segmented and water masked mosaic (C), and classified habitats (D).

**Figure 2:** Example of how a variable (in this case the standard deviation of elevation) can differentiate habitats at certain scales but not others. The intermediate scales highlight differences in marsh and oysters while the finer and coarser scales do not.

![Figure 2](image2.png)
Indo-Pacific red lionfish (Pterois volitans/miles complex) in the Western Atlantic Ocean have been the most successful marine fish invasion on record, causing region-wide negative effects on reef fish communities and ecosystem processes. Mitigating their impacts is a top priority for marine resource managers; however, suppressing lionfish densities is confounded by rapid replenishment, source-sink dynamics, and deepwater refuges. Developing lionfish fisheries has been proposed as market-based solution to control their densities and augment commercial fishermen livelihoods. My dissertation research examines the potential effectiveness of a commercial lionfish fishery in the northern Gulf of Mexico (nGOM) by studying (1) lionfish detection and removal efficiency, (2) the potential for deepwater lionfish traps, (3) population effects from a novel lionfish disease, and (4) bioeconomic models for a commercial lionfish fishery.

Accounting for detection and removal efficacy is necessary for evaluating lionfish management targets as population-and community-level effects of lionfish removals may be diminished by undetected lionfish remaining in the system. My recent work on lionfish detection and removal efficiency quantified the effectiveness of lionfish surveys and removal efforts (doi.org/10.1016/j.fishes.2019.01.002) quantified. We found that previous surveys on nGOM natural reefs likely underestimated densities, which may be 3X higher than previously reported. Removal efficiency for spearfishing was 87% on artificial reefs and 67% on natural reefs, and 47% on Caribbean coral reefs. Incomplete removal efficiency, in concert with density-dependent processes, may explain recent findings that sustained lionfish removal efforts had no discernible positive impacts on native reef fish communities.

To date, the capacity to control lionfish has primarily been from spearfishing using open-circuit SCUBA. However, most of the invaded range is in mesophotic depths (> 40 m) inaccessible to divers and where lionfish densities are higher. Lionfish traps have been proposed as a means to remove deepwater lionfish. I developed and tested traps on nGOM artificial reefs (nwdistrict.ifas.ufl.edu/2018/), and recently completed fieldwork that examined the effectiveness of three trap designs – Florida lobster traps, Atlantic sea bass pots, and Gittings purse traps (Fig. 1) – to remove lionfish biomass from mesophotic reefs while assessing potential impacts to native reef fishes.
Preliminary results suggest the Gittings purse traps are the best choice for lionfish removal, but that further research and development will likely be necessary to prevent bycatch issues and increase catch rates.

High population densities and low genetic diversity in their invaded range suggest lionfish could be vulnerable to pathogenic control. We reported the first observed disease in invasive lionfish found in fish harvested in the nGOM in summer 2017 which appeared to spread throughout the invaded range. ([edis.ifas.ufl.edu/fa209](edis.ifas.ufl.edu/fa209)). Following the disease emergence, we observed changes in lionfish populations. Population surveys indicated mean lionfish density declined approximately 75% on high density artificial reefs, 55% on low density artificial reefs, and 75% on natural reefs in 2018 (Fig 2a). Regional commercial lionfish spearfishing landings and catch per unit effort (CPUE) concurrently declined (Fig 2b). Collectively, these results provide evidence for density-dependent epizootic population control and have implications for lionfish management strategies.

Findings from the work above will help me develop bioeconomic models for a commercial lionfish fishery. Lionfish fisheries are open access (i.e., having little or no regulations), which are economically inefficient because they don’t create surplus profit. Paradoxically, efforts to overfish lionfish decreases harvester profitability. Bioeconomic models of a lionfish fishery allow evaluation of effort levels where fishing effort and harvest will cause overfishing (i.e., population control) and the stock levels where harvesters would be expected enter or exit the fishery. These models will be used to consider challenges and solutions for a long-term, market-based fishery. My work aims to assist fisheries managers and commercial fishermen by understanding the economic processes and ecological effects of a novel invasive species fishery.

Figure 1 – Image of the Gittings purse traps deployed near an artificial reef in the northern Gulf of Mexico.

Figure 2 – Changes in northern Gulf of Mexico lionfish populations observed with (a) remotely operated vehicle surveys and (b) commercial spearfishing catch per unit effort (CPUE).
Histological, Histochemical and Biochemical Characterization of Larval Digestive System Ontogeny in Two Characid Species to Inform Weaning Protocols

Among the many challenges encountered during the production of freshwater ornamental fish, larval nutrition persists as a bottleneck. Limited survival, abbreviated growth and apparent dependence on live feeds are all characteristic of this life stage in many ornamental fishes. A significant amount of the ornamental larvae reared intensively upon first feeding are fed newly-hatched *Artemia franciscana* (brine shrimp) nauplii, which is costly and has inconsistent availability. Members of the family Characidae, and particularly tetras, appear to require live feeds for larval propagation. Live feeds exhibit disadvantages relative to prepared microparticulate diets (MDs), specifically pertaining to availability, labor, and cost.

I approached this problem by first directly evaluating the dependence of these species on live feeds at the onset of exogenous nutrition. After 10 days of feeding beginning at first feeding, Larval Black Tetra *Gymnocorymbus ternetzi* and Neon Tetra *Paracheirodon innesi* indeed exhibited poor survival and growth from MDs relative to *Artemia*. Following this confirmation of live feed dependence, I characterized the digestive system ontogeny of each species using histology, histochemistry, and biochemical analysis of digestive enzyme activities from the onset of exogenous feeding through the larval stage. Both species exhibited an agastric, altricial larval stage, as well as low digestive enzyme activity at the onset of exogenous feeding followed by abrupt increases in trypsin, lipase, and pepsin activity. In *P. innesi*, histological differentiation of the stomach, including gastric gland formation and production of neutral mucopolysaccharides, as well as the onset of pepsin activity, did not occur until 20 days post hatch (dph). For *G. ternetzi*, these developmental milestones were not reached until 22 dph. This shift from agastric to gastric digestive modes is indicative of a proliferation of digestive capacity and subsequent prey diversity.

Based on this information, experiments were conducted to evaluate different weaning times from *Artemia* to a MD. For each species, twenty replicate tanks were fed *Artemia* exclusively from hatch through the end of the trial, a MD exclusively, or were transitioned from *Artemia* to a MD at three different timepoints. For *P. innesi* fed until 32 dph, and weaning beginning at 12 dph and 17 dph, survival was similar to live *Artemia* (mean: 22.0 ± 1.7%), while weaning beginning at 22 dph resulted in lower survival (16.2 ± 1.3%); MD only resulted in the lowest survival (0.8 ± 0.3%). For *G. ternetzi* fed until 33 dph, weaning beginning at 13 dph exhibited higher survival (20.6 ± 1.8%) than live *Artemia* and weaning beginning at 18 dph and 23 dph (mean: 13.6 ± 1.5%), while the MD resulted in the lowest survival (0.8 ± 0.2%). For both species, weaning did not result in statistically higher growth than *Artemia*. These results indicate that weaning is possible prior to gastric differentiation, potentially resulting in the reduction of *Artemia* use in the larval culture of both characid species.
Photomicrographs of *P. innesi* gastrointestinal tract at 17 dph (a, 100x), 20 dph (b, 100x). Stomach (S), gastric glands (GG), pyloric valve (PV), intestine (I).
Age, growth, and reproduction of Yellowfin Tuna in the Gulf of Mexico and U.S. Atlantic

Yellowfin Tuna *Thunnus albacares* is a highly migratory species found in tropical and subtropical oceans around the world. Highly valued as a food source, Yellowfin Tuna supports lucrative commercial and recreational fisheries. Yellowfin Tuna in the Atlantic are managed as a single stock by the International Commission for the Conservation of Atlantic Tunas (ICCAT). The northern Gulf of Mexico off the mouth of the Mississippi River is an especially productive area for Yellowfin Tuna, with oil platforms acting as fish aggregating devices (FADs). Despite its economic importance, basic life history information for the species from U.S. waters is limited. The goal of my research is to address key uncertainties in the growth and reproductive biology of Yellowfin Tuna in U.S. waters to better inform stock assessment and ultimately to improve the management of the Yellowfin Tuna Atlantic stock.

My first research objective focuses on Yellowfin Tuna age, growth, and longevity. Through a collaborative effort with the National Marine Fisheries Service (NMFS) in Panama City, FL, and the Louisiana Department of Fish and Wildlife (LDFW), over 3,000 Yellowfin Tuna sagittal otoliths (“ear stones”) were collected during 2004-2017 by at-sea or dockside samplers throughout the U.S. Atlantic and Gulf of Mexico, mostly from the recreational or commercial fishery. These fish were also measured and ranged in size from 636-1901 mm curved fork length (CFL). To age the fish, their otoliths were sectioned through the core using a low speed saw and annual growth increments (annuli or “rings”) were counted as successive opaque and translucent zones (Figure 1). Estimated ages ranged from 1 to 18 years old, which surpasses the current longevity estimate of 11 years used in previous stock assessments for the Atlantic Ocean. An increased estimate of longevity for Yellowfin Tuna directly impacts estimates of natural mortality (mortality not caused by fishing). Longer-lived species tend to have lower natural mortality and are potentially more susceptible to fishing pressure. The length of each fish combined with its age estimate was then used to model growth of Yellowfin Tuna using a von Bertalanffy growth model. Growth was similar between males and females until the onset of sexual maturity and then males reached a larger size than females (Figure 2).

![Figure 1. Transverse section of a Yellowfin Tuna sagittal otolith aged to 18 years old. The first 5-7 years were based on broad and diffuse banding patterns. The enlarged region shows the low contrast banding pattern for the last 10 years of the fish.](image)
My second research objective focuses on the reproductive biology of Yellowfin Tuna by estimating the spawning season, the size and age that females reach sexual maturity, spawning frequency, and batch fecundity (estimate of the number of eggs released during a spawning event). Of the fish collected for the age and growth study, 469 ovaries were also collected and preserved. Histological sections were then taken for each ovary, which shows the microscopic structure of individual eggs in the ovary. I assigned ovaries to a reproductive stage (immature, developing, spawning capable, actively spawning, regressing, regenerating) and found that they have the potential to spawn nearly year-round, but peak spawning occurs during May-August. Yellowfin Tuna are also batch spawners, which means that they spawn multiple times during the same reproductive season. Females have the potential to spawn almost daily, with an estimated spawning frequency of 1.7 days. They spawn an average of 3.3 million hydrated eggs per batch, with higher estimates observed in larger, older females. Estimates of spawning frequency and fecundity aid in determining the spawning potential of the population. Estimated length at 50% sexual maturity was 1098 mm CFL for females. Whole ovary weight did not increase relative to CFL until females reached ~1180 mm, which aligned with the assignment of females in spawning condition (Figure 3).

Basic life history data can continue to be improved and used by ICCAT in future stock assessments to ensure the long term sustainability of Atlantic Yellowfin Tuna.
FAS UPDATES

iTAG Launches New Website for Marine Animal Tracking

Animal migrations are some of the most dramatic natural events on the planet, from wildebeest on the Serengeti to monarch butterflies traveling to Mexico. In fish, an iconic example of migration is salmon returning to their birth sites in huge numbers to spawn before they die. However, there are still many unknowns in marine animal movement patterns, as their travel occurs underwater and often far offshore. Sue Lowerre-Barbieri hopes to change this through a collaborative movement ecology research program, iTAG (Integrated Tracking of Aquatic Animals in the Gulf of Mexico).

With more than 100 current members from the US, Mexico, Cuba and the Caribbean, the program has already collected more than 11 million “detections” of tagged marine animals. Members using acoustic tracking methods can upload detected species data directly to the site. Researchers can search the database for their own tag numbers to see where their tagged species have traveled.

To learn more or start sharing your data, visit the new iTAG website at www.itagscience.com.

Faculty Tapped for Aquaculture Expertise

Craig Watson and Cortney Ohs from the Tropical Aquaculture Lab were appointed to the Technical Advisory Committee for the USDA Southern Regional Aquaculture Center (SRAC) representing Florida and UF. Their participation, along with Marty Tanner of Segrest Farms and Aquatica, assures that the issues and needs of Florida’s producers are considered in SRAC programs.
FAS/FWC Fishing Tournament Results

The 23rd Annual UF Fisheries and Aquatic Sciences – FWC Fishing Tournament is complete!

We had a total of 10 boats and 30 anglers this year.

Anglers were greeted with excellent weather, which allowed boats to venture out to Seahorse Reef by mid-morning and spread throughout the Cedar Key/Waccasassa/Suwannee area.

- **Largest Redfish** – Jason Dotson, 26.75 inches. Really a perfect tournament fish that he and Drew Dutterer brought in this year.

- **Largest Spotted Seatrout** – 17-year old Trey Stanfield, fishing with Mike Allen, Natalie Allen and Chris Wynn. This was the first tournament that Trey has ever fished, and he came out a winner with a really fat 20-inch trout.

- **Largest Mackerel** – George Tanner, 24 inches. George’s boat again had an excellent catch of Spanish Mackerel from Seahorse Reef.

- **Most Impressive Cooler AND Largest Cobia** – Jason “Mo” Bennett and Steve Larsen. These guys have been fishing the tournament for close to 20 years, and this year they had a banner day with 8 Spanish Mackerel, one nice Seatrout, and a 42-inch Cobia to top it off. They found the Cobia swimming near a large Tiger Shark out on Seahorse Reef. Mo’s son Jace was on board as well!

**Bringing Science to the People**

When Dr. Bill Seaman retired in 2006, it was important to him that he retired “to something” instead of “from something.”

“As a faculty member, I was so fortunate to have done something that I loved. I wanted to use my time in retirement to give back as much as I could,” said Bill.

Bill still remains involved in academia, and regularly consults with faculty. He also writes a monthly science column for his local newspaper and published the “Encyclopedia of Ocean Sciences: Artificial Reefs” in 2019.

However, Bill has recently discovered a new passion for environmental education, working with new audiences in his community of Montreat, North Carolina.

Click here to read more about Bill’s journey in retirement
RECENT GRADUATES

Lauren Lapham - MS - Risk-Based Approach to Evaluate Alligator Gar Atractosteus Spatula Aquaculture in Florida

Shane Ramee - PhD - Evaluation of Potential Masculinization Techniques for Two Freshwater Ornamental Species, the Rosy Barb and Dwarf Gourami

Amanda Croteau - PhD - Evaluation of Coastal Marsh Restoration Efforts in Robinson Preserve, Tampa Bay, Florida

Kristen Dahl - PhD - Life History and Ecology of Invasive Lionfish Populations in the Northern Gulf of Mexico: Impacts to Native Reef Fish Communities and Their Potential Mitigation

Jeffrey Greenspan - MS - Factors Related to Presence of Blue Tilapia in Florida Lakes

Lauren Lapham - MS - Risk-Based Approach to Evaluate Alligator Gar Atractosteus Spatula Aquaculture in Florida

Emma Pistole - MS - Pioneer Snook: the Genetic Effects of the Northward Range Expansion of Common Snook (Centropomus undecimalis) in the Gulf of Mexico

Isigi Kadagi - PhD - Contextualizing Socio-Ecological Interactions in Recreational and Artisanal Fisheries: Implications for Sustainable Use and Management of Billfish in the Western Indian Ocean

Daniel Elefante - MS - Evaluation of Larval Culture Methods for Three Marine Finfish, Monodactylus sebae, Lagodon rhomboides, and Sear crumenophthalmus

Shane Ramee - PhD - Evaluation of Potential Masculinization Techniques for Two Freshwater Ornamental Species, the Rosy Barb and Dwarf Gourami

Erica Ross - PhD - The Effects of Environmental Change and Pathogen Specificity on the Chemosensory Ecology of Panulirus argus: Refining Fundamental Tools and Implementing New Technology

Geoffrey Smith - PhD - Impacts of a Non-Native Piscivore, The Pike Killifish, on Juvenile Common Snook

Emma Pistole - MS - Pioneer Snook: the Genetic Effects of the Northward Range Expansion of Common Snook (Centropomus undecimalis) in the Gulf of Mexico

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Marina Schwartz - MS - Effects of Nutrient Reduction on the Water Quality and Largemouth Bass Micropterus salmoides Population in Lake Alice, Gainesville, Florida

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Marina Schwartz - MS - Effects of Nutrient Reduction on the Water Quality and Largemouth Bass Micropterus salmoides Population in Lake Alice, Gainesville, Florida

MFAS
Stephanie Bogle
Tyler Cremeans
Danielle Florenzen
Brent Lehman
Brian McKenna
Luke Richards
Emily Roan
Stephen Tracy

Marine Sciences BS
Eric Bovee
Amber Ellis
Taylor Hames
Monica Henry
Reid Hewitt
Jesse LeBrecht
Madeline Lewis
Elizabeth Mayes
Matthew Morgan
Cher Nicholson
Clair Norden
Jasmine Schwadron
Ashley Shanor
Lindsey Skaggs
Sarah Stewart
Moriah Taylor

Alyssa Varney
Logan Walker
Ethan Weber
Jacob Wiley
WHAT WE DID THIS SUMMER

SFRC faculty and students engaged in teaching, research, and extension programs locally and abroad.

Don Behringer led 12 students in the UF in Cuba study abroad trip. The program provides a hands-on understanding of the coastal and island ecosystems of Cuba and introduction to Cuban history and culture.

Faculty from FAS and the Center for Aquatic and Invasive Plants hosted 42 high school and college students as part of the Florida Youth Institute.

Undergraduate Alyssa Varney interned with Callaway Marine Technologies doing artificial reef jobs in Miami.

Undergraduate Alexis Moyle spent her summer conducting fieldwork with Dr. Lindsey Reisinger, studying the behavior of invasive and native crayfish at differing latitudes.

Experimental traps for catching invasive lionfish were placed 30 miles offshore of Destin, FL.
AWARDS & RECOGNITION

FACULTY & STAFF

Tom Frazier was appointed Florida’s First Chief Science Officer

Leslie Sturmer was named one of Florida’s Top 500 influential business leaders.

Don Behringer was awarded a University Term Professorship

Shirley Baker was selected for the Preparing Organizational Leaders in Agriculture (POLA) project

Matt DiMaggio was appointed to the US Aquaculture Society Board of Directors

STUDENTS

Caroline Barnett was recognized for her service as a CALS Ambassador and graduate of their Leadership Institute.

Esteban Rodofili was awarded a 2019-2020 Grinter Fellowship

Abigail Scro was awarded a research grant from the Lerner-Grey Memorial Fund

Kate Rose won the ET York Medal of Excellence
UPCOMING EVENTS

Final Family Fishing Day – Saturday, November 16

Family Fishing Day is held at the FAS Millhopper fishing ponds. All ages and ability levels are encouraged to participate. We offer a railed fishing deck with two handicapped accessible ramps for those with disabilities who enjoy the thrill of fresh water fishing! Come for a morning of fun, family-oriented, freshwater fishing. We have loaner poles and bait available, but everyone is welcome to bring their own equipment and bait.

This month we will celebrate Veteran’s Day and award the Sharon Fitz-Coy scholarships.

http://sfrc.ufl.edu/fish/outreach/ffs/ffd/

Fall FAS Seminar Series

The FAS seminar series features experts in the field of fisheries and aquatic sciences for a 1-hour lecture/discussion followed by food, beverages, and socialization. Seminars are on Fridays 3:30 – 4:30pm in the FAS conference room, or join online at:


Nov 8: Noemi Espinosa Andrade & Valentine Vaeoso, Comunidad y Biodiversidad (COBI) & National Park of American Samoa - “Perspectives on Fisheries Resource Management in the Caribbean and South Pacific”

Nov 15: Robert Ulanowicz, University of Maryland Center for Environmental Science (Chesapeake Biological Lab), Department of Biology (UF) - “Ecological Network Analysis In lieu of Mechanical Models”

Nov 22: Sue Lowerre-Barbieri, Fish & Wildlife Research Institute (FWC), Fisheries & Aquatic Sciences Program (UF) - “Integrating Movement into Ocean Use Management”

For more info, visit: http://bit.ly/fas_f2019
RECENT PUBLICATIONS


Lucieer V, **Lecours V** & Dolan MFJ (Eds.): Marine Geomorphometry. MDPI, 400 p., 2019.


