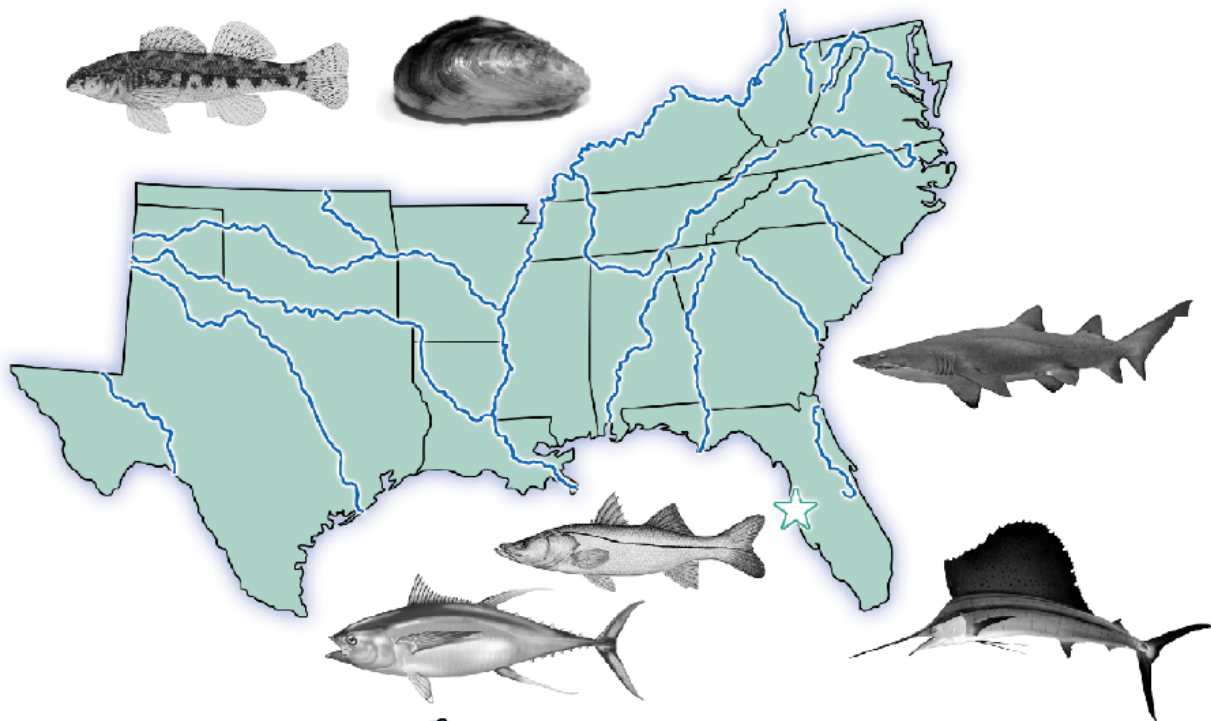


Fisheries Connectivity: “Headwaters to Oceans”



Southern Division American Fisheries — Society —

**19th Annual Spring Meeting
January 13-16, 2011 • Tampa, FL**

Hosted by the Florida Chapter of the American Fisheries Society

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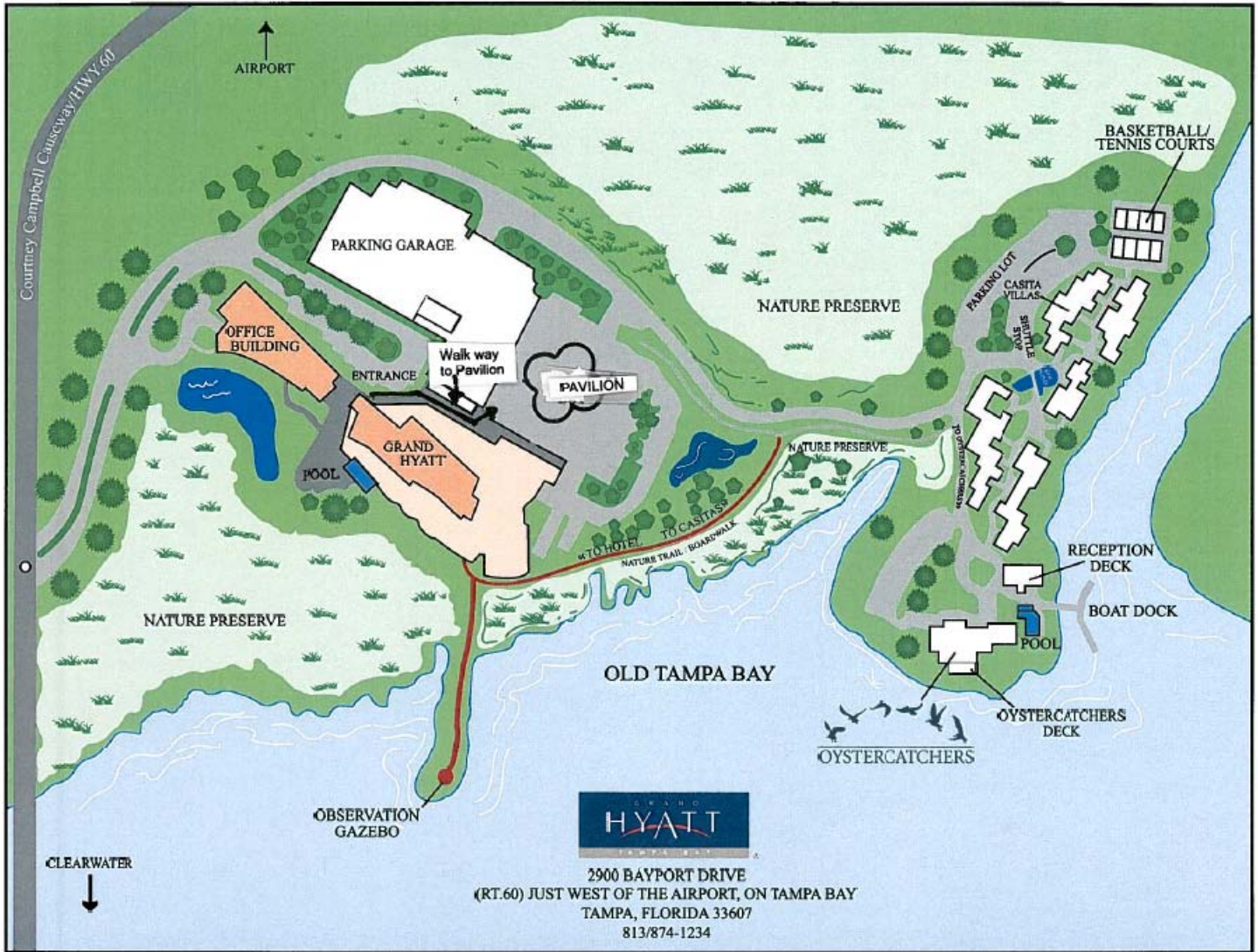
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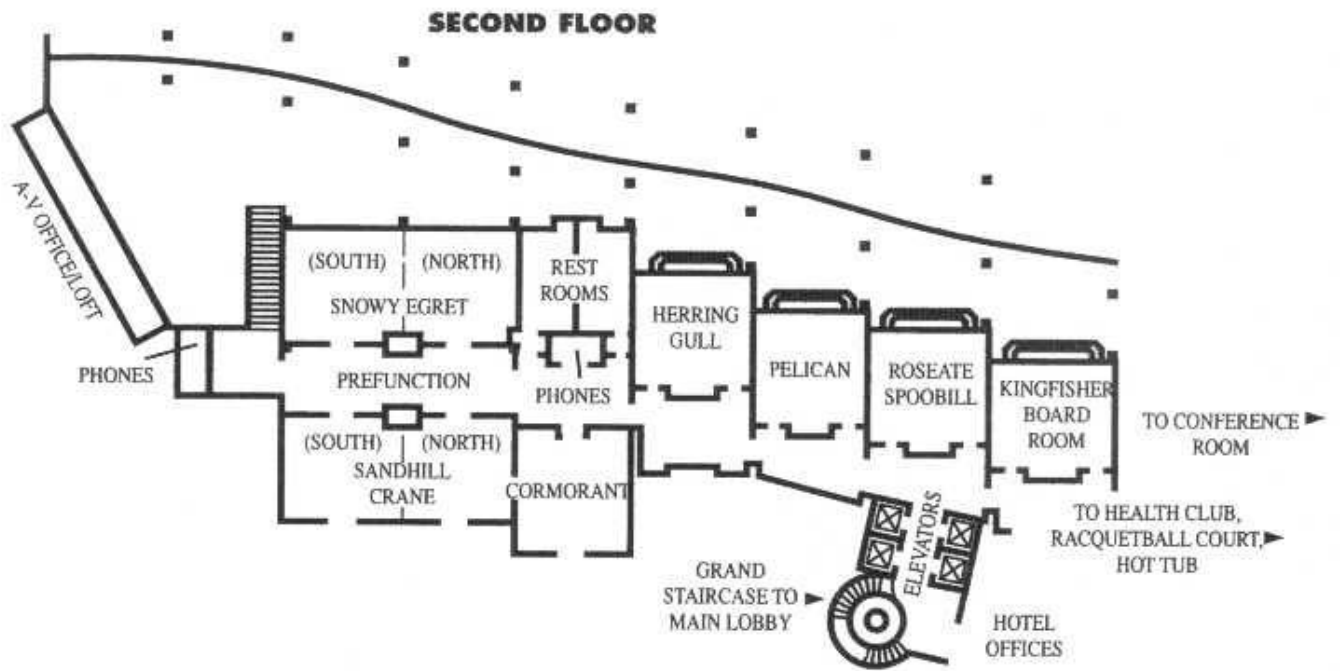
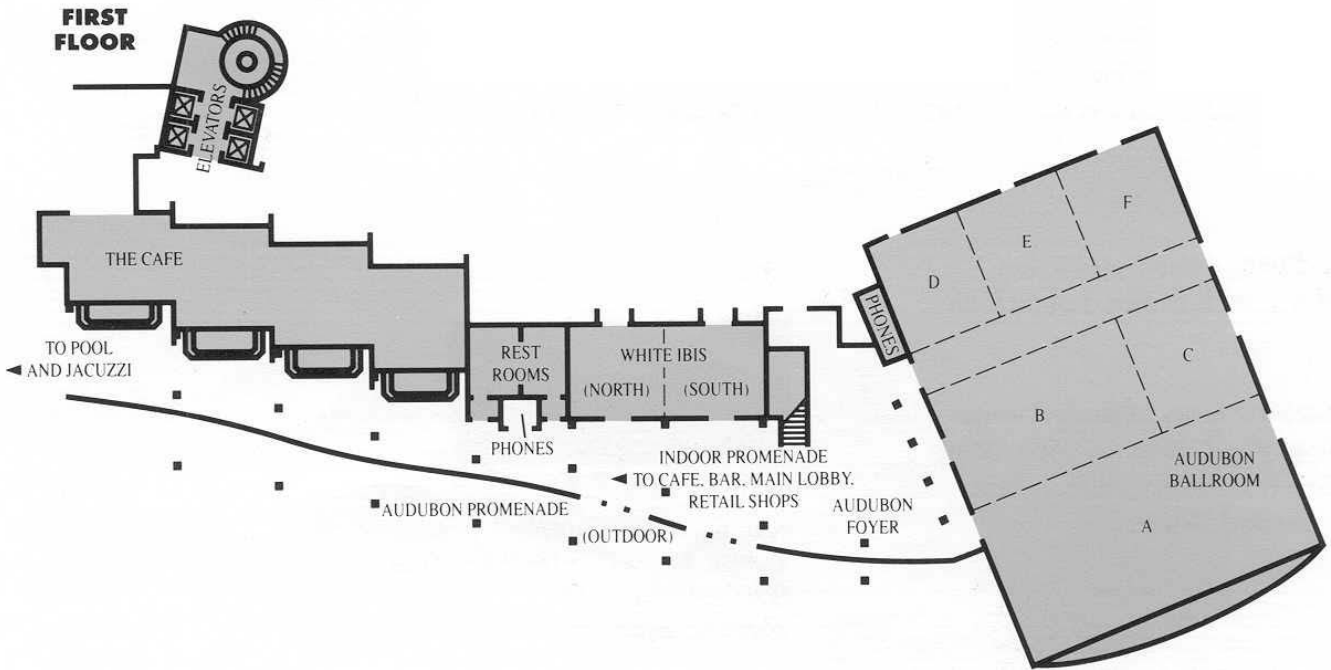
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Grand Hyatt Gounds Layout and Conference Room Floor Plan



Grand Hyatt Gounds Layout and Conference Room Floor Plan



Schedule at a Glance

Thursday, January 13

Time	Event	Location/Room
7:30 AM - 5:00 PM	Registration	Tower Pool Windows
8:00 AM - 12:00 PM	Catfish Committee	Sandhill Crane south
9:00 AM - 5:00 PM	Reservoir Committee	Snowy Egret south
9:00 AM - 5:00 PM	Warmwater Streams Committee	White Ibis south
1:00 PM - 5:00 PM	Nongame Committee	Cormorant
1:00 PM - 5:00 PM	Aquaculture Committee	Pelican
1:00 PM - 5:00 PM	Small Impoundments Committee	Sandhill Crane north
1:00 PM - 5:00 PM	Striped bass Committee	White Ibis north
1:00 PM - 5:00 PM	SDAFS EXCOM Officers Retreat	Kingfisher
5:30 PM - 8:30 PM	SDAFS Leadership Training	Pelican

Friday, January 14

Time	Event	Location
7:30 AM - 5:00 PM	Registration	Tower Pool Windows
8:00 AM - 12:00 PM	Powerpoint Workshop	White Ibis
8:00 AM - 5:00 PM	Population Modeling Workshop	Audubon I/E
9:00 AM - 5:00 PM	Simulation Tools for Monitoring Workshop	Audubon I/D
10:00 AM - 12:00 PM	SDAFS EXCOM	Snowy Egret
12:00 PM - 1:00 PM	Past Presidents Lunch	Herring Gull
1:00 PM - 5:00 PM	Stakeholder Workshop	Audubon I/F
1:00 PM - 5:00 PM	Finding a Job	White Ibis
1:00 PM - 5:00 PM	Student Paper Judging	Snowy Egret
2:00 PM - 4:00 PM	Poster/Vendor setup	Audubon III/A
2:00 PM - 4:00 PM	Okaloosa Darter Recovery Group	Conference Room
5:00 PM - 6:30 PM	SDAFS Business Meeting	Snowy Egret
6:30 PM - 8:00 PM	Poster/Vendor session	Audubon III/A
6:30 PM - 8:00 PM	Student Professional Social	Audubon Promenade

Saturday, January 15

Time	Event	Location
7:30 AM - 12:00 PM	Registration	Tower Pool Windows
8:00 AM - 5:00 PM	Poster/Vendor Display	Audubon III/A
8:00 AM - 9:00 AM	Plenary Session	Audubon Pavilion
9:00 AM - 9:20 AM	Break	
9:20 AM - 10:20 AM	SE Reef Fishes Symposium	White Ibis
9:20 AM - 10:20 AM	Darter Symposium	Snowy Egret North
9:20 AM - 10:20 AM	Snook Ecology Symposium	Sandhill Crane
9:20 AM - 10:20 AM	Freshwater Mussels Symposium	Herring Gull
9:20 AM - 10:20 AM	Reproductive Resilience Symposium	Cormorant
9:20 AM - 10:20 AM	Contributed Papers - Management: Status	Snowy Egret South
9:20 AM - 10:20 AM	Contributed Papers - Non-Native Fishes	Roseate Spoonbill
9:20 AM - 10:20 AM	Contributed Papers - Angler Assessment	Pelican
10:20 AM - 10:40 AM	Break	

10:40 AM - 12:00 PM	SE Reef Fishes Symposium	White Ibis
10:40 AM - 12:00 PM	Darter Symposium	Snowy Egret North
10:40 AM - 12:00 PM	Snook Ecology Symposium	Sandhill Crane
10:40 AM - 12:00 PM	Freshwater Mussels Symposium	Herring Gull
10:40 AM - 12:00 PM	Reproductive Resilience Symposium	Cormorant
10:40 AM - 12:00 PM	Contributed Papers - Management: Recruitment	Snowy Egret South
10:40 AM - 12:00 PM	Contributed Papers - Rivers/Dams I	Roseate Spoonbill
10:40 AM - 12:00 PM	Contributed Papers - Aquaculture/Stocking I	Pelican
12:00 PM - 1:20 PM	Student Mentor Lunch	Audubon Pavilion
1:20 PM - 3:00 PM	SE Reef Fishes Symposium	White Ibis
1:20 PM - 3:00 PM	Darter Symposium	Snowy Egret North
1:20 PM - 3:00 PM	Snook Ecology Symposium	Sandhill Crane
1:20 PM - 3:00 PM	Freshwater Mussels Symposium	Herring Gull
1:20 PM - 3:00 PM	Reproductive Resilience Symposium	Cormorant
1:20 PM - 3:00 PM	Contributed Papers - Management: Evaluation I	Snowy Egret South
1:20 PM - 3:00 PM	Contributed Papers - Movement Monitoring I	Roseate Spoonbill
1:20 PM - 3:00 PM	Contributed Papers - Aquaculture/Stocking II	Pelican
3:00 PM - 3:20 PM	Break	
3:20 PM - 5:00 PM	SE Reef Fishes Symposium	White Ibis
3:20 PM - 5:00 PM	Darter Symposium	Snowy Egret North
3:20 PM - 5:00 PM	Snook Ecology Symposium	Sandhill Crane
3:20 PM - 5:00 PM	Freshwater Mussels Symposium	Herring Gull
3:20 PM - 5:00 PM	Reproductive Resilience Symposium	Cormorant
3:20 PM - 5:00 PM	Contributed Papers - Management: Evaluation II	Snowy Egret South
3:20 PM - 5:00 PM	Contributed Papers - Non-Native Fishes	Roseate Spoonbill
3:20 PM - 5:00 PM	Contributed Papers - Feeding Ecology	Pelican
5:00 PM - 5:30 PM	Break	
5:30 PM - 6:30 PM	FLAFS Business Meeting	White Ibis
6:30 PM - 10:00 PM	Dinner, Raffle, and Social	Oystercatcher's Deck

Sunday, January 16

Time	Event	Location
7:30 AM - 9:00 AM	Registration	Tower Pool Windows
8:00 AM - 12:00 PM	Poster/Vendor Display	Audubon III/A
8:20 AM - 10:00 AM	SE Reef Fishes Symposium	White Ibis
8:20 AM - 10:00 AM	Contributed Papers - Sampling methods I	Snowy Egret North
8:20 AM - 10:00 AM	Contributed Papers - Movement Monitoring II	Herring Gull
8:20 AM - 10:00 AM	Contributed Papers - Management: Evaluation III	Snowy Egret South
8:20 AM - 10:00 AM	Contributed Papers - Rivers/Dams II	Roseate Spoonbill
8:20 AM - 10:00 AM	Contributed Papers - Fisheries Methods I	Pelican
10:00 AM - 10:20 AM	Break	
10:20 AM - 12:00 PM	Contributed Papers - Reef Fishes	White Ibis
10:20 AM - 12:00 PM	Contributed Papers - Sampling methods II	Snowy Egret North
10:20 AM - 12:00 PM	Contributed Papers - Movement Monitoring III	Herring Gull
10:20 AM - 12:00 PM	Contributed Papers - Management: Evaluation IV	Snowy Egret South
10:20 AM - 12:00 PM	Contributed Papers - Rivers/Dams III	Roseate Spoonbill
10:20 AM - 12:00 PM	Contributed Papers - Fisheries Methods II	Pelican

Saturday, January 15

Plenary Session (Audubon Pavilion): Dr. William T. Hogarth

Room	White Ibis	Snowy Egret South	Snowy Egret North	Sandhill Crane	Herring Gull	Roseate Spoonbill	Pelican	Cormorant	
Session	SE Reef Symposium	Management Session	Darter Symposium	Snook Symposium	Mussels Symposium	Contributed Papers	Contributed Papers	Repro Resilience Symposium	
9:15	Symp Intro	Status	Page, Symp Intro	Symp Intro	Symp Intro	Non-Native Fishes	Angler Assessment	Symp Intro	
9:20	Barbieri, L.	Fritts, M.	Albanese, B.	Gilmore, G.	Williams, J.	Rehage, J.	Schlechte, J.	Cass-Calay, S.	
9:40	Mitchell, W.	Gordon, B.	Argentina, J.	Dutka-Gianelli, J.	Williams, J.	Zajcek, P.	Hutt, C.	Shertzer, K.	
10:00	Bachelier, N.	Miyazono, S.	Bart, H.	Rolls, H.	Moyer, G.	Westhoff, J.	Lopez, D.	Lombardi, L.	
10:20		Break		Brame, A.	Johnson, N.		Break		
10:40	SE Reef Symposium	Recruitment	Darter Symposium	Snook Symposium	Mussels Symposium	Rivers/Dams I	Aquaculture & Stocking I	Repro Resilience Symposium	
11:00	DeVries, D.	Peterson, N.	Jordan, F.	Boucsek, R.	Rypel, A.	Smith, J.	Sager, C.	Barbieri, L.	
11:20	Switzer, T.	Dagel, J.	Kaintz, M.	Johnson, K.	Arnold, T.	Bedharski, M.	Porta, M.	Lowerre-Barbieri, S.	
11:40	Reichert, M.	Boxrucker, J.	Compton, M.	Trotter, A.	Gascho-Landis, A.	Peterson, D.	McDonnell, A.	McBride, R.	
12:00	Chagaris, D.	Hightower, J.	Dunn, C.	Dutka-Gianelli, J.	Stoeckel, J.	Heitman, F.	Lochmann, S.	Mann, D.	
				Lunch					
1:20	SE Reef Symposium	Evaluation I	Darter Symposium	Snook Symposium	Mussels Symposium	Movement Monitoring I	Aquaculture & Stocking II	Repro Resilience Symposium	
1:40	Lindberg, W.	Finch, C.	Irwin, E.	Young, J.	Wisniewski, J.	McKinney, J.	Jordan, A.	Heppell, S.	
2:00	Patterson, W.	Robinson, K.	Coombs, J.	Marsh, S.	Shea, C.	Carvalho, F.	Thompson, B.	Walters, S.	
2:20	Gardner, C.	Smith, W.	Rakes, P.	Ley, J.	Herrington, K.	McCormick, L.	Johnston, J.	Heppell, S.	
2:40	Vecchio, J.	Woodside, K.	Reeves, D.	Adams, A.	Herrington, K.	Keirstetter, D.	Schooley, J.	Piercy, A.	
3:00	Schobernd, Z.	Bitz, R.	Roberts, J.	Barbour, A.	Jones, J.	Parkyn, D.	Jaggers, J.	Smith, G.	
				Break					
3:20	SE Reef Symposium	Evaluation II	Darter Symposium	Snook Symposium	Mussels Symposium	Non-Native Fishes	Feeding Ecology	Repro Resilience Symposium	
3:40	Raley, P.	Barthel, B.	Austin, J.	Adams, A.	Moles, K.	Odenkirk, J.	Bangley, C.	Cooper, W.	
4:00	Carrroll, J.	Leone, F.	Sterling, K.	Winner, B.	Fritts, A.	Cannister, M.	Weidner, T.	Saborio-Rey, F.	
4:20	Biesinger, Z.	Buckmeier, D.	Discussion	Lorenzen, K.	Hazelton, P.	Discussion	Taylor, M.	Discussion-Murawski	
4:40	Collins, A.	Sartwell, T.	Discussion	McCawley, J.	Bringolf, R.	Discussion	Copeland, N.	Discussion	
	Speed Presentations	Hysmith, B.	Discussion	Taylor, R.	Wayman, W.	Discussion	Lauretta, M.	Discussion	

Sunday, January 16

Room	White Ibis	Snowy Egret South	Snowy Egret North	Sandhill Crane	Herring Gull	Roseate Spoonbill	Pelican	Cormorant	
Session	SE Reef Symposium	Management Session	Darter Symposium	Snook Symposium	Mussels Symposium	Contributed Papers	Contributed Papers	Repro Resilience Symposium	
8:20	Stephen, J.	Evaluation III	Sampling Methods I	Movement Monitoring II	Rivers/Dams II	Fisheries Methods I			
8:40	Ballenger, J.	Thomas, E.	Hanglesben, M.	Johnston, B.	Camp, E.	Zapf, D.			
9:00	Flaherty, K.	Peterson, N.	Bonvechio, K.	Flowers, H.	Timmons, B.	Harbeitner, R.			
9:20	Foramonti, C.	Kerns, J.	Collier, W.	Hoffmayer, E.	Peacock, C.	Barkowski, N.			
9:40	Berrane, D.	Dotson, J.	Bohrman, T.	Piriano, M.	Olive, J.	Lang, E.			
10:00		Mauck, M.	Franks, J.	Mudrak, P.	Rubec, P.	Baker, B.			
				Break					
10:20	Reef Fishes	Evaluation IV	Sampling Methods II	Movement Monitoring III	Rivers/Dams III	Fisheries Methods II			
10:40	Syc, T.	Trippel, N.	Binion, B.	Cole, A.	Rubec, P.	Waine, M.			
11:00	Wagner, C.	Strong, W.	Patterson, C.	Kuklinski, K.	Cooney, P.	Stubbs, T.			
11:20	Sauls, B.	Saari, C.	Ryswyk, R.	Raabe, J.	Lochmann, S.	Scharer, R.			
11:40	Tetzlaff, J.	Guindon, K.	Neal, J.	Earley, L.	Lee, C.	Ayers, P.			
			Hibbard, A.		Harris, J.	Radabaugh, K.			

Plenary Session

Biographical Sketch - William T. Hogarth, Ph.D.

Dr. William Hogarth is currently the Dean of the College of Marine Science at the University of South Florida since 2008. He served as the Assistant Administrator for Fisheries with the National Marine Fisheries Service (NMFS) for six years, and various other leadership positions with NMFS from 1994 to 2001, including the Regional Administrator for the Southwest and Southeast Regions. Prior to his career with NMFS, he was the Director of North Carolina Division of Marine Fisheries from 1986-1994, following eleven years with Carolina Power and Light Company as the Environmental Technology Manager.

Dr. Hogarth has served in the capacity as management and conservation of marine fisheries, protection of marine mammals, sea turtles and coastal fisheries habitat. His background and experience has focused on a wide range of environmental, scientific, and marine policy issues. He also served as the U.S. Government Commissioner and Chairman for the International Commission for the Conservation of Atlantic Tunas, and as the U.S. Government Commissioner and Chairman for the International Whaling Commission.

Oral Presentation Abstracts (Alphabetized by presenter. Student presenters in bold)

Presenter: Adams, A.J.; Email: aadams@mote.org

Effects of the January 2010 thermal disturbance on snook on spawning grounds of southwest Florida

Adams, A.J.¹, J.E. Hill¹, B. Kurth², and A.B. Barbour³

¹Mote Marine Laboratory, Charlotte Harbor Field Station, P.O. Box 529, Pineland, FL 33945

²Biology Department, Stetson University, 421 N. Woodland Blvd, DeLand, FL 32723

³Program of Fisheries and Aquatic Sciences, School of Forest Resources and Conservation, The University of Florida, PO Box 110600, Gainesville, FL 32611

Disturbances play a fundamental role in maintaining abundance and diversity by influencing competition, productivity, and life history strategies. Despite the general appreciation of the ecological importance of disturbances, there is still a lack of understanding on disturbance effects, particularly in marine environments. This is due largely to lack of sufficient pre- and post-disturbance data, insufficient spatial scale of study, and not examining disturbances in a theoretical framework. In January 2010, subtropical southwestern Florida (USA) experienced extreme cold for 13 days, which caused extensive mortality of many fish species. The effect of this thermal disturbance on common snook (*Centropomus undecimalis*) was assessed using three years (2007-2009) of pre-disturbance and one year (2010) of post-disturbance data from a tag-recapture program conducted over a large spatial scale (28 km) on Gulf of Mexico barrier islands of Florida. All metrics pointed to a significant disturbance effect: post-disturbance snook abundance was 41.88% and 75.57% less, respectively, than the two years immediately pre-disturbance; the percent of samples with zero snook caught more than tripled post-disturbance; post-disturbance inter-annual recapture rate declined by two orders of magnitude; and post-disturbance apparent survival of marked fish was 96-97% lower than pre-disturbance. Using a theoretical framework, we classified the cold event as an infrequent, high intensity, press disturbance, and conclude it had a severe effect on the spawning snook population. This finding provides a base from which to study the response (recovery) of the snook population to thermal disturbance, and contributes to a better understanding of disturbances for marine fishes.

Presenter: Adams, A.J.; Email: aadams@mote.org

Characteristics of spawning ground fidelity by snook: a multi-year perspective

Adams, A.J.¹, J.E. Hill¹, and C. Samoray²

¹Mote Marine Laboratory, Center for Fisheries Enhancement, Charlotte Harbor Field Station, P.O. Box 529, Saint James City, FL 33956

²Biology Department, Michigan State University, East Lansing, MI 48824

Spawning site fidelity has long been documented for anadromous salmonids, and more recently in estuarine and marine fish. The level of fidelity has implications for population dynamics, conservation, and management. This study extended a previous examination of spawning ground fidelity for common snook, *Centropomus undecimalis*. We used tag-recapture methods to study movements of adult snook within and between years along 28 km of Gulf of Mexico barrier island beaches of Florida (USA), spawning grounds for snook, during spawning season (May through September) from 2007 through 2010. Of 3,316 snook tagged, 186 were recaptured (5.61% recapture rate) and, of those, 181 (97.31 %) were recaptured on the same island where they were tagged. One hundred seven of the recaptured snook were recaptured in the same year they were tagged, and 79 were recaptured one or more years after they were tagged, indicating fidelity was expressed within and across years. Distance between tag and recapture locations demonstrated fidelity at a spatial scale much smaller than barrier island (mean distance between tag and recapture = 1.59 ± 0.12 km; island lengths 6.8, 8.9 and 12.4 km). Furthermore, mapping of capture locations revealed clumped distribution of snook on spawning grounds, further suggesting snook propensity for specific

Oral Presentations

locations during spawning season. We conclude that common snook show a high level of spawning site fidelity in southwest Florida, which may result in spawning group segregation, may influence the response of snook to disturbances, and may have implications for adult-to-nursery ontogenetic connectivity.

Presenter: Albanese, B.; Email: brett.albanese@dnr.state.ga.us

Status and habitat use of the goldline darter (*Percina aurolineata*) in the Coosawattee River system of northwest Georgia

Albanese, B.¹, D. Weiler¹, M. Camp¹, and B. Freeman²

¹ Georgia Department of Natural Resources, Nongame Conservation Section, Hwy 278 SE, Social Circle, GA 30025

² The University of Georgia, Georgia Museum of Natural History, Athens, GA 30602-7882

The federally threatened goldline darter (*Percina aurolineata*) has a disjunct distribution in the Coosawattee and Cahaba Rivers in Georgia and Alabama, respectively. Despite its legal status, very little is known about the life history, habitat requirements, and conservation status of this species. In order to estimate the proportion of sites currently occupied, we surveyed 27 sites located in major tributaries upstream of Carter's Lake and in Talking Rock Creek during 2009-2010. We used a backpack electrofisher held upstream of a stationary seine to sample 12 or more fixed area quadrats at each site and then measured habitat characteristics in each quadrat. Our design also allowed us to account for incomplete species detection in our estimate of site occupancy. We observed goldline darters at 70% of sites surveyed, which was comparable to our estimated occupancy rate (78%) that accounts for incomplete species detection. Preliminary analyses suggest an association with moderate depths and velocities within riffles and runs of large streams. Despite the high detection probability associated with our sampling methods (90 % for 12 quadrats), only a single individual was captured in Talking Rock Creek. Similarly, a concurrent survey of 10 sites in the Coosawattee River downstream of Carter's Lake failed to detect any goldline darters despite their past occurrence in this reach. Our results suggest that goldline darters are widely distributed upstream of Carter's Lake, are rare in Talking Rock Creek, and are rare or possibly extirpated from the lower Coosawattee River.

Presenter: **Argentina, J.**; Email: jea@vt.edu

Are variegate darters (*Etheostoma variatum*) actually rare or imperiled in Virginia?

Argentina, J.¹ and P. Angermeier²

¹ Fisheries and Wildlife Sciences, Virginia Tech, Blacksburg, VA 24061

² U.S. Geological Survey, Virginia Cooperative Fish and Wildlife Research Unit, Virginia Tech, Blacksburg, VA 24061

Definitions of rarity include both abundance and distributions of species. Though widespread and considered generally common across their entire range, variegate darters (*Etheostoma variatum* Kirtland) are listed as endangered in Virginia where they occur only in the Big Sandy River drainage. Their apparent imperilment is due to supposed population declines, range contractions, and a variety of threats, including poor habitat and water quality. However, long-term biological data on this species is sparse. We analyzed three years (2008-2010) of data on distribution, population genetics, and population biology from fish that persist in Virginia to assess population status. Based on genetic analyses, variegate darters seem to have a stable historic population size and moderate levels of individuals breeding each year ($N_e > 740$), and we have observed annual recruitment. An initial population estimate at one site, based on mark-recapture, indicates variegate darters exist at densities of $\sim 0.1/\text{m}^2$. Though these densities vary across time and space, we consider variegate darters relatively common in habitats in which they

Oral Presentations

occur in Virginia based on these data and surveys at other locations across their range. However, the preferred habitat in Virginia is rare, spanning only 30 river kilometers. Upstream distribution seems to be limited by watershed area, and a flood-control dam just downstream of the state line creates an effective barrier between the Virginia population and downstream Kentucky and West Virginia populations. Therefore, current extinction risk from a single catastrophic event, such as a fly-ash spill, combined with a near-zero likelihood of recolonization from downstream, leaves this population at risk and warrants its continued protection.

Presenter: **Arnold, T.E.**; Email: tarnold@ufl.edu

A comparison of the oxygen isotope method and the internal line technique for age determination in *Amblema neislerii* mussels

Arnold, T.E.¹, N.M. Rankin², K.J. Herrington³, J. Curtis¹, and M. Brenner¹

¹University of Florida, Dept. of Geological Sciences, 241 Williamson Hall, Gainesville, FL, 32611

²U.S. Fish and Wildlife Service, Warm Springs Fish Technology Center, 5308 Spring Street, Warm Springs, GA 31830

³U.S. Fish and Wildlife Service, Panama City Ecological Services Office, 1601 Balboa Avenue, Panama City, FL 32405

Eight endangered *Amblema neislerii* mussels were collected from the Apalachicola River, Florida and sectioned along the line of maximum growth. Shell carbonate was drilled out along growth lines at 50- μ m resolution for oxygen isotope ($\delta^{18}\text{O}$) analysis. High-resolution sampling exposed seasonal, temperature-driven fluctuations in oxygen isotopes, with a maximum intra-annual variation of 2.96‰. This range reflects a 12.83°C change in river water temperature through the year. Mussel ages derived from oxygen isotope data were compared to ages obtained from counting translucent and opaque bands within the shell, the latter thought to reflect annual increments. Isotope-derived ages match the internal line age estimates for mussels ≤ 2 years old. The internal line method yields age estimates for young adults (~8 years) that are greater than isotope-derived age estimates by an average of 1.25 years. For the oldest individuals (18-24 years), the internal line technique generated ages that exceed isotope-inferred values by a mean of 5.75 years.

Presenter: Ayers, P.; Email: ayers@utk.edu

Creating aquatic and fish habitat maps for Tennessee River systems

Ayers, P.¹, S. Bakaletz², R. Schapansky², M. Kulp², and J. Herring³

¹Biosystems Engineering, University of Tennessee, Knoxville, TN 37996

²National Park Service, BISO, OBRI, GRSM

³U.S. Forest Service, Cherokee National Forest, TN

A GPS-based underwater videomapping system (UVMS) was used to map 45 river miles of the NPS Obed Wild and Scenic River (OBRI) river system, 81 miles of the NPS Big South Fork River and Recreation Area (BISO) river system, 16 miles of the NPS Great Smoky Mountains (GRSM) Abrams creek and 12 miles of the USFS Cherokee National Forest Citico creek. The objective was to develop and utilize a system to generate large-scale aquatic habitat maps. The UVMS is canoe and kayak-mounted with georeferenced under and above water cameras, depth sounder and underwater lasers. GIS maps of substrate (modified Wentworth scale), embeddedness (EPA classification), depth and river characteristic (pool, riffle, run) were developed. A technique to define optimum habitat locations for endangered fish and mussel species was implemented. Habitat suitability indexes algorithm for endangered fish species were also developed. GIS-based video tours of the above and below water river features will be demonstrated.

Oral Presentations

Presenter: Austin, J.D.; Email: austinj@ufl.edu

Phylogeography of the Okaloosa darter

Austin, J.D.¹, H.J. Jelks², B. Tate³, and F. Jordan⁴

¹ Wildlife Ecology and Conservation, University of Florida, PO Box 110430, Gainesville, FL

² Florida Integrated Science Center, United States Geological Survey, 7920 Northwest 71st Street, Gainesville, FL 32653

³ U. S. Fish and Wildlife Service, Jackson Guard Natural Resources Facility, Eglin Air Force Base, Niceville, FL 32578

⁴ Biological Sciences, Loyola University New Orleans, 6363 St. Charles Avenue, New Orleans, LA 70118

Endangered Okaloosa darters (*Etheostoma okaloosae*) are small, benthic fish limited to six streams that flow into three bayous of Choctawhatchee Bay in northwest Florida, USA. We analyzed the complete mitochondrial cytochrome b gene and 10 nuclear microsatellite loci for 255 and 273 Okaloosa darters, respectively. Bayesian clustering analyses and AMOVA reflect congruent population genetic structure in both mitochondrial and microsatellite DNA and this structure reflects historical isolation of Okaloosa darter streams nested within bayous. Most the six streams appear to have exchanged migrants though they remain genetically distinct. The U.S. Fish and Wildlife Service recently proposed to reclassify Okaloosa darters from endangered to threatened status. Our genetic data support the reclassification of Okaloosa darter ESUs in the larger Tom's, Turkey, and Rocky creeks from endangered to threatened status. However, the three smaller drainages (Mill, Swift, Turkey Bolton creeks) remain threatened by their small population sizes and anthropogenic pressures on the remaining habitat.

Presenter: Bacheler, N.; Email: nate.bacheler@noaa.gov

Spatial distribution of reef fish in southeastern US coastal waters: survey design and management implications

Bacheler, N.¹, M. Reichert², B. Gardner³, V. Bartolino⁴

¹ National Marine Fisheries Service, Southeast Fisheries Science Center, 101 Pivers Island Road, Beaufort, NC 28516

² Marine Resources Research Institute, South Carolina Department of Natural Resources, 215 Fort Johnson Road, Charleston, SC 29412

³ Fisheries and Wildlife Sciences Program, Department of Forestry and Environmental Resources, College of Natural Resources, North Carolina State University, Raleigh, NC 27695

⁴ Institute of Marine Research, Swedish Board of Fisheries, P.O. Box 4, 45321 Lysekil, Sweden

Understanding the spatial distribution of reef fish populations is essential for the design of robust fishery-independent surveys and thus effective fisheries management. The spatial structure of reef fish populations in southeastern US coastal waters is determined by the geographic distribution of species, the spatial arrangement of individuals and their associated hard-bottom habitats, and the movement patterns of individuals. We examined the spatial distribution of three reef fish species in southeast US coastal waters, each with differing life histories: black sea bass (*Centropristis striata*), vermilion snapper (*Rhomboplites aurorubens*), and red pogy (*Pagrus pagrus*). Chevron trap data from the Marine Resources Monitoring, Assessment, and Prediction Program (MARMAP; 1990 – 2009) were used for our analyses. Typically, MARMAP deploys up to six baited chevron traps in one trap set, with a minimum distance of 200 m between traps, and traps soak for approximately 90 minutes. Trap data were analyzed using annual variograms to determine the scale of spatial autocorrelation, a phenomenon where observations close in geographic space are more similar than those widely separated. Spatial autocorrelation was observed for all three species. The variogram range parameter indicated that the distance over which spatial autocorrelation occurred varied by species but was stable over time for each species. These results suggest that spatial dependencies observed in the chevron trap data may bias both the accuracy and precision of indices of abundance. Two solutions

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are offered. First, the minimum distance between traps could be increased to the range distance observed from the variograms, but this approach would substantially reduce the number of traps that could be deployed each year, require different sampling approaches for each species, and affect the continuity of the long-term dataset. Alternatively, spatial autocorrelation could be accounted for directly in the models used to calculate relative abundance.

Presenter: **Baker, B.**; Email: bbaker@uaex.edu

Spawning distribution and population characteristics of white bass in Pool 4 of the Arkansas River

Baker, B.W. and S.E. Lochmann

Aquaculture/Fisheries Center, University of Arkansas at Pine Bluff, 1200 North University Drive, Pine Bluff, AR 71601

Spawning behaviors and dynamics of white bass *Morone chrysops* in the Arkansas River have not been documented. An assessment of the population is needed to provide a scientific basis for management. We sampled white bass during their spawning season in the 10 primary tributaries found within Pool 4 in the Arkansas River. The pool was divided into three segments (upper, middle, lower). Each segment had three tributaries. Each tributary was sampled every third week during the spawning season to determine spatial variability. One tributary (Caney Bayou), known to be occupied by white bass during the spawning season, was sampled weekly to document temporal variability of the spawn. White bass were collected by boat-mounted electrofishing. The catch per unit effort (CPUE) averaged (SD) 6.2 (16.9) fish/h across the pool. The CPUE for Caney Bayou averaged 8.5 (20.3) fish/h. Caney Bayou was the most utilized site, but other sites were also utilized during the spawning season. Precipitation and temperature appear to influence spawning effort. Once water temperature reached 13°C, white bass activity near tributaries increased. In addition, there was a positive relationship between precipitation and the occurrence of white bass in a tributary. Overall gender ratio was 1 ♂:2 ♀, while the gender ratio in Caney Bayou was 1 ♂:3 ♀. Two indices of population size structure were calculated. The PSD was 68.9 and the PSD_P was 53.7. Average relative weight across all cohorts was 103 (23.5). The average TL for age-1 white bass was 204 (31.5) mm, and for age-3 white bass was 353 (21.3) mm. The oldest white bass collected was a 7-year-old. Total annual mortality was 49.3% using a catch curve regression. As habitat alterations occur and water allocations and releases are modified, understanding the critical habitats and conditions supporting favorable spawning and recruitment is imperative.

Presenter: Ballenger, J.C.; Email: ballengerj@dnr.sc.gov

Population dynamics of black sea bass, *Centropristis striata*, along the southeastern coast of the United States: Temporal and spatial patterns

Ballenger, J.C., S. Bitterwolf, L. DiJoy, and J. Stephen

Marine Resources Research Institute, South Carolina Department of Natural Resources, 217 Fort Johnson Road, Charleston, SC 29412

Black sea bass are a temperate marine species that are an integral member of reef fish communities from Maine to northeastern Florida along the Atlantic coast of the United States. Like many members of the family Serranidae, black sea bass are protogynous hermaphrodites, transitioning from female to male during their life. Throughout their range, black sea bass support substantial commercial and recreational fisheries. In Atlantic waters off the southeastern coast of the United States, a recent stock assessment indicates that the black sea bass population is currently overfished and that overfishing continues. This assessment assumes there is a unit stock of black sea bass that does not exhibit any spatial variability in life history traits and only temporal variability in the proportion of

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females mature. Using data collected on black sea bass as part of fishery-independent monitoring of reef fish communities in the region conducted by the MARMAP program, we investigate this assumption of near constant spatial and temporal life history traits. Since 1978, the MARMAP program has collected biological samples from 50,154 individuals through 2009, of which 48,247, 42,374 and 41,089 have been aged, have been sexed, and had maturity assessed, respectively. Using this data, we investigated the presence of spatial and temporal differences in weight-length regressions, length-at-age, female lengths and ages at maturity, lengths and ages at sexual transition, sex ratios, and age-specific natural mortality rates. Samples were placed in strata based on collection period (Early – 1978-1989; Mid – 1990-1999; Late – 2000-2009), depth of collection (Inshore – <30 m; Offshore – ≥30 m) and latitude (North – ≥32° N; South – <32° N). We present preliminary results with some discussion on potential stock assessment and management implications. Additional discussion centers on the potential for fishery-induced evolution in the black sea bass population in Atlantic waters off the southeastern coast of the United States.

Presenter: **Bangley, C.W.**; Email: Bangleyc09@students.ecu.edu

Feeding habits of migratory spiny dogfish (*Squalus acanthias*) in North Carolina waters

Bangley, C.W.¹ and R.A. Rulifson²

¹Department of Biology, Flanagan 388, East Carolina University, Greenville, NC

²Institute for Coastal Science and Policy, and Department of Biology, Flanagan 385, East Carolina University, Greenville, NC

Spiny dogfish (*Squalus acanthias*) are known to occur in large numbers off the coast of North Carolina from November to March. Little is known of the regional diet of spiny dogfish overwintering off of North Carolina, but they are suspected of having significant influence on the marine community. Stomach contents were collected from dogfish in North Carolina waters during the USFWS-lead Cooperative Winter Tagging Cruise in February and the NOAA/NMFS Spring Bottom Trawl Survey in March. 399 dogfish were sampled, mostly large females captured in water less than 30 m in depth. Flushed stomach tubes were used to collect stomach contents during the NOAA/NMFS survey. All prey items were identified to the lowest possible taxon and weight (g), number, and frequency of occurrence were recorded. Abundance data were also recorded for all species encountered during the surveys. The diet included a variety of teleosts and invertebrates including both benthic and pelagic species. Diet and community data were analyzed to determine if overwintering dogfish are showing prey selectivity and if size, sex, and environmental factors influence their feeding habits.

Presenter: Barbieri, L.; Email: Luiz.Barbieri@myfwc.com

Fishery-independent surveys of living resources along the eastern Gulf of Mexico: an overview of recent developments

Barbieri, L., R. McMichael, T. Switzer, S. Keenan

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

Commercial and recreational fisheries in the Gulf of Mexico support multi-billion dollar fisheries. Recent assessments indicate that numerous Gulf of Mexico stocks are currently overfished and/or undergoing overfishing, due in large part to increasing fishing effort in recent decades. Although the assessment and management of exploited species has traditionally relied heavily on fisheries-dependent data, the importance of fisheries-independent data has long been recognized. In the Gulf of Mexico, the National Marine Fisheries Service coordinates several long-term monitoring surveys targeting various habitats, species, and life history stages. Several

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of these surveys (e.g., reef-fish video surveys, groundfish trawl surveys) are conducted cooperatively with various state partners to increase overall sampling effort and maximize survey efficiency while also assuring the comparability of collected data. Additional surveys within estuarine and nearshore waters are conducted by each respective state agency, although survey design and sampling methods vary among states. To date, data from state/federal surveys have contributed to the assessment of several taxonomic groups, including tunas, mackerels, groupers, snappers, drums, and jacks. Despite the relative success of these varied surveys, the recent Deepwater Horizon incident has forced scientists and managers to critically reassess the ability of existing surveys to characterize fisheries resources. At a recent workshop, the strengths and limitations of various ongoing surveys were identified, and recommendations made to enhance these surveys to provide data required to meet a variety of emerging needs (e.g., single-species stock assessment, ecosystem-based fisheries management, Deepwater Horizon impact assessment). This talk will provide a historical overview of key fisheries-independent surveys in the Gulf of Mexico as well as recent efforts to improve fisheries-independent data collections.

Presenter: Barbieri, L.; Email: Luiz.Barbieri@myfwc.com

Reproductive success and stock resilience: what do we need to know to improve fisheries management?

Barbieri, L. and S. Lowerre-Barbieri

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

Approximately 25% of the world's fisheries are considered overexploited and a number of stocks have collapsed, leading to a reevaluation of our assessment methods and management goals. Reproduction has been traditionally incorporated into stock assessments very simply through the stock-recruitment relationship and spawning stock biomass. Given the complexity of reproductive strategies, it is not surprising that spawning stock biomass cannot predict reproductive success (i.e., the numbers of offspring surviving to harvestable age which is usually older than reproductive age). The impact of exogenous factors on larval survival, in conjunction with the large fecundities of most exploited marine species have led some to conclude that there is often little relationship between reproductive rate and reproductive success at the population level. However, there is a need to distinguish between yield, which is usually well-correlated with year-class strength, and resilience of a stock, which should be more closely linked to factors associated with reproductive success. Regardless of high fecundity and low larval survival rates certain adult traits must be associated with having greater numbers of offspring survive. We discuss the need to incorporate the conservation of intra-population reproductive diversity (at the spatial and temporal levels), population connectivity, balanced population structure, and associated population resilience as objectives for long-term fisheries sustainability.

Presenter: **Barbour, A.**; Email: snook@ufl.edu

Cold snap effects on juvenile survival in mangrove creeks

Barbour, A.¹, and A. Adams²

¹The University of Florida, School of Forest Resources and Conservation, Program for Fisheries and Aquatic Sciences, P.O. Box 110600, Gainesville, FL 32611

²Mote Marine Laboratory, Center for Fisheries Enhancement, Fisheries Habitat Ecology Program, Charlotte Harbor Field Station, P.O. Box 529, Pineland, FL 33956

The freeze of January 2010 affected adult populations of common snook (*Centropomus undecimalis*) throughout Florida, but impacts on juveniles are unknown. To determine the effect on juvenile snook, we compared apparent

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survival estimates in Charlotte Harbor, FL mangrove nursery habitat in the year before the freeze to the year of the freeze. In three tidal mangrove creeks, we used PIT tags to mark 862 juveniles (< 320 mm SL) between November 2008 and June 2009, and 593 juveniles between November 2009 and February 2010. Using an array of 11 autonomous PIT tag antennae and seine netting, we recaptured over 80% of all marked fish at least once. This detailed mark-recapture data allowed for highly precise monthly apparent survival calculation. Freeze effects were patchy, with an approximate 5% reduction in apparent survival in the first creek, a 10-20% reduction in the next, and a 40-50% reduction in the last. Hypotheses on the origin of these patchy effects are postulated, and initial inferences on the existence of compensatory recruitment will be made following juvenile sampling during fall 2010.

Presenter: **Barkowski, N.**; Email: nbarkowski@uaex.edu

Examination of gender specific markers in plasma and surface mucus of *Morone chrysops*

Barkowski, N.A., S. Lochmann, and A.H. Haukenes

University of Arkansas at Pine Bluff, 1200 N. University Drive, Pine Bluff, AR 71601

Sex steroids and vitellogenin have been examined in a variety of teleost fishes to investigate the reproductive system. These constituents are typically measured in plasma, however surface mucus samples have been shown to be an effective substitute in several species of fish. We are attempting to validate mucus sampling as an approach to investigate the reproductive events in white bass *Morone chrysops* by measuring 11 α -ketotestosterone (11-KT) and vitellogenin (VTG) in both surface mucus and plasma samples. White bass were collected from a spawning population during March and April, 2010 via angling and electrofishing. Fish were tagged and held in 100-l tanks. Male and female white bass were injected with carp pituitary extract (10 mg/kg) or saline and plasma and mucus samples were collected for 11-KT assay. Similarly, samples from males and females treated with estradiol (10 mg E₂/kg) or the peanut oil carrier were collected and assayed for VTG. Qualitative examinations of 11-KT concentrations in plasma illustrate differences between males and females. Concentrations of 11-KT and VTG in all mucus and plasma samples will be determined. These data will then be used to ascertain if the measured concentrations in these different sample types are correlated. These data may help demonstrate if mucus samples have utility as a tool to assess the annual reproductive cycle of white bass.

Presenter: **Bart, H.L.**; Email: hank@museum.tulane.edu

Collapse of the darter fauna of the Pearl River (Louisiana, Mississippi)

Bart, H.L. Jr.¹ and K.R. Piller²

¹ Tulane University Museum of Natural History, Belle Chasse, LA 70037

² Department of Biological Sciences, Southeastern Louisiana University, Hammond, LA 70402

The Pearl River system is home to 20 species of darters (Family Percidae), all of which are historically known from the main stem of the river. Over the nearly four decades since Royal D. Suttkus and Gerald D. Gunning started their fish monitoring survey in the mainstem of the Pearl River, the fish community has experienced some rather dramatic changes. The greatest changes involved benthic fishes, especially darters. We used data on Pearl River fishes from the Royal D. Suttkus Fish Collection, and from monitoring work presently being conducted by KRP, to assess long term abundance trends of darters and other fishes. The steepest population declines involved species adapted to main-channel, riffle habitats. One species, the Pearl darter (*Percina aurora*), was extirpated from the Pearl River sometime after 1973. We attribute the collapse of the Pearl River darter fauna to channel instability resulting from the altered flow regime caused by construction of Ross Barnett Dam near Jackson, Mississippi. We relate changes in darter abundance over time to flood pulses in the period after completion of the dam.

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Presenter: Barthel, B.; Email: Brandon.Barthel@myfwc.com

Genetic investigations of Florida's Panhandle bass populations

Barthel, B.^{1*}, M. Tringali¹, S. Seyoum¹, C. Puchulutegui¹, J. Knight², A. Strickland³ and C. Paxton⁴

¹ Florida Fish and Wildlife Research Institute, 100 8th Avenue S.E., Saint Petersburg, FL 33701

² Florida Fish and Wildlife Research Institute, Blackwater Fisheries Research and Development Center, 8384 Fish Hatchery Road, Holt, FL 32564

³ Florida Fish and Wildlife Research Institute, Joe Budd Field Office, 5300 High Bridge Road, Quincy, FL 32351

⁴ Florida Fish and Wildlife Conservation Commission Division of Freshwater Fisheries Management, Northwest Regional Office, 3911 Highway 2321, Panama City, FL 32409

More than half of the recognized black bass species (*Micropterus*) are present in Florida Panhandle streams, including the two species with the most restricted ranges, i.e., shoal bass (*M. cataractae*) and Suwannee bass (*M. notius*). Although habitat degradation is the most serious threat to Panhandle bass populations, there is potential for interspecific hybridization to pose a more immediate threat in some cases. In other states, introductions of non-native species have led to introgressive hybridization and genetic swamping of populations of endemic species. The Florida Fish and Wildlife Conservation Commission has implemented a genetic study to help conserve native black bass species by (1) determining which species are present in Panhandle streams and (2) monitoring populations for evidence of hybridization between species. Thus far, these investigations have uncovered two genetically distinct forms of spotted bass (*M. punctulatus* and *M. sp. cf. punctulatus*) in Panhandle streams, one of which was previously unrecognized and has yet to be described (*M. sp. cf. punctulatus*). Members of this provisional taxon appear to be more closely related to Guadalupe bass (*M. treculi*) than northern spotted bass (*M. punctulatus*) and may be native inhabitants of western Panhandle coastal lotic systems. Genetic studies have also documented that Chipola River shoal bass are hybridizing with *M. sp. cf. punctulatus*, *M. punctulatus*; and *M. salmoides*. During the course of three sampling years, nearly 10% of the presumptive shoal bass collected from the Chipola River were hybrids. Specimens will be tested from the Chipola River at regular intervals to determine whether this important population of shoal bass continues to be threatened by introgression.

Presenter: **Bednarski, M.**; Email: bednarskim@warnell.uga.edu

Influences of seasonal river flow on recruitment of shortnose sturgeon, *Acipenser brevirostrum*, in the Altamaha River, Georgia

Bednarski, M.S. and Peterson, D.L.

Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA 30602

The shortnose sturgeon is a small, long-lived, late-maturing amphidromous sturgeon species that inhabits large tidal rivers on the Atlantic coast of North America. In response to range-wide declines in abundance caused by overfishing and habitat degradation, shortnose sturgeon were listed as endangered in 1967. Like other Acipenserids, shortnose sturgeon require specific habitats in freshwater rivers areas for successful reproduction. Presently, long-term studies assessing the influence of in-river conditions on shortnose sturgeon recruitment are completely lacking. The objective of this study was to quantify the effects of riverine conditions on shortnose sturgeon recruitment in the Altamaha River, Georgia. From 2004-2010, we used entanglement gear to conduct mark-recapture population estimates of age-1 shortnose sturgeon within the Altamaha River using the Huggins closed-capture model in Program Mark. Over the seven years of the study, point estimates of age-1 juveniles varied from 31 - 3860 individuals. Using these estimates as an index of recruitment we then used linear regression to quantify the effects of different environmental variables on abundance of age-1 juveniles. Our results show that shortnose sturgeon recruitment in the Altamaha River was positively linked to the duration of high flow during the spring spawning season in the previous year. These findings suggest that flow is a key factor affecting long term trends of the Altamaha River population. We suggest that future studies assess the long-term viability of the Altamaha shortnose sturgeon population within the context of global climate change and growing demands for water resources within the Altamaha basin.

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Presenter: Berrane, D.; Email: David.Berrane@noaa.gov

Age and growth of lionfish, *Pterois volitans*, from coastal waters of North Carolina

Potts, J.C.¹, D.J. Berrane¹, and J.A. Morris, Jr.²

¹ National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service, Center for Coastal Fisheries and Habitat Research, 101 Pivers Island Road, Beaufort, NC 28516

² National Oceanic and Atmospheric Administration (NOAA), National Ocean Service, Center for Coastal Fisheries and Habitat Research, 101 Pivers Island Road, Beaufort, NC 28516

An age and growth study of lionfish, *Pterois volitans*, was conducted using sagittal otoliths collected primarily by fishery independent dive operations throughout the calendar year from 2004-2009 in Onslow Bay, North Carolina. Sagittal otoliths (n = 814) were removed from lionfish ranging in size from 90 – 464 mm total length (TL). When viewed whole, the sagittal otoliths were relatively thick and highly opaque. Otoliths were small and required embedding in epoxy to be sectioned. Lionfish ranged from calendar age 0 to 8 years, and most of the fish (90%) were age 3 or younger. Growth was rapid during the first and second year of life, attaining on average 150 mm TL within the first year, but also reaching up to 220 mm TL. During the second year, lionfish averaged 230 mm TL, but were as large as 318 mm TL. The von Bertalanffy growth equation based on observed TL at age was $L_t = 455.1(1 - e^{-0.32(t + 1.22)})$. Based on this assessment, the earliest back-calculated spawning year was 1998 (n = 1) which corresponds well with the first report of lionfish in Onslow Bay, NC, in 2000. This research suggests that the lionfish population in Onslow Bay, NC is dominated by young individuals, which is indicative of an establishing population.

Presenter: **Biesinger, Z.**; Email: zbiesing@ufl.edu

Habitat effects on gag performance and home range

Biesinger, Z.^{1*}, W. Lindberg¹, and B. Bolker²

¹ Program in Fisheries and Aquatic Sciences, School of Forest Resources and Conservation, University of Florida, P.O. Box 110600, Gainesville, FL 32611-0600

² Department of Mathematics and Statistics, McMaster University, 1280 Main Street West, Hamilton, ON L8S 4K1, Canada

Fisheries models often treat demographic parameters as constant across large spatial scales. But spatial variation in habitat-dependent processes may be important to population dynamics, especially for species with spatially structured life histories, like gag (*Mycteroperca microlepis*). To explore the connections between landscape and individual movement and fitness, we compare movement decisions and performance of gag living in different settings. Gag establish residency at physical shelters and roam the surrounding landscape for food. We compare the movement (e.g. home range size) and performance measures (i.e. relative weight, recent growth) of juvenile gag established on experimental reefs in either sandy or hard-bottom settings. June through December 2009, we acoustically tagged eight gag on each of three sand and three hard-bottom plots surrounded by a fixed array of five hydrophones. With tags transmitting every 2s, we triangulated two-dimensional positions of individuals over 250m for 14d. Comparing 90% kernel density estimates of home range size, we find that gag on sand-bottom reefs use, on average 361m² while those on hard-bottom reefs use, on average 1341m² (t(4.90), df=4, p=0.004). In conjunction with categorical habitat maps and detailed water flow measurements, we use gag positional data to relate movement decisions and performance to the fixed and fluid environment. Understanding this linkage is a step toward incorporating habitat variation across the continental shelf into fisheries population models. As fisheries management tools become increasingly spatial (e.g. marine protected areas, artificial habitat enhancements) a better understanding of the relationship between landscape structure, movement, and performance may increase management effectiveness.

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Presenter: Binion, G.; Email: greg.binion@tpwd.state.tx.us

Efficacy of a light attractant for increasing trap net catch rates for crappies

Binion, G^{1*}, Daugherty, D², Schlechte, W³, Ott, R⁴, and Bister, T⁵

¹ Texas Parks and Wildlife Department, PO Box 116, Mathis, TX 78368

^{2,3} Texas Parks and Wildlife Department, 5103 Junction Highway, Mountain Home, TX 78058

⁴ Texas Parks and Wildlife Department, 11810 FM 848, Tyler, TX 75707

⁵ Texas Parks and Wildlife Department, 3802 E. End Blvd. So., Marshall, TX 75672

Sampling crappie populations to adequately describe vital rates and population characteristics has proven difficult in many fisheries due to low catch rates. A potential improvement that has yet to be considered is the use of trap nets fitted with a light attractant. We evaluated the efficacy of trap nets fitted with a battery-operated, submersible light mounted within the net mouth by comparing CPUE and size structure of fish collected to that of standard (i.e., unlighted) trap nets in 7 Texas reservoirs. Lighted trap nets caught significantly fewer fish when compared to standard trap nets (mean CPUE = 10.0 and 12.9 fish/net night [nn], respectively). Catch rates of stock-size fish also differed between lighted and standard trap net treatments, with lighted sets capturing significantly fewer fish; we detected no significant difference between catch rates for preferred-sized fish. Length frequency distributions of crappie collected by each trap net treatment were similar and did not significantly differ in 4 of the 5 lakes tested. Our results suggest that trap nets fitted with artificial lights in the net mouth may reduce catch rates rather than improve them.

Presenter: Bitz, R.; Email: roger.bitz@myfwc.com

Incremental growth methods and future research plans for shoal bass in the Chipola River, Florida

Bitz, R. and P.A. Strickland

Florida Fish and Wildlife Conservation Commission, 5300 High Bridge Rd., Quincy, FL 32351

Shoal bass *Micropterus cataractae* are indigenous to limited sections within the ACF (Apalachicola, Chattahoochee, and Flint) river system, and are listed as a species of special concern in Florida. The Chipola River near Marianna (NW Florida) contains the only sustained population of this species in the state. Because of its status and restricted range, limited amounts of age-and-growth data have been published. The objective of this study was to determine growth of the species using a non-lethal method. Shoal bass sampling via boat electrofishing was conducted in late summer 2009 and spring and summer 2010. Of >700 fish tagged in 2007-2009, a total of 96 PIT-tagged shoal bass were recaptured. Existing age data was used to calculate average incremental growth on 72 individuals for three different age ranges (ages 1-2, 1-3, and 2-3). Shoal bass grew 82 ± 8 mm/year, 71 ± 5 mm/year, and 42 ± 5 mm/year from ages 1-2, 1-3, and 2-3, respectively. Topics such as habitat use, movement, genetics, and behavior need to be further evaluated to better understand this endemic black bass species. Future research will be geared towards evaluating spawning duration and associated habitat.

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Presenter: **Bohrman, T.F.**; Email: Bohrmann@ufl.edu

Evaluating sampling efficiency in depletion surveys using hierarchical Bayes

Bohrmann, T.F. and M.C. Christman

University of Florida Institute of Food and Agricultural Sciences, Department of Statistics and School of Natural Resources and Environment, McCarty Hall C, PO Box 110339, University of Florida, Gainesville, FL 32611-0339

Estimating animal abundance is an essential part of natural resource management or conservation. However, the cost associated with abundance estimation varies and can be high for populations that are difficult to sample. Researchers, particularly in fisheries management, often sample such populations using depletion surveys. Depletion surveys rely upon successive removals of animals, without replacement, in order to estimate abundance. These researchers also must decide on other sampling protocol, including the data collection technique. Data collection techniques may include depletion gear, vessel or personnel. To inform this decision, we propose a supplement to the hierarchical Bayesian models which have recently been used to analyze depletion data. Using Bayesian sample size methodology along with a hierarchical model, we present a framework for estimating the efficiency of data collection techniques which have previously been used in sampling. By applying the sample size methodology, the researcher can estimate the expected variability in abundance estimates for each data collection technique and apply this information to future sampling decisions. Additionally, this framework allows the estimation of expected variability for various numbers of removal passes, which may further inform protocol decisions. We demonstrate the methodology using a data set of Chesapeake Bay blue crab depletion surveys.

Presenter: Bonvechio, K.; Email: Kim.Bonvechio@myFWC.com

Comparison of sinking and floating gill nets for collecting shads (*Dorosoma* sp.) and black crappie (*Pomoxis nigromaculatus*) in three Florida lakes

Bonvechio, K.I., S.M. Hooley, S. Crawford, and R.E. Sawyers

Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, Freshwater Fisheries Research Section, 601 W. Woodward Ave., Eustis, FL 32726

We compared the catch rate and size structure of shads (*Dorosoma* sp.) and black crappie (*Pomoxis nigromaculatus*) collected by floating and sinking experimental gill nets to determine which net type would be most appropriate for long-term monitoring of these species in Florida lakes. We sampled three lakes of varying trophic states, and sinking gill nets generally yielded higher catch rates than floating gill nets for the three target species, although the catch rate of shad species was low for our mesotrophic lake, regardless of the net type. Furthermore, sinking nets also tended to capture a wider range of sizes of target fish, and more species overall. Based on our sampling targets, we estimated that approximately 21 sinking gill nets would be adequate for assessing shad populations in eutrophic systems. Neither net type was deemed sufficient for the capture of target species in our mesotrophic system or for black crappie in any system; thus other gears or modifications of this gill net protocol may be needed for low productivity systems and for capturing black crappie in Florida lakes. Although standardizing sampling protocols over a wide geographic area has many benefits, the results of this study illustrate the continued need for evaluating and, when necessary, modifying protocols to provide meaningful data for the long-term management of target species.

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Presenter: **Boucek, R.**; Email: rbouc003@fiu.edu

Resource partitioning among snook and three freshwater mesoconsumers in the Upper Shark River estuary

Boucek, R. and J. Rehage

Department of Environmental Studies, Florida International University, 11200 S.W. 8th Street Miami, FL 33199

Many consumers throughout natural ecosystems are subsidized by pulsed resources. At the onset of the pulse, multiple consumer taxa are able to simultaneously exploit additional food sources. However, as the resource diminishes over time, competition may increase such that the temporal scale to which species are supported by pulsed resource subsidies may depend on how well the species or individuals compete with others. In Everglades National Park (ENP), distinct hydrologic seasons influence prey availability in the marsh-mangrove ecotone. In the dry season, decreasing water levels in upstream marshes force fishes into tidal mangrove creeks. At the same time, ecotonal abundances of estuarine transient consumers, dominated by snook (*Centropomus undecimalis*), triple, likely in response to increased freshwater prey abundance. In this study, we documented how snook seasonally partition resources with spatially co-occurring freshwater mesoconsumers (e.g., largemouth bass (*Micropterus salmoides*), Florida gar (*Lepisosteus platyrhincus*), and bowfin (*Amia calva*)), in the upper Shark River estuary, ENP. For our research approach, we removed stomach contents from each focal species via pulsed gastric lavage. Results from 2010 indicate that in the early dry season all consumers heavily exploit and share marsh-based prey; however, as freshwater prey become less abundant in the late dry season and is absent in the wet season, consumers began to partition resources. Our analysis suggests that snook extensively utilize marsh based prey subsidies and potentially out-compete other species for this resource as it depletes. These data will provide a greater understanding of how estuarine snook populations respond in a trophically-mediated manner to seasonal and longer-term (i.e., from restoration) hydrological variation.

Presenter: Boxrucker, J.; Email: jboxrucker@sbcglobal.net

Reservoir fisheries habitat partnership: Collaborative efforts to restore fish habitat in the nation's reservoirs

Boxrucker, J.

Coordinator-Reservoir Fisheries Habitat Partnership, 9321 E. State Highway 9, Norman, OK 73026

The Reservoir Fisheries Habitat Partnership (RFHP) is one of 17 partnerships recognized by the National Fish Habitat Action Plan. RFHP is the only partnership that encompasses the entire country. RFHP is a national collaborative partnership established to promote the protection, restoration and enhancement of habitat for fish and other aquatic species through collaborative actions that contribute to: 1) the ecological health and function of reservoirs and their associated waters and watersheds; 2) the sustainability and enhancement of reservoir fisheries; 3) the well-being of fish and other aquatic species and communities, therein; 4) public awareness of the conservation issues and challenges facing reservoir and associated waters and watershed management in the 21st Century; and 5) the quality of life of the American people. RFHP has focused on developing an assessment of fisheries habitat impairments in reservoirs nationwide and developing a set of physical metrics that would serve to classify reservoirs. Dr. Steve Miranda and Rebecca Krogman have developed an online survey to score individual reservoirs on a Likert system on a variety of habitat impairments. Dr. Reed Green and Kirk Rodgers from University of Arkansas-Little Rock are using data-mining techniques to search online databases for metrics useful in developing a reservoir classification system. The impairment survey and classification system will be merged to determine if physically similar reservoirs share common habitat impairments. RFHP funded one project in 2010; a native vegetation restoration project on Lake Conroe, Texas. Four projects will be selected for funding in 2011.

Presenter: **Brame, A.**; Email: adam.brame@noaa.gov

Ecological assessment of juvenile snook over a small spatial scale in a tidal tributary of Tampa Bay, Florida

Brame, A.¹, C. McIvor², D. Hollander¹, E. Peebles¹

¹ University of South Florida, College of Marine Science, 140 7th Ave South, St. Petersburg, FL 33701

² U.S. Geological Survey, St. Petersburg Coastal and Marine Science Center, 600 4th St. South, St. Petersburg, FL 33701

It is widely accepted that wetlands serve as nursery habitat for numerous estuarine fish species, however few studies look past simple measures of abundance to define these habitats. In the fall of 2006 we set out to better define nursery habitat of common snook, *Centropomus undecimalis*, by sampling a tidal creek and connected ponds in both upstream and downstream portions of a single Tampa Bay wetland. We collected snook, potential prey and measured habitat variables in each habitat, taking standard fish measurements (i.e., abundance, condition, size) to determine relationships between habitat, density, and general health. We also retained whole snook for stable carbon and nitrogen isotopic analysis. We found higher densities of juvenile snook in ponds (5.2 ± 1.06 snook/100m²) and upstream locations (5.5 ± 1.10) compared to creek sites (2.2 ± 0.47) and downstream portions of the wetland (2.0 ± 0.34). Snook collected from ponds were on average smaller (55.3 ± 1.17 mm SL) than those collected from the creek (66.7 mm SL ± 1.71), but condition (K) did not differ between the two site types. Isotopic compositions of snook were distinctly different between ponds and the creek suggesting little movement between habitat types. Snook collected in ponds were isotopically enriched in nitrogen and depleted in carbon relative to those collected in creeks. This result suggests more nutrient recycling occurred in the ponds, likely due to reduced flushing in these habitats. Based on isotopic composition, juvenile snook feed on small fishes at the 2nd trophic level and obtain carbon from benthic microalgae and particulate organic matter. Stable isotope ratios in conjunction with more frequently used variables such as abundance and growth seem to produce a clearer description of snook nursery habitat through the interpretation of fish diet and movements.

Presenter: Bringolf, R.B.; Email: rbringolf@warnell.uga.edu

How do we develop ecologically-relevant standardized glochidia toxicity tests?

Bringolf, R.B.¹, A.K. Fritts¹, M.C. Barnhart², W.G. Cope³

¹ Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA 30602

² Missouri State University, Department of Biology, 901 S. National Avenue, Springfield, MO 65897

³ North Carolina State University, Department of Environmental and Molecular Toxicology, Raleigh, NC 27695

Water quality criteria are pollutant concentration goals intended to be protective of aquatic life. Criteria are based on toxicity test results from a variety of aquatic taxa but until recently data for native freshwater mussels were not considered in criteria development. Recent standardization of test methods has led to acceptance of juvenile mussel data but many questions remain about the implementation of glochidia test data. Glochidia are advantageous for toxicity testing because large numbers can be obtained more readily and more cost effectively compared to juvenile mussels, yet concerns about appropriate test duration given the wide variation in duration of viability (hours to days) and host attachment strategies among mussel species have precluded acceptance of glochidia toxicity data. Ideally, glochidia test duration would be ecologically relevant and would reasonably accommodate the variety of strategies used by mussels to attach glochidia to host fish. The period of viability provides the basis for determination of relevant toxicity test durations if certain assumptions are met. We will determine if glochidia viability (determined by closing response to NaCl) is equivalent to the duration of infectivity-the ability to attach to host fish and metamorphose successfully into the juvenile stage. Viability and infectivity will be compared at six time intervals (0, 6, 24, 48, 96, 144 hr) following glochidia extraction from females. The same approach will be used for three species that utilize different strategies to attach glochidia to host fish. This study will provide the basis for standardizing the duration for glochidia tests.

Presenter: Buckmeier, D.; Email: david.buckmeier@tpwd.state.tx.us

Population dynamics of alligator gar in the Trinity River, Texas

Buckmeier, D.L.¹, N.G. Smith¹, J.W. Schlechte¹, and A.M. Ferrara²

¹Texas Parks and Wildlife Department, Heart of the Hills Fisheries Science Center, 5103 Junction Highway, Mountain Home, TX 78058

²Nicholls State University, Department of Biological Sciences, 223 Gouaux Hall, Thibodaux, LA 70310

The popularity of alligator gar *Atractosteus spatula* trophy fisheries in Texas have increased substantially in recent years. The most popular destination is the Trinity River, which originates near Dallas and flows for > 1,100 km to the Gulf of Mexico. In 2007 the Texas Parks and Wildlife Department initiated efforts to estimate alligator gar population metrics, movements, and habitat use in the Trinity River. It appears the population is able to sustain current harvest, but is at risk of losing the trophy component due to overfishing. Alligator gar have low natural mortality, live more than 50 years, are slow to mature, and have variable recruitment likely associated with spring flooding. While growth of young fish can be very fast (up to 122 cm in 3 years), it takes about 20 years for fish to attain a length of 183 cm. We estimate the population of alligator gar ≥ 107 cm in the upper Trinity River (about 300 km) is ~9,200 fish, of which ~4% of the population is harvested annually under the 1 fish per day harvest regulation. Population models suggest current harvest is near the maximum that is sustainable. Telemetry showed most fish remained within 20 km of the original site of capture, although some fish moved > 100 km in only a few days. There was little intermingling of fish tagged near the estuary with fish tagged further upstream, suggesting there may be multiple stocks in the river. Alligator gar primarily used deep pools during normal and low flow periods and used tributary or backwater habitats during spring floods when flows exceeded 250 m³/s. If the popularity of this fishery continues to grow, increased harvest will likely reduce size and age structure. Harvest regulations that are independent of fishing effort could be used to maintain trophy fisheries.

Presenter: **Camp, E.**; Email: edvcamp@ufl.edu

Changes in submersed aquatic vegetation affect predation risks of common prey fish *Lucania parva* (Cyprinodontiformes: Fundulidae) in a spring-fed coastal river.

Camp, E.¹, D. Gwinn², W. Pine³, and T. Frazer⁴

¹ School of Forest Resources and Conservation, Fisheries and Aquatic Sciences Program, University of Florida, 7922 NW 71st Street, Gainesville, FL 32605

² School of Forest Resources and Conservation, Fisheries and Aquatic Sciences Program, University of Florida, 7922 NW 71st Street, Gainesville, FL 32605

³ Department of Wildlife Ecology and Conservation, University of Florida, 110 Newins-Ziegler Hall, University of FL 3261

⁴ School of Forest Resources and Conservation, Fisheries and Aquatic Sciences Program, University of Florida, 7922 NW 71st Street, Gainesville, FL 32605

Predation can play a key role in population dynamics of aquatic organisms and structuring of aquatic ecosystems. A key ecological question with management implications is how predation risks experienced by certain populations will be affected by environmental alterations, such as habitat change. We assessed how a broadly observed habitat change—the shift in submersed aquatic vegetation from rooted macrophytes to filamentous macroalgae—would impact the relative predation risks experienced by *Lucania parva*, a small bodied prey fish important to food web dynamics in many ecosystems. We conducted tethering experiments in three habitat types in a coastal river where shifts in aquatic vegetation from rooted macrophytes to filamentous macroalgae have been observed. We found relative predation risks were highest in bare substrate, intermediate in a native rooted macrophyte, *Vallisneria americana*, and lowest in filamentous macroalgae. These results provide evidence that *L. parva* may not experience increased predation due to shifts in vegetation type, but instead mortality of *L. parva* populations may decline due to

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reduced predation risk. Our results are counter to the widely held perception that shifts in submersed aquatic vegetation from macrophytes to macroalgae yield exclusively negative faunal impacts, and may be useful for assessing implications of habitat change.

Presenter: Cannister, M.J.; Email: mcannister@usgs.gov

The national Nonindigenous Aquatic Species Database and alert system

Fuller, P.L.¹ and M.J. Cannister²

¹ U.S. Geological Survey, 7920 NW 71st Street, Gainesville, FL 32653

² Jacobs Technology (contractor to U.S. Geological Survey), 7920 NW 71st Street, Gainesville, FL 32653

The Nonindigenous Aquatic Species (NAS) database (<http://nas.er.usgs.gov>) functions as a repository and clearinghouse for occurrence information from across the United States. It contains locality information on more than 1,100 species of vertebrates, invertebrates and vascular plants introduced as early as 1850. Taxa include foreign species as well as those native to North America that have been transported outside of their natural range. Locality data are obtained from many sources including literature, state, federal and local monitoring programs, museum accessions, on-line databases, websites, professional communications and on-line reporting forms. The NAS web site provides immediate access to new occurrence records through a real-time interface with the NAS database. Visitors to the web site can use a set of pre-defined queries to obtain lists of species according to state or hydrologic basin of interest. Fact sheets, distribution maps and information on new occurrences are continually posted and updated. Managers need to know what is new to their area, or new to a nearby area, in order to respond quickly. Conversely, managers are encouraged to report their observations of new occurrences to the NAS database so the information can be disseminated to other managers, researchers, and the public. In May 2004, the program developed an Alert System to notify registered users of new introductions as part of a national early detection/rapid response system. Users can register to receive alerts based on geographic or taxonomic criteria.

Presenter: Carroll, J.; Email: Jessica.Carroll@MyFWC.com

Utility of dorsal spines in non-lethal aging of reef fishes on the West Florida Shelf

Carroll, J., T. Switzer, and S. Keenan

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

The ability to accurately age fish is a vital component of effective fisheries management. However, in a climate of increased public awareness and acceptance of Marine Protected Areas (MPAs) as well as large-scale fishery closures, reliance on lethal sampling may not be a viable, long-term option for all species. This is especially a concern for many reef fishes (especially those in the grouper-snapper complex) that are experiencing overfishing, or are overfished. The FWC–Fish and Wildlife Research Institute has implemented an extensive reef fish monitoring program along Florida’s west-coast shelf, of which non-lethal sampling of dorsal fin spines has been a focus. Of the total 2,685 dorsal fin spines collected from 24 species of fish between 2007 and 2009, 915 have corresponding otoliths with which a hard part comparison is being completed. For gag (*Mycteroperca microlepis*) and red snapper (*Lutjanus campechanus*), respectively, 70% and 65% of spine ages agreed with otolith ages, while 95.4% and 93.1% of spine ages were within one year of otolith ages. Such results demonstrate a promising future for non-lethal aging in species or systems where otoliths may not be available.

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Presenter: **Carvalho, F.**; Email: fcorreia@ufl.edu

Spatiotemporal variability in blue shark dive behavior in the South Atlantic Ocean

Carvalho, F.¹, D.J. Murie¹, F. Hazin², D.C. Parkyn¹, and D. Martins².

¹Program of Fisheries and Aquatic Sciences, School of Forest Resources and Conservation, University of Florida, 7922 NW 71st St., Gainesville, FL 32653.

²Laboratório de Oceanografia Pesqueira, Departamento de Pesca e Aquicultura, Universidade Federal Rural de Pernambuco, Rua Dom Manuel de Medeiros 3 s/n, Dois Irmãos, CEP 52171-900, Recife/PE, Brazil

Pop-up Satellite Archival Tags (PSAT) were deployed on mature female blue sharks *Prionace glauca* (n=10) off the coast of Brazil in the southwest Atlantic Ocean to determine the variability in their dive behavior and depth profiles across space and time. A generalized additive model (GAM) was used to identify potentially important biological and environmental covariates that could influence the vulnerability of blue sharks as bycatch in the pelagic longline fishery in the region. The unscented Kalman Filter Sea Surface Temperature State-Space Model (UKFSST) was used to predict the most probable track of the tagged sharks during the monitored period. In most regions and seasons, all ten sharks showed a strong bimodal time-at-depth distribution, with apparent differences in dive behavior recorded for day versus night periods. During the daytime period, blue sharks spent 87% of their time at depths >100 m in contrast to the nighttime period when they spent only 7% of their time >100m and 93% of their time in waters <100 m deep. Based on the GAM, five predictor variables could describe the potential vulnerability of blue shark to pelagic longline gear: depth of the thermocline, latitude, sea surface temperature, bathymetry, and quarter of the year. In addition, trans-oceanic migration of blue sharks was supported by one female that moved across the South Atlantic Ocean from Brazil to the Gulf of Guinea, suggesting that sharks caught off the coast of South America may be part of the same stock that is exploited off the west coast of Africa. Information on variability in blue shark dive behavior across space and time may ultimately be incorporated into a habitat-based stock assessment for blue shark in the South Atlantic Ocean.

Presenter: Cass-Calay, S.L.; Email: Shannon.Calay@noaa.gov

An evaluation of the performance of age-structured stock assessment models given uncertainty in basic biological parameters; with particular emphasis on reproduction

Cass-Calay, S.L.

NOAA Fisheries – Southeast Fisheries Science Center, Miami Laboratory, Highly Migratory Species Branch (SFD), 75 Virginia Beach Drive Miami, FL 33149

Given the paucity of high-quality reproductive information in the U.S. Gulf of Mexico and Caribbean, there is much debate concerning the most appropriate specification of reproductive parameters for use in stock assessments. At a minimum, age-structured stock assessments require information regarding maturity, fecundity and spawning frequency. When this data is lacking, proxies can be used (e.g., weight-at-age, gonad weight) but the potential implications of model misspecification are rarely evaluated. In addition, stock assessment models have frequently ignored the implications of gender transition (e.g., red grouper, gag grouper) by calculating management references using only female biomass. To date, the management implications of this simplification remain poorly understood. The objective of this research is to evaluate the sensitivity of stock assessment results (e.g., stock status and recovery plans) to misspecification of reproductive parameters, with application to commonly assessed species in the U.S. Gulf of Mexico.

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Presenter: **Chagaris, D.**; Email: Dave.Chagaris@myfwc.com

A multi-species, multi-gear model for analyzing policy options in the Gulf of Mexico reef fish fishery

Chagaris, D.^{1,2}, Mahmoudi, B.¹, and M. Allen²

¹ Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, 100 8th Ave SE, St. Petersburg, FL 33703

² University of Florida, Department of Fisheries and Aquatic Sciences, 7922 NW 71st St., Gainesville, FL 32653

Overfishing has substantial ecological and economic impacts on reef fish communities and the fisheries they support. We developed a multi-species, multi-fleet fisheries model of the West Florida Shelf reef fish community and incorporated economic and social indicators of each fishery in order to assess the tradeoffs associated with fisheries management policies. Ecopath with Ecosim software was used to organize the trophic structure of the system and simulate the effect that single-species policy options have on others species in the system. We also allowed Ecosim to search for optimal combinations of fishing effort that, given the underlying trophic structure, would maximize multiple performance measures in the combined fishery (economic, social, mandated rebuilding, or ecosystem structure). Results indicated that reductions in fishing mortality of gag grouper will have only slight impacts on other harvested species, whereas reductions in fishing mortality of red snapper will have potentially strong, negative effects as they outcompete other species for food resources. Harvest policies that involve major prey groups such as bait fishes and shrimp, had the biggest effect on the largest number of groups. The optimization procedure resulted in different combinations of fishing effort depending on the weight given to each performance measure. For example, when optimized for profits, predators and/or competitors were removed to increase the abundance of valuable market species with potential for high biomass. This model could be used to screen for unintended consequences of single species policy options and as a tool for ecosystem based fisheries management for reef fish fisheries in the Gulf of Mexico.

Presenter: **Cole, A.J.**; Email: ajcole42@students.tntech.edu

Seasonal distribution and thermal ecology of muskellunge in Melton Hill Lake, Tennessee

Cole, A.J.¹ and P.W. Bettoli²

¹ Tennessee Cooperative Fishery Research Unit, Tennessee Technological University, Cookeville, TN 38505

² U.S. Geological Survey, Tennessee Cooperative Fishery Research Unit, Tennessee Technological University, Cookeville, TN 38505

The Tennessee Wildlife Resources Agency has stocked muskellunge *Esox masquinongy* fingerlings into Melton Hill Lake in east Tennessee since 1998, creating a unique sport fishery on the southern edge of this species' natural range. It has recently become a very popular fishery; however, the distribution of muskellunge in Melton Hill Lake throughout an entire year is largely unknown to anglers and biologists alike. Melton Hill Lake, a 2,303-ha mainstem reservoir on the Clinch River, offers a thermally heterogeneous environment resulting from cold hypolimnetic discharges from an upstream dam and warmwater discharged from a coal-fired electric generation plant. Adult muskellunge (n=30) were surgically implanted with temperature-sensing radio transmitters between January and March 2010. Fish have been located biweekly since March 2010. The objectives of this study are to: 1) describe the seasonal distribution of adult muskellunge in Melton Hill Lake; 2) determine seasonal thermal preferences; and 3) examine the possible influence of forage fish availability on habitat and temperature selection by muskellunge. Maps of monthly and seasonal fish distributions were created using 50% kernel density estimates with ArcGIS software. Monthly and seasonal differences in temperature selection, depth occupied, and distance to the nearest shore will be tested with a mixed-model ANOVA. Forage fish have been sampled seasonally with a stratified random design using boat-mounted DC electrofishing gear. A mixed-model ANOVA will be used to assess spatial and temporal variability in forage fish composition and abundance.

Presenter: **Collier, W. R.**; Email: wcollier@tntech.edu

A comparison of sampling gear targeting lake sturgeon in the upper Tennessee River

Collier, W.R.¹ and P.W. Bettoli²

¹Tennessee Cooperative Fishery Research Unit, Tennessee Technological University, Cookeville, TN 38505

²U.S. Geological Survey, Tennessee Cooperative Fishery Research Unit, Cookeville, TN 38505

Over 75,000 state-endangered lake sturgeon *Acipenser fulvescens* have been reintroduced into the French Broad River and Holston River in east Tennessee since 2000. The purpose of this study was to evaluate the efficacy of boat electrofishing and gillnet sampling in terms of maximizing the catch of lake sturgeon while minimizing bycatch. Modified gill nets were fished overnight in four reaches of the French Broad River and the headwaters of Fort Loudoun Lake in summer 2009 (N = 44 nets), winter 2010 (N = 40), spring 2010 (N = 39), and summer 2010 (N = 39). Those gillnet samples (N_{total} = 162 net deployments) captured four lake sturgeon and 227 other fish. Fifty-four 10-minute electrofishing transects were sampled at three sites in the French Broad River and Holston River during winter, spring, and summer 2010; 188 fish, but no lake sturgeon, were collected. The stilling basins below Douglas Dam and Cherokee Dam have been sampled with electrofishing gear each month since April 2010; to date, one lake sturgeon has been collected. Barring a dramatic increase in catch rates this fall and winter, we conclude that low catches of stocked lake sturgeon are the result of poor survival of stocked fish, the lack of suitable habitat in the headwaters of Fort Loudon Lake, or both factors.

Presenter: **Collins, A.**; Email: angela.collins@myfwc.com

A big fish story: Goliath grouper distribution and movements in the eastern Gulf of Mexico

Collins, A.B.^{1,2}, and L.R. Barbieri¹

¹Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, 100 8th Avenue S.E., St. Petersburg, FL

²University of South Florida, Department of Biology, 4202 E. Fowler Avenue, Tampa, FL

A cooperative team of scientific, recreational and commercial SCUBA divers was organized to collect data regarding goliath grouper habitat associations, abundance, size distribution and site fidelity in the central eastern Gulf of Mexico. Artificial and natural habitats (7 – 48 m) were surveyed over a two year period. Goliath grouper were observed during all months of the year and were present during 74% of all surveys (280/378). Presence and abundance were significantly related to habitat type and depth, with highest presence and abundance recorded over deep, artificial reefs. The number of goliath grouper observed during a single survey ranged from 0 to 24. The mean number observed per site over artificial reefs was 4.53 versus 0.45 over natural habitat. The number of fish observed over artificial habitats tended to increase with site depth and site size. There was not a significant seasonal effect on abundance or presence; however, the highest numbers of individuals were observed during the summer months. Goliath grouper measured via underwater videography ranged in size from 40 – 205 cm total length (TL). The majority of individuals observed were between 100 -150 cm TL; however, multiple small (< 100 cm) and large (> 150 cm) individuals were also observed throughout the depth range surveyed. A total of 172 goliath grouper were fitted with external identification tags, and 27 individuals were resighted or recaptured throughout the study period. Time at large ranged 1 – 713 days. The majority of resighted individuals were observed at the same site as their initial tagging, although fish were documented to move as far as 203 km. The information collected during the course of this project should provide insight regarding the ecology of goliath grouper within the study area and can potentially assist with future management efforts involving this protected species.

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Presenter: Compton, M.; Email: stretch.compton@ttu.edu

Distribution, ecology, and conservation of *Etheostoma cinereum* (Ashy darter) and *Percina squamata* (Olive darter) from the Rockcastle River, Kentucky

Compton, M. and C.M. Taylor

Texas Tech University, Department of Natural Resources Management, Goddard Building: MS 2125, Lubbock, TX 79409

Etheostoma cinereum and *Percina squamata* inhabit the Cumberland and Tennessee rivers and are of considerable conservation concern. To understand the distribution, status and ecology of the darters, 30 random sites were established from 4th and 5th order reaches of the Rockcastle River (18 and 12 sites, respectively), during the summers of 2009 and 2010. At each site, 3x10 m plots were systematically distributed throughout the stream reaches to obtain fish assemblage (via backpack electrofishing) and microhabitat data. Supplemental sampling (seining and backpack electrofishing) was conducted at all sites to complete the assemblage data and to target habitats of suspected focal species presence. A total of 482 and 480 plots were sampled in 2009 and 2010, respectively. In 2009 a total of 98 ashy darters were collected from 50 plots within 17 sites, while a total of 5 olive darters were collected from 4 plots at 2 sites. In 2010 a total of 126 ashy darters were collected from 70 plots within 16 sites, while 2 olive darters were collected from 2 plots at 2 sites. Four habitat types within the stream reaches were identified from a cluster analysis of 15 microhabitat environmental variables and a species indicator analysis recognized ashy and olive darters as occupying the same habitat type. Ashy darter habitat use appears to be segregated between age classes. Overall, we found 326 ashy darters from 21 sites and 21 olive darters from 8 sites. The ashy darter is a common, widespread species in the Rockcastle River, while the olive darter is rare in occurrence and abundance.

Presenter: Coombs, J.A.; Email: jcoombs@utk.edu

A success story: Re-introduction of darters into the Pigeon River, Tennessee and North Carolina

Wilson, J.L.¹, J. Burr², S. Fraley³ and T. Russ⁴ and J.A. Coombs⁵

¹ Department of Forestry, Wildlife and Fisheries, University of Tennessee, 274 Ellington PSB, Knoxville, TN 37996-4563

² Division of Water Pollution Control, Tennessee Department of Environment and Conservation, 3711 Middlebrook Pike, Knoxville, TN 37921

³ Division of Inland Fisheries, North Carolina Wildlife Resources Commission, 50 Trillium Way, Clyde, NC 28721

⁴ Division of Inland Fisheries, North Carolina Wildlife Resources Commission, 645 Fish Hatchery Rd., Marion, NC 28752

⁵ University of Tennessee, Forestry, Wildlife and Fisheries, 274 Ellington Plant Sciences, Knoxville, TN 37996

In 2001, a cooperative effort was begun to restore native fish populations to the Pigeon River, once so polluted that all mollusks and many fish species were extirpated. Volunteers from federal and state agencies, industry, and private organizations created the Pigeon River Recovery Project to begin re-introduction of fish and other aquatic species. Early successes in TN led to the expansion of the project into western NC. Twenty species of fish collected from the French Broad basin and the upper reaches of the Pigeon River have been re-introduced into the Pigeon River at selected sites in TN and NC. The first 3 candidates were the gilt, bluebreast and blueside darters, followed by the stripetail darter in 2003. Reproduction was first documented in gilt darters in 2003. Monitoring surveys over the past five years have documented gilt, bluebreast, and stripetail darters, mountain madtoms, and mountain brook lampreys in the Pigeon River, TN. In 2005, a survey of the lower Pigeon River documented gilt darters in nearly every riffle; this species appears to be re-colonizing the lower Pigeon River. Of nine transplanted species in NC, four shiners (mirror, telescope, Tennessee, silver) and the gilt darter have been collected during monitoring efforts.

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As of 2010, silver and telescope shiners have re-established populations in a 15-mile segment of the Pigeon River in NC, and gilt and stripetail darters have established populations, along with the mountain brook lamprey, in TN.

Presenter: Cooney, P.; Email: patrickbcooney@hotmail.com

Influence of dams, big and small, on tropical diadromous fishes

Cooney, P.B.¹ and T.J. Kwak²

¹North Carolina Cooperative Fish and Wildlife Research Unit, Department of Biology, NC State University, Campus Box 7617, Raleigh, NC 27695

²U.S. Geological Survey, North Carolina Cooperative Fish and Wildlife Research Unit, Department of Biology NC State University, Campus Box 7617, Raleigh, NC 27695

Recent research demonstrated impacts of large dams on migrations and life cycles of native amphidromous fishes in Puerto Rico. However, little is known on impacts of other artificial barriers to fish passage (small dams and road crossing) in tropical island river and stream corridors. With no available database of artificial stream barriers, we set out to find and document these impediments to assess their influence on distribution and abundance of native fishes. We surveyed a total of 293 manmade barriers, 70 reached heights of at least 3 m above the downstream water surface (height for fish to traverse), 120 between 1 and 3 m, and 103 were less than 1 m. In total, 74% (6,773 river km) of riverine habitat is impeded by artificial barriers in Puerto Rico, creating a disconnect of upstream habitat from the ocean. The remaining 26% (2,414 river km) of riverine habitat is almost exclusively at lower elevations, limiting higher altitude stream habitat availability. We sampled fish across the island from 118 locations, incorporating all 46 major river drainages in Puerto Rico. From these samples, we confirmed that while high dams completely exclude all native fish species from accessing upstream habitat, some low barriers appear to allow passage of several native fish species. Understanding the influence of all artificial stream barriers on native fish passage will aid in increasing stream habitat availability and enhancing freshwater fish communities in Puerto Rico.

Presenter: Cooper, W.; Email: wade.cooper@myfwc.com

Incorporating spatial reproductive processes into management strategy evaluations of Florida's nearshore fisheries

Cooper, W. and S. Lowerre-Barbieri

Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission, 100 8th Ave. S.E., St. Petersburg, FL 33701

An increasing number of studies highlight the importance of spatial distributions and age structure as key drivers in fisheries reproduction and recruitment success. However, these processes are often unaccounted for in management decisions, where many stocks are primarily managed based upon spawning stock biomass (SSB) as a proxy for the total egg production driving recruitment. Incorporating these detailed processes into fisheries simulation models can help elucidate their influences on population productivity, and for some sensitive stocks, help identify optimal management strategies for sustainability. This presentation will discuss current research incorporating spatially-dependent reproductive behaviors into an agent-based simulation model of spotted seatrout, *Cynoscion nebulosus*, in an effort to explore the importance of these processes in driving population productivity within the Tampa Bay estuary. Preliminary results of ongoing simulations will be presented that assess the contribution of select spawning locations within the estuary to the total recruitment, and explore the utility of SSB as a biological reference point for the productivity of this species. Ongoing and future efforts will additionally be discussed that incorporate these processes into management strategy evaluations for Florida's nearshore recreational fisheries.

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Presenter: **Copeland, N.**; Email: Njcopel@okstate.edu

The effects of age-0 gizzard shad abundance on piscivore abundance and condition in southern reservoirs

Copeland, N. and D. Shoup

Oklahoma State University, Natural Resource Ecology and Management, 008c Ag Hall, Stillwater, OK 74078

The majority of piscivores found in southern US reservoirs consume primarily age-0 gizzard shad ($\leq 100\text{mm}$). Therefore, a high gizzard shad biomass could still lead to predator limitations if most of the biomass is too large to be eaten. Previous studies comparing gizzard shad abundance and piscivore prey demand have only considered one or a few piscivores, but many southern reservoirs have seven or more piscivores in the community. This suggests prey limitation may be more common than these studies suggest. A recent modeling study demonstrated that up to 70% of piscivore communities would be food limited when gizzard shad abundance is at the 50th percentile of published densities. However, this has not been tested in the field. We used 29 years of data from the Oklahoma Department of Wildlife Conservation and Arkansas Game and Fish Commission to test for correlations between gizzard shad abundance (catch per unit effort [CPUE] or biomass) and piscivore abundance (CPUE or biomass), relative weight, and proportional size distributions. Correlations were then used to develop predictive models that can be used to evaluate predator-prey balance in southern reservoirs.

Presenter: **Dagel, J.**; Email: jdagel@cfr.msstate.edu

Crappie recruitment relative to floodplain inundation in Mississippi flood-control reservoirs

Dagel, J.D.¹ and L.E. Miranda²

¹Mississippi State University College of Forest Resources; Department of Wildlife, Fisheries and Aquaculture; P.O. Box 9690, Mississippi State, MS 39762

²USGS Mississippi Cooperative Fish and Wildlife Research Unit, P.O. Box 9861, Mississippi State, MS 39762

Crappies *Pomoxis* spp. evolved in river systems as floodplain specialists, thriving in backwaters and temporally inundated habitats, adeptly roaming in and out of these environments to spawn. Flood-control reservoirs typically exhibit large annual draw-downs where exposed areas resemble a natural floodplain. In these reservoirs, the amount of floodplain habitat available for spawning depends on timing and magnitude of water level rises. We estimated the amount and cover types of inundated floodplain at various water levels and assessed the effects of inundation on crappie recruitment in flood control reservoirs in northwest Mississippi. Land cover types were classified into four broad categories including mudflats, herbaceous vegetation, shrubs, and forests. Recruitment of age-0 crappies was indexed with trap-net samples taken in late summer of 2009 and 2010. Relations between age-0 abundance and land cover were tested using regression procedures. Percent composition of herbaceous vegetation, shrubs, and forests increased with water level, whereas mudflats decreased. Age-0 crappie abundance was directly related to vegetative land cover and inversely related to extent of mudflats during the mid-March to mid-May spawning period. The management of rule curves to include biologically significant flooding may be a useful management strategy for promoting crappie recruitment in reservoirs where substantial sections of the floodplain can be inundated.

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Presenter: DeVries, D.; Email: doug.devries@noaa.gov

Habitat stratification and selectivity: important considerations in the design of a fishery-independent reef fish survey

DeVries, D., C. Gardner, J. Brusher, P. Raley, and G. Fitzhugh

NOAA Fisheries Panama City Lab, 3500 Delwood Beach Rd., Panama City, FL 32408

Incorporating stratification by habitat type in the design of a reef fish survey is an obvious way to improve efficiency, optimize survey resources, and obtain more accurate abundance estimators for a given species. The issue becomes complex in a multi-species survey covering many habitats, and may require post-stratification of collection records. The heavily exploited reef fishes in the northeastern Gulf of Mexico are closely tied to hard/live bottom habitat most or all of their lives; and cross-shelf side scan mapping and video surveys on the northern West Florida shelf have revealed that such habitat is not only widespread, but also varies widely in relief, rugosity, morphology, density, area, and in density and composition of attached biota. Not surprisingly, these different forms of hard bottom often hold different suites and densities of reef fishes; and demographics within species may also vary. All of these factors can result in species-specific effects on precision and accuracy of survey indices, and must be considered in designing, and analyzing data from, a multi-species reef fish survey. Both red and gray snapper were rarely observed over sponge/gorgonian habitat in Apalachee Bay but were very common over more rocky, higher relief reefs in the same region; mean video counts were ~10 fold higher and CV's were ~70-75% smaller in the latter vs. the former area. White grunt, black seabass, and hogfish abundances differed sharply across the Cape San Blas zoogeographic boundary. Hogfish also appeared to prefer more rocky reefs, while black seabass were much more common on gorgonian-sponge-algae-dominated reefs. Gear selectivity was clearly demonstrated in gray snapper, which were observed in ~60% of video samples west of Cape San Blas, but were never taken in traps from the same sites.

Presenter: Dotson, J.; email: jason.dotson@myfwc.com

Evaluating harvest regulations for trophy largemouth bass management

Dotson, J.R.¹, M.S. Allen², J.A. Kerns², and W.F. Pouders³

¹ Florida Fish and Wildlife Conservation Commission, Eustis Fisheries Research Laboratory, 601 West Woodward Avenue, Eustis, FL 32726

² School of Forest Resources and Conservation, The University of Florida, 7922 Northwest 71st Street, Gainesville, FL 32653

³ Florida Fish and Wildlife Conservation Commission, Southwest Region Headquarters, Division of Freshwater Fisheries Management, 3900 Drane Field Road, Lakeland, FL 33811

Trophy-sized fish are a critical component of recreational largemouth bass *Micropterus salmoides* fisheries, and many agencies have prioritized management actions to improve catches of trophy-sized fish to meet angler expectations. Length-based harvest regulations are commonly used to increase abundance of trophy-sized fish, but it is often difficult to determine the effectiveness of regulations with field studies due to rarity of large fish in both sampling programs and creel surveys. We used an age-structured simulation model parameterized for a trophy largemouth bass fishery to evaluate the potential for a range of size limits (e.g., minimum length limits, maximum length limits, protective slot limits, and mandatory catch-and-release) to increase abundance and angler catches of trophy largemouth bass. We assessed the performance of the model by comparing model-predicted angler catch rates with multiple years of creel survey catch rate information from Florida lakes with varying harvest regulations. Model simulations suggested that harvest regulations could substantially increase abundance and angler catch of trophy fish, even at relatively low exploitation rates ($U = 0.2$). The number of angler trips required to catch a trophy fish was expected to decline from 83 under a 350-mm minimum length limit to 47 for a 600-mm minimum length limit. Maximum size limits and slot limits also showed potential to substantially improve trophy catches. The

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model performed well at predicting the empirical trends in angler catch of trophy-sized fish, and thus could be utilized to forecast the effectiveness of regulation changes with estimates of critical population metrics for fisheries. There are trade-offs associated with highly restrictive harvest regulations (i.e., lower harvest), and managers should consider angler expectations prior to implementing such regulations.

Presenter: **Dunn, C.**; Email: cdunn05@vt.edu.

Habitat use and behavior of candy darters *Etheostoma osburni* may mediate interactions with an introduced congener

Dunn, C. G.¹ and P. L. Angermeier²

¹ Department of Fisheries and Wildlife Conservation, Virginia Tech, Blacksburg, VA 24060

² U.S. Geological Survey, Virginia Cooperative Fish and Wildlife Research Unit, Virginia Tech, Blacksburg, VA 24060

The candy darter *Etheostoma osburni* is endemic to the New River drainage. Its distributional range has been reduced over the last century, resulting in isolation of three remaining strong populations. Habitat loss and a recently introduced potential competitor, the variegated darter *E. variatum*, have been implicated as main contributors to candy darter decline; however, little is known about habitat utilization and availability at these remaining sites. Our objectives are to compare habitat utilization and availability between two remaining strong populations. We will present preliminary results on ontogenetic shifts in candy darter habitat utilization. For example, young-of-year occupied the entire breadth of available habitat whereas adults selected the fastest available current velocities; juveniles displayed intermediate habitat use. We will also show underwater video of candy darter territoriality and spawning, and discuss how these may affect future interactions with the introduced variegated darter. Both species are strongly territorial and exhibit egg-burying behavior, which promotes hybridization. These behaviors suggest that future species interactions may negatively affect candy darters as variegated darters spread in the Greenbrier River drainage.

Presenter: Dutka-Gianelli, J.; Email: Jynessa.dutka-gianelli@myfwc.com

The snook species of east central Florida: a review

Dutka-Gianelli, J.¹, R. Ruiz-Carus², R. Taylor², M. Tringali², S. Seyoum², J. Whittington³, and R. Gilmore, Jr.⁴

¹ Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, Indian River Field Laboratory. 1220 Prospect Ave, Suite 285, Melbourne, FL 32901

² Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, 100 Eighth Avenue SE, St. Petersburg, FL 33701

³ Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, Tequesta Field Laboratory. 19100 SE Federal Highway, Tequesta, FL 33469

⁴ Estuarine, Coastal, and Ocean Science, Inc. 5920 First St. SW, Vero Beach, FL 32968

The species in the genus *Centropomus* (snook or robalo) have a broad distribution in the New World and are important aquatic top predators and key species throughout their range. They are among the most valuable fish throughout their range, particularly in Florida, where they are designated game fish since 1957. Misidentification of the *Centropomus* species is a common problem among researchers, especially when working with small juveniles, which are morphologically similar. The goal of this study was to examine historical and recent collections of *Centropomus* species captured in Florida, to review the available literature on taxonomy, and to update an identification key for the *Centropomus* species present in Florida. The current study documented the presence of

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four *Centropomus* species previously known to occur in Florida: *C. undecimalis* (common snook), *C. pectinatus* (tarpon snook), *C. parallelus* (smallscale fat snook), and *C. ensiferus*, swordspine snook. In addition, *C. mexicanus* (largescale fat snook) is recorded for the first time in Florida. The recent collections of *C. mexicanus* are an extension of its distribution into east central Florida, where these five species are sympatric. Morphological identification of the five species of snook is supported by mtDNA sequence analysis and microsatellite DNA genotyping. A revised key for morphological identification of these species is presented. This key should be used with caution when applied to the *C. parallelus* – *mexicanus* complex, because these cryptic species are similar in appearance and their meristic characters overlap. Examination of a larger number of individuals of all sizes is necessary to solve this problem. Further genetic analysis will elucidate the population structures and the potential for hybridization between these *Centropomus* species in Florida as well.

Presenter: Dutka-Gianelli, J.; Email: Jynessa.dutka-gianel@myfwc.com

Using telemetry and conventional tagging to track the movements of two apex predators in east central Florida

Dutka-Gianelli, J.¹, R. Taylor², J. Whittington³, J. Young³, A. Trotter², S. Marsh³, A. Berry³, and B. Yeiser³.

¹Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, Indian River Field Laboratory, 1220 Prospect Ave, Suite 285, Melbourne, FL. 32901

²Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, 100 Eighth Avenue, SE. St. Petersburg, FL. 33701

³Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, Tequesta Field Laboratory, 19100 SE Federal Highway, Tequesta, FL. 33469.

Understanding the patterns of movement and habitat utilization is important for protection and proper management of *Centropomus undecimalis*, common snook (CS), and *Micropterus salmoides*, largemouth bass (LMB), since these two apex predator species co-occur in freshwater and low salinity brackish water habitats and are highly sought after gamefish species in southeast Florida. The objectives of this study were to describe the movement patterns of CS and LMB in the St. Lucie River and adjacent areas using acoustic telemetry and conventional tagging techniques. Movement patterns and habitat utilization of CS and LMB were described using recaptures of conventional external dart tags (N= 505 CS and 318 LMB) in conjunction with data collected from fish tagged with surgically implanted acoustic transmitters (N= 62 CS and 36 LMB) which were detected by a robust array of stationary acoustic receivers (N= 160) deployed along a 300 km span of Florida east coast. Preliminary results showed high detection and recapture rates for the acoustically tagged fish, indicating good survival rates. A total of 14% of the dart tagged CS and 23% of the dart tagged LMB were recaptured and released since tagging; and 32% of acoustically tagged CS and 39% of acoustically tagged LMB were detected after the January 2010 cold snap. Preliminary analyses indicated that CS travel long distances between river systems and inlets in a short period of time, showing seasonal movements that result in broad intermixing between local CS populations along the east coast of Florida. Most of the acoustically tagged CS in rivers moved into one or more inlets during summer spawning season (41% and 18% during the first and second spawning seasons, respectively). Acoustic detections indicated that LMB tend not to emigrate from their tagging locations, staying in one area with little movement and showing high site fidelity overall.

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Presenter: **Earley, L.A.**; Email: lae0003@tigermail.auburn.edu

Movement and habitat use of shoal bass, *Micropterus cataractae*, in a regulated section of the Chattahoochee River

Earley, L.A. and S.M. Sammons

Department of Fisheries and Allied Aquaculture, 203 Swingle Hall, Auburn University, Auburn, AL 36849

Shoal bass, *Micropterus cataractae*, are endemic to the Apalachicola drainage and have been designated a species of High Conservation Concern in Alabama and of Special Concern in Georgia. Much of their original distribution in the Chattahoochee River has been reduced due to impoundments, particularly in the Fall Line region, where 9 dams occur in a 64-km reach. However, isolated populations persist in the headwaters or tailwaters of these dams. This section of the river is regulated by West Point Dam, which is a hydro-peaking facility. To examine the habitat use and behavior of shoal bass in this section, 40 shoal bass were collected and implanted with 3.6-g radio tags in the headwaters of Bartletts Ferry Reservoir, below a small lowhead dam. These fish were tracked approximately every 7-d over a 35-week period for a total of 760 locations. During July-September, seven diel surveys were conducted, during which 8 fish were tracked throughout a 12-h period. The goal of these surveys was to determine the effects of hydropeaking operations on fish distribution, movement, and habitat use. Shoal bass were commonly found using bedrock and boulder habitat rather than vegetated and sandy habitat, especially during times of higher flow. Fish were found in deeper water depths during the summer. However, some shoal bass remained in shallow, rocky habitats throughout the entire survey and did not move out to deeper water. Several fish moved back and forth between the tailwater and a nearby tributary stream that flowed into the Chattahoochee River, possibly for refuge from peaking hydropower flows for spawning. The effects of hydropower peaking flows and dam fragmentation on obligate river species continue to be poorly understood, but data from this study suggests several strategies used by these species to adapt to altered flow regimes.

Presenter: **Finch, C.**; Email: coltonfinch@ufl.edu

Adaptive management in regulated rivers: influencing growth and survival of an endangered cyprinid

Finch, C. and W.E. Pine III

University of Florida, Department of Wildlife Ecology and Conservation, 110 Newins-Ziegler Hall, Gainesville, FL 32611

Most large river systems are highly modified to provide a suite of goods and services for human users. Environmental alteration or degradation often occurs as a result of river regulation to the detriment of native fish communities. Regulatory policies such as the US Endangered Species Act and increased global environmental awareness in recent years has led to efforts to mitigate reductions in fish populations while maintaining civil, municipal, recreational, and commercial benefits of river regulation. The Glen Canyon Dam Adaptive Management Program is testing fish population responses to a series of “steady flow” experiments during fall in the Colorado River, AZ. We assessed growth rates of endangered humpback chub *Gila cypha* during normal fluctuating flows and during the flow experiment to determine if the experimental conditions altered growth or survival. Results from this and similar large-scale ecosystem experiments can be useful in assessing fish – flow relationships and informing dam operations on other regulated rivers.

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Presenter: **Fioramonti, C.**; Email: carrie.fioramonti@noaa.gov

Regional differences in age and growth of Gulf of Mexico gray triggerfish, *Balistes capricus*

Fioramonti, C.^{1,2}, R. Allman¹, W. Patterson².

¹NOAA Fisheries, 3500 Delwood Beach Road, Panama City, FL 32408

²University of West Florida, 11000 University Parkway, Pensacola, FL 32514

Gray triggerfish (n = 1,436) were sampled from 2003 to 2008 along the west Florida shelf from recreational and commercial hook and line and commercial long-line fisheries, as well as from fishery-independent sources. Females were predominant among both fisher-dependent (1.9:1) and fishery-independent (1.3:1) data. Fork length (FL) ranged from 75 to 697 mm (mean = 353 mm). Translucent zones in dorsal spine sections were validated as annuli by marking captive fish (n = 5) exposed to natural conditions with oxytetracycline; thus, spine sections were used to age fish. Average percent error between primary and secondary readers was high (8.9%) for a subset of samples (n = 115), so all spines were aged by both readers and any disagreements resolved before a final age was assigned. Age ranged from 0 to 14 y with a mean of 4.1 y for recreational hook and line, 4.6 y for commercial hook and line, and 6.7 y for commercial long-line samples. Mean age of fishery-independent samples was 3.8 y for hook and line, 3.4 y for trap, and 1.3 y for trawl gears. Gray triggerfish entered the commercial hook and line and recreational fisheries by age 3 and the commercial long-line fishery by age 7. Two von Bertalanffy growth functions (VBGF) were fitted to triggerfish FL at age data, one which fit all three parameters of the VBGF and a second which omitted the parameter, t_0 . Resultant models were $L_t = 2052(1 - e^{-(0.023(t+3.781)})}$ and $L_t = 560(1 - e^{-(0.247(t))})$, respectively. Fits of additional growth functions are being explored and will be presented, as well as regional differences in age and growth.

Presenter: Flaherty, K.; Email: kerry.flaherty@myfwc.com

A retrospective analysis of the spatial and temporal distribution of gray snapper (*Lutjanus griseus*) in Florida's estuarine habitats

Flaherty, K., T. Switzer, B. Winner, and S. Keenan

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

Gray snapper, *Lutjanus griseus*, use a variety of habitats through their ontogeny and are estuarine-dependent as juveniles. Juveniles are found in estuarine nursery areas, such as seagrass beds or mangrove shorelines; adults are most often found in deep channels and farther offshore, associated with hard bottom habitats. Indices of abundance were constructed for juvenile (<100 mm SL) and subadult (≥ 100 mm SL) gray snapper based upon data collected during long-term fisheries-independent monitoring of estuarine systems along the Gulf and Atlantic coasts of Florida. This time series, encompassing up to fourteen years of data (1996-2009) depending on the estuary, was used to determine size-specific relationships between abundance, habitat, and environmental conditions. Juvenile and subadult gray snapper were collected year-round in the southernmost estuaries and from July through November in the northern estuaries. In addition to timing of estuarine occupancy, abundance varied with latitude with more gray snapper collected in warmer, southern estuaries. For the majority of estuaries sampled, the percentage of bottom covered with aquatic vegetation at a sampling site positively influenced the abundance of juveniles and subadults. Annual abundance varied over the sampling period, with juvenile peaks in abundance translating to subadult peaks in the following years. Combining data collected from this long-term estuarine sampling with recent (2009-present) additional sampling targeting structured habitats should enhance our ability to refine indices of abundance for juvenile and subadult gray snapper.

Oral Presentations

Presenter: **Flowers, H.J.**; Email: hjflower@ncsu.edu

A long-term telemetry study of Gulf sturgeon in the Apalachicola River, Florida

Flowers, H.J.^{1,2}, W.E. Pine, III¹, and F. Parauka³

¹ Fisheries and Aquatic Sciences Program, School of Forest Resources and Conservation University of Florida, 7922 NW 71st St., Gainesville, FL 32653

² Present Address: North Carolina Cooperative Fish and Wildlife Research Unit, Department of Biology, North Carolina State University, Raleigh, NC, 27695

³ Panama City Field Office, U.S. Fish and Wildlife Service, 1601 Balboa Ave., Panama City, FL 32405

Long-term telemetry studies are valuable as they have the potential to provide large amounts of data regarding movement and habitat usage, even with relatively small sample sizes. A three year telemetry study was conducted with Gulf sturgeon *Acipenser oxyrinchus desotoi* (N=13) on the Apalachicola River, Florida, using VEMCO acoustic telemetry tags and VR2 passive receivers. Telemetry data allowed us to describe seasonal movement and habitat selection, as well as spawning timing, periodicity, and site selection. Telemetry data were also used to calculate estimates of capture probability during sampling events. In conjunction with a larger, multi-river, Gulf sturgeon tagging study (N=45), we were able to obtain estimates of inter-basin movement as in two out of the three study years an individual tagged in a foreign system was relocated in the Apalachicola River. We recommend long-term telemetry studies be incorporated into monitoring programs of Gulf sturgeon and other species.

Presenter: Franks, J.; Email: jim.franks@usm.edu

Bluefin tuna (*Thunnus thynnus*) larvae from the Gulf of Mexico: collections taken during the Deepwater Horizon oil spill

Franks, J.¹, B. Comyns², E. Hoffmayer¹, R. Waller¹, and M. Blake¹

¹Center for Fisheries Research and Development, Gulf Coast Research Laboratory, The University of Southern Mississippi, Ocean Springs, MS

²Department of Coastal Sciences, Gulf Coast Research Laboratory, The University of Southern Mississippi, Ocean Springs, MS

Atlantic bluefin tuna (*Thunnus thynnus*) larvae were collected from the Gulf of Mexico (Gulf) during May 2010 at eddies associated with Loop Current western and northern frontal zone boundaries. Sampling was conducted with funding from the NMFS Southeast Area Monitoring and Assessment Program (SEAMAP) in support of NMFS development of fishery independent indices of spawning biomass of bluefin tuna in the Western North Atlantic Ocean. More than 300 larvae were identified in surface neuston net (0.333 mm mesh) collections taken along transects located perpendicular to the Loop Current boundaries. These findings further confirm the Loop Current frontal zone boundary region and associated oceanographic features as bluefin larval habitat, as previously documented by GCRL bluefin larval collections from May 2003 - 2009. Peak spawning period for bluefin tuna in the Gulf is April-May, which in 2010 occurred concurrently with the Deepwater Horizon oil spill. Considering the depressed status of Western Atlantic bluefin stocks and the proximity of the spill to bluefin spawning grounds, the potential for deleterious impacts from the spilled oil to bluefin life stages, critical habitats, and recruitment success was of paramount concern. This presentation provides an overview of the 2010 bluefin larval collections (some taken from oil-impacted waters) and outlines future research utilizing the 2010 collections.

Oral Presentations

Presenter: **Fritts, A.K.**; Email: frittsa@warnell.uga.edu

Development of a non-lethal approach for assessing stress in freshwater mussels

Fritts, A.K.¹, J.T. Peterson², and R.B. Bringolf¹

¹ Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA 30602

² USGS, Georgia Cooperative Fish and Wildlife Research Unit, Warnell School of Forestry and Natural Resources, Athens, GA 30602

The Southeastern U.S. is home to a diverse assemblage of freshwater mussels, which are the most imperiled fauna in North America. Threats to this group include habitat degradation, pollution, and alterations to natural flow regimes. Many of the aforementioned threats are of serious concern in the Flint River Basin, a system highly impacted by agricultural water usage. The Flint Basin is home to a diverse assemblage of aquatic organisms, including five federally listed mussel species. Due to the imperiled status of these mussels, the development of effective nonlethal biomonitoring techniques is imperative. Changes in tissue glycogen and hemolymph chemistry profiles are potential biomarkers for non-lethally monitoring stress in freshwater mussels. To assess how these parameters may change in response to a stress event, lab studies were conducted in which little spectaclecase (*Villosa lienosa*), southern rainbow (*V. vibex*) and elephant ear mussels (*Elliptio crassidens*) were exposed to three temperature treatments: 25°C, 30°C, and 35°C. Tissue and hemolymph samples were collected from five different animals in each temperature treatment at Day 0, 3, and 7. Tissue samples were analyzed for glycogen levels and hemolymph was analyzed for a suite of parameters with a Hitachi Blood Chemistry Analyzer. Glycogen levels and hemolymph chemistry parameters that responded to stress (high temperatures) will be incorporated into a biomonitoring approach for wild populations of imperiled freshwater mussels in the Flint River basin. Field validation of this approach is in progress. These data will help inform managers of at-risk populations prior to large scale mortality events.

Presenter: **Fritts, M.**; Email: frittsm@warnell.uga.edu

Status of Atlantic and shortnose sturgeon in the Satilla and St Mary's Rivers, GA

Fritts, M.W. and D. Peterson

Warnell School of Forestry and Natural Resources, University of Georgia

Atlantic and shortnose sturgeons are components of the biodiversity of fishes in the rivers of the North American Atlantic coast, but overfishing and habitat destruction have extirpated many populations. Historical records indicate that both species once inhabited the Satilla and St Mary's Rivers, Georgia, but neither species has been documented in recent years. The objective of this project was to assess the population status of Atlantic and shortnose sturgeon in the Satilla and St Mary's Rivers, and to evaluate the current habitat availability for these species in each river system. A rigorous sampling program for both species was initiated in October 2008 and continued to July 2010. We expended >2800 hours of sampling effort on both river systems. On the Satilla River we captured 220 Atlantic sturgeon, but only eleven shortnose sturgeon. Only 9 Atlantic sturgeon and one shortnose were captured on the St Mary's. Weekly measures of basic water quality suggested that low dissolved oxygen (<3 mg/L) and high water temperatures (>27°C) during the summer months may affect survival and growth of young sturgeon that require freshwater riverine habitats. While our findings suggest that a remnant population of Atlantic sturgeon may still remain in the Satilla River, habitat degradation from current agricultural, silvicultural, and municipal developments will likely jeopardize the continued existence of both species in these rivers.

Oral Presentations

Presenter: Gardner, C.; Email: Chris.Gardner@noaa.gov;

Reef fish community structure and demographics on hard bottom reefs off northwest Florida revealed by an ROV visual survey

Gardner, C., D. DeVries, and P. Raley

NOAA Fisheries Panama City Lab, 3500 Delwood Beach Rd., Panama City Beach, FL 32408

In 2006 we began studying fish community structure, trophic dynamics, demographics, and habitat associations on hard bottom habitats from nearshore to the shelf break (70m) in the northeastern Gulf of Mexico, as well as delineating and quantifying those habitats using multibeam sonar. Three sites were sampled seasonally (winter, summer, and fall) in each of three depths: 23 (inshore), 37 (midshelf), and 49 m (offshore). Video data on species composition, relative abundance, and size structure were collected using an ROV. Specimens for age, food habits, and stable isotope analyses were collected using hook-and-line, traps, and spears. Diversity was much higher midshelf and offshore, primarily because of the occurrence of more tropical unexploited species. Gray snapper abundance was >30 fold higher inshore (491/ha) than at midshelf (16/ha), with none observed offshore. Gray snapper were larger midshelf ($\bar{x} \pm 95\% \text{ CL}$: 407 \pm 13 mm FL) than inshore (330 \pm 6 mm FL) with no sub-legal sized (<305 mm) gray snapper observed midshelf. Except for gray snapper inshore and vermilion snapper offshore, red snapper was the most abundant exploited reef fish in all strata, averaging 66/ha inshore, 112/ha midshelf, and 96/ha offshore. Red snapper tended to be older offshore; with a modal age of 3, vs. 2 midshelf and inshore, but had similar modal size structure in all depth strata. Among red grouper, three cohorts were dominant (1999, 2002, 2006), and individuals were notably smaller and younger inshore than in the two deeper strata. In addition to monitoring these hard bottom, low relief reefs (<2m), we've started studying high relief reef habitats through NGI for years 4 and 5. These reefs are in similar depths to our current midshelf and offshore sites (37-49m), but host relief of up to 10m. Thus far, the habitat has been mapped using side scan sonar and ROV visual sampling is ongoing.

Presenter: **Gascho Landis, A.**; Email: andrewmgl@gmail.com

Seasonal robust design capture-recapture and PIT tagging to examine population dynamics of *Villosa lianosa*

Gascho Landis, A.¹, T. Mosley¹, C. McGowan², and J. Stoeckel¹

¹ 203 Swingle Hall, Department of Fisheries and Allied Aquacultures, Auburn University, Auburn AL 36849

² Alabama Cooperative Fish and Wildlife Research Unit, 108 M. White Smith Hall, Auburn University, Auburn, AL 36849

Population estimates of freshwater mussels are largely lacking in the literature, due in part to the difficulty involved in deriving these estimates. Robust design capture-recapture is a sampling strategy that allows for the estimation of several important population parameters: survival, population size, capture probability, and temporary emigration. Freshwater mussels burrow in the stream benthos, making them unavailable for capture and thus considered temporarily emigrated. PIT tags can aid in locating mussel that are difficult to find during visual and tactic searches, demonstrating site fidelity, not permanent emigration. To explore these techniques we selected a *Villosa lianosa* bed on Chewacla Creek, AL and visited this site in April, August, and October/November of 2010. In each sampling period, we performed visual and tactical searches of the entire site on three separate days, tagging all mussels with a PIT tag and plastic number tag. Following the three day search we located tagged individuals using a PIT reader. Results will allow us to compare detection probabilities across three different seasons in which mussels are typically sampled and using two different techniques. Sampling design must carefully consider time of year because mussel availability for sampling may be influenced by environmental or behavioral factors.

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Presenter: Gordon, B.; bgordon07@sbcglobal.net

Current status of Grand Lake paddlefish stock and implications for harvest management

Scarnecchia, D.¹ and B. Gordon²

¹ University of Idaho, Moscow, ID 83844-1136

² Oklahoma Department of Wildlife Conservation, 300 S. Aquarium Drive, Jenks, OK 74037

Although paddlefish investigations have been conducted in Oklahoma since the 1950s, the opening of the Research and Processing Center (RPC) on Grand Lake in 2008 has provided us with detailed quantitative fishery information that was previously unavailable. This is the third year of intensive paddlefish research and stock assessment of Grand Lake paddlefish conducted jointly by the Oklahoma Department of Wildlife Conservation (ODWC) and the University of Idaho (UI). As part of this joint effort, ODWC is currently assembling and analyzing all available historical paddlefish data into a comprehensive Oklahoma Paddlefish Plan involving all Oklahoma waters and paddlefish harvest management units. Such a plan will require one or more years to complete. A sustainable plan for the species to accompany the successful roe donation/caviar processing activities at the RPC are the two critical aspects by which the ultimate success of the Oklahoma Paddlefish Management Program will be judged by state agencies, federal agencies, conservation organizations, and the public. In 2008 and 2009, the higher than anticipated angler interest and harvest in the Grand Lake paddlefish snag fishery indicates that a timely review was warranted of stock status, existing harvest regulations, and possible harvest management options which led to regulation changes in 2010.

Presenter: **Guindon, K.**; Email: Kathy.Guindon@MyFWC.com

Scaling effects of sub-lethal catch-and-release angling in tarpon (*Megalops atlanticus*)

Guindon, K.¹, D. Westmark¹, J. Carroll¹ and D. Mann²

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

² University of South Florida, College of Marine Science, 140 7th Avenue South, St. Petersburg, FL 33701.

Angling events will cause anaerobic activity resulting in physiological disruptions that may have consequences compromising the health and survival of tarpon. Both adult and sub-adult tarpon support Florida's predominantly catch-and-release and economically important recreational fishery, so maximizing post-release survival and minimizing sub-lethal stress effects are critical to its sustainability. In this study, stress responses after exhaustive exercise (angling) were measured using an array of blood chemistry parameters, including hematocrit, hemoglobin, plasma cortisol, glucose, lactate, and select electrolytes. Angled adults were compared to adult tarpon in a resting state (controls). Angled sub-adults were also compared to those in a resting state. Adult tarpon were then compared to sub-adults to determine any size-related, intra-species variation in stress responses after angling. Finally, because smaller tarpon are logistically easier to handle and may be subjected to prolonged air exposure by anglers for hook removal or photographs, we evaluated the effect of 60 seconds of air exposure with horizontal or vertical handling out of the water relative to non-air exposed fish in angled sub-adult tarpon. Angling duration, handling time, body size and environmental factors related to capture events were correlated to blood chemistry parameters using a non-parametric, multivariate analysis. The duration and magnitude of the angling event had a positive effect on responses of most parameters, and responses were more extreme in adult tarpon than sub-adults, with the exception of cortisol. Environmental parameters had minimal influence on observed physiological responses. Sub-adults showed no difference in responses among handling treatments with and without air exposure and exhibited no short term mortality. Using appropriate tackle and avoiding excessive handling should help minimize metabolic and acid-base imbalances. Tarpon seem capable of physiological recovery in the absence of extreme stressors.

Presenter: **Hangsleben, M.**; Email: mhangsleben@ufl.edu

Evaluation of electrofishing catchability for fish sampling in Florida lakes

Hangsleben, M. and M.S. Allen

University of Florida, Department of Fisheries and Aquatic Sciences, 7922 NW 71st St., Gainesville, FL 32653

Electrofishing catch per unit effort (CPUE) has been widely used by fisheries managers to index fish abundance. However, for managers to use CPUE as an index of abundance they must assume that catchability (q = the fraction of fish stock captured per unit effort) is constant across sampling years. We assessed how catchability varied among fish species and lake conditions for five small lakes and a series of ponds in Florida. Marked populations of largemouth bass *Micropterus salmoides*, bluegill *Lepomis macrochirus*, and lake chubsucker *Erimyzon sucetta* were established at each lake. Catchability was measured using standardized sampling during the fall, spring, and summer at each lake using only marked fish. The ponds contained largemouth bass and bluegill and were drained after electrofishing to measure catchability during the summer. After one year our results indicate that catchability varied substantially across seasons and fish species. For example, in one lake catchability averaged .0033 for largemouth bass in the fall but .0008 in the summer, an order of magnitude difference. Catchability between species in the fall ranged from .0007 for bluegill and .0046 for lake chubsucker. The pond studies showed that catchability can vary substantially between sampling events for fish species in the same season, indicating that CPUE will often not reliably track fish abundance. Our results suggest that electrofishing CPUE data will not reliably track fish abundance in cases where changes in fish abundance are minor relative to the variability in catchability, across sampling events.

Presenter: **Harbeitner, R.**; Email: harbeirc@eckerd.edu

Altered responsiveness to oxidative stress in killifish from a Superfund Site

Harbeitner, R.¹, A. Timme-Laragy², and M. Hahn²

¹Eckerd College, 4200 54th Avenue South, St. Petersburg, FL 33711

²Woods Hole Oceanographic Institution, 266 Woods Hole Road, Woods Hole, MA 02543

New Bedford Harbor (MA, U.S.A.) is a Superfund site inhabited by killifish (*Fundulus heteroclitus*) with a defective aryl hydrocarbon receptor (AHR) leading to PCB and dioxin resistance. This study examines the effect of additional stressor, oxidative stress, on these resistant fish induced by prooxidant tBHQ (*tert*-butylhydroquinone). A deformity score, % survival, hatching rate and heart rate were measured to determine killifish sensitivity. Two of the three killifish embryo exposures to tBHQ indicated that New Bedford Harbor embryo are more sensitive to tBHQ than were Scorton Creek (MA, U.S.A.; reference site) killifish embryos. For both populations, larvae were more sensitive than embryos to tBHQ. Gene expression was paired with these phenotypic changes in the exposed fish to examine the interactions of the Nrf2-AHR signaling pathways. Nrf2 is a transcription factor that responds to oxidative stress while AHR is a transcription factor that regulates gene expression. The AHR deficient New Bedford Harbor population is ideal for studying possible cross-talk between these pathways, and this is still a work in progress.

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Presenter: Harris, J.E.; Email: jeharris@ncsu.edu

Identification of American shad spawning sites and spawning habitat use in the Pee Dee River, North Carolina and South Carolina

Authors: Harris, J.E.¹ and J.E. Hightower²

¹ North Carolina Cooperative Fish and Wildlife Research Unit, North Carolina State University, Department of Biology, Campus Box 7617, Raleigh, NC 27695

² U. S. Geological Survey, North Carolina Cooperative Fish and Wildlife Research Unit, North Carolina State University, Department of Biology, Campus Box 7617, Raleigh, NC 27695

We examined spawning site selection and habitat use of American shad *Alosa sapidissima* in the Pee Dee River, North Carolina and South Carolina, to help inform management and restoration in this flow-regulated river. We completed oblique plankton tows at multiple locations to identify spawning sites and we tracked radio-tagged adults on spawning grounds to evaluate spawning habitat use and movement patterns in relation to changes in water discharge rates. Most spawning was estimated to occur in the 25-river kilometer (rkm) section starting just below the lowermost dam in the system, Blewett Falls Dam, in the piedmont physiographic region; however, spawning also occurred downstream in the coastal plain. The piedmont region is higher in gradient and is predicted to have slightly higher current velocities and shallower depths on average than the coastal plain. In addition, the piedmont region is dominated by larger substrates such as boulders and gravel, whereas the coastal plain is dominated by sand. Higher densities of American shad eggs were collected by plankton sampling after sunset, as compared to during the day, and the average age of eggs collected at night was also younger. Most radio-tagged American shad remained in discrete areas (average linear range = 3.6 rkm) during the spawning season and generally occupied water velocities between 0.20 and 0.69 m/s, depths between 1.0 and 2.9 m, and substrates dominated by boulder/bedrock and gravel. American shad remained in the same general areas throughout the spawning season and appeared to make only small-scale changes in distribution with changes in water discharge rates.

Presenter: **Hazelton, P.D.**; Email: hazeltonp@warnell.uga.edu

Use of a partial life-cycle assay to determine effects of contaminants on freshwater mussel populations

Hazelton, P.D. and R.B. Bringolf

Warnell School of Forestry & Natural Resources, University of Georgia, Athens, GA 30602

Freshwater mussels (Family Unionidae) have a unique lifecycle in which the larvae (glochidia) are brooded in marsupial gills of the female mussel before being released into the water column where they must attach to (parasitize) fish gills or fins for a period of days to weeks, in order to transform into the juvenile life stage. Each stage of this complex lifecycle presents an opportunity for exposure to contaminants yet the potential for adverse sublethal effects on glochidia and juveniles is largely unexplored to date. We have developed a partial life-cycle test to track the effects of water-borne toxicants on adult brooding female mussels, as well as glochidia and early juveniles. This assay incorporates metabolic and behavioral responses of the adult female with metrics of glochidia viability, transformation success, and early juvenile survival to assess critical periods of exposure during early life history of freshwater mussels. Benefits of this assay to more traditional toxicology methods are the use of environmentally relevant contaminant concentrations and exposures. Furthermore, data endpoints are directly applicable to models of population level effects, leading to more realistic identification of toxic threats to natural populations. We have conducted this assay using fluoxetine (Prozac) and perfluorooctane sulfonate (PFOS, an industrial surfactant), and identified unique effects for each compound at concentrations measured in polluted watersheds. We evaluate the advantages and disadvantages of this assay and its use in identifying effects of other chemical and physical water-quality stressors on unionid life history and recruitment.

Oral Presentations

Presenter: Heitman, J.F.; Email: JFredd@aol.com

Evaluation of a barrier net for preventing fish impingement in a Missouri hydropower reservoir

Stoner, G.¹, R. O'Hearn¹, and J.F. Heitman²

¹ Missouri Department of Conservation

² AMERICAN AQUATICS, INC.

Historically fish impingement occurred at Bagnell Dam which creates Lake of the Ozarks in south central Missouri. This fish impingement has resulted in significant numbers of fish to be injured and/or killed. Frequently large paddlefish (*Polyodon spathula*) as large as 1.6 m TL passed through the turbines, and anglers often dipped up limits of game fish during generation periods. As part of a settlement from a large fish kill and the FERC re-licensing process the dam operator, Ameren UE, was required to provide funding for a study determine the effectiveness of a fish barrier net that was placed in the reservoir to prevent fish impingement. The study consisted of two years of downstream monitoring both before and after installation of the net. Results of the study indicate that the net was effective in preventing fish impingement at Bagnell Dam.

Presenter: Heppell, S.A.; Email: Scott.Heppell@oregonstate.edu

Oceanographic patterns associated with Nassau grouper aggregation spawn timing: Shifts in surface currents on the nights of peak spawning

Heppell, S.A.¹, B.X. Semmens², C.V. Pattengill-Semmens³, P.G. Bush⁴, B.C. Johnson⁴, C.M. McCoy⁴, J. Gibb⁴, and S.S. Heppell¹

¹ Department of Fisheries and Wildlife, 104 Nash Hall, Oregon State University, Corvallis, OR 97331

² NOAA Northwest Fisheries Science Center 4726 38th Ave. NE Seattle, WA 98105

³ Reef Environmental Education Foundation (REEF), PO Box 246, Key Largo, FL 33037

⁴ Department of Environment, Cayman Islands Government, P.O. Box 486GT, Grand Cayman, Cayman Islands

There is virtually nothing known about the fate of fish larvae born on spawning aggregations from the time of spawning to settlement, yet the location of the aggregation site must be important in determining their fate. While aggregations always form in the same place and at the same time in part to assure a large number of adults will congregate for spawning, oceanographic patterns of dispersal and retention of the larvae may provide a driving force for the selection of specific spawning locations. During the winters of 2008 and 2009 we deployed Surface Velocity Profile drifters at the Nassau grouper spawning aggregation site on Little Cayman Island, BWI. A single drifter was deployed each night, then recovered 12 hours later in order to determine trajectory paths off the aggregation. In contrast to the path taken on nights prior to spawning, in both years the drifters released on the night of peak spawning showed substantial eddy formation near the aggregation site. This repeated pattern suggests an oceanographic-based "importance of place" for the aggregation site that may result in local recruitment. This would mean that local aggregations of fish are directly responsible for the long-term survival of local populations. This gives substantial credence to the need to identify and protect specific locations because they are unique and critical to the long-term survival of the many species that aggregate there.

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Presenter: Heppell, S.; Email: selina.heppell@oregonstate.edu

Linking age-specific variation in reproductive output to year class variance: why we should manage for age structure

Heppell, S.S.

Department of Fisheries and Wildlife, 104 Nash Hall, Oregon State University, Corvallis, OR 97331

Truncation of age structure is unavoidable if an entire stock is susceptible to fishing mortality, and may have serious repercussions for species with age-specific maternal effects on offspring quality or timing of spawning. Meta-analysis of recruitment variance across a wide range of fishes suggests that fished populations experience greater variance, potentially due to changes in average female reproductive success associated with age structure. Productivity estimates from deterministic models are not likely to change dramatically if fertility is age-dependent rather than biomass-dependent. This is because a) most young females in a population are below the 50% mature level and therefore contribute relatively few offspring anyway, b) relatively few fish reach the oldest age classes, even under natural mortality conditions, and c) per capita fertility has a low impact on population growth rate relative to annual survival. However, in simulations with variable environmental conditions, the potential value of a broad age structure becomes more apparent. When females of different ages spawn at different times of year, the chances of matching ocean productivity can increase. I show simulation results for black rockfish on the Oregon coast under variable ocean productivity regimes that are based on observed upwelling indices. An increase in the length of the spawning season, due to a mixture of early and late spawning females, can promote population resilience when larval survival is highly stochastic. Further analysis with simulated populations and evaluation of the relationship between age structure, environmental variance and recruitment patterns may elucidate why maternal effects are more prevalent in some species or families than others.

Presenter: Herrington, K.J.; Email: Karen_Herrington@fws.gov

Population viability analysis and recovery implications for the endangered fat threeridge mussel (*Amblema neislerii*)

Herrington, K.J.¹, P.S. Miller², J. Ziewitz³, S.C. Pursifull¹, S.J. Herrington⁴, and N.M. Rankin⁵

¹ U.S. Fish and Wildlife Service, Panama City Field Office, 1601 Balboa Ave, Panama City, FL 32405

² IUCN / SSC Conservation Breeding Specialist Group, 12101 Johnny Cake Ridge Road, Apple Valley, MN 55124

³ U.S. Fish and Wildlife Service, Southeast Region, 2639 North Monroe Street, Suite A-200, Tallahassee, FL 32303

⁴ The Nature Conservancy, Florida Chapter, 10394 NW Longleaf Drive, Bristol, FL 32321

⁵ U.S. Fish and Wildlife Service, Warm Springs Fish Technology Center, 5308 Spring Street, Warm Springs, GA 31830

We developed a population viability analysis (PVA) for the endangered fat threeridge (*Amblema neislerii*) to evaluate the current status of the population and explore which demographic parameters may be the most sensitive to alternative management practices. A stage-structured, female-only population matrix model of fat threeridge demography was developed with input data on stage-specific fecundity and survival rates. Stage classes and associated survival and fecundity estimates were derived either from available fat threeridge data or by using data from the closely related congener, *Amblema plicata*. Because of uncertainty around our measured adult survival estimate of 0.89, we evaluated three different levels of adult survival (low=0.89, moderate=0.91 and high=0.98). Results of PVA simulations indicate that under low adult survival, the population of fat threeridge in the Apalachicola River is in a long-term, relatively slow decline. In contrast, the high adult survival estimate leads to a population that shows a fairly vigorous 8% rate of increase in the long-term. The sensitivity of the models to measurement uncertainty of the different demographic parameters was also evaluated to decide which parameters are most important to the model output. Results indicate that female adult survival has the greatest impact on long-term population dynamics. At this time we believe the most appropriate estimate of adult survival is the lower

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bound estimated from field data, and the fat threeridge population in the Apalachicola River is in a long-term, relatively slow decline. However, results of the elasticity analysis stress the importance of more reliable estimates of adult female survival and its variability over time, in order to improve our understanding of the population dynamics of the fat threeridge in the Apalachicola River.

Presenter: Herrington, K.J.; Email: Karen_Herrington@fws.gov

Movement and habitat relationships of the endangered fat threeridge (*Amblema neislerii*) in the Apalachicola River, Florida

Herrington, K.J.¹, M.M. Gangloff², S.C. Pursifull¹, and B. Zettle³

¹ U.S. Fish and Wildlife Service, Panama City Field Office, 1601 Balboa Avenue, Panama City, FL 32405

² Appalachian State University, Department of Biology, 287 Rivers Street, Suite 232 JET Building (ORSP) Boone, NC 28608

³ U.S. Army Corps of Engineers, Mobile District, P.O. Box 2288, Mobile, AL 36628-0001

The Apalachicola River contains the largest remaining population of the federally endangered fat threeridge mussel (*Amblema neislerii*), which is endemic to the Apalachicola-Chattahoochee-Flint (ACF) River Basin. Because fat threeridge mussels are largely aggregated along mainstem channel margins at water depths <1 m, reduced flows resulting from reservoir management and consumptive uses may significantly impact this population. Our goal was to determine how habitat and mussel movements affect fat threeridge survival at various flow levels in the Apalachicola River. We quantified habitat conditions and the distribution of mussels at specific depth intervals in the river channel at multiple sites in the Apalachicola River from 2007–2010. We re-sampled several sites under different flows to further quantify the range of movement of mussels in the river channel. Our results indicated that fat threeridge occur at moderately depositional, moderately sloping sites on the up- and downstream ends of point bars. At both low and moderate flow levels (e.g., 5000 cfs and 9000 cfs), fat threeridge were highly clumped with the greatest densities occurring at depths < 1 m. Our results suggest that reach-scale flow and substrate conditions may influence mussel abundance more than micro-habitat conditions and that mussels move along the bank slope to maintain optimal depth, flow and substrate conditions regardless of water level. Mussels were generally able to maintain optimal depths with declining flow levels; however, many became exposed and died at sites where the slope was relatively flat or in areas with backwater swale habitats. These results suggest that interactions between flow levels and channel slope may limit habitat conditions and strongly affect fat threeridge densities. These data will be used by the U.S. Fish and Wildlife Service and Army Corps of Engineers to evaluate how ACF reservoir management impacts fat threeridge populations in the Apalachicola River.

Presenter: **Hibbard, A.L.**; Email: hibbaral@eckerd.edu

Integrating the Florida Keys National Marine Sanctuary research permit database with ArcGIS to visualize scientific utilization patterns

Hibbard, A.L.^{1,2} and S. Donahue³

¹ Eckerd College, Marine Science Discipline, 4200 54th Avenue South, Saint Petersburg, FL 33711

² NOAA Ernest F. Hollings Undergraduate Scholar, Florida Keys National Marine Sanctuary, 33 East Quay Road, Key West, FL 33040

³ Florida Keys National Marine Sanctuary, 33 East Quay Road, Key West, FL 33040

Because most scientific activities occurring within the Florida Keys National Marine Sanctuary are not exempt from the Sanctuary regulations, the FKNMS issues approximately 60-70 research-based permits a year to allow scientists

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to conduct their work. Despite the high species richness due to diverse community types, most consumptive research is known to focus on the vulnerable coral reefs. Generally, coral reef scientists keep their consumptive “foot print” to a minimum, but resource managers are beginning to monitor these activities to facilitate research collaboration if it results in reduced impact to the resources. As a result, this project tests whether ArcGIS can be used to assess spatial patterns in consumptive research within the FKNMS and evaluate trends in resource (taxonomic) utilization. In relation to the main hypothesis, this work will suggest whether or not scientists potentially miss out on collaborative opportunities based on their overlapping interests and/or spatial coverage. These two questions drive the need for the creation of visual aids to help resource managers reduce and/or reassess potential impacts. The success of not only displaying permitted locations on a map, but identifying “hot spots” of high consumption and heavy use will allow Sanctuary resource managers the insight to reduce permitting to these areas of high interest. This could effectively spread the research footprint to more of the Florida Keys or encourage the sharing of data between scientists to reduce the overall human impact on the reef. Lastly, statistics for permittee compliance with other permit requirements (e.g., validating their permits and submitting the necessary reports) were quantified in order to examine ways the permitting process could be improved.

Presenter: Hightower, J.E.; Email: jhightower@ncsu.edu

Bayesian methods for analyzing fisheries data

Hightower, J.E.

U.S. Geological Survey, North Carolina Cooperative Fish and Wildlife Research Unit, Department of Biology, Campus Box 7617, NC State University, Raleigh, NC 27695

Most analyses of fisheries data are done using “classical” statistical methods. For example, we could fit a von Bertalanffy growth curve to age and length data using nonlinear regression. The analysis would be based solely on the current data, and would not take into account any prior information (e.g., results of a pilot study or estimates for other systems). An increasingly popular alternative is to use Bayesian methods that can take into account prior information as well as the current data. This makes it possible to build on previous work, using new data to refine prior estimates of model parameters. The availability of free and powerful software such as WinBUGS and OpenBUGS has greatly facilitated the use of Bayesian methods. This software can be used to fit more complex and biologically realistic models than can be handled using classical statistical methods. Examples including a von Bertalanffy growth curve and tag-return model will be used to illustrate advantages of a Bayesian approach.

Presenter: Hoffmayer, E.; Email: eric.hoffmayer@usm.edu

Were whale sharks (*Rhincodon typus*) in the northern Gulf of Mexico impacted by the Deepwater Horizon oil spill?

Hoffmayer, E.¹, J. McKinney¹, J. Franks¹, J. Hendon¹, and W. Driggers²

¹ Center for Fisheries Research and Development, Gulf Coast Research Laboratory, The University of Southern Mississippi, Ocean Springs, MS

² NOAA Fisheries, Mississippi Laboratories, Pascagoula, MS

Since whale sharks, *Rhincodon typus*, inhabit northern Gulf of Mexico (nGOM) waters during spring – fall of each year, considerable concern was expressed regarding their well-being following the Deepwater Horizon oil spill that occurred in the region during the spring and summer of 2010. Other than historical anecdotal accounts of whale shark sightings in the nGOM, some dating back to the 1930's, little was known about their seasonal occurrence and distribution, biology, and ecology in the region until the Gulf Coast Research Laboratory (GCRL) initiated the

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Northern Gulf of Mexico Whale Shark Research Program in 2003. One of the program's primary objectives is to document the distribution of whale sharks in the nGOM via reports of sightings provided by collaborating fishers and offshore petroleum industry personnel. To date, over 300 sightings have been reported with approximately one third of those involving aggregations of up to 200 individuals. The program is documenting that whale sharks are abundant in the nGOM and their seasonal occurrence is highly predictable. Additionally, satellite tagging data and photo identifications have established connectivity between whale sharks in the nGOM and the Caribbean Sea. This presentation summarizes current knowledge on whale sharks in the nGOM and addresses the topic of potential impacts to whale sharks from the Deepwater Horizon oil spill.

Presenter: **Hutt, C.P.**; Email: chutt@cfr.msstate.edu

A stated choice analysis of Texas catfish angler fishing trip preferences

Hutt, C.P.¹, K.M. Hunt¹, J.W. Schlechte², and D.L. Buckmeier²

¹ Human Dimensions and Conservation Law Enforcement Laboratory, Dept. of Wildlife, Fisheries, & Aquaculture, Mississippi State University, Box 9690 Mississippi State, MS 39762

² Texas Parks and Wildlife Department, Heart of the Hills Fisheries Science Center, 5103 Junction Highway, Mountain Home, TX 78058

Freshwater catfish species traditionally have not been the focus of most inland fisheries agencies; however, this is changing in many states where catfish are growing in popularity among anglers. The U.S. Fish and Wildlife Service reported that 1.035 million Texas anglers (56%) spent 11.6 million days pursuing catfish in 2006, more than any other species of fish in the state. We conducted a survey of 1,078 anglers identified as catfish anglers in a statewide survey of Texas anglers. Data from the survey were used to analyses angler preferences for catfishing trips using a stated choice experiment. Respondents were presented with paired hypothetical fishing trip scenarios for catfish and asked to choose the trip that they most preferred. Trip scenarios varied by the relative number of catfish caught and harvested, the relative size of catfish caught, the type of water body on which the trip took place, the level of site development, and distance traveled. A fractional factorial design was used to generate 56 choice sets with each angler presented six choice sets to minimize fatigue. A multinomial logit model was used to analyze angler preferences where choice served as the dependent variable and trip attributes served as the predictor variables. Angler choice was most affected by distance traveled with anglers being 1.8 times more likely to choose a fishing site within 10 miles of home compared to a site 11-100 miles from home, and 0.4 times as likely to choose a site over 100 miles from home. The second largest predictor of angler choice was the relative size of catfish caught (1.6 times greater for larger than usual catfish and 0.6 times for smaller) followed by number caught and harvested. Anglers preferred larger reservoirs (100+ acres) and rivers compared to smaller reservoirs. Anglers also preferred access sites with boat ramps.

Presenter: Hysmith, B.T.; Email: bruce.hysmith@tpwd.state.tx.us

Impacts of tournament mortality on a Texas largemouth bass fishery

Hysmith, B.T.¹, J.H. Moczygamba¹, M.T. Driscoll², R. A. Myers³, and M.S. Allen⁴

¹ Texas Parks and Wildlife Department, P.O. Box 1446, Pottsboro, TX 75076

² Texas Parks and Wildlife Department, Route 2, Box 535, Jasper, TX 75951

³ Texas Parks and Wildlife Department, 134 Braniff Drive, San Antonio, TX 78216

⁴ School of Forest Resources and Conservation, University of Florida, P.O. Box 110600, Gainesville, FL 32653

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Prompted by a decline in the “big fish” component of the largemouth bass *Micropterus salmoides* population, we determined impacts of tournament angling at Amon G. Carter Reservoir, Texas (623 ha). Concerns regarding tournament-related impacts on black bass have often been investigated, but few studies have quantified population implications. In 2007, we tagged 786 largemouth bass in Amon G. Carter Reservoir and estimated exploitation by angler type (tournament and non-tournament) via creel survey sampling. A simulation model was used to estimate the impact of tournament mortality on total fishing mortality and an age-structured model was used to predict changes in largemouth bass population size structure and abundance given hypothetical 25%, 50%, 75%, and 100% reductions in the number of fish retained by tournament anglers. Tournament mortality was responsible for 34-92% of largemouth bass total fishing mortality. Given a 50% reduction in the number of tournament-retained fish, abundance of largemouth bass ≥ 356 and ≥ 457 mm was predicted to increase by 6% and 9%, respectively. Tournament angling impact on total fishing mortality and largemouth bass population abundance was substantially greater at Amon G. Carter Reservoir than at previously investigated reservoirs.

Presenter: Irwin, E.R.; Email: irwiner@auburn.edu

Conservation of four darter species in response to adaptive flow management in the Tallapoosa River below Harris Dam

Irwin, E. R¹. and K. D. M. Kennedy²

¹United States Geological Survey, Alabama Cooperative Fish and Wildlife Research Unit, School of Forestry and Wildlife Sciences, Auburn, AL 36849

²Alabama Cooperative Fish and Wildlife Research Unit

The inundation and disruption of natural flow regimes of shoal habitats in medium sized rivers has been hypothesized to be the primary cause for imperilment of fishes in Southeastern rivers. Adaptive management of flows was implemented below Harris Dam on the Tallapoosa River, Alabama in spring 2005. Fundamental objectives related to flow management included maximizing persistence of native fauna, including species of concern to federal and state agencies. Long-term data were used to estimate occupancy of four darter species (three species of concern) prior to implementation of management targeted to increase occupancy rates. During the management period, fishes were collected on shoals each year with pre-positioned area electrofishers and habitat variables were measured. Estimates of species detection, occupancy, local extinction, and colonization were calculated for selected species using maximum likelihood methods; estimates were modeled as a function of measured covariates using the logit link function. Specific habitat variables (velocity, depth and vegetation) affected detection probabilities for species differentially. Best-model estimates of occupancy, local extinction, and colonization were constant among all sites for lipstick darter, Tallapoosa darter, and bronze darter. Occupancy probability of bronze darter was estimated as 1.0 at all sampled sites. Lipstick darter and Tallapoosa darter occupancy probabilities were estimated to increase from 0.91 to 0.99, and from 0.73 to 0.90, respectively, across the Tallapoosa basin during the sampling period. Muscadine darter occupancy varied based on water-year; occupancy estimates decreased steadily during 2007-2009 (drought years) and subsequently increased in 2010. We hypothesize that flow management was responsible for increases in occupancy rates of lipstick darter and Tallapoosa darter via changes in stability and persistence of shoal habitat below Harris Dam; however occupancy rates were always high. In addition, the effects of drought on darter species were apparent but appeared to be mitigated below Harris Dam because of flow management.

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Presenter: Jagers, B.V.; Email: bruce.jagers@MyFWC.com

Ploidy of grass carp (*Ctenopharyngodon indella*) in the Suwannee River, Florida

Jagers, B.V.¹, J. Hinkle², and A.D. Martin²

¹Florida Fish and Wildlife Conservation Commission, 601 W. Woodward Ave., Eustis, FL 32726

²Florida Fish and Wildlife Conservation Commission, 3377 E. U.S. Hwy. 90, Lake City, FL 32055

In February 2010, the Florida Fish and Wildlife Conservation Commission (FWC) collected a sample of 27 grass carp (*Ctenopharyngodon idella*) from the Suwannee River at Manatee Springs and within Manatee Springs Run for the purpose of determining ploidy. Twenty-one of these grass carp were tested for ploidy via a Coulter Counter. Five fish were determined to be diploid and sixteen were determined to be triploid. Diploid grass carp are capable of reproducing under the right environmental conditions. While grass carp reproduction has not been documented in the Suwannee River, the environmental conditions in the Suwannee River are similar to the environmental conditions required for successful grass carp reproduction. Positive identification of grass carp eggs or larvae from nekton samples would be diagnostic of successful grass carp reproduction in the Suwannee River. Although grass carp have not been legally stocked in the Suwannee River, a feral population of grass carp may persist in the Suwannee River due to escapement from permitted stocking sites, escapement from hatcheries, illegal introductions and possibly reproduction. Freshwater springs have been identified as an FWC Wildlife Legacy priority habitat for conservation. Schools of feeding grass carp could have an impact on spring run vegetation in that they could eliminate preferred species such as hydrilla (*Hydrilla verticillata*) and southern naiad (*Najas guadalupensis*) or prevent re-growth of non-preferred species such as vallisneria (*Vallisneria americana*). It would be difficult or impossible to remove grass carp from a large system such as the Suwannee River with technology that is currently available. However, there are recommendations which can be made to aid in the establishment and conservation of aquatic vegetation in spring runs associated with the Suwannee River. Smart et al. (1996) and Smart and Dick (1999) provide recommendations for the establishment and protection of aquatic plants in the presence of herbivores. These recommendations center on the use of fencing to allow root systems of aquatic plants to establish without grazing pressure from herbivores and the establishment of local nursery colonies of aquatic plants which are permanently protected from herbivores.

Presenter: Johnson, K.; Email: Kevin.Johnson@MyFWC.com

Diet habits of common snook from three coastal southeast Florida rivers and their similarities with largemouth bass

Johnson, K.¹, J. Kerns², J. Dutka-Gianelli³, and E. Leone⁴

¹Florida Fish and Wildlife Conservation Commission, FWRI, Melbourne Freshwater Fisheries Field Lab, 2595 McGraw Ave., Melbourne, FL 32934

²University of Florida, School of Forest Resources and Conservation, Program in Fisheries and Aquatic Sciences, 7922 NW 71st St., Gainesville, FL 32653

³Florida Fish and Wildlife Conservation Commission, FWRI, Indian River Field Lab, 1220 Prospect Ave., Suite 285, Melbourne, FL 32901

⁴Florida Fish and Wildlife Conservation Commission, FWRI, Gainesville Wildlife Research Lab, 1105 SW Williston Rd., Gainesville, FL 32601

Common snook *Centropomus undecimalis* and largemouth bass *Micropterus salmoides* support some of the most important recreational fisheries in the state of Florida. These apex predator species coexist in many of Florida's coastal river systems. Detailed information on how populations of these two predators coexist is lacking. This study was designed to analyze diet habits of these two species and assess overlap between them in three southeastern Florida Rivers, the Loxahatchee, the St. Lucie (north and south fork), and the St. Sebastian. A total of 4,488 common snook and 629 largemouth bass were collected and examined for diet contents between May 2007 and

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March 2010. Of those, 2625 (58%) common snook and 352 (56%) largemouth bass contained one or more diet item. A total of 35 unique families and 12 functional groups (i.e., fish, crab, shrimp, etc.) were identified within stomach contents. Diet analysis is still on going but diet overlap indices such as Schoener's (1970) will be used to quantitatively compare diets of common snook and largemouth bass. Cumulative prey curves will be used to determine whether a sufficient number of samples have been collected to precisely describe the diet for each species. Various other statistical analyses will be used to determine if common prey items vary seasonally, by predator size, or habitat type.

Presenter: **Johnson, N.A.**; Email: floridamussels@gmail.com

The utility of a comprehensive DNA barcode library for a regional assemblage of freshwater mussels (Bivalvia: Unionidae)

Johnson, N.A.^{1,2}, J.D. Williams³ and J.D. Austin^{1,4}

¹ School of Forest Resources and Conservation, Program in Fisheries and Aquatic Sciences, University of Florida, Gainesville, FL 32653

² U.S. Geological Survey, Southeast Ecological Science Center, Gainesville, FL 32653

³ Florida Museum of Natural History, University of Florida, Gainesville, FL 32601

⁴ Department of Wildlife Ecology and Conservation, University of Florida, Gainesville, FL 32601

The ability of DNA barcoding to provide species-level identifications has been demonstrated for a variety of taxonomic groups. We are building a comprehensive DNA barcode library using the mitochondrial *cytochrome C oxidase* (COI) gene for the most imperiled group of organisms in North America, the freshwater pearly mussels (Bivalvia: Unionidae). The first phase of the project involves exhaustively sampling unionid diversity in rivers of the Eastern Gulf and South Atlantic. To date, > 75% of taxa currently recognized from these basins are included in the COI library. We are testing the ability of the 650 base pair section of the COI gene to: i) permit rapid, reliable identification of unknown specimens at multiple developmental stages, ii) facilitate the discovery and description of new species, iii) track the origin of introduced populations and iv) other forensic and ecological applications. Preliminary analyses show patterns of molecular diversity are largely consistent with estimates based on morphological taxonomy. However, results indicate both sequence-based and morphological-based methods are overly conservative in specific lineages. We highlight these discrepancies and provide suggestions for further detailed genetic, morphological, life history, and ecophysiological studies to guide an integrative taxonomic framework useful for informing effective conservation management strategies.

Presenter: Johnston, B.; Email: bjohnston02@sbcglobal.net

Monitoring paddlefish (*Polyodon spathula*) movement with ultrasonic telemetry in the Grand (Neosho) River system

Johnston, B. and B. Gordon

Oklahoma Department of Wildlife Conservation, 300 S. Aquarium Dr., Jenks, OK 74037

Due to the threat of over-harvest, paddlefish *Polyodon spathula* were listed by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 1998 as one of the species threatened by extinction. The paddlefish population in the Grand River system is an economic boom to the region around Grand Lake and its tributaries. Twenty-two paddlefish were collected (18 sexually mature females and 4 sexually mature males) from Grand Lake using gill nets, and implanted with Ultrasonic Transmitters. Ninety-five percent (21 of 22) of the tagged fish were detected by at least one of the Submersible Ultrasonic Receivers (SURs). Data from 2008

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did locate potential spawning sites in the Neosho River, upstream from Miami Park. Locations of the three gravid females in the Neosho River coincided with Paddlefish Research and Processing Center data showing that most of the spawned out females were brought into the center during the same time frame (29 March -21 April 2008). The data obtained from the Elk River location indicate that none of the tagged fish were utilizing the Elk River as a potential spawning site. None of the non-gravid females were detected above the Grays Ranch location.

Presenter: Johnston, J.; Email: johnston_odwc@hotmail.com

Contribution of stocked sauger to the broodstock populations in R.S. Kerr and W.D. Mayo Reservoirs on the Arkansas River navigation system

Johnston, J.S. and G.L. Peterson

Oklahoma Dept. of Wildlife Conservation, 9097 N. 34th St. W., Porter, OK 74454

Over the last few decades, sauger *Stizostedion canadense* have become an important fish species in Oklahoma. This is due to the popularity of the Oklahoma Department of Wildlife Conservation's (ODWC) saugeye *Stizostedion vitreum* x *Stizostedion canadense* stocking program and anglers discovering that sauger make excellent table fare. Sauger are native to Oklahoma, found in the Poteau, Illinois, Red, Neosho, and Arkansas Rivers. Little research on sauger has been conducted in Oklahoma to date. Although sauger populations currently appear stable, several threats to successful recruitment exist. Commercial navigation on the Arkansas River (McClellan-Kerr Navigation System) is maintained through a system of locks and dams. Construction of the system in the 1970's destroyed the sauger's natural spawning habitat. Sauger broodstock are collected by electrofishing below the Arkansas River dams in Eastern Oklahoma yearly from mid February to mid March. ODWC stocked 15,000 sauger fingerlings in the Arkansas River from 2000 to 2002 to augment population size, but these stockings were never formally evaluated. Since the spring of 2002, no sauger have been stocked in the Arkansas River. Maceina et al. (1998) found sauger mature around 300 mm in the Tennessee River of Alabama. Average length of age-1 males was 269 mm and age-1 females was 268 mm. In 2002 over 30% of the sample collected below Webber Falls Dam on the Arkansas River was <300 mm in length. During the 2007 broodstock collection, no fish <300 mm were recorded. Electrofishing, gillnet, and rod and reel sampling will be performed in 2008 and 2009 to evaluate the sauger population in R.S. Kerr and W.D. Mayo reservoirs. Otoliths will be removed from 10 fish per 25 mm length group. In 2010 and 2011, 20,000 sauger fingerlings will be marked with oxytetracycline (OTC) and stocked into R.S. Kerr Reservoir. Post-stocking, electrofishing, gillnet, and/or rod and reel sampling will be performed bi-annually in R.S. Kerr and W.D. Mayo Reservoirs. Otoliths will be removed from 10 fish per 25 mm length groups. Age-1 and age-2 sauger will be checked for OTC marks. Results from this study will indicate to what degree fingerling stocking impacts the sauger population, and whether continued stocking is justified.

Presenter: Jones, J.W.; Email: jess_jones@fws.gov

Population modeling and demography of two endangered mussel species in the Clinch River, U.S.A.: Quantitative criteria to evaluate harvest and reintroduction of *Epioblasma brevidens* and *Epioblasma capsaeformis*

Jones, J.W.^{1,2}, R.J. Neves² and E.H. Hallerman²

¹ U.S. Fish and Wildlife Service, Department of Fisheries and Wildlife Sciences, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061

² Department of Fisheries and Wildlife Sciences, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061

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Population modeling of two endangered mussel species, *Epioblasma brevidens* and *E. capsaeformis*, in the Clinch River, U.S.A., was conducted to determine suitable harvest levels for translocation of sub-adults and adults, and quantitative criteria to evaluate performance and recovery of extant and reintroduced populations. For both species, the recommended annual harvest was <1% of local population size to minimize risk of decline. Reintroduction modeling indicated that size of the initial population created during a 5 y build-up phase greatly affected final population size at 25 y, being similar to size at the end of the build-up phase, especially when expected growth rate was low (e.g., 1-2%). Excluding age-0 individuals, age-1 juveniles or recruits on average comprised approximately 11% and 15% of a stable population of each species, respectively. Age-class distribution of a stable or growing population was characterized by multiple cohorts, including juvenile recruits, sub-adults, and adults. Molecular genetic and demographic data indicated that the ratio of N_e/N_c was ~5% for both species. Based on this ratio and predicted declines of genetic variation at different population sizes, target total sizes for reintroduced or recovered populations of each species should be $\geq 5,000$ individuals ($N_e=250$) and $\geq 10,000$ individuals ($N_e=500$), respectively, and ideally should be comprised of multiple smaller demes spread throughout a river. Demes of both species in the river are currently large enough to sustain harvest for translocation and reintroduction purposes, offering an effective biological recovery strategy.

Presenter: **Jordan, A.**; Email: alyssa.jordan@myfwc.com

Dispersal and habitat use of largemouth bass (*Micropterus salmoides floridanus*) from a supplemental stocking within protected coves on Lake Okeechobee, Florida

Jordan, A.^{1,2}

¹ Florida Fish and Wildlife Conservation Commission, Habitat and Species Conservation, 3991 27th Court, Okeechobee, FL 34974

² Florida Atlantic University, Department of Biology, 777 Glades Road, Boca Raton, FL 33431

After long periods of high water and the 2004 hurricanes, vegetation and largemouth bass populations (*Micropterus salmoides floridanus*) were at an all time low. Drought conditions in subsequent years allowed vegetation re-growth, which provided habitat and food for the 430,000 fingerling bass (1-2 inches) that were stocked on Lake Okeechobee between 2009 and 2010. It is impossible to restock all of Lake Okeechobee because of its immense size (1,732 km²), but by stocking into protected coves that have undergone recent habitat restoration the hope was that the local populations would be “bumped”. Since stocking is generally not done in freshwater systems this large, sampling methods are still experimental. Fin clips were taken from captured bass for genetic analysis to determine if they were wild or stocked recaptures. With the two years of stockings, two different sampling methods were used to try and track the dispersal and habitat uses of these fingerling bass. These methods should hopefully show the dispersal of the stocked bass, and if they disperse out of the protected coves where they were stocked. Habitat preference will also be examined, especially within the areas that had recently undergone habitat restoration projects. Mortality estimates are not able to be predicted, and percent contribution is not expected to be high in a system this large, but instead an explanation can be offered for lower than expected recaptures (compared to smaller systems where this number of bass is a large percent of the population). Results are pending, and potentially these studies will result in better methods to determine the success of stocking in large systems such as Lake Okeechobee.

Presenter: Jordan, F.; Email: hjelks@usgs.gov

Conservation status of pinewoods darters in Little Pee Dee and Lumber River drainages of North and South Carolina

Jordan, F.¹ and H. Jelks²

¹Department of Biological Sciences, Loyola University New Orleans, 6363 St. Charles Avenue, New Orleans, Louisiana, 70118

²Southeast Ecological Science Center, US Geological Survey, 7920 NW 71st Street, Gainesville, Florida, 32653

Pinewoods darters (*Etheostoma mariae*) are small benthic fish found in first and second order streams in the sandhill region of North and South Carolina, USA. Pinewoods darters have special conservation status in North and South Carolina and have been recommended as a candidate species for the federal Endangered Species List. Rohde and Arndt (1991) assessed distribution and status of pinewoods darters and found that habitat deterioration resulted in extirpation of this species from 31% of historical collection localities. The primary objective of this study was to revisit most of the sites sampled by Rohde and Arndt to evaluate present conservation status of pinewoods darters. Using mask and snorkel, we removed darters with plastic nets during three consecutive passes. Pinewoods darters were present at 78.7% of sites sampled. We also found pinewoods darters at 13 sites within the Little Pee Dee and 13 sites within Lumber River drainages where they were considered extirpated or where they had not been collected in previous surveys. Average abundance of pinewoods darters was 15.6 fish per 10 m of stream and ranged from 0 to 50.4 per reach. Tessellated darters (*E. olmstedii*) co-occurred with pinewoods darters at 69.7% of our census sites, averaged 15.6 fish per 10 m of stream, and ranged from 0 to 57.2 per reach. Pinewoods darters occupied aquatic vegetation, detritus, twigs, fibrous root mats, and other forms of cover, especially along the margins of streams. Tessellated darters were found throughout stream reaches, including barren sand in the middle of channels. Visual censuses provide quantitative baseline data to assess future changes in abundance and conservation status of pinewoods darters.

Presenter: Kaintz, M.; Email: mkaintz@wlf.louisiana.gov

Summer patterns of microhabitat use by blackbanded darters

Kaintz, M.¹ and F. Jordan²

¹Inland Fisheries Division, Louisiana Department of Wildlife and Fisheries, 2000 Quail Drive Baton Rouge, Louisiana, 70808.

²Department of Biological Sciences, Loyola University New Orleans, 6363 St. Charles Avenue, New Orleans, Louisiana, 70118.

Blackbanded darters (*Percina nigrofasciata*) are small benthic fish found in streams of the Gulf and southern Atlantic Coastal Plains. Working in streams on Eglin Air Force Base in northwestern Florida, we quantified abundance of blackbanded darters and examined their patterns of microhabitat use during the summer of 2002. Fish were counted in 17 separate 20-m stream sections while snorkeling and their positions were marked with size-coded survey flags. We then determined the substrate type, bottom flow, midwater flow, canopy cover, distance to bank, distance to open sand, and depth for each fish. We observed 500 blackbanded darters. On average, each 20-m reach of stream contained 29±22 blackbanded darters (range 3-94). Blackbanded darters preferred streams that were relatively deep, fast, wide, and covered by a well-developed canopy. Fish were typically found on or near patches of sand. Patterns of microhabitat use varied among size classes and may reflect differences in vulnerability to predators. Larger fish occupied deeper and faster flowing water than small fish. Similarly, larger fish were more likely to occupy open sand and stray further away from abundant cover along stream margins.

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Presenter: **Kerns, J.A.**; Email: Janice.Kerns@ufl.edu

Measuring fishing mortality across a broad spatial range for freshwater systems

Kerns, J.A.¹, M.S. Allen¹, and J.R. Dotson²

¹ Department of Fisheries and Aquatic Sciences, University of Florida, 7922 Northwest 71st Street, Gainesville, Florida 32653

² Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute - Freshwater Fisheries Research; 601 West Woodward Avenue, Eustis, Florida 32726

Fisheries scientists typically obtain fishing mortality estimates using tagging studies conducted within single lake basins or defined sections of rivers. Mortality estimates are essential to develop management plans for a fishery, and estimates are frequently extrapolated to other systems. The purpose of this study is to evaluate an inexpensive method for assessing fishing mortality for largemouth bass across a broad spatial scale. This objective was complete by employing a passive tag reward study across a largemouth bass management regulation area within central Florida. The lakes within this region potentially represent a wide range of exploitation rates, trophic levels, fish abundance, and recruitment levels. In the first year of this study a total of 503 fish were tagged, of which, approximately half were tagged with high reward tags (\$200) and the other half were tagged with low reward tags (\$5). To date 81 tags have been returned with 24 fish reported as harvested. The study design will not provide exploitation estimates for any specific lake due to a low number of tagged fish per lake, but will provide an estimate of the overall fishing mortality for the region. The results of this study provide critical information needed to identify management strategies (e.g., harvest restrictions) that could improve recreational fisheries and be particularly helpful with improving trophy fisheries, which are an important economic aspect of fisheries in Florida.

Presenter: Kerstetter, D.W.; Email: kerstett@nova.edu

Habitat utilization and short-duration movements of the pelagic stingray *Pteroplatytrygon violacea* in the western North Atlantic

Weidner, T. and D.W. Kerstetter

Nova Southeastern University Oceanographic Center, 8000 North Ocean Drive, Dania Beach, FL 33004

The pelagic stingray *Pteroplatytrygon violacea* is the only true pelagic dasyatid stingray, and the species is commonly encountered as bycatch in the pelagic longline fishery targeting swordfish and tunas. However, very little is known about its habitat utilization and whether depth or temperature differences between the pelagic stingray and the pelagic longline gear type could be used to develop fisheries bycatch mitigation techniques. Three pop-up satellite archival tags (PSATs) with 13-day deployment durations were deployed on pelagic stingrays in 2010 in both the South Atlantic Bight (n=1) and the northern Gulf of Mexico (n=2). Data from these tags indicate a clear diel difference in behavior, with all three animals displaying deeper depth utilizations during daylight periods. All three animals also displayed frequent short-duration (*ca.* 5-minute lengths) movements of more than 50 m from the "baseline" depth of the diel period and a thermal range of approximately 8° C over a 24-hour period.

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Presenter: Kuklinski, K.E.; Email: kkuklinski@odwc.state.ok.us

Using Passive Integrated Transponder (PIT) tags to determine the interconnectivity of the striped bass fishery along the Arkansas River, Oklahoma

Kuklinski, K.E.

Oklahoma Fishery Research Laboratory, 500 E. Constellation, Norman, OK 73072

The Arkansas River system in Oklahoma supports one of the few inland populations of naturally reproducing striped bass (*Morone saxatilis*) in the southeastern United States. Oklahoma Department of Wildlife Conservation (ODWC) staff collect striped bass broodstock from the river to produce striped bass and hybrid striped bass for ODWC stocking programs throughout the state, making this a highly valuable fishery. Recent proposals by Tulsa County, OK and legislative entities may threaten the striped bass fishery in the Arkansas River. The proposed Arkansas River Corridor (part of Tulsa County's Vision 2025 Plan) incorporates the establishment of numerous low-water dams throughout Tulsa County on a stretch of river from Keystone Dam to the Tulsa/Wagoner County line (68 km) for enhancing aesthetic quality and development opportunities. The proposed series of low-water dams along the Arkansas River in Tulsa County may impact movements and reproductive success of resident striped bass. In 2009, age structure analysis of 605 striped bass in the study area revealed fast growth through age-8+. 141 creel surveys from 2009 revealed that striped bass anglers harvest 69% (493 of 715) of fish caught, and that the average length of a harvested striped bass was 624 mm. In 2010, 340 individuals were implanted with PIT tags and ten fish have been recaptured. One individual was recaptured in the Lower Illinois River after being initially tagged in the Eufaula tailwaters more than three months earlier and about 65 river kilometers apart. The presentation will cover results to date including management implications and future study plans.

Presenter: **Lang, E.T.**; Email: erik.lang@eagles.usm.edu

Seasonal and tidally-driven reproductive patterns in the saltmarsh topminnow (*Fundulus jenkinsi*)

Lang, E.T.¹, N.J. Brown-Peterson¹, M.S. Peterson¹, and W.T. Slack²

¹ Department of Coastal Sciences, University of Southern Mississippi, Ocean Springs, MS

² U.S. Army Engineer Research and Development Center, Vicksburg, MS

Fundulus jenkinsi is recognized federally and within a number of northern Gulf of Mexico states as a Species of Concern. Little is known about its life history, but a detailed reproductive histology study of *F. jenkinsi* can provide the foundation needed to quantify reproductive parameters in this rare species in need of conservation. Monthly gonadosomatic index (GSI) of male and female *F. jenkinsi* indicated a spawning season from April through August. However, ovarian histological analysis suggested March through August was a more accurate spawning season. The multiple oocyte stages within *F. jenkinsi* in the Spawning Capable reproductive phase indicates batch spawning, similar to other members of its family. Although many estuarine members of the family Fundulidae exhibit a semi-lunar spawning pattern, the oocyte composition of *F. jenkinsi* ovaries suggested spawns occur multiple times between spring tides both within a population and on the individual level. Spawning did not occur on neap tides, and no late secondary growth vitellogenic oocytes (SGI) were found in females captured during neap tide. The lack of SGI oocytes in females during the spawning season suggests the necessity for establishing a new sub-phase within the Spawning Capable phase, termed the Redeveloping sub-phase. This new sub-phase is applicable to other batch spawning species with group synchronous oocyte development. This work contributes an estimation of *F. jenkinsi* spawning frequency that may be pertinent to its conservation and also provides another link to vital salt marsh habitat surfaces across its range.

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Presenter: **Lauretta, M. V.**; Email: mattvl@ufl.edu

Habitat mediated trophic dynamics within spring-fed, coastal rivers

Lauretta, M.V., W.E. Pine, and T.K. Frazer

University of Florida, Program in Fisheries and Aquatic Sciences, 7922 NW 71st St, Gainesville, Florida 32653

Anthropogenic impacts to freshwater and marine environments, including modified biogeochemical cycling, can affect ecosystem productivity and alter producer community composition. However, the responses of upper trophic levels to changes in producer communities are not well understood. We studied the producer, invertebrate and fish communities in two coastal rivers in Florida to examine population-level impacts to freshwater and marine fishes from large-scale changes in submersed aquatic vegetation. Both rivers were historically comprised of dense macrophyte communities, but precipitous declines in aquatic vegetation over the last decade have resulted in altered producer communities. We estimated the biomass of producers, invertebrates and fishes biannually over a three-year period, and examined the diets of fishes to quantify prey composition. We created a trophic mass balance model to map energy pathways from producers to consumers and simulated a long-term ecosystem time series to predict fish population responses to changes in producer composition and biomass. Our results indicated that vegetative habitat loss impacts individual species disproportionately resulting in altered community composition and trophic interactions of freshwater and marine fishes. This information about the influence of producer communities on upper trophic level dynamics is critical to understanding coastal ecosystem responses to large-scale environmental changes.

Presenter: Lee, C.; Email: Corey.Lee@myFWC.com

Post-hurricane recovery of black crappie and largemouth bass fisheries on Lake Okeechobee, Florida

Lee, C.W., A. Jordan, B. Bachelder, and D. Fox

Florida Fish and Wildlife Conservation Commission, 3991 SE 27th Court, Okeechobee, FL 34974

Largemouth bass (*Micropterus salmoides floridanus*) and black crappie (*Pomoxis nigromaculatus*) fisheries on Lake Okeechobee are worth tens of millions of dollars annually to the economies surrounding the lake from both tournaments and recreational angling. These fisheries were nearly wiped out when a series of events combined to create the “perfect storm” on the lake. Lake Okeechobee had been operated at a high regulation schedule to provide flood relief and to act as a secondary water supply for much of South Florida in drought events. In 2004, back-to-back hurricanes (Frances and Jeanne) within 20 days landed direct hits on the lake creating a seiche of 2.6 m and 3.5 m for each storm, respectively, from the south to north ends of the lake. This wave energy destroyed the vegetation in the littoral edge of the lake—critical habitat to both bass and crappie as foraging area, spawning habitat, and nursery to juvenile fish—and also stirred up sediments that impeded light penetration which prevented re-growth of aquatic vegetation. In 2007-08, Lake Okeechobee experienced a record drought that allowed much of the littoral edge to experience re-growth of both emergent and submerged vegetation. The drought also had a negative impact on fisheries in the lake, severely limiting available habitat. In August 2008, Tropical Storm Fay landed on South Florida and pounded the Okeechobee basin increasing the Lake Okeechobee water level four feet in less than one month, which moved water back into the shallow marsh allowing the aquatic vegetation re-growth to expand. This dynamic shift in water and vegetation allowed for increased forage fish populations and large, previously unavailable spawning areas for both bass and crappie. Largemouth bass CPUE has achieved levels not seen in over a decade and crappie CPUE continues to increase from historic lows in the long-term data set.

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Presenter: Leone, F.J.; Email: fjleone@agfc.state.ar.us

Population characteristics of paddlefish in the Arkansas River, Arkansas: Implications for the management of an exploited fishery

F.J. Leone¹, J.N. Stoeckel², and J.W. Quinn¹

¹ Arkansas Game and Fish Commission, 2 Natural Resources Drive, Little Rock, Arkansas, 72205

² Fisheries and Wildlife Program, Arkansas Tech University, Russellville, Arkansas, 72801

Paddlefish *Polyodon spathula* (n = 751) were collected with gill nets from three navigation pools (Pool 13, Ozark Lake, and Lake Dardanelle) of the Arkansas River, Arkansas from 2003 through 2005 to assess population characteristics and to determine the effects of exploitation. Paddlefish collected ranged from 558 mm to 1088 mm eye to fork length (EFL; mean = 914 mm), 1.6 to 21.4 kg (mean = 11.6 kg), and 4 to 16 y (n = 544). Mean catch-per-unit-effort was 0.96 fish/108 m² of gill net/24-hr and was lowest for Lake Dardanelle sampling. Paddlefish sampled from Lake Dardanelle had higher absolute fecundity, relative weight, predicted length infinity (L_{∞}), and annual mortality values than those captured from other pools. The yield-per-recruit option in Fisheries Analyses and Simulation Tools (FAST) indicated that both growth overfishing and recruitment overfishing likely occurred prior to 2003 with a minimum length limit (MLL) of 813-mm, recruitment overfishing would likely occur at Lake Dardanelle with a 914-mm MLL, but would not likely occur with a 940-mm MLL. Our results indicate that navigation pools on the Arkansas River need to be treated as separate management units depending on available habitat, and paddlefish in Lake Dardanelle appeared to be more vulnerable to overharvest than those from the more riverine Pool 13.

Presenter: Ley, J.; Email: Janet.Ley@MyFWC.com

Common snook movements across the boundary of the Kennedy Space Center Estuarine Reserve

Ley, J.A.¹, E.A. Reyier², J. Dutka-Gianelli³

¹ Florida Fish & Wildlife Commission, 100 8th Avenue Southeast, St. Petersburg, Florida 33701

² IHA Environmental Services, Mail Code: IHA-300, Kennedy Space Center, Florida 32899

³ Florida Fish & Wildlife Commission, Indian River Field Lab, 1220 Prospect Avenue, Suite 285, Melbourne, Florida 32901

Spatial approaches to fisheries management may include establishing no-take reserves, where fishing is prohibited but spillover and enhanced recruitment are expected to benefit surrounding fisheries. The 24km² Banana River No-Take Reserve (BRNTR), established in 1962 within the Kennedy Space Center security area, is a prime example of a long-term no-take reserve. To document common snook (*Centropomus undecimalis*) movements in relation to the BRNTR, acoustic transmitters were surgically implanted in 30 individuals (532-852mm TL) in Aug/Nov-2009. Over 160 receivers spanning 300km² have been used to detect acoustically-tagged fish during the subsequent 15 months. Most snook movements out of the BRNTR occurred during two periods: (1) ten left during a cold-snap in Oct-2009, and (2) ten more left as temperatures gradually cooled during Nov-2009. When a record cold event occurred in Jan-2010, only ten of the tagged snook remained within the BRNTR. Most of these snook (n=8) died in deep man-made basins when water temperatures fell below 10⁰C. Currently, none of the 30 snook remain alive within the BRNTR. Of the survivors that migrated, 17 have been detected in/near oceanic inlets south of the reserve (<190km). Because BRNTR is near the northern boundary of snook distribution, the Oct/Nov-2009 cold periods may be typical of autumn events that trigger southward migrations, promoting mixing within the east coast population. However, the Jan-2010 cold event was extreme, and snook that had not migrated south earlier in the season died. Survival may be possible for non-migrants in the BRNTR during less severe winters, and thus learned behavior may explain why some individuals chose not to migrate. The current investigation illustrates how extreme events can severely deplete the population of a singular no-take reserve. To be effective as fisheries management

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tools, multiple no-take reserves should be spread throughout the range of the focal species, to avoid the risk of putting all your eggs in one basket.

Presenter: Lindberg, W.; Email: wjl@ufl.edu

Intrinsic habitat quality: Implications for fisheries independent monitoring with gag as an example

Lindberg, W.¹, M. Christman², D. Marcinek¹, Z. Biesinger¹, and T. Bohrmann²

¹ Program in Fisheries and Aquatic Sciences, School of Forest Resources and Conservation, University of Florida, P.O. Box 110600, Gainesville, FL 32611-0600

² Department of Statistics and the School of Natural Resources and Environment, University of Florida, P.O. Box 110339, Gainesville, FL 32611-0339

Fisheries-independent annual indices and trends of gag abundance for 2001 through 2010 were developed by an approach that controls effects of intrinsic habitat quality at sampling sites. We hypothesized, based on theory (MacCall 1990) and prior experiments (Lindberg et al. 2006), that trends in gag abundance (i.e., rates of change) would be affected by intrinsic habitat quality, and that gag census data from replicate reefs of two different intrinsic qualities would yield an interaction of year*habitat quality, with the lower quality habitat showing a faster decline (or the higher quality habitat showing a faster increase). This prediction for a declining stock was corroborated by log-linear trend analysis. However, given (a) the incorporation of episodic natural mortality in the updated gag stock assessment model, (b) at least two recent strong year classes of gag, and (c) the anticipation of stock recovery following management actions, we also examined non-linear mixed models for the predicted trends and interaction within a time-series expected to have periods of both decrease and increase in fish abundance. Replicate fixed sampling sites (N=132) were sampled once each summer (June-September) by the same skilled science divers using a standardized underwater visual census (UVC). Log-transformed gag counts were modeled using a mixed model in PROC GLIMMIX in SAS® v9.2. For this 10-year time-series, a statistically significant model included higher order trends and year*habitat interactions. The relatively lower quality habitat had an overall significant declining linear trend while the relatively higher quality habitat had a significant quartic trend. Inflexions in the quartic trend coincide with the episodic natural mortality and strong YOY year classes. This reinforces prospects for habitat-based fisheries independent indices of gag abundance being more sensitive to changes in stock size than fisheries independent indices that disregard intrinsic habitat quality.

Presenter: Lochmann, S.E.; Email: slochmann@uaex.edu

Do cannibalistic hybrid striped bass grow faster than their siblings?

Lochmann, S.E., L.A. Will, C.L. Williams, M.L. Warner, A.J. Williams, B. Baker, and B.A. Timmons

Aquaculture/Fisheries Center, University of Arkansas at Pine Bluff, 1200 N. University Dr., Mail Slot 4912, Pine Bluff, AR 71601

During two one-week studies, large hybrid striped bass larvae were exposed to daily diets of formulated feed alone, smaller hybrid striped bass larvae alone, or both feed and larvae. Fifteen 3.87-L glass jars were filled with 3 L of dechlorinated water. Aeration was provided by individual aquarium pumps. During the first study, larvae were stocked at a density of four large larvae per jar. In jars with feeding treatments of larvae only or feed and larvae, ten smaller larvae were stocked. The number of smaller larvae was daily replenished to remain at a density of ten larvae per jar. Jars with treatments of feed only, and both feed and larvae, were fed twice daily ad libitum. During the second study, only one large larva was stocked in each jar, with three smaller larvae stocked in jars according to the same treatments as study one. In study one, there was no significant difference in growth among treatments ($F =$

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1.18, $df = 11$, $P > 0.05$). In study two, there were significant differences among the treatments ($F = 5.28$, $df = 11$, $P < 0.05$). The growth rate of the feed and larvae treatment was 0.59 mm/d faster than the feed only treatment. Cannibalism in the larvae only treatment usually accounted for losses of 1-2 larvae/cannibal/day. Cannibalism had a positive effect on growth rate. Large larvae exhibit faster growth because of efficient feeding and cannibalism.

Presenter: Lochmann, S.E.; Email: slochmann@uaex.edu

Feeding natural zooplankton to alligator gar fingerlings in tanks

Lochmann, S.E., L.A. Will, C.L. Williams, M.L. Warner, A.J. Williams, B. Baker, and B.A. Timmons

Aquaculture/Fisheries Center, University of Arkansas at Pine Bluff, 1200 N. University Dr., Mail Slot 4912, Pine Bluff, AR 71601

Growth and survival of alligator gar larvae fed formulated feed and wild zooplankton, formulated feed and *Artemia* nauplii, or formulated feed, *Artemia* nauplii and wild zooplankton, from 5-21 dph were examined. Alligator gar fed formulated feed alone served as a control. Larvae were stocked into 75-L tanks at 2 larvae/L. There were two replicates of each treatment and two controls in each of four recirculation systems. Larvae offered live feed were fed at a rate of 5 prey mL⁻¹.d⁻¹ of wild zooplankton or *Artemia* nauplii. Larvae fed both types of live prey were fed at a rate of 10 prey.mL⁻¹.d⁻¹. All larvae were offered formulated feed at a rate of 10% of body weight/d. At 12 dph, there was a significant difference in growth ($F = 7.50$, $df = 31$, $P < 0.001$), with the formulated feed and *Artemia* nauplii treatment having faster growth than the control. At 21 dph, there were significant differences in growth among treatments ($F = 3.57$, $df = 31$ $P = 0.026$). The formulated feed and *Artemia* nauplii treatment had a significantly higher growth rate than the other two treatments and the control. However, the growth rate of *Artemia* and feed was only 0.16 mm/d faster than the control. There were no significant differences in survival among treatments and the control. When time and costs are considered, the feed only treatment appears to be the most appropriate treatment for raising alligator gar to 21 dph.

Presenter: Lombardi, L.; Email: linda.lombardi@noaa.gov

Reproductive parameter choices during the SEDAR assessment of tilefish and yellowedge grouper in the Gulf of Mexico

Lombardi, L.¹, G. Fitzhugh¹, J.F. Walter III², B. Linton², and M. Cook³

¹ NOAA Fisheries Service, Southeast Fisheries Science Center, Panama City, FL

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

³ NOAA Fisheries Service, Southeast Fisheries Science Center, Pascagoula, MS

Parameterizing reproduction in fish stock assessments represents a tradeoff between complex, parameter and data-intensive models that could, in theory, capture biological reality or models which reduce complex reproductive biology to simpler equations and few parameters. Stock assessments for Gulf of Mexico golden tilefish (*Lopholatilus chamaeleonticeps*) and yellowedge grouper (*Epinephelus flavolimbatus*) were recently conducted through the Southeast, Data, Assessment and Review (SEDAR) process. Both species are protogynous but not all tilefish are born female, nor do all fish appear to change discretely into males. Both species were assessed using two models: Stock Synthesis (SS) and Stochastic Stock Reduction Analysis (SRA). SS explicitly models (and can estimate) length at maturity, the probability of sex change at age, explicit relationships for fecundity as well as differential growth, mortality and even fishery or survey selectivity for males and females. In contrast, SRA only incorporates a fixed length at maturity and does not explicitly model sex change. Particularly for hermaphroditic species, it is not clear which measure (female only, both males and females or male only) is the most appropriate

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measure of spawning stock biomass (SSB). Furthermore it is not always clear that we have the data to either externally derive or internally (within the model) estimate the parameters to quantify complex life histories. In this paper we compare the two approaches: simple (SRA) and complex (SS) to modeling reproduction and explore implications of different proxies for SSB given complex reproductive life histories.

Presenter: Lopez, D.; Email: jdltclay@aol.com

Characteristics, attitudes, and expenditures of tournament anglers at Lucchetti Reservoir, Puerto Rico

Lopez, D.¹ and K.M. Hunt^{2*}

¹ Puerto Rico Department of Natural and Environmental Resources, HC 01 Box 6322, Yauco, PR 00698

² Human Dimensions & Conservation Law Enforcement Laboratory; Department of Wildlife, Fisheries, and Aquaculture, Mississippi State University, Box 9690, Mississippi State, MS 39762-9690

* Corresponding author: kmhunt@cfr.msstate.edu

Lucchetti Reservoir is highly sought after by fishing clubs in Puerto Rico as a site for largemouth bass tournaments. Annually, 24 tournaments are held at Lucchetti and tournament anglers make up the majority (75%) of fishing effort at the reservoir. In 2010, a self-administered mail questionnaire was developed to determine tournament angler characteristics, trip characteristics on their most recent tournament fishing trip at Lucchetti, and their attitudes toward regulations and facilities. Member lists were obtained from 10 fishing clubs which resulted in a sample of 336 tournament anglers. About 46% of anglers (n=144) responded to the survey. Tournament anglers were almost exclusively male (99%), and fished an average of 43 days and participated in 14 bass tournaments in the previous year. About 73% of anglers felt live wells should be required during tournaments and 80% supported catch and release during tournaments. Most anglers (75%) were supportive of the 305mm length limit on bass, but only 44% were supportive of the 12-fish bag limit. Most (55%) were supportive of reducing the daily bag limit to 5-fish or converting to a catch and release fishery (64%). On their most recent tournament trip to the reservoir, anglers spent an average of US \$247 on trip-related expenditures with 43% of monies spent in the municipality surrounding the reservoir. Most anglers indicated that satisfaction could be increased with updates to various reservoir facilities. Results of this study have provided management personnel with a better understanding of how management strategies affect anglers, and the monetary impacts of tournaments to the local economy. Additionally, the survey process made tournament anglers feel that they were part of the management process, and identified where agency and angler thought differ on important issues related to the fishery.

Presenter: Lorenzen, K.; Email: klorenzen@ufl.edu

Appraising the potential for hatchery enhancement of common snook *Centropomus undecimalis* on the Florida Gulf Coast to contribute to fisheries management goals

Lorenzen, K.¹, K.M. Leber², L. Barbieri³

¹ School of Forest Resources and Conservation, University of Florida, 7922 NW 71st St., Gainesville, FL 32653

² Mote Marine Laboratory, 1600 Ken Thompson Parkway, Sarasota, FL 34228

³ Fish and Wildlife Research Institute, 100 Eighth Avenue SE, St. Petersburg, FL 33701

The common snook *Centropomus undecimalis* stock of the Florida Gulf coast supports an important recreational fishery. Fishing effort has risen continuously and the stock is overfished with a current spawner biomass at about 20% of the unexploited level. We use a population model to assess the potential of more restrictive fishing regulations and aquaculture-based stock enhancement to improve fisheries catch rates and stock conservation status. A 50% reduction in fishing effort (through access restriction) or a switch to catch-and-release angling only would be

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required to improve catch rates two-fold and restore spawner biomass to 40% of the unexploited value. Aquaculture-based enhancement using reproductively competent hatchery fish could achieve this goal without further fishing restrictions, but would substantially reduce the truly wild component of spawner biomass. Releasing sterile hatchery fish would meet catch rate targets without affecting total spawner biomass or replacing truly wild with hatchery-type spawners. Aquaculture-based enhancement has the potential to expand management options but involves complex considerations and tradeoffs that are as yet poorly appreciated in fisheries management.

Presenter: Lowerre-Barbieri, S.; Email: Susan.Barbieri@myFWC.com

Reproductive timing strategies in marine fish: reproductive opportunities, drivers, and constraints

Lowerre-Barbieri, S.K.¹, K. Ganias², F. Saborido-Rey³, H. Murua⁴, and J.R. Hunter⁵

¹ Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission, St. Petersburg, FL 33701

² Laboratory of Ichthyology, School of Biology, Aristotle University of Thessaloniki, Thessaloniki 54124 Macedonia, Greece

³ Institute of Marine Research (CSIC) Eduardo Cabello 6 36208 Vigo, Spain

⁴ AZTI Tecnalia, Herrera Kaia, Portualde z/g, Pasaia (20110), Basque Country, Spain

⁵ jhunter6@san.rr.com

Reproductive timing, i.e., the temporal pattern of reproduction, is considered to be a fundamental aspect of a species' life-history strategy. Because of this, variability in reproductive timing has long been studied by ecologists, and components of reproductive timing are well-established in our understanding of fish population growth, especially the onset of sexual maturity. This reproductive trait is incorporated into models of population productivity through estimates of spawning stock biomass and through simulations of life-history tradeoffs, such as reproductive opportunities versus survival, reproductive opportunities versus growth (i.e., r versus K), and individual fitness tradeoffs associated with reproducing early versus late. Birth date also affects population growth of marine fishes, and has long been acknowledged in terms of the match or mismatch between spawning seasonality and optimal conditions for larval survival. However, to improve our ability to predict a population's resilience both to fishing and other stressors, such as climate change, we need to better understand the inherent variability in a population's reproductive timing. In this presentation we synthesize important advances made in understanding reproductive timing from various fields, including: reproductive physiology, aquaculture, and ecology. We begin by developing the concept of reproductive timing strategies, integrating reproductive traits over multiple temporal scales and presenting the range of lifetime reproductive opportunities and their relationship with reproductive lifespan in exploited marine fishes. We then review what is known about oocyte dynamics and endocrine control necessary to support these patterns. Ultimate and proximate cues driving reproductive timing are then discussed within a spatial and energetic context. We conclude with a comparison of warmwater and coldwater habitats and how they will affect reproductive timing strategies and the need to better understand linkages between energetic thresholds and gonadal development.

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Presenter: Mann, D.; Email: dmann@marine.usf.edu

Mapping grouper spawning aggregations with passive acoustics

Mann, D.¹, J. Locascio¹, C. Wall¹, M. Montie¹, M. Scharer², C. Koenig³, M. Nemeth², F. Coleman³, and R. Appeldoorn²

¹ University of South Florida, College of Marine Science, 140 7th Ave. South, St. Petersburg, FL 33701

² University of Puerto Rico-Mayaguez, Department of Marine Sciences, Isla Magueyes, La Parguera, 00667 Lajas, Puerto Rico

³ Florida State University, Coastal and Marine Laboratory, St. Teresa Beach, FL 32358

Passive acoustic recordings were used to study the behavior of red hind (*Epinephelus guttatus*) at spawning aggregation sites off of Puerto Rico and Mona Island, and goliath grouper (*Epinephelus itajara*) and red grouper (*Epinephelus morio*) on the West Florida Shelf (WFS). The sounds produced by each species were unique, low-frequency pulsed sounds associated with reproductive-related behavior. Male red hind produced sounds composed of a series of pulses that graded into a tonal-like sound, mostly during territorial patrolling. Long-term acoustic recorder data from the west coast of Puerto Rico and Mona Island showed similar diel periodicities of sound production of red hind, but had different monthly peaks in sound production. Goliath grouper sounds consisted of low-frequency individual pulses (50-100 Hz) and were produced with a lunar periodicity. Peaks in sound production occurred nightly after midnight, but sounds were also produced throughout the day. Sound production and associated behavior of red grouper were recorded using a remotely operated vehicle (ROV) at depths of 80-100 m. Red grouper sounds were similar to those made by red hind. Shelf-scale mapping of red grouper sound production is being performed with Slocum gliders, which are relatively quiet autonomous vehicles. Passive acoustic techniques can provide synoptic, long-term time series of sound production associated with reproductive activities of soniferous species at widely spaced sites.

Presenter: Marsh, S.; Shawn.Marsh@myfwc.com

Use of acoustic telemetry data to establish spawning patterns of common snook, *Centropomus undecimalis*, along Florida's East coast

Marsh, S.¹, J. Whittington¹, R. Taylor², J. Dutka-Gianelli³, J. Young¹, A. Berry¹, and B. Yeiser¹

¹ Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, Tequesta Field Lab, 19100 SE Federal Hwy., Tequesta, FL 33469.

² Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, 100 8th Avenue SE, St Petersburg, FL 33701

³ Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, Indian River Field Lab, 1220 Prospect Avenue, Suite 285, Melbourne, FL 32901

The biology, spawning patterns and distribution of common snook, *Centropomus undecimalis*, along Florida's east coast is complex. To better understand this species' ability to migrate freely between freshwater, estuarine and coastal reef habitats FWRI established an acoustic telemetry program to study common snook. FWRI strategically placed an east coast acoustic receiver array using Vemco® technology and formed a collaborative agency array known as the Florida Atlantic Coast Telemetry (FACT) group. Geographic receiver and sampling locations ranged from Kennedy Space Center Estuarine Reserve to Palm Beach inlet, including five inlets and the Sebastian, St. Lucie and Loxahatchee Rivers. During 2008-2010, 239 common snook, *Centropomus undecimalis*, were internally tagged with V-16 acoustic transmitters and passively tracked. The tagged fish ranged in length from 602 to 1109 mm TL, and were presumed sexually mature based on previous studies. Monitoring the daily movement of these snook between habitat systems indicated that spawning frequency and duration is variable and may indicate skip spawning. These observations have also provided additional measures of habitat utilization, site fidelity, and

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multiple inlet use. Preliminary results of this study have revealed that although sexually mature snook have the potential to spawn every 1-2.5 days, snook consistently move in and out of spawning aggregations, spending as much time in freshwater and estuarine habitats during a spawning season. This indicates that snook do not spend the duration of a spawning season participating with the major spawning aggregations found in the inlets.

Presenter: Mauck, M.; Email: mmauck@simplynet.net

Striped bass management in Lake Texoma: A case history

Mauck, M.

Oklahoma Department of Wildlife Conservation, 2021 Caddo Hwy, Caddo, OK 74729

Striped bass have been introduced into hundreds of inland impoundments and in several instances natural reproduction and recruitment have developed. This paper will focus on Lake Texoma (Oklahoma-Texas) where a self-sustaining population has abounded for numerous decades and has remained one of the nation's premier striped bass destinations. We will examine the environmental characteristics that have fostered natural recruitment, the historical influence on harvest management, and the importance of this resource to anglers and fisheries managers.

Presenter: McBride, R. S.; Email: richard.mcbride@noaa.gov

A reassessment of dolphinfish (*Coryphaena hippurus*) maturation, spawning frequency, and fecundity based on a histology-based appraisal of their ovaries

McBride, R.S.¹, D.J.G. Snodgrass², D.H. Adams³, S.J. Rider⁴, and J.A. Colvocoresses⁵

¹ National Marine Fisheries Service, Northeast Fisheries Science Center, 166 Water Street, Woods Hole, MA 02543

² National Marine Fisheries Service, Southeast Fisheries Science Center, 75 Virginia Beach Drive, Miami, FL 33149

³ Florida Fish & Wildlife Conservation Commission (FWC), Florida Fish & Wildlife Institute (FWRI), 1220 Prospect Avenue, Suite 285, Melbourne, FL 32901

⁴ Alabama Division of Wildlife and Freshwater Fisheries, Fisheries Section, 64 N. Union Street, Suite 551, Montgomery, AL 36130

⁵ FWC, FWRI, 100 Eighth Avenue, SE, St. Petersburg, FL 33701

Many aspects of dolphinfish reproductive biology are well known, but this study, which examined gonad histology, radically altered previous estimates of spawning frequency and annual egg production. This study examined ovarian histology of 621 females collected in three Florida regions: the Keys (south Florida, Atlantic Ocean), Cape Canaveral (east coast, Atlantic Ocean), and the Panhandle (west coast, northern Gulf of Mexico). Size at 50% maturity, 419 mm fork length, was not regionally specific, and corresponded to an age of approximately 3 months. Spawning frequency was highest in winter and spring, and as often as every other day for larger females, but evidence of spawning occurred in all calendar months. Batch fecundity (BF) ranged from 20,000 to 620,000 eggs and was significantly related to fork length (FL), $BF = 0.000005 \times FL^{3.62}$, similar to reports from other studies. Applying our new estimates of spawning frequency increased a previous estimate of annual fecundity from 0.24 – 3 million eggs per year to 15 – 174 million eggs per year. Such high values of reproductive potential, together with the small size and young age at maturity, are consistent with this species' resilience to fishing pressure.

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Presenter: McCawley, J.; email: jessica.mccawley@myfwc.com

Snook management in Florida: Successful forward movement

McCawley, J. and M. Robson

Florida Fish and Wildlife Conservation Commission, Division of Marine Fisheries Management, 2590 Executive Center Cir. E, Suite 201, Tallahassee, FL 32301

A review of the history of snook management in Florida will be given. The presentation will highlight the recent management history since the last Snook Symposium in 2006 as well as changes made as a result of the 2010 cold weather events. As a proactive management measure to protect the snook population, a statewide closure was implemented in response to the extended cold weather event in early 2010. After reviewing available information on the effects of this cold kill the Commission chose to keep the snook fishery closed to harvest on the Gulf coast through September 1, 2011. On the Atlantic coast snook harvest was opened on September 17, 2010, but will close again on December 17 and remain closed until September 1, 2011 in order to protect snook during the winter as well as during the spring and summer spawning aggregation periods. Snook stamp fee changes will also be covered as the snook stamp cost increased to \$10 on July 1, 2010.

Presenter: **McCormick, L.**; Email: mccormlr@eckerd.edu

Local leopards: The movement of *Triakis semifasciata* in La Jolla shallows

McCormick, L.¹, A. Nosal², and S. Kohin³

¹ Eckerd College, Marine Science

² Scripps Institution of Oceanography

³ NOAA, Southwest Fisheries Science Center

The Leopard Shark, *Triakis semifasciata*, is a coastal Triakid hound shark ranging from the northern United States to Baja, Mexico. Large aggregations of this species, composed primarily of mature females, are commonly seen in the ecological reserve off La Jolla Shores Beach and other shallow coves in southern California from July to October. The purpose of their presence is unknown, but generates enormous public interest as a local tourist attraction and mascot. In a preliminary study, *T. semifasciata* were in La Jolla Shores during daylight hours, but absent during high tides. The purpose of this study was to see whether females moved to Devil's Slide, a nearby, shallow rocky reef where they had been observed on several occasions. Seventeen female sharks were tagged in La Jolla in 2009-2010 with passive acoustic tracking technology (Vemco: V16 T/P, V9 A/T/P, and V16 Pinger tags) and detected by underwater receivers (Vemco: VR2W) existing in La Jolla shores and newly deployed in Devil's Slide. Data were collected from June 18, 2010 to July 26, 2010 and over 26,000 detections were analyzed to determine movement patterns between the two locations in comparison to the local tides. Individuals were sporadically present with no discernable pattern of movement, and it was concluded that although *T. semifasciata* utilized both areas, there was no preference for either location during high tide. The destination of the movement has yet to be found, opening the possibility for further research through active tracking, temporary accelerometer tagging, or additional receiver locations.

Presenter: **McDonnell, A.W.**; Email: amcdonnell@cfr.msstate.edu

Enhancing ecological services in earthen ponds for 21st century fish production

McDonnell, A.W.¹, R. Kröger¹, and C.S. Tucker²

¹Mississippi State University, Department of Wildlife, Fisheries, and Aquaculture, P. O. Box 9690, Mississippi State, MS 39762

²Thad Cochran National Warmwater Aquaculture Center, 127 Experiment Station Road, P. O. Box 197, Stoneville, MS 38776

The need for increased catfish production has led to innovative culture strategies. The partitioned aquaculture system developed by researchers at Clemson University physically separates the fish holding and oxygen production/waste treatment functions of ponds, allowing for better control of these processes. The partitioned aquaculture system, however, is too management-intensive for commercial use. Scientists at Mississippi State University's, Thad Cochran National Warmwater Aquaculture Center, have developed a split pond system which is less intensive and uses existing ponds for retrofit construction rather than relying on entirely new construction. The key criterion in the split pond design is providing efficient nitrogen removal for improved water quality. During the day, a low speed paddlewheel housed within the split pond circulates water between the fish and oxygen production/waste treatment compartments. At night, mechanical aeration provides sufficient oxygen concentrations on the fish side while the oxygen production/waste treatment side is un-aerated. We compared traditional earthen and split pond hourly nitrogen concentrations by month throughout the culture growing season. Data were analyzed to identify statistical differences in nitrogen concentrations as a function of pond and month. Total inorganic nitrogen (mg/L) concentrations in the earthen pond (median = 2.16) were statistically greater than concentrations in both compartments of the split pond ($P < 0.01$). In comparison, there were no statistical differences in total inorganic nitrogen between the fish compartment (median = 1.53) and the waste compartment (median = 1.44) of the split pond ($P = 0.48$). These preliminary results suggest the split pond may be a viable option for catfish farmers because it has the ability to supply the fish with increased oxygen and enhance nitrogen removal processes relative to that of a traditional earthen pond.

Presenter: **McKinney, J.**; Email: Jennifer.mckinney@eagles.usm.edu

Distribution modeling of whale sharks, *Rhincodon typus*, in the northern Gulf of Mexico

McKinney, J., E. Hoffmayer, W. Wu and R. Fulford

Department of Coastal Sciences, Gulf Coast Research Laboratory, The University of Southern Mississippi, 703 East Beach Drive, Ocean Springs, 39564,

Whale sharks, *Rhincodon typus*, have a circumglobal distribution and are thought to be highly migratory. Due to their protected status, understanding critical habitat is essential for proper management. The goal of this study was to describe the probable distribution of whale sharks in the northern Gulf of Mexico using Maximum Entropy (MaxEnt) and Ecological-Niche-Factor-Analysis (ENFA), two algorithms designed for predicting species distribution. This study also aimed to determine the environmental suite associated with whale shark occurrence in the region. Models were developed using sightings locations with feeding animals (>2 individuals) for the temporal period of June through September of 2008 and 2009 with the following predictor variables: bathymetric slope, distance from physical features and remotely sensed sea surface temperature, chlorophyll concentrations and sea surface height anomalies. Cohen's kappa and the area under the receiver operating characteristic curve (AUC) were used to evaluate model performance with an external testing dataset. Kappa values ranged from 0.28 – 0.69 and AUC values ranged from 0.73 – 0.80, indicating that the predicted distribution had a fair to substantial agreement with the testing data. Distance to continental shelf edge, petroleum platforms and chlorophyll were the predominant contributors to model output. These predicted associations are ecologically meaningful, in that whale sharks may be exploiting regions of high food availability (i.e., upwelling along the shelf edge increases primary productivity), or

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mechanistic caused by observer bias on or near petroleum platforms. The spatial distribution of suitable habitat is dynamic; therefore, it is recommended that this approach be expanded over a longer study period in order to delineate long-term trends in distribution and consistent areas of high suitability. This study demonstrated the advantages of combining multiple modeling approaches when studying a species' ecological preference.

Presenter: Mitchell, W.; Email: warren.mitchell@noaa.gov

A review of fishery-independent sampling programs in southeastern U.S. coastal waters: where does a new effort fit in?

Mitchell, W.¹, M. Reichert², N.M. Bacheler¹, and G.T. Kellison¹

¹National Marine Fisheries Service, Southeast Fisheries Science Center, 101 Pivers Island Road, Beaufort, NC 28516

²SC-Dept. Natural Resources, Marine Resources Research Institute, 217 Fort Johnson Road, Charleston, SC 29412

Over many decades, fishery-independent time series have been important to the fisheries management process for reef fish. Here we review surveys known to exist in southeastern US Atlantic Ocean waters, and provide examples of data applications. As in the Gulf of Mexico, Atlantic reef fish surveys focus on various habitats, species, and life history stages, and are supported by a mixture of state and federal funding. To date, relative abundance and life history data from state and federal surveys have contributed to the assessment of several taxonomic groups, including tilefish, sea bass, groupers, snappers, jacks, and porgies. Following a 2009 workshop hosted by the South Atlantic Fishery Management Council and NOAA Fisheries Southeast Fisheries Science Center, additional efforts to monitor reef fish resources were funded and initiated in 2010. Efforts were designed to complement ongoing surveys by the Marine Resources Monitoring, Assessment, and Prediction (MARMAP) Program based in South Carolina, and incorporate additional survey methods. The newly-created Southeast Fisheries-Independent Survey (SEFIS) group, based in Beaufort, NC, was tasked with increasing fishery-independent sampling efforts in southeast US coastal waters to address both immediate (e.g., red snapper) and long-term data needs. Various scientific objectives were addressed during 63 SEFIS at-sea days in 2010; chevron trap samples were a primary focus (n=484), with high-definition video cameras attached to 98% of traps. Beyond a historical overview and description of recent efforts in southeastern US Atlantic Ocean waters, this review will conclude by introducing two symposium objectives: (1) to foster a collective awareness of recent changes to regional fisheries-independent monitoring surveys, and (2) initiate discussions on the further integration of data from these surveys to improve our understanding of reef fish resources throughout the southeastern US.

Presenter: Miyazono, S.; Email: seiji.miyazono@ttu.edu

Spatiotemporal patterns of desert stream fish assemblages relative to local and regional processes in the Trans-Pecos region of Texas

Miyazono, S. and C.M. Taylor

Department of Natural Resources Management, Goddard Hall Box 42125, Texas Tech University, Lubbock, TX 79409

The Rio Grande and its tributaries in the Trans-Pecos region of Texas have been impacted by a variety of anthropogenic activities such as dewatering, reduced water quality, impoundment, channelization, and the introduction of non-native species. These environmental manipulations have negatively affected the native fishes leading to extirpations and population declines throughout the region. It is imperative to gain an understanding of the factors that determine the persistence and maintenance of these fish assemblages, in the Rio Grande and its

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spring-fed, tributary habitats. We hypothesize that the persistence and maintenance of fish assemblages in these spring-fed habitats can be modeled by three primary processes: 1) adequate fish dispersal through the river corridor, 2) local environmental conditions that are maintained by spring flow, and 3) the presence/abundance of introduced species such as the plains killifish, *Fundulus zebrinus*. To understand these local and regional processes, we will determine seasonal and yearly patterns of abundance, distribution, and habitat use for fish assemblages from Alamito, Terlingua and Tornillo Creeks, as well as the Rio Grande proper. Preliminary data and analyses will be presented in light of this hypothetical framework.

Presenter: Moles, K.; Email: kmoles@tntech.edu

Mussel restoration: population augmentation, reintroductions and habitat restoration

Tennessee Cooperative Fishery Research Unit, Tennessee Tech University, Cookeville, TN 38505

Mussel populations are in a precipitous decline throughout much of the southeastern United States; several species have gone extinct, numerous populations have been extirpated and other populations are but a remnant of what they once were. The fragmentation of mussel populations mandates an active approach for their conservation and restoration. Consequently, restoration of mussel populations is a priority for many state and federal agencies. Some of the tools necessary for restoration are available. While the basic techniques for propagating mussels were developed about 100 years ago, but only recently (~15 years) have these techniques been modified to successfully propagate and culture endangered species. The ability to produce large numbers of endangered mussels has led several state and federal agencies to establish large-scale propagation programs. In a few cases, large healthy populations of some species have been identified that could serve as donor populations for translocating adult mussels. However, identification and restoration of suitable habitats for augmenting or reintroducing mussels has not kept pace with the development of culture techniques and identification of donor populations for translocation. There is a critical need for an objective evaluation of existing habitat, identification of the factors involved in the local demise of mussel populations and most importantly, amelioration of these factors. In our zeal to restore mussels, we often overlook habitat evaluation and restoration as the most appropriate first course of action. If mussel conservation is to succeed, we must choose wisely among the tools available and insure availability of suitable habitats.

Presenter: Moyer, G.R.; Email: greg_moyer@fws.gov

Tools for assessing genetic diversity within and among populations of threatened freshwater mussels

Moyer, G.R. and A.S. Williams

U.S. Fish and Wildlife Service, Warm Springs Fish Technology Center, 5308 Spring Street, Warm Springs, GA 31830.

The Apalachicola-Chattahoochee-Flint River Basins (ACF) supports one of the most diverse freshwater mollusk assemblages in the Southeast United States. Historically, the ACF had approximately 14 genera and 33 species; however, over the past decade, four of these species have gone extinct with six others (*Amblema neislerii*, *Hamiota subangulata*, *Medionidus penicillatus*, *Pleurobema pyriforme*, *Elliptio chipolaensis*, and *Elliptoideus sloatianus*) protected under the Endangered Species Act. To assist in the recovery of these species through future population genetic studies, we report on the development of microsatellite loci for *Pleurobema pyriforme*, *Amblema neislerii*, and *Elliptoideus sloatianus* and assess the utility of these markers for the other threatened or endangered ACF mussels. We also use these markers to assess the genetic diversity within and among sampling locations of *Pleurobema pyriforme* and *Elliptoideus sloatianus* from throughout the ACF.

Presenter: **Mudrak, P.**; Email: pam0007@auburn.edu

Predation effects on juvenile red snapper, *Lutjanus campechanus*, in the northern Gulf of Mexico

Mudrak, P. and S. Szedlmayer

Marine Fish Laboratory, Department of Fisheries and Allied Aquaculture, Auburn University, 8300 State Hwy 104, Fairhope, AL 36532

Small “nursery” reefs (0.3 x 1.0 x 1.2 m) were built in July 2008 (n = 20) and July 2009 (n = 20), 28 km south of Dauphin Island, Alabama, in the northern Gulf of Mexico. We also built larger “adult” reefs in April 2008 (n=10) and April 2009 (n=10; 8 m³; steel cages 2.5 x 2.6 x 1.2 m). Each year 10 small reefs were placed 15 m away from the larger reefs and 10 were placed 500 m away from the larger reefs. The 15 m distance was considered within the range of larger predatory fishes on the adult reef, while the 500 m distance was considered outside the usual foraging distance of these larger fish. All reefs were visually surveyed by SCUBA divers. During each survey all fish were identified, counted and placed in estimated 25 mm length categories. Surveys were completed on all 2008 reefs (n=20) in August 2008. We completed two surveys on all 2009 reefs (n=20) in August and September 2009. We detected significantly lower numbers of age-0 red snapper on small reefs that were near (15 m) the large reefs compared to those that were far (500 m) from the large reefs. In 2008, the mean \pm SD density of age-0 red snapper on the 500-m reefs = 15.9 ± 12.3 m⁻³, compared to 0.0 ± 0.0 m⁻³ on the 15-m small reefs (ANOVA, $p < 0.05$). We also detected a significant differences in 2009 with more age-0 red snapper on the 500 m reefs (mean \pm SD = 23.6 ± 21.0 m⁻³) compared to the 15 m reefs (mean \pm SD = 0.1 ± 0.2 m⁻³; ANOVA, $p < 0.05$). We suggest that larger fish associated with the large reefs reduced age-0 red snapper recruitment to the small 15 m reefs.

Presenter: Neal, J.W.; Email: jneal@cfr.msstate.edu

Comparison of active versus passive gear for sampling threadfin shad *Dorosoma petenense*: Case study from tropical reservoirs

Prchalova, M.¹, J. W. Neal², K. Olivieri Velázquez², M. Lloyd², M. Muñoz-Hincapié³, M. Ríha^{1,4}, N. Peterson², S. García Vazquez³, and T. Jůza^{1,4}

¹Biology Centre of the AS CR, v.v.i., Institute of Hydrobiology, České Budějovice, Czech Republic

²Mississippi State University, Department of Wildlife, Fisheries and Aquaculture, Box 9690, Mississippi State, MS

³Puerto Rico Field Station, Mississippi State University, Department of Wildlife and Fisheries, Ponce, Puerto Rico

⁴Faculty of Science, University of South Bohemia, České Budějovice, Czech Republic

Standardized sampling protocols of freshwater fishes have recently become a national focus among state agencies throughout the United States. In the U.S. territory of Puerto Rico, threadfin shad are the most important prey species for highly targeted reservoir sport fish species including largemouth bass. However, standardized sampling protocols have yet to be established for threadfin shad in Puerto Rico reservoirs. Our objective was to compare active trawling versus passive gillnetting for sampling threadfin shad in tropical freshwater reservoirs. We compared a 3x3-m fixed frame fry trawl (10 m long; 6 and 4 mm mesh in the main body and cod end, respectively) with epipelagic (0-1.5 m depth) and mesopelagic (1.5-3.0 m depth) experimental gillnets. Gillnets were constructed with 5, 6.25, 8, 10, 12.5, 15.5, 19.5 and 24 mm bar mesh in 2.5 m long panels. Reservoirs were divided into upper and lower longitudinal sections, and the trawl was towed for two minutes at three fixed sites per reservoir section at a depth sampling 0-3 m. Gillnets were standard overnight sets. Trawling caught 10x more shad than gillnets with less than 1% bycatch, and displayed no size selectivity except for shad larger than 90 mm. Gillnets revealed significant size selectivity, variable catches, and 23% bycatch. The most abundant size classes of shad caught with trawling and gillnetting ranged between 20-30 mm and 50-80 mm, respectively. Comparable size range (intersection of sizes from both gears) was 45-80 mm. Below the lower threshold, gillnets underestimate shad abundance, above the upper threshold trawl underestimate shad abundance. Gillnets were unable to catch the most abundant sizes of shad in all reservoirs, however, experimental mesh size was too large to accurately sample smaller

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shad (i.e., 20-30 mm). Whereas shad larger than 90 mm represent less than 1% of the total population, preliminary data indicate that trawling is preferred over gillnetting for sampling threadfin shad in Puerto Rico Reservoirs.

Presenter: Odenkirk, J.; Email: John.odenkirk@dgif.virginia.gov

Potomac River northern snakehead update

Odenkirk, J.

Virginia Department of Game and Inland Fisheries

Northern snakehead (NSH) were first documented in the tidal Potomac River in 2004. Since then, efforts have been made to monitor relative abundance and gain understanding of NSH biology and ecology. Annual electrofishing surveys over seven years suggested an increasing population, and NSH boat electrofishing catch rate in three core tributary creeks in 2010 was 7.8 fish/hr – a record and statistically higher than most other years. Angler catch rate also increased in 2010 (over 100% from the next highest year) based on reported catches and creel surveys (which also indicated most anglers do not report NSH). Gut content evaluation revealed consumption of 19 species of fish plus frogs and crayfish, but only banded killifish were considered a major food item based on frequency of occurrence. Bluegill, pumpkinseed, white perch, American eel and yellow perch were second tier food items. Otolith interpretation remained difficult, and the need for known-age fish to verify otolith annuli led to the apparently unsuccessful OTC marking of a cohort of YOY in a floodplain pond adjacent to Dogue Creek in 2009. Recapture measurements of 16 floy-tagged fish in 2010 (mean time-at-large=284 d) resulted in a mean daily growth increment of 0.28 mm/d (SD=0.24). Of the 216 NSH collected by VA biologists in 2010, 153 were tagged and released as part of a cooperative tagging study with the USFWS, 19 were recaptures, and 44 were sacrificed. Recapture locations suggested minimal movement of tagged fish; however, known range expanded greatly in 2010. Commercial catches in passive sampling gears led to increased sampling in waters previously thought to be too saline, and NSH have now been confirmed from nearly the entire length of the Potomac River including most tributaries.

Presenter: Olive, J.; Email: jasono@mdwfp.state.ms.us

Restoration of Gulf Coast strain walleye (*Stizostedion vitreum*) habitat on Mackeys Creek, Mississippi

Campbell, R.¹ and J. Olive²

¹ U.S. Fish and Wildlife Service Private John Allen National Fish Hatchery, 111 Elizabeth St., Tupelo, MS 38804

² Mississippi Department of Wildlife, Fisheries, and Parks, 272 CR 995, Tupelo, MS 38804

The Gulf Coast Strain (GCS) walleye, *Stizostedion vitreum*, is a distinct genetic strain of walleye endemic to rivers and streams of the Mobile River drainage in Alabama and Mississippi. These fish were widely distributed, if not abundant, throughout the Tombigbee River basin in northeast Mississippi, prior to the 1960's. Anthropogenic habitat alterations of streams during the 20th century have caused a decline in native stocks. The construction of the Tennessee-Tombigbee Waterway (TTW) in the 1970's-1980's, which substantially altered the entire Upper Tombigbee River system, led to further significant alteration and/or destruction of GCS walleye habitat. Mackeys Creek is one of the two headwater streams that form the East Fork of the Tombigbee River, and is located in northeast Mississippi. GCS walleye were collected in this stream in samples from the 1960's through the 1980's. Although sampling efforts have been minimal since the 1980's, no GCS walleye have been collected in recent years. Funding through the Southeastern Aquatic Resources Partnership (SARP) provided an opportunity for the U.S. Fish and Wildlife Service (USFWS) and the Mississippi Department of Wildlife, Fisheries, and Parks (MDWFP) to partner to restore and/or improve GCS walleye habitat on this stream. Streambank and channel restoration was the

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first priority, followed by creating or enhancing existing spawning habitat in the stream. A site was selected where head cutting of the stream bed was believed to have ended, and the first phase of restoration was implemented at that location. A peak-stone dike was constructed to stabilize the bank, and a modified grade control was installed in the stream bed. Immediately upstream of this site, a gravel bed was installed to provide a fish spawning habitat. Additionally, an adjacent pond used for waterfowl management will be used as a nursery pond to raise advanced fingerling GCS walleye for restocking efforts.

Presenter: Parkyn, D.C.; Email: dparkyn@ufl.edu

Patterns of movement and mortality of greater amberjack in the Gulf of Mexico

Parkyn, D., D. Murie, J. Austin, G. Smith, and D. Colle

University of Florida, 7922 NW 71st Street, Gainesville, FL.

Movements of greater amberjack (*Seriola dumerili*) were examined as one means of assessing mixing between Gulf of Mexico, and West Atlantic stocks, as well as the implications for harvest management of this species. To date we have tagged over 1270 fish from three regions in the Gulf as well as the Western Florida Keys, removing 2-3 pectoral finrays for aging and a fin clip for genetics from each fish. Despite closures due to the oilspill of 2010, 145 tags have been returned, with the average number of days at large being 86 ± 124 days. In general, the size of tag-return fish was skewed to larger individuals, both because of minimum size limits for recreational and commercial fishers, as well as the fact that amberjack grew at an average rate of ~ 1.5 mm per day. Movements of individual fish ranged from 0-1300 km, with an average distance moved of 70 km (median = 6 km) prior to recapture. Pop-up satellite tags confirmed this site specificity. The number of returned tags was not uniform across tagging areas or by gear type. The higher rate of recapture in some regions appeared to be indicative of higher fishing pressure on this species in these regions, although a seasonal component was evident. In addition, the overall high rate of recapture (11%) may be a function of lower release mortality of these fish, which we attribute, in part, to features of the swimbladder of amberjack that we have not previously observed in other species, as well as stamina.

Presenter: Patterson, C.P.; Email: cpatterson@odwc.state.ok.us

Electrofishing for largemouth bass: An evaluation of Oklahoma's standardized sampling procedures

Patterson, C.P.

Oklahoma Department of Wildlife Conservation, Norman, OK 73072

Standardized sampling procedures are important to fisheries managers and are required to evaluate fish populations over time and among lakes. The goal of these procedures is to ensure accurate and precise estimates. In 2009 and 2010, largemouth bass electrofishing duration times of 5, 10, and 15 minutes were evaluated on four lakes in central Oklahoma to determine the precision of each. The coefficient of variation of the mean (CV_x) indicated that variability increased as duration decreased. Catch per unit effort (CPUE), CV_x , and length frequencies were also compared between historical fixed sites and sites selected from a stratified random design. Random samples exhibited a lower CPUE and higher variability than the historical fixed sites although Wilcoxon Rank Sum tests indicated no differences ($\alpha = 0.05$). In addition, length frequencies overall were not significantly different (Kolmogorov-Smirnov test, $\alpha = 0.05$) between fixed and random sites. Historical electrofishing data from lakes statewide were also reviewed to determine if samples sizes, which are based on lake size, were adequate to detect a 25% or 50% change in the population. Samples from approximately 95% of the lakes were able to detect a 50%

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change in the population regardless of size, although smaller lakes (6 samples) were less likely to detect a 25% change than larger lakes (24 samples).

Presenter: Patterson, W.F., III; Email: wpatterson@uwf.edu

The effect of fishing on reef fish community, trophic, and size structure at artificial reef sites in the northeastern Gulf of Mexico

Patterson III, W.F.¹, J.H. Tarnecki¹, and D.T. Addis^{1,2}

¹Department of Biology, University of West Florida, 11000 University Parkway, Pensacola, FL

²Florida Fish and Wildlife Research Institute, 100 8th Avenue SE, St. Petersburg, FL 33701

Reef fish community structure and population demographics were examined at 27 artificial reefs located between 15 to 20 nm south of Santa Rosa Island, FL. Study reefs were a subset of reefs built by the state of Florida in spring 2003; site locations were not advertised to the public in hopes of creating no-harvest refugia for exploited fishes. All reefs were sampled quarterly from fall 2004 through summer 2008 with a micro remotely operated vehicle (ROV) equipped with a laser scale. Video samples from the ROV were analyzed to estimate taxa-specific fish densities and to estimate fish size distributions from laser data. Over the course of the study, 134,698 individual fish belonging to 99 taxa were counted at reef sites. Red snapper was the predominant reef fish present, constituting 25.6% of all individuals and 42.8% of estimated fish biomass. A fishing experiment was conducted by advertising coordinates of 9 study reefs to the fishing public in spring 2007. Estimated piscivore biomass declined by 46% at experimental (i.e., fished) reefs after spring 2007, while planktivore and invertivore biomass increased by 96% and 56%, respectively. Instantaneous disappearance rates estimated with catch curves indicated mortality (y^{-1}) increased 20.5% for red snapper and 17.3% for gray triggerfish at experimental versus control reefs following the advertising of coordinates to the public. However, high disappearance rates for red snapper indicated that their low site fidelity (estimated with tagging data) likely exposed them to high regional fishing mortality rates even prior to releasing experimental coordinates, thus negating any potential refuge effect. The opposite was true for gray triggerfish, thus indicating fishes that display high site fidelity may benefit even from small-scale protected areas. These and the study results described above have important implications for the role of artificial reefs in the fisheries management, which will be discussed.

Presenter: **Peacock, C.**; Email: cpeacock@uaex.edu

Effects of hydrology on the largemouth bass *Micropterus salmoides* population in the Arkansas River

Peacock, C. and M.A. Eggleton

University of Arkansas at Pine Bluff, Aquaculture/Fisheries Center, 1200 N. University Dr., Box 4912, Pine Bluff, AR 71601

Hydrology can affect sport fish populations by influencing their rates of recruitment and growth. Long-term electrofishing data, collected in the Arkansas River's Lake Dardanelle, from 1991-2009 suggested a strong inverse relationship between largemouth bass catch per unit effort (CPUE) and mean adjusted flow from the previous year. Although this relationship suggests a link between largemouth bass recruitment and annual hydrology, the effects that hydrology may have on annual growth rates through the life of cohort have not been intensively studied. During 2004, 2005, and 2010, annual growth increments were generated from backcalculated length at age data using largemouth bass collected across different navigation pools of the Arkansas River. Using age-1 through age-6 cohorts from 2004-2005 (n = 1,728), growth increments of largemouth bass were positively correlated to years with longer low-water (<15,000 ft³/s) periods, especially during fall months. Conversely, annual growth increments of

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largemouth bass were negatively correlated to years with sustained periods of high flow (>50,000 ft³/s). During the period 2007-2009, the lower Arkansas River experienced hydrological extremes each year, with 29% of the days annually exceeding 100,000 ft³/s. Population data collected during 2010 indicated a general decrease in bass growth throughout the river compared to 2004-2005 both in terms of mean length and mean weight at age. Specifically, age-4 and age-5 largemouth bass were significantly ($P<0.05$) smaller than corresponding cohorts from 2004 and 2005, with weight differences being more dramatic. Additionally, CPUE was 50% decreased in 2010. This suggests weak 2007 and 2008 year classes.

Presenter: Peterson, D.L.: Email dpeterson@warnell.uga.edu

Recruitment trends of Atlantic sturgeon, *Acipenser oxyrinchus oxyrinchus*, in the Altamaha River, Georgia: Are we on the road to recovery?

Peterson, D.L. and M.S. Bednarski

Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA 30602

Atlantic sturgeon once supported a lucrative commercial fishery throughout the U.S. eastern seaboard; however, decades of overharvest and habitat alteration have decimated most populations. In response, the Atlantic States Marine Fisheries Commission closed this fishery in 1998, and today, this species is being considered for federal listing under the Endangered Species Act. Unfortunately, the effects of the fishery closure are unclear because of a lack of quantified data on current abundance and population trends. Recent studies have shown, however, that mark-recapture estimates of age-1 cohorts may provide a quantified measure of recruitment that can forecast long-term population trends. The objectives of this study were 1) to assess recruitment of age-1 Atlantic sturgeon in the Altamaha River and 2) to determine which environmental factors are most influential in determining year class strength of Atlantic sturgeon. From 2004-2010, we conducted mark-recapture estimation of age-1 Atlantic sturgeon cohorts within the Altamaha River using the Huggins closed-capture model in Program Mark. Over the seven years of the study, age-1 population estimates varied from a low of 433 in 2006 to a high of 6225 in 2010. The seven consecutive years of cohort abundance estimates were then used to create a recruitment model to evaluate effects of different environmental variables on annual recruitment. Our results showed that the primary factor affecting recruitment of Atlantic sturgeon during our study was the number of years elapsed since the fishery closure. These findings provide the first quantified evidence that the 1998 fishery moratorium has aided in the recovery of the species. Though our results are promising, additional years of recruitment data are needed to confirm a positive trend in recruitment, and hence, recovery of the Altamaha population. Similar efforts are needed on other rivers to evaluate population trends and key recruitment variables in other parts of the range.

Presenter: **Peterson, N.**; Email: npeterson@cfr.msstate.edu

Genetic population structure of an introduced Florida largemouth bass population in Puerto Rico with comparisons to populations in the United States

Peterson, N. and J.W. Neal

Mississippi State University, Department of Wildlife, Fisheries and Aquaculture, Box 9690, Mississippi State, MS 39762

Little attention has been given to the genetic population structure of fish populations following introduction, especially in small impoundments where the founding population size is generally low, and subsequent stockings are uncommon. Reproduction among a few related individuals can lead to the loss of genetic diversity within a population and result in decreased growth, reduced fitness, and increased mortality. An extreme example can be

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found among populations of Florida largemouth bass *Micropterus salmoides floridanus* in small reservoirs in Puerto Rico, which were originally established in 1957 from a small founder stock of 30 fish imported from the United States. Compared to largemouth bass populations in the continental United States, largemouth bass in Puerto Rico show reduced growth post-maturation and extremely high mortality rates, with less than one percent of largemouth bass surviving beyond age 3. We hypothesize slow growth and high mortality is the consequence of low genetic diversity resulting from an accumulation of 53+ years of inbreeding. Our objectives are to 1) determine and compare genetic diversity of an isolated Florida largemouth bass from Cerrillos Reservoir, Puerto Rico, to bass from the continental United States, to 2) determine the genetic population structure of Florida bass from genetically isolated pond populations in the Southeastern United States, and to 3) develop recommendations for gene pool diversification through supplemental stocking in small impoundments. Nuclear (microsatellite) markers derived from anal fin tissue will be used to evaluate genetic diversity parameters such as the average number of alleles per locus, observed and expected heterozygosity, and inbreeding coefficients, among populations. This study provides the opportunity to better understand the effect of low founder population size and genetic isolation in fish populations, and to model the importance of gene pool diversification in isolated water bodies (i.e., small impoundments).

Presenter: Piercy, A.; Email: andrew.piercy@unf.edu

Reproductive cycles and the effects of reproductive variation on sandbar shark population growth

Piercy, A.

Department of Biology, University of North Florida, Jacksonville, FL. 32224

The reproduction of the sandbar shark, *Carcharhinus plumbeus*, in the western North Atlantic Ocean and Gulf of Mexico was examined from specimens collected through fishery-dependent and -independent sampling programs. Morphological measurements of the sharks and reproductive organs were taken and Indices of maturity were constructed using measurements of gonads, genital ducts, and claspers. Gonadosomatic indices and variation in genital duct condition were used to determine seasonal trends in reproduction of mature sharks. Sandbar sharks have discrete seasonal reproductive cycles: males produce sperm from January to May with a peak in May and females develop eggs from January to May with ovulation occurring in June. Gestation was 12 months, from July to the following June, with parturition in late June. Females were shown to exhibit a greater than two year reproductive cycle in contrast with previous studies. Demographic analysis was used to determine the magnitude of effect that variations in reproductive parameters can have on population growth.

Presenter: **Piraino, M.**; Email: piraino@auburn.edu

A test of a new fine scale telemetry system with red snapper, *Lutjanus campechanus*, in the northern Gulf of Mexico

Piraino, M.N. and S.T. Szedlmayer

Department of Fisheries and Allied Aquaculture, Auburn University, 8300 State Hwy 104, Fairhope, AL 36532

A fine scale (~m scale) positioning system (VPS, VEMCO) was tested and used to continuously track red snapper movements relative to an artificial habitat in the northern Gulf of Mexico. Initially a test transmitter was suspended at 15 m depths with known latitude and longitude positions for system calibration and testing. We compared these known positions with the VEMCO reported VPS calculated positions. The mean \pm SD distance between the known and VPS positions was 20.7 ± 7.8 m. Additional comparisons of VPS positions to a known position of a stationary control transmitter showed a mean \pm SD difference of 1.0 ± 0.7 m. To evaluate this new tracking method with live

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fish we tagged five red snapper with transmitters. One fish was lost, one fish was tracked for 45 d, and three fish lost their transmitter as indicated by stationary VPS positions. Two of the lost stationary transmitters were then relocated within 2 m of the VPS calculated positions. The tracked red snapper showed consistent residency around the artificial habitat. This fish also showed diel changes in distance from the artificial habitat, with significantly greater range during night periods (37.5 ± 5.2 m) compared to day periods (30.1 ± 4.5 m). This new VPS showed accurate locations of test transmitters and is a major advance in the tracking capabilities of offshore marine fishes.

Presenter: **Porta, M.J.**; Email: mike.porta@okstate.edu

Stocking contribution of shoal bass in the Morgan Falls Dam tailwater of the Chattahoochee River, Georgia

Porta, M.J.¹ and J.M. Long²

¹Oklahoma Cooperative Fish and Wildlife Research Unit, Department of Natural Resource Ecology and Management, Oklahoma State University, 404 Life Sciences West, Stillwater, Oklahoma 74078

²U.S. Geological Survey, Oklahoma Cooperative Fish and Wildlife Research Unit, Department of Natural Resource Ecology and Management, Oklahoma State University, 404 Life Sciences West, Stillwater, Oklahoma 74078

In attempt to restore the shoal bass population in the Chattahoochee River below Morgan Falls Dam, the Georgia Department of Natural Resources and the National Park Service initiated a five year shoal bass stocking program. A total of 211,000 shoal bass were stocked at three sites below Morgan Falls Dam from 2003 to 2007. Stocked fish were marked with 500-700 mg/L Oxytetracycline (OTC) so they could be distinguished from naturally produced fish. In all years shoal bass were stocked in early May as Phase I fingerlings (~25 mm), however in 2004 and 2005, approximately 10,000 shoal bass were held over, marked a second time with OTC, and stocked in early June as Phase II fingerlings (~75 mm). When collected soon after stocking in 2004, Phase I fingerlings represented a greater proportion of the juvenile sample at sites further downstream from the dam. Conversely, Phase II fingerlings represented a greater proportion of the juvenile sample at sites closer to the dam. A total of 121 adult shoal bass were collected to evaluate stocking contribution. Stocked shoal bass contributed 100% to the 2003-2007 year classes, and contributed 62% to the overall adult population sampled. The 2004 stocking event contributed the most to the adult fishery (41%), with 2005, 2006, and 2007 contributing the remaining 20% of stocked fish in the adult sample. In 2004 and 2005 when shoal bass were stocked as both Phase I and Phase II fingerlings, Phase II fingerlings dominated those cohorts (92% of 2004 cohort and 57% of 2005 cohort). It appears that when stocking shoal bass below Morgan Falls Dam, the distance of the stocking site from the dam, and size of fish stocked affected the success of the stocking effort.

Presenter: **Raabe, J.K.**; Email: jkraabe@ncsu.edu

Behavior of migratory fishes in a North Carolina river following dam removals

Raabe, J. K.¹ and J. E. Hightower²

¹ North Carolina Cooperative Fish and Wildlife Research Unit, North Carolina State University, Department of Biology, Campus Box 7617, Raleigh, NC 27695

² U. S. Geological Survey, North Carolina Cooperative Fish and Wildlife Research Unit, North Carolina State University, Department of Biology, Campus Box 7617, Raleigh, NC 27695

Dam removals are contentious processes that are increasing for both economic and ecological reasons. Migratory fish species may benefit most from eliminating barriers and restoring access to upstream habitat, but limited evaluations exist. We conducted a study from 2007-2010 on the Little River, North Carolina, a tributary to the

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Neuse River, to assess migratory fish responses to removal of three dams since 1998. We used a resistance board weir near the river mouth to tag migratory fishes with passive integrated transponders (PIT). PIT antennas were installed upstream, including at former dam sites, to determine the extent of migrations, identify spawning grounds and migratory cues, and to evaluate passage efficiency of a notched dam. Fish migrations were most extensive during freshets that also aided in notched dam passage. We found that a relatively high percentage of fish migrated past former dam sites, with 8-15% of American shad *Alosa sapidissima* and 31-43% of gizzard shad *Dorosoma cepedianum* utilized restored habitat to the farthest upstream extent, an impassable dam. Cases of predation on American shad by invasive flathead catfish *Pylodictis olivaris* were concerning, especially since flathead catfish abundance and migrations increased substantially over the study period. Nevertheless, the results provide strong support for further efforts to restore currently inaccessible habitat through removal of derelict dams.

Presenter: **Radabaugh, K.**; Email: kradabau@mail.usf.edu

Variation in fish $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ on the West Florida Shelf: Implications for site fidelity and selective trophic pathway effects

Radabaugh, K., S. Huelster, D. Hollander and E. Peebles

University of South Florida, College of Marine Science, 140 Seventh Avenue South, St. Petersburg, FL 33701

Climatic gradients, water depth, and geographic variations in river discharge impart spatiotemporal heterogeneity to the stable-isotope baselines of coastal food webs. This baseline variation increases the utility of stable-isotope maps, or “isoscares,” by providing new spatial and temporal perspectives on the site fidelities of motile marine organisms and the dominant primary production pathways that support their biomass. SEAMAP groundfish surveys at more than 130 locations on the West Florida Shelf (eastern Gulf of Mexico) were used to acquire more than 1,400 fish and invertebrate specimens for analysis of bulk-tissue $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$. The first West Florida Shelf isoscape, which was completed during summer 2009, revealed strong isotopic trends along latitudinal, longitudinal, and depth gradients. $\delta^{15}\text{N}$ composition indicated site fidelities were generally high for these trawl-caught fishes. Benthic microalgae obtained from sea urchin stomachs was enriched in ^{13}C relative to phytoplankton, providing a marker for trophic pathways that originate from benthic primary producers. Some fish species (e.g., littlehead porgy, *Calamus proridens*) appear to obtain nearly all of their biomass via benthic primary production, whereas others (inshore lizardfish, *Synodus foetens*, and dusky flounder, *Syacium papillosum*) derive their biomass from a combination of benthic and planktonic primary producers. This suggests variation in the benthic light environment will have a selective effect on the production of fish biomass.

Presenter: Rakes, P. L.; Email: xenisma@gmail.com

History and status of captive propagation efforts and releases of the endangered boulder darter, *Etheostoma wapiti*, in the Elk River and Shoal Creek in Tennessee

Rakes, P. L., J. R. Shute, C. L. Ruble, and M. A. Petty

Conservation Fisheries, Inc., 3424 Division Street, Knoxville, TN 37919

Conservation Fisheries, Inc. (CFI) first began efforts to propagate the boulder darter in 1994 using a closely related surrogate species, the bloodfin darter, *E. sanguifluum*. Production of boulder darters began with 5 individuals in 1995 with incremental increases since then. Propagation protocols have been significantly refined over the years with many recent techniques devised to incubate eggs and rear the difficult early pelagic larval stage. Captively produced fish were initially released to several sites in the Elk River to augment that population, track survivorship and dispersal of VIE-tagged fish (visible elastomer implants, Northwest Marine Technologies), and study the effects

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of habitat restoration efforts. Following final approval of Nonessential Experimental Population (NEP) status for much of lower Shoal Creek in Lawrence County, Tennessee and Lauderdale County, Alabama, stocking of this stream was initiated in spring of 2005. Subsequent monitoring detected survivorship of stocked fish, but no evidence of wild reproduction until 2008. Multiple wild-spawned year classes were observed in 2009 and 2010, as well as downstream dispersal of “wild” fish approximately three stream miles in 2010.

Presenter: Raley, P.; Email: Patrick.Raley@noaa.gov

Between a rock and a hard place: using side scan sonar and underwater video to identify and classify hard bottom habitats in the northern Gulf of Mexico

Raley P., C. Gardner, D. DeVries, and J. Brusher

NOAA Fisheries Panama City Lab, 3500 Delwood Beach Rd., Panama City Beach, FL 32408

The west Florida shelf (WFS) supports some of the most valuable reef fish fisheries in the U.S. Gulf of Mexico. However, very little of its area has been mapped with enough resolution to accurately locate and quantify the bottom habitat these fisheries are tied to. Such maps are essential for designing an efficient fishery independent survey of reef fishes, enabling pre-stratification by habitat, minimizing variance and optimizing survey resources. In support of a fishery independent reef fish survey, the Panama City NMFS lab began mapping cross-shelf transects on the northern WFS using a dual frequency 600/1200 kHz side scan sonar. In seven days, 10 single swath cross-shelf transects ~20-30 nm X 150 m, primarily in depths from 10 to 30 m, were mapped in Apalachee Bay in the Florida Big Bend, yielding approximately 1400 new hard bottom sites. Additionally, 355 sites were found in a 13.2 km² area of high relief (up to 10m) off Panama City. An inexpensive live video drop camera, a high definition video camera array, and occasionally an ROV were used for visual ground truthing of a select number of the side scan targets. After ground truthing multiple types of raw side scan images (n=150), we developed a classification scheme based on rugosity, relief, and reef area. In the Big Bend, scattered rock reefs dominated, accounting for ~70% of the marks. Of the remaining targets, 19% were gorgonian/sponge reefs, 5.5% were solid rock reefs, 3% were ledges, and 2.5% were small algal reefs, artificial structures, or shell/gravel bottom. Off Panama City, solid rock accounted for 40% of the sites marked. Ledges and scattered rock followed with 35% and 24%, respectively, and artificial structures made up the remainder.

Presenter: **Reeves, D.B.**; Email: dbreeves@loyno.edu

Response of endangered Okaloosa darters to restoration of stream habitat

Reeves¹, D.B., W.B. Tate², and F. Jordan¹

¹ Department of Biological Sciences, Loyola University New Orleans, 6363 St. Charles Avenue, New Orleans, Louisiana, 70118

² U.S. Fish & Wildlife Service, Jackson Guard Natural Resources Facility, Eglin Air Force Base, Niceville, Florida, 32578

Okaloosa darters (*Etheostoma okaloosae*) are small benthic fish restricted to six small drainages in northwestern Florida. These fish inhabit clear, free-flowing streams with sandy bottoms and plentiful submerged aquatic plants, root mats, woody debris, and other forms of cover. In addition to having a limited geographic distribution, Okaloosa darters were added to the Endangered Species List because of concerns about loss of habitat. One of the criteria for improving conservation status of Okaloosa darters is restoration of suitable stream habitat. The purpose of this talk is to describe preliminary responses of Okaloosa darters to restoration of habitat in two sites where streams were impounded. The impoundment at Tom's Creek near State Road 123 was upstream of an abandoned railroad

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crossing made of unstable sediment covering a metal culvert unsuitable for fish movement. American beaver maintained a permanent impoundment by blocking the narrow opening of this culvert. The impoundment on Anderson Branch was a recreational fishing pond formed and maintained by a dam. Control structures were removed, impoundments were drained, sediment was removed, new channels were created, woody debris was added, and flow was restored at both of these sites during the summer of 2010. Riparian vegetation was planted to stabilize sediments, but submerged aquatic vegetation was allowed to colonize naturally following restoration. We visually quantified abundance of Okaloosa darters and characterized habitat in multiple reaches above, within, and below these restoration sites prior to restoration and monthly thereafter. Prior to the study, Okaloosa darters were abundant in free-flowing sections above and below both restoration sites, but not in the impoundments. Individual adult Okaloosa darters colonized both restoration sites within three months of restoration, although abundance was substantially lower than in most control sites. Control sites below Anderson Branch were negatively affected by sediment released during the restoration process.

Presenter: Rehage, JS; Email: rehagej@fiu.edu

Nonnative fishes in the Everglades: what is the role of canals as key habitats?

Rehage, J.S. and D. Gandy

Earth & Environment Dept., Florida International University, 11200 SW 8th St., Miami FL 33199

Nonnative species pose a serious threat to the ecological integrity and biodiversity of natural ecosystems, including those found within protected areas. Presently in Everglades National Park (ENP), fourteen nonnative fishes are established, yet we know little about how they interact with native biota, their response to hydrological disturbance including restoration efforts, and their overall impact. A subset of these nonnative fishes are new invasions since 2000, several of them accompanying restoration projects, while more are expected. Ongoing research examines the impact of nonnative fishes on lower trophic levels and ecosystem processes, how their impact is mediated by hydrology, the potential for new invasion threats from bordering canals, and the alternatives for their containment. Canals are an integral component of the present-day, altered Everglades. Canals disrupt water flow, hydroperiod, and connectivity, and act as a source for nutrients, pollutants, and invasive species by linking urban and agricultural waters with more pristine habitats. Yet, we have a poor understanding how canals function as habitat for both native and nonnative fishes and their ecological interplay with adjacent marsh habitats.

We examined the fish communities of canals bordering ENP via boat-mounted electrofishing. Fish communities appeared distinct among canals, with nonnative fishes composing between 8% and 70%. Habitat complexity and other abiotic factors seem to be influencing natives & nonnatives differently (e.g., littoral habitat structure). Because restoration efforts call for the removal of only a small portion of canals, there is a strong need to better understand how these 'novel habitats' function as habitat. In addition, canals are being used by restoration projects to deliver water to Everglades marshes often with little consideration of their role in the spread of nonnative taxa. Our research should yield valuable insights for more effective management as we restore the system.

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Presenter: Reichert, M.; Email: ReichertM@dnr.sc.gov

CPUE and life history trends of 15 reef fish species from Atlantic waters off the SE US coast (1980-2010)

Reichert, M., J. Stephen, J. Ballenger, and D. Wyanski

Marine Resources Research Institute, South Carolina Department of Natural Resources, 217 Fort Johnson Rd., Charleston, SC 29412

The Marine Resources Monitoring, Assessment and Prediction (MARMAP) program has been conducting fishery-independent reef fish research for over 30 years in coastal waters along the Atlantic coast of the southeastern United States. Monitoring efforts have been concentrating on the species of the South Atlantic Fisheries Management Council's snapper/grouper complex, which tend to congregate over hard and live bottom habitats. In the last 30 years, the MARMAP program has mostly utilized traps and short bottom longline gear for the collection of biological samples and data. Information is utilized in the calculation of CPUE and life history parameters, particularly as input for stock (SEDAR) assessments. This time series represents the only fishery-independent index of abundance for many snapper/grouper complex species in the region. This paper will provide a brief overview of the MARMAP program and will provide information on trends in relative densities (i.e., CPUE) of the most abundant reef fish species in the MARMAP catches. In addition, we present and discuss some trends in life history parameters over the time period.

Presenter: **Roberts, J.**; Email darter@vt.edu

Using spatial ecological and genetic data to inform conservation of endangered Roanoke logperch

Roberts, J.H.¹, P.L. Angermeier², and E.M. Hallerman¹

¹ Department of Fisheries and Wildlife Sciences, Virginia Tech, Blacksburg, VA 24061

² U.S. Geological Survey, Virginia Cooperative Fish and Wildlife Research Unit, Blacksburg, VA 24061

Effective darter conservation rests upon determining 1) the geographic scales over which key population processes operate, and 2) which populations are in greatest need of protection or restoration. We synthesized results of movement, demographic, and genetic studies to draw inferences about the geographic scaling of population processes in federally endangered Roanoke logperch (*Percina rex*). We then used among-population variation in geographic distribution, genetic diversity, and genetic divergence to rank the seven known Roanoke logperch populations with respect to demographic and genetic threats. Movement, demographics, and gene flow all appeared to operate over the spatial scales of rivers to watersheds, indicating the importance of regionally-focused conservation strategies for this species. Apparent levels of demographic and evolutionary threat varied widely among populations. Two populations were geographically extensive, contained high genetic diversity, and were regarded as relatively "safe", whereas two other populations were geographically restricted, had low genetic diversity, and therefore were regarded as "insecure" for both demographic and genetic reasons. Such a ranking system could be used to develop scientifically defensible prioritization strategies for conservation of Roanoke logperch, and may prove useful for conservation of other darters as well.

Oral Presentations

Presenter: **Robinson, K.**; Email: filerk@warnell.uga.edu

Maximizing YOY spot *Leiostomus xanthurus* emigration from a South Carolina estuary: an evaluation of coastal impoundment management alternatives via structured decision-making

Robinson, K.F.¹ and C.A. Jennings²

¹ Georgia Cooperative Fish and Wildlife Research Unit, Warnell School of Forestry and Natural Resources, University of Georgia

² United States Geological Survey, Georgia Cooperative Fish and Wildlife Research Unit

Estuaries are among the most productive of all ecosystems and provide critical nursery habitat for many young-of-the-year (YOY) marine fishes. Along the South Carolina coast, former ricefield impoundments in estuarine areas are managed as waterfowl habitat. Marine fishes that enter these structures during water-level manipulation become trapped and suffer high mortality. Because these fish cannot emigrate to coastal waters to complete their life cycles, the impoundments act as sinks. We compared effects of impoundments and other stressors such as predation and drought on YOY spot (*Leiostomus xanthurus*) emigration from the Combahee River, SC. We also identified management options that would maximize YOY spot emigration. We used structured decision analysis via a Bayesian belief network (BBN) to evaluate five management decisions: implement fishing regulations for spot, close impoundments while YOY spot are abundant in the river, change water-level manipulation to improve egress from impoundments, breach all impoundments, or maintain status quo. The optimal management decision was to change the water-level manipulation strategy to increase egress from impoundments. The results of this model can be used adaptively for impoundment management along the Combahee River and can be modified for other estuarine areas or fish species.

Presenter: **Rolls, H.**; Email: rollsh@mail.usf.edu

Defining fish nursery habitats of *Centropomus undecimalis* using otolith elemental fingerprinting

Rolls, H.¹, D. Jones¹, E. Peebles¹, C. McIvor², and J. Ley³.

¹ College of Marine Science, University of South Florida, 140 7th Avenue South, St. Petersburg, FL 33701

² USGS

³ Florida Fish and Wildlife Conservation Commission, FWRI

Common snook (*Centropomus undecimalis*) use tidal creeks and backwaters in mangrove and saltmarsh environments as nursery habitat throughout the Tampa Bay estuary in west-central Florida. The relative contribution of these nursery grounds to the recreational fishery has not yet been quantified. Scientists are increasingly using elemental signatures contained within fish otoliths to identify geographic nursery areas that contribute disproportionately to adult fish stocks, so that resource managers can prioritize the conservation and restoration of these areas. The chemical composition of the otolith acts as a natural tag, reflecting the ambient water chemistry of the juvenile nursery habitat, and can thus be used as an “elemental fingerprint” to distinguish fish from different geographic origins. We are using laser ablation inductively coupled mass spectrometry (LA-ICP-MS) to analyze the elemental fingerprints of 95 young-of-the-year snook otoliths from 16 Tampa Bay tributaries. We will then analyze the juvenile portions of 80 adult snook otoliths from the same cohort in order to match them to their probable nursery areas, as defined by young-of-the-year otoliths. Preliminary tests on juvenile red drum (*Sciaenops ocellatus*), a fish species with a similar life history, have shown that otoliths from fish captured in different geographic locations within the greater Tampa Bay estuary are highly distinctive, with replicate observations clustering together within a Random Forest classification.

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Presenter: Rubec, P.J.; Email: peter.rubec@myfwc.com

An evaluation of the transferability of habitat suitability models between Tampa Bay and Charlotte Harbor, Florida

Rubec, P.J.¹, J. Lewis², D. Reed¹, and C. Westergren¹

¹Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, 100 Eighth Ave SE, Saint Petersburg, Florida 33701

²Detect Inc., 3160 Airport Road, Panama City, Florida 32405

Spatial models and methods were developed by the Fish and Wildlife Research Institute to conduct habitat suitability modeling (HSM) in Tampa Bay and Charlotte Harbor. The models predict spatial distributions of estuarine species from data collected by fisheries independent monitoring (FIM) and other sources. Respective FIM catch rates (CPUEs) for 22 life stages of 11 species of estuarine fish and shrimp were standardized across gear types. Splines were fit to mean CPUEs across environmental gradients and input as suitability indices (S_i s) to HSM. The HSM analyses included computation of the geometric mean of S_i s associated with grid-based habitat layers within the ArcMap GIS to produce predicted seasonal HSM maps. The models were verified by overlaying gear-corrected CPUEs onto the predicted maps to determine whether observed mean CPUEs increased across predicted suitability zones. Maps created from abundance indices within each estuary and reciprocally transferred from the other estuary were used to test transferability of the models. The HSM models run with five factors did not work as well as models built by varying the number of factors in the model. Seasonal within and transferred HSM maps for each estuary, created with varying S_i s, exhibited increasing verification scores 97-98% of the time. Seasonal HSM map pairs (within and transfer) were similar 78% of the time in Charlotte Harbor and 91% of the time in Tampa Bay. The transferability of HSM models between estuaries can be used to predict species distributions and abundances in estuaries lacking fisheries monitoring. It can be used to support determination of critical habitat for threatened and endangered species, habitat areas of particular concern (HAPCs) for fisheries management, to support natural resource damage assessment (NRDA) for oil spill response, and to support coastal zone planning and management.

Presenter: Rubec, P., Email: Peter.Rubec@myfwc.com

Comparison of spatial statistical models developed to support habitat suitability modeling in Florida estuaries

Rubec, P.¹, J.A. Ault², S.J. Smith², R. Kiltie³, L. McEachron¹, and E. Leone³

¹Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, 100 Eighth Ave SE, Saint Petersburg, Florida 33701

²University of Miami, Rosenstiel School of Marine and Atmospheric Science, Division of Marine Biology and Fisheries, 4800 Rickenbacker Causeway, Miami, Florida 33149

³Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, Biostatistics and Modeling Program, 1105 Southwest Williston Road, Gainesville, Florida 32601

The Fish and Wildlife Research Institute (FWRI) has been developing models to relate species abundances to estuarine and coastal habitats using spatial modeling. During Phase I, habitat suitability models (HSM) were developed using the geometric mean (GM) algorithm in Tampa Bay (TB), Charlotte Harbor (CH), and Rookery Bay (RB). Catch rates (CPUEs) were found to be transferable between TB and CH, and from CH to RB. The GM HSM predicted CPUEs in numbers per square meter to define four suitability zones. One disadvantage of the GM approach is that it does not take into account the fact that datasets obtained from fisheries independent monitoring (FIM) often have zero inflation. During Phase II research, Delta-Log Normal (DLN) models were developed by Drs. Ault and Smith. The DLN models split the FIM data into positive CPUEs and frequency of occurrence datasets that were then modeled separately. While the DLN deals with the zero inflation, difficulty was encountered in using it to produce predicted HSM maps. Another approach developed by Drs. Kiltie and Leone is the Zero-Inflated Gamma (ZIG) model. It simultaneously fits splines across environmental gradients for both positive CPUE data and

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frequency of occurrence data to account for zero-inflation. SAS programs can compute Akaike Information Criterion (AIC) indices to determine which combinations (out of 31 possible combinations) of five environmental factors provide the best HSM models for predicting species' distributions and abundances. Dr. Rubec has been evaluating the use of gear-corrected (GC) ZIG models in TB and CH. More recently, Mr. McEachron has been evaluating models that do not require the computation of GC factors prior to running the HSM. These include ZIG models, Generalized Additive Models (GAM), Random Forest Walk (RFW), and Boosted Regression Tree (GBM) models. Research is ongoing to determine which models are best suited for FWRI.

Presenter: Rypel, A.L.; Email: andrewrypel@yahoo.com

The ecology of freshwater mussel growth

Rypel, A.L.^{1,2} and W.R. Haag²

¹Washington University in Saint Louis, Campus Box 1137, One Brookings Drive, Saint Louis, MO 63130,

²USDA Forest Service, Center for Bottomland Hardwoods Research, 1000 Front Street, Oxford, MS 38655

Growth is a core element of an organism's life-history. We summarize our recent studies on freshwater mussel growth in North America. In contrast to generalized depictions of freshwater mussels as long-lived and slow growing, we found a range of growth plans for freshwater mussels at multiple scales. Growth can differ widely across species, across populations of the same species, and between sexes. Maximum longevity was explained best by growth rate and not by length providing support for the rate of living hypothesis and its molecular mechanism, the free radical theory of ageing. Biochronologies (time-series estimates of growth inferred from shell growth increments) can also be a powerful tool for understanding factors that influence mussel growth. Across species and populations, annual mussel growth was often significantly and inversely correlated with stream flow. Further, growth chronologies among species at a site, and even across geographically separated populations, were highly synchronous. In two regulated rivers, growth synchrony and flow-growth correlations were disrupted, presumably due to altered hydrology. Non-annual growth disturbances occurred sporadically and unpredictably. However, annual growth was significantly depressed during years in which disturbance rings were produced relative to undisturbed individuals. Because mussel growth corresponds strongly to many environmental factors, growth rates may be useful for studying impacts of habitat degradation and climate change on mussels and aquatic ecosystems in general.

Presenter: Ryswyk, R.; ryan_ryswyk@hotmail.com

Correcting for length bias of common warmwater sport fish sampled with standardized experimental gill nets

Ryswyk, R.¹ and D. Shoup²

¹ Oklahoma Dept. of Wildlife Conservation. 19333 State Hwy. 49 Lawton, OK 73507

² Oklahoma State University 008C Ag Hall, Stillwater, OK 74077

Size selectivity of gill nets is widely discussed in the literature, but to date no one has examined the selectivity of the standard gill net design suggested by Bonar et al. (2009 Standard Methods for Sampling North American Freshwater Fishes). Size selectivity can affect a number of metrics of concern to fisheries managers including length frequencies and size indices. To examine the size selectivity of the standard gill nets, we sampled white crappie, white bass, hybrid striped bass, sauger, walleye, and channel catfish in five Oklahoma reservoirs and used the SELECT method to model five log-linear selectivity curves (normal, normal location, log normal, gamma, and bimodal). The bimodal model was best fit for all species. The bimodal model was used to adjust length frequencies and PSDs. While some differences between adjusted and unadjusted catch data existed, the mesh sizes specified in

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the new standard gill net design appears to minimize the length bias for most species that has traditionally been suggested for gill nets. Unadjusted and adjusted length frequencies were not significantly different for any species; however, PSD, PSD-P showed changes $\geq 5\%$ for white crappie and white bass that may be of importance to managers. When the standard net is used in other systems similar to the ones we sampled, our bimodal selectivity curve could be used to adjust length frequencies and PSDs to better represent the fish that encountered the net.

Presenter: **Saari, C.R.**; Email: cnosac1@tigers.lsu.edu

Comparison of age and growth of red snapper (*Lutjanus campechanus*) from three habitats in the northwestern Gulf of Mexico

Saari, C.R. and J.H. Cowan, Jr.

Department of Oceanography and Coastal Sciences, School of the Coast and Environment, Louisiana State University, Baton Rouge, LA 70803

Numerous studies have examined the age and growth parameters of red snapper in the northern Gulf of Mexico (GOM); however, none of these studies have examined red snapper from natural hard-bottom banks and reefs. Current knowledge of red snapper age and growth is based upon data from artificial habitats, which represent less than 5% of the suitable habitat in the GOM, or from fisheries-dependent data with undisclosed habitat types. We compared red snapper morphometrics and growth parameters from three different habitats (i.e., shelf edge banks, standing oil and gas platforms, and toppled oil and gas platforms) on Louisiana's continental shelf during the summers of 2009 and 2010. Across all of the habitats, red snapper were small (mean total length of 487 mm, mean total weight of 1.77 kg) and from the younger age classes (mean age of 4.1 years), with relatively few fish older than eight years. The majority of red snapper on these habitats appear to be derived from the strong 2004, 2005, and 2006 year-classes. Total length, total weight, and age-frequency distributions significantly differed among the habitats. Red snapper from the banks had a significantly smaller mean size-at-age (both total length and total weight) than the other two habitats. Red snapper length-weight relationships and growth rates also differed among the habitat types. Preliminary results suggest larger, faster growing individuals inhabit low-relief structure. This study addresses the void in the baseline age and growth trends of red snapper on natural habitats in the GOM. Comparison of the demographics and growth parameters from this study will help elucidate trends in habitat-specific age and growth information for red snapper and can be used to better inform fisheries managers.

Presenter: Saborido-Rey, F.; Email: fran@iim.csic.es

Implementing reproductive potential in fish stock assessment procedures: Results from the European research network FRESH

Saborido-Rey, F.

Institute of Marine Research, Vigo, Spain

In 1992 the cod stock in the Northwest Atlantic collapsed suddenly. Stock assessment was not able to predict the collapse. A posterior analysis revealed, however, that several signals were evident as a decline in the cod stock reproductive potential (SRP) was present. But the different parameters involved in SRP were not part of the assessment procedure. As a consequence the Northwestern Atlantic Fisheries Organization established in 2000 the Working Group of Reproductive Potential. Considerable progress on the significance of the SRP concept was developed within this group. However, to develop mechanisms for implementing SRP into stock assessment and management, the European organization COST (Cooperation in the Field of Scientific and Technical Research) supported in 2007 a four-year Action, entitled, Fish Reproduction and Fisheries, FRESH. FRESH has established a

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network of European and North-Atlantic researchers to co-operate on the improvement of i) knowledge on fish reproduction in relation to fisheries and ii) current assessment methodology in order to promote sustainable exploitation of marine fish resources. The Action has formed a focal point for the disparate national, European and North-American research initiatives in this research area. Further, it aims to assist in the development of future marine policy objectives, such as the recovery of overexploited fish stocks. The success of FRESH has been due to the range of approaches COST has supported (Working Groups, Workshops, STSMs, Training Schools), providing the basis for a scientific network with a relative low demand of extra dedication from researchers involved in stock assessment and management. Additionally, dissemination of results has led to increased support from managers and stakeholders supporting work in this field.

Presenter: Sager, C.; Email: csager@simplynet.net

Evaluation of the Florida largemouth bass stocking program in Oklahoma

Sager, C.

Oklahoma Department of Wildlife Conservation, 2021 Caddo Highway, Caddo, OK 74729

The Oklahoma Department of Wildlife Conservation (ODWC) began stocking Florida largemouth bass in Oklahoma in the early 1970's. Since that time, numerous evaluations and hatchery production capabilities have guided the development of the stocking program. The goals of the program are to alter the genetic composition of the largemouth bass population and to increase the number of trophy fish. Genetic data taken from trophy bass caught in Oklahoma indicate that this program has been successful in numerous reservoirs throughout the state. The high demand on hatchery production along with scheduled hatchery renovations has resulted in a need for the ODWC to again evaluate its FLMB stocking policies and protocol. The current evaluation will be focused on maximizing the effectiveness of FLMB stockings. This study will evaluate the percent contribution of FLMB stocked at various rates in southern Oklahoma reservoirs. Results from this study will be used to modify ODWC protocol and will allow managers to more efficiently and effectively influence the genetics of largemouth bass populations in Oklahoma.

Presenter: Sartwell, T.; Email: tim.sartwell@accsp.org

Improvements in data collection spark new ideas in reporting compliance and overall data quality

Sartwell, T.

Atlantic Coast Cooperative Statistics Program, 1050 N Highland St., Suite 200 A-N, Arlington, VA 2201

The Atlantic Coastal Cooperative Statistics Program (ACCSP) is a cooperative state-federal program to design, implement and conduct marine fisheries statistics data collection programs and to integrate those data into a single data management system. The primary ACCSP data collection system is the Standard Atlantic Fisheries Information System (SAFIS) which has improved the timeliness and availability of commercial fisheries data for participating partners. SAFIS allows partners to monitor quotas, reporting compliance and reporting accuracy more effectively, efficiently and instantaneously. The real-time nature of SAFIS has eliminated the delay between reporting and data entry/processing providing partners with the opportunity to proactively manage and avoid surpassing quotas. Customized queries have allowed several states to review reporting problems, validate fishermen and dealer reporting against paper records and in some cases reduce or eliminate paper records. More complete reporting results in the availability of better data for stock assessment purposes. The ACCSP standardized reporting system improves the quality, quantity and resolution of available data, as well as providing a more efficient mechanism to compile and access fisheries data for analysis.

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Presenter: Sauls, B.; Email: Beverly.Sauls@MyFWC.com

Use of a mail survey and catch card survey to characterize recreational fishing for a regionally concentrated target species on Florida's West Coast – Preliminary results of a pilot study

Sauls, B., L. Wiggins, and C. Bradshaw

Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, 100 8th Avenue, S.E. Saint Petersburg, FL 33701

In Florida, recreational catch and effort is estimated using a survey designed to develop region-wide estimates for the Gulf of Mexico, and the west coast of Florida is sampled as one geographic area. Red snapper are concentrated in the northern portion of the survey area, primarily off the coast of the Florida panhandle, and are less accessible to recreational anglers further south due to their lower abundance and increased distance offshore. We developed a pilot study to characterize regional directed fishing effort, harvest, and discard rate and size distribution from west Florida where recreational fishing for red snapper is spatially and seasonally variable. Recreational anglers fishing from a private boat in Florida are required to possess a saltwater fishing license, with some exemptions for youth and seniors. We sampled 3% of saltwater license holders (approximately 3,000) each month and conducted a mail and internet survey beginning in January, 2010. The monthly survey was designed to collect information on numbers of private boat fishing trips targeting and/or catching red snapper or associated reef fish species, as well as area fished, numbers of red snapper harvested (during the open recreational season), and numbers of licensed and non-licensed anglers per trip. The survey was conducted during months when red snapper harvest was open and closed. Less than 10% of the surveys were returned, which is considered low for this survey methodology. In addition to the mail survey, we developed a catch card that was distributed to recreational anglers at boat ramps, marinas, fishing clubs, and other places where red snapper anglers could be found. Anglers were asked to take the card with them during a recreational fishing trip and record numbers of red snapper released by size category. Over 200 catch cards have been returned. We will summarize preliminary results of both surveys.

Presenter: **Scharer, S.**; Email: rms26@students.uwf.edu

Preliminary age estimates of the endangered smalltooth sawfish of South Florida

Scharer, R.M.¹, W.F. Patterson III¹, J.K. Carlson², and G. Poulakis³

¹ University of West Florida, Pensacola, FL

² NOAA, National Marine Fisheries Service, Southeast Fisheries Science Center, Panama City, FL

³ Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, Charlotte Harbor Field Laboratory, FL

Smalltooth sawfish, *Pristis pectinata*, is the first marine fish species listed as endangered under the US Endangered Species Act, yet basic life history data critical for conservation are lacking for this species. To address this, we have begun a project to examine whether sawfish can be aged based on counts of opaque zones in vertebrae and rostral teeth. These structures were collected from naturally deceased fish (n =12) in southern Florida. Transverse sections were made through vertebral centra and were read with transmitted light under a stereo microscope. No staining was required due to opaque and translucent zones being clearly defined in vertebral sections. Each section was read independently by two readers without any prior knowledge of fish size. If counts differed between readers, age was assigned by consensus. Size of aged fish range from 600 mm to 4327 mm total length, and age estimates based on vertebral sections are zero to ten years. Age validation currently is being explored through examination of calcium and trace metal concentrations across vertebral sections with laser ablation-inductively coupled plasma-mass spectrometry. Lastly, longitudinal sections of rostral teeth are being examined to explore whether analysis of rostral teeth may provide an accurate non-lethal aging method.

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Presenter: Schobernd, Z.; Email: zeb.schobernd@noaa.gov

A comparison of reef fish abundance indices from trap versus video surveys in southeastern U.S. coastal waters

Schobernd, Z., C. Schobernd, and N. Bacheler

National Marine Fisheries Service, Southeast Fisheries Science Center, 101 Pivers Island Road, Beaufort, NC 28516

Finding the ideal gear to consistently and accurately assess the status of reef fish communities has been an elusive component in the development of fishery-independent (FI) monitoring programs throughout the southeastern US. For much of the past twenty years, chevron traps have been the primary FI gear used in southeastern US waters. Aside from enabling generation of indices of abundance for captured species, traps enable the collection of otoliths and reproductive tissues for population characterization. Fish traps are selective in the taxa and size ranges of fish they collect, however, and may not effectively sample all the commercially relevant snappers and groupers of the region. Recent and proposed fishery closures have highlighted the importance of fishery-independent data, and the need to assess the utility of chevron traps to reliably detect spatiotemporal trends in relative abundance compared with other potential survey gears. Taking a cue from Gulf of Mexico reef fish surveys, video cameras (in this case mounted on chevron traps) were incorporated into a new fishery-independent reef fish survey developed for the waters from Cape Lookout, NC, to St. Lucie Inlet, FL, but initially focused in waters off GA and northeastern FL. Preliminary data from the survey's first year were used to compare trap catches with fish counts from videos. Proxies for abundance of key species were compared between traps and videos. Video counts were typically considerably greater than trap catches for most taxa, and trap catches did not correlate well with video counts for most key species. These findings suggest that a video survey, when performed in conjunction with trap gear to collect biological samples, can be a more effective survey approach than trapping alone.

Presenter: Schlechte, J.W.; Email: Warren.Schlechte@tpwd.state.tx.us

Surveying Texas' freshwater catfish anglers

Schlechte, J.W.¹, D.L. Buckmeier¹, K. Hunt², C. Hutt², B. Neely³, S. Dumont³, J. Tibbs⁴, and J. Leitz⁵

¹ Texas Parks and Wildlife Department, Heart of the Hills Fisheries Science Center, 5103 Junction Highway, Mountain Home, TX 78058

² Mississippi State University, Human Dimensions and Conservation Law Enforcement Laboratory, Dept. of Wildlife, Fisheries, & Aquaculture, Box 9690 Mississippi State, MS 39762

³ Texas Parks and Wildlife Department, 5325 N 3rd, Abilene, TX 79603

⁴ Texas Parks and Wildlife Department, 8684 LaVillage Ave., Waco, TX 76712

⁵ Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, TX 78744

Catfish *Ictalurus* spp. provide a popular recreational fishery in Texas. We conducted a survey designed to assist in developing future management goals and actions. We report the results of a statewide mail-based survey sent to 1078 catfish anglers, and two local mail-surveys, one sent to 1000 anglers in the Abilene area, and another sent to 52 jugline anglers from Lakes Lewisville, Richland Chambers, and Waco, TX. Response rates ranged from 57% to the statewide survey (after excluding surveys that were undeliverable) to 29% for the Abilene survey. The objectives of the statewide survey were to identify angler types, as well as associated characteristics and desires of each group. Results suggest a diversified group of anglers, but with some strong commonalities. Anglers are predominantly older males who have fished for years and fish >20 days annually. They have median incomes of \$60,000 to \$80,000, are college-educated, fish predominantly from boats with rod-and-reel, and have approximately \$7300 invested in their fishing equipment. Most consider a trophy catfish to be greater than 30". The biggest issue our anglers had with the amenities was there was often too much litter. Results from the Abilene survey showed considerable overlap with the statewide, with the exception that Abilene anglers were less satisfied. Results from

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the survey of jugline anglers suggest that catching trophy catfish is not a high priority, although the majority support regulations designed to increase abundance of large fish. Three-fourths of the total jugline harvest was by 25% of the anglers, suggesting that few jugline anglers caught and kept fish. Future work will try to address concerns that our surveys are not getting input from low-avidity and low-income anglers. TPWD management objectives will be developed based on these surveys of catfish anglers.

Presenter: **Schooley, J. D.**; Email: jschooley02@sbcglobal.net

Effects of hatchery rearing on post-release swimming depth and avian predation for an endangered Colorado River Catostomid

Schooley, J.D.¹ and P.C. Marsh²

¹ Oklahoma Department of Wildlife Conservation, 300 S Aquarium Dr Jenks, OK 74037 (formerly of Arizona State University, School of Life Sciences)

² Marsh and Associates, 5016 S Ash Ave Suite 108 Tempe, AZ 85282

Hatchery rearing is a staple methodology in augmentation of declining populations, yet the effects of extended captive rearing are often detrimental to survival post-release. Surface feeding in fish hatcheries can lead to unnatural foraging behaviors and slow acclimation to wild conditions- both aspects affecting fish health and survival. New trammel netting and analytical methodologies were developed which allow for estimation of changes in swimming depth over time for stocked fish. For demersal species such as the endangered razorback sucker *Xyrauchen texanus*, abnormal swimming depth post-release may contribute to avian predation mortality. For razorback sucker released in a lower Colorado River backwater, a behavioral shift towards surface avoidance was demonstrated over 100 days post-release. In situations where long-term survival of stocked fish is expected, consideration for the effects of captive rearing must play a role in population management towards species recovery.

Presenter: **Shea, C.P.**; Email: cpshea@warnell.uga.edu

Estimation of mussel population response to hydrologic alteration in the Apalachicola, Chattahoochee, and Flint River Basin

Shea, C.P.¹; J.T. Peterson²; and J.M. Wisniewski³

¹ Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA 30602

² USGS, Georgia Cooperative Fish and Wildlife Research Unit, Warnell School of Forestry and Natural Resources, Athens, GA 30602

³ Georgia Department of Natural Resources, Wildlife Resources Division, Nongame Conservation, Social Circle, GA 30025

The southeastern United States has experienced severe, recurrent drought and rapid human population growth during recent decades, resulting in greater demand for water resources. During the same time period, freshwater mussels (unionids) in the Region have experienced substantial population declines. Consequently, there is growing interest in determining how mussel population declines are related to activities associated with water resource development. Determining the causes of mussel population declines requires, in part, an understanding of the factors driving mussel population dynamics. However, little is known of basic mussel ecology, life history, and population-level parameters for many species. We developed Pradel reverse-time capture-recapture models to estimate survival, recruitment, and population growth rates for three federally endangered mussel species in the Apalachicola-Chattahoochee-Flint River Basin, Georgia. The models were parameterized using mussel capture-recapture data collected over six consecutive years from Sawhatchee Creek, a small Chattahoochee River tributary located in

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southwestern Georgia. Mussel survival and recruitment were modeled as a function of stream discharge, species, and other factors. Model results suggest that mussel survival was negatively related to stream discharge, whereas recruitment was strongly and positively related to stream discharge during the spring and summer. Using these models, we simulated mussel population dynamics under increasing levels of water use to evaluate the relative effectiveness of alternative flow regulations. The simulations suggested that the relative risk of extinction increased with increased water use for the three endangered mussel species across a range of flow regulations. These models will be used in conjunction with ongoing research to inform management decisions aimed at identifying and conserving at-risk populations of rare and endangered unionids.

Presenter: Shertzer, K.; Email: Kyle.Shertzer@noaa.gov

Age and size dependence of the number of annual spawns: implications for stock assessment

Shertzer, K.¹, G. Fitzhugh², T. Kellison¹, and D. Wyanski³

¹ NOAA Fisheries Southeast Fisheries Science Center - Beaufort Laboratory 101 Pivers Island Road, Beaufort, NC 28516

² NOAA Fisheries Southeast Fisheries Science Center – Panama City Laboratory, 3500 Delwood Beach Road, Panama City, FL 32408

³ South Carolina Department of Natural Resources, 217 Fort Johnson Road, Charleston, SC 29412

Most stock assessments utilize some measure of population reproductive potential, typically spawning biomass. Although spawning biomass is relatively easy to compute, it does not always account adequately for effects of population structure. For example, two hypothetical populations, one with predominantly young fish and one with predominantly (but fewer) old fish, could have equivalent spawning biomass but quite different reproductive potential. Weak correlation between spawning biomass and reproductive potential is likely most pronounced in the tropics and subtropics, where species tend to spawn in batches, with indeterminate fecundity and protracted spawning. In such cases, computing annual reproductive output requires estimates of batch fecundity (BF) and number of annual spawns, which requires knowledge of spawning frequency (SF) and duration of spawning season. While BF is commonly measured by age (or size), the other variables are not, and in the absence of relevant data, most stock assessments assume that the annual number of spawns is constant across age. We reviewed the literature and found that this assumption is typically not valid, as both spawning duration and SF generally increase with age or size. We demonstrate effects of such an assumption on stock assessments, both in general and through example using a species of grouper, gag (*Mycteroperca microlepis*). This study underscores the need for better understanding of age- or size-dependent contrast in the number of annual spawns, and we conclude that for species where data do not indicate otherwise, the default assumption of invariance should be replaced with one that accounts for contrast in spawning frequency.

Presenter: **Smith, G.**; Email: geoffreyhsmith@ufl.edu

Implications of skewed sex ratios on population dynamics of greater amberjack

Authors: Smith, G., D.J. Murie, and D.C. Parkyn

Program of Fisheries and Aquatic Sciences, School of Forest Resources and Conservation, University of Florida, 7922 NW 71st Street, Gainesville, FL 32653

Greater amberjack, *Seriola dumerili*, is a pelagic reef fish that is managed in the US as two separate stocks, the Gulf of Mexico and the South Atlantic. The most recent stock assessment for the Gulf stock found it to be overfished and undergoing overfishing. Sex-specific spatial distribution and exploitation may contribute to our understanding of

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the stock's overexploitation. This may be important for greater amberjack since schools in some regions may predominantly be one sex or the other and, based on the fisheries, amberjack may be subject to sex-specific mortality. These factors may lead to sex ratios that are highly skewed from an assumed ratio of 1:1. Altered sex ratios have been found to influence population dynamics in sex-changing fish, and it may be that in a gonochoristic fish that exhibits sexually dimorphic growth, such as greater amberjack, there may also be an influence. Age, size, and sex structured models incorporating a range of potential sex ratios were used to evaluate the potential effects of skewed sex ratios in greater amberjack. Outputs from the models, including male and female spawning stock biomass, and egg, sperm, and fertilized egg production, have demonstrated that female skewed sex ratios may impart some resilience, while even moderately male skewed sex ratios may be considerably more susceptible to overfishing.

Presenter: Smith, J.A.; Email: joseph.smith@tpwd.state.tx.us

Importance of river-reservoir connectivity for migratory reservoir fishes

Smith, J.A., P. Fleming, K. Bodine, and D. Buckmeier

Texas Parks and Wildlife Department, Heart of the Hills Fisheries Science Center, 5103 Junction Hwy., Mountain Home, Texas 78058.

Increased demands for water in Texas will lead to greater hydrologic variability in Texas' rivers and reservoirs. Recent research in the Colorado River of Texas suggests as water levels decrease, the greatest reduction in littoral habitat will occur in river-reservoir transitional zones. Connectivity to upstream riverine habitats may be broken entirely for extended periods, threatening migratory reservoir fish species that use lotic habitats for part of their life cycle. In response, the Texas Parks and Wildlife Department (TPWD) is currently studying the movement patterns and habitat associations of white bass (*Morone chrysops*), blue catfish (*Ictalurus furcatus*), and gray redhorse (*Moxostoma congestum*) in a reservoir within the Colorado River basin. Ultrasonic telemetry is being used to evaluate the timing, frequency and hydrologic conditions associated with fish movement between river and reservoir habitats. In addition, use of mainstem river and reservoir tributaries is being monitored to allow identification of areas important to these reservoir migrants. Ultimately, coarse-scale physical habitat data can be used to develop habitat suitability indices and to provide a baseline for evaluating habitat within the Colorado River system. Preliminary data suggests seasonal variation in movement through the transition zone for two of the three study species. Understanding the movement patterns, habitat requirements and potential threats to these species will allow TPWD to provide technical information needed for responsible decisions about water allocations for fish, fishing, and aquatic recreation.

Presenter: **Smith, W.**; Email: wes2316@gmail.com

Population modeling to guide Caribbean freshwater riverine fishery management

Smith, W.E.¹ and T.J. Kwak²

¹North Carolina Cooperative Fish and Wildlife Research Unit, Department of Biology, NC State University, Campus Box 7617, Raleigh, NC 27695

²U.S. Geological Survey

The management of Caribbean freshwater riverine fisheries is limited by a lack of ecological information. The bigmouth sleeper, *Gobiomorus dormitor*, is a native Caribbean amphidromous species with sport fish potential, but little is known of its life history, population dynamics, and habitat requirements. To date, parameters required to develop a basic Leslie matrix population model for bigmouth sleeper populations are generally unavailable. Thus,

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we studied bigmouth sleeper movement and migration patterns and estimated important life history parameters, size at maturity, growth rates, and survival rates for bigmouth sleeper in Rio Mameyes, Puerto Rico. The results of fishery simulations and sensitivity analyses of the projection matrix indicate that bigmouth sleeper populations may be highly productive and robust to high rates of angling and exploitation. Furthermore, they may be most sensitive to factors affecting age-0 survival, a result that emphasizes the importance of flow regulation during critical periods when amphidromous larvae drift downstream to the ocean. Mark-recapture sampling of PIT-tagged bigmouth sleeper indicates that this species is highly sedentary. Although bigmouth sleeper populations may be able to sustain high rates of fishing mortality, low rates of individual movement suggest that public river access points could become locally depleted. These findings represent important first steps in understanding the ecology of the species and a basis for future strategic management planning toward riverine sport fishery development.

Presenter: **Stephen, J.A.**; Email: stephenj@dnr.sc.gov

Effects of minimum size limit regulations on exploited fish populations: comparing life history parameters of legal and sublegal fish

Stephen, J.A.^{1,2}, P.J. Harris², and M.J.M. Reichert²

¹Marine Science Program, University of South Carolina, 701 Sumter St, EWS 617, Columbia, SC 29208

²SC Department of Natural Resources, 217 Ft. Johnson Rd., Charleston, SC 29412

Commercial fisheries that are managed with minimum size limits protect small fish of all ages and may affect size-selective mortality effects by differentially removing fast growing fish. This may decrease the exploited population's average size at age, maturation, or sexual transition. When fishery-independent data are not available, the comparison of life history parameters of landed to regulatory discarded fish will indicate if differential mortality is occurring due to the capture of young but large fish (fast growing phenotype). Indications of this differential mortality would include the discard portion having similar age ranges but smaller sizes at age, maturation, and sexual transition as landed fish. We examined three species with size limits, but different exploitation histories. The heavily exploited species (vermillion snapper and red porgy) show signs of this differential mortality. Their landed catch include many young, large fish while discarded fish had similar age range and mean ages but smaller sizes at age than the landed fish. Scamp showed no signs of differential mortality due to size-selective fishing. Landed catch consisted of old large fish and discarded scamp had little overlap in age ranges, significantly different mean ages, and only small differences in size at age when compared to landed fish.

Presenter: **Sterling, K.**; Email: kasterli@olemiss.edu

An assessment of gene flow throughout the range of the Yazoo darter *Etheostoma raneyi* (Percidae: *Ulocentra*): has anthropogenic habitat alteration prevented migration?

Sterling, K.¹, B. Noonan¹, M.L. Warren Jr.², and D.H.Reed³

¹Department of Biology, University of Mississippi Box 1848, University, MS 38677-1848

²Center for Bottomland Hardwoods Research, Southern Research Station, USDA, Forest Service, 1000 Front Street, Oxford, Mississippi 38655-4915

³Department of Biology, University of Louisville, Louisville, KY 40292

Etheostoma raneyi is a range restricted snubnose darter in the Upper Gulf Coastal Plain of north-central Mississippi. Like other snubnose darters, the Yazoo darter is a small (<60mm), sexually dimorphic, benthic insectivore that usually does not survive past its first year. They inhabit perennial 1st-4th order streams with clean sand substrate, abundant in-stream wood, and moderate flow. Flood abatement projects over the past century resulted in the

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construction of hundreds of impoundments and channelization of extensive stream reaches which altered the habitat and flow regimes of these streams. These alterations have likely resulted in the creation of barriers to dispersal. Using microsatellite markers, we quantified gene flow and population genetic structure at 18 sites across the range of the species, including sites with possible barriers between them. Our results indicate that there is substantial population subdivision within and between watersheds at small spatial scales. Demes showing less genetic differentiation are separated by low order stream reaches with what we perceive to be higher quality habitat that has undergone less alteration. Demes showing higher genetic differentiation tend to be separated by lower quality habitat and higher order streams that have been greatly altered. We believe that currently observed patterns of population genetic structure results from both a dynamic history as watersheds changed character over time and from more recent anthropogenic habitat alteration.

Presenter: Stoeckel, J.; Email: jas0018@auburn.edu

Integration of multiple techniques to investigate mating systems in freshwater mussels

Stoeckel, J.¹, A. Gascho Landis¹, T. Mosley¹, N. Rankin², and G. Moyer²

¹203 Swingle Hall, Department of Fisheries and Allied Aquacultures, Auburn University, Auburn AL 36849

²U.S. Fish and Wildlife Service, Warm Springs Fish Technology Center, 5308 Spring Street, Warm Springs, GA 31830

A thorough understanding of freshwater mussel reproduction is required to develop effective conservation strategies. While much attention has been focused on post-fertilization aspects such as host identification and glochidial transfer strategies, the actual fertilization process has been often treated as a “black box”. We have developed and validated a low-cost (< \$300) technique using equipment available from local hardware stores to map locations of individual mussels in shallow (≤ 4 ft) streams with an accuracy of ± 6 inches. We are integrating this mapping technique with PIT tagging and robust design mark-recapture techniques to investigate the mating system of *Villosa lienosa* in a small, second order stream. Using this approach, we are tracking the location and movement of >100 tagged mussels every two weeks from April through November. Mark-recapture sampling is being used to estimate actual population density and whether capture efficiency varies with season. Results will address questions such as 1) do males move upstream prior to spawning? 2) Do males and females aggregate during spawning? 3) Is fertilization in females dependent upon number of proximal males? We also plan to employ genetic techniques to determine whether females are primarily fertilized by upstream males and to document fertilization distances between mussels. Integration of multiple techniques shows great promise in examining mating systems of freshwater mussels in natural systems. Studies such as this will provide valuable insight into the relationships between population density, fertilization efficiency, and effective population size of this important but declining group of freshwater organisms.

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Presenter: Strong, W.; Email: Will.Strong@myfwc.com

Comparison of two stocking techniques on the survivability of hatchery-reared fingerling Florida largemouth bass

Strong, W.¹, T. Tuten¹, E. Nagid¹, B. Eisenhauer², K. Johnson², and J. Kerns³

¹Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, 7922 NW 71st Street, Gainesville, FL, 32653

²Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, 2595 McGraw Ave, Melbourne, FL 32934

³University of Florida, School of Forest Resources and Conservation, Program in Fisheries and Aquatic Sciences, 7922 NW 71st Street, Gainesville, FL, 32653

Genetically identifiable, hatchery-reared Florida largemouth bass *Micropterus salmoides floridanus* fingerlings (43-105 mm) were stocked using two treatments (clumped and scattered) into lakes Blue Cypress (42,000/treatment) and Wildcat (8,500/treatment), Florida, to compare mortality rates between the two stocking techniques. At each lake, the clumped cohort was stocked at a single site while the scattered cohort was distributed along 1.5 km of the opposing shoreline. Initial stocking mortality (72 h) was approximately 12% for all cohorts, except for the clumped cohort in Blue Cypress Lake (31%). Mortality (*A*) from 14 days to approximately six months post-stocking was significantly higher for the clumped cohort (93%) compared to the scattered cohort (53%) at Blue Cypress Lake. However, at Wildcat Lake, *A* was not significantly different between the clumped (77%) and scattered (81%) cohorts during the same time period. Results from Blue Cypress Lake suggest that scattering fish over a large area can potentially increase the effectiveness of largemouth bass stocking when compared to stocking fish at a single location, but results from Wildcat Lake indicate that further research is necessary to provide fisheries managers with improved recommendations.

Presenter: **Stubbs, T. J.**; Email: tstubbs@cfr.msstate.edu

Spatial and temporal variability of sediment nutrients and benthic macroinvertebrates in recreational fishing ponds

Stubbs, T.J. and R. Kröger

Department of Wildlife, Fisheries and Aquaculture, Mississippi State University, P.O. Box 9690, Mississippi State, MS 39762

Eight earthen recreational fishing ponds in northern Mississippi were sampled with the objectives of describing temporal characteristics and estimating potential spatial relationships between sediment nutrients (phosphorus, carbon and nitrogen) and benthic macro-invertebrate density and diversity. The establishment of this relationship will help improve the understanding of trophic interactions and pathways within freshwater systems that are managed bottom-up as opposed to top-down. Ponds were sampled every 100 meters along the shoreline with an Ekman Dredge. Data were analyzed to determine if there were statistically significant correlations between sediment nutrient concentrations and benthic macro-invertebrate community characteristics. In a comparison through all seasons, there was no correlation between phosphorus Pw concentrations and invertebrate abundances ($P > 1.00$; $R^2 = 0.00$). Invertebrate diversity consistently decreased throughout the year, with chironomids, gastropods and oligochaetes being the top three species sampled each season. Mean invertebrate abundance and phosphorus concentration decreased from winter to spring, however, rebounded in the summer. Summer invertebrate abundance was statistically lower than both winter ($P > 0.02$) and spring ($P > 0.002$). There was a little correlation ($P > 0.93$; $R^2 = 0.057$) between invertebrate abundance and the carbon:nitrogen ratio in the winter. Based on these results, data suggests weak correlations may exist in spatial and temporal variation between sediment nutrient concentrations and benthic macro-invertebrate community characteristics.

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Presenter: Switzer, T.; Email: Ted.Switzer@MyFWC.com

Characterizing reef fish resources in the eastern Gulf of Mexico using a habitat-based sampling approach: results from the Florida Middle Grounds

Switzer, T., S. Keenan, B. Winner, and J. Vecchio

Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, 100 8th Avenue SE, St. Petersburg, FL 33701

Reef fishes have historically supported lucrative commercial and recreational fisheries throughout much of the southeastern United States, although recent stock assessments indicate that several high-profile reef fishes (e.g., *Mycteroperca microlepis*, *Lutjanus campechanus*) are currently overfished and/or undergoing overfishing. The assessment and management of exploited reef fishes has been hampered by the relative paucity of fisheries-independent data, although various agencies have begun to address these limitations through modified and/or expanded fisheries-independent surveys along both the Gulf of Mexico and South Atlantic coasts. Surveys of reef fishes are costly and time-intensive, so it is essential for these surveys to be as efficient as practicable. Accordingly, we explored the utility of a habitat-based, stratified-random survey design to facilitate the characterization of reef-fish resources in the Florida Middle Grounds (FMG). Available high-resolution bathymetry and backscatter data were summarized to assign 0.1nm x 0.3nm sampling units to one of eight habitat strata based on a combination of relief and bottom-hardness metrics. Sampling was conducted at randomly-selection stations during the spring and fall of 2009 using a multi-gear approach (stationary video cameras, chevron traps, and vertical hooked gear) to quantify the abundance and size-structure of reef-associated fishes. Statistical analyses identified significant differences in overall community structure among habitat strata. In general, bottom hardness was more important than relief in structuring FMG communities. For most reef fishes (e.g., *Epinephelus morio*, *Rhomboplites aurorubens*, *Lutjanus griseus* and *Balistes capriscus*), observed abundances increased significantly with bottom hardness. In contrast, both *Lutjanus campechanus* and *Mycteroperca microlepis* generally exhibited highest abundance at high-relief sites. Results from this exploratory survey indicate that incorporating habitat strata into survey design will increase the efficiency of reef-fish surveys, although implementing such an approach would require a concomitant investment in broad-scale mapping efforts.

Presenter: Syc, T.; Email: Taras258@gmail.com

A comparison of red snapper, *Lutjanus campechanus*, from “old” (2006) to “new” (2009/2010) artificial habitats in the northern Gulf of Mexico

Syc, T. and S. Szedlmayer, S.

Auburn University, Department of Fisheries and Allied Aquacultures, 8300 State Highway 104, Fairhope, AL 36532

Whether or not artificial reefs actually result in increased production of red snapper populations has been difficult to answer. One aspect that may help this evaluation is a comparison of reef age to resident fish age. If artificial reefs actually produce new biomass, we suggest that old reefs would have older fish compared to younger reefs. To test this we compared red snapper populations from “old” reefs (built in 2006) to “young” reefs (built in 2009 and 2010). We sampled red snapper populations with fish traps, hook and line, and SCUBA surveys (visual fish counts, photographs, and HI8-video) from April to November 2010. Densities of red snapper on the old reefs (mean \pm SD = 129 \pm 45) were significantly greater compared to the new reefs (mean \pm SD = 59 \pm 96; t-test, df = 36; $P < 0.006$). We collected 587 fish from old reefs ($N = 18$) and 441 fish from young reefs ($N=19$). In the laboratory, all fish were measured, weighed and otoliths removed for ageing. All otoliths were aged by two independent readers, and if ages differed the otolith was examined a third time. Red snapper were significantly older and larger on old reefs (mean \pm SD = 3.9 \pm 1.1 yrs and 1.9 \pm 1.4 kg) compared to young reefs (mean \pm SD = 2.0 \pm 1.7 yrs and 0.7 \pm 1.4 kg; t-test, $P < 0.001$). Growth rates based on weight were significantly greater on the old reefs (mean \pm SD = 0.53 \pm 0.24 kg/yr) compared to young reefs (mean \pm SD = 0.29 \pm 0.25 kg/yr; t-test, $P < 0.001$). This pattern of older fish on 2006 reefs

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compared to younger fish on 2009-2010 reefs supports actual production of this species from artificial reefs in the northern Gulf of Mexico.

Presenter: **Taylor, M.A.**; Email: mtaylor@bio.fsu.edu

Foraging ecology of estuarine-dependent juvenile fishes in a river-dominated estuary (Apalachicola Bay, Florida)

Taylor, M.A.¹, J.K. Craig², and J. Wanat³

¹ Florida State University, Department of Biological Science

² Florida State University Coastal and Marine Laboratory

³ Apalachicola Estuarine Research Reserve

Estuaries provide important nursery habitats that support the production of ecologically and economically important fishes. Apalachicola Bay experiences considerable variation in hydrography due largely to variation in river flow that may impose constraints on the functioning of juvenile nursery habitats. Using juvenile spot, a common estuarine-dependent species, as a model species I am testing the hypothesis that variability in diet of juvenile spot within primary nursery habitats is related to seasonal variation in river flow and associated environmental conditions. The diets of 154 juvenile spot (9 – 112 mm standard length) from 12 locations throughout Apalachicola Bay sampled monthly in 2009 were included in this analysis. Individual stomach and intestine contents were identified to the lowest taxonomic level possible, counted, and a volumetric measurement was estimated for each prey category. The relative importance and percent frequency of occurrence of individual prey items was then calculated. Prey items of juvenile spot included harpacticoid and calanoid copepods, ostracods, small bivalves, nematodes, gammarid amphipods, and polychaetes. The frequency of occurrence and index of relative importance were compared between sites in Apalachicola Bay and among monthly sample collections. Continued diet and future stable isotope analyses over two years will contribute to a better understanding of the effects of variable freshwater input on the foraging ecology of juvenile spot during their residency in estuarine nursery habitats.

Presenter: Taylor, R.G.; Email: ron.taylor@myfwc.com

Common snook: how their biology complicates their population status

Taylor, R.G.

Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, 100 8th Ave. S.E., St. Petersburg, FL 33701

Common snook have been a mainstay of Florida's fisheries since World War II and their harvest has been regulated since 1947. Even though regulations have become increasingly strict during the ensuing 64 years, the stocks continue to be 'overfished' for reasons that are not well understood. Because they are at the northern extreme of their distribution, ecological disturbances cause unpredicted catastrophic natural mortalities that thwart predicted results from additional appropriate regulations. Loss of critical upland wetlands and the 'mangrove fringe' confound projected stock abundance. Biological differences in reproduction, growth, longevity, mortality, and survival rates between coasts and the sexes differentially impacts biological reference points. It is difficult to ascertain spawning stock biomass when a species has vacillating sex ratios due to hermaphroditism or to predict spawning potential when spawning frequencies fluctuate because of skip spawning. Lack of knowledge of the total reproductive potential is compounded by not understanding the role of adult snook found on nearshore reefs and in Florida Bay. Genetic variation between the Atlantic and Gulf stocks may be the impetus for many of these differences but is there some intrinsic mechanism that accounts for population instability? Or has the carrying

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capacity been met? Florida currently utilizes a minimum SPR (Spawning Potential Ratio) of 40% as a target value and any less value indicates the population has been deemed 'overfished' or diminished to an unacceptable level and triggers additional regulation. However, past evidence suggests that the biological minimum threshold for SPR is around 25%, a level that has been consistently achieved since stock assessments have been conducted. In reality; we must develop and support conservative regulations that insure allowed exploitation levels result in robust stocks notwithstanding Florida's unpredictable exponential growth and fishing effort.

Presenter: **Tetzlaff, J.C.**; Email: jctetz@ufl.edu

Effectiveness of size limits and bag limits for limiting fishing mortality rates of gag grouper in the Gulf of Mexico

Tetzlaff, J.C. and W.E. Pine III

Fisheries and Aquatic Sciences Program, School of Forest Resources and Conservation, Institute of Food and Agricultural Sciences, University of Florida, PO Box 110600, Gainesville, Florida 32653-3071

Gag grouper (*Mycteroperca microlepis*) support a valuable recreational and commercial fishery in the Gulf of Mexico. The most recent stock assessment of this population concluded that gag are overfished and undergoing overfishing. Despite an array of management regulations, gag exploitation rates remain at unsustainable levels and proposed reductions in gag harvest will require additional regulatory measures. One potential reason why current regulations have been ineffective is that large increases in recreational effort coupled with stringent regulations have created a highly inefficient recreational fishery for gag with annual discard mortalities currently exceeding recreational gag harvest. We used an age-structured equilibrium analysis which included discard mortality to examine the efficacy of size and bag limits as regulatory tools to identify: (1) optimal regulatory policies, (2) trade-offs in yield, efficiency and stock rebuilding, (3) potential negative interactions between size and bag limits on equilibrium recruitment, and (4) potential implications of cumulative mortality from multiple capture events on optimal policy recommendations. Our results suggests alternative regulations could optimize the fishery and increase long-term yield but would require more stringent regulations, resulting in decreases in exploitation, short-term yield, and efficiency. Regulation of the recreational fishery through size and bag limits alone is unlikely to meet required reductions in exploitation needed to rebuild the Gulf of Mexico gag population. Alternative management approaches such as effort restrictions and spatially explicit policies involving spatial and temporal closures that account for the ontogenetic and seasonal migration patterns of gag may be required to manage gag at sustainable levels.

Presenter: Thomas, E.; Email: eric.thomas@myfwc.com

An evaluation of a slot limit regulation for largemouth bass (*Micropterus salmoides*) on Lake Kerr, Florida: Implications for slot limit regulations in Florida

Thomas, E.

Florida Fish and Wildlife Conservation Commission, Division of Freshwater Fisheries Management, Northeast Region, Ocala, FL

Lake Kerr is a 1,289-hectare mesotrophic lake in Marion County, Florida with an over-abundance of sub-harvestable size largemouth bass (*Micropterus salmoides*) and good numbers of trophy bass. In 2006, the Florida Fish and Wildlife Conservation Commission (FWC) implemented a slot limit regulation on largemouth bass in an effort to increase the number of intermediate-sized bass. Anglers were allowed to harvest three bass, of which one could be > 610mm and three could be < 381mm. The three-fish bag limit was used because of the limited choices available

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to fisheries managers at the time. A five-year study utilizing electrofishing and peak-season creel data was initiated to evaluate the effectiveness of the slot limit in altering population size structure. Proportional stock densities, relative stock densities, and cumulative frequency plots were used to compare population size structures from electrofishing results before and after the regulation change. Creel results were analyzed to compare angler effort, catch, and harvest. The results showed no change in the population size structure from the electrofishing data. Creel results showed high variation in angler effort, a decline in catch, and an increase in harvest. While harvest increased, it did not increase enough to shift the population size structure. We recommend that the FWC's policy on special fishing regulations needs to be flexible enough to allow fisheries managers to implement regulations that are biologically sound and have the opportunity to be successful.

Presenter: Thompson, B.; Email: brandon.thompson@myfwc.com

Behavior and survival of hatchery reared advanced fingerling largemouth bass using radio telemetry

Thompson, B., W. Porak, and N. Trippel

Eustis Fisheries Research Laboratory, Florida Fish and Wildlife Conservation Commission, 601 West Woodward Avenue, Eustis, Florida 32726

Domestication affects of pellet-reared largemouth bass have been documented at the Florida Bass Conservation Center including; behavioral, anatomical, and health related alterations. While studies have shown poor post-stocking survival rates of less than 3% for pellet-reared bass in Florida lakes, advancements in the culture process such as out-of-season spawning, transitioning to live prey, and a new healthy diet should increase survival. A radio-telemetry study was conducted on Lake Carlton (Lake County, FL) in the spring of 2009 and 2010 to evaluate the short term behavior and survival of pellet-reared largemouth bass once stocked into the wild. Wild juvenile bass were also radio-tagged to identify behavioral and survival differences between hatchery and wild largemouth bass. In the first 30 days post stocking, hatchery bass (n=30) suffered 62% mortality compared to 18% experienced by the wild bass (n=20). Of the 30 hatchery tagged bass, 47% were determined to have succumbed to predation and three were suspected to be bird predation. Movement (average meters per day \pm SE) was also significantly different between the wild (25.7 ± 10.2 m) and hatchery-reared bass (74.5 ± 16.1 m). Surviving wild bass had significantly faster growth (1.7 ± 0.29 mm TL) in percent body weight gained per day in comparison with hatchery-reared bass (0.4 ± 0.19 mm TL). Conclusions from this study indicate that pellet-reared largemouth bass continue to suffer from domestication affects, leading to lower fitness and higher predation. Further research needs to be done to reduce domestication affects by conditioning them to predators prior to being stocked into the wild.

Presenter: **Timmons, B. A.**; Email: btimmons@uaex.edu

Influences of biological vegetation control on sport fish characteristics and aquatic plant communities in southern Arkansas

Timmons, B.A. and S.E. Lochmann

Aquaculture/Fisheries Center, University of Arkansas at Pine Bluff, 1200 N. University Dr., Mail Slot 4912, Pine Bluff, AR 71601

The Ouachita and Saline Rivers, creeks, sloughs, lakes, and swamps cross Felsenthal National Wildlife Refuge (FNWR). The FNWR developed an aquatic vegetation problem that hindered angler access and reduced public visits. Fish sampling was performed in 2008 prior to vegetation control, and repeated in 2009 and 2010. Largemouth bass *Micropterus salmoides* and bluegill *Lepomis macrochirus* were sampled with a boat electrofisher. Vegetation was sampled in 2008 prior to vegetation control and again in 2010. Twenty-meter transects and 1-m²

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quadrats were used to determine vegetation cover and biomass. Grass carp *Ctenopharyngodon idella* were stocked in late 2008 and early 2009 at a rate of 11 fish/ha. ANOVAs were used to compare fish population characteristics. A least significant difference test was used to compare differences in the mean pre-stocking and post stocking. Pre-stocking and post-stocking vegetation percent cover and biomass were compared using a percent similarity index. The pre-stocking mean (SE) CPUE of largemouth bass was 11 (0.9) fish/hr and the mean CPUE of bluegill was 40 (9) fish/hr. Post stocking mean CPUE of largemouth bass were 28 (4) and 30 (2) fish/hr for 2009 and 2010, respectively. Post stocking mean CPUE of bluegill were 81 (17) and 53 (4) fish/hr for 2009 and 2010, respectively. Post stocking relative abundance was significantly different for largemouth bass. Post stocking relative abundance for bluegill differed significantly in 2009. The pre-stocking mean percent cover was 12 (28)% and the mean biomass was 62 (163) g/m². The post-stocking mean percent cover was 34 (45)% and the mean biomass was 138 (346) g/m². The most abundant aquatic vegetation pre-stocking were American Lotus *Nelumbo lutea*, Hydrilla *Hydrilla verticillata*, and Egeria *Egeria densa*. The most abundant aquatic vegetation species post-stocking were American Lotus, Water Lily *Nymphaea odorata*, and Coontail *Ceratophyllum demersum*.

Presenter: Trippel, N.; Email: Nick.Trippel@myfwc.com

Stock enhancement of largemouth bass in two Florida lakes

Trippel, N.¹, W. Porak¹, B. Thompson¹, M. Matthews², and R. Stout²

¹ Florida Fish and Wildlife Conservation Commission, Eustis Freshwater Fisheries Laboratory, 601 W. Woodward Ave, Eustis, FL 32726

² Florida Fish and Wildlife Conservation Commission, Florida Bass Conservation Center, 3583 C.R. 788, Webster, FL 33597

The Florida Fish and Wildlife Conservation Commission has developed a science based largemouth bass stocking program for the state of Florida. We hope to increase the number of fish caught by anglers through supplemental stocking of advanced fingerling bass into hypereutrophic lakes early enough and at sizes large enough to consume young-of-the-year shad, which are too large for naturally produced age-0 bass to feed on. If successful, the hatchery fish should add to and not replace fish produced naturally. Lakes Griffin and Carlton in Lake County, Florida are being stocked during consecutive years with 100–mm bass at a rate of 62 fish/ha. A Schnabel mark-recapture population estimate was done annually at Lake Carlton in March using electrofishing gear. Ten months after the initial stocking, we estimated there were 31 (95% Confidence Interval 11-419) stocked fish in Lake Carlton, which accounted for 10.2% of bass in their size range (160-260mm). Telemetry studies on Lake Carlton estimated survival of hatchery fish in 2010 to be 38% at 30 days post-stocking. Predation from fish and birds was estimated to be 62% for hatchery fish and 0% for similar-sized wild fish during the same time period. Diet analyses found only three (3.5% of all fish sampled) hatchery fish total in 2009 with shad in their stomachs and nine fish total (8.1% of all fish sampled) during 2010, indicating that the stocked largemouth bass were not utilizing this abundant prey base. We also researched effects of conditioning to natural photoperiod, live prey, and exposure to predators in ponds before stocking into the wild. Preliminary results from conditioning studies at the hatchery indicated that exposure to predators and/or size at stocking may significantly contribute to post-stocking survival rates.

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Presenter: Trotter, A.; E-mail: Alexis.Trotter@MyFWC.com

Aperiodic migrations and use of riverine habitats by common snook: evidence for skip spawning

Trotter, A.¹, R. Taylor¹, D. Blewett², and P. Stevens²

¹ Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, 100 8th Ave. S.E., St. Petersburg, Florida 33701

² Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, Charlotte Harbor Field Laboratory, 585 Prineville St., Port Charlotte, Florida 33954

Common snook support a valuable recreational fishery that contributes significantly to Florida's economy and have been the subject of numerous diverse studies that defined aspects of their life history, reproductive biology, and fishery dynamics. Current assessment models contain assumptions based on historical reproductive schedules measured at the population level during the early 1990's. For species in which spawning is linked with migration behavior, relatively new telemetry approaches for understanding migration are challenging population-level understanding of habitat residency and specifications of spawning schedules. We conducted an acoustic telemetry study of the movements and migrations of common snook during 2005-2007 in the tidal reaches of the Caloosahatchee River, a major tributary of Charlotte Harbor. We determined 60% of the tagged snook left the study area, presumably to high-salinity waters where spawning occurs, during at least one of the spawning seasons of the three year investigation. The onset and duration of these annual migrations are within the findings of previous reproductive studies, however individual dynamics vary. Unexpectedly, 40% of the tagged snook remained continuously inside the monitored portion of the river (for up to three years), providing evidence for skip spawning. This high resolution information on the behavior of individual snook should be incorporated into future stock assessments because these detailed data indicate differential individual contribution to total spawning biomass which may affect the predicted condition of stocks.

Presenter: Vecchio, J.; Email: julie.vecchio@myfwc.com

Seasonal dynamics of reef-associated fishes on shallow water reefs on the West Florida Shelf

Vecchio, J., T. Switzer, and S. Keenan

Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, 100 8th Ave. S.E., St. Petersburg, Florida 33701

Stock assessment scientists throughout the southeastern U.S. have increasingly requested fisheries independent data for reef-fish stock assessments. Most reef-fish sampling protocols have relied heavily on annual synoptic surveys; however, year-round, fixed-station monitoring provides valuable information on seasonal dynamics of reef fish assemblages at specific sites. Accordingly, the Florida Fish & Wildlife Conservation Commission, Fish & Wildlife Research Institute has initiated surveys of 11 reef sites in the eastern Gulf of Mexico. Using stationary underwater video camera arrays to quantify reef-associated fish assemblages, we sampled nearshore, natural hardbottom areas (10-20 m depth). Videos were recorded quarterly at each reef from November 2009 to August 2010. Data obtained from these surveys includes various habitat metrics, fish species composition, and maximum number of individuals per taxon. Fishes encountered throughout the year included red grouper (*Epinephelus morio*), scamp (*Mycteroperca phenax*), hogfish (*Lachnolaimus maximus*), tomtate (*Haemulon aurolineatum*), white grunt (*Haemulon plumierii*), porgies (*Calamus* spp.), pufferfishes (*Sphoeroides* spp.), and wrasses (*Halichoeres* spp.). Additional federally-managed species observed during at least two seasons included gray and red snappers (*Lutjanus griseus* & *Lutjanus campechanus*) and gray triggerfish (*Balistes capricus*). Rarely observed species included one goliath grouper (*Epinephelus itajara*) and one green sea turtle (*Chelonia mydas*). Non-parametric statistical analyses were used to explore seasonal and spatial comparisons of overall community structure. Indices of diversity and abundance will also be presented for each location and each season. Data collected at fixed station reefs can be used as an important

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frame of reference for comparisons to data from stratified random sampling surveys, and may capture seasonal cross-shelf migrations that synoptic sampling is unable to observe.

Presenter: **Waine, M.W.**; Email: wainemw@gmail.com

Assessing spawning runs of anadromous fishes using a Bayesian analysis of split-beam and DIDSON count data

Waine, M.W.¹, J.E. Hightower², K.M. Boswell³, and B.J. Reich⁴

¹ North Carolina Cooperative Fish and Wildlife Research Unit, North Carolina State University, Department of Biology, Campus Box 7617, Raleigh, NC 27695

² U. S. Geological Survey, North Carolina Cooperative Fish and Wildlife Research Unit, North Carolina State University, Department of Biology, Campus Box 7617, Raleigh, NC 27695

³ Department of Oceanography and Coastal Sciences, Louisiana State University, Baton Rouge, LA 70803

⁴ Department of Statistics, North Carolina State University, Campus Box 8203, Raleigh, NC 27695

Riverine hydroacoustics offer a non-invasive technique to assess anadromous populations during upstream migrations (spawning runs) to riverine habitats. We monitored spring spawning runs in 2008 and 2009 of hickory shad *Alosa mediocris*, American shad *Alosa sapidissima*, alewife *Alosa pseudoharengus*, blueback herring *Alosa aestivalis*, striped bass *Morone saxatilis*, and white perch *Morone americana* in the Roanoke River, NC using a combined sonar study design. We used side aspect split-beam echosounding and DIDSON transects to obtain point counts across the river channel and throughout the water column. The split-beam covered ~30% of the river cross section, while DIDSON transects provided resolution in unsampled areas (opposite bank and near bottom). From weekly DIDSON transects in 2009, we found upstream migrants were bottom and shore oriented, with 75% within 1 m of the bottom and 82% within 20 m of each bank. Using a Bayesian modeling framework, we estimated daily run size based on modeled spatial densities from the combined sonar count datasets, and a conditionally autoregressive model to smooth spatial trends to unsampled areas. Daily estimates in both years were strongly correlated in space and time, explained further by spatial covariates included in the model (e.g., distance from bank). We identified run timing of anadromous fishes using drift gillnetting and boat electrofishing, and found that peaks in catch were significantly correlated with modeled daily estimates. We partitioned model estimates to species specific run sizes using a 7 d moving average of daily catch data. Results indicate a currently low population size of American shad, a consistent result with other river-specific assessments of this population. Run estimates for other targeted anadromous fishes appear relatively stable. Our survey methods and analysis pathway enhance run size monitoring techniques, especially in rivers where fixed side-aspect hydroacoustics monitoring covers only a fraction of the entire river cross section.

Presenter: **Wagner, C.W.**; Email: cwagner@bio.fsu.edu

Use of natural markings to identify individual Nassau grouper, *Epinephelus striatus*

Claydon, J.A.B.¹, Wagner, C.W.², and Calosso, M.C.¹

¹ The School for Field Studies Center for Marine Resource Studies; 1 West Street South Caicos, Turks and Caicos Islands

² Florida State University, Department of Biological Science; 319 Stadium Drive, Tallahassee, FL 32304;

Nassau groupers, *Epinephelus striatus* (Serranidae), have patterns of dark spots around their eyes. This study investigated whether these spots could be used as natural markers to identify individuals from digital photographs taken *in situ*. In order to serve as useful natural tags, markings need to be unique, to persist over time and to be

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distinguishable from photographs without the need to capture individuals. Photographs were taken of juvenile Nassau groupers ranging in size from an estimated 9 to 40 cm TL in a seagrass area in South Caicos, Turks and Caicos Islands. Individuals appeared to display unique patterns of spots. The pattern of spots on the left and right side of individuals were similar but not identical. Individuals were recognizable by the spots around their eyes which persisted over the four week study period. These natural markers were recognizable from photographs taken with an unsophisticated underwater digital camera while SCUBA diving and snorkeling. The use of natural markings of Nassau groupers has the potential to enhance information collected during underwater visual census of this species.

Presenter: Walters, S.; Email: Sarah.Walters@myfwc.com

The spatial distribution of sciaenid spawning sites and their vulnerability to episodic high mortality rates due to red tide

Walters, S., S. Lowerre-Barbieri, and J. Bickford

Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission
100 8th Avenue SE, St. Petersburg, FL 33701

Adult sand seatrout (*Cynoscion arenarius*) and spotted seatrout (*Cynoscion nebulosus*) are soniferous congeners sharing similar diel and seasonal spawning periodicities. A passive acoustic survey using a random stratified design detected spawning aggregations of both species over two sequential spawning seasons (2004-2005) in Tampa Bay, Florida. Although spotted seatrout and sand seatrout share overlapping spawning seasons and similar life history characteristics, the survey demonstrated that different areas and habitats were used for spawning. In 2005, an intense and protracted red tide (*Karenia brevis*) entered Tampa Bay three months after spawning season had begun, significantly affecting spawning aggregations of both species. Although both species experienced significant declines in aggregations, sand seatrout were more severely affected because of the concentration of spawning sites in the middle of the bay, coinciding with the path of passively transported red tide cells into the estuary. Conversely, spotted seatrout aggregations were close to shore and broadly distributed, reducing the exposure of aggregations to red tide toxins. Ultimately, the survey provided insight concerning the affects of an episodic event on these two species and how their habitat selections influenced their ability to survive. Typically, it is difficult to assess the effect of environmental alterations on marine fish populations due to complexities in measuring the extent of the perturbation and the magnitude of the loss to the population. Our spatially explicit data further demonstrates the widespread effects of red tide on fisheries and provides an important tool for assessing the magnitude of loss to spawning fish populations. Given the recreational popularity of spotted seatrout, being able to access this type of fluctuation in natural mortality increases our ability to accurately apply population buffers needed to sustainably support fishing.

Presenter: Wayman, W.R.; Email: william_wayman@fws.gov

In-vitro transformation of purple bankclimber (*Elliptoideus sloatianus*) glochidia

Wayman, W.R.

U.S. Fish and Wildlife Service, Warm Springs Fish Technology Center, 5308 Spring Street, Warm Springs, GA 31830

The purple bankclimber (*Elliptoideus sloatianus*) is a federally threatened species of freshwater mussel that only occurs in the Apalachicola-Chattahoochee-Flint River Basin and the Ochlocknee River. The Recovery Plan for the purple bankclimber calls for the development of captive propagation and re-introduction techniques, so that

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populations can be augmented or expanded, and to re-establish populations in historic habitat. Currently no known endemic host fish exist for this species. The development of a transformation technique for purple bankclimber glochidia would allow restoration and re-introductions efforts to begin for this species. Glochidia were collected from several gravid mussels held at the Warm Springs National Fish Hatchery. The glochidia were rinsed with sterile water and culture media to remove as many contaminants as possible prior to distribution into culture plates. Glochidia were aliquoted into 6-well culture dishes containing 4 ml of culture media. The plates were incubated at 25 ± 1 °C in a water-jacketed incubator with a CO₂ concentration of 3%. Culture media (2 ml) was replaced daily. After 18 days, the culture media was removed and exchanged with sterile fresh water to induce transformation. After 24 hours, the percentage of transformed juvenile mussels was determined for each well. In initial experiments, glochidial transformation rates averaged $50 \pm 29\%$ (excluding wells where fungal contamination was excessive) per plate, and was highly variable, ranging from 0 to 79% transformed per well. As methods improved at removing contaminants from the glochidia, so did transformation rates. In later experiments, glochidial transformation averaged $67 \pm 13\%$, with a range of 48 to 83% per well.

Presenter: **Weidner, T.A.**; Email: tweidner@nova.edu

Combined gut-content and stable isotope trophic analysis of the pelagic stingray (*Pteroplatytrygon violacea*) from the western North Atlantic Ocean

Weidner, T.A., A.C. Hirons, and D.W. Kerstetter

Nova Southeastern University Oceanographic Center, 8000 North Ocean Drive, Dania Beach, FL 33004 USA

The understanding of an organism's trophic level is vital to understanding the impact that a specific species has on the ecosystem, and trophic relationships are vital for correctly modeling ecosystems and ecosystem effects of fisheries removals. The pelagic stingray is a common bycatch species in the Atlantic pelagic longline fishery and understanding its ecological impacts are necessary to make correct assumptions for pelagic ecosystems. The pelagic stingray is found in sub-tropical and tropical waters worldwide and is thought to inhabit the epipelagic zone of the ocean based on fishery catch records. Very few studies have been done on the diets of the pelagic stingray, most with low sample sizes. For this work, 120 specimens (63 males and 61 females) were collected during commercial pelagic longline fishing operations in the U.S. South Atlantic Bight between August 2008 and December 2009. Diet composition of these stingrays was assessed for variance among seasons, gender, and body lengths (age class proxy). Stomach contents were fixed in formalin, then dissected and quantified to the lowest possible taxonomic level. Preliminary stomach content dissections have shown the major consumed items were teleost species (36.37%), shrimp (28.57%), and squid (23.38%). This was in contrast to previous diet studies from the Pacific Ocean which found mollusks (50%) to be the dominant prey item, followed by Actinopterygian fishes (19%) and crustaceans (17%). In addition, stable isotope analysis of $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ was performed on white dorsal muscle to correlate trophic feeding level data and the gut-content analysis. The $\delta^{13}\text{C}$ values of the pelagic stingray were recently compared to literature-published values for the stomach content species and values of analyzed swordfish from the region. The results suggest the stingrays were possibly feeding on a different base of the food web. The range in $\delta^{15}\text{N}$ values showed foraging across several trophic levels.

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Presenter: **Westhoff, J. T.**; Email: jtw7a1@mail.missouri.edu

Intolerant invader: The role of natural and anthropogenic factors in the displacement of two native crayfishes by an invasive

Westhoff, J.T.¹, C.F. Rabeni¹, and S.P. Sowa²

¹ Missouri Cooperative Fish and Wildlife Research Unit, University of Missouri-Columbia, 302 Anheuser Busch Natural Resources Building, Columbia, MO 65211

²The Nature Conservancy, Michigan Field Office, 101 E. Grand River Ave., Lansing, MI 48906

Native crayfishes are often extirpated from portions of their range due to interaction with invasive species, anthropogenic alterations of environmental conditions, or a combination of factors. In the St. Francis River drainage of Missouri, the introduced species *Orconectes hylas* is suspected of displacing two native crayfishes throughout much of their range. Our goals were to identify the natural and anthropogenic factors related to the current distributions these crayfishes and determine if anthropogenic activities might be related to declines in the natives or establishment of the invasive. Crayfish collection records were spatially linked to a suite of natural (e.g., soils, geology, stream size, etc.) and anthropogenic features (e.g., cropland cover, impervious surface cover, mines, etc.) and analyzed using decision tree analysis to create probability-based presence models for each species. Factors related to geology and soils were the best natural predictors of species distribution and agricultural-related factors were the most influential anthropogenic activity related to species distributions. All associations between the invasive species and anthropogenic factors were negative, indicating they are not likely to establish in heavily impacted areas. Overall, our models had high correct classification rates and we were able to reliably predict the presence of the invasive species in the invaded drainage. Results will be used to further refine the search for a mechanism of species displacement and as a planning tool for future management.

Presenter: Williams, J.D.; Email: fishwilliams@gmail.com

Freshwater mussels of Florida project

Williams, J.D.¹, G.L. Warren¹, and R.S. Butler²

¹ Florida Fish and Wildlife Conservation Commission, Gainesville, FL 32653

² U.S. Fish and Wildlife Service, Asheville Ecological Services Field Office, Asheville, NC 28801

The project objective is to produce a book on the freshwater mussels of Florida. Of the 300 species of mussels in the U.S., about 60 (in 20 genera) occur in Florida. The mussel fauna is highly endemic, with 39 species confined to the Florida and rivers flowing into the state from Alabama and Georgia. Presence of seven additional species is considered hypothetical as they occur only in river drainages in Alabama and Georgia that flow into Florida. Most of the mussel diversity is found in the river drainages from the Escambia River east to the Suwannee River. Peninsular Florida supports limited diversity, 12 native species and one introduced, but has large populations in most rivers and lakes. Shell morphology, soft anatomy and genetic analysis are being used to delineate distribution, identify cryptic diversity and evaluate taxonomic status of poorly known mussels. Ongoing field efforts include sampling all major river drainages of Florida. Review of museum collections will provide the historical baseline for evaluating the current distribution and conservation status of the fauna. The final product will include shell description and photographs, dot distribution maps, life history and host fishes information, habitat, ecology and conservation status.

Oral Presentations

Presenter: Williams, J.D.; Email: fishwilliams@gmail.com

Conservation status of Southeastern freshwater mussels

Williams, J.D. and members of the AFS Endangered and Threatened Mussels Committee

Florida Museum of Natural History, University of Florida, Gainesville, FL 32611

Freshwater mussel diversity in the southeastern U.S. is regionally the highest in North America. There are 265 species and 15 subspecies, a total of 280 taxa, that occur in the 11 southeastern states. The number of taxa per state ranges from a high of 181 in Alabama to a low of 35 in South Carolina. Based on the AFS Endangered and Threatened Mussels Committee assessment, of the 280 taxa, 29 (10%) are considered extinct or possibly extinct, 182 (65%) imperiled (endangered, threatened or vulnerable) and 69 (25%) currently stable. The percentage of imperiled taxa per state ranges from a high of 71% in Virginia to a low of 42% in Louisiana, with an average level of 57% imperilment in the 11 southeastern states. Since the 1993 AFS assessment, which included 252 taxa, 193 (77%) have had no change, 40 (16%) have declined and 19 (8%) have had slight improvements in their conservation status. The improved status of many taxa is due to discovery of additional populations. The U.S. Fish and Wildlife Service currently lists 79 as endangered and 8 as threatened, with an additional 17 species proposed for candidate Federal conservation status. The decline and threats to the southeastern mussel diversity is the result of past and continuing habitat alteration and destruction and introduction of nonindigenous species. Emerging threats to mussels and their host fishes will be discussed.

Presenter: Winner, B.L.; Email: brent.winner@myfwc.com

The assessment of common snook through fishery-independent methods in Florida

Winner, B.L.¹, T.C. MacDonald¹, C.B. Guenther¹, D.A. Blewet², and R.H. McMichael, Jr.¹

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

²Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission, 585 Prineville St., Port Charlotte, FL 33954

The common snook is a popular game fish that commonly occurs in coastal, estuarine, and riverine waters of Florida from Cape Canaveral on the Atlantic coast to Tampa Bay on the gulf coast. Their size, fighting ability, and food value have made them one of Florida's most esteemed sport fish for inshore anglers. Recreational fishing pressure on common snook has increased dramatically since the 1980s, and snook stocks remain overfished throughout their Florida range. The Fisheries-Independent Monitoring (FIM) program at the Fish and Wildlife Research Institute has been collecting data to assess the relative abundance and distribution of common snook since 1989. The FIM program currently conducts sampling in Tampa Bay, Charlotte Harbor, and Indian River Lagoon estuaries using standardized methods, gear, and a stratified-random sampling design. Relative abundance, size and age structure, spatial and temporal distribution, and habitat preference of common snook along shoreline habitats were estimated for each of the estuaries. Significant differences in relative abundance of common snook among estuaries, suggests a marked variation in population abundance on a regional scale. Several factors (e.g., mangrove and seagrass habitat, salinity, and water temperature) were linked with common snook relative abundance and distributions among estuaries. The FIM program's long-term monitoring data base has been used to 1) determine the effects of recent decadal red tide and 'cold kill' events on common snook populations in Florida, 2) estimate common snook size and age structure data to compare populations over time among estuaries, and 3) investigate the linkage between peaks in common snook juvenile recruitment and future adult abundance. A comprehensive fisheries-independent sampling approach has facilitated a better understanding of how common snook interact with their environment throughout Florida and provides annual abundance estimates and population demographic data that is used to manage common snook populations in Florida.

Oral Presentations

Presenter: Wisniewski, J.M.; Email: jason_wisniewski@dnr.state.ga.us

Lessons learned from a long-term mussel tagging study

Wisniewski, J.M.¹, J.T. Peterson², S. Abbott³, C. Shea⁴, and C. Stringfellow⁵

¹ GA Department of Natural Resources, Wildlife Resources Division, Nongame Conservation Section, 2065 Hwy 278 SE, Social Circle, GA 30025

² U.S. Geological Survey, Georgia Cooperative Fish and Wildlife Research Unit, University of Georgia, Athens, GA 30602

³ U.S Fish and Wildlife Service, Georgia Ecological Services, P.O. Box 52560, Ft. Benning, GA 31995

⁴ Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA 30602

⁵ Columbus State University, Department of Biology, 4225 University Avenue, Columbus, Georgia 31907

In 2005, we began a long-term mussels tagging study in Sawhatchee Creek, Early County Georgia. The goals of the study were to generate estimations of population size, survival, growth, and gravidity for three federally listed unionids. A 100-meter reach of the creek was sampled every June from 2005 until 2010. Target species were identified, measured, sexed, tagged, and released back into the study reach. This information was recorded yearly for all previously tagged individuals and all newly collected individuals were tagged. Nine hundred forty total mussels were tagged since 2005. Mean capture per sample was 242 and ranged from 208 to 300 individuals. Capture probabilities for the Oval pigtoe (*Pleurobema pyriforme*), Gulf moccasinshell (*Medionidus penicillatus*), and Shinyrayed pocketbook (*Hamiota subangulata*) were 0.70, 0.64, and 0.73, respectively. No individuals have been collected on all 6 sampling occasions and only 3% of individuals have been collected more than 3 times. During the first 4 years of the study, 1st captures accounted for more than 50% of the total catch while the frequency of subsequent captures increased. These results suggest that capture efficiency of endangered unionids in our study site was poor despite fairly large sampling crews and ideal sampling conditions.

Presenter: Woodside, K. Email: katie.woodside@gmail.com

Shoal bass *Micropterus cataractae* stock assessment in the Chipola River, Florida

Woodside, K., C. Paxton, and N. Kierl

Florida Fish and Wildlife Conservation Commission, Division of Freshwater Fisheries Management, 3911 Highway 2321, Panama City, FL 32409

Shoal bass *Micropterus cataractae* primarily occur in Florida within a limited range in limestone shoal areas of the upper Chipola River. Shoal bass are included in the Northwest Florida five black bass aggregate bag limit with a 305 mm minimum size. Stock assessments and life history data on the shoal bass is limited within its Florida range. Population and life history dynamics including modified Schnabel population estimates, length frequencies, total annual mortality estimates, age and growth, diet, and creel survey estimates are being examined in an ongoing study in the Chipola River. Shoal bass collected via boat electrofishing from three river sections were weighed, measured, and fin clipped for mark recapture population estimates. The section between Peacock Bridge and Johnny Boy landing hosted the largest population in 2009 at 1034 fish followed by the Magnolia Bridge to Peacock section at 987 fish. Fish in 2009 ranged in size from 125 mm to 525 mm total length. In 2008 and 2010, shoal bass were sacrificed for stomach content and otolith analysis. Total annual mortality and mean length at age was estimated in 2008, but age 3 and age 5 fish were not collected. Preliminary stomach content analysis indicated a diet consisting primarily of crayfish (Cambaridae) followed by fish (mostly Ictaluridae). A roving creel survey conducted from February to October 2009 described the study reach as a bream fishery and gave low estimates of shoal bass catch and harvest. An estimated 25% of the 1256 shoal bass caught were harvested. Data analysis at this time indicates that shoal bass populations are robust and harvest mortality relatively low. Shoal bass habitat is limited in Florida and much of the life history surrounding spawning and movement remains unknown.

Oral Presentations

Presenter: Young, J.; Email: Joy.Young@myfwc.com

Preliminary results from a new study: Life history and habitat utilization of common snook, *Centropomus undecimalis*, on coastal wrecks and reefs of Florida's East Coast

Young, J.¹, R. Taylor², J. Whittington¹, J. Dutka-Gianelli³, S. Marsh¹, A. Berry¹, B. Yeiser¹, E. Ault¹, and G. Stoecklin¹

¹ Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, Tequesta Field Lab, 19100 SE Federal Hwy., Tequesta, FL 33469.

² Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, 100 8th Avenue SE, St Petersburg, FL 33701.

³ Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, Indian River Field Lab, 1220 Prospect Avenue, Suite 285, Melbourne, FL 32901

Common snook, *Centropomus undecimalis*, have been documented on wrecks and reefs offshore Florida's east coast since the 1950's. However little is known of this population of snook. Recently some user groups on the east coast have argued that the snook population status generated from the snook assessment may be overly conservative due to inadequate sampling of offshore snook. To provide more conclusive evidence of population dynamics and to which degree the adults of this offshore population contribute to spawning events FWRI established an offshore snook study. The goals of this study include establishing exchange rates between offshore and inshore snook and contribution to known spawning aggregations. This study is complimentary to an already existing inshore acoustic telemetry project conducted by the FWRI. Using information from FWRI Dive Program's visual surveys, coastal resource managers, and reports from user groups (divers and anglers), we placed 18 Vemco acoustic receivers at sites with documented snook sightings. The offshore array is part of a collaborative effort of several organizations conducting acoustic telemetry research known as the Florida Atlantic Coast Telemetry (FACT) group. During the summers of 2009 and 2010, 44 common snook were captured at nearshore and offshore sites and surgically implanted with Vemco V-16 acoustic transmitters. Due to the challenging nature of actively tracking fish offshore, passive telemetry is the ideal choice for long-term monitoring of these animals. Movement data gathered from this study have helped to establish additional measures of habitat utilization, site fidelity, and potential spawning behavior. Preliminary results indicate that offshore snook populations show high site fidelity with little exchange with inshore populations during both spawning and non-spawning seasons.

Presenter: Zajicek, Paul.; Email: zajicep@doacs.state.fl.us

Marine ornamental fish in Florida waters

Zajicek, P.¹, C. Watson², and S. Hardin³

¹ Florida Dept of Agriculture and Consumer Services, 1203 Governor's Square Blvd, Ste 501, Tallahassee, Florida 32301-2961

² UF-Tropical Aquaculture Laboratory, 1408 24th Street Southeast, Ruskin, Florida 33570

³ Florida Fish and Wildlife Conservation Commission, 620 South Meridian Street, Tallahassee, Florida 32399-1600

Thirty marine ornamental fish have been reported from Florida waters since 1984. All but four species are reported as individual fish at different locations. Twelve of the 30 species have not been observed since 2005. A marine ornamental pathway risk analysis completed in 2007 indicated the highest risk of introduction rested within the aquarium hobbyists. An education and outreach effort directed at hobbyists through hobbyist organizations, retailers, and public aquariums was launched in late 2010.

Oral Presentations

Presenter: **Zapf, D.H.**; Email: ZAPFD09@students.ecu.edu

Inferring natal origins and migrations of adult river herring in Albemarle Sound, NC using otolith microchemistry

Zapf, D.H. and R.A. Rulifson

Institute for coastal Science and Policy, and Department of Biology, East Carolina University, Greenville, NC 27858

River herring stocks in North Carolina have been declining for more than 25 years. Important river herring spawning habitat must be identified to ensure that harvest moratoriums and other recovery efforts are successful. River herring are anadromous and evidence suggests they return to natal tributaries to spawn. Otolith microchemistry was used to investigate the degree to which adult river herring return to natal tributaries of the Albemarle Sound, NC to spawn. Adult river herring were collected from the Scuppernong River in 2009, and the Chowan and Perquimans Rivers in 2010. Elemental concentrations at the core of otoliths were measured with inductively coupled plasma mass spectrometry. Elemental concentrations were used to group fish by river of capture. Sr:Ca ratios were measured across the entire width of the otolith in order to infer migration history. Adult river herring were classified to the river in which they were captured with high accuracy. River herring of similar ages and origin showed variable lifetime migration patterns.

Poster Presentations

Poster Presentation Table (Alphabetized by author. Student presenters in bold)

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- Demographic and distribution trends of red snapper, red grouper, and gag on the northern West Florida Shelf as revealed in a trap and video survey 2
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- Distribution and characterization of hard bottom habitat in two cross-shelf side scan transects in Apalachee Bay, Florida 3
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- Fisheries-independent monitoring of juvenile gag, *Mycteroperca microlepis*, along the Gulf coast of Florida 4
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Presenter: Ayala, O.; Email: Oscar.Ayala@MyFWC.com

A preliminary analysis of reef fish CPUE and gear selectivity of various hook and line gears used in the recreational for-hire fishery in Florida

Ayala, O., and B. Sauls.

Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, 100 8th Avenue, S.E. Saint Petersburg, FL 33701

The objective of this analysis is to examine the effects of variable hook and line gear types on the selectivity and capture rates of reef fish species in Florida. This study may be informative when designing fisheries independent surveys using hook and line gear, and will also be useful as new fisheries independent programs are incorporated into stock assessments, which have historically relied on fisheries dependent data. We placed observers on randomly selected trips aboard recreational for-hire vessels and observed recreational anglers using hook and line gear either provided by the vessel or individual customers. As fish were caught, we recorded fishing depth and area; species and length; hook size, type, and location; bait used; and method of hook removal. From June, 2009 through October, 2010 we sampled a total of 319 half and full day trips in the panhandle, Tampa Bay, and Keys regions of Florida. In the panhandle and Keys, deeper waters are accessible during single-day trips; whereas, in the Tampa Bay region, deep water is further offshore and for-hire trips >24 hours are not uncommon. We sampled 19 multi-day trips (approximately 36 hours each) in and around the Florida Middle Grounds and up to 100 miles offshore. In addition to randomly sampled trips, we privately chartered 23 trips. On these trips we collected data from both hook and line gear provided by the vessel and standard gear currently in use for fisheries independent monitoring. For this preliminary analysis, we will focus on reef fish species commonly caught during recreational fishing and examine the potential effects of terminal gear on fish species, size and catch rate for a variety of depths and areas. This will be done using multiple regression analysis to determine which factors are significant. We will also compare catch rates using standard and variable gears.

Presenter: Ayers, P.; Email: ayers@utk.edu

Underwater video mapping for assessing and monitoring coral reef ecosystem health and fish habitat

Ayers, P.

Biosystems Engineering and Soil Science, University of Tennessee, Knoxville, TN 37996

Assessing and monitoring coral reef ecosystem health and fish habitat is essential for understanding immediate and long-term environmental impacts. An Underwater Video Mapping System (UVMS) is a technique to acquire Global Positioning System (GPS)-based georeferenced underwater images that allow mapping of underwater features. The system automatically interfaces the GPS and underwater video image providing a location for each picture. Using the UVMS, underwater features essential for assessing and monitoring coral reef ecosystem health and fish habitat can be acquired and mapped using Geographic Information System (GIS). The UVMS was used to acquire underwater images in sections of the coral reef ecosystem in Moloka'i, Hawaii and Biscayne National Park (BISC). Factors contributing to the assessment of coral reef health were identified and mapped. These features include marine debris (discarded items including ropes, traps, etc.), coral damage (from boat, anchor, etc.), coral disease and other health issues (i.e. black band disease), endangered coral species, and indicator fish (fish that suggest good water quality). In the 0.2 square km survey within BISC, 8 locations of black band disease were recorded. In a 1.7 km transect over Pacific Reef, 9 observation of marine debris were mapped. For the BISC survey, increasing swath width from 20 meters to 40 meters decreased substrate map accuracy from 93.4% to 73.6%. In Moloka'i, dense coral was observed for 40% of the transect, and sand with algae represented 13% of the survey site. The UVMS is a

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useful tool for providing large-scale assessments of the coral ecosystem health and fish habitat, and identifying areas that need further detailed investigation. It also provides an opportunity to resurvey the same coral reef ecosystem and monitor health and fish habitat changes.

Presenter: Ayers, P.; Email: ayers@utk.edu

Snorkel camera underwater video mapping system for georeferenced fish population analysis

King, C.¹, P. Ayers¹, B. Connell¹, K. Swinson¹, J. Herrig²

¹Biosystems Engineering and Soil Science, University of Tennessee, Knoxville, TN 37996

²U.S. Forest Service, Cherokee National Forest, TN

A Snorkel Camera Underwater Video Mapping System (SCUVMS) was developed to record and map fish populations while also observing habitat characteristics including; substrate, embeddedness and river characteristics. The SCUVMS consists of an underwater bullet camera mounted to a snorkel mask and a Garmin GPS18 DGPS receiver. The video footage and the GPS audio output are combined on a Digital Video Recorder in order to create georeferenced underwater images. The system is powered by a 12-volt battery and stored in a waterproof case that is strapped to a life jacket for easy mobility. The final product generates “video maps” of underwater fish and habitat within ArcGIS. The maps can later review created within ArcGIS using geovideo technologies to help determine possible endangered fish population counts and locations, as well as habitat characteristics for possible relocation areas for endangered fish. A 440 meter section on Citico Creek was snorkel-mapped on August 9, 2010. The fish population density by species and snorkel effort hours were determined. This technology provides an approach to standardize snorkel fish surveys.

Presenter: **Barnett, B. K.**; Email: Beverly.Barnett@noaa.gov

Interspecific and regional variation in otolith chemical signatures between juvenile red and lane snappers in the northern Gulf of Mexico

Barnett, B. K.¹ and W. F. Patterson, III²

¹NOAA Fisheries – SEFSC – Panama City Laboratory, 3500 Delwood Beach Road, Panama City, FL 32408

²University of West Florida, 11000 University Parkway, Pensacola, FL 32514

Otolith chemical signatures (Ba:Ca, Mg:Ca, Mn:Ca, Sr:Ca, Li:Ca, $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$) of juvenile red and lane snapper species were compared among three regions in the Gulf of Mexico (Alabama/Mississippi; Louisiana; and Texas) to test if signatures from lane snapper could be used as a proxy for red snapper signatures. A two factor multivariate analysis of variance (MANOVA), with species and region main effects, was computed to test for regional and interspecific differences, while analysis of variance (ANOVA) models were computed to test for the same differences in individual constituents. Signatures were significantly different among regions (MANOVA, $p < 0.001$) and between species nested within region (MANOVA, $p < 0.001$). Among constituents, Li:Ca, Ba:Ca, Sr:Ca, and $\delta^{13}\text{C}$ were significantly different between species (ANOVA, $p < 0.05$). These significant interspecific differences in otolith chemical signatures indicate that lane snapper otolith chemistry does not serve as an accurate proxy for red snapper signatures.

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Presenter: **Bolow, K.**; Email: bolow@nsu.nova.edu

Age and growth of four mesopelagic fish species by incorporation of otolith marginal increment analysis

Bolow, K. and D.W. Kerstetter

Nova Southeastern University Oceanographic Center, 8000 North Ocean Drive, Dania Beach, FL.

We apply whole and transverse-sectioned otolith ageing techniques to develop indices of somatic growth of four mesopelagic bycatch species in the commercial tuna and swordfish industries by using otolith growth increment widths. The objectives of this study are to i) develop otolith growth chronologies for escolar (*Lepidocybium flavobrunneum*), oilfish (*Ruvettus pretiosus*), snake mackerel (*Gempylus serpens*), and longnose lancetfish (*Alepisaurus ferox*), and ii) to integrate this information with the von Bertalanffy growth function to determine the rate of growth in length and weight, and iii) to create a methodological tool for other researchers aging deep-sea teleost species. From 2008 to 2010, these mesopelagic fishes were collected as bycatch from pelagic statistical areas in the Gulf of Mexico and the U.S. South Atlantic Bight from commercial pelagic longline vessels. Visual interpretation and UTHSCSA ImageTool measurement software is used in conjunction with a 12.2 megapixel digital camera to identify narrow and wide banding patterns of growth increments. Age assessments will be done via double blind marginal increment analysis. Presence of annual growth patterns was verified by measuring the width of the most distal ring of the sagittal otolith, plotting the width against the month of landing and visualizing the increased width of deposition as distance from the spawning month increases. The harvesting of these individuals has an unknown ecological impact and they currently fall under no protective regulations. Determining growth rates of these mesopelagic fishes give us baseline data for population analysis and future comparisons. Additionally, the processes followed in this research may serve as protocol for future research.

Presenter: **Brewton, R.A.**; Email: rachel.brewton@eagles.usm.edu

Impacts of the *Deepwater Horizon* oil spill on the health and growth of estuarine fish and ecosystem functionality

Brewton, R.A., R. J. Griffitt, and R.S. Fulford

Gulf Coast Research Lab, University of Southern Mississippi, 703 East Beach Street, Ocean Springs, MS 39564

In order to assess impacts of the 2010 *Deepwater Horizon* oil spill to coastal habitats we will look at both short-term and long-term effects on individual fish. We will then use the information obtained to model the population-wide effects. To assess short-term effects of the oil spill, 2 estuarine fish species: *Cynoscion nebulosus* (spotted seatrout) and *Sciaenops ocellatus* (red drum) were collected approximately 3 months after the closure of the oil well at locations which received oil inflow. These 2 fish species have varied life histories and therefore may have dissimilar responses to the introduction of oil into their habitat. Various biomarker stress responses will be evaluated within these fish; such as Cytochrome P450-1A (CYP1A) levels and EROD activity. Fish growth and health will be used as an indicator to assess long-term effects of the oil spill. Otoliths will be collected at 1 and 2 years following the oil spill and average fish growth will be determined using incremental margin analysis. The post-oil spill otoliths will be compared to historical otoliths from the same location and also with otoliths from fish in an unaffected area in a modified Before-After-Control-Impact (BACI) design. Additionally, during the 1 and 2 year collection events, various morphometric indices will be used to evaluate fish health. The results obtained from the molecular bioindicators will be compared to the growth and health data to test for habitat specific correlations between short-term stress and long-term effects.

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Presenter: Brown-Peterson, N. J.; Email: nancy.brown-peterson@usm.edu

Reproductive cycles in Southeastern U.S. fishes: Importance of standardized terminology

Brown-Peterson, N.J.¹, D.M. Wyanski², S.K. Lowerre-Barbieri³, F. Saborido-Rey⁴, J. Tomkiewicz⁵ and B.J. Macewicz⁶

¹ Department of Coastal Sciences, University of Southern Mississippi, Ocean Springs, MS

² South Carolina Department of Marine Resources, Charleston, SC

³ Florida Fish and Wildlife Conservation Commission, St. Petersburg, FL

⁴ Instituto de Investigaciones Marinas, Vigo, Spain

⁵ Technical University of Denmark (DTU Aqua), Charlottenlund, Denmark

⁶ National Marine Fisheries Service, La Jolla, CA

There is a wide diversity in reproductive strategies among fishes in the southeastern United States, yet all fishes participate in one or more reproductive cycles during their lifetime. A reproductive cycle, which is typically annual, includes gonadal recrudescence, release of gametes or offspring one or more times, elimination of unused gametes at the end of the spawning season, and regeneration of germ cells in preparation for the next cycle. However, the proliferation of terminologies to describe each of these phases within a reproductive cycle has resulted in confusion and hindered communication among researchers in fish-related disciplines. We review a recently introduced standardized terminology and demonstrate its applicability to the range of reproductive strategies observed in southeastern fishes. Fish enter the Developing phase as gonadal recrudescence begins, and progress to the Spawning Capable (SC) phase with the appearance of fully grown tertiary vitellogenic oocytes or the presence of spermatozoa in the lumen of the testicular lobules. Females with oocytes in late stages of oocyte maturation or males with freely flowing milt move into the Actively Spawning sub-phase of the SC phase for release of gametes. Batch spawning species remain in the SC phase throughout the spawning season. All fish move into the Regressing phase at the end of the spawning season, which is often characterized by atresia of unused gametes. The proliferation of germ cells (oogonia or spermatogonia) and lack of active gametogenesis is characteristic of the Regenerating phase. This terminology can easily be modified for fishes with alternate reproductive strategies such as hermaphrodites (addition of Transition phase), livebearers (addition of Gestation phase) and batch spawners with group synchronous oocyte development (Redeveloping sub-phase of the SC phase). Adoption of this terminology will allow scientists and managers to more clearly describe important milestones in fish reproductive biology.

Presenter: DeVries, D.; Email: doug.devries@noaa.gov

Demographic and distribution trends of red snapper, red grouper, and gag on the northern West Florida Shelf as revealed in a trap and video survey

DeVries, D., C. Gardner, J. Brusher, and P. Raley.

NOAA Fisheries Panama City Lab, 3500 Delwood Beach Rd., Panama City, FL 32408

A fishery-independent survey of inner shelf, hard bottom habitat (6-41 m depths) in the NE Gulf of Mexico off NW Florida, including Apalachee Bay in the Florida Big Bend region, using chevron fish traps, was begun in 2004, with stationary video cameras added in 2005 and stereo cameras in 2009. The survey yields age- and size-specific recruitment indices and considerable information on spatial and temporal patterns in demographics and community structure of reef fishes. Red snapper, red grouper, and gag, especially pre-recruits, are frequently detected with cameras, and all are also captured in traps, although gag less often. Size structure of trap-caught red snapper was unimodal, stable, ranged from ~250 to 450 mm TL annually, but did show a small increase in modal size in 2008 and 2009. Modal age of red snapper was 2 yr during 2005-08 and 3 yr in 2009, very few >age 4 were caught, and no strong year classes were apparent. Both abundance and frequency of occurrence video data for red snapper showed major increases in Apalachee Bay in 2009. Age and multimodal size structure trap data revealed three dominant cohorts (99, 02, 06) of red grouper during 2004-2009, and suggested possible age-related depth or spatial

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patterns. Red grouper video data showed relative abundance increased regionally and across the shelf in 2009. Trap-caught gags were primarily ages 1-3, and in 2008 and 2009 were overwhelmingly from the 2007 cohort. Size data from 2010 suggest this cohort continues to dominate the population off northwest Florida. Gag relative abundance in 2008 and 2009 from video sampling showed good evidence of increasing numbers region-wide. This survey has demonstrated its ability to provide considerable age-specific, geo-referenced, region-wide data on pre-recruits of the three most exploited, economically important reef fish species in the NE Gulf.

Presenter: **Dobbs, J.**; Email: dobbsj10@ecu.edu

Inferring natal origin of NC Central Southern Management Area striped bass using otolith chemistry

Dobbs, J.M., and R.A. Rulifson

Institute for Coastal Science and Policy, and Department of Biology, East Carolina University, Greenville, NC 27858

Striped bass are one of the most important recreational fisheries in the state of North Carolina. The NC Wildlife Resource Commission stocks striped bass into the Neuse and Tar River systems (Central Southern Management Area). Both systems have spawning populations, but no age zero fish have been collected in these systems to support this. Striped bass are anadromous and, although highly migratory, evidence has shown they return to their natal streams to spawn. Fish will be collected on the spawning grounds during spawning season for two years. Length and weight of each fish will be taken to determine K-factor. Gonads will be weighed to determine GSI. Livers will be weighed to determine Liver Somatic Index (LSI). These measurements will be used to determine the condition of the fish. Scales and otoliths will be removed for ageing. Otoliths will be removed and the cores and cross sections analyzed by Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICPMS). The microchemistry of the otoliths will be analyzed to see if it reflects chemical signatures of the Tar and Neuse River Systems.

Presenter: **Dowling, A.**; Email: adowling4@gmail.com

In the hot seat with ciguatera: An evaluation of a commercial test kit and the relative frequency of ciguatera in two species of Hawaiian reef fishes

Bienfang, P.K.¹, S.V. DeFelice¹, and A.E. Dowling²

¹ Center for Oceans and Human Health, Pacific Research Center for Marine Biomedicine, and School of Ocean and Earth Science and Technology, University of Hawaii at Manoa, 2500 Campus Rd MSB #205, Honolulu, HI 96822

² Biology Department, East Carolina University, 701 E 5th St, Greenville, NC 27858

Ciguatera Fish Poisoning (CFP) is a foodborne illness that poses serious concerns for public health and fisheries along tropical and subtropical coasts. Consuming flesh from tropical fish containing ciguatoxins produced by certain dinoflagellates causes CFP. The ciguatoxins are stable despite handling of the fish, temperature, and pH and have generally been costly, complex, and time-consuming to detect. The Cigua-Check® Fish Poison Test Kit was developed commercially as a reliable, fast, and inexpensive means to assess potentially consumable fish for dangerous levels of ciguatoxins. This study analyzed the reader variability and effectiveness of the Cigua-Check® Fish Poison Test Kit relative to N2a bioassay methods to assess the presence of Ciguatera in two taxa of fish from Oahu and other main Hawaiian Islands. The initiative was to determine relative frequencies of Ciguatera in roi, *Cephalopholis argus*, and kole, *Ctenochaetus strigosus*, in Hawaii. Roughly one hundred samples of each fish were tested for Ciguatera using these two methods. To examine reader variability, four different readers blindly interpreted the Cigua-Check® outcomes. Cigua-Check® produced some conflicting results among readers and in

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comparison to the bioassay (false negatives and a false positive). The N2a data allow that approximately 70% of roi and 57% of kole samples tested positive (hot) for the presence of ciguatoxins. While for the Cigua-Check® data, only 5% of roi and 18% of kole were reported hot by all four readers. Additionally, the Cigua-Check® kit produced inconsistent results when interpreted by various individuals; all four readers reported the same outcome in only 37.5% of the samples. Given that the relative frequency of hot specimens in both species was over 50% and that Cigua-Check® produced results that were inconsistent among different readers, fishermen and researchers should use caution when assessing whether or not a fish is hot based on results from the Cigua-Check® kit.

Presenter: Fitzhugh, G.; Email: Gary.Fitzhugh@noaa.gov

A review of intra-annual multiple spawning in fish

Fitzhugh, G.

NOAA Fisheries, Panama City Laboratory, Panama City, FL 32408, 850-234-6541 ext.214

Sub-tropical fishes of the southeastern US are commonly noted to spawn multiple batches of eggs over extended reproductive seasons, in contrast to more temperate species. The challenge this presents for determining fecundity and reproductive potential prompted a review of the literature on multiple spawning. A total of 182 papers were surveyed that reported some information about the frequency or number of spawns occurring within a given time period. From these, 271 records were extracted by species, area and year. There were few direct statements about determinate/indeterminate patterns (11%) or synchrony (7%) of oocyte recruitment. While spawning duration significantly increased moving towards the equator, there were few records for the tropics. Most records of multiple spawning (74%) occurred between 25-40 degrees N and S of the equator. Of the records for determinate spawners, most were greater than 40 degrees from the equator while indeterminate spawners were typically reported less than 40 degrees. The latitudinal trends may signal a dominant effect of temperature on the biology affecting multiple spawning. Factors used to estimate spawning frequency, such as post-ovulatory follicle duration, were notably temperature dependent. From a total of 44 families, 10 families comprised most of the records (77 %) including in order; Engraulidae, Clupeidae, Sciaenidae, Scombridae, Carangidae, Serranidae, Lutjanidae, Paralichthidae, Sparidae and Cyprinidae. The review highlights areas where more study and contrast are needed. Clearly the tropics are missing, perhaps because of the latitudinal economics of fisheries management but also perhaps due to aspects of the biology, such as the possibility of year round spawning, which further increases the difficulty of estimating annual reproductive potential. Moving away from the equator, more comparative work may be justifiably centered around 40 degrees N and S regarding the potential for De novo vitellogenesis.

Presenter: **Gardner, P.G.**; Email: patgardner@ufl.edu

Influence of temperature on catch-and-release mortality indices for gag grouper

Gardner, P.G., D.J. Murie, and D.C. Parkyn

University of Florida, School of Forest Resources and Conservation, Program of Fisheries and Aquatic Sciences, 7922 NW 71st St., Gainesville, FL 32653

Management of gag grouper *Mycteroperca microlepis* in the Gulf of Mexico includes minimum size limits, total allowable catch quotas, and seasonal closures to prevent overfishing. Minimum size limits attempt to decrease overfishing by allowing fish within a sublegal cohort to reproduce in the future. For management to be effective at preventing overfishing, specific factors leading to high rates of catch-and-release mortality must be understood. Sublegal-sized gag brought to the surface from depth experience barotrauma that can lead to injury and mortality. Although capture depth has been demonstrated to be the primary predictor of catch-and-release mortality for gag,

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water temperature may also influence catch-and-release injury and mortality. In summer, high water temperatures may increase stress through increased anaerobic metabolism while fish fight on the line and are handled on deck. The overall goal of this study is to quantify temperature effects on catch-and-release mortality indices of gag grouper. Specific objectives include assigning an on board condition index established from behavioral and reflex responses along with external injury, assigning an index based on an internal necropsy, and quantifying lactate within white muscle for gag captured during the summer and winter in the Gulf of Mexico. These indices will be compared to better understand the effects of temperature on the potential catch-and-release mortality of gag grouper.

Presenter: **Harrah, T.**; Email: tjh08c@fsu.edu

Distribution and characterization of hard bottom habitat in two cross-shelf side scan transects in Apalachee Bay, Florida

Harrah, T., P. Raley, C. Gardner, and D. DeVries

NOAA Fisheries Panama City Lab, 3500 Delwood Beach Rd., Panama City, FL 32408

Little is known about the quantity, distribution, and types of inner- and mid-shelf hard bottom habitats – essential to reef fish populations – in the NE Gulf of Mexico. High resolution habitat maps are essential for maximizing efficiency, accuracy, and precision in fishery-independent reef fish surveys. Such maps are also invaluable for marine spatial planning and for predicting, assessing, and modeling impacts of many natural and anthropogenic events and actions. The objective of this study was to quantify, classify, and map hard bottom habitat in two cross-shelf transects (11-25 m, 22 nm x 150 m,) surveyed with a Marine Sonics dual frequency (600/1200 khz) side scan sonar in Apalachee Bay off Florida's Big Bend. Marine Sonics Sea Scan software was used to obtain location, reef type, area, and vertical relief of all patches of hard bottom habitat. The reef classification scheme was developed by comparing ground truth still and video images with acoustic images. Habitat maps were created using ArcGIS. Overall, 5% of the western and 3% of the eastern transect was hard bottom habitat. Four reef types were identified: scattered, pavement, gorgonian/sponge, and ledge. Scattered was the most common type in both transects (~68%), while ledge was by far the least common – (0.5% in eastern, 0% in western). Hard bottom habitat occurred across all depths but not uniformly; in the western transect most was in 15-22 m, but in the eastern transect it was concentrated in slightly shallower depths (12-18m). Reefs ranged in area from 10 to ~20,000 m², averaging 2200 m² in the western and 1390 m² in the eastern transect, and there was no obvious relationship between patch size and depth. Various forms of hard bottom habitat are widely distributed on, and likely compose at least 5% of, the northern West Florida shelf between depths of 10-25m.

Presenter: **Huddleston, M.**; Email: mhuddles@utk.edu

Ecosystem impacts of hemlock woolly adelgid (*Adelges tsugae*) induced eastern hemlock (*Tsuga canadensis*) mortality in the Great Smoky Mountains National Park

Huddleston, M.¹, J.L. Wilson¹, W. Clatterbuck¹, and D.A. Etnier²

¹University of Tennessee, Department of Forestry, Wildlife and Fisheries, Knoxville, TN 37996

²University of Tennessee, Department of Ecology and Evolutionary Biology, Knoxville, TN 37996

An invasive pest, hemlock woolly adelgid (*Adelges tsugae* Annand) is widely distributed within the GSMNP and is causing widespread mortality of eastern hemlock (*Tsuga canadensis* (L.) Carr.). The ecosystem impacts (both terrestrial and aquatic) from the loss of this tree species are still unknown. The loss of a keystone species like eastern hemlock has the potential to alter species presence, abundance and diversity in the effected systems. A study was initiated during the summer of 2009 utilizing aquatic macroinvertebrates to assess the effects of eastern

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hemlock mortality on aquatic species presence, abundance, and diversity. Preliminary metrics suggest that eastern hemlock mortality will lead to aquatic system changes. Early results suggest that changing forest composition as a result of eastern hemlock mortality will impact aquatic systems by altering species presence, abundance, and /or diversity, or by creating shifts in functional feeding group dominance. These changes are likely to lead to a loss of some highly specialized species in these systems, while increasing the abundance of other less specialized species. Analyses are currently under way and available results will be presented.

Presenter: **Hughes, C. S.**; Email: Hughesc97@students.ecu.edu

Movement and site fidelity of striped bass (*Morone saxatilis*) in Albemarle Sound/Roanoke River stock determined from otolith and water chemistry analysis

Hughes, C. S.¹ and R. Rulifson²

¹ Coastal Resources Management Doctoral Program, East Carolina University, Greenville, NC 27858

² Institute for Coastal Science and Policy and Department of Biology, East Carolina University, Greenville, NC 27858

The strategic habitat areas of striped bass (*Morone saxatilis*) continue to be a topic of interest to researchers, fisheries managers, recreational and commercial fishermen. This research will evaluate movement and site fidelity of the key species by assessing trace elements in otoliths and water chemistry in the Albemarle Sound/Roanoke River stock of North Carolina. Intensive fishing pressure caused a drastic decline in the catch of the species in this area during the late 1970's through the mid 1990's. Proper fishery management techniques to include stock enhancement programs, creel limits, slot limits, habitat improvement, water quality improvement, and seasonal length proclamations were conducted. The Albemarle Sound-Roanoke River striped bass fishery was declared fully recovered in 1997 and is the third largest population of striped bass along the Atlantic Coast. While research has been conducted to assist in successfully managing this species, major advances in otolith chemistry will provide answers to key questions about movement and strategic habitat areas in this fishery.

Presenter: **Kappler, K.**; Email: kapplekc@eckerd.edu

Euphausiid species and size selectivity by predatory pollock in the Bering Sea

Kappler, K.¹ and T. Buckley²

¹ Department of Marine Science, Eckerd College, 4200 54th Ave S, St. Petersburg, FL 33711

² NOAA Alaska Fisheries Science Center, 7600 Sand Point Way NE, Seattle, WA 98115

As part of a larger program designed to gain a better understanding of food web structure in the Bering Sea ecosystem, the NOAA Alaska Fisheries Science Center (AFSC) has recently increased its focus on the predator-prey relationship between walleye pollock (*Theragra chalcogramma*) and euphausiids (krill) in the eastern Bering Sea. The use of euphausiids as pollock prey was characterized by comparing fresh euphausiids sampled in Methot nets to those found in pollock guts preserved in formalin. Our study involved two components. First, we investigated the effect that formalin preservation has on euphausiid length. Then we compared the species and length compositions of net and stomach samples. We found that the lengths of euphausiids preserved in formalin were equivalent to those before preservation. At small spatial scales, species and length compositions of euphausiids in stomachs did not match those sampled in the field. However, when we grouped samples into inshore (< 200 m depth) and offshore (> 200 m depth) components, species compositions in stomachs roughly matched those of nets, though euphausiids in net samples were generally longer than those consumed by pollock. These results suggest that

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pollock show no preference in terms of prey species, but that they either prefer small prey or the digestion process reduces the size of euphausiids in stomachs.

Presenter: **Karch, A.**; Email: ak481@nova.edu

Use of simulation analyses to investigate yellowfin tuna (*Thunnus albacares*) growth models in the Atlantic Ocean incorporating gear selectivity

Karch, A.¹, A. Hirons¹, S. Cass-Calay², and D.W. Kerstetter¹

¹Nova Southeastern University Oceanographic Center, 8000 North Ocean Drive, Dania Beach, FL 33004

²NOAA Fisheries, Southeast Fisheries Science Center-Miami Laboratory

The growth rate of a fish is a fundamental component used in stock assessments to help determine the population size and the fishery pressure affecting the species. There has been recent debate within the stock assessment community regarding which type of growth model best represents the true growth rate of yellowfin tuna, *Thunnus albacares* in the Atlantic Ocean; specifically, whether assessments should use a traditional von Bertalanffy growth curve or a so-called “two-stanza” growth curve, which has one growth rate for smaller individual tuna and another for larger sizes. Using a simulated population based on known biological parameters from the stock in the Atlantic Ocean, and the Stock Synthesis 3 program available through the National Oceanic and Atmospheric Administration (NOAA), a simulated yellowfin tuna population is compared to each model in order to determine the merits of each growth rate assumption. In addition, gear selectivity during fishing operations often affects the length composition data from fisheries dependent sources. Gear types such as trawls and longlines tend to select for adult tunas since they are deployed deeper in the water column and therefore have been shown to have a logistic shaped selectivity curve. Gear types such as gillnets are more apt to target schools of tunas of the same size and therefore create a dome-shaped selectivity curve. The simulated population was further used to determine the effects of different growth rates on gear selectivity within each of the growth models.

Presenter: Keenan, S.F.; Email: Sean.Keenan@myfwc.com

Fisheries-independent monitoring of juvenile gag, *Mycteroperca microlepis*, along the Gulf coast of Florida

Keenan, S.F., T. Switzer, and R. McMichael

Florida Fish & Wildlife Conservation Commission, Fish & Wildlife Research Institute, 100 8th Ave. SE, St. Petersburg, FL 33701

Gag (*Mycteroperca microlepis*) are part of a reef-fish complex that has historically supported a multi-billion dollar recreational and commercial fishing industry in the eastern Gulf of Mexico. Despite their productivity, a 2009 interim assessment indicated stocks were overfished and experiencing overfishing, which has led to a NOAA proposed rule for closure of the recreational fishery and a severe reduction of the commercial quota during 2011. Given these proposed strict management measures, it has become increasingly important to develop improved fishery-independent estimates of juvenile recruitment to forecast changes in future productivity. The Florida Fish and Wildlife Conservation Commission have a long-term fisheries independent monitoring program to provide data on nekton within major estuaries along the Gulf coast. Although this program was not specifically developed to target gag, juveniles are frequently collected during sampling. Data from 183m shoreline haul seine sets (1999 to 2009) were analyzed to examine the ecology and habitat preference of juvenile gag. Juveniles were most abundant between July and September although recruitment varied latitudinally among estuaries. Results from generalized linear modeling indicated the relative abundance of juvenile gag were significantly related to temperature, salinity, bottom slope and SAV cover. Results from these long-term surveys were used to develop a sampling survey (2008 & 2009) targeting shoal habitats in areas containing >50% coverage of seagrasses. Analysis from two years of focused sampling indicated an increased ability to detect fine-scale temporal and regional variability in gag recruitment. Future efforts involve incorporation of otolith microchemistry techniques which may enhance our understanding of connectivity between estuaries and nearshore/offshore habitats.

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Presenter: **Little, R.**; Email: little@eckerd.edu

Genetic structure of Atlantic and Gulf populations of dusky pipefish *Syngnathus floridae* in Florida

Tan¹, M., C. Michael¹, H. Shapiro¹, R. Little¹, K. Mack¹, L.B. Van Woudenberg¹, S. Denison², and W.A. Szelistowski^{1,2}

¹Galbraith Marine Science Laboratory, Eckerd College, 4200 54th Ave. South, St. Petersburg, FL 33711

²Biology Department, Eckerd College, 4200 54th Ave. South, St. Petersburg, FL 33711

Syngnathus floridae, dusky pipefish, live in submerged aquatic vegetation along the Gulf and Atlantic coasts of North America. Previous work using mitochondrial and microsatellite DNA suggests that Gulf (Texas, Florida) and mid-Atlantic (North Carolina, Virginia) *S. floridae* populations exhibit regional variation in population structure. However, it is unknown if these differences are due to separate Gulf vs. Atlantic populations as has been found for many other species including the sympatric Gulf pipefish *S. scovelli*, or if they simply reflect the disjunct nature of the distribution of *S. floridae*, which is absent between mid-Florida and southern South Carolina. By examining mitochondrial control region haplotypes of *S. floridae* collected from three sites along the western (Tampa Bay), southern (Florida Keys) and eastern (Fort Pierce) coasts of Florida, we are analyzing differences in population structure to determine if this species has separate Gulf and Atlantic stocks. Our initial findings will be presented. Results have implications for the population genetics of organisms with life history traits favoring limited dispersal such as small, sedentary adults and a lack of planktonic egg and larval stages.

Presenter: McBride, R.S.; Email: richard.mcbride@noaa.gov

A histological appraisal of dolphinfish (*Coryphaena hippurus*) oogenesis, maturation, and spawning offshore of Florida

Rowinski, Y., and R.S. McBride

National Marine Fisheries Service, Northeast Fisheries Science Center, 166 Water Street, Woods Hole, MA 02543

Although several studies have examined dolphinfish oocyte development using fixed tissue samples, few have used histology to examine oocyte development and individual maturity. This study examined ovarian histology of 621 females collected in three Florida regions: the Keys (south Florida, Atlantic Ocean), Cape Canaveral (east coast, Atlantic Ocean), and the Panhandle (west coast, northern Gulf of Mexico). The purpose here was to outline a baseline morphological description of dolphinfish oogenesis, including developmental synchronicity between pre-vitellogenic and vitellogenic oocyte stages and a definition of maturity classes, to improve our understanding of its life history and parameter estimation for stock assessments. We illustrate oogonial proliferation, folliculogenesis, cytoplasmic inclusions such as cortical alveoli and yolk granules, maturation, and common forms of atresia. Asynchronous recruitment of primary oocytes to vitellogenesis occurred throughout the spawning season. Six maturity classes were observed: two immature classes (immature, maturing) and four mature classes (spawning capable, spawning active, partially spent, and postspawning). Maturation and spawning was evident in all three regions offshore of Florida's Atlantic and Gulf coasts.

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Presenter: **Means, Z.**; Email: zameans@eckerd.edu

Genetic similarities of Florida and Georgia populations of Gulf Pipefish, *Syngnathus scovelli*

Mack, K. J, J. Bennett, Z. Means, K. Roth, Z. O'Donoghue, and W.A. Szelistowski

Galbraith Marine Science Laboratory, Eckerd College, 4200 54th Ave. South, St. Petersburg, FL 33711

Syngnathus scovelli, Gulf Pipefish, inhabit shallow seagrass beds along the entire continental coast of the Gulf of Mexico and the Atlantic coast of Florida. In addition, an isolated population occurs in salt marsh habitats in northern Georgia's Ogeechee River Estuary, the northernmost limit of the range of *S. scovelli*. Populations in Florida are highly structured, with mitochondrial DNA (mtDNA) control region haplotype frequencies differing among locations in the Gulf, and strong genetic differences between Gulf and Atlantic populations including no shared haplotypes. Fish from Georgia have been reported to differ from Florida fish in some meristic characters, however it is unknown whether this simply reflects temperature differences or if the Georgia population is genetically distinct. We are using mtDNA control region sequences to assess how *S. scovelli* from the Ogeechee River compare to those from Florida. The study attempts to determine if the Georgia population is genetically different from Florida populations, and if so, if Georgia fish have unique haplotypes or if they share haplotypes with fish from Florida's Atlantic and/or Gulf coasts. Preliminary findings will be reported. Results will be examined in the context of the biogeographical history of the southeast United States.

Presenter: McWhorter, K.R.; Email: kyle.mcwhorter@myfwc.com

Passive acoustic array designs for shipwrecks: A case study using goliath grouper

McWhorter, K.R.¹ and A. Collins^{1,2}

¹ Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, 100 8th Avenue S.E., St. Petersburg, FL

² University of South Florida, Department of Biology, 4202 E. Fowler Avenue, Tampa, FL

Goliath grouper are a sedentary species that are assumed to have strong site fidelity and are known to regularly inhabit shipwrecks. As part of an ongoing effort to assess Goliath grouper distribution and abundance along Florida's central west coast, six shipwrecks were chosen as deployment sites for an array of acoustic receivers. Each site was mapped and characterized in the field (length, width, height, heading, bottom type, and material). Using these attributes, identification of site features that may impede tag detection was noted and the listening area of each receiver and the entire array was quantified. Previous research has indicated that under ideal conditions, acoustic receivers (Vemco VR2s) have a listening radius of 400-800 meters. However, turbidity and thermoclines may reduce this range to less than 150 meters. Using GIS software, sites were characterized and environmental conditions were analyzed to determine the most appropriate locations for receivers. To ensure identification of Goliath grouper presence or absence, multiple receivers were deployed conservatively at short ranges (75 meters) around each site. This design approach allows for each receiver's listening range to have a strong spatial overlap with the other receivers in the array. Using knowledge of site use by Goliaths from previous research, range test tags were placed by divers at specific locations on each wreck (inside and out) over multiple days. Results from the range tests will determine the effective capability of the array to detect tagged Goliath groupers inhabiting shipwrecks.

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Presenter: Murie, D.J.; email: dmurie@ufl.edu

Reproduction and the occurrence of skip-spawning in greater amberjack in the Gulf of Mexico

Murie, D.J., D.C. Parkyn, and G. Smith.

Program of Fisheries and Aquatic Sciences, School of Forest Resources and Conservation, University of Florida, 7922 NW 71st Street, Gainesville, FL 32653

Greater amberjack were sampled throughout the Gulf of Mexico from 1989 to 2008 through partnership with the National Marine Fisheries Service, the Florida Marine Research Institute, the Gulf States Marine Fisheries Commission, the Louisiana Department of Fisheries and Wildlife, and the University of Florida. In total, 1,838 fish were sampled for otoliths and length data, with 769 of these also sampled for gonads for reproductive analysis. Gonads were weighed whole and subsampled for histology with sections stained with hematoxylin and eosin for staging. Greater amberjack were sexually dimorphic with respect to their growth, with females larger at age than males, but differences were minimal and only differed significantly at ages 2, 4 and 5 yr. Based on a gonadosomatic index (GSI), female greater amberjack had a peak spawning period in the Gulf of Mexico during March and April, with most reproductively active females caught off the coast of Louisiana. This confirmed the presence of a spawning stock of greater amberjack in the northern Gulf of Mexico. The peak spawning period for male greater amberjack was extended compared to females and male GSI was relatively high from February through May. Based on logistic regression, approximate 50% maturity in females occurred between 850 and 900 mm FL and between 3 and 4 yr of age. The smallest mature female was 501 mm FL, the youngest mature female was 1 yr old, and the oldest immature female was 6 yr of age. During March to May of 2006-2008, up to 25% of mature females were “resting” or skip-spawning, and were therefore not actively engaged in spawning in those years.

Presenter: **Olsen, Z.**; Email: zachary.t.olsen@usm.edu

Understanding the trophic role of Gulf Menhaden (*Brevoortia patronus*) using carbon and nitrogen stable isotopes: A presentation of research methods and preliminary results

Olsen, Z., R. Fulford, and K. Dillon

Gulf Coast Research Laboratory, 703 East Beach Drive, Ocean Springs, MS, 39564

Gulf menhaden (*Brevoortia patronus*) play multiple roles in the Gulf of Mexico coastal ecosystem as filter feeders and as an important food source for many recreationally and economically important finfish. As filter feeders, they feed on a large variety of plankton and detritus and provide an important ecosystem service by grazing various plankton species and potentially lessening the effects of eutrophication in certain areas. Gulf menhaden also support a large commercial fishery, and little is known about the impact of fishing on the role of this species in the food web. Determining their feeding habits is very important in determining the effects that these fish have on the ecosystem. This study examines the trophic dynamics of Gulf menhaden and how they differ spatially, temporally, and ontogenetically using stable carbon and nitrogen isotopes. Fish are being collected by gill net, cast net, and purse seine at various locations throughout the Northern Gulf of Mexico; including Pascagoula Bay, Mississippi Sound and Bay Saint Louis from sites that represent various strata (bay, sound, shelf) throughout the summer and fall of 2010 and 2011. A large size-range of fish including juveniles, sub-adults and adults are being collected to examine ontogenetic shifts. Four size fractions of plankton/ detritus are also being collected covering the total size range of filterable particles. Stable nitrogen and carbon isotopes will be examined in the fish and plankton samples to determine trophic level and carbon source with an eye toward food web modeling and ecosystem based management of the species.

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Presenter: Parks, S.L.; Email: sheri.parks@MyFWC.com

Assessing the accuracy and precision of digital imaging technology for measuring lengths of reef-associated fishes

Parks, S., Vecchio, J., and Caillouet, R.

Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, 100 8th Avenue SE, St. Petersburg, FL 33701

The use of underwater digital imaging technology in the monitoring of reef-associated fishes has increased in recent years. This non-extractive imaging method augments traditional capture gears by providing data on the distribution and abundance of trap, hook, or diver-wary taxa, while also allowing for characterization of various habitat metrics. The Florida Fish & Wildlife Conservation Commission (FWC) and NOAA-Fisheries have incorporated Stationary Video Camera Array (SVCA) observations as a supplementary method of quantifying reef fishes and macro-invertebrates during routine monitoring efforts on the West Florida Shelf. Each SVCA is equipped with a digital video camera and a pair of stereo-still image cameras. The left and right still cameras provide images with a parallax reference, allowing for the use of stereo measurements to estimate the size of viewed fishes within a distance of 5 meters from the array. Since 2006, FWC has used SVCA systems and Vision Measurement Systems software (VMS) to identify and measure over 1,500 individuals from over 60 different taxa. To assess the measurement limits of the system, several fish cut-outs of known sizes were photographed under controlled conditions at a variety of distances and aspect angles. Measurements were made via the VMS software after calibration with a 3D standardized target. Analyses indicated that both distance and aspect angle contributed to observed variability in repeated measurements of the same individual. Measurements made with VMS generally underestimated the size of the cut-outs; deviation from true-fish length generally increased as both distance and aspect angle increased. Further research will explore the efficacy of corrective equations to account for these limitations and further increase the accuracy of fish measurements using stereo camera systems.

Presenter: **Powers, J.**; Email: powersj09@students.ecu.edu

Temporal and spatial variability of juvenile spotted seatrout to shallow sandy habitats in Pamlico Sound, North Carolina

Powers, J., A. Overton, and W. Mabe

East Carolina University, Department of Biology, Greenville, North Carolina 27858, USA
North Carolina Center for Biodiversity, East Carolina University, Greenville, North Carolina 27858

The association of juvenile spotted seatrout with submerged aquatic vegetation is well documented; however, their association with other estuarine habitats including shallow sandy areas is not well understood. The goal of this project was to evaluate habitat use of juvenile spotted seatrout along shallow sandy beaches in Pamlico Sound, North Carolina. The specific objectives were to examine the spatio-temporal distribution of spotted seatrout and evaluate the effects of environmental factors that influence distribution patterns. Juvenile spotted seatrout were collected bimonthly at 18 locations along a downstream gradient in Pamlico River, North Carolina from August through November (2009-2010) with an 18-m beach seine. Fish ranged in size from 22 to 160 mm total length (TL) and 0.1 to 35.0 g. Spotted seatrout were most abundant going 16.1 km downstream from Fork Point Island and the month with the most abundant juvenile spotted seatrout was September. These sub-sites were characterized as sandy substrates with organics and detritus, and favorable water quality (temperature 22.2 ± 5.8 °C, dissolved oxygen 8.0 ± 1.9 mg/L, salinity 10.5 ± 4.9 psu). Salinity in the lower 16.1 km portion of the river near Pamlico Sound was significantly different ($14.3\text{psu} \pm 3.1$) than the upper 32.2 km section ($8.8\text{psu} \pm 4.4$) going downstream from Fork Point Island ($p=.0001$). The results of this study show how a euryhaline environment and substrate could potentially influence fish distribution patterns within a watershed. The study will also be used to support the development of a fishery management plan for spotted seatrout in North Carolina.

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Presenter: Purtlebaugh, C.; Email: Caleb.Purtlebaugh@MyFWC.com

Cooperative research with industry partners: a preliminary examination of the utility of hooked-gear surveys in providing fisheries-independent data for reef fishes on the west Florida shelf

Purtlebaugh, C., T. Switzer, B. Winner, and S. Keenan

Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, 100 8th Avenue SE, St. Petersburg, FL 33701

Reef fishes along the Gulf coast of Florida support multi-million dollar commercial and recreational fisheries, with species such as red snapper (*Lutjanus campechanus*), gag (*Mycteroperca microlepis*), and red grouper (*Epinephelus morio*) among the most heavily-targeted. Many exploited reef fishes along the southeastern United States coast are currently overfished and experiencing overfishing. Recognizing the need for broad-scale, fisheries-independent data and as an important step in the development of an offshore reef fish monitoring program, the Florida Fish and Wildlife Conservation Commission conducted a study in partnership with the commercial and charter fishing industry to evaluate the efficacy of using commercial and recreational hooked gear as part of reef fish monitoring on the west Florida shelf. Seasonal surveys (spring and summer 2010) were conducted within two regions of the west Florida shelf: waters off the Florida Panhandle and mid-peninsular Florida. Within each region, sampling effort was stratified by depth (≤ 20 fathoms and > 20 fathoms); in the deeper areas, limited sampling effort was allocated to regions closed to fishing. Reef fish catch rates and size-frequencies of recreationally-used hook-n-line gear and commercially-used gear (bandit gear and electromates) were compared. Terminal tackle for each fishing rig consisted of a combination of two circle hooks; three circle-hook sizes (8/0, 11/0 and 13/0) were used to test for possible effects of hook size on catch rates, size selectivity, and species composition. Catches in mid-peninsular Florida were dominated by red grouper (N=277) and red snapper (N=236), while catches off the Florida Panhandle were dominated by red snapper (N= 972) and gag (N=75). Results from this study will be used to recommend a sampling design for incorporating fisheries-independent hooked gear methods into existing West Florida shelf reef fish surveys.

Presenter: **Richards, T.**; Email: tr10g@fsu.edu

Microhabitat associations of a semi-terrestrial fish, *Kryptolebias marmoratus* (Poey 1880) in a mosquito-ditched mangrove forest, west-central Florida

Richards, T.¹, J. Krebs^{2,*}, and C. McIvor³

¹ Department of Biological Sciences, Florida State University, 319 Stadium Drive, Tallahassee, FL 32306

² Jacobs Technology 5401 W Kennedy Blvd # 900 Tampa, FL 33609-2467

* Present address: Department of Integrative Biology, University of South Florida, 4202 E. Fowler Avenue Tampa, FL 33620

³ United States Geological Survey, Southeastern Ecological Science Center, 600 4th St. South, Saint Petersburg, FL 33701

Mangrove rivulus (*Kryptolebias marmoratus*) is one of the few species of fish that is able to use exposed intertidal and potentially supratidal habitats for prolonged periods of time. Based on previous work demonstrating frequent use of subterranean crab burrows, damp leaf litter and logs, we examined the microhabitat associations of rivulus in a mosquito-ditched mangrove forest on the Gulf coast of Florida near the northern limit of its distribution. We captured 161 rivulus on 20 dates between late April and mid-December 2007 in nine trench traps sunk into the forest floor. Fish ranged in size from 7 to 35-mm SL. Peak abundance in mid-summer coincided with recruitment of a new year-class. The three study sites occurred in proximity to one another (<0.5 km) and experienced similar water temperatures and salinities. Nevertheless, they differed in their degree of tidal inundation, standing stock of leaf litter, and density of fiddler crab burrow entrances. Two of the sites (East and Interior) were characterized by elevation profiles that plateaued between 10-15m from the subtidal mosquito ditch, whereas the third site (West)

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maintained a steep slope throughout. The two sites with elevational plateaus may have retained more standing water at low tide than the site with a steeper linear intertidal profile. We observed the highest mean catch of rivulus at a site with an elevational plateau combined with the highest standing stock of leaf litter and greatest density of crab burrow entrances. However, relations between microhabitat variables (distance from permanent subtidal water, elevation, amount of leaf litter and density of crab burrow entrances) were complex and difficult to relate directly to frequency of rivulus capture. Nonetheless, mangrove rivulus was consistently collected with greater frequency 5-15 m into the forest than adjacent to the water's edge, and is thus readily characterized as a high intertidal habitat specialist.

Presenter(s): Sechler, D.; Email: dawn.sechler@myfwc.com

Fish community assemblages in the Peace River, Florida

Sechler, D., and M.E. Call

Florida Fish and Wildlife Conservation Commission, 3900 Drane Field Rd, Lakeland, FL 33811

The Peace River is the largest softwater stream in southwest Florida. Urban and agricultural development within the watershed over the past 100 years has led to surface water withdrawal, conversion to agriculture, nutrient loading from agriculture, conversion to housing and urban use, and phosphate mining. Future demands may result in further degradation of habitat and water quality which could adversely affect fish communities. Fish are an excellent indicator of ecological condition and a comprehensive data base is needed for future management decisions. From fall (September-December) 2008 through spring (February-May) 2010 fish were collected bi-annually via electrofishing to determine fish assemblage within three designated zones (i.e., lower, middle, upper) of the river. Additionally, quantified microhabitat measurements were made in each electrofishing transect including physical (e.g., woody debris counts, macrophyte coverage) and chemical (e.g., salinity, temperature) parameters for comparison with fish assemblage data. We determined fish population characteristics (e.g., species richness, diversity), calculated habitat suitability indices and curves, as well as determined whether fish assemblages differ across river section, season, year, and with environmental variables (e.g., depth, macrophyte coverage). During all years we found that the most popular game fish, exotic fish, and most abundant fish species sampled utilize similar moderately complex habitats. Fish assemblages differed ($p=0.05$, $R=0.42$) in each section (e.g., upper) of the river but did not differ across seasons, nor years. In addition, the strongest correlations of community structure with physiochemical variables and habitat metrics occurred for the lower and middle sections ($p>0.745$) of the river. Results of this study provide a baseline for future research and can assist water managers when establishing or adjusting minimum flows and levels (MFLs).

Presenter: Stallings, C.D.; Email: stallings@bio.fsu.edu

Faunal communities in seagrass beds of Florida's Big Bend region

Stallings, C.D.¹, A. Mickle¹, J.A. Nelson², M.G. McManus^{3*}, and C.C. Koenig¹

¹ Florida State University Coastal and Marine Laboratory, St. Teresa, FL 32358

² Florida State University, Dept of Earth, Ocean and Atmospheric Science, Tallahassee, FL 32306

³ The Nature Conservancy, Tallahassee, FL 32301

*current address: U.S. Environmental Protection Agency, National Center for Environmental Assessment, Cincinnati, OH 45268

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Seagrass beds are important habitats that serve as nursery, feeding, and sheltering grounds for many marine species. Indeed, Florida seagrass beds are inhabited by a diverse and great abundance of animals, including many that are economically-important and 120 species of fish and 37 species of macro-invertebrates identified as “species of greatest conservation need” by the Florida Comprehensive Wildlife Conservation Strategy. Many of these animals are found in the Big Bend region of Florida, home to one of the largest (~ 3000 km²) and most pristine seagrass beds in North America, yet the region-wide patterns of faunal distribution, organization, diversity and abundance are not well-understood. We have recently completed field operations of a two-year study designed to elucidate such community- and population-level patterns and will present preliminary findings. Our study used a spatially-balanced sampling design to select 250 sites from FWC’s GIS seagrass layer. Sites were visited during summer months (i.e., when annual productivity in Florida seagrass beds is highest) and were sampled if they comprised ≥ 10% seagrass cover; 168 sites met this criterion. Sampling was conducted using 2m beam trawls towed for 75m. All captured animals were identified to lowest taxonomic level possible, placed in one of six size classes, and counted. Both richness and abundance varied by two orders of magnitude across sites during the first year of sampling (i.e., 2009), suggesting high levels of heterogeneity; catch data from the second year of sampling (i.e., 2010) are still being worked-up. We will ultimately examine the relationship between community patterns and a suite of potentially-important explanatory parameters including those at both local- and broad-scales. Our ongoing research on the *patterns* in seagrass beds of the Big Bend will both be informative for future management and conservation efforts and will likely stimulate future research on the processes driving them.

Presenter: **Stratton, M.**; Email: stratton.ma@gmail.com

Application of community indicators to the snapper grouper complex in southeastern U.S. Atlantic Continental Shelf waters

Stratton, M.¹, M. Reichert², J. Stephen², J. Kucklick³, and C. Plante¹

¹ Grice Marine Laboratory, College of Charleston, 205 Fort Johnson Rd, Charleston, SC 29412

² South Carolina Department of Natural Resources, 217 Fort Johnson Rd, Charleston, SC 29412

³ National Institute of Standards and Technology, Hollings Marine Laboratory, 331 Fort Johnson Rd, Charleston, SC 29412

The development of indicators to test for anthropogenic and environmental effects on fish communities is imperative to support an ecosystem approach to fisheries management. Changes in the community indicators mean trophic level (TL), mean weight (W), and mean length (L) were investigated for reef-associated snapper grouper species inhabiting continental shelf waters of the southeastern U.S. Atlantic coast. To calculate TL , the trophic positions of individual fish from 15 species were first estimated using stable isotope ratios of $^{15}\text{N}/^{14}\text{N}$ ($\delta^{15}\text{N}$) in fish white muscle tissue. When compared across a broad size range, 12 of 15 species exhibited significant positive linear relationships ($P < 0.05$) between body weight and $\delta^{15}\text{N}$. $\delta^{15}\text{N}$ values were also positively correlated to body size for all species combined ($y = 9.01 + 0.22x$; adjusted- $R^2 = 0.26$; $F = 142_{1,402}$; $P < 0.001$), supporting evidence documented in other aquatic systems of strong size-based trophic structuring in fish communities. These species-specific linear models were then applied to species-size-abundance data from a snapper grouper fishery-independent dataset to detect temporal changes in TL during 1990–2009. Time series analysis indicates no change in TL during this period despite documented changes in abundance, biomass and size structure for individual species. In contrast, W and L increased markedly, indicating positive size-based changes at the community level (i.e., the average fish is bigger). Results suggest that TL is not a sensitive temporal indicator for this fish community, probably due to a high level of trophic redundancy among species (i.e., high trophic niche overlap). W and L do appear to be sensitive community indicators and potentially detectable on time scales relevant to management decision-making (one to two years), although a more rigorous statistical power analysis is warranted. Increasing size-based trends demonstrated in this fish assemblage indicate the beginnings of successful rehabilitation of this fish assemblage at the community level.

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Presenter: **Stubbs, T.J.**; Email: tstubbs@cfr.msstate.edu

The effects of hydrology on flathead catfish growth in two Iowa reservoirs

Stubbs, T.J.¹, N.M. Kuntz¹ and R. D. Schultz²

¹ Department of Wildlife, Fisheries and Aquaculture, Box 9690. Mississippi State University, Mississippi State, MS 39762

² Iowa Department of Natural Resources, 24570 U.S. Highway 34. Chariton, Iowa 50049

We compared growth of flathead catfish *Pylodictis olivaris* from two flood control reservoirs in Iowa (Red Rock and Rathbun reservoirs). We also compared various hydrologic and morphometric variables such as average depth, reservoir surface area, relative water fluctuations, water retention time, and the number of days above conservation pool. Flathead catfish were collected in 2003 and 2007 between the months of May and August using low-frequency pulsed DC electrofishing. Fish were measured for total length (TL; mm) and weighed (g). Pectoral spines were removed from all flathead catfish and sectioned through the basal recess using a low-speed saw. Annuli were measured from all samples and back-calculated lengths at age were estimated using the Dahl-Lea method. Data were analyzed for each reservoir to identify statistical correlations between hydrologic and morphometric characteristics and flathead catfish growth. Red Rock reservoir had a larger surface area, greater variation in water level ($P < 0.02$), and significantly more days ($P < 0.001$) above conservation pool than did Rathbun reservoir. Furthermore, Red Rock reservoir yielded faster growth rates ($P < 0.001$) and also indicated greater longevity for flathead catfish than did Rathbun reservoir with maximum ages of 18 and 13 respectively. Our data suggests a strong correlation between flathead catfish growth and both hydrologic and morphometric variables. These variables need be taken into account when managing for flathead catfish in large reservoirs.

Presenter: Szelistowski, W.A.; Email: szeliswa@eckerd.edu

Genetic structure of Florida populations of Gulf pipefish *Syngnathus scovelli* and chain pipefish *S. louisianae*

Szelistowski, W.A.^{1,2}, A.M. Downey-Wall^{1,3}, C.G. Storer^{1,4}, R.C. Harbeitner¹, A. Rickli-Rahman¹, N.W. Van Bibber¹, L.B. Van Woudenberg¹, and S.H. Denison²

¹ Galbraith Marine Science Laboratory, Eckerd College, 4200 54th Avenue South, St. Petersburg, FL 33711

² Department of Biology, Eckerd College, 4200 54th Avenue South, St. Petersburg, FL 33711

³ Department of Biological Sciences and Southeast Environmental Research Center, Florida International University, Miami, FL 33199

⁴ School of Aquatic and Fishery Sciences, University of Washington, Seattle, WA 98105

Population structure in marine organisms is believed to be largely dependent on dispersal ability. Members of the family Syngnathidae, the pipefishes and seahorses, are small and sedentary as adults and have no planktonic egg or larval stages, and might therefore be expected have highly structured populations. We studied the population genetics of Gulf and Chain Pipefish, *Syngnathus scovelli* and *S. louisianae*, which occur sympatrically in seagrass beds in Florida. We collected fish from several locations on both coasts and compared mitochondrial DNA control region sequences between locations. For 239 Gulf Pipefish, we identified 41 haplotypes. Haplotypes were shared among locations within both the Gulf and the Atlantic. However, there were no shared haplotypes between Gulf and Atlantic populations, and fish from these two regions were significantly differentiated. A haplotype phylogeny found that 12 of the 15 Atlantic haplotypes comprised a single monophyletic clade nested within Gulf haplotypes, suggesting an historic separation of Atlantic from Gulf fish. For 124 Chain Pipefish we identified 42 haplotypes, the 8 most common of which were found on both coasts. There was little evidence for separate Gulf and Atlantic populations, and a haplotype phylogeny showed no discernable evolutionary relationships associated with geographic location. These data suggest significant gene flow for *S. louisianae* around the southern tip of Florida. The lack of genetic separation between Gulf and Atlantic fish suggests that *S. louisianae* has substantially greater dispersal ability than *S. scovelli*, and a population structure more comparable to larger fish with high dispersal

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potential. Dispersal in this species may be linked to offshore rafting as *S. louisianae* is common in drifting sargassum mats. This study suggests that genetic structure may differ greatly between closely-related species with similar habitat requirements and life history characteristics.

Presenter: **Tarnecki, J.H.**; Email: Jtarnecki83@gmail.com

Differences in fish community and trophic structure at northern Gulf of Mexico natural versus artificial reefs

Tarnecki, J.H., W.F. Patterson III, and J.T. Neese

Department of Biology, University of West Florida, 11000 University Parkway, Pensacola, FL

Reef fish communities were sampled at natural (n = 24) and artificial (n = 26) reef sites in the northeastern Gulf of Mexico during 2009-10. Community structure was estimated from video samples collected with point-count or transect sampling conducted with a micro remotely operated vehicle that was equipped with a laser scale. Fish (n = 854) then were captured with hook and line, and otolith, stomach, and muscle tissue samples extracted from each individual. Community structure was significantly different between reef types (ANOSIM, $p < 0.001$), but not among depth strata (ANOSIM, $p = 0.121$). Fish community differences between habitats were driven by larger reef fishes, such as lutjanids, haemulids, and balistids, having higher densities on artificial reefs, while small planktivores and invertivores, such as apogonids, chaetodontids, labrids, priacanthids, pomacanthids, and tetraodontids, had higher densities at natural reefs. Most fishes that co-occurred in natural and artificial habitats had similar size distributions between them, although amberjack were larger at artificial reefs and vermilion snapper and red porgy were larger at natural reefs. Red snapper (n = 468) growth rate was not significantly different between natural and artificial reefs (Likelihood Ratio Test, $p = 0.624$), and other co-occurring fishes also had similar size at age between habitat types. Stomach content analysis revealed few intraspecific differences in diet between habitat types, although stable isotope ($\delta^{13}C$, $\delta^{15}N$, $\delta^{34}S$) analysis of muscle samples indicates that fish fed at slightly higher trophic levels, and that their prey tended to be slightly more pelagic than benthic, on artificial reefs. Overall, results indicate few intraspecific differences in trophic ecology and no real differences in size at age exist between habitat types. However, there are clear differences in community structure and fish density between natural and artificial reefs, which have clear implications for reef fish vulnerability to fishing mortality.

Presenters: **Van Bibber, N.W.**; Email: vanbibnw@eckerd.edu

Genetic changes in Gulf pipefish *Syngnathus scovelli* along the southeast Florida coast

Van Bibber, N.W., A.J. Burnham, A.R. Gestl, C.T. Gilkey, R.C. Harbeitner, Z.G. O'Donoghue, M.H. Tan, A.R. Walsh, and W.A. Szelistowski

Galbraith Marine Science Laboratory, Eckerd College, 4200 54th Avenue South, St. Petersburg, FL 33711

The Gulf Pipefish, *Syngnathus scovelli*, occurs on both coasts of Florida where it is abundant in shallow seagrass habitats. Dispersal ability in this species is potentially limited due to its reliance on submerged vegetation in the juvenile and adult stages, its weak swimming abilities, and a lack of planktonic eggs and larvae in its life cycle. Previous work using mitochondrial DNA (mtDNA) control region sequences found a strong break between Gulf and Atlantic populations occurring in southeast Florida. In the current study we are using mtDNA sequences to identify the exact location and nature of this break and elucidate the factors that produced and maintain it. We collected specimens along the SE Florida coast from the Florida Keys to the southern Indian River Lagoon, including Long Key, Islamorada, Barnes Sound, southern Biscayne Bay, Miami, Lake Worth, Jupiter Inlet, and Fort Pierce. Gulf haplotypes were found extending north to Miami and Atlantic haplotypes extending south to Lake Worth. The coastline between Miami and Lake Worth, a stretch of approximately 75 km, consists primarily of high-energy

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sandy beaches which have apparently served as a long-term barrier to gene flow between Gulf and Atlantic fish. Preliminary data suggest that although Atlantic locations are similar genetically, significant differences occur among the locations with Gulf haplotypes. Genetic differences among these Gulf sites are unusual in light of their proximity to each other and the apparent lack of current dispersal barriers. These results imply that dispersal is inherently very limited in *S. scovelli*.

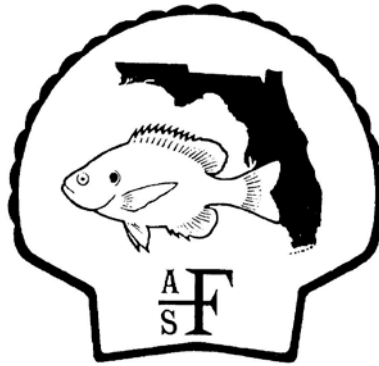
Presenter: Weather, E.; Email: eric.weather@myfwc.com

Integration of side-scan sonar surveys into multi-gear reef fish monitoring on the west Florida shelf

Weather, E., R. Caillouet, and S. Keenan

Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, 100 8th Avenue SE, St. Petersburg, FL 33701

Through a cooperative effort with the National Marine Fisheries Service, the Florida Fish and Wildlife Conservation Commission is developing a fisheries-independent monitoring program of reef fish on the west Florida shelf. As part of this program, several fishery sampling gears are utilized to evaluate reef fish abundance and distribution near high relief and complex bottom habitats in depths from 10 to 110 meters. Benthic habitats in this region are characterized as a mosaic of sand and shell hash interspersed with patchy low relief rock outcroppings. Due to the lack of detailed bathymetric data for much of the west Florida shelf, the initial sampling universe was created using a combination of low resolution rugosity information, areas of presumed hard bottom based on historic surveys, and commercial fishing sites. Beginning in 2010, a towed side-scan sonar system was used to locate reef habitats. Prior to deploying fishery sampling gear, side-scan surveys were conducted one nautical mile east and west of a pre-selected sampling station. The sampling gear was then set on the best available habitat observed in the side-scan survey. We propose a real-time habitat classification methodology to describe surveyed areas from initial interpretation of side-scan data, such as backscatter intensity, variability and coverage. This habitat classification scheme was tested on two sites where side-scan data was compared to geo-referenced imagery collected by cameras fixed to the sampling gear. This iterative process will assist in the development of a habitat-based sampling approach for fishery-independent, reef fish surveys.



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