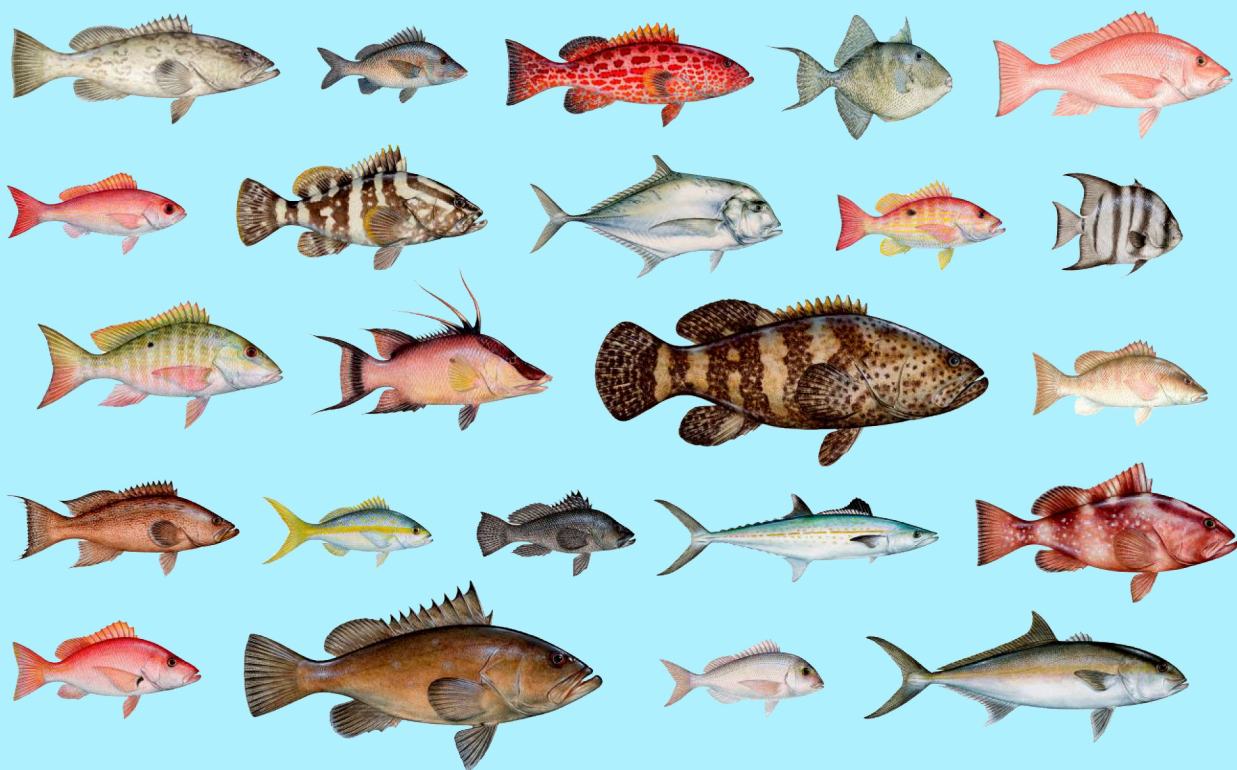


# **28<sup>th</sup> Annual Meeting of the Florida Chapter of the American Fisheries Society**



## **Conserve Florida's Reef Fishes**

**February 19-21, 2008  
4-H Camp Ocala, Altoona, Florida**

## **The Florida Chapter of the American Fisheries Society**

### Chapter Officers

President: Eric Nagid, FWC

President-Elect: Will Patterson, UWF

Past-President: Chuck Cichra, UF

Secretary-Treasurer: Linda Lombardi-Carlson, NOAA

### Major Contributors for our Annual Meeting:

Webmaster: Bob Wattendorf, FWC

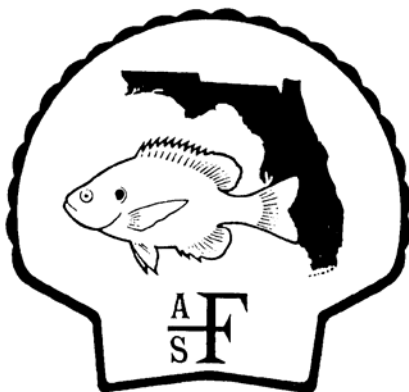
Newsletter Editor: Jaclyn Debicella

Raffle Co-Chairs: Andy Strickland, FWC and Allan Collins, NOAA, retired

Student Travel Awards & Roger Rottmann Memorial Scholarships: Chuck Cichra, UF

Continuing Education: Richard McBride, NOAA

Membership Database Manager: Larry Connor, FWC



**Thanks to everyone for their symposium and contributed presentations!**

**Thanks to all the moderators and judges!**

**28<sup>th</sup> Annual Meeting of the Florida Chapter American Fisheries Society  
February 19-21, 2008  
4-H Camp Ocala, Altoona, Florida**

*General Program*

**Tuesday, February 19**

11:00am – 6:00pm / Registration

12:00pm – 1:00pm / Lunch

1:00pm – 5:00pm / Contributed Papers

5:00pm – 7:00pm / Poster Setup

6:00pm – 7:00pm / Dinner

7:00pm – 8:00pm / Formal Poster Session  
Followed by the *bonfire social*

**Wednesday, February 20**

7:00am – 8:00am / Breakfast

7:30am – 6:00pm / Registration

8:00am – 12:00pm / **Symposium: *Ecology and Conservation of Florida's Reef Fishes***

12:00pm – 1:00pm / Lunch

1:00pm – 2:40pm / **Symposium Continued**

3:00pm – 5:00pm / Contributed Papers

5:00pm – 6:00pm / Student Subunit Meeting (all students); Time to relax (all others)

6:00pm – 7:00pm / Dinner

7:00pm – 8:00pm / **Chapter Business Meeting**  
Awards presentation: Student Awards – Travel and Roger Rottmann Scholarship  
Followed by THE RAFFLE, AUCTION, and the *bonfire social*

**Thursday, February 21**

7:00am – 8:00am / Breakfast

7:30am – 9:00am / Registration

8:00am – 12:00pm / Contributed Papers

12:00pm – 1:00pm / Lunch

1:00pm – 1:10pm / **Awards presentation:**  
Best Papers/Best Posters; Power Tie and Lampshade Awards

## Day-By-Day Agenda - 28<sup>th</sup> Annual Meeting - Florida Chapter American Fisheries Society

### Tuesday, February 19

11:00am — 6:00pm / **Registration**

12:00pm — 1:00pm / **Lunch**

1:00pm — 1:20pm / **Welcome – Eric Nagid, Chapter President**

#### *Contributed Papers*

**Moderator:** Eric Nagid, FWC

1:20pm — \*Bunch, A.J. and M.S. Allen. Dissolved oxygen dynamics in tussock-forming aquatic macrophytes.

1:40pm — Dotson, J., B. Johnson, and C. Steward. Lake Griffin experimental gizzard shad removal: Assessment of black crappie bycatch and potential population-level impacts

2:00pm — \*Flowers, H.J., W.E. Pine, and S.J.D. Martell. How many gulf sturgeon were there? A preliminary stock reduction analysis (SRA) to estimate historic population size

2:20pm — Rogers, M. and M.S. Allen. Potential largemouth bass stocking success at Lake Seminole, Florida: An Ecopath with Ecosim model

2:40pm — Trippel, N., W. Porak, R. Stout, and M. Matthews. Florida's Bass Conservation Center: Past, present, and future

#### **3:00pm — BREAK**

**Moderator:** Mike Allen, UF

3:20pm — Bonvecchio, K., J. Estes, and S. Crawford. Kick Off 2006: FWC's Freshwater fisheries long-term monitoring program

3:40pm — Bethea, D., M., L. Hollensead, and J. K. Carlson. Distribution and abundance of early life stages of shark species in the panhandle of Florida, 2003-2007

4:00pm — Flaherty, K.E., B.L. Winner, T.S. Switzer. Catch and release mortality estimates for red drum in Tampa Bay, FL.

4:20pm — \*Carvalho, F., D. Murie, F. Hazin, H. Hazin, and G. Burgess. CPUE and Catch trends of blue shark (*Prionace glauca*) and shortfin mako (*Isurus oxyrinchus*) in the western South Atlantic Ocean from 1978-2006

4:40pm — \*Dunham, N.M., R.E. Matheson, Jr., and J.J. Torres. The life history of the lined seahorse, *Hippocampus erectus*, in Tampa Bay, Florida

5:00pm — 7:00pm / **Poster Setup**

6:00pm — 7:00pm / **Dinner**

7:00pm — 8:00pm / **Formal Poster Session** (Beverages and snacks will be in the poster area;  
Presenters will be available to answer questions from 7-8 pm)  
Followed by the *bonfire social*

Throughout the program, an asterisk (\*) indicates a student presentation. Underscore indicates person presenting talk or poster.

**Poster Session (7:00pm – 8:00pm)**

\*Addis, D.T., W.F. Patterson, III, and M.A. Dance. Site fidelity and movement of reef fishes tagged at unreported artificial reef sites off northwest Florida

Caillouet, R., J. Vecchio, and S. Keenan, S. Methods of video and still frame analyses in assessing reef-associated fishes

Camilleri, S., D. Gannon, E. Berens, J. Gannon, and K. Brueggen. Effects of red tide on the occurrence of fish calling

\*Carney, A.S., D.M. Durieux, Z.B. Klein, and E.A. Mason. Regeneration of caudal spines following breakage or loss in juvenile Atlantic stingrays, *Dasyatis sabina*

\*Carvalho, F., J. Pacheco, F. Hazin, D. Murie, and G. Burgess. Effects of hook type and soak time on shark catches for a pelagic longline fishery in the southwestern equatorial Atlantic Ocean

Cook, M. and L. Lombardi-Carlson. Reproductive seasonality and maturity of scamp, *Mycteroperca phenax*, from Florida's west coast.

Delpizzo, G., and T. Lange. Trends in freshwater mercury bioaccumulation in Florida

DeVries, D. and J. Brusher. A trap and stationary video survey of inner shelf hard bottom habitat in the NE Gulf of Mexico

Duncan, M.S., L.D. Hollensead, L. Carter-Gray, F.M. Parauka, and S. Bolden. Fine-scale movement of Gulf of Mexico sturgeon relative to critical habitat within Escambia, East, Pensacola, and Choctawhatchee Bays, Florida, following Hurricanes Ivan (2004) and Dennis (2005)

Gorecki, R., K. Gregalis, and R. Lehnert. Changing fish assemblages associated with different flow rates in the Apalachicola River, FL.

\*Hanke, M., D. Lambert, and K. Smith. A GIS model designed to predict the ability of *Cynoscion nebulosus* to escape a hypoxic zone in the St. Johns River, Florida.

\*Louder, C.A., W.F. Patterson, III, and R. Allman. Recruitment dynamics of gray snapper *Lutjanus griseus* among West Florida Estuaries

\*Machemer, E., B.J. Armstrong, and D.W. Kerstetter. A spatial approach to catch and effort with pelagic longline gear

McBride, R.S., P.E. Thurman, and L.H. Bullock. Regional variations of hogfish life history (Labridae: *Lachnolaimus maximus*) in Florida: consequences for spawning biomass and egg production models

Mille, K., J. Dodrill, B. Horn. Strategies for management of artificial reefs in the state of Florida

\*Olson, G.L. and W.A. Szelistowski. Adaptations of juvenile mangrove littorinids to decrease predation by the pufferfish *Sphoeroides rosenblatti*

\*Storer, C.G., R.C. Harbeitner, A. Rickli-Rahman, N.W. Van Bibber, and W.A. Szelistowski. Genetic structure of Florida populations of Gulf pipefish, *Syngnathus scovelli*

\*Vinita, K., J.B. Wilson, and W.A. Szelistowski. Patterns of stingray injuries to humans at Fort De Soto Park, Florida

**Wednesday, February 20**

All day / **Registration**

7:00am – 8:00am / **Breakfast**

8:00am – 8:10am / **Welcome – Will Patterson, Chapter President-Elect and Program Chair**

**Symposium: *Ecology and Conservation of Florida's Reef Fishes***

***Symposium Papers***

**Moderator:** Will Patterson, UWF

8:10am — Bohnsack, J. The future of Florida's reef fisheries: Challenges and opportunities.

8:40am — Hood, P. An update on the status and regulation of federally managed reef fish species in the southeast.

9:00am — Dodrill, J., K. Mille, B. Horn. Diversifying Florida's artificial reef program: Can artificial reefs play a role in an ecosystem approach to fisheries management?

9:20am — Kellison, T., V. McDonough, D. Harper, and J. Tilmant. Changes over time in reef fish community structure in the upper FL Keys, USA: Fishing impacts and management implications

9:40am — \*Huebert, K.B. and S. Sponaugle. Swimming trajectories of settlement-stage coral reef fish larvae in the Florida Keys

**10:00am — BREAK**

**Moderator:** Gary Fitzhugh, NOAA Fisheries

10:20am — Gardner, C. and D. DeVries. Cross-shelf patterns in fish community structure and demographics on hard bottom habitat off northwest Florida

10:40am — Keenan, S.F. and T. Switzer. Multi-gear sampling of reef fish on the west Florida shelf: Results from a cooperative, fishery-independent, pilot project

11:00am — Hale, L., L. Hollensead, and J. Carlson. Catch of red grouper (*Epinephelus mori*) from the bottom longline fishery in waters off the coast of Florida

11:20am — Ribera, M., S. Harter, and A. David. Using geographic information systems (GIS) in fisheries management: The West Florida Shelf and the South Atlantic Bight.

11:40am — Koenig, C.C. and F.C. Coleman. Demographics, density and seasonal movement patterns of reef fish in the northeastern Gulf of Mexico associated with marine reserves.

**12:00pm — LUNCH**

***Symposium continued***

**Moderator:** Doug DeVries, NOAA Fisheries

1:00pm — McBride, R., G. Fitzhugh, and A. Collins. A case study of hogfish, *Lachnolaimus maximus*. Fish houses, hard parts, sex change, and SEDAR

1:20pm — Fitzhugh, G., R. McBride, L. Lombardi-Carlson, and M. Cook. Assessing reef fish reproductive potential: Time for new direction?

1:40pm — Lindberg, W. Feasibility of standardizing reef habitat quality to improve accuracy in fisheries independent monitoring of pre-reproductive female gag, *Mycteroperca microlepis*

2:00pm — \*Rankin, T.L. and Sponaugle, S. Temperature effects on early life history traits and population replenishment of a reef fish

2:20pm — Graham N.A.J, T.R. McClanahan, \*M.A. MacNeil, S.K. Wilson. N.V.C. Polunin, and S. Jennings. Canaries of the sea: Climate warming and the integrity of coral reef ecosystems

## **2:40pm — BREAK**

### ***Contributed Papers***

**Moderator:** Ted Switzer, FWC

3:00pm — \*Lauretta, M., W.E. Pine, III, T.K. Frazer, E. Nagid, and J.C. Tetzlaff. The abundance and distribution of fishes in two spring-fed coastal rivers in Florida

3:20pm — \*Tetzlaff, J.C., W.E. Pine, III, T.K. Frazer, and M.V. Lauretta. Energetic consequences of habitat loss to an apex predator

3:40pm — \*Burgess, O.T., W.E. Pine, III, and S.J. Walsh. The importance of floodplain connectivity to fish populations in the Apalachicola River, Florida: Insights from telemetry

4:00pm — \*Thompson, K. and J.E. Hill. Mosquitofish as biotic resistance to invasion: Predation on two exotic poeciliids

4:20pm — Dutterer, A.C., E.V. Camp, M.V. Lauretta, and W.E. Pine, III. Development of a fish monitoring program for non-wadeable streams: A test case from the Santa Fe River, Florida

4:40pm — Tuten, M.T., W.A. Strong, E.J. Nagid, and M.M. Hale. Comparison of haul seine and otter trawl catches of black crappie *Pomoxis nigromaculatus* at Lakes Parker and Griffin

5:00pm — 6:00pm / **Student Subunit Meeting (All students)**

6:00pm — 7:00pm / **Dinner**

7:00pm — 8:00pm / **Chapter Business Meeting – Please Attend!**

**Awards Presentations:** Student Awards – Travel and Roger Rottmann Scholarship  
Followed by THE RAFFLE, AUCTION, and the *bonfire social*

## **Thursday, February 21**

All day / **Registration**

7:00am — 8:00am / **Breakfast**

8:20am — 8:30am / **Announcements**

### ***Contributed Papers***

**Moderator:** Will Patterson, UWF

8:00am — Lange, T., and G. Delpizzo. "I heard you can't eat fish from that lake": The true story about Florida's fish consumption advisories

8:20am — Garreau, C. and D. Scheidt. Watercraft use patterns in the federally managed portions of Mosquito Lagoon, east-central Florida

8:40am — Taylor, D.S. Tropical Eleotrids: Looking in all the Wrong Places?

9:00am — \*Shepard, K., W.F. Patterson, III, D.A. Devries, and C. Palmer. Estimating the contribution of Atlantic king mackerel *Scomberomorus cavalla* to winter mixed-stock fisheries in south Florida

9:20am — Hardin, S., C. Watson, and P. Zajicek. Conducting a risk analysis for Florida's marine ornamental pathway

9:40am — Reyier, E., R. Lowers, D. Scheidt, and D. Adams. Movement patterns of adult red drum *Sciaenops ocellatus* in a shallow Florida lagoon as determined by autonomous acoustic telemetry

**10:00am — Break**

**Moderator:** Kerry Flaherty, FWC

10:20am — \*Nelson, J.A., J.P. Chanton, F.C. Coleman, and C.C. Koenig. FLUX by FIN: Fish mediated carbon and nutrient flux between northeastern Gulf of Mexico seagrass beds and offshore reef fish communities.

10:40am — \*Carlton, J.S. and S.K. Jacobson. An assessment of media frames in the 1994 "Net Ban" conflict: Fisheries management and the public agenda

11:00am — Vecchio, J. and T. Switzer, T. Say Cheese! A pilot study to assess the use of stationary video camera arrays in monitoring reef-associated fish assemblages

11:20am — Winner, B.L., T.S. Switzer, and G. Onorato. A comparison of hooked gears as a tool for monitoring Florida reef fishes: Does hook size matter?

11:40am — \*Brennan, N.P., C.J. Walters, and K.M. Leber. Manipulations of stocking magnitude: addressing density-dependence in a juvenile cohort of common snook *Centropomus undecimalis*

12:00pm — 1:00pm / **LUNCH**

1:00pm — 1:15pm / **Awards Presentation:**

Best Papers - Student and Non-student

Best Posters - Student and Non-student

Power Tie and Lampshade awards

**Abstracts for the 28<sup>th</sup> Annual Meeting of the Florida Chapter American Fisheries Society**  
(in alphabetical order)

**\*Addis, D.T., W. F. Patterson, III, and M.A. Dance**

*Student • Poster Presentation*

University of West Florida. 11000 University Parkway; Pensacola, FL, 32514  
dta2@students.uwf.edu; wpatterson@uwf.edu; mad@students.uwf.edu

**Site fidelity and movement of reef fishes tagged at unreported artificial reef sites off NW Florida**

We have been conducting a tagging study to examine species-specific site fidelity to and movement from unpublished artificial reefs (n = 9) located 15-20 miles south of Pensacola, Florida. A total of 3,110 fish were tagged with internal anchor tags quarterly from March 2005 to Dec. 2007. The most frequently tagged species were red snapper (n = 2,114), red porgy (n = 422), gray triggerfish (n = 267), gag (n = 96), and vermillion snapper (n = 84). Eighty-one tagged individuals were recaptured at tagging reefs on subsequent trips and fishers reported a total of 194 fish caught away from reefs. Mean distance moved by recaptured red snapper, gray triggerfish, and groupers was 24.7 km, 7.5 km, and 14.5 km, respectively. Size of fishes present at reef sites was estimated with a laser scaler attached to a remotely operated vehicle. Few red snapper (< 5%) observed at study sites were above the recreational fishery's legal size limit (406 mm TL), while more than half (53%) of the gray triggerfish measured were above that species' legal size limit (305 mm FL). Preliminary estimations of species specific site fidelity were computed using Burnham's (1993) joint encounter model in the MARK (White 1998) software package. Results indicate that red snapper displayed lower site fidelity to and greater movement from tagging sites than gray triggerfish; grouper parameters were intermediate in comparison. Higher movement observed in red snapper may have increased vulnerability to high fishing mortality at nearby artificial and natural reefs, hence the lack of larger red snapper observed. Therefore, unreported artificial reef sites may not serve as effective harvest refugia for species that display low site fidelity and move between fished and unfished areas.

**Bethea, D.M., L. Hollensead, J.K. Carlson**

*Platform Presentation*

NOAA Fisheries, SEFSC Panama City Laboratory, 3500 Delwood Beach Rd., Panama City, FL 32405  
Dana.Bethea@noaa.gov

**Distribution and abundance of early life stages of shark species in the Panhandle of Florida, 2003-2007**

Identification and conservation of essential fish habitat are important components of providing adequate management and conservation for shark populations. This is of particular importance when attempting to understand the dynamics of young sharks in coastal areas to provide better information for juvenile shark distribution and abundance. Gillnets were fished in four areas in the panhandle of Florida (~29°40'N, 85°13'W) from April through October 2003-2007: St. Andrew Bay, Crooked Island Sound, St. Joseph Bay, and the Gulf-side of St. Vincent Island. A total of 689 sets were made. Captured sharks species were measured, sexed, and assessed for life history stage, and when in good condition, tagged and released. Differences in size distribution were observed between areas. In St. Andrew Bay, Crooked Island Sound, and St. Joseph Bay (three protected areas), the most abundant species-life stage combinations were Atlantic sharpnose shark juveniles (37-74 cm FL, mean=54.5) and young-of-the-year (25-54 cm FL, mean=38.5) and bonnethead young-of-the-year (43-52 cm FL, mean=43.7). However, on the Gulf-side of St. Vincent Island, the most abundant sharks were blacktip juveniles (50-107 cm FL, mean=78.1 cm FL), finetooth juveniles (50-105 cm FL, mean=84.9 cm FL), and spinner juveniles (56-104 cm FL, mean=79.0). Generalized additive models were used to examine the relationship between catch-per-unit-effort (CPUE, # of sharks per net per hour) and several environmental factors of the most abundant species encountered – Atlantic sharpnose, blacktip and bonnethead shark. In most cases, models demonstrated low correlation between CPUE and environmental factors. Although not significant,

CPUE for young-of-the-year Atlantic sharpnose and juvenile blacktip shark correlated with turbidity/water clarity and juvenile bonnethead shark correlated with salinity. Future work will examine how area co-varies with environmental factors as well as anthropogenic influences such as the level of urban development and land use surrounding a particular area.

**Bohnsack, J.**

*Symposium Keynote*

NOAA Fisheries, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149

Jim.Bohnsack@noaa.gov

**The future of Florida's reef fisheries: Challenges and opportunities**

Florida faces unique critical challenges of protecting coral reefs and maintaining sustainable fisheries in the face of a growing human population and demands for reef resources, recreation and employment. "Traditional" problems include overfishing, pollution, epidemic diseases, toxic algal blooms, and habitat modification and loss from coastal development. Estuaries, important to many reef fish species, are being impacted by loss to urban development, reduced freshwater flow, and nutrient enrichment. Emerging issues include threats of biodiversity loss from aquaculture, petroleum extraction, liquid natural gas facilities, invasive species, and global climate change involving increased U/V exposure, storms, coral bleaching, sea levels, and ocean acidity. These problems seem overwhelming, but offer opportunities for scientists, students, educators, and managers. Meeting these challenges requires greater scientific knowledge and understanding, public awareness, and better professional training for a new generation of fishery professionals. Florida AFS is in a unique position to help meet these challenges and provide effective management for Florida's reef ecosystems by clearly articulating problems, conducting research, providing management advice, and training managers. Although we need to be realistic, we can be optimistic thanks to new tools and technology for mapping, assessment, and modeling. Automated chemical and physical monitoring capabilities (NOAA CREWS and satellite programs); and the use of optics (e.g. LIDAR and stereo optics) and acoustics (e.g. DIDSON) facilitate data collection. Analyses is improved by inexpensive and increased computer power, and better statistical and experimental designs. I expect growth in applied research to restore coral reefs and depleted stocks, control invasive species, and mitigate habitat loss. Especially promising are ecosystem-based approaches to coral reef management that involve spatial and adaptive management, including marine reserves. To facilitate these efforts we need a more educated and involved public, including volunteers and NGOs, such as the Reef Environmental Education Foundation ([www.REEF.org](http://www.REEF.org)). The need has never been greater.

**Bonvechio, K.<sup>1</sup>, J. Estes<sup>2</sup>, and S. Crawford<sup>1</sup>**

*Platform Presentation*

<sup>1</sup>FL FWC, 601 W. Woodward Ave., Eustis, FL 32726

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**Kick Off 2006: FWC's freshwater fisheries long-term monitoring program**

With the help of a Federal Aid Wallop-Breaux grant, the Florida Fish and Wildlife Conservation Commission (FWC) implemented a standardized long-term sampling program for inland waters in 2006, which involves collecting environmental, fishery-dependent and fishery-independent data. A manual was drafted to provide standard sampling procedures, and quality control measures were taken to ensure these procedures were used by all sampling personnel. Fish were collected using multiple gears and in multiple seasons so that changes in the fish community and targeted sport fishes could be monitored through time. In coordination with the Florida LAKEWATCH program, fish community data (i.e., length and weight by species) were collected via electrofishing from 42 Florida lakes in the fall 2006 and spring 2007. Another eleven lakes were sampled using experimental gill nets during the winter 2006-07. Sport-fish directed sampling included waterbodies targeted for largemouth bass (n=27), black crappie (n=9), bluegill (n=4), redear sunfish (n=3), striped bass (n=1), and *Alosa* species (n=1). For nineteen of these populations, age data were collected in addition to length and weight data to assess and monitor growth

and age structure. Estimates of sportfish catch, harvest, effort, and success rates were also made from creel survey data collected from sixteen water bodies over various time periods. Finally, a standard data-entry procedure was established with the aid of a State Wildlife Grant to provide FWC biologists and researchers a central location for the entry, storage and retrieval of these data. Efforts continue to assess and refine these standardized sampling procedures, including evaluating gear effectiveness, establishing statistically-sound sample size requirements, and addressing biologists' concerns.

**\*Brennan, N.P.<sup>1</sup>, C.J. Walters<sup>2</sup>, and K.M. Leber<sup>1</sup>**

*Student • Platform Presentation*

<sup>1</sup>Mote Marine Laboratory, 1600 Ken Thompson Parkway, Sarasota, Florida 34236

<sup>2</sup>Department of Fisheries and Aquatic Sciences, University of Florida, Gainesville, FL 32653

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### **Manipulations of stocking magnitude: Addressing density-dependence in a juvenile cohort of common snook *Centropomus undecimalis***

We released hatchery-reared juvenile common snook *Centropomus undecimalis* to test the effects of augmenting age-1 abundance by 100% (high augmentation, n=2) versus 10% (low augmentation, n=2) in estuarine creeks of southwestern Florida. We monitored in-creek abundance of age-1 snook 1 mo. before releases in May 2002 to estimate wild snook density and stocking magnitude. All sampling used seining standardized for effort, gear efficiency, and depletion-removal. After releases, sampling continued for 1 yr. Initially (1 mo. post-release), creeks with high augmentation showed a 126% and 74% increase in total age-1 abundance, and low augmentation creeks a 6% increase and an 18% decrease. Total age-1 abundance declined during fall in all creeks, but by winter, abundance increased again comparable to earlier levels (132% and 67% above the pre-release estimates in high augmented creeks and 8% and 5% in creeks with low augmentation). While overall density was elevated in both high augmentation creeks, hatchery-reared snook in one creek experienced a 64-85% loss within 1 mo. after release; loss of hatchery-reared or wild snook was negligible in other experimental creeks. Pre-release density was not a good predictor of creek productive capacity, suggesting variation in habitat production and localized recruitment. Further work is needed to understand inter-cohort density-dependent interactions, food chain responses, and variation in habitat productivity.

**\*Bunch, A.J. and M.S. Allen**

*Student • Platform Presentation*

Department of Fisheries and Aquatic Sciences, University of Florida, Gainesville, FL 32653

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### **Dissolved oxygen dynamics in tussock-forming aquatic macrophytes**

Stabilization of lake levels due to altered hydrology exacerbates the rate at which dense vegetation mats (i.e., tussocks) form. Tussocks affect water quality (e.g., dissolved oxygen and temperature) and substrate (i.e., accumulation of organic material), and thus, may affect fish community composition. I identified spatial and temporal trends in dissolved oxygen (DO) with respect to tussock-forming macrophyte species (i.e., cattail, pickerelweed, water primrose, smartweed, and torpedograss) and biomass levels. In dense vegetated habitats, DO tended to be hypoxic during night and morning hours with an increase in DO during the afternoon, but the magnitude of the increase was influenced by macrophyte species and/or biomass levels. Some habitats exhibited anoxia throughout the diel DO profile. Poeciliids and Cyprinodontids (88% of total catch) dominated the fish community in tussock habitats during fish collections at Lakes Istokpoga and Kissimmee. These fish are more adapted to environmental extremes (i.e., hypoxia/anoxia and hyperthermia) than Centrarchids, which only contributed 7% to total catch. Management strategies to limit tussock formation will decrease the extent and longevity of hypoxia/anoxia and create habitats that can maximize the diversity of fish communities and increase abundance of species that support fisheries.

**\*Burgess, O.T., W.E. Pine, III, and S.J. Walsh**

*Student • Platform Presentation*

Department of Fisheries and Aquatic Sciences, University of Florida, Gainesville, FL 32653  
otburge@ufl.edu; billpine@ufl.edu; swalsh@usgs.gov

**The importance of floodplain connectivity to fish populations in the Apalachicola River, Florida: Insights from telemetry**

Lotic fishes are widely believed to use aquatic floodplain systems as spawning and rearing habitats. The perception that floodplain habitats are important for fish recruitment has led to river rehabilitation projects that focus on restoring altered rivers to natural flow patterns, including seasonal inundation of floodplains. Few studies have documented the home ranges of lotic fishes to assess the use of inundated forested floodplains, and fewer studies have linked the spatial and temporal uses of aquatic floodplain habitats with spawning events. Additionally, no studies have determined if fish populations in secondary aquatic floodplain systems are independent of populations in the mainstem river. We used telemetered fishes from five species to examine movement patterns in the mainstem of the Apalachicola River, FL and two associated systems characterized by forested floodplains. Our preliminary findings suggest that aquatic forested floodplain or mainstem habitat use was associated with the season for redear sunfish (*Lepomis microlophus*), largemouth bass (*Micropterus salmoides*), and spotted sucker (*Minytrema melanops*). Results for channel catfish (*Ictalurus punctatus*) and spotted bass (*Micropterus punctulatus*) were inconclusive, possibly due to low sample size. These results may have management implications pertaining to the establishment of an appropriate flow regime for this river system that may be beneficial to fish populations related to spawn timing and spawning habitat availability.

**Caillouet, R., Vecchio, J., Keenan, S.**

*Poster Presentation*

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**Methods of video and still frame analyses in assessing reef-associated fishes**

Reef-associated fishes, principally those of the grouper-snapper complex, continue to be some of the most heavily targeted, yet least studied species of the west Florida shelf. Historically, management of reef fishes has relied heavily on fisheries-dependent data, although recent reviews of reef fish stock assessments have highlighted the need for fisheries-independent surveys. Accordingly, a recent FWC Fish and Wildlife Research Institute study tested the utility of several different sampling methods to monitor reef-associated fishes. As part of this study, visual surveys were conducted using stationary underwater video camera arrays (SVCA) comprised of both digital video and still cameras. Here we will illustrate the methods used to analyze data from over 75 hours of video recorded during this study. The methodology used in this study followed a standardized protocol modified from National Marine Fisheries Service (NMFS) video reading methods. Camera analyses offer many benefits over traditional sampling gears. Camera-based surveys are generally less species/size selective than other sampling methods and represent an ideal technique for targeting habitats that are too complex to be effectively sampled by other methods. Camera analyses allow scientists to assess key habitat parameters (substrate, biota, current, turbidity) as well as gather information on associated species composition and maximum simultaneous abundance of each species. A total of 4,793 individuals representing 89 different taxa were identified in this study. Data obtained for these individuals is greatly enhanced by the ability to measure observed specimens using stereo images recorded by still cameras and Video Measurement Software. The use of SVCAs will undoubtedly be an integral component in developing an ecosystem-based approach to monitor reef fishes in the eastern Gulf of Mexico.

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### **Effects of red tide on the occurrence of fish calling**

Florida red tide, caused by the dinoflagellate *Karenia brevis*, occurs frequently on the west coast of Florida. *K. brevis* produces powerful neurotoxins (brevetoxins) which can kill fish, marine mammals, sea birds and sea turtles, and can cause hypoxia. Yearly fish abundance surveys, using a purse seine and passive acoustics, were conducted during the summers of 2004-2007 in Sarasota Bay. Passive acoustics are a non-invasive and inexpensive method of detecting fish, many species of which are known to make sound. Five habitats surveyed: open bay, seagrass, Gulf of Mexico, sandflat, and mangrove. A significant decrease in the abundance of most fish species in response to red tide was detected. We tested for association between red tide and fish calling, using passive acoustics methods. We conducted logistic regressions to test the association of fish calls (overall and separately for toadfish *Opsanus beta*, pigfish *Orthopristus chrysoptera*, and catfish *Ariopsis felis*) with *K. brevis* cell counts, presence of red tide conditions (>100,000 cells/L) habitat type, temperature, depth, dissolved oxygen, sea state, presence of boats, and presence of dolphins. Fish calls (total) were dependent upon *K. brevis* cell counts and habitat (-2LL=146.0, Cox & Snell  $R^2=0.108$ , Nagelkerke  $R^2=0.150$ ,  $p=0.01$ ). Toadfish calls were dependent upon habitat and *K. brevis* cell counts (-2LL=117.2, Cox & Snell  $R^2=0.184$ , Nagelkerke  $R^2=0.271$ ,  $p<0.01$ ). Catfish calls were dependent upon the presence/absence of dolphins (-2LL=47.2, Cox & Snell  $R^2=0.094$ , Nagelkerke  $R^2=0.249$ ,  $p<0.01$ ). Fish calling was most likely to be heard in the open bay habitat, although due to sound transmission differences, this may not reflect greater abundance in this habitat. *K. brevis* cell counts were negatively associated with overall rate of fish calling, consistent with previous findings of decreased abundance of fish during red tide episodes.

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### **An assessment of media frames in the 1994 "Net Ban" conflict: Fisheries management and the public agenda**

Public opinion of natural resource controversies can be influenced by so-called media effects -- the manner in which mass media cover news stories. Two broad theories of media effects are agenda setting, the process by which media influence what topics are on the public "agenda", and issue framing, the process of by which media influence how the public thinks about an issue. This study analyzes the media coverage leading up to the November, 1994 vote on Amendment 3, the so-called "Save Our Sealife" amendment banning the use of entanglement nets in Florida waters. We examine the use of two different story framing methods: episodic coverage, which focuses on specific, concrete stories of individuals affected by an issue, and thematic coverage, which focuses on a broader-based presentation of general trends and evidence. We characterize newspaper coverage of the net ban controversy to determine how news stories differed with regard to type of frame used (episodic or thematic), number of causes of fishery decline (one of the stated reasons for the net ban) mentioned, assignment of responsibility for fishery decline, and use of scientific evidence to explain fishery decline. The results of the study help to explain the passage of Amendment 3 and offer lessons learned for more effective communication of fisheries science and management information.

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**Regeneration of caudal spines following breakage or loss in juvenile Atlantic stingrays,  
*Dasyatis sabina***

Stingrays possess one or more venomous caudal spines used for defensive purposes. Although several studies have shown that new, larger spines annually replace the previous year's spines as stingrays grow, only one study (on the round stingray *Urobatis halleri*) tested if rays replace lost spines prior to the normal replacement cycle. No study has demonstrated whether broken spines are re-grown or replaced. We are performing an experiment on captive Atlantic stingrays, *Dasyatis sabina*, to determine if rays with spines experimentally removed or clipped grow replacement spines or new tips. Preliminary evidence suggests that removed spines grow replacements, however it is unclear at this point if clipped spines are replaced. To date we found no evidence suggesting that clipped spines regenerate new tips. The developmental and ecological implications of spine replacement will be discussed.

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**CPUE and catch trends of blue shark (*Prionace glauca*) and shortfin mako (*Isurus oxyrinchus*) in the western South Atlantic Ocean from 1978-2006**

Pelagic longline fisheries targeting tunas and swordfish account for the majority of pelagic shark catches in the Atlantic Ocean. The blue shark, *Prionace glauca*, is considered the most abundant species among the pelagic sharks in the Atlantic and is frequently caught by the Brazilian longline fishery. Although much less abundant than the blue shark, the shortfin mako, *Isurus oxyrinchus*, is also a common epipelagic species caught in the longline fishery. Catch per unit effort (CPUE) data for blue and shortfin mako sharks caught by the Brazilian tuna longline fleet were analyzed to determine the relative trends in their abundance over the past three decades. Catch and effort from 67,335 longline sets done by the Brazilian tuna fleet in the south western Atlantic Ocean, from 1978 to 2006, were analyzed. CPUE of both shark species were standardized using a negative binomial error structure. The negative binomial model explained 32.0% and 23.0% of the variance for the blue shark and shortfin mako shark, respectively. The target species (cluster) was the most important factor, explaining 57.2% and 29.3% of the deviance in blue shark and shortfin mako shark CPUE, respectively. Year and fishing area were the next most important variables, while time period (quarter) of the year played a minor role. In spite of year to year oscillation, with a few spikes and drops, blue shark and shortfin mako shark CPUE seemed to be relatively stable, particularly in the last 6 years.

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### **Effects of hook type and soak time on shark catches for a pelagic longline fishery in the southwestern equatorial Atlantic Ocean**

The incidental mortality of sharks due to longline fisheries has been widely held responsible for declining populations of several species and, therefore, mitigation measures are urgently need. Gear modifications, such as the use of circle hooks, in particular, are showing promising results in reducing bycatch mortality. The amount of time that baited hooks are available to fish (soak time) is likely to be another important factor influencing fish mortality, in general. To evaluate this, the catch composition, catch rates, hooking location and time, and number of fish alive at haulback were monitored during 12 sets from a commercial vessel operating in the southwestern equatorial Atlantic Ocean. Circle (size 16/0, 0° offset) and J-style (size 9/0, 10° offset) hooks were deployed in an alternating fashion. Hook-time recorders were used to assess time of hooking, but only in fishes caught on "J" hooks. Of 143 sharks caught, the catch rates for blue, night, silky, tiger, shortfin mako, dusky, nurse, and oceanic whitetip sharks were significantly ( $P < 0.05$ ) higher for circle hooks. In contrast, the catch rates for scalloped hammerhead and bull sharks were significantly higher for "J" hooks. However, all sharks caught by circle hooks were hooked significantly more often in the mouth in contrast with "J" hooks, which hooked more often in the throat or gut. For J-hooks overall, 76% of sharks were hooked during the first 2 h in sets with soak times ranging between 9 and 11 h. Overall larger mature sharks had a lower hook mortality (24.7%) than smaller mature sharks (42.1%). Night sharks suffered 100% mortality rate during the first 2 h of the set. Our results suggest that the use of circle hooks and short sets in the pelagic longline fishery will increase the survival of shark species at haulback.

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### **Reproductive seasonality and maturity of scamp, *Mycteroperca phenax*, from Florida's west coast.**

Scamp, *Mycteroperca phenax*, represent an important component of western Florida's commercial and recreational grouper fisheries. Despite its importance, there is a lack of available reproductive and age information which is essential to properly manage a fishery. Scamp were sampled monthly from 1977 to 1980 to obtain gonads and otoliths to determine spawning seasonality and age at sexual maturation. Gonads ( $n=1,050$ ) and sagittal otoliths ( $n=550$ ) were removed from fish ranging in size from 109-752 mm FL. Reproductive analysis indicated scamp are protogynous hermaphrodites, females ( $n=645$ ) ranged in size from 109-752 mm FL, ages ranged from 2-17 years. Male ( $n=398$ ) scamp were 440-752 mm FL, ages ranged from 6-23 years. Females transitioned into males between 493-609 mm FL and 9-11 years of age. Although large females were collected they were not observed in the oldest age classes, only 6% of females were older than age eleven. Females began to sexually mature at 360 mm FL and 3 years of age. Reproductive development began in December and females spawned from late February through early July with peak spawning occurring in April and May. Males displayed a much longer spawning season than females as spawning capable males were found during all months of the year. Spermatogenic development began as early as August or as late as March, varying greatly between fish. Most males were spawning capable well beyond the end of the females spawning season, some continued to produce spermatozoa through September. However, the majority of spawning capable

males were found from November through July. The seven transitional fish were collected throughout the year suggesting no specific period for transition.

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**Trends in freshwater mercury bioaccumulation in Florida**

In 2007, Florida Department of Health issued 619 mercury fish consumption advisories compared to 563 in 2006. Increases have occurred due to increased sampling and lower criteria for the protection of human health; not necessarily because of a worsening mercury problem. We examined trends in mercury bioaccumulation in largemouth bass, a ubiquitous, top-level predator well suited for trends analyses because of its ability to bioaccumulate mercury. Mercury concentrations in muscle tissue of 10,371 largemouth bass (*Micropterus salmoides*) collected between 1983 and 2007 were pooled on regional and local scales to evaluate spatial and temporal trends. Regional analyses were conducted in three regions including the Shark River Slough in Everglades National Park, Water Conservation Areas 1, 2, and 3, and all waters north of Lake Okeechobee. Regional trends were evaluated by ANOVA while site specific trends were evaluated by ANCOVA using age as a covariate because of size-dependent mercury bioaccumulation. Alternatively, site specific trends were evaluated by comparison of age-standardized mercury concentrations. In Shark River Slough, annual means decreased significantly ( $P < 0.001$ ) since reaching a maximum of 3.04  $\mu\text{g/g}$  in 1997. Even so, all bass collected between 1989 and 2007 ( $n=408$ ) exceeded the USEPA fish tissue methyl-mercury criteria of 0.3  $\mu\text{g/g}$  for protection of human health. In the water conservation areas, annual means decreased consistently from a high of 1.95  $\mu\text{g/g}$  in 1989 to 0.51  $\mu\text{g/g}$  in 1999 after which they stabilized near 0.5  $\mu\text{g/g}$ . The 1999 to 2006 annual means (range; 0.36 – 0.52  $\mu\text{g/g}$ ) were significantly lower ( $P < 0.01$ ) than all years prior to 1998 and represent about a 70% decline in concentrations from the early 1980s. In spite of declines, 67% of largemouth bass in the water conservation areas remain above the EPA fish tissue criterion. Annual means north of Lake Okeechobee varied between 0.33 and 0.78  $\mu\text{g/g}$  with no apparent trends. Specific site analyses are presented for each region to further evaluate local trends in mercury bioaccumulation.

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**A trap and stationary video survey of inner shelf hard bottom habitat in the NE Gulf of Mexico**

A fishery-independent survey of inner shelf, low profile hard bottom habitat using chevron fish traps was begun in the northeastern Gulf of Mexico in 2004; objectives include developing age-specific recruitment indices of exploited reef fishes and examining spatial and temporal patterns in demographics and community structure. In 2005, collection of relative abundance data using stationary video cameras was added. Traps routinely caught gag, red grouper, red snapper, gray triggerfish, black seabass, and white grunt and were effective in detecting year class progressions in young red grouper and gag. Moreover, the age results suggest differences among regions in recruitment success for these two important shallow water grouper species. At 41 sites sampled with both gears, video data showed hogfish, scamp, and gray snapper present at 10-24% of sites, while none were present in the traps, reflecting widely differing gear selectivity for these species.

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**Diversifying Florida's artificial reef program: Can artificial reefs play a role in an ecosystem approach to fisheries management?**

From the late 1960s through 1990, Florida's artificial reef program was a narrowly focused "fishing reef" program formally created by statute in 1982. A single person administered a grants-in-aid program tasked with providing financial assistance to partnering local coastal governments to construct saltwater artificial reefs by paying for the transport of available secondary use reef-building materials. The implicit primary reef program purpose which exists to this day is to increase catch efficiency and expand the number of discrete reef areas where aggregating assemblages of targeted reef fish can be caught by a steadily expanding boating population of recreational anglers. There was initial internal and external resistance to promoting and financing non-reef construction activities (e.g., research, monitoring/assessment) which was perceived as resources taken away from the actual building of artificial reefs. In recent years this resistance has partially abated with the annual availability of state saltwater fishing funding (\$300,000) and USFWS Federal aid in Sport Fish Restoration grant funds (\$400,000). By the mid 1990s the current program, diversified to facilitate state or federally funded reefs to be constructed with one or more of the following intended objectives: 1) enhance private recreational and charter fishing and diving/ecotourism opportunities; 2) provide a socio-economic benefit to local coastal communities; 3) increase reef fish habitat; 4) reduce user conflicts; 5) facilitate reef related ecological research; and, 6) while accomplishing objectives 1-5, do no harm to fishery resources, Essential Fish Habitat (EFH), or human health. Other research and monitoring projects began to be funded that were not directly tied in with requirements to build artificial reefs. This presentation discusses programmatic efforts to support a better understanding of artificial reef ecology and application in terms of an ecosystem approach to fisheries (EAF) while identifying obstacles to this effort including stakeholder perception of artificial reefs.

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**Lake Griffin experimental gizzard shad removal: Assessment of black crappie bycatch and potential population-level impacts**

A commercial gill net fishery for gizzard shad *Dorosoma cepedianum* was established by the St. Johns River Water Management District from 2002-2007 at Lake Griffin, Florida, in an attempt to reduce re-suspension of internal nutrients and improve water quality and clarity. Bycatch primarily consisted of reproductively mature black crappie *Pomoxis nigromaculatus*, which also support the primary sport fishery at the lake. Commercial bycatch can potentially have population-level effects and represent serious concerns for the sustainability of fisheries. For this study, we assessed total black crappie bycatch from the gill net fishery, quantified recreational fishing effort and harvest, and utilized an age-structured population dynamics model to investigate potential population-level impacts of bycatch. Simulations were performed from a stock reduction analysis (SRA) population dynamics model for three harvest scenarios to investigate the sustainability of the black crappie fishery. We used a weighted transitional spawning potential ratio (SPR) as a biological reference point to evaluate the potential of recruitment overfishing under different harvest policies. Results suggest that further increases in harvest from the recreational fishery and/or due to commercial bycatch in the gill net fishery could risk recruitment overfishing. The greatest risk for recruitment overfishing due to bycatch occurs when recreational exploitation is already high. Thus, the potential benefits of gizzard shad removal should be weighed against bycatch impacts to the black crappie fishery. We propose maintaining a target spawning potential ratio (SPR) of 0.3-0.4 through 2020 as a measurable objective for the black crappie fishery in order to prevent the potential for recruitment overfishing. We also recognize the need to establish

measurable and achievable objectives for water quality/clarity improvements resulting from the removal of gizzard shad in order to determine if the objectives can be met without harmful impacts to the black crappie population.

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**Fine-scale movement of Gulf of Mexico sturgeon relative to critical habitat within Escambia, East, Pensacola, and Choctawhatchee Bays, Florida, following Hurricanes Ivan (2004) and Dennis (2005)**

Hurricanes Ivan (September 2004) and Dennis (July 2005) came ashore in northwest Florida over areas previously designated as critical habitat for Gulf sturgeon *Acipenser oxyrinchus desotoi*. Fifty-eight Gulf sturgeon were tagged with ultrasonic transmitters and released within Escambia, Yellow, Blackwater, and Choctawhatchee Rivers in June, July, September, and October 2005 to determine whether habitat patterns were similar to those observed prior to the hurricanes. Gulf sturgeon marine migration from these rivers into the Pensacola and Choctawhatchee Bay systems was monitored by underwater acoustic receivers stationed throughout each bay from October 2005 through June 2006 (study period 1) and from September 2006 through August 2007 (study period 2). The majority of the fish resided in the bays from November through April, with a few fish remaining until June or July before migrating back into the rivers. Although one fish, which was tagged in the Choctawhatchee River, exhibited an atypical behavior of remaining in the upper portion of Escambia Bay for the entire summer (June - September) of 2006 and again returned in June and July 2007. Several fish displayed the propensity to travel among different bays and rivers, but the most notable included a fish which was tagged in the Choctawhatchee River in 2005 and migrated into the Apalachicola River in spring 2006 and then returned to the Choctawhatchee River in spring 2007. Santa Rosa Sound, the seaward arm of the Pensacola Bay system, supported 22 sturgeon for varying periods of time, up to 80 days, between November 2005 and April 2006 and 15 fish the following year (including 11 fish from the previous year and 4 fish not recorded during study period 1). Most of these habitat use patterns have been previously documented, therefore we could not conclude that the hurricanes altered Gulf sturgeon habitat use in the Pensacola and Choctawhatchee Bay systems.

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**The life history of the lined seahorse, *Hippocampus erectus*, in Tampa Bay, Florida**

Seahorses, genus *Hippocampus*, are subject to a large and continuously-growing international trade. Concerns on the trade effects of seahorse populations worldwide have led to their international protection by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). In order to manage seahorse populations, we first need to understand their basic biology. The objective of this study was to describe the life-history, relative abundance, and distribution of *Hippocampus erectus* in the Tampa Bay estuary. Fifty-five specimens were collected throughout Tampa Bay from 2004 to 2006 using 21.3-m offshore seines and 6.1-m otter trawls. Catch-per-unit-effort (individuals 100 m<sup>-2</sup>) was highest in the lower part of the bay where seagrass beds were dense. Monthly length-frequencies were generated using both samples collected in this study as well as data collected by the Fisheries-Independent Monitoring Program in Tampa Bay from 1989 until 2003, to confirm a bi-modal breeding season. These results were validated by collection of pregnant males and ripe females, which were most

commonly found from March through May and again from October through December. Brood pouches were found to have clutch sizes ranging from 122-1,212 embryos. Seahorses collected in this study ranged in size from 4-mm to 160-mm, and age 0 to 3 years. Age 0 fish were reared in captivity after collection and used in length/weight analysis. Conventional methods of aging fish could not be applied to this species, so scanning Electron Microscopy (SEM) was used to enumerate age-specific marks on vertebrae; data were then paired against length-weight charts to estimate age by length and weight. Based on the data observed of these short-lived animals, lined seahorses have a low reproductive rate compared to other aquarium fish and therefore should remain on the CITES listing.

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**Development of a fish monitoring program for non-wadeable streams: A test case from the Santa Fe River, Florida**

Florida's riverine ecosystems are tremendous ecological assets that contain a suite of rare habitat types and a variety of endemic fish and invertebrate species. However, these lotic ecosystems are some of the most at-risk ecosystems in Florida partially due to ongoing water disputes and expansion of surface and subsurface water withdrawals to meet human needs. To aid resource managers in assessing fish communities in non-wadeable Florida rivers, we are developing a sampling and analysis framework to rapidly assess composition, abundance, and community diversity metrics in the Santa Fe River. Our primary objective is to develop a logistically efficient sampling methodology using boat electrofishing that will allow us to develop a monitoring program to assess abundance trends in four key fish species (spotted sucker, redbreast sunfish, largemouth bass, and Suwannee bass) that is robust to natural intra-annual variation. Trends in abundance can then be compared to extant abiotic monitoring programs by cooperating agencies to relate fish population trends to abiotic metrics such as flow duration and magnitude. Key results to date include (1) a sampling framework and closed population analysis metric that appears to be robust to emigration and immigration, (2) identifying tradeoffs in quantitative resolution for various efforts of sampling frequency and intensity, (3) slow build up of tagged fish populations which is likely indicative of low long-term tag retention, and (4) large seasonal variation in the abundance of spotted suckers.

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**Assessing reef fish reproductive potential: Time for new direction?**

Assessments need some measure of population reproductive potential. The default ingredients are an estimate of stock biomass and a maturity function which yields spawning stock biomass (SSB). However equivalent levels of SSB don't always equal equivalent levels of reproductive potential and thus estimates of fecundity or other proxies (gonad weight, condition) are often asked for. In the southern U.S., we have the added challenge that many of our species are indeterminate spawners requiring batch fecundity (BF) and spawning frequency (SF) estimates to provide meaningful annual estimates of reproductive output. The result, due to paucity of data, is that assessments of reef fish have utilized no consistent approach. Various assessments used SSB, BF by age, BF by length interpolated to age, and gonad weight. We are not aware that any SEDAR assessments have yet factored in spawning frequency. Spawning frequency is only important to an age-based assessment if there is an age or year effect. But few studies anywhere return SF contrasts by age or year; a testimony to sampling difficulties. So what do we do? One idea is to turn our focus to energy allocation available to reproduction (which is an

ecosystem quantity) rather than just counting eggs. A second idea is to rely more on scientific observer programs to collect biological information. We discuss some of the logistics to be considered and present some new (to fisheries) technology that might allow an energetic approach.

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**Catch and release mortality estimates for red drum in Tampa Bay, FL**

The recreational red drum fishery is unique in that most red drum harvested by fishers are immature individuals captured within estuarine waters. Furthermore, with restrictive daily bag and slot limits being enforced, a high proportion of individuals being caught are subsequently released. Information on the size of red drum being caught by anglers, as well as the mortality of released fish, has significant bearing on the inshore population and can help estimate the level of annual escapement. Experiments using hook-and-line sampling were conducted seasonally to provide an estimate of recreational catch-and-release hooking mortality for red drum, as well as to relate mortality to hooking location, hook type, fight time, handling time, and various other parameters. Assistance from volunteer recreational fishermen and local guides was utilized when available. Hooked red drum were individually tagged with a plastic dart tag and then placed into a floating mesh net pen located close to the sampling site for observation over a 48-hour time period. A total of 234 fish (range: 203 – 604 mm SL) were caught over 8 different experiments; 13 of these fish died within 48 hours. Logistic regression analyses indicated that hook position and temperature significantly influenced the probability of mortality. The overall mortality rate of 5.56 % is comparable to other short-term mortality studies. Lip-hooked fish had the lowest mortality rate (3.70 %), while fish hooked in the throat had the highest (18.75 %). Over 60 % of mortalities occurred in experiments that had mean temperatures above 26 degrees Celsius. Hook type and fish size significantly influenced the probability of a fish being deep-hooked (throat- or gut-hooked), with 24.68 % of fish caught with J-hooks being deep-hooked. Catch and release fishing, though an effective management tool for reducing take, can contribute to cryptic mortality, especially in warm waters.

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**How many Gulf sturgeon were there? A preliminary stock reduction analysis (SRA) to estimate historic population size**

The goal of many species recovery plans is the restoration of populations to historic or pre-exploitation levels. However, there is often uncertainty in what these levels were, as is the case with Gulf sturgeon *Acipenser oxyrinchus desotoi* in Florida. We attempt to reconstruct the historic Gulf sturgeon population in Florida with an SRA (stock reduction analysis) model using a time series of landings records, population estimates, and biological data. Reliable estimates of historic population size provide important information for resource managers to assess magnitude in population change, develop more realistic recovery targets, and assess time to recovery estimates.

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**Cross-shelf patterns in fish community structure and demographics on hard bottom habitat off northwest Florida**

In fall 2006 we began a study, funded by NOAA's Northern Gulf Institute, to examine the fish community structure, trophic dynamics, demographics, and habitat associations on hard bottom reef habitats from nearshore to the shelf break in the northeastern Gulf of Mexico. A key objective was to delineate and quantify these habitats in two 3 x 30 nm transects using multibeam sonar. Three fixed sites, located within one of the multibeamed transects, were sampled in each of 3 depth strata: 23, 37, & 49 m during February, June, and October. Video data on species composition, abundance, and size structure were collected using an ROV equipped with scaling lasers. Specimens for age, food habits, and stable isotope analyses were collected using standardized hook-and-line gear. The fish community was much more diverse on midshelf reefs (61 species) than on those nearshore (45 species). The relative abundance of gray snapper was >40 fold higher on the nearshore sites (446/ha) than at midshelf (10/ha), with none observed at the outer shelf sites. Except for gray snapper nearshore, red snapper was the most abundant exploited reef fish in all strata, averaging 77/ha nearshore, 102/ha at midshelf, and 147/ha in the outer shelf stratum, although the differences were not significant. Scamp was the most abundant exploited serranid in all three strata and was one of the five most abundant exploited reef fish in each. Red grouper were much smaller inshore (mean±95% CL: 253±29 mm FL) than in the two deeper strata (midshelf: 524±53 mm FL). Gray triggerfish, scamp, and red snapper showed no obvious differences in size structure among strata, although modal sizes of the latter were slightly smaller inshore (250 mm FL) than in the mid (275 mm) and outer shelf (300 mm) strata.

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**Watercraft use patterns in the federally managed portions of Mosquito Lagoon, east-central Florida**

Aerial surveys were conducted to quantify watercraft and resource utilization patterns within the portion of Mosquito Lagoon, Florida that is jointly managed by Kennedy Space Center, Merritt Island National Wildlife Refuge and Canaveral National Seashore. In 2002, 96 bi-weekly surveys, one weekday and one weekend day used a fixed-wing aircraft that followed a 72km transect and covered 162.5km<sup>2</sup>. Data collected included watercraft type, location, activity and the number of trailers present at boat ramps. In 2006, the survey was repeated and expanded to include the northern portion of Mosquito Lagoon. The data from the current study will be compared to the 2002 data which displayed that 79% of the watercraft were of the recreational fishing type boat (< 26 ft length), over 50% of the boats observed occurred in an area of only 57km<sup>2</sup>, and more boats overall were observed on the weekend days versus weekdays with a ratio 2.1 to 1. The relationship between the number of boats observed and the number of trailers present at ramps yielded an R<sup>2</sup> of 0.883. Our study provides a tool resource managers can use to make informed decisions to help monitor the health of natural resources such as sea grass beds, shellfish harvesting areas, and manatee aggregation areas to help facilitate the natural resource management plans within the jointly managed boundaries. The data supports that the Refuge infrastructure has a significant and direct influence on the accessibility to resources within Mosquito Lagoon.

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**Changing fish assemblages associated with different flow rates in the Apalachicola River, FL**

River flow rates are an increasingly important and controversial subject due to both natural drought conditions and human consumptive uses. The Apalachicola River, Northwest Florida is a prime example of how conflicts between different users can arise. Water levels have fluctuated dramatically over the past few years, which raises the question what is happening to the fish and invertebrates community living there. Changes in flow and salinity are a natural occurrence in coastal rivers, and the fish and invertebrates found there are suited to tolerate these changes. Given their tolerance to a wide range of conditions, will different flow rates have a significant impact on this community? Using data collected from the tidal portion of the Apalachicola River since 2003 (July through October of each year), the fish and select macro-invertebrate assemblages between years and regions of the river were compared using PRIMER software. Differences were determined through the use of MDS and ANOSIM. These assemblages were correlated with salinity and temperature measurements made at the time of sampling, as well as monthly river flow data from USGS. As expected, the assemblages differed significantly between the drought years of 2006 and 2007 and the wetter years of 2003 and 2004. While there was a good deal of species overlap in the communities found in the lower vs. upper regions of the river, they still differed significantly. With ongoing monitoring and further analysis, we hope to determine if these differences are a result of spatial shifts in the community, as well as the duration of these changes.

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**Catch of red grouper (*Epinephelus mori*) from the bottom longline fishery in waters off the coast of Florida**

The bottom longline fishery is active in the Atlantic Ocean from about the Mid-Atlantic Bight to south Florida and throughout the Gulf of Mexico. An observer program has monitored this fishery since 1994 to observe catch and bycatch on these vessels; however, observer coverage has historically focused on vessels targeting shark. With the recent closures of the shark fishery and growing concerns of shark bycatch in non-shark targeted sets, observer coverage has been extended to cover any vessel fishing with bottom longline gear, regardless of target. Since July 2005, observers covered 11 trips and 213 hauls targeting reef fish (primarily grouper and snapper). Data collected include size and disposition of catch. Biological and meristic data are also collected from a random subsample of the catch. Haul characteristics and catch frequencies for red grouper (*Epinephelus mori*) in Florida waters (both Gulf of Mexico and South Atlantic) are of particular interest, since red grouper is the main target for many of these vessels and is the major component of the shallow water reef fish fishery. Red grouper catch data will be compared to haul characteristics such as location, depth, and hook type and at-sea mortality will be examined. Future observations of reef fish targeting bottom longline vessels will continue to provide essential at-sea fishery dependent samples and data for stock assessment on many different species of reef fish.

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### **A GIS model designed to predict the ability of *Cynoscion nebulosus* to escape a hypoxic zone in the St. Johns River, Florida**

The meso/polyhaline portion of the lower St. Johns River extends from the Fuller Warren Bridge in Jacksonville, Florida to the Atlantic Ocean. This stretch of the river has an area that undergoes seasonal hypoxia in July and August. *Cynoscion nebulosus* are an estuarine dependent fish that utilizes the lower St. Johns River as spawning and nursery grounds. Utilizing Geographical Information Systems (GIS), the scope of the study is to determine the ability of juvenile *Cynoscion nebulosus* to escape large scale hypoxic events. Using ARCVIEW 7.0 digital maps of the lower St. Johns River were converted into a raster and given a set cell size. Three different starting locations within the hypoxic zone for the St. Johns River were picked based upon densities of catches of young of the year *C. nebulosus*. For each location, four different size classes of fish were modeled (25, 50, 75 and 100 mm) to determine if the amount of time it would take the fish to escape. The output of the computer model illustrates that only the largest size class would have the chance to escape the hypoxic zone. The model is in the early stages, several biotic and abiotic assumptions must be addressed in order to have a hydrographically accurate, working model.

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### **Conducting a risk analysis for Florida's marine ornamental pathway**

Three state agencies responded to Florida's Comprehensive Wildlife Conservation Strategy which called for a risk assessment on all exotic marine/estuarine animals in Florida's aquarium trade by organizing and managing a pathway risk analysis. The agencies recruited 18 importer, wholesaler, retailer, producer, research, and agency representatives to implement a methodology described in a federal publication: *Generic Nonindigenous Aquatic Organisms Risk Analysis Review Process*. The participants determined that the global marine ornamental trade consists of approximately 20 million fish specimens, 10 million invertebrate specimens (excluding coral), and 10 million coral pieces. These major groups are composed of approximately 1,500 fish species, 200 coral species, and 500 invertebrate species (excluding coral). Source regions are Indonesia, Philippines, South Pacific, Red Sea, Caribbean, South Atlantic, and Indian Ocean. Currently, 22 exotic ornamental marine fish species are reported in Florida waters. One of the 22 species is established as a reproducing population in the South and mid-Atlantic outside of State of Florida waters. Participants described marine ornamental pathway links and nodes from sources to consumers and analyzed the potential for economic, environmental or perceived (social or political) effects. They were very certain the potential economic costs were low and the economic benefits high based upon literature and general knowledge. Potential and real environmental effects were judged to be low based upon literature and combined participant knowledge. However, the participants were very certain the perceived risks were high based upon concerns identified in the scientific literature and media reports which may result in the implementation of stricter state regulations, on-site inspections, and reporting. Risk mitigation activities were suggested for the unlicensed retail sale link and the consumer nodes. Funding was provided by the Florida Fish and Wildlife Conservation Commission, Florida's Wildlife Legacy Initiative, and the U.S. Fish and Wildlife Service, State Wildlife Grants program.

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**An update on the status and regulation of federally managed reef fish species in the southeast**

There are 42 species of reef fish managed in the Gulf of Mexico exclusive economic zone (EEZ) and 73 species managed in the South Atlantic EEZ. In the Gulf, of the species where the status is known, four of seven are undergoing overfishing and two of four species are considered overfished. In the South Atlantic, 11 of 17 species are considered undergoing overfishing and three of six species are overfished. In the past, the stocks have been managed with varying degrees of success using measures such as bag limits, size limits, trip limits, and closed seasons. However, these measures have limitations for reef fish species by creating increased discard mortality rates and developing derby fisheries. To overcome these limitations, traditional management measures are being complemented with other management measures such as marine protected areas, individual fishing quotas, and new fishing gear requirements.

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**Swimming trajectories of settlement-stage coral reef fish larvae in the Florida Keys**

Larval dispersal and connectivity result from biophysical interactions between larvae and their environment. While transport can be driven primarily by oceanographic processes, larval behavior can also be important. Settlement stage coral reef fish larvae often have considerable swimming abilities and use acoustic and olfactory cues for settlement habitat selection. In the Florida Keys, an extensive bank/barrier reef system is in close proximity to a major western boundary current. In this environment, habitat selection behavior could greatly affect larval dispersal, depending on the distance larvae can effectively orient, navigate, and swim. To investigate the spatial scale of orientation and navigation, *in situ* observations of bicolor damselfish (*Stegastes partitus*) larvae were conducted 1 km offshore of Molasses Reef, Key Largo, Florida. Settlement-stage larvae from light-trap samples were released by scuba divers and observed for 10 min. Swimming trajectories were reconstructed in 3-D from speed, direction, depth, and current measurements. Individual directionality and group choice of swimming direction were analyzed using circular statistics. Directionality and swimming speeds were used to estimate the spatial scale of effective navigation.

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**Changes over time in reef fish community structure in the upper FL Keys, USA: Fishing impacts and management implications**

Coral reef ecosystems worldwide are being impacted by anthropogenic and natural stressors, yet a lack of historical data often limits our ability to quantify change over time and thus to assess the necessity and exigency of management and conservation measures. We compared current (2006-2007) reef fish community structure at seven patch reef sites in Biscayne National Park, FL, USA, with that observed during a historical study (1977-1981), using the same methods as the historical study. Significant differences were observed in reef fish community structure and frequency-of-occurrence of both fishery

targeted and non-targeted species. Significant declines over time in frequency of occurrence for multiple fishery-targeted species suggest that fishing impacts have contributed to the alteration of community structure. The changes observed in this study are consistent with those observed in other reef systems that are heavily utilized by humans, and may continue given predicted increases in human population and fishing pressure in south FL and the upper FL Keys.

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**Multi-gear sampling of reef fish on the west Florida shelf: Results from a cooperative, fishery-independent, pilot project**

The many species of commercially and recreationally important reef fishes found along the west Florida shelf have been experiencing overfishing in recent decades; however, the unique life-history attributes of reef fishes, combined with acknowledged limitations of available data, render their effective management complicated. A pilot program was designed to evaluate the efficacy of multiple gear types to monitor reef fish populations through a cooperative partnership among the Fisheries-Independent Monitoring program (Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute), NOAA National Marine Fisheries Service and individuals from the commercial fishing industry. Two spatially- and temporally-separate research cruises were conducted to account for seasonal movements and potential differences in sampling efficiency at different depths: a fall 2006 cruise conducted within inshore areas west of Tampa Bay and a summer 2007 cruise conducted in the Florida Middle Grounds. Stationary underwater video camera arrays, chevron traps, longlines and kali poles were deployed in both 2006 and 2007, while hook-and-line surveys were added for 2007. During fall 2006, there were 4,038 individuals observed from 62 total taxa. Seven taxa were common to the four gears; however, the widest diversity of taxa ( $n=42$ ) were observed by the underwater camera system (27 taxa unique to cameras). During summer 2007, 3,132 individuals were observed from 95 taxa. Seven taxa were common to all five gears and underwater cameras observed 67 taxa. Stationary video cameras collected information on the widest diversity of reef taxa; however, does not allow for collection of biological material and data processing is time consuming. Extractive gears such as longlines and hook-and-line were most effective in collecting managed species such as red grouper while also allowing for collection of biological information such as age from otoliths and sex from gonads. Of the extractive gears, chevron traps collected the widest diversity of taxa, while also collecting smaller individuals of managed taxa. Results of this study demonstrated the capabilities of a large-scale, fishery-independent monitoring program to accumulate high resolution data on biological communities on near- and off-shore reef-associated habitats through the use of multiple sampling methodologies.

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**Demographics, density and seasonal movement patterns of reef fish in the northeastern Gulf of Mexico associated with marine reserves**

Shelf-edge reserves, Madison Swanson and Steamboat Lumps, were established in 2000 by the Gulf of Mexico Fishery Management Council and the National Marine Fisheries Service primarily to allow the study of causes of apparent fishing-induced sex-ratio alterations in gag. Males historically comprising 15 to 25% of the gag population now only comprise 2 to 5%. The objectives of this study were to: (1) evaluate the gag sex-ratio problem and (2) evaluate reserve function by non-destructively determining demographic patterns (size, age, sex ratio, and movement patterns) primarily for gag, red grouper, and red snapper. Non-lethal methods were developed to capture reef fish on gag spawning sites inside and outside the reserves. Fish were sampled, tagged (dart or transmitter), then released at capture sites.

Poaching, primarily on gag, was intense in 2004 and 2005 which likely distorted the results for that species. Nevertheless, through telemetry we found that male gag remain on spawning sites year round. Also, gag sex ratio increased significantly in 2003, but then declined to background levels in 2004 and 2005. Large red snapper males and females and scamp males also remain close to spawning sites year round. Reef fish home ranges were small relative to the size of the reserves. Red grouper had the smallest home ranges. The size and age of red grouper, red snapper, and scamp were significantly greater inside reserves than outside, but there was no significant difference in gag. The density of gag and red snapper was significantly greater inside the reserve than outside. We demonstrate that red grouper are habitat engineers, digging large excavations which may contribute important nursery habitat for juveniles of other reef fish such as vermilion snapper. Red grouper exhibit lek-like pair mating in their excavations and males produce stereotypic pre-spawning sounds.

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**"I heard you can't eat fish from that lake": The true story about Florida's fish consumption advisories**

Fish consumption advisories are intended to providing specific advice on selecting a healthy diet of fish low in contaminants. No attempt is made to discourage individuals from eating fish since catching and eating fish is a sport that anyone can participate in and fish provide a diet high in protein and essential fatty acids. However, research has shown that public awareness is difficult to obtain and many anglers and consumers either don't know or don't care about fish contaminants. The Department of Health, Department Environmental Protection, and Fish and Wildlife Conservation Commission along with state universities coordinate sampling, analyses, and risk assessment for Florida's advisory program. Risk assessments utilize numeric fish tissue criteria (concentration protective of human health) to calculate recommended meal frequencies that range from "2 meals per week" to "Do Not Eat". Recommended meal frequencies are listed for specific waterbodies for both sensitive and general populations. Fish tissue criteria are also used to determined waterbody impairment under section 303(d) of the clean water act. In 2007, the number of freshwaters under advisory increased to 281; an increase of 11% over 2006. Mercury is primarily responsible for advisories; however, several exist due to polychlorinated biphenyls (PCBs), organochlorinated pesticides, and dioxins. Largemouth bass have the highest levels of mercury for freshwater species and the greatest number of consumption advisories but 21 other species are currently under advisory. Recommendations for marine waters are segregated into two regions that including south Florida (Florida Bay, Biscayne Bay and the Florida Keys) and the remaining coast. Specific consumption recommendations for are given for 60 marine species due entirely because of mercury contamination except one advisory for saxitoxins in fish from the Indian River Lagoon. We further discuss the range and extent of fish consumption advisories in Florida and future directions needed to increase public awareness.

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**The abundance and distribution of fishes in two spring-fed coastal rivers in Florida**

Patterns of abundance, distribution and species composition of submersed aquatic vegetation in several spring-fed rivers along the Gulf coast have changed markedly over the last decade. Of particular concern is the loss of native macrophytes and concomitant increase in nuisance species including filamentous macroalgae. Because quantitative data on the abundance and distribution of fishes in these coastal rivers

is lacking, the effects of the vegetative alterations on faunal communities (fishes in particular) are, at present, unknown. Fish sampling was initiated in the Chassahowitzka and Homosassa rivers in 2007 to complement an existing long-term water quality and plant monitoring program. Multiple-pass mark-recapture electrofishing surveys and block-netted seine depletions were conducted in July and August. Estimated probability of capture varied between species and rivers for both gear types. Absolute abundance estimates were compared to catch rate data to demonstrate potential bias in relative abundance indices. Freshwater and small-bodied fish abundances were greater in river reaches where submersed aquatic vegetation was most prevalent, while several saltwater fish species exhibited greatest numbers in areas largely devoid of vegetation.

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**Feasibility of standardizing reef habitat quality to improve accuracy in fisheries independent monitoring of pre-reproductive female gag, *Mycteroperca microlepis***

MacCall's (1990) Basin Model effectively applied the population theory of density-dependent habitat selection (DDHS) to marine fisheries, and Lindberg et al. (2006) experimentally established that gag (*Mycteroperca microlepis*) exhibit DDHS primarily for structural shelter, even at the expense of growth. Together these developments suggest that intrinsic habitat quality for gag can be assessed, mapped and enhanced. Furthermore, we expect small standardized reefs of intermediate habitat quality to be effective sampling stations for the fisheries independent monitoring (FIM) of pre-reproductive females as they transit the shallow continental shelf of the northeastern Gulf of Mexico. Such reefs already exist in the Suwannee Regional Reef System and in conjunction with the Steinhatchee Fisheries Management Area. We predict that mean abundance of gag among replicate reefs in these systems will vary directly with the overall stock size of gag, while the variance among such replicates will vary inversely with stock size. Consideration is also being given to effects of the geographic distribution of natural reef habitat quality across spatial scales. Results to be presented will constitute a preliminary test of these predictions in the context of a longer-term, large-scale research program. If successful, this approach could add an accurate FIM time-series to those datasets currently available for indexing gag stock assessments, and add data for a life history stage important in the spatial dynamics of gag in the eastern Gulf. However, even if successfully applied to gag, this same approach might not be appropriate for other reef fishes with substantially different spatial behaviors and population structures.

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**Recruitment dynamics of gray snapper (*Lutjanus griseus*) among west Florida estuaries**

Many of Florida's economically important fish species depend on coastal estuaries for growth and survival as juveniles before moving offshore, connecting nearshore and offshore productivity. Gray snapper typify this pattern of estuarine-dependency, relying on mangroves and seagrass beds during early life. We examined gray snapper recruitment potential from coastal systems among four regions along the west Florida shelf in an effort to link habitat with recruitment. Juvenile snapper (n = 324) were sampled with a 6.1-m otter trawl and a 21.3-m center bag seine using a stratified random sampling protocol within systems from August through December in 2006. Juvenile density was significantly different among sampling regions and habitat types (ANOVA, p < 0.01). Daily fish age was estimated from opaque zones in lapilli. Growth functions computed from size-at-age data were significant among regions (ANCOVA test for slopes, p < 0.001). Results suggest region-specific differences in recruitment potential exist

among estuarine and coastal systems along the west Florida shelf. Future work will include analysis of otolith element and stable isotope signatures among regions in an effort to link inshore recruitment with eventual recruitment to adult populations offshore.

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#### **A spatial approach to catch and effort with pelagic longline gear**

Catch-Per-Unit-Effort (CPUE) with pelagic longline gear is traditionally reported as the number of fish caught per 1000 hooks. However, this measure does not capture differences in the amount of area swept by the gear during its overnight “soak time” while actively fishing. Using ArcGIS and GPS-based coordinates of the start, end, and intermediate points along the deployment and retrieval of pelagic longline gear in the western North Atlantic during 2003 and 2004, we generated polygons to obtain swept area estimates for each set. Weak, but significant, relationships were seen between traditional and area-based CPUE values, suggesting further exploration of the area-based CPUE is warranted. Additionally, no statistical differences were found between four-sided polygons generated with only start-end points from deployment and retrieval and multi-sided polygons that incorporated intermediate points, suggesting that available data in the Pelagic Observer Program could be used in the future to make a larger, historical comparison of CPUE methodologies.

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#### **Canaries of the sea: Climate warming and the integrity of coral reef ecosystems**

Abstract: Coral reefs are currently among the ecosystems most heavily impacted by climate change, where coral bleaching has led to substantial losses in hard coral cover throughout the world. In addition to the corals themselves however, exceptionally diverse communities of plants, fish, and invertebrates, are dependent on coral habitats and we have little information about how losses in coral cover have affected these organisms to date. The complex interactions of geography, oceanography, and management at both local and regional scales greatly complicates understanding of what has changed so far and what coral reef communities will look like in the future. Using examples that span the Indo-Pacific, this talk will focus on what has happened to reef fish communities that have been exposed to coral bleaching at the regional scale and what changes can we expect in reef fish communities with increased climate warming.

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**A case study of hogfish, *Lachnolaimus maximus*: fish houses, hard parts, sex change, and SEDAR**

Hogfish are a valuable fishery species to Florida and the region but they are not common in fish houses. Efforts to define management reference points have been stymied because hogfish are largely harvested by recreational divers using spearguns, but this fishery sector that has not been well surveyed (e.g., by the Marine Recreational Fisheries Statistical Survey). A variety of regulations are used to control harvest; most conspicuously, the minimum size limit is 30.5 cm fork length (FL;  $t_r \approx 3$  years). However, hogfish can grow to 1 m in length and can live over 20 years. Furthermore, hogfish are monandric, protogynous hermaphrodites that form spawning harems, and sex change generally occurs at sizes larger than 30 cm FL. Synthesis of life history data using yield-per-recruit or egg-per-recruit models raise the specter of both recruitment overfishing and growth overfishing of hogfish in south Florida. One interesting outcome of such analyses demonstrates that spawning female or male stock biomass is a poor proxy for egg production, a finding that is becoming widely known for a variety of fish species. Unpublished *in situ* observations are providing additional information about hogfish spatial population dynamics that may be useful for policy development regarding the management of this valuable fishery species.

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*Poster Presentation*

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**Regional variations of hogfish life history (Labridae: *Lachnolaimus maximus*) in Florida: consequences for spawning biomass and egg production models**

Life history traits of hogfish, a hermaphroditic reef fish, varied between samples from the Florida Keys (south Florida) and the eastern Gulf of Mexico (eastern gulf). Differences in female survivorship were associated with a high spawning stock biomass-per-recruit (SSB/R) in the eastern gulf (38% relative to a virtual, unfished population) and a low SSB/R in south Florida (16%); male SSB/R values were similar in each region even though there was a several year difference in the age at 50% maturation between sexes. In addition, regional differences in batch fecundity resulted in much higher lifetime fecundity in the eastern gulf compared to south Florida (9.7 vs. 2.1 million eggs). Relative to a virtual, unfished population, lifetime fecundity was still about 38% in the eastern gulf but only 8% in south Florida. Lifetime fecundity is not easy to measure, but the results here demonstrate how the SSB/R model can overstate the resiliency of fish stocks to recruitment overfishing. Both models, along with a previously published yield-per-recruit model, demonstrate the potential benefits to yield and recruitment that could result from an increase in the minimum size limit for hogfish.

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**Strategies for management of artificial reefs in the state of Florida**

Encompassing 34 of 35 different coastal counties spread along 1,357 miles of ocean fronting coastline (846 miles fronting the Gulf of Mexico and 511 miles fronting the Atlantic Ocean), Florida manages one of

the most diverse, and most active artificial reef programs in the United States. The Florida artificial reef program is the only state program in the United States that is not exclusively run at a state agency level where the state holds all the artificial reef area permits. Because of the extent of coastline and the statewide local involvement in reef activities, the Florida Fish and Wildlife Conservation Commission (FWC) program is a cooperative partnership with local coastal governments to manage diverse habitats, differing user groups, variable funding and materials of opportunity. In response to long-range planning initiatives, in 2003 the FWC completed a long-range Artificial Reef Strategic Plan to serve as a blueprint for both the FWC and the local coastal government reef programs. Representing the broad range of public interests in artificial reefs throughout Florida, the plan is comprised of guiding principles, goals, and objectives that optimize biological and economic benefits, provide policy guidance, support research and data collection, pursue additional funding opportunities, provide a framework for public education and outreach, and provide guidance for operational planning at the state, regional, and local levels of artificial reef construction and monitoring.

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**FLUX by FIN: Fish mediated carbon and nutrient flux between northeastern Gulf of Mexico seagrass beds and offshore reef fish communities.**

In the northeastern Gulf of Mexico pinfish (*Lagodon rhomboides*) and as well as many other species egress in the fall and spawn on reefs far offshore. Pinfish alone can exhibit biomass densities as high as 3.4 metric tons/km<sup>2</sup> of seagrass. This massive flux of prey items into the offshore environment could represent a major food source for the economically important reef fish that inhabit the offshore environment. Furthermore, the timing of the egress occurs 3-4 months prior to the spawning seasons of the two most valuable grouper species in the Gulf of Mexico, gag (*Mycteroperca microlepis*) and red grouper (*Epinephelus morio*). We intend to use stable isotopes (<sup>13</sup>C and <sup>34</sup>S) tracers to track energy flows from Florida Big Bend near-shore seagrass beds to highly productive offshore reef fish communities. The first step toward achieving our goal is to determine the isotopic turnover rates for gag grouper tissues and then apply these rates to observed isotope values from the wild population to determine the timing and magnitude of any shift toward an inshore-derived diet. Over the past year we conducted a diet switch experiment on 4 gag grouper held at the FSUMCL. The results of this experiment indicate that we are able to trace the pinfish diet as it was incorporated into the muscle, liver and gonad tissue. The carbon turnover rates varied among the three tissues with muscle being the slowest and liver the fastest. Although it is generally believed that metabolism is insignificant in tissue turnover rates for ectotherms, adult gag tissue turnover is driven primarily by metabolic turnover and not growth. We also found that the physiological changes gag undergo in preparation for spawning may enhance our ability to trace and determine the significance of seagrass production to gag reproduction.

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**Adaptations of juvenile mangrove littorinids to decrease predation by the pufferfish *Sphoeroides rosenblatti***

The adults of two species of mangrove periwinkles, *Littoraria varia* and *L. variegata*, use vertical migration and growth to a size refuge to avoid intense predation by the puffer fish *Sphoeroides rosenblatti* in the Gulf of Nicoya, Costa Rica. Juveniles of both species, however, are unable to migrate above the predatory range of puffers, which can reach up to 13 cm above the water surface, and are too small to satisfy the size refuge obtained by adults. We hypothesized that juveniles of these species have mechanisms that reduce predation during this period of high vulnerability. Data from field surveys and predation trials

revealed that juveniles exhibit several anti-predation adaptations that minimize exposure to predation, or the time spent in the vulnerable size range: 1) increasing vertical distribution above the water surface within the predatory range of puffers, 2) concealment in submerged root junctures, 3) special vertical migration behaviors, and 4) fast growth. The results from this study suggest that *S. rosenblatti* plays an important role in determining the ecology, behavior, and life history traits of juvenile *L. varia* and *L. variegata*.

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**Temperature effects on early life history traits and population replenishment of a reef fish**

Knowledge about the early life histories of reef fishes is essential to improved management of their populations. Temperature is a primary factor influencing growth during the early life of fishes, and growth-related processes can affect the magnitude and composition of recruitment events and early juvenile survival. To elucidate the effects of temperature and growth-related processes on recruitment and post-settlement survival, 13 monthly cohorts of newly settled bicolor damselfish *Stegastes partitus* were sampled in the upper Florida Keys, USA over multiple years. Late-stage larvae were collected in light traps and juveniles were censused and collected immediately after settlement and over sequential three-day periods. Otolith analysis was used to determine timing of hatching, pelagic larval duration (PLD), timing of settlement, larval and juvenile growth rates (otolith increment widths), and size-at-age. Mean near-reef water temperature explained 43% of variation in PLD, 37% of variation in growth rates during the late larval period, and 38% of variation in growth rates during early juvenile life. Comparison of overall mean traits among cohorts indicated that survivors generally had longer PLDs, were larger at settlement, and grew more slowly during the first six days of juvenile life. A comparison of these results with similar research indicates that traits important to early survival may species-specific.

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**Movement patterns of adult red drum (*Sciaenops ocellatus*) in a shallow Florida lagoon as determined by autonomous acoustic telemetry**

The red drum (*Sciaenops ocellatus*) is one of the most popular coastal sportfishes in the southeastern United States and supports a large recreational fishery throughout the northern Indian River Lagoon (IRL) system, Florida. In this ongoing study, we use an array of twenty-seven acoustic receivers to autonomously monitor diel and seasonal movements of adult red drum in Mosquito Lagoon, a 159 km<sup>2</sup> basin of the IRL system. Since May 2006, 44 adult fish (95 cm mean fork length) have been tracked on average 261 days (maximum 545 days) resulting in over 354,000 position detections. While most individuals exhibited some site fidelity to release locations, intra-estuarine movement increased markedly during fall spawning months. During this time, five fish emigrated to Atlantic Ocean waters through nearby Ponce Inlet while sixteen fish were detected moving (often temporarily) into lower salinity waters of the IRL proper via Haulover Canal. Daily fluctuations in detection rates were also observed, indicating changing water depth preferences over a 24-hour period. These preliminary results confirm that many adult Mosquito Lagoon red drum are long term estuarine residents and suggest that this population may be particularly vulnerable to high angling pressure. Continued tagging and monitoring efforts (including the addition of 7 more IRL receivers in fall 2007) will provide further insights as to red drum habitat use, site fidelity, schooling behavior, and estuarine spawning behavior.

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### **Using geographic information systems (GIS) in fisheries management: the West Florida Shelf and the South Atlantic Bight**

For the past six years the NOAA Fisheries Panama City laboratory has been conducting research on the efficacy of Marine Protected Areas (MPAs) as fishery management tool. This work has focused on two areas; two established MPAs in the northeastern Gulf of Mexico along the West Florida shelf and five proposed MPAs in the South Atlantic Bight between North Carolina and Florida. The fishing regulations in both areas are designed to protect and enhance populations of economically valuable reef fish, primarily gag grouper (*Mycteroperca microlepis*) in the Gulf of Mexico and seven species of grouper and tilefish in the South Atlantic. These species are considered to be at risk due to current stocks and life history characteristics which made them vulnerable to overfishing. All of them are slow growing and long-lived species. Additionally, grouper are protogynous hermaphrodites with harem spawning focused on high-relief hardbottom sites. Similar methodologies are followed in both areas, estimating species abundance and distribution along habitat associations based on stationary remote camera and remote operated vehicle (ROV) video data. Research in both areas is currently ongoing, and bathymetric mapping is not yet complete. Integrating all available data in geographic information systems (GIS) is essential for the assessment of MPAs and the health of reef fish populations. There is a great need for accurate and comprehensive maps of seafloor habitat, especially those showing the distribution and habitat preferences of economically valuable species. The Panama City Laboratory has been creating a GIS project combining high-resolution geological data (multibeam bathymetry and acoustic backscatter) and fisheries data (habitat preference and historical abundance and distribution) for both areas. Spatial analysis of the data and seabed classification is underway using ArcGIS 9.x (ESRI) and QTC Multiview software (Quester Tangent). This presentation will show the preliminary results of these analyses and the data available for the areas studied.

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### **Potential largemouth bass stocking success at Lake Seminole, Florida: an Ecopath with Ecosim model**

Stocking is a commonly used tool in fisheries management to restore and enhance sportfish populations. Availability of suitable forage for stocked fish is thought to be critical to stocking success, and thus, metrics to evaluate the potential for a system's forage base to support hatchery released fish are needed. We constructed an ecosystem food web model using Ecopath with Ecosim for Lake Seminole, Florida, to evaluate its potential as a tool for largemouth bass *Micropterus salmoides* stocking applications. We collected data in 2004 using small block nets and electrofishing to provide biomass, survival, and diet inputs for the Ecopath model. We used Ecosim to simulate stocking densities from zero to 150 fingerlings per hectare and to predict the relationship between stocking densities and total adult standing crop. Ecosim predicted that total adult standing crop could be increased by up to 30% at stocking densities of 150 fingerlings/hectare, however the relationship between stocking density and total standing crop showed diminishing returns as stocking rates increased. Predictions indicated that cannibalism would regulate total standing crop at high stocking densities and that stocking at high rates would result in substantial replacement of wild fish by hatchery fish. Ecopath with Ecosim is a useful tool for evaluating potential stocking success as well as identifying important research questions for stocking programs.

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### **Estimating the contribution of Atlantic king mackerel (*Scomberomorus cavalla*) to winter mixed-stock fisheries in south Florida**

There are two genetic stocks of king mackerel in US waters, but three distinct migratory groups (i.e., populations): western GOM, eastern GOM, and Atlantic. Fish from the eastern GOM and the US Atlantic migrate south each winter to waters around south Florida where the stocks mix. All fish landed in a management-defined winter mixing area are assumed to be GOM fish by the Gulf of Mexico and South Atlantic Fisheries Management Councils for assessment and regulatory purposes. However, historic evidence suggests there is some level of Atlantic contribution to the mixed winter landings. We derived distinct natural population-specific tags from otolith shape and otolith chemical signatures to distinguish GOM from Atlantic fish such that tags could be used to estimate the contribution of the Atlantic stock to winter mixing zone landings. Fish were sampled in summer 2006 summer spawning season when stocks were separate, and then the following winter across three south Florida sampling zones. Following aging, otolith shape analysis was conducted on the fish prior to cleaning and pulverizing otoliths for C and O stable isotope analysis with isotope ratio-mass spectrometry. Linear discriminant function analysis of stock-specific otolith shape and isotope data of summer-sampled fish resulted in mean classification accuracies of 66.0% and 80.95%, respectively. We then parameterized sex-specific maximum likelihood models with the shape and isotope data to estimate the Atlantic contribution to 2006-07 winter landings. Geographic and temporal trends in estimated Atlantic stock contribution to winter landings were consistent across all models. Atlantic contribution was greater in the eastern-most zone than the western-most zone, and the percent of landings from the Atlantic population in the eastern-most zone increased as the season progressed with a lower Atlantic contribution in December and January than February and March. The Atlantic contribution was greater than zero for all models suggesting the current management strategy of assigning all winter landings to the GOM population is inaccurate and should be reconsidered.

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### **Genetic structure of Florida populations of Gulf pipefish, *Syngnathus scovelli***

Information on the population genetics of Florida's marine fishes is limited mainly to relatively large species with widely-dispersed planktonic eggs and larvae. We examined genetic structure of Florida populations of the Gulf pipefish *Syngnathus scovelli*, a small sedentary species that gives birth to free-swimming juveniles following incubation of eggs and embryos in a brood pouch. We sequenced the 485-base pair mitochondrial control region for 80 specimens from five locations: St. John's River and Indian River on Florida's Atlantic coast, and Apalachicola Bay, Tampa Bay and Charlotte Harbor on Florida's Gulf coast. We identified 16 variable sites and 21 haplotypes. Pair-wise comparison of sequences among locations revealed significant differences between all populations except for between Tampa Bay and Charlotte Harbor. Haplotypes 1-13 occurred only in Gulf coast sites and haplotypes 14-21 only in Atlantic coast sites. This haplotype distribution may indicate that there are two distinct lineages of *S. scovelli*.

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**Tropical eleotrids: Looking in all the wrong places?**

Eleotrid fishes ("Sleepers") are widespread in subtropical and tropical freshwater and estuarine habitats, but largely have received little scientific study. In the Caribbean/Western Atlantic, most species spend all or portions of their life-cycles in freshwater rivers or estuaries, associated with dense vegetation. However, recent observations on three species (*Dormitator maculatus*, *Eleotris pisonis* and *Guavina guavina*) suggest they may sometimes occupy atypical "niches" that are fossorial or cavernicolous. In the Bay Islands, Honduras, *D. maculatus* were taken from mangrove land crab (*Ucides cordatus*) burrows. *Eleotris pisonis* were taken from a variety of habitats in the Bay Islands: 1) a high-salinity pool, located well above the spring high tide line and 15 m from oceanic water, 2) burrows of the great land crab (*Cardisoma guanhumi*) in a cattail swamp at the landward edge of a mangrove swamp, 2.3 km from the ocean, and 3) from an oligohaline cave system located at least 1 km from oceanic water, but with apparent subterranean connection. In addition, an approximately 150 mm SL specimen was observed emerged adjacent to a rocky fissure in a black mangrove basin forest. Water in the fissure was observed to "surge" in apparent conjunction with wave action in the ocean (.5 km distant). The fish slithered back into the fissure when approached. A single specimen of *G. guavina* was taken from a *C. guanhumi* burrow near Port Canaveral, Florida. Nine other specimens (25-195 mm SL) were taken from *U. cordatus* burrows in the Bay Islands with traps or hook and line. Finally *G. guavina* was taken from a mangrove island on the Belize Cays within a small 'sinkhole' pond at the very interior of a cay. These combined observations suggest that eleotrids are diverse in their selection of microhabitat and that a variety of habitats must be explored while seeking them.

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**Energetic consequences of habitat loss to an apex predator**

Increased nutrient loading and altered flow regimes in Florida's spring-fed, coastal rivers are possible drivers of documented changes in the structure of submersed aquatic vegetation communities (i.e. abundance, distribution and species composition). The broader ecological consequences of these changes in vegetative habitat, however, are not well understood. The objective of this study is to investigate the role of structural habitat (submersed aquatic vegetation) as it relates to the foraging behavior and energy acquisition rates of a freshwater apex predator, *Micropterus salmoides*. Specifically, we investigate the foraging costs and overall energy budgets of wild fish in rivers that vary markedly in their vegetative character, but are otherwise similar with respect to their chemistry, e.g., temperature, salinity and nutrient concentrations, and physical attributes, e.g., depth and flow. Our approach is to combine multiple independent methods of research including telemetry, diet analysis, muscle enzyme analysis, growth analysis, and bioenergetics modeling, to determine the potential energetic consequences on foraging behavior in rivers that afford different degrees of structural habitat complexity. This study attempts to link broad-scale changes in habitat to both individual and population growth rates using a bioenergetics framework.

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### **Mosquitofish as biotic resistance to invasion: predation on two exotic poeciliids**

Predation by native species may limit the invasibility of communities. Mosquitofish *Gambusia* spp. are common, small-bodied livebearing fish native in many freshwater systems in the USA. Previous work has shown that predation by mosquitofish on small-bodied fishes to be a strong factor in shaping community structure both with naturally co-occurring fishes and where mosquitofish have been introduced. Furthermore, recent research demonstrates that mosquitofish are not gape-limited and can effectively prey on slightly larger fishes. Florida has many established nonindigenous fishes, yet few are small-bodied. We experimentally investigated what role mosquitofish predation may have in limiting invasions of small-bodied nonindigenous fishes. In a series of three mesocosm experiments using two common ornamental poeciliids (swordtail *Xiphophorus hellerii* and variable platyfish *X. variatus*) we tested 1) the effect of predator density on adult survival following introduction, 2) the effect of predator density on a stage-structured population, and 3) effect of habitat structural complexity on predation efficiency of mosquitofish. Mosquitofish successfully killed adults of both species even though these individuals were significantly larger than the mosquitofish. Density effects of mosquitofish were not significant in platyfish survival, where survival remained high across treatments, but was a significant factor with swordtails, which had lower survival with increasing mosquitofish densities. Mosquitofish presence was shown to have a strong negative effect on survival of juveniles. Interestingly, mosquitofish predation efficiency on swordtails was shown to actually increase with increasing stem density, although results were not significant with platyfish. Our results suggest that predation on juveniles by mosquitofish is likely a strong factor in limiting invasion success of these species. Direct mortality on adults also may be a factor with swordtails. In both species there was an observed shift in habitat use in the presence of mosquitofish and this may be an important indirect effect, perhaps facilitating other predators.

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### **Florida's bass conservation center: Past, present, and future**

The Florida Fish and Wildlife Conservation Commission's Florida Bass Conservation Center and Richloam Fish Hatchery has produced more than 6.5 million largemouth bass *Micropterus salmoides* since the 1960's. This hatchery recently received a \$15 million renovation to increase production capabilities. We will provide a historical perspective of our agency's bass stocking programs and include the hatchery's new production goals. Early research on stocking of advanced size (~100-mm TL) bass indicated that pellet-reared bass had difficulty transitioning from artificial feed to live prey after being stocked. Studies showed feeding behavior and predation success of naïve pellet fed largemouth bass differed from experienced wild fish, and that learning of naïve bass occurred following limited exposure to live prey. These and other research findings are being incorporated into new hatchery protocols. New production goals include more than 1.5 million fingerlings (<35-mm TL) and up to one million advanced-size (~100-mm TL) largemouth bass. We will follow guidelines of our agency's new fish genetics policy to insure genetic conservation of wild populations. This includes protecting the genetic integrity of Florida bass *Micropterus salmoides floridanus* by genetically testing brood fish, and avoiding translocations of genes from bass populations in one Genetic Management Unit (GMU) into another as a result of state stocking programs. Pellet-reared bass will be fed live fish (e.g. mosquitofish *Gambusia affinis*) before being stocked, which should enhance their ability to capture prey and increase survival in the wild. Current research efforts are focused on creating genetic markers using microsatellite DNA technology to differentiate hatchery fish from wild bass, and developing an experimental artificial diet to avoid a liver

disease and still yield acceptable growth rates. Other research plans include developing and evaluating different post-release strategies. To assess the success of these new stocking programs, pre- and post-stocking evaluation protocols will be developed and implemented.

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### **Comparison of haul seine and otter trawl catches of black crappie *Pomoxis nigromaculatus* at Lakes Parker and Griffin**

Capture data are commonly used to make important inferences of and management decisions for fisheries resources. However, size and species selectivity occurs in almost all sampling gears. We compared black crappie *Pomoxis nigromaculatus* catch data (i.e., size and age structure) between otter trawls and haul seines at Lakes Parker and Griffin. Otter trawls were pulled by Florida Fish & Wildlife Conservation Commission (FWC) personnel, whereas the haul seines were pulled by experienced commercial fishers. At both systems, the otter trawls caught a larger size range of black crappie including individuals < 100 and > 300 mm TL. Haul seines did not effectively catch black crappie < 206 mm TL and did not catch any individuals <180 mm TL. However, despite otter trawls catching larger individuals, they did not catch as many larger (> 200 mm TL), older aged fish ( $\geq$  age-2) when compared to the haul seines.

**Vecchio, J. and T. Switzer**

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### **Say Cheese! A pilot study to assess the use of stationary video camera arrays in monitoring reef-associated fish assemblages**

Reef-associated fishes of the eastern Gulf of Mexico, including recreationally and commercially valuable members of the snapper-grouper complex, are poorly-studied. Many are classified as overfished or are currently experiencing overfishing. These species can be challenging to monitor using traditional sampling methods due to depth-constraints and gear selectivity. Stationary underwater video camera arrays (SVCA) provide an opportunity to sample these assemblages in a non-extractive way. The Florida Fish and Wildlife Conservation Commission's Fisheries Independent Monitoring (FIM) program used SVCAs during two gear testing cruises on the central west Florida shelf during fall 2006 and summer 2007. A method of recording was developed from NOAA Fisheries video-reading programs and the extant FIM data recording protocols, including a reference library of positively identified taxa. Over 75 hours of video were viewed, and taxon abundance within each video read was conservatively estimated as the maximum number of individuals observed simultaneously. In fall 2006 videos, 42 different taxa were identified with *Diplectrum formosum*, *Caranx crysos*, and *Decapterus* spp. being observed most frequently. These videos showed little variability in fish assemblage structure and no difference between baited and unbaited deployments. From summer 2007 videos, 66 taxa were identified, with *Calamus* spp., *Halichoeres* spp., and *Pagrus pagrus* occurring most frequently. Significant differences in assemblage structure were evident in association with observed habitat characteristics such as relief, attached biota type, and total biota cover. Reef-type habitats, dominated by hard substrates, vertical relief, and high cover of sessile invertebrates exhibited the highest abundance of *Stegastes* spp., *Halichoeres* spp., *Calamus* spp. *Holacanthus bermudensis*, *Mycteroperca phenax*, and *Lutjanus griseus*. Although SVCAs do not provide necessary biological samples for estimating demographic parameters, they do provide distinct advantages as we move toward ecosystem-based fisheries management in the eastern Gulf of Mexico.

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**Patterns of stingray injuries to humans at Fort De Soto Park, Florida**

The venomous barbs of stingrays are a common source of injury to humans in some coastal areas, but few studies have investigated the demographics of people injured or the relationship between injury patterns and local environmental factors. We analyzed injury reports collected by Fort De Soto Park staff for three years to assess patterns related to month, site, time of day, and tidal and lunar cycles, and to summarize demographic information for people injured. Injuries were concentrated in summer months, apparently due to both increased human visitation as well as seasonal use of shallow habitats by stingrays. However, the monthly pattern varied greatly among years and sites and may be due to local movement patterns of rays, especially juvenile bluntnose stingrays, *Dasyatis say*. Injuries were highest from late morning to late afternoon, possibly reflecting beach use by bathers. An analysis of the relationship between injury frequency and lunar and tidal cycles, as well as demographic information on injured humans, will be presented. The results from this study may be useful to park managers to reduce the incidence of stingray injuries in the future.

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*Platform Presentation*

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**A comparison of hooked gears as a tool for monitoring Florida reef fishes: Does hook size matter?**

As an important step in the development of an offshore reef-fish monitoring program, the FWC's Fish and Wildlife Research Institute conducted a study designed to test the effectiveness of multiple sampling gears in collecting reef fishes. Two spatially- and temporally-discordant research cruises were conducted, a fall 2006 cruise conducted within inshore areas west of Tampa Bay and a summer 2007 cruise conducted in the Florida Middle Grounds. As part of this study, two hooked gears (longlines and kali poles) were deployed to compare catch rates, size-frequencies, and species assemblages between gears. Each gear was equipped with three sizes of circle hooks (8/0, 11/0, and 15/0) to test for possible hook size effects on reef-fish catch. Significant differences in both catch rates and numbers of species collected were evident between gears, with longlines exhibiting higher catch rates and species diversity than kali poles. Catch from both gear types was dominated by *Epinephelus morio*, which ranged from 29 - 71% of the total catch. Size-frequencies were similar between gears. Comparisons within each gear type suggested a general decrease in reef-fish catch rates and overall species diversity with increased hook size. Larger hooks generally collected larger fishes in both gear. Fish communities sampled by longlines and kali poles differed significantly; however, within each gear there were no differences among fish communities sampled by the three hook sizes. Abundances of apex predators were surprisingly higher on 8/0 and 11/0 hooks, however larger taxa (*Carcharhinus plumbeus* and *Galeocerdo curvier*) were more frequently collected on larger hooks (15/0). These studies have yielded important insight into the most appropriate sampling methods for targeting specific components of offshore reef-fish assemblages and this information is being used to design a fisheries-independent survey of reef fishes in the eastern Gulf of Mexico.

