



NOAA Coral Reef Conservation Program Southeast Fisheries Science Center Activities and Accomplishments

2007-2010

**Compiled By:
Tara Dolan
Jennifer Schull**



U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southeast Fisheries Science Center
75 Virginia Beach Drive
Miami, Florida 33149

October 2012



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**US Department of Commerce
National Marine Fisheries Service
Southeast Fisheries Science Center**

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Science Spotlight:

Featured stories highlighting SEFSC's cutting edge research and outreach.

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Flavia Tonioli, SEFSC Miami, FL: p. 36

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Jennifer Doerr, SEFSC Galveston, TX: p. 32

Jiangang Luo, RSMAS: p. iv (top), 10, 14

Keith Pamper, Shedd Aquarium: p. 30, 38

RVC Multi-Agency Team: p. 16, 18, 30, 45, 46

SEFSC Panama City, FL: p. 20, 22

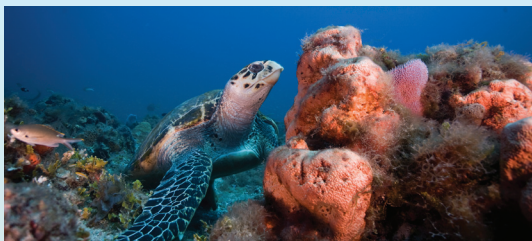
Tara Dolan, SEFSC Miami, FL: p. Cover (bottom), 6, 24, 28, 34, 40

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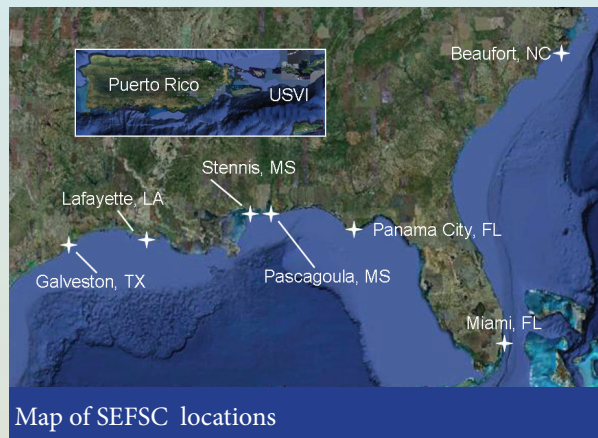
Acronyms

AUV	Autonomous Underwater Vehicle
CITES	Convention on the International Trade of Endangered Species
CRCA	Coral Reef Conservation Act
CRCP	Coral Reef Conservation Program
DOI	Department of the Interior
ECOSUR	El Colegio de la Frontera Sur
ESA	Endangered Species Act
FACT	Florida Atlantic Coast Telemetry Project
FoProBim	Fondation pour la Protection de la Biodiversité Marine
FWC	Florida Fish and Wildlife Conservation Commission
FWRI	Florida Fish and Wildlife Research Institute
FKNMS	Florida Keys National Marine Sanctuary
FSA	Fish Spawning Aggregation
GMFMC	Gulf of Mexico Fishery Management Council
HAPC	Habitat Area of Particular Concern
HBOI	Harbor Branch Oceanographic Institution
MPA	Marine Protected Area
NCCOS	NOAA - National Center for Coastal Ocean Science
NMFS	NOAA - National Marine Fisheries Service
NOAA	National Oceanographic and Atmospheric Administration
NOS	NOAA - National Ocean Service
NPS	National Park Service
REEF	Reef Environmental Education Foundation
ROV	Remotely Operated Vehicle
RSMAS	Rosenstiel School of Marine and Atmospheric Science, University of Miami
RVC	Reef Visual Census
SAFMC	South Atlantic Fishery Management Council
SAB	South Atlantic Bight
SEDAR	Southeast Data Assessment and Review
SEFSC	Southeast Fisheries Science Center
STFA	St. Thomas Fishermen's Association
SWFSC	Southwest Fisheries Science Center
TRACES	Trans-Atlantic Coral Ecosystem Study
UNCW	University of North Carolina - Wilmington
USFWS	United States Fish and Wildlife Service
USVI	United States Virgin Islands
UVI	University of the Virgin Islands
VI DPNR	Virgin Islands Department of Planning and Natural Resources



The Southeast Fisheries Science Center

The Southeast Fisheries Science Center (SEFSC) is one of six research centers within the National Marine Fisheries Service (NMFS). Also known as NOAA Fisheries, NMFS is an agency of the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA). The SEFSC is headquartered in Miami, Florida, and implements research and monitoring programs throughout the Southeastern United States to provide information for sustainable management of fishery resources, habitat conservation, and recovery of protected resources and endangered species. The Southeast Regional Office in St. Petersburg, Florida administers the management of federal marine resources in the region.



Map of SEFSC locations

The SEFSC is responsible for the federal marine resources of the eight south-easternmost states, Puerto Rico, and the US Virgin Islands. SEFSC provides scientific support for NMFS' fishery management activities for the South Atlantic, Gulf of Mexico, and Caribbean Fishery Management Councils, as well as Navassa Island National Wildlife Refuge. The SEFSC interacts with the Gulf and Atlantic States Marine Fisheries Commissions and provides scientific support for US participation in the International Commission for the Conservation of Atlantic Tunas (ICCAT), The United Nations International Oceanographic Commission for the Caribbean and Adjacent Regions (IOCARIBE); and the Gulf and Caribbean Large Marine Ecosystem programs (LME), amongst others. The SEFSC works jointly with the governments of many neighboring countries on projects of mutual interest under bilateral and multi-lateral science agreements.

The SEFSC oversees five laboratories, each with unique expertise and capabilities: Miami, Florida; Panama City, Florida; Beaufort, North Carolina (a joint National Ocean Service-NMFS Facility); Galveston, Texas (with additional facilities in Lafayette, Louisiana) and Pascagoula, Mississippi (with additional facilities at the Stennis Space Center, Mississippi). Fishery and port sampling staff are located throughout the region. The laboratories collaborate readily, and provide the tools needed to support efficient and effective ecosystem management of the region's resources. The SEFSC has three major NOAA research vessels berthed in Pascagoula, Mississippi: the 170 ft. OREGON II, the 224 ft. GORDON GUNTER, and the 209 ft. PISCES, a state-of-the-art acoustically quiet research vessel commissioned in 2009. SEFSC has a large fleet of smaller research vessels throughout the region which serve as platforms for various research activities.

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SEFSC Pascagoula:	3209 Frederic Street, Pascagoula, Mississippi, 39567
SEFSC Galveston:	4700 Avenue U, Galveston, Texas, 77551
SEFSC Beaufort:	101 Pivers Island Road, Beaufort, North Carolina 28516
CIMAS	Cooperative Institute of Marine and Atmospheric Studies, 4600 Rickenbacker Cswy. Miami, FL 33149



Coral Reef Research & Monitoring

Introduction

You can't understate the value of coral reefs to the United States. Beyond their intrinsic beauty, their cultural importance, or their diversity, they are economic drivers and critical components of our coastal communities. Preserving coral reef health and vitality has always been a part of the NMFS mission, as we strive to maintain the sustainability of our nation's fisheries, protect vital marine habitats, and protect imperiled species. SEFSC works predominantly in the Southeastern US and US Caribbean, home to some of the most important reefs in the United States.

Off Florida, reefs extend over 560 linear km from Stuart, Florida (Martin County) through the Dry Tortugas. The Florida Keys National Marine Sanctuary encompasses some of the most valuable reef resources in the nation, with value for commercial and recreational fishing, and a vast tourism enterprise. Florida's coral reefs alone contribute an estimated \$4.4 billion to the US economy and provide over 70,000 jobs (Johns 2001). The reefs of the US Caribbean (Puerto Rico, the US Virgin Islands, and Navassa) are no less important and are nested within a diverse geopolitical region that depends heavily on their reef resources for food, jobs, tourism, and coastal protection. US Caribbean coral reef fisheries alone are valued at over \$14M a year (NMFS, pers comm.) and new valuation studies for US Caribbean coral reefs (expected in 2012) should highlight their broader economic importance.

The passage of the Coral Reef Conservation Act (CRCA) in 2000 organized the SEFSC's coral reef research and monitoring efforts under one NOAA-wide program, the Coral Reef Conservation Program (CRCP). The CRCP integrates our work with that of other NOAA colleagues, regional partners, and state and territory managers. SEFSC strives to achieve the goals of the CRCA to "conserve and manage" US coral reefs while meeting its statutory responsibilities for sustainable fisheries and threatened and endangered species. Over the years, SEFSC's coral reef related activities have focused on reef fish population dynamics and behavior, connectivity of habitats and life history phases, management performance (including MPAs), coral ecology and recovery, and the economic value and socio-cultural importance of coral reefs.

SEFSC scientists work domestically and internationally, in shallow and deep habitats, and with both traditional and state of the art technologies. We strive to communicate our science as broadly as possible, and are always committed to the highest science standards, publishing extensively in the scientific literature and participating in scientific forums around the world.

CRCP has grown in influence and importance over the years and has shifted its focus to meet the urgent and changing conservation needs of coral reefs. In 2007, an external program review recommended the CRCP refine its geographic and thematic foci, and shift resource allocations to local, place based conservation and management, among other recommendations. A new CRCP program manager, Kacky Andrews was welcomed in 2007 and instituted a well-defined strategy for addressing the recommendations from the program review and for the future of the program (see Figure 1). The Magnuson-Stevens Fishery Conservation and Management Act, the main driver for fisheries management in the US, was reauthorized in



Coral Reef Research & Monitoring

2007. This gave NMFS new authority and new responsibilities for ending overfishing, and also establishing a new “Deep Sea Coral Research and Technology Program” which is now also administered by CRCP. The new Magnuson reauthorization brought attention to the lack of critical data needed for assessing reef fish stocks in the US Caribbean – a call to action for both the CRCP and NMFS.

The time period between 2007 and 2010 was marked by institutional change at the CRCP. With input from myriad stakeholders, the program reorganized around three central coral reef “threats” – Climate Change, Fishing Pressure, and Land Based Sources of Pollution. The program focused its efforts geographically and honed its priorities according to the needs of local and regional resource managers; new strategies were developed for their international, socio-economic, and communications components.

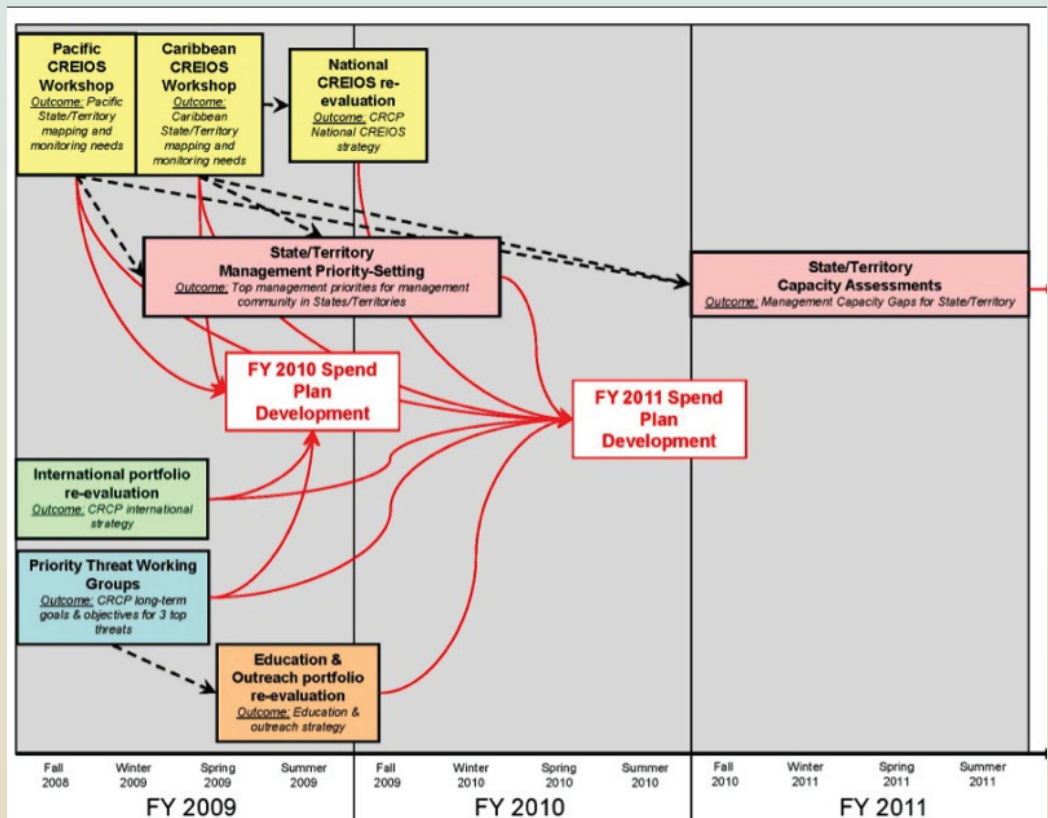


Figure 1: CRCP Roadmap diagram. FY 2009-2011

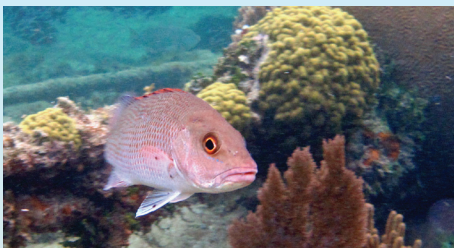
SEFSC was poised to chronicle and study two major events during the 2007-2010 time period: the April 2010 Deepwater Horizon Oil Spill, and the invasion of the Indo-Pacific lionfish on Caribbean and Florida reefs. The CRCP’s new strategy was finalized and fully implemented by fiscal year 2011. With that date in mind, this report is designed to describe SEFSC’s coral reef program activities, accomplishments, and capacity during this transitional phase. It highlights our accomplishments, partnerships and products and shows how our efforts support the conservation and management of reef resources. Most importantly, this report acknowledges the contributions of SEFSC’s exceptional coral reef scientists, who are truly the drivers of this compelling work.



*Johns, G.M., V.R. Leeworthy, F.W. Bell, and M.A. Bonn. 2001. Socio-economic study of reef resources in Southeast Florida and the Florida Keys. Broward County Department of Planning and Environmental Protection. Fort Lauderdale, FL.



SEFSC Coral Reef Projects 2007-2010



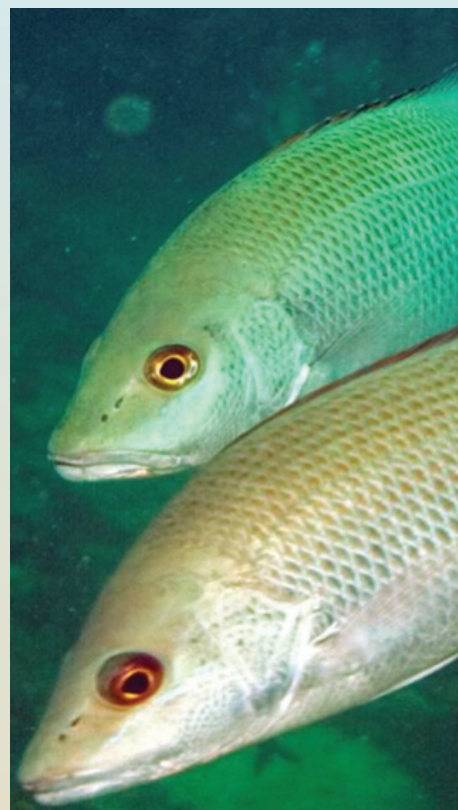
Spawning Aggregations: Protecting the Future

Each year, when the time is just right, certain species of reef fish amass at particular locations to participate in simultaneous reproductive events known as reef fish spawning aggregations (FSAs). These occurrences are a vital part of the life cycle of many reef fish, most notably snapper and grouper species. However, this life history trait makes these species particularly vulnerable to overfishing, as fishers have learned to exploit FSAs. Worldwide, many spawning aggregations have been fished to such an extent that they are no longer viable.

Protecting the ability of fish to aggregate to spawn is a key action coral reef managers can take to ensure the long-term sustainability of coral reef fish stocks. The SEFSC provides ecosystem-level science designed to identify, monitor, and ultimately recover FSAs to managers, a powerful tool for achieving their goals of ecosystem and fisheries sustainability.

Why do fish aggregate at specific locations? How do fish populations respond once aggregations are fished out? Have management efforts to protect aggregations been effective? Scientists at SEFSC are using multiple approaches including aerial surveys, drop camera arrays, fisheries sonar, diver surveys and acoustic mapping to find the answers.

In the Florida Keys, acoustic mapping technologies, developed and used with partners at the University of Miami, National Ocean Service (NOS) and Florida Fish and Wildlife Conservation Commission (FWC), have enabled SEFSC scientists to characterize FSAs remotely, considerably increasing the areas that can be surveyed during research missions. Through single-beam sonar mapping, SEFSC researchers led by **Dr. Todd Kellison**, and partners found that reported FSAs in the Florida Keys had similar seafloor profiles, including occurring on or adjacent to drowned or outlier reefs, allowing scientists to begin to predict other locations that might be important for spawning fish. Such predictive capabilities helped guide surveys off Key West, where aggregations of mutton snapper (*Lutjanus analis*) and gray snapper (*Lutjanus griseus*) were found. Aerial surveys confirmed that these aggregations continue to be targeted by commercial and recreational fishers. In fact, throughout the FL Keys, no known FSAs are specifically protected by management actions.



Gray snapper (*Lutjanus griseus*)
Photo credit: SEFSC Beaufort, NC.

Results of this project are shared with managers of the Florida Keys National Marine Sanctuary (FKNMS) to use in reassessment of marine zoning boundaries of marine protected areas. Sites identified as FSA locations may become candidates for future protection.

SEFSC scientists are also using hydroacoustic tools to assess potential and known aggregation sites in Puerto Rico. In collaboration with the University of Puerto Rico- Mayaguez, the team's ongoing work resulted in closures to commercial and recreational fishing on the entire shelf of Puerto Rico during the red hind (*Epinephelus guttatus*) spawning season.

Additionally, this work contributed to changing the MPA boundary around Mona Island in Puerto Rico to provide spatial protection for deeper-water reef FSA. Back in the Florida Keys, the team incorporates lessons learned to characterize shallow water habitat use for another species of grouper, black grouper (*Mycteroperca bonaci*). Other highlights of SEFSC's contributions to spawning aggregations are shared on Page 8 – "Mutton Snapper: Making a Recovery".

Documentation of reef fish recovery at FSA's validates the use of both MPAs and seasonal closures as powerful and effective management tools for protecting spawning aggregations. The development of a conceptual model for reef characteristics that correlate with FSA presence will help to facilitate prediction of additional FSA sites. Resource managers are increasingly incorporating FSA information into their management plans to provide benefits, not just for aggregating reef fish, but for the entire ecosystem.



Left: Gray snapper (*Lutjanus griseus*) migrate from inshore habitats to reefs to reproduce. *Photo credit:* Todd Kellison SEFSC Beaufort, NC.

Right: SEFSC scientific divers deploy a camera array. *Photo credit:* Mike Judge, SEFSC Miami, FL.



Mutton Snapper: Making a Recovery

At Riley's Hump in the Dry Tortugas Ecological Reserve, mutton snapper may have finally caught a break. This commercially important species was once overexploited to the point that spawning aggregations were no longer forming, reducing the ability of this important fish species to reproduce. But since Riley's Hump was protected within the Tortugas South Ecological Reserve in 2001, scientists at Florida Fish and Wildlife Conservation Commission (FWC) and SEFSC, in collaboration with NOS, Reef Environmental Education Foundation (REEF), University of South Florida, University of Miami and FKNMS, have closely monitored mutton snapper populations for signs of recovery.

After years of increasingly positive signs at Riley's Hump, research teams were rewarded in July 2009 with the first documentation of successful mutton snapper spawning at Riley's Hump. The project, led by SEFSC scientist **Michael Burton**, has provided much needed scientific evidence that even severely exploited species, once protected from excessive fishing pressure, may recover.

The multi-agency team relied heavily on expert scientific divers from all partner organizations to conduct visual surveys and deploy cameras to monitor aggregations before and after protection measures were put in place. Researchers followed the movements of acoustically tagged snappers and groupers as they made annual migrations from Dry Tortugas National Park to spawn at Riley's Hump. Promising evidence of increased concentrations of mutton snapper during "spawning moons" on Riley's Hump encouraged the team to deploy cameras overnight in an effort to document spawning. Divers were also deployed to visually census snapper abundance.

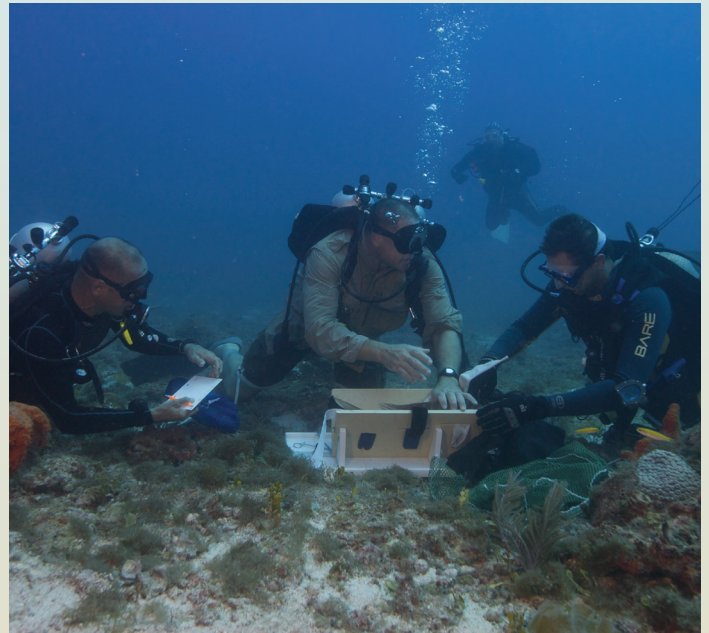
When the scientists rolled the footage captured by the divers, the team were first to witness that mutton snapper continue to come together to spawn at Riley's Hump, evidence that the marine reserve protecting the aggregation had accomplished one of its key goals. The divers captured unprecedented footage of multiple spawning events and the cameras deployed overnight captured footage of not only a mutton snapper spawning event, but also a rare sighting of a great white shark cruising through the schools of muttons. Overall, the effort was an exciting discovery for SEFSC and partner and a great success for the recovering snapper aggregation.



Mutton snapper (*Lutjanus analis*) gather to spawn off of Riley's Hump. Photo credit: Chris Parsons

To complement their efforts to document snapper aggregations, SEFSC in partnership with NCCOS, is using active multibeam sonar, creating a sonar picture of habitat, to characterize where aggregations take place. Moving forward, these two organizations are also investigating the potential to monitor grouper spawning aggregations with passive acoustic technology. With partners Dr. Jim Locascio of USF and Chris Taylor of NCCOS, SEFSC scientists deployed hydrophones at likely spawning locations to record characteristic sounds made by the aggregating grouper. The hydrophones will be retrieved after a year underwater, hopefully full of data indicating how grouper aggregations have fared recently.

Results from these studies highlight the importance of habitat linkages between adjacent MPAs and provided valuable support for an ecosystem approach to reef fisheries management. Regional fisheries management councils as well as the FKNMS Advisory Council incorporate this information to improve use and effectiveness of MPAs. Documentation of mutton snapper spawning after years of overexploitation further demonstrates the value of using marine reserves as a tool to protect both coral reef fishes and the habitats on which they depend.



Top right: Scientific divers on Riley's Hump, impanting an acoustic tag as part of a collaborative project with NPS. Photo credit: Colm O'Reilly. Bottom: Mutton snapper (*Lutjanus analis*) are a commercially and recreationally important reef species. Photo credit: Chris Parsons

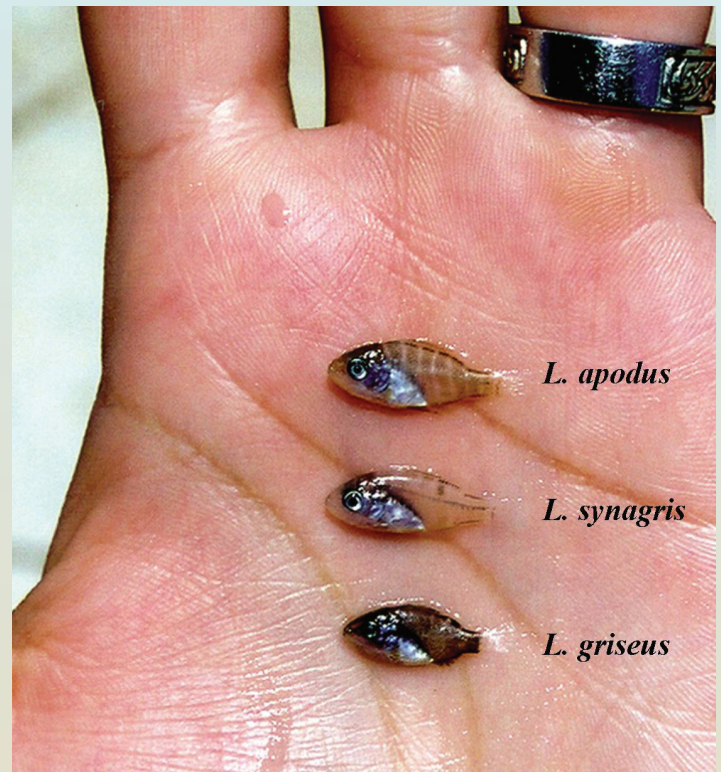


Early Life History of Coral Reef Fish

Coral reefs are not closed ecosystems, they are influenced by processes which extend well beyond the reef edge. Ecosystem-based management for coral reefs must take larval recruitment and connectivity into account. Larval fish can travel great distances, spending months in the plankton before they settle on coral reefs. They may also settle close to their birthplace, as is the case with the offspring of spawning mutton snapper at Riley's Hump in the Tortugas Ecological Reserve, stocking the Florida Reef Track with larvae. The Early Life History Unit at SEFSC is a multi-disciplinary team, led by **Dr. John Lamkin**, which is working to understand processes that govern connectivity of reef fish populations.

In collaboration with El Colegio de La Frontera Sur (ECOSUR) in Chetumal, Mexico, the Early Life History Unit is investigating connections between coral reef fish populations in Mesoamerica and the Florida Keys. The team conducted research cruises in the Mexican Caribbean to survey offshore larval populations using plankton tows in the context of their physical and chemical environment. Results indicate that these areas are connected by fast moving ocean currents, which can distribute larval fish along the mesoamerican reef, and perhaps all the way to the reefs of the Florida Keys and the Dry Tortugas. The large-scale patterns revealed by these studies are essential to the implementation of place-based management tools such as networks of Marine Protected Areas.

Among the species recovered in the tows were several reef species of economic importance, including snappers and groupers, indicating that robust spawning aggregations along the eastern coast of the Yucatan could supply reef fishes to reefs downstream. This highly collaborative project fosters international cooperation and the exchange of knowledge between international partners.



Top: Larval snapper. Photo credit: Early Life History Unit, SEFSC Miami, FL.
Bottom: Early Life History Unit Team on deck during a research cruise. Photo credit: Early Life History Team.



Selected larval fishes of the USVI. (Left to right, starting at the top): Squirrelfish, Blenny, Spaghetti Eel, Seahorse, Grouper, Large tooth flounder, Cardinalfish, Deepwater Cardinalfish, Snake Mackerel, Snapper, Codlet, Dolphinfish, Helmetfish, Surgeonfish, Filefish, Lanternfish, Grouper, Left Eye Flat fish. *Photo credit:* Early Life History Unit, SEFSC Miami, FL.

To further understand the ecology of larval reef fish in the Caribbean, SEFSC scientists focused on the role of multiple inshore and offshore habitats, including some known spawning sites in the USVI. Offshore plankton tows were coupled with inshore surveys to determine the location and relative importance of spawning sites specific to coral reef fish. The scientists released floating drifters, devices to study currents. Results showed drifters followed looping paths, indicating the possibility that many of the reef fish born in USVI waters will stay in the region. Closer to shore, juvenile fish and newly settled larvae were sampled with light traps and seine nets in collaboration with the Virgin Islands' Department of Planning and Natural Resources (DPNR) and the University of the Virgin Islands (UVI).

These fish collections included a diversity of fish larvae, including many economically important coral reef fish such as snappers, parrotfish and bonefish. The team conducts simultaneous biological and physical oceanography surveys which generated data to elucidate patterns in larval fish abundance, distribution and diversity along physical and chemical gradients. SEFSC scientists maintain a strong collaborative partnership with Atlantic Oceanographic and Meteorological Laboratory (AOML), working together to understand the connection between larval fish and their physical environment.

The Early Life History Unit and partners have provided managers with quantifiable and defensible information on sources and sinks of reef fish larvae that are needed to make sound management decisions. Knowledge of the early stages of key reef fish species helps researchers measure their spawning success and determine the health of larval populations, which in turn affects the overall health of coral reefs. Management of fisheries resources and marine reserves requires baseline data on recruitment and transport of key larval reef fishes. This research has contributed to the conversation on implementing a network of MPAs that support effective management.

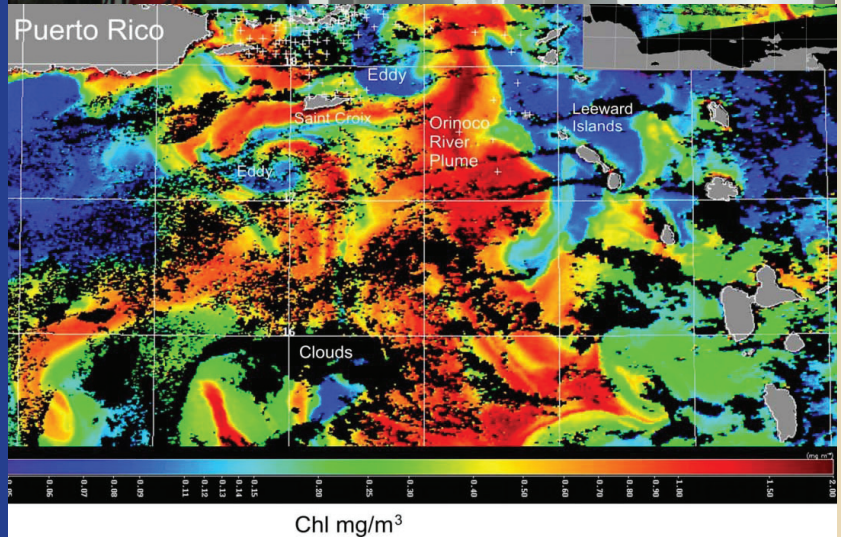


Science Spotlight

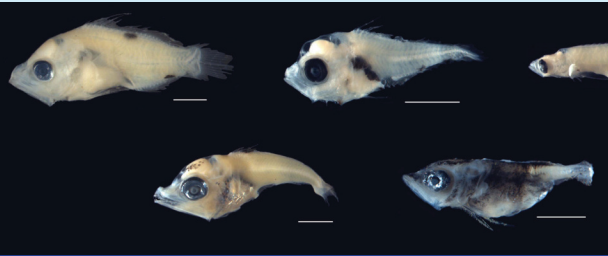
Larval Fish in Green Water: Understanding the Orinoco Plume

Cruising through the USVI, researchers from the Early Life History Unit floated over a peculiar plume of water. Flow-through physical and chemical data revealed areas of low surface salinity and very high chlorophyll. Confirmed by satellite ocean color imagery, this large area of “green water” could be traced back to its South American source: the Orinoco and Amazon rivers. Green water events have only been detected previously by remote sensing.

The cruise documented the first time the plume has extended as far to the northeast as the USVI, and the SEFSC team was the first ever to groundtruth it at sea. The Early Life History Unit made another exciting discovery: larval coral reef fish were less likely to be collected near the presence of green water. The transient, unusual event was captured by combining a full suite of physical oceanographic and biological sampling methods. Information gathered will aid in understanding the extent of “green water” events and their effect on reef fish populations in the region.



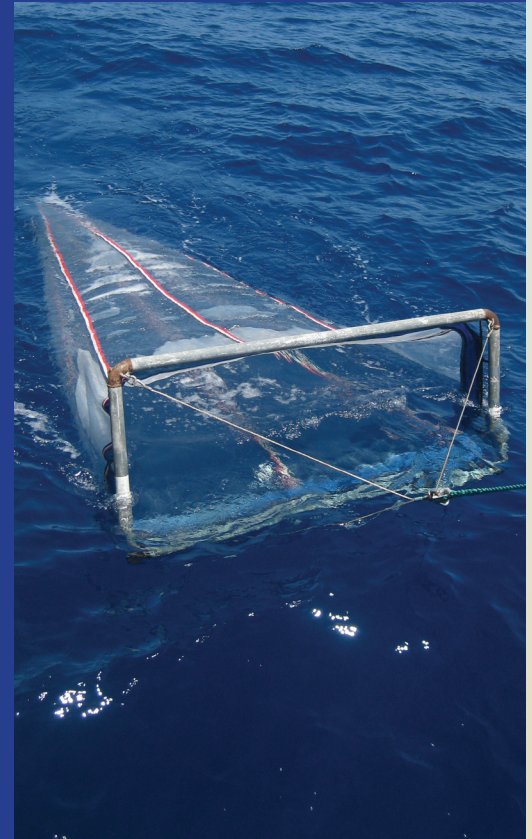
Top: CIMAS Scientist Estrella Malca deploys a MOCNESS tow from the NOAA Ship *Gordon Gunter*. Photo credit: SEFSC Miami, FL. Bottom: Map of chlorophyll concentration in the Caribbean during a green water event. Red coloration corresponds to highest chlorophyll concentration. Image credit: Early Life History Unit, SEFSC Miami, FL.



Science Spotlight

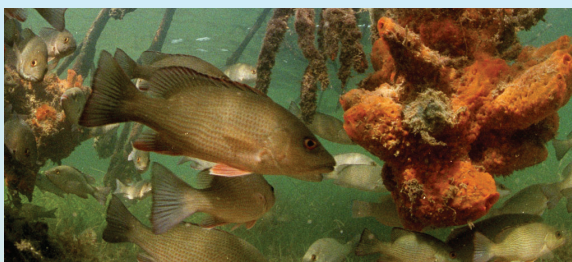
Connecting People to Connect Reef Systems

Many important connections were made at the MPA Capacity-Building and Mesoamerican Reef Connectivity Workshop in Chetumal, Mexico. Collaboratively organized by SEFSC and El Colegio de la Frontera Sur (ECOSUR), the workshop brought together coalitions of managers and scientists to enhance regional ability to study larval fish populations in the region. Scientists and managers from four neighboring countries attended. The workshop also contained a field component to assess larval fish in critical shallow coral reef habitats and nursery habitats in an MPA that is strategically located to take advantage of current systems for larval exchange. It was a successful workshop in both the field and in the conference. Attendees formed lasting partnerships to work toward the common goal of protecting fish at their earliest life stages for the benefit of reef fish populations across the region.



Top: Neuston net tows are used to collect larger, more developed pelagic larval fishes, such as billfishes and tuna. *Photo credit:* SEFSC Miami, FL.

Bottom: Participants of the MPA Capacity Building and Mesoamerican Reef Connectivity Workshop in Chetumal, Mexico. *Photo credit:* Early Life History Unit, SEFSC Miami, FL.

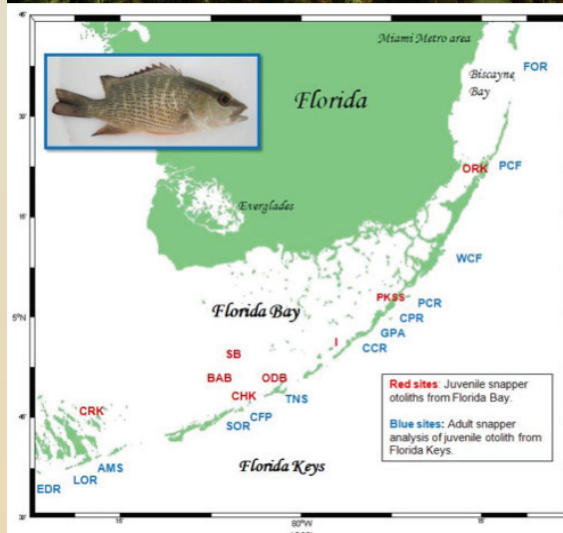


Coral Reef Connections: Linking Onshore & Offshore Habitats

Many of the fish that inhabit coral reefs as adults lived for part of their young lives in mangrove and seagrass habitats, key components of tropical and subtropical ecosystems. The submerged prop roots of mangroves provide protection from predators, and an abundance of food for vulnerable juvenile reef fish. In order to preserve healthy adult populations of reef fish, management plans must protect habitats used by fish at other life stages as well. Investigating the role that these critical nursery habitats play in the lives of reef fish and finding the similarities and differences in life-histories of the fish that migrate from them is essential for sound coastal zone management, especially in the face of coastal development.

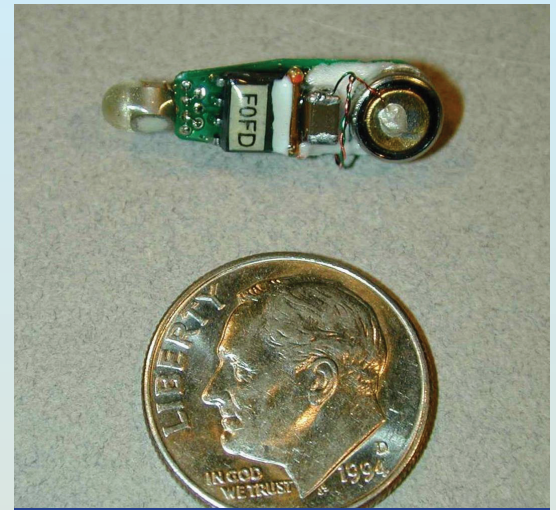
Picking up from 2006's Symposium on Mangroves as Fish Habitat, scientists at SEFSC have launched several new collaborations to link the science of both adult and juvenile phases of fish as they complete their journey from nursery habitats to the reef. To better understand the connectivity between these two habitats, scientists made use of extensive long-term fish visual census data sets, examined fish life history through analysis of chemical tracers in the fish themselves, and tracked fish in the field using acoustic tagging technology.

In the clear conditions of Biscayne Bay, SEFSC's **Dr. Joe Serafy** has been conducting visual surveys of the mangrove prop root fish communities for over ten years. Coral reef fish expert **Dr. Jim Bohnsack** has been concurrently conducting visual surveys of Florida Keys coral reefs (See "Making Every Dive Count on page 16). SEFSC scientists, **Dr. John Walter** and Dr. David Jones integrated these two long-term datasets to follow a cohort of reef fish from the mangrove to seagrass beds to the reef. The study provided further evidence of connectivity between these habitats. The SEFSC team identified several areas within the bay such as mangroves adjacent to coral reefs, which contribute more heavily to adult reef fish populations, facilitating targeted protection.



Top: Gray Snapper Photo credit: Jiangang Luo, RSMAS.
Bottom: Map depicting sampling sites for otolith study. Photo credit: Early Life History Unit, SEFSC Miami, FL.

Delving further into the processes which govern fish migrations to the reef, a groundbreaking project by Dr. **Trika Gerard**, Dr. **John Lamkin** and Dr. Monica Lara, traces the source of reef gray snapper back to their juvenile habitat through chemical signatures in the otoliths (ear bones) of the fish. Otoliths show growth like the rings on a tree, and they also give scientists information about the life history of the fish through chemical traces left behind by different environmental conditions. They serve as natural tags for tracking fish, allowing researchers to map which areas of juvenile habitat contribute the most to adult fish populations out on the coral reefs.



Acoustic tag. Photo credit: Early Life History Unit, SEFSC Miami, FL.

Where does a young reef fish living in the mangroves like to spend it's time? SEFSC scientists are tracking mangrove fish in real time using acoustic tag technology to find the answer. As part of the Florida Atlantic Coast Telemetry Project (FACT) SEFSC's Samantha Whitcraft and Dr. **John Lamkin** launched a collaborative effort with partners at Florida International University, the University of Miami, and Loxahatchee River District to track the usage of mangrove habitats in an urban estuary by sub-adult gray snapper and important reef species.

Another acoustic tagging project, this one conducted by Dr. **Joe Serafy** in partnership with Jiangang Luo of RSMAS, studied the daytime and nocturnal movements of juvenile gray snapper, as they made their way around the mangroves, seagrass beds and eventually the reefs. Fish were implanted with miniature acoustic tags, which transmitted to receivers placed strategically at transition zones between the habitats. Fish were also tracked in real time by researchers following the unique acoustic signals from each tag with another receiver handled by a researcher on a boat. The team set up a video-surveillance system on the edge of the mangroves to record daily movements of fish. Results of SEFSC research which used these innovative methods to follow fish provide direct support for the strategy of conserving both inshore seagrass and mangrove habitats as well as offshore coral reefs.

The ability to map the areas of juvenile fish habitat which make the greatest contributions to adjacent reef fish habitats, is a powerful tool for managers who can then prioritize those areas for protection. Providing for enough nursery habitat area in protection measures is critical to preventing decline of the reef species that depend on these habitats to complete their life cycles. Policy-makers use this information to support ecosystem-based management and assessment of fish stocks, which are required by regional fisheries management plans.

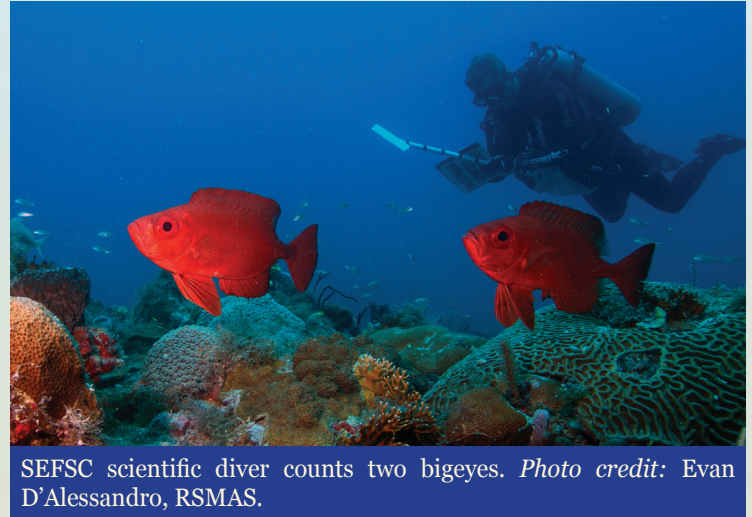


Gray Snapper swim among mangrove prop roots. Photo credit: Jiangang Luo, RSMAS



Making Every Dive Count: Visual Reef Census Supports MPA Management

“Go divers go!” That’s the call to action that SEFSC team members hear just before they plunge into the waters off the Florida Keys to begin their annual visual reef fish census. Why census coral reef fish visually instead of just tallying fisheries landings? The rigorous methodology developed by a team of scientists at SEFSC led by **Dr. Jim Bohnsack** and **Dr. Ben Ruttenberg**, allows researchers to count fish underwater and accurately determine coral reef fish population composition, abundance, size structure, habitat preferences and condition---metrics that are difficult or impossible to measure at the dock.



SEFSC scientific diver counts two bigeyes. *Photo credit:* Evan D’Alessandro, RSMAS.

With the increase in use of ecosystem based management practices such as area closures and marine protected areas, this protocol is the practical solution to allow for comparisons of fish populations before and after areas are closed to fishing and within and outside of the boundaries of marine reserves. Information obtained in these efforts provides the basis for better evaluation and management of coral reef ecosystems.

In collaboration with partners from four different agencies (see Towards a Multi-Agency Approach” on page 18), SEFSC’s Reef Visual Census (RVC) team have amassed one of the most extensive and useful datasets in coral reef research today, painting a picture of how reefs have changed over the last three decades. The goal of the fishery independent stock assessment research is to help improve sustainable use of reef fisheries resources. From 2007-2010, the RVC team spent 2,380 person-hours underwater (that’s over three months!) surveying the coral reefs of Southeast Florida, the Florida Keys and the Dry Tortugas.

Divers collect data on the abundance and sizes of different species of fish as well as benthic habitat characterization data to help determine habitat relationships to fishery productivity. The agencies use these data to quantitatively compare different habitats and protection measures and to track changes in the health of commercially important reef fish populations over time. RVC information has contributed to a Caribbean-wide study of the status of coral reef fish populations and also to studies of linkages between fished species and benthic communities.



Scientific Diver and RVC fish counter, **Jack Javech** of SEFSC Miami, FL enters the water. *Photo credit:* SEFSC Miami, FL

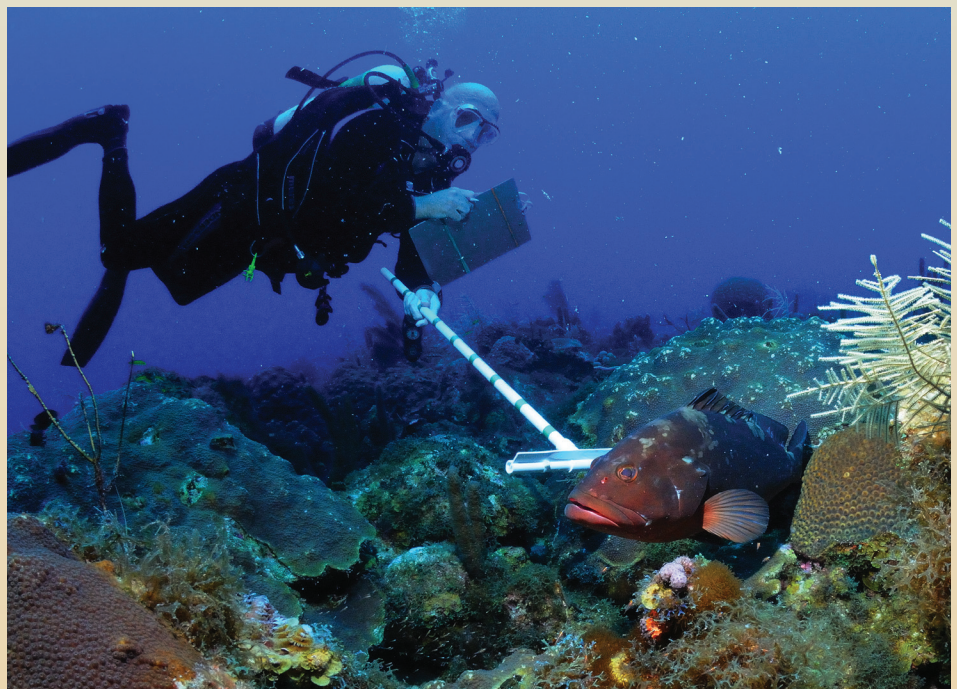
Recently, scientists at SEFSC have used the RVC dataset to tackle critical issues in the design and management of Marine Protected Areas (MPAs). Studies have evaluated the influence of reserve size and boundary length on the relative rate of fish density change in reserves versus fished reefs for exploitable fish species. This is a key piece to the puzzle in weighing tradeoffs between reserve size and number. Currently only 6% of the Florida Keys are designated marine reserves. RVC research has contributed to zoning plans for marine reserve management areas designed to reduce user conflicts. Plans to rezone some of these areas in the coming years will incorporate research by the RVC team.

In January 2007, the management plan for the network of no-take marine reserves in the Dry Tortugas National Park became effective, linking conservation efforts to a similar network in the Florida Keys National Marine Sanctuary established in 1997. The focus of recent research has been the continued evaluation of the Research Natural Area, a no-take marine reserve implemented in 2007 that encompasses 46 % of the waters of Dry Tortugas National Park.

Results are also used to improve understanding of ecosystem dynamics and guide ecosystem management. SEFSC scientists take advantage of the long term dataset to get a picture of changes in reef fish communities over time. Historical datasets are used to understand baseline conditions in these habitats and subsequently monitor the effectiveness of these no-take marine reserves by comparing trends in fish populations between areas closed and open to fishing or before and after closures. Reserve proponents hope that fish density increases within MPAs will spread to the surrounding habitats. This “spill-over effect” would benefit the entire reef, not just the closed area. Fishermen benefit too, as fish move out of closed areas and into fishable waters.

The team continues to track abundance of key ecological and economically important species such as black and goliath grouper. SEFSC scientists documented promising results: the majority of no-take marine reserves had measureable benefits to several exploited species and new results have provided evidence that MPAs benefit the surrounding fisheries as well.

The RVC team has a long and successful history of providing sound science which can be directly used by management. Data collected by the RVC team can serve many purposes: assessing fisheries management practices, monitoring protected species, intergration into fisheries stock assessments, measuring impact of invasive species such as lionfish, and providing baseline data for natural and human-made disasters such as gear impacts and oil spills. Overall, RVC research has provided a strong scientific foundation to help NOAA better manage coral reef fisheries.



Scientific diver, Dr. Jerry Ault of the University of Miami, one of SEFSC's partner organizations, sizes up a grouper. *Photo credit: Jiangang Luo, RSMAS*



Towards a Multi-Agency Approach to Reef Fish Monitoring

To monitor coral reef ecosystems along the 560 km long Florida Reef Tract, SEFSC scientists called on help from more than a few good research partners. The Reef Visual Census team launched a collaborative effort among government and university groups to consolidate the efforts of multiple agencies to monitor the status and trends of reef fish communities in the Florida Keys under a single unified protocol. The multi-agency protocol is the first of its type for marine monitoring efforts in the nation and builds on nearly 30 years of reef fish monitoring in the Florida Keys by several different agencies. The protocol provides a cost effective and efficient way for each agency to contribute to a single broad initiative. The Multi-Agency Protocol can also provide a model for future work in the region and beyond. In fact, the group has begun planning to expand monitoring efforts to include the remaining portion of the reef tract north of Miami. This method has also been adopted by coral reef fish monitoring programs in the US Pacific.

What really makes this program special is the unprecedented level of interagency coordination and collaboration. The groups joined together, working, training and diving side-by-side, to collect crucial data on coral reef fish populations. The framework for the project was the product of many years of communication between agencies to fine-tune a visual census methodology that could achieve the goals and objectives of each agency involved.

To create the protocol, SEFSC scientists and partners convened a series of meetings to ensure that the conservation efforts and management targets of each agency would be met. Representatives from each group were involved in the process of adjusting existing protocols, allowing the team to inform and critically evaluate every step, from diver training to data analysis. In the meetings, every detail of the protocol was discussed even down to the formatting of the data sheets.

Working together, the RVC team can survey a broader range of habitats in a more efficient manner. The agencies divide the workload from sampling design to data analysis and the science divers go on joint training missions prior to the research cruise to foster consistency in data collection as well as collaborative working relationships. The groups divide up the annual sampling load based on their available resources and geographic priorities. The data are entered into a common data platform and pass through a rigorous quality control process prior to being shared with the partners. But collaboration doesn't stop there, researchers from different agencies and university groups who worked together on the RVC missions have equal access to the data and have co-authored several publications.



Scientific diver tallying fish.
Photo credit: SEFSC Miami, FL.



Researchers at of the multi-agency team: *Photo credit: RVC Multi-Agency Team*

The collaborative effort involves state and federal partners, including SEFSC, the National Park Service, and the State of Florida Florida Fish and Wildlife Research Institute (FWRI), as well as academic partners at the University of Miami's Rosenstiel School of Marine and Atmospheric Science. As the project expands to the northern portion of the Florida Reef Tract, additional partners from other state agencies and other academic institutions will be added. From 2007-2010 the team spent 2,380 person hours underwater and many more above conducting research to improve management of South Florida's coral reef fisheries resources.

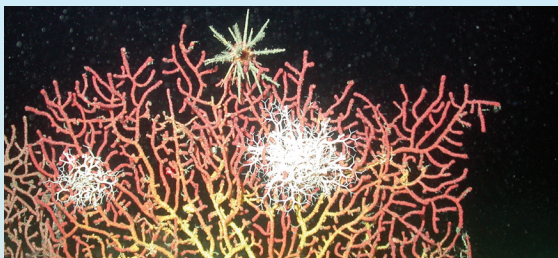
Science Spotlight: RVC Team Featured on "Changing Seas"

The RVC program's monitoring effort in Dry Tortugas National Park was featured on an episode of WPBT's award-winning series "Changing Seas". The episode, entitled "No Fish Left Uncounted" followed scientists beneath the waves as they counted fish. This nationally televised program highlighted the multi-agency effort to better understand how fishing pressures and environmental changes affect populations of marine resources within the Dry Tortugas National Park. The program featured interviews with several SEFSC scientists and partners. "No Fish Left Uncounted" provides a fish-eye view into the hard work of the RVC team and their mission to sustain Florida's reef fisheries for future generations. You can watch the video at:

<http://www.changingseas.tv/episode201.html>



Dr. Jerry Ault of RSMAS being interviewed.
Photo credit: Alexa Elliot, WPBT2



Monitoring and Protecting Reef Fish Habitat

Marine protected areas (MPAs) are tools that can be implemented to accomplish a wide variety of spatial conservation goals. Closing areas to fishing not only protects fish, but also the habitat on which they depend. Many coral reef fishes, especially those in the snapper-grouper complex are either overfished or are facing serious declines.

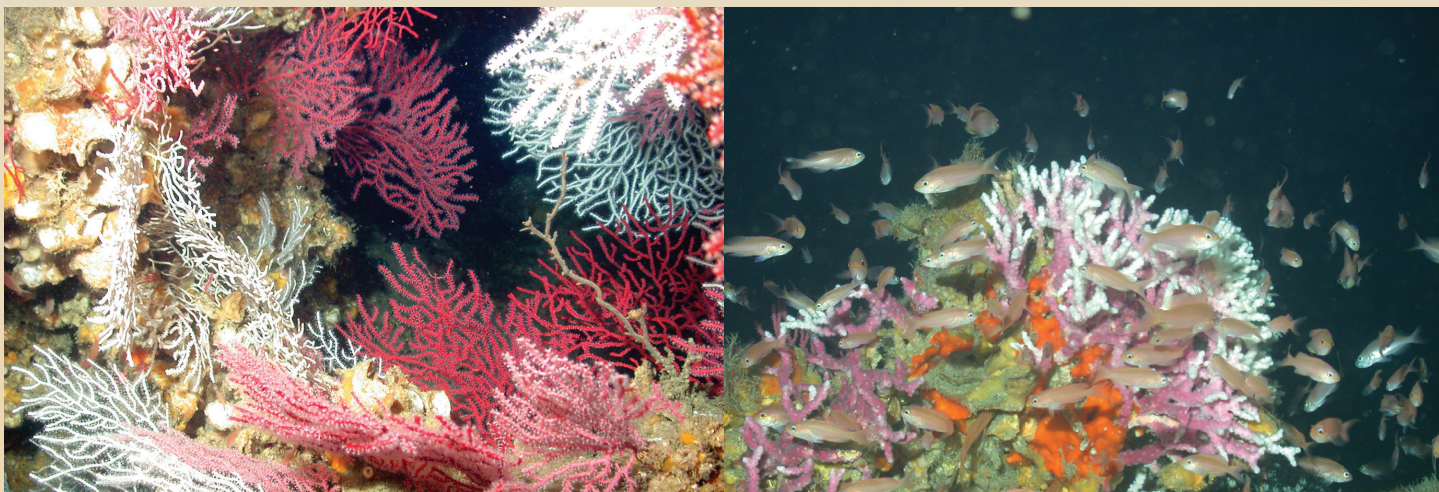
To facilitate the recovery of these economically and ecologically important reef fish, SEFSC conducts research on the efficacy of MPAs as a protective measure. Through the use of carefully designed monitoring strategies, researchers explore the linkages between reef fish populations and habitat.



Photo credit: UNCW and SEFSC Panama City, FL.

SEFSC researchers are working to describe the location and quality of reef fish habitats in deep water beyond the reach of traditional visual survey techniques including SCUBA. Building on their multi-beam mapping projects from previous years, the team uses remotely operated vehicles (ROV's), stationary camera arrays, and acoustic techniques to assess fish stocks and habitat conditions in these remote areas.

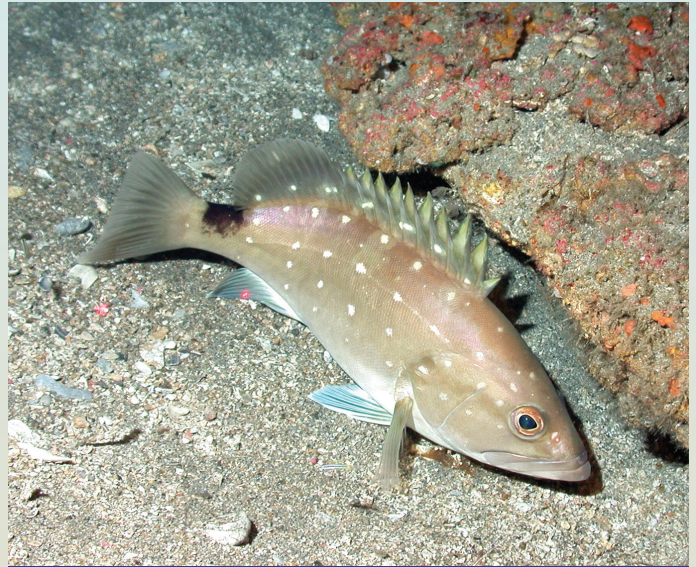
SEFSC scientists have provided scientific support for MPA designation and evaluation in several areas: the northeastern Gulf of Mexico along the west Florida Shelf, the South Atlantic Bight between southern North Carolina and northern Florida, the Oculina Banks off of Florida's central Atlantic coast, Pulley Ridge northwest of the Dry Tortugas in the eastern Gulf of Mexico and the deep-coral habitats between North Carolina and southern Florida. This work supports fisheries management by monitoring the efficacy of protective measures before and after they are implemented.



Benthic life on Madison-Swanson. *Photo credits: UNCW and SEFSC Panama City, FL.*

Work by SEFSC scientists in many cases has led to direct management action. One impact to deep coral and relatively shallower habitats along the continental shelf, is interaction with bottom-tending fishing gear. Based on science provided by the SEFSC team and with input and collaboration from fishers, the SAFMC established several allowable fishing corridors within South Atlantic continental shelf Habitat Areas of Particular Concern (HAPC) for golden crab and royal red shrimp, which constitute the primary fisheries in this area. SEFSC scientists worked with fishers to evaluate the borders of the HAPCs and strive for a solution that accommodates fishers, while still achieving conservation goals.

The Madison-Swanson and Steamboat Lumps MPAs were implemented by the Gulf of Mexico Fisheries Management Council (GMFMC) in June 2000 as a management alternative to ameliorate highly skewed sex ratios and decreased population levels in gag (*Myceteroperca microlepis*) due to overfishing. SEFSC scientists led by **Dr. Christopher Gledhill** from the Pascagoula laboratory and **Andrew David** from the Panama City laboratory were tasked with evaluating these northern Gulf of Mexico MPAs as a tool for correcting demographic concerns about gag. Gag, and many other similar grouper species are particularly vulnerable to fishing because they are slow growing, long-lived, aggregate to spawn, and have complex life histories—most changing from female to male as they grow. As a result of efforts by SEFSC scientists, the GMFMC extended the duration of MPA closures to protect targeted species in this at-risk area.



A juvenile snowy grouper. Photo credit: SEFSC.

In February 2009, the South Atlantic Fishery Management Council (SAFMC) designated eight MPAs between Cape Hatteras, NC, and the Florida Keys to protect seven species of the deepwater snapper-grouper complex considered to be overfished. The SEFSC research team had been monitoring the area for several years prior to the creation of the MPA, providing an excellent opportunity to make comparisons of areas within and outside the reserves, before and after the closure. The closed areas contain habitat which supports populations of economically valuable reef fish including groupers, snappers and tilefish. The *Phantom S2* ROV from the University of North Carolina at Wilmington (UNCW), the *Hela* ROV from the University of Connecticut, and a stationary camera array were used to survey the five northernmost, natural-bottom MPAs, providing maps, imagery and data to the SAFMC for use in evaluation of the MPAs.

Moving forward, the team will continue to monitor MPAs in the South Atlantic and other areas in an effort to continually improve understanding and protection of reef fish and their associated habitats. SEFSC and partners are collaborating with research groups from around the country to apply these techniques and technologies to other regions.



Exploring Deep-Sea Coral Ecosystems

Deep-sea coral ecosystems are extremely productive areas, acting as hotspots for biodiversity and providing habitat for various commercially important fish and invertebrate species. These fragile and slow-growing corals live along continental shelves, slopes, canyons, ocean ridges and seamounts, generally in waters ranging from 50 m to over 2,000 m (160 ft- 6,500 ft) in depth. Although they are often subject to fishing pressure, many of these highly productive areas have yet to be mapped or explored due to their depth and remoteness. Deep coral habitats are on the frontier of coral reef research. Only recently have advancements in multibeam mapping, remotely operated vehicles (ROV) and autonomous underwater vehicle (AUV) technology made studying the deepest growing corals logistically feasible. SEFSC scientists including **Andy David**, and partners are pioneering new projects to monitor and protect deepwater coral habitats.

NOAA's Deep Coral Program was initiated in 2009, mandated under the new Magnuson-Stevens Fishery Conservation and Management Act requirements. The Deep Sea Coral Research and Technology Program is being implemented through a regional strategy, starting in the southeast region and adding projects on a rolling basis. SEFSC scientists, among the first to explore these habitats off the Atlantic coast of Florida, are now lending their expertise to characterize deep coral habitat in other areas.

In collaboration with researchers from a number of universities, SEFSC scientists employed internationally known ROV's and submersibles to capture video footage from the deepest coral habitats in the region. The list of famous ROVs and submersibles used in this research includes the *Jason II* from Woods Hole Oceanographic Institute, the *Kraken 2*, an ROV from University of Connecticut, two ROV's from SWFSC in La Jolla, California, and the *Johnson SeaLink*, a manned submersible from Harbor Branch Oceanographic Institute. Navigating the depths, the team advanced scientific understanding of the range and distribution of key deep water coral species along with other objectives. For example, the team found the deep water coral *Lophelia pertusa* off of Jacksonville, FL in 200m depth, cutting in half the previous shallowest depth recorded for this species in US waters.



Harbor Branch Oceanographic Institute submersible *Johnson SeaLink* about to be deployed from the *RV Seward Johnson*. Photo credit: SEFSC Miami, FL. Opposite top: *Lophelia pertusa*. Photo credit: SEFSC



Exploring deep coral habitat provides the scientific basis for improved management of these little-understood but extremely important ecosystems. In 2010 the South Atlantic Fisheries Management Council (SAFMC) designated five areas as deep coral HAPC covering roughly 60,000 km² between North Carolina and the Florida Keys. This HAPC is currently the largest on the east coast. Data from this project will also be contributed to international efforts such as the Trans-Atlantic Coral Ecosystem Study (TRACES).

Science Spotlight: *Twilight Reefs of Pulley Ridge*

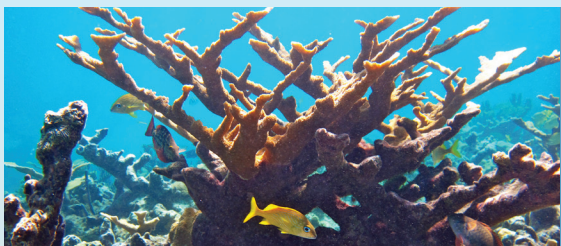
Mesophotic coral ecosystems are light-dependent coral communities and their associated communities of algal, sponge and fish species occur in the deepest half of the photic zone starting at 30-40m and extending to over 150m in tropical and subtropical regions. Mesophotic coral ecosystems have received relatively little attention compared to their shallower counterparts due to their reduced accessibility.

The deepest hermatypic coral reef in the continental US is located on Pulley Ridge off the southwest coast of Florida. SEFSC scientists mapped the area using multibeam sonar to help design a systematic survey to quantify abundance and distribution of corals, other invertebrates and targeted reef fish species. Since the designation of Pulley Ridge as a Habitat Area of Particular Concern (HAPC) by the Gulf of Mexico Fisheries Management Council, work by SEFSC scientists has provided evidence that protected area boundaries included all coral habitat and seem to be sufficient to boost coral and fish populations.

Research here provides opportunities to discover why and how these corals are more resilient than their shallower counterparts. Although these ecosystems harbor many of the same species found in shallow waters, they are also colonized by a number of species only found at depth. These areas may also serve as refugia for shallow and mid-depth species and thus warrant special protection to maintain local and regional biodiversity.



Marine life of Pulley Ridge. Photo credits: UNCW and SEFSC Panama City, FL



Monitoring Threatened Corals

Since the listing of two coral species, elkhorn (*Acropora palmata*) and staghorn (*A. cervicornis*), as Threatened under the Endangered Species Act in 2006, SEFSC researchers have been leading the way in research and monitoring to support recovery planning for these imperiled reef-building corals. Long-term monitoring efforts and population assessments have determined that these corals are in serious trouble. But what is really responsible for their decline? And what can be done to promote their recovery? Scientists with SEFSC's Benthic Ecology Unit, under the leadership of **Dr. Margaret Miller** and **Dr. Dana Williams**, are hard at work answering these critical conservation questions.



Top: *Acropora palmata*. Photo credit: Dana Williams, CI-MAS

Bottom: *Acropora cervicornis*, Mona Island, Puerto Rico. Photo credit: Andy Bruckner

The Benthic Ecology Unit is surveying *Acropora* abundance and condition and is monitoring trends in these parameters over time. Researchers are working to understand what conditions may have caused the precipitous decline of these Atlantic basin corals, what factors currently impede recovery, what actions may be taken to promote their natural recovery, and what proactive assistance may be appropriate and effective. The ongoing development of a recovery plan for threatened *Acropora* species will form the basis for a coordinated effort to save these key species from the brink.

Critical issues being addressed by the Benthic Ecology Team include understanding the genetic basis for colonies or stands that might display resilience to climate change and/or disease, improving restoration (see "Restoring Reefs" page 26) and monitoring of the remaining *Acropora* stands, both in the US and the eastern Caribbean. SEFSC scientists monitoring extant stands of *Acropora palmata* in the Florida Keys have documented these species' reduced ability to recover from storm damage and disease: not enough broken fragments reattached to the substrate to form successful new colonies.

ESA listed species require status reviews every five years and population status must be evaluated across the entire species range for invertebrates. SEFSC scientists are working to build partnerships with other organizations to expand monitoring



SEFSC scientific divers measuring *Acropora palmata*, Photo credit: Dana Williams, CIMAS

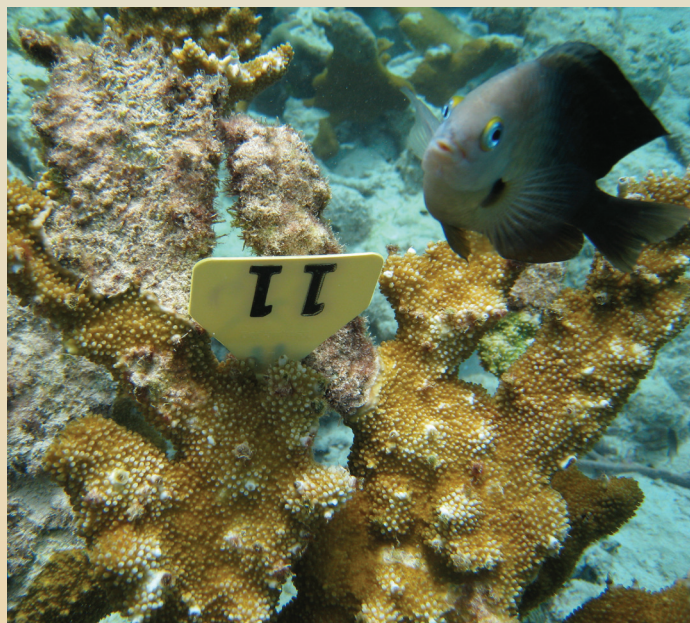
efforts to cover a larger portion of the species' range. Monitoring efforts detailed in SEFSC's 2006 "Demographic monitoring protocols for threatened Caribbean *Acropora* spp. Corals", have been adopted both locally and by other agencies and researchers throughout the region.

Recently, efforts have been expanded to Curaçao, Puerto Rico, Jamaica and Navassa Island (See "Navassa Island: A Caribbean Case Study" on page 30) and throughout the South Florida region. SEFSC has collaborated in

several successful monitoring partnerships with University of Puerto Rico-Mayaguez, University of the Virgin Islands, SeaMester, University of Miami, Scripps Institute of Oceanography and Florida Fish and Wildlife Conservation Commission to study *Acropora* species over time and at multiple scales, from regional populations down to the individual colony.

These monitored populations are tracked to identify new recruits as well as document losses from multiple conditions such as disease, physical damage and predation. A publication resulting from this project quantifies the current proportion of *A. palmata* loss in the Florida Keys attributable to specific conditions. While disease impacts, at the current state of knowledge, are not something managers can control, predator removal and/or rescue of hurricane damaged fragments are potential local management actions that could directly address the most important sources of mortality in this population.

By conducting a network of collaborative monitoring efforts across the region, including Puerto Rico, the USVI and the eastern Caribbean, scientists are filling geographic gaps in knowledge and allowing for better, range-wide understanding of critical metrics of species status. Ongoing characterization of *A. palmata* colonies in Puerto Rico and the USVI has alerted scientists to several patterns of threats and impacts. Broad, collaborative monitoring initiatives are leading to prioritized Caribbean-wide management, based on scientifically-validated best practices and observed population condition and resilience in order to recover these threatened corals.



Acropora palmata tagged by researchers for identification and monitoring. Photo credit: Benthic Ecology Unit, SEFSC Miami, FL



Restoring Reefs

Dense stands or “thickets” of elkhorn coral (*Acropora palmata*) and staghorn coral (*A. cervicornis*) used to be hallmarks of Caribbean coral reefs. Today, few can recall what that seascape looked like. With increasing man-made and natural stressors threatening the health of Caribbean reefs, human assistance in the form of coral restoration is becoming an ever more practical tool to help hasten the recovery of fragile coral reefs and the ecosystems they support.

The *Acropora* species have been referred to as “ecosystem engineers” or key reef builders, which create habitat structure for numerous species, from charismatic reef fish to cryptic invertebrates. The viability of these corals is essentially linked to the viability of species that depend on them and Caribbean reefs as a whole—the reason why they are a focus of scientists’ and managers’ efforts to develop and evaluate diverse restoration approaches.

“We are really seeing a paradigm shift in the role of coral restoration as a conservation measure,” says SEFSC scientist **Dr. Margaret Miller**. Restoration capacity has increased immensely in the past few years: larger scale restoration projects are now feasible. Localized projects such as SEFSC scientist **Dr. Ron Hill** and Dr. Andy Bruckner’s effort to restore a coral reef damaged by the 1997 grounding of the M/V Fortuna Reefer in Puerto Rico, were excellent test cases for the potential of restoration as a tool.

SEFSC’s restoration efforts led by Dr. Miller’s team have expanded into a multi-organizational initiative to mobilize state-of-the-art “coral-gardening” approaches and new tools that incorporate coral genetic diversity into an effective region-wide conservation effort with numerous restoration sites throughout the Caribbean. SEFSC has taken a much more active approach to restoration, partnering with coral field-nurseries as underwater research and development laboratories where new techniques are constantly being explored and applied. As Dr. Miller says, “Our goal with these nurseries is to take advantage of the scientific opportunities they provide, and build a strong scientific basis for moving forward with reef-scale coral restocking.”



Tending to *A. cervicornis* outplants. Photo credit: Benthic Ecology Unit, SEFSC Miami, FL



Collecting *A. palmata* larvae from parent colonies. Photo credit: Benthic Ecology Unit, SEFSC Miami, FL

Acropora are remarkable coral species in that they can reproduce both sexually and asexually. *Acropora* reproduce sexually by releasing their gametes into the water column in carefully timed spawning events. Asexual reproduction occurs when fragments broken from adult colonies grow into clones of their parents, provided they properly attach to the right substrate. The scientists of SEFSC's Benthic Ecology Unit take advantage of this by using a dual approach to coral restoration: growing corals from collected gametes, and also working to support coral restocking by attaching fragments to the reef, either broken fragments from wild colonies or cultured fragments from the nursery. Researchers collect coral gametes during spawning events to enhance fertilization and settlement success by caring for larvae in a laboratory setting.

In partnership with RSMAS, the Benthic Ecology Unit uses these laboratory raised corals, coupled with field experiments, to learn which physical and chemical conditions promote or reduce the ability of larvae to settle and attach to suitable substrate, survive and grow. Dr. Miller and her team are exploring many variables that might influence the ability of new corals to thrive, including: temperature, pH, substrate composition, and genetic makeup of the corals themselves. Once the colonies are grown, they can be transplanted to nurseries, and eventually, the reef.

Science Spotlight:

SEFSC's *Acropora* Recovery Team Featured in the *Endangered Species Bulletin*

SEFSC's *Acropora* Recovery Team was featured in the Summer 2009 issue of the US Fish and Wildlife Service publication *Endangered Species Bulletin*. The article highlighted the work of SEFSC scientists **Dr. Margaret Miller**, **Dr. Dana Williams** and partners on filling the knowledge gaps and providing best available science for evaluating status of these species, resulting in ESA listing. *Acropora* species were once common features of Caribbean reefs. Now it's estimated that less than 3% of their original populations remain. The article underscored the hard work of SEFSC scientists to document and understand coral decline and develop successful techniques for restoration and recovery.



Summer 2009 issue of the US Fish and Wildlife Service publication *Endangered Species Bulletin*



Science Spotlight

Reef Restoration in the Age of the Aquarius

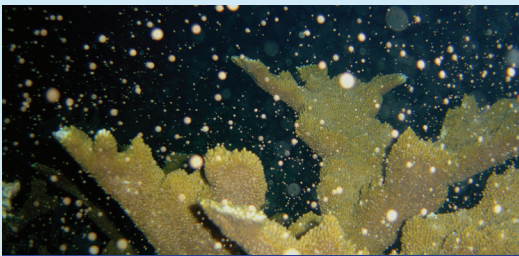
The Benthic Ecology Unit and partners have recently undertaken a large-scale coral transplantation experiment in the Florida Keys at the Aquarius, a unique underwater research station for saturation diving missions. Set at 60 ft below the waves, researchers live in the Aquarius for up to a week allowing them to conduct the repetitive dives without having to surface, allowing the team to conduct intensive nursery operations.

In collaboration with The Coral Restoration Foundation and academic partners, SEFSC scientists are conducting large coral transplant experiments designed to compare the performance of corals from different sources. Additional experiments have focused on the ability of different transplant arrangements to minimize threat from predators and comparing disease dynamics between wild vs. transplanted corals.



Dr. Lubchenco visits *A. palmata* transplant.
Photo credit: Frazier Nivens

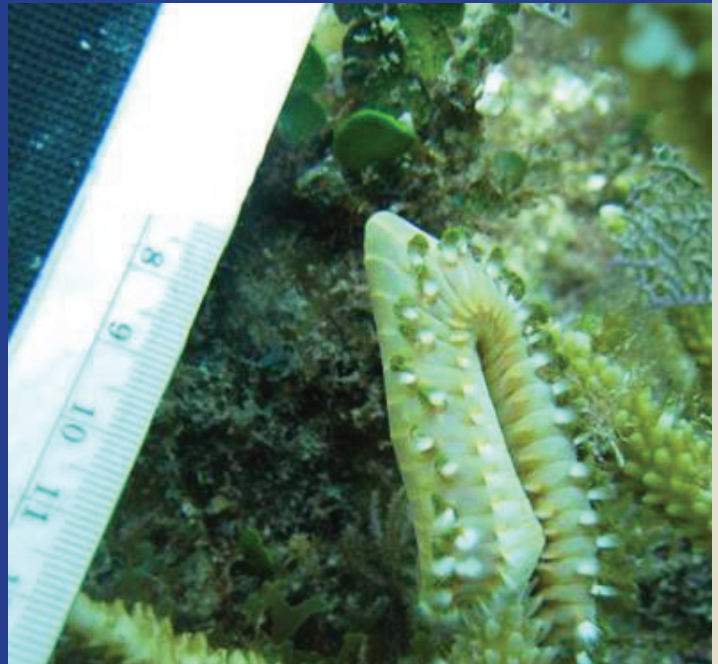
The Aquarius project is providing scientific support for a large scale coral nursery project funded under the American Recovery and Reinvestment Act. Re-stocked *Acropora* corals have highly variable survivorship at different sites, but have enjoyed media attention and even a personal visit from Dr. Jane Lubchenco, the Administrator of NOAA.



Science Spotlight

Keeping Up with Coral Predators

The decline of *Acropora* corals has changed many coral reefs from spectacular three-dimensional living structures to flat stretches of pavement with reduced ecosystem function. SEFSC's Benthic Ecology Unit is working to understand the causes of decline of endangered *Acropora* corals. For *Acropora*, it is death by a thousand cuts, with impacts from disease, predation, temperature-induced bleaching and physical damage from tropical storms. While coral predators have always been around, their impact is compounded now because they are becoming more concentrated on what is remaining of their favorite food - and having a larger impact than ever before. The Benthic Ecology Unit is investigating the impact of these predators (including snails and fireworms), their ability to transmit disease, and the appropriateness of predator removal as a recovery strategy. Scientists and managers have long been aware of many factors that can kill *Acropora*, however, recent work by the Benthic Ecology Unit (Williams & Miller, *in press*) actually quantifies tissue loss due to each stressor, including predation by snails.



A fireworm preys on *A. cervicornis*.
Photo credit: Benthic Ecology Unit, SEFSC Miami, FL

This groundbreaking study goes beyond just reporting the prevalence of each stressor in a given population, it sheds new light on the relative impact of each. For example: although corallivorous snails are the most prevalent condition, their impact ranks third behind disease and physical damage to *Acropora palmata* in the Florida Keys. At the current state of knowledge, disease impacts are beyond managers' direct control, but local interventions can include removal of predators and rescue of hurricane damaged fragments. SEFSC researchers are investigating if these tractable local management actions can have a measurable impact on coral recovery. By working to understand what people can do to help restore these valuable corals, SEFSC researcher are hoping to reverse decades of decline.



Navassa Island: A Caribbean Case Study

Thirty five nautical miles off the coast of Haiti lies the little known island of Navassa, a designated US National Wildlife Refuge and an excellent case study in ecosystem science. SEFSC scientists first visited Navassa Island in 2002 to characterize coral habitat in a relatively pristine, remote US location. The project has evolved into a multi-agency holistic ecosystem assessment, incorporating benthic ecology, habitat mapping, reef fish assessments, and human dimensions. The uninhabited island provides researchers with an opportunity to study these components of reef health, free from the influence of local land-based pollution.

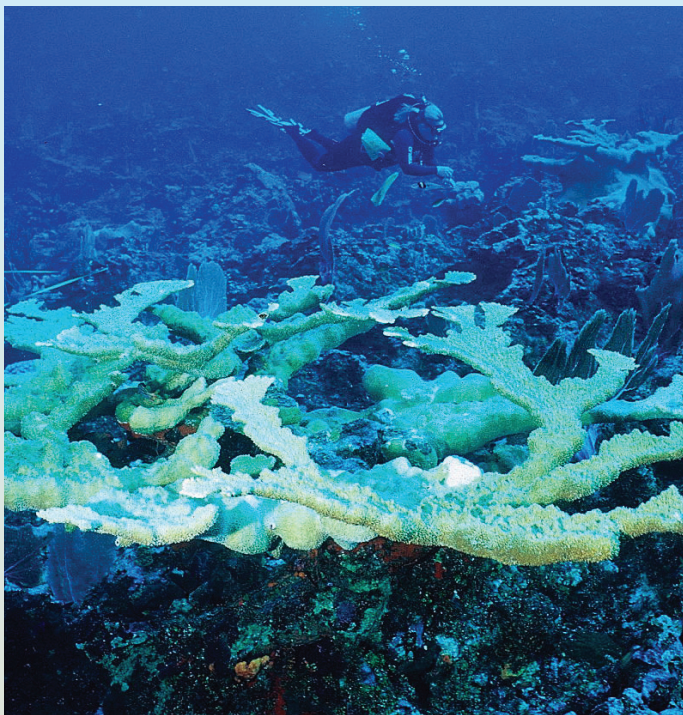
Navassa may be devoid of land-based impacts, but it is still subject to fishing pressure from a small fleet of Haitian boats. Despite these unique circumstances, research at Navassa provides insight into long-term trends in the region. “Navassa is a microcosm of the Caribbean” says SEFSC scientist **Dr. Margaret Miller**. Trends on Navassa in benthic community structure, declines in fish size and abundance, and fisheries escalation, are generally representative of trends in the greater Caribbean region.

Researchers from SEFSC joined forces with the United States Fish and Wildlife Service (USFWS), the University of Miami and the Haitian NGO: Fondation pour la Protection de la Biodiversité Marine (FoProBiM), to characterize ecosystems and fishing activities in the waters of Navassa. The multi-agency interdisciplinary team sent to document trends on Navassa’s reefs returned with surprising results. During a routine reef assessment mission to characterize coral habitat on Navassa in 2006, the Benthic Ecology Unit documented an unexpected mass bleaching event. “Sometimes you happen on a dramatic event like this...we had no anticipation of finding bleached coral, since elsewhere in the Caribbean the most severe bleaching events took place the year before”, says Miller. Unexpectedly, the endangered *Acropora palmata* corals (see “Monitoring Threatened Corals” on page 24) were spared the bleaching experienced by several other species.

Mirroring trends in the wider Caribbean, fishing effort on Navassa has escalated rapidly in the past few years. As an increasing number of Haitian fishers target Navassa’s reef fish, a multi-disciplinary effort was launched to document the social and ecological implications. SEFSC, with help from FoProBim’s socioeconomic experts, explored the social context of fishing impacts on Navassa reefs through direct observation and ethnographic documentation.



Researchers record and measure a fisherman’s catch.
Photo credit: SEFSC Miami, FL



The team reported a shift in gear use from traditional methods such as traps and hook and line gear to more destructive net gears as the effectiveness of traditional methods declined due to overfishing. To monitor the rapid escalation in fishing pressure from a fish eye-view, SEFSC enlisted the help of its RVC fish counters (see “Making Every Dive Count” on page 16) to conduct underwater visual assessments of reef fish communities, to intergrate both with the benthic ecology and the socioeconomic impacts. Both groups documented declines in the average size and abundance of fish on Navassa’s reefs, while the number of fishers targeting the reef steadily increased. Since 2006 though, there appears a relaxation in the intensity of trap fishing and cessation of net fishing and an apparent increase in the size of fish species targeted by traps.

The Reef and Fisheries Assessment of Navassa Island National Wildlife Refuge represents the only source of ongoing information on marine resources and reef fisheries at Navassa Island. In the six years since the study began, reefs in Navassa, despite relief from land-based pollution, have manifested the same problems as elsewhere in the Caribbean such as declines in coral cover, and reef fish size and abundance. Despite the significant challenges facing Navassa’s reefs, the project has served to broaden our understanding of Caribbean reef ecosystems. The strong partnerships forged between federal researchers and local non-governmental organizations are essential to facilitate future conservation initiatives in the region, especially considering ongoing challenges in neighboring Haiti.



Top: CIMAS scientist Dana Williams among the *Acropora palmata* stands. Photo credit: SEFSC Miami, FL

Left: Haitian artisanal fishers traditionally fish the waters off of Navassa Island. Haiti is 35 nm from Navassa. Photo credit: SEFSC Miami, FL.



Tracking Caribbean Queen Conch

The queen conch, *Strombus gigas*, a large marine gastropod, is an economically valuable, culturally iconic species and an important component of Caribbean ecosystems and reef fisheries. Despite basin-wide management efforts by local and federal agencies and international agreements, such as the species' listing under Appendix II of the Convention on International Trade in Endangered Species (CITES), conch populations throughout the western Atlantic have continued to decline. Although fishing is the most widely known, and managed, activity attributing to the declines, other causes such as environmental change may also be contributing factors.

Despite the queen conch's value as a coral reef fishery resource, little is known about how these once-abundant grazers interact with their environment. SEFSC scientists are applying innovative approaches to understand habitat needs, movement rates, migration corridors, and population trends. Researchers have applied a multi-strategy approach of traditional mark-and-recapture techniques combined with novel sonic tracking technologies and habitat assessments in bays around St. John, USVI that are subject to different levels of fishery regulation. Results from this project contributed to regional stock assessments for the US Caribbean conch fishery by Southeast Data Assessment and Review (SEDAR).



Queen conch, (*Strombus gigas*) St. John, USVI. Photo credit: Jennifer Doerr, SEFSC Galveston, TX.

Researchers have learned some surprising things about conch habits from this study. Mature conch utilize a variety of different habitats, and their migrations correlate with a suite of environmental cues. Over 5,266 conch were tagged between 2005-2010 for the mark-and-recapture study. During the same time period, 155 conch were fitted with acoustic tags, each with a unique frequency. An array of hydrophones strategically positioned throughout several bays in St. John, recorded signals from passing tagged conch.

NOAA researchers led by **Dr. Ron Hill** and **Jennifer Doerr** collaborated with the NOAA/NMFS Apex Predator Program, Narragansett Laboratory, who were monitoring habitat use by 5 species of neonate sharks, to share an array of acoustic receivers and exchange tag detection data. The partnership allowed researchers to increase the number of receivers for both studies and expand their efforts into a broader range of sites. NCCOS's Biogeography team added hydrophones for mid-shelf and nearshore fish tracking that further expanded spatial coverage for tracking conch populations.

Acoustic tracking during extended times between field expeditions provided vital information on site fidelity of various size and age classes of queen conch, their daily movement patterns, timing and distance of migration patterns, and general habitat use. Results of this research project further emphasize that conch

require a variety of inshore habitats for population success. Adult conch are known to move progressively deeper as they mature, but through this study resource managers can understand which particular habitat types they use most.

The project, with partners at NPS, allows direct comparisons of conch densities, recapture rates, growth, migration, movement, and survival between fished and non-fished/no-take areas as well as an MPA regulated for limited, non-commercial fishing. Recapture rates detected in this study within the no-take areas suggest fairly high levels of retention and compliance with fishing restrictions. Overall, research by the SEFSC team demonstrated that densities of conch in the USVI are low but showing signs of improvement as exhibited by at least two years of strong recruitment in some locations.

Although CRCP funding for conch research ended in 2010, data collection will continue thanks to established partnerships with the University of the Virgin Islands and the NMFS Narragansett Lab. As additional analyses are completed, the project will continue to provide local, regional, and federal coral reef managers with information they need to evaluate conch stocks and improve the outlook for this economically valuable and culturally significant species.

Science Spotlight: *Students Say: “Stop Killing Baby Conch!”*

Students at the Giffit Hill School on St. John, USVI have a strong message for poachers of undersized conch. The campaign began in part as a reaction to piles of discarded undersized queen conch shells turning up on the shores of local bays. SEFSC researchers, **Jennifer Doerr** and **Dr. Ron Hill**, working under a NMFS Educational Grant, visited classrooms to present information on queen conch biology, ecology, fisheries management, and other coral reef-related issues to elementary students. The lesson plans were based on their CRCP-funded conch research and the teacher arranged a field trip to the study site in Fish Bay.



Jennifer Doerr of SEFSC gives a demonstration to students. *Photo credit: Jennifer Doerr, SEFSC Galveston, TX.*

In the field, the high school class learned about habitat types, field survey methods, environmental data collection, and even got to locate, measure, and tag conch with the SEFSC researchers. The students participated in ongoing shoreline surveys of fished conch where they were outraged to discover scores of undersized shells. They developed the Stop Killing Baby Conch campaign to get their message out. An article chronicling the student's activities and SEFSC involvement was published in a local newspaper. One of the most important outcomes of this project would be a cultural shift in how the community thinks about conch, starting with the youngest residents of the Virgin Islands. This NMFS educational project is an excellent example of SEFSC outreach and education programs, based on sound research, empowering local youth to become involved in conservation efforts in their communities.



Fishery-Independent Trap Study of St. Croix, U.S.VI

The US Caribbean is a multifaceted, vibrant ecologically and culturally diverse region where fishing traditions dating back several hundreds of years are used alongside modern methods. However, there is much we have yet to learn about these islands and their unique coral reef resources. New management requirements under the re-authorized Magnuson-Stevens Fisheries Conservation and Management Act, necessitate improved data collection to provide scientific basis for annual catch limits.

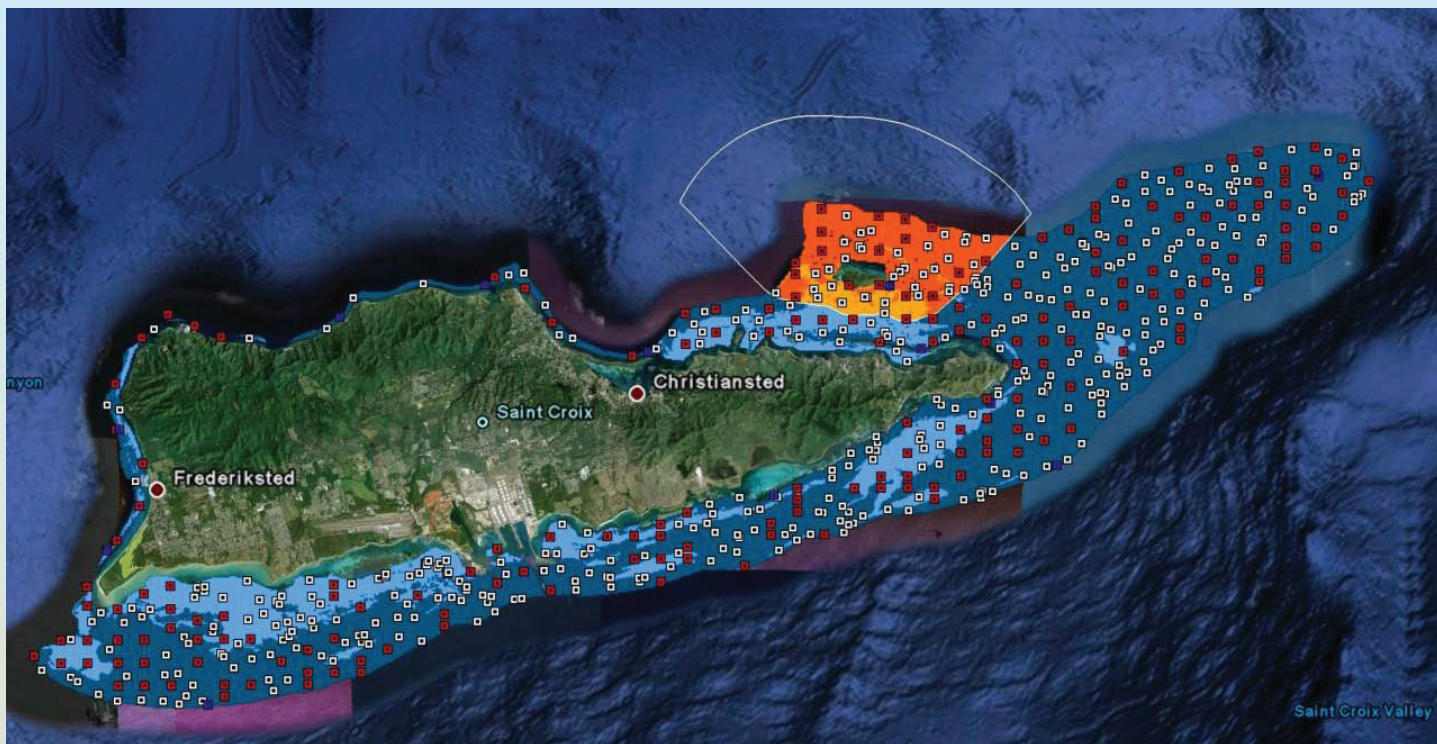
SEFSC scientists led by **Dr. Todd Gedamke** and **Dr. John Walter** are engaging the local fishing community to monitor fish populations of the St. Croix shelf using traditional trap gear as an addition to traditional fisheries data collection. This project is the first comprehensive fishery-independent cooperative survey of an entire island shelf in the US Caribbean.

Why St. Croix? The US has a legal mandate to assess and monitor fish populations and fisheries within national waters. St. Croix was chosen for the pilot study because pre-existing socio-economic and fisheries work in the region demonstrated support from multiple resource managers and the fishing community. Additionally, the relatively small size of the continental shelf and the existence of pre-existing habitat mapping and baseline visual reef-fish datasets made St. Croix an ideal location to test out this novel approach.

Thus far, fishers and scientists working together have sampled over 600 trap stations that will give the first shelf wide assessment of St. Croix reef fisheries. Fish traps were chosen as the survey method because their consistency of design promotes standardization and creates an even playing field in which talent of the fisher doesn't factor into success. Traps catch a wide variety of species and fish are kept alive. Traps are a traditional fishing method on St. Croix. The trap methodology was met with broad acceptance among participating Cruzan fishers, many of whom contributed to the trap-design process.



Collecting data for the St. Croix fishery-independent trap study. *Photo credit: Cindy Grace.*



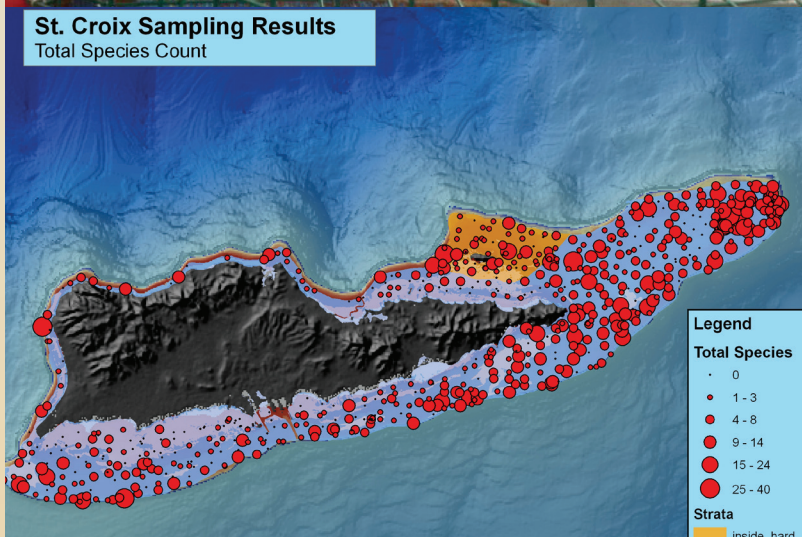
Above: Sampling design for the St. Croix Trap Study. The design is a combination of a systematic grid and stratified random protocol, overlaid with a geostatistical analysis technique developed by **Dr. John Walter** (SEFSC).

This project has so far been a success in large part due to strong partnerships between SEFSC, the NCCOS Biogeography Program, the St. Croix Fishers Association, the NPS, the USVI Department of Planning and Natural Resources and UVI. Collaboration with the fishing community was essential and resulted in better participation and execution. Over 2,800 fish representing 67 species, many of which are ecologically and economically important were collected, providing scientists with a snapshot of fisheries resources across the entire fishable shelf.

This study provides an excellent example of a cost-effective, shelf-wide, statistically rigorous fishery independent survey that can be applied to other areas in the region and beyond.



St. Croix Sampling Results
Total Species Count



Middle: Fish caught during in a trap during experimental fishing for the pilot study. *Photo credit: Cindy Grace.* Bottom: St. Croix sampling results from pilot study, total species count.



Socioeconomics: The Human Dimension of Reef Conservation

Coral reefs have long provided sustenance, income and employment to many coastal communities worldwide. The successful implementation of coral reef protection policies requires understanding of how these policies will affect communities, which rely on the variety of resources that coral reefs provide. SEFSC's social scientists are working to gain a further understanding of the ways in which humans interact with reef resources in economic and cultural contexts. The information collected by this unique program assists the Fisheries Management Councils in developing culturally sensitive policies, which encourage compliance and minimize unnecessary economic impacts to communities.



Screenshot of the South Florida Sportfishing Geodatabase developed by the Social Science Research Group at SEFSC Miami, FL.

The Social Science Research Group at SEFSC, led by **Dr. Juan Agar**, with contributions from **Flavia Tonioli** and **Dr. Brent Stoffle**, is collaborating on several ongoing initiatives to characterize fishing communities in the US Caribbean. Building on an adaptive management framework, these projects contribute baseline information to evaluate the performance of fisheries management actions and to track changes in fishing communities over time. Knowledge of how the reef resources and management actions are perceived by fishers contributes to the development of management paradigms which promote awareness within the community. The projects are being done with standardized methods that can be repeated in new areas over time.

In addition, SEFSC researchers led by **Dr. David Carter** are using innovative GIS-based tools to spatially document sportfishing in South Florida. The researchers have developed a web application that integrates and maps recreational fishing activity from multiple data sources. Users can select to view fishing effort by vessel type (private or charter) and by year from 1991 through 2003. This project has the potential to greatly improve socioeconomic analysis of spatially oriented fisheries management policies such as siting Marine Protected Areas and evaluating the socio-economic impacts of fisheries closures.



A fisherman mends his net. *Photo credit: Juan Agar, SEFSC Miami, FL.*

Concerns over the potential impact of trap fishing on coral reefs prompted the Social Science Research Group to evaluate costs and earnings of fishers and create spatial analysis tools for understanding which fisheries are most profitable to communities, by species, fishing gear type and region. A census of fishermen on St. Croix and Puerto Rico revealed the presence of a diverse fishery, with variable levels of fishing dependence in the USVI and fishers exhibiting a more diversified livelihood strategy in Puerto Rico and St. Croix.

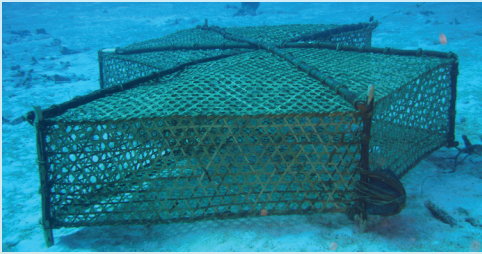
Trends in changing gear types and the employment of multiple livelihood strategies to supplement fishing income were observed throughout the US Caribbean. The findings highlighted the need for targeted fisheries management policies as fishing communities are not the same throughout the US Caribbean and may respond differently to the same regulatory constraint.

The Social Science Research Group directly evaluates the potential impact of specific management actions on fishing communities and surveys fisher's perceptions of the biological and socio-economic condition of the fishery and the efficiency of management actions. Initial findings suggest acceptance of management action is greater when the fishermen were afforded a larger role in the management process. The results were used to guide best management practices by the Caribbean Fisheries Management Council.

The human dimensions program at SEFSC is a collaborative effort to provide managers with a deeper understanding of how fishing communities adapt to management actions and enhance the mechanisms by which fishermen can contribute their knowledge and perspectives into the management process.



USVI Fisherman. *Photo credit: Jennifer Schull, SEFSC Miami, FL.*



Building a Better Fish Trap

Trap fishing is an important traditional fishing practice throughout much of the Caribbean. Traps are effective at catching reef species in the highly complex habitats of the coral reef environment. However, many of the fish caught in traps are juveniles or small, non-targeted herbivorous species such as surgeonfishes, parrotfishes and others. Herbivores play a critical ecological role on Caribbean reefs: through their grazing herbivores help to prevent macroalgae from outcompeting and overgrowing corals. When these fishes are brought quickly to the surface, as they are in fish traps, they may suffer mortality from the rapid change in pressure even if they are released over the side of the boat. If they escape from the trap while on bottom, they will survive to fulfill their role in the coral reef ecosystem.

SEFSC scientists are working collaboratively with the fishing community investigating the suite of effects of fish traps on reefs and working to improve trap design to reduce bycatch of valuable reef herbivores —a win-win situation for both fishermen and reefs.



SEFSC scientific divers installing prototype vented traps in the USVI. *Photo credit: Vanessa Wright.*

SEFSC scientists led by **Dr. Ron Hill** developed a plan in collaboration with the St. Thomas Fishermen's Association (STFA) to test prototype traps with escape vents designed to allow small non-target fish to escape. But how do you allow for the escapement of bycatch species while retaining target species?

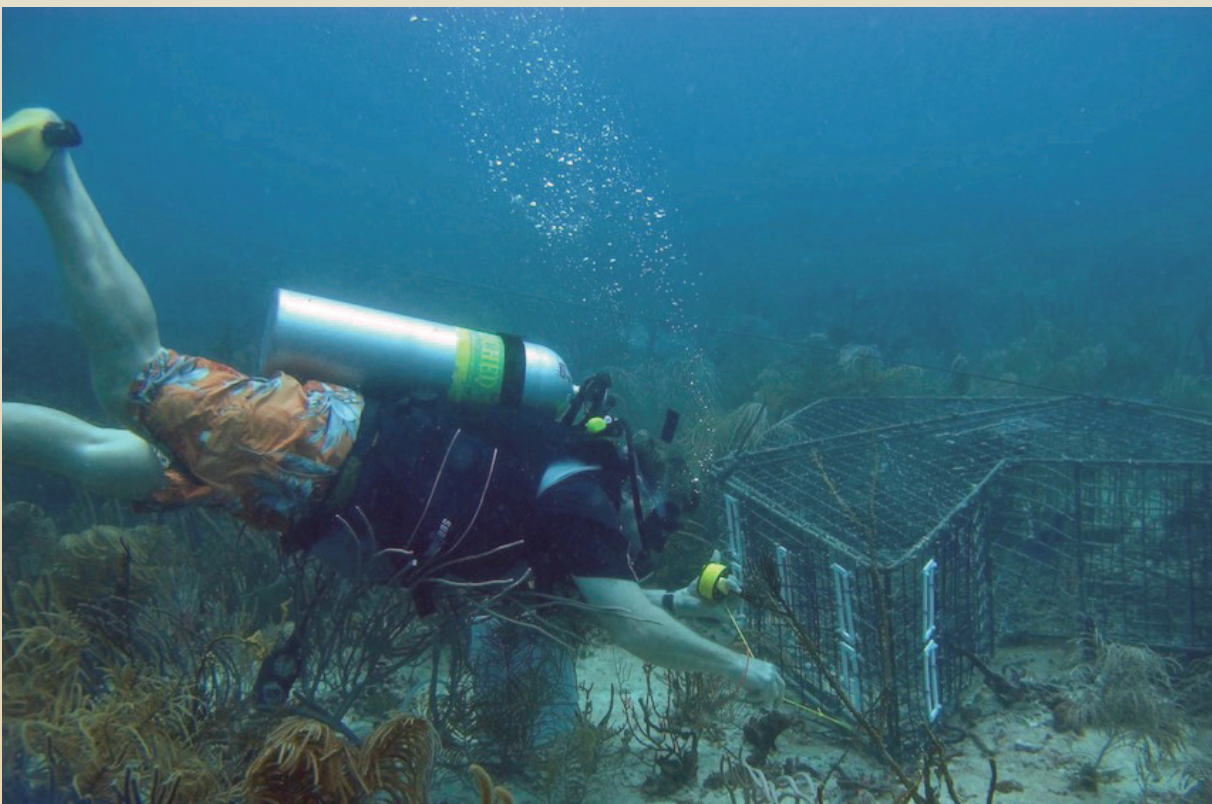
First, the team surveyed local fish markets to collect data on the average width and height of species caught in traps. These observations allowed researchers to estimate the right size for escape vents to maximize escapement of non-target species while retaining desirable species/sizes. Second, a team of scientific divers observed the behavior of target and non-target species within traditional fish traps.

Diver observations were supplemented by video taken over eight days, which recorded activity and movements of numerous species caught in the traps. Researchers determined that, contrary to traditional knowledge, fish escape mainly while the trap is soaking and not while it is being hauled. The team also demonstrated that vents could release by-catch while retaining target species.

Additional testing evaluated placement of escape vents for non-target species at different locations in the traps. Several different prototypes with a variety of vent sizes and placements are being tested during commercial fishing. Extended testing of the recommended vents is being conducted with a grant from the NMFS Cooperative Research Program to the STFA. The STFA and SEFSC scientists will continue to collaborate on this effort, fostering compliance and increasing awareness of the possibility and importance of reducing by-catch within fishing communities.

The trap improvement study joins a suite of related projects aimed at quantifying and minimizing the impact of traps on coral reefs. This study was conceived as an extension of a collaborative study of traps as marine debris by the NOAA Marine Debris Program, NCCOS, NMFS-SEFSC, the University of the Virgin Islands, and STFA. Other related projects by SEFSC scientists and collaborators have investigated trap-induced damage within the coral reef ecosystems of the Virgin Islands, Florida Keys and Puerto Rico and, more recently, on the health and productivity of colonies of Staghorn Coral (*Acropora cervicornis*). (For more on *A. cervicornis* monitoring efforts, see “Monitoring Threatened Corals” on page 24).

Together, these efforts improve our knowledge of the impacts of reef fishing practices on coral reef ecosystem health. Through understanding and quantifying these interactions, researchers provide essential information to fishermen and resource managers about the sustainability of fishing practices applicable across the region. Improved trap design will further improve the sustainability of trap fisheries by reducing by-catch of herbivores and juveniles fishes, allowing non-target species to escape and fulfill their critical role in the ecosystem.



In the USVI, a SEFSC scientific diver installs a prototype vented trap. The strategically placed vents will allow non target species to escape, drastically reducing bycatch. Photo credit: Vanessa Wright.



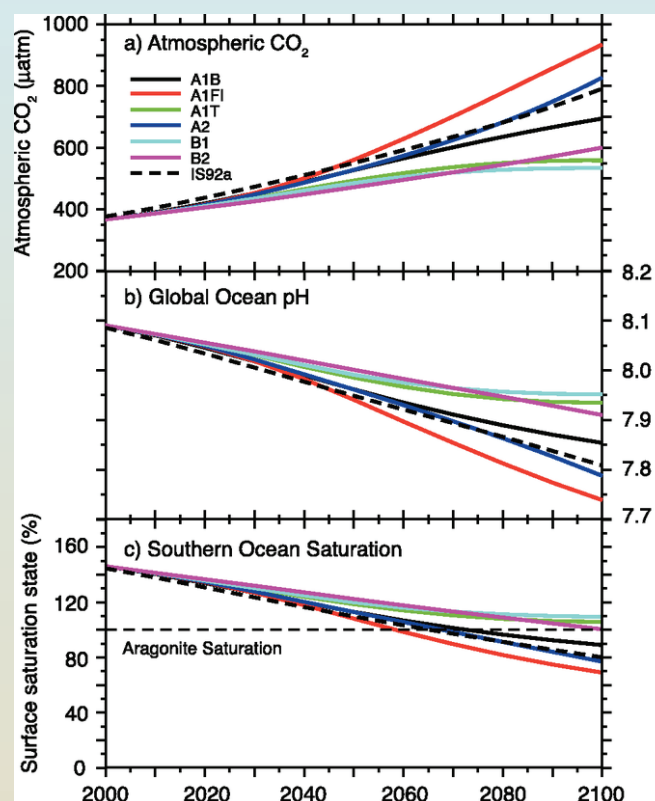
SEFSC's Contributions to the Science of Climate Change

Climate change has been identified as a significant threat to coral reef ecosystems worldwide. As a result of climate change, reefs must contend with thermal stress, ocean acidification, sea level rise; altered frequency, intensity and distribution of tropical storms; altered ocean circulation; mass coral bleaching and infectious disease. Carbon-dioxide (CO_2) absorbed into the ocean from the atmosphere, decreases the ocean's pH, reducing the ability of reef-building organisms to create their calcium-carbonate skeletons, impairing processes that have been ongoing for millions of years.

SEFSC scientists are taking action to incorporate climate-change impacts into a new strategy to conserve coral reef and fisheries resources from an ecosystem-based perspective. Below are some examples of investments SEFSC and CRCP are making to better understand climate impacts on coral reef ecosystems.

In collaboration with Dr. Peter Glynn of the University of Miami, SEFSC scientist **Dr. Joe Serafy** is investigating the role of climate change on coral reef fish community dynamics off Panama's Pacific coast. Located within the boundaries of Panama's Coiba National Park, this area has received virtually no fishing pressure or watershed development for over 80 years. Dr. Glynn's study is one of the world's longest-running efforts to study coral reef communities, spanning over 30 years. The study investigates patterns in reef fish communities caused by El Niño and La Niña events as a proxy for climate change. "Discerning climatic impacts from other sources of variability (natural and anthropogenic) on systems as complex as coral reef communities requires multi-decadal datasets on a wide range of species", writes Serafy.

Results suggest strong correlations exist between metrics used to measure the health of coral habitat, such as percent coral cover, and those metrics which measure the health of fish communities, such as species diversity. These findings reflect the critical linkage between reef fish and their habitat. Further monitoring of this area will likely underline the importance of conserving coral habitat for reef fish species in the face of climate change.

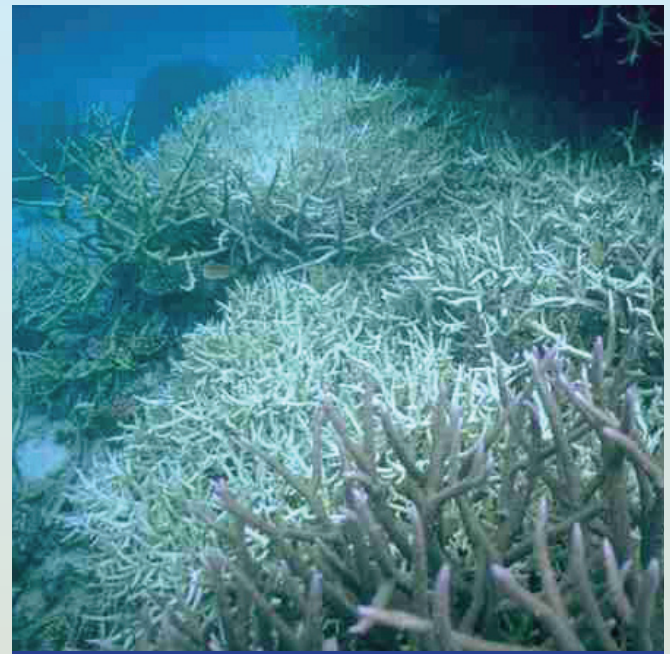


Atmospheric carbon dioxide, global ocean pH, and saturation of Aragonite - a compound that corals need to build their skeleton. Credit: IPCC 2007*



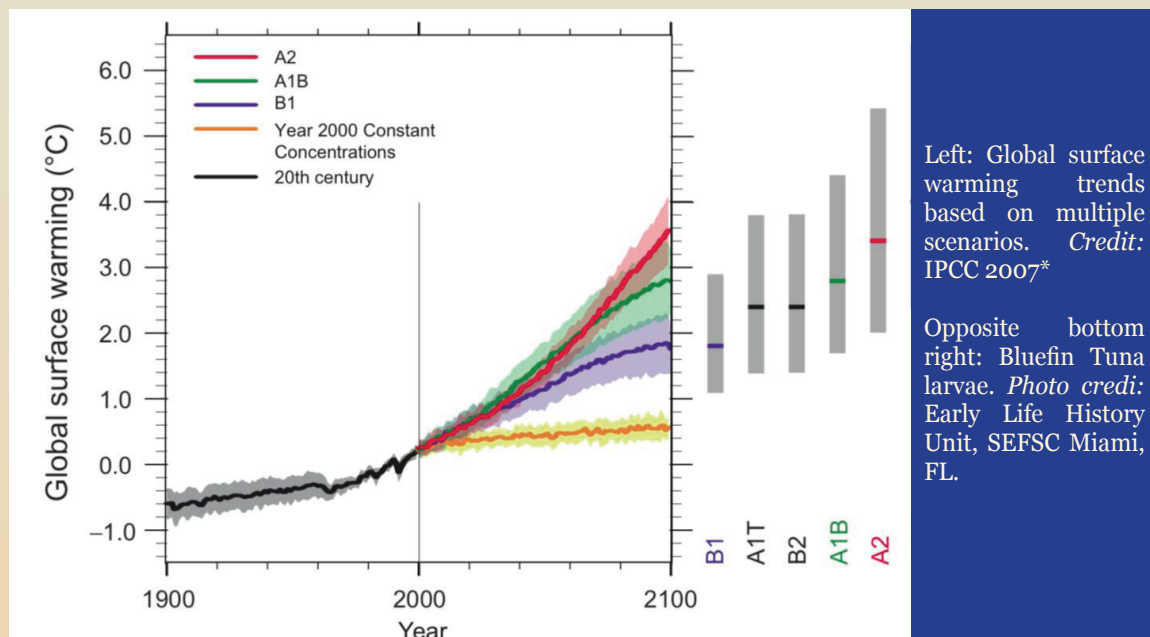
The Benthic Ecology Unit at SEFSC is working on the coral side of the equation, investigating threats of climate change to threatened coral species. In collaboration with the University of Miami, SEFSC researchers under the leadership of **Dr. Margaret Miller** are investigating the effects of enhanced CO₂ levels on the fertilization and settlement rate of elkhorn coral (*Acropora palmata*) larvae.

Using *Acropora* as a model, Dr. Miller and her team are exploring the relative impacts of climate stressors on reproduction, growth and survival. Results demonstrated impaired fertilization rates under 50-yr and 100-yr projected CO₂ levels. Substrates that were conditioned in high CO₂ seawater yielded lower rates of settlement, providing further evidence that this threatened coral is likely to face a challenging future.



Bleached *Acropora cervicornis*. Under heat stress, corals may lose their symbiotic algae. Photo credit: NOAA-NESDIS

The Early Life History Unit at SEFSC will be exploring future trends and impacts related to climate change on larval fish transport, and eventual recruitment. Modeling efforts by the Early Life History Unit led by **Dr. John Lamkin and Dr Barbara Muhling**, have already begun to predict future trends under scenarios of changing water temperature, increased coral bleaching rates and altered current regimes affecting larval development and distribution in the Gulf of Mexico and the Caribbean. Initial studies of climate change impacts on larval fish and spawning areas focused on bluefin tuna, but the team will be expanding efforts to include reef fish species of the Gulf and Caribbean in the near future.



Left: Global surface warming trends based on multiple scenarios. Credit: IPCC 2007*

Opposite bottom right: Bluefin Tuna larvae. Photo credit: Early Life History Unit, SEFSC Miami, FL.

* IPCC, 2007: Summary for Policymakers. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Coral Reef Conservation Program

SEFSC Researchers and Areas of Interest

2007-2010



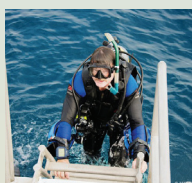
Dr. Juan Agar, SEFSC Miami, FL, juan.agar@noaa.gov

- Socio-economic analysis of marine reserves in the US Caribbean
- Economics of fisheries in the US Caribbean
- Profiling fishing communities in the US Caribbean



Dr. Jim Bohnsack, SEFSC Miami, FL, jim.bohnsack@noaa.gov

- Marine Protected Areas monitoring and effectiveness
- Coral reef fish ecology and population dynamics
- Southeast Florida Reef Tract Studies



Michael Burton, SEFSC Beaufort, NC, michael.burton@noaa.gov

- Spawning aggregation recovery
- Riley's Hump and Tortugas North Ecological Reserve reef fish assemblages and spawning aggregations
- Effects of MPAs on recovering exploited reef fish populations



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- Economic analysis of recreational fishing in Florida, Gulf of Mexico, and US Caribbean
- Sportfishing valuation and forecasting



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- Habitat and fish assemblage characterization of deep shelf reefs
- Meso & deep reef MPA effectiveness
- Multibeam mapping of shelf edge reef habitats, NE Gulf MPAs, South Atlantic MPAs, Oculina HAPC and Pulley Ridge (SW Florida)
- Deep coral ecosystems



Jennifer Doerr, SEFSC Galveston, TX, jennifer.doerr@noaa.gov

- Conch population dynamics in the US Virgin Islands
- Fish trap designs to reduce by-catch of reef herbivores
- Shallow-water coral reef habitat research



Dr. Todd Gedamke, SEFSC Miami, FL, todd.gedamke@noaa.gov

- Data poor assessment methodologies
- Cooperative research programs
- Innovative survey/sampling designs

Coral Reef Conservation Program

SEFSC Researchers and Areas of Interest

2007-2010



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- Larval fish ecology
- Larval fish transport, and recruitment connectivity
- Otolith microchemistry



Stacey Harter, SEFSC, Panama City, FL, stacey.harter@noaa.gov

- Habitat and fish assemblage characterization of deep shelf reefs
- Meso & deep reef effectiveness
- Multibeam mapping of shelf edge reef habitats, NE Gulf MPAs, South Atlantic MPAs, Oculina HAPC and Pulley Ridge (SW Florida)
- Deep coral ecosystems



Dr. Ron Hill, SEFSC Galveston, TX, ron.hill@noaa.gov

- Fish trap impacts on reefs and design to reduce bycatch
- Modeling population dynamics of reef fish communities
- Vessel grounding site recovery, Fortuna Reefer, Mona Island
- Ecology of corals and reef fish in Puerto Rico and the VI
- Conch populations of the Virgin Islands



Dr. Todd Kellison, SEFSC Beaufort, NC, todd.kellison@noaa.gov

- Reef fish ecology
- Fish-habitat relationships
- Reef fish spawning aggregations



Dr. John Lamkin, SEFSC Miami, FL, john.lamkin@noaa.gov

- Larval fish ecology, biological oceanography and modeling.
- Reef fish utilization of marine protected areas and adjacent habitats
- Mesoamerican reef larval fish distribution and retention
- Otolith microchemistry and larval fish connectivity



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- Larval fish ecology & dispersal
- Otolith microchemistry & ageing
- Connectivity/MPAs
- Capacity building



Dr. Margaret W. Miller, SEFSC Miami, FL, margaret.w.miller@noaa.gov

- Ecology and status of the *Acroporid* corals and other ESA candidate corals
- Ecological restoration of vessel grounding sites
- Coral disease, genetics, predator dynamics, coral reproduction and survival
- Coral reef ecology of Navassa Island

Coral Reef Conservation Program

SEFSC Researchers and Areas of Interest

2007-2010



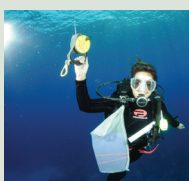
Dr. Barbara Muhling, CIMAS/RSMAS, barbara.muhling@noaa.gov

- Larval fish ecology & dispersal
- Biological oceanography and modeling



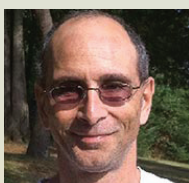
Dr. Benjamin Ruttenberg, SEFSC Miami, FL, benjamin.ruttenberg@noaa.gov

- Quantitative ecology and reef fish population dynamics
- Impacts of anthropogenic and environmental factors on reef fish populations
- Changes in marine communities over large temporal and spatial scales



Jennifer Schull, SEFSC Miami, FL, jennifer.schull@noaa.gov

- Strategic science planning and coordination, Science communication
- Grouper ecology
- Outreach and education



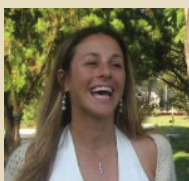
Dr. Joe Serafy, SEFSC Miami, FL, joe.serafy@noaa.gov

- Ontogeny and multiple habitat use of reef fishes
- Mangrove and seagrass habitats
- Watershed influences and reef connectivity
- Essential fish habitat for coastal and pelagic fishes



Dr. Brent Stoffle, SEFSC Miami, FL, brent.stoffle@noaa.gov

- Profiling fishing communities in Puerto Rico and the US Virgin Islands
- Oral history and contemporary assessment of Navassa Island fishermen
- Social impact assessments



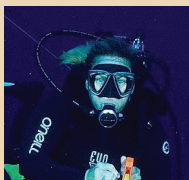
Flavia Tonioli, CIMAS/RSMAS, Miami, FL, flavia.tonioli@noaa.gov

- Socio-economic analysis of marine reserves in the US Caribbean
- Economics of sustainable fisheries in the US Caribbean
- Profiling fishing communities in the US Caribbean



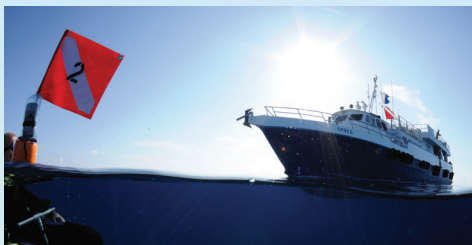
Dr. John Walter, SEFSC Miami, FL, john.f.walter@noaa.gov

- Socio-economic analysis of marine reserves in the US Caribbean
- Economics of fisheries in the US Caribbean
- Profiling fishing communities in the US Caribbean



Dr. Dana Williams, CIMAS/RSMAS, Miami, FL, dana.williams@noaa.gov

- *Acropora* population ecology
- Coral disease



SEFSC Coral Reef Research & Conservation Partners

2007-2010

Federal

National Environmental Satellite Data and Information Service (NESDIS)

National Marine Fisheries Service

Northeast Fisheries Science Center: Narragansett, RI lab

Southwest Fisheries Science Center: La Jolla, CA lab

National Ocean Service

National Centers for Coastal Ocean Science-NCCOS

Biogeography Program

Center for Coastal Environmental Health and Biomolecular Research

Office of National Marine Sanctuaries-ONMS

Florida Keys National Marine Sanctuary

Office of Response and Restoration

Marine Debris Program

National Park Service

Biscayne National Park

The Dry Tortugas National Park

Virgin Islands National Park Service

South Florida and Caribbean Inventory and Monitoring Network

NOAA National Sea Grant Office

The National Undersea Research Program

National Undersea Research Center (NURC)

At University of North Carolina at Wilmington

At University of Connecticut

Oceanic and Atmospheric Research (OAR)

Atlantic Oceanographic Meteorological Laboratory (AOML)

The U.S. Fish and Wildlife Service

United States Geological Service

Fishery Management Councils

The Caribbean Fishery Management Council

The Gulf of Mexico Fishery Management Council

The South Atlantic Fishery Management Council

State & Territorial

Florida Fish and Wildlife Conservation Commission

Florida Fish and Wildlife Research Institute

Puerto Rico Department of Natural and Environmental Resources

Virgin Islands Department of Planning and Natural Resources

Division of Fish and Wildlife.

Local/Regional

Loxahatchee River District

Miami-Dade County Department of Permitting, Environment and Regulatory Affairs (PERA)

SEFSC Coral Reef Research & Conservation Partners

2007-2010



Private

Harbor Branch Oceanographic Institute
Woods Hole Oceanographic Institute

Academic

Centro de Investigacion y de Estudios Avanzados del Insituto Politecnico Nacional (CINVESTAV) - Mexico
El Colegio de La Frontera Sur (ECOSUR) - Mexico
Florida Atlantic University
Florida International University
Pennsylvania State University
Sea-Mester
University of Connecticut
University of Miami
 Rosenstiel School of Marine and Atmospheric Science
 Cooperative Institute of Marine and Atmospheric Studies (CIMAS)
University of North Carolina at Wilmington
 Cooperative Institute for Oceanic Exploration Research and Technology
University of Puerto Rico
 U.P.R. - Mayaguez
University of South Florida
University of the Virgin Islands

NGOs

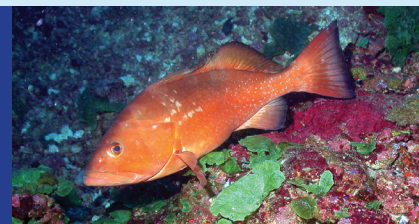
Coral Restoration Foundation
Florida Aquarium
Fondation pour la Protection de la Biodiversité Marine (FoProBim)
John G. Shedd Aquarium
The Mesoamerican Reef Fund (MAR Fund)
The Nature Conservancy
The Reef Environmental Education Foundation (REEF)
The St. Croix Fishermen's Association
The St. Thomas Fishermen's Association (STFA)

International

Cayman Islands Department of Environment
Comision Nacional de Areas Naturales Protegidas (CONANP, Mexico)
Direccion de Medio Ambiente (local government environmental agency)
 Ayuntamiento de Solidaridad, Quintana Roo, Mexico

CRCP Publications

by SEFSC Authors 2007-2010



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Rademacher, K. 2010. Survey of Madison-Swanson and Steamboat Lumps MPAs. Cruise Report: R/V Caretta Cruise. January 2010. 5 pp.

Schull, J. (ed.). 2010. SEFSC Coral Reef Program: FY2010 Project Accomplishment Report. NOAA Technical Memorandum. NMFS-SEFSC-628, 44pp.

Smith, R., **J.T. Lamkin, T. Gerard, B. Muhling, E. Malca, S.Privoznik**, L. Johns, and N. Melo. 2010 Preliminary cruise report NOAA Ship Nancy Foster Cruise NF1001-1002. Coral Reef Ecosystems Research and Reef Fish Resources project. USVI larval distribution and supply.

Valdez-Moreno, M., L. Vásquez-Yeomans, M. Elías-Gutiérrez, N.V. Ivanova, and P.D. N. Hebert. 2010. Using DNA barcodes to connect adults and early life stages of marine fishes from the Yucatan Peninsula, Mexico: potential in fisheries Management. Marine and Freshwater Research 61:665–671

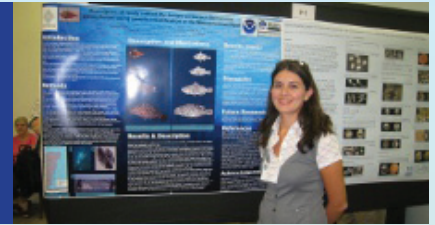
Valdés-Pizzini, M., **J. Agar**, K. Kitner, C. García-Quijano, M. Tust, and F. Forrestal. 2010. Cruzan Fisheries: A rapid assessment of the historical, social, cultural and economic processes that shaped coastal communities' dependence and engagement in fishing in the island of St. Croix, U.S. Virgin Islands. NOAA Series on U.S. Caribbean Fishing Communities. NOAA Technical Memorandum NMFS-SEFSC-597, 144 pp.

Victor, B.C., L. Vasquez-Yeomans, L.Valdez-Moreno, L. Wilk, **D.L. Jones, M.R. Lara**, C. Caldow, and M. Shivji. 2010. The larval, juvenile and adult stages of the Caribbean goby, *Coryphopterus kuna* (Teleostei: Gobiidae): a reef fish with a pelagic larval duration longer than the post-settlement lifespan. Zootaxa 2346: 53-61.*



Purple reef fish in Dry Tortugas National Park. *Photo credit:* Tara Dolan, SEFSC Miami, FL.

CRCP Presentations & Posters by SEFSC Researchers 2007-2010



SEFSC scientists present their research at scientific meetings all over the world, demonstrating the high profile of their science and the relevance of their work.

2006**

Minello, T. J., and R. L. Hill. 2006. Comparative Analysis of Adjacent Marine Habitats: Characterizing Essential Fish Habitat for Caribbean Fishery Species. Poster presentation, Science in the Park: the Virgin Islands National Park's 50th Anniversary Conference on Marine and Terrestrial Scientific Research. St. John, USVI. November 2006.

Lamkin, J. et al. 2006. Monitoring coral reef fish use of MPAs and recruitment connectivity between the Florida Keys and Mesoamerican reefs. Poster presentation at American Fisheries Society, Larval Fish Conference. Lake Placid, NY.

2007

Ault, J., S. Smith, J. Luo, T. Kellison, and J. Bohnsack. 2007. Community-based analysis of reef fish habitat use in the Florida Keys. American Fisheries Society Symposium 50: Linking estuarine-marine habitats.

Beard, M., B. Mason, M. Miller, V. Shestopalov, and V. Slepak. 2007. 'First identification of photosensitive cells in corals: An opsin-like protein and photoreceptor cells present in coral larvae may allow substrate discrimination during settlement.' Oral presentation. Marine Benthic Ecology Meetings. April 2007, Atlanta GA.

Bohnsack, J., J. Ault, S. Smith, and T. Kellison. 2007. Visual reef fish monitoring supports ecosystem-based management in Florida. AFS Symposium 42. Looking at the Bigger Picture: Long Term Monitoring in Fisheries.

David, A.W., and C.T. Gledhill. 2007. Northeast Gulf of Mexico Marine Reserve Program. Gulf of Mexico Fishery Management Council. Biloxi, MS. October 2007.

Doerr, J.C., and R. L. Hill. 2007. A Preliminary Analysis of Habitat Use, Movement, and Migration Patterns of Queen Conch, *Strombus gigas*, in St. John, USVI, Using Acoustic Tagging Techniques. Gulf and Caribbean Fisheries Institute 60th Annual meeting. Punta Cana, Dominican Republic. November 2007.

Gerard, T. 2007. Monitoring coral reef fish utilization of marine protected areas and inshore habitats in Florida Bay. (1067-2007). PhD Dissertation Defense. Rosenstiel School of Marine and Atmospheric Science. Miami, FL.

Gerard, T. 2007. Monitoring coral reef fish utilization of marine protected areas and inshore habitats in Florida Bay. (1067-2007). NOAA Educational Partnership Program Science and Education Forum.

Hill, R.L. 2007. *Lessons Learned Building Ecosystem Models*. 8th Biennial State of the Bay Symposium. Galveston, Texas. January 2007.

Hill, R., M. Schärer, M. Nemeth, and A. Bruckner. 2007. Reef fish habitat use as a measure of coral reef restoration success at the Fortuna Reefer grounding site, Mona Island, Puerto Rico. Oral presentation, 60th annual meeting of the Gulf and Caribbean Fisheries Institute. Punta Cana, Dominican Republic. November 2007.

Kellison, G.T., and D. Harper. 2007. Spatial trends in size and abundance of fishery targeted reef fish in the FL Keys, USA. 60th annual meeting of the Gulf and Caribbean Fisheries Institute, Punta Cana, Dominican Republic. November 2007.

** Previously unreported CRCP presentations from 2006 are included for completeness.

- Kellison, T.**, J. Luo, **S. Frias-Torres**, P. Johnson, P.S. Rand, and **J.E. Serafy**. 2007. Electronics in the prop-roots: Application of multi-beam sonar and stereo video for fish community data collection in mangroves. American Fisheries Society Symposium: Marine Fish Ecology.
- Koch, V.** 2007. The use of political ecology in the study of black grouper habitat and behavior. University of Miami, RSMAS student presentation.
- Koch, V.** 2007. The why, how and where of fish movement- the movement behavior of black groupers (*Mycteroperca bonaci*). University of Miami, RSMAS student presentation.
- Lamkin, J.** et al. 2007. Monitoring coral reef fish use of MPAs and recruitment connectivity between the Florida Keys and Mesoamerican reefs (1244-2007). NOAA CRCP Seminar Series.
- Lamkin, J.** et al. 2007. Monitoring coral reef fish use of MPAs and recruitment connectivity between the Florida Keys and Mesoamerican reefs. Oral Presentation in CONANP's MBRS Station to Xcalak Fishermen and general public (Larvas de peces y oceanografía física del Sistema Arrecifal Mesoamericano).
- Marshak, A. R., **R. L. Hill**, **P. Sheridan**, M. T. Scharer, and R. S. Appeldoorn. 2007. In-Situ Observations of Antillean Fish Trap Contents in Southwest Puerto Rico: Relations to Habitat Damage and Overfishing. Poster presentation. 137th Annual. American Fisheries Society. San Francisco, CA. September 2007.
- Miller, M.W.** 2007. 'Are reef restoration structures self-defeating?' Oral presentation. Marine Benthic Ecology Meetings. April 2007. Atlanta GA.
- Miller M.W.**, J.W. Wiener, **D.B. McClellan**, and **B. Stoffle**. 2007. Preliminary effort and yield estimates from the Haitian fishery at Navassa Island. 60th annual meeting of the Gulf and Caribbean Fisheries Institute. Punta Cana, Dominican Republic. November 2007.
- Serafy, J.** 2007. Mangrove shoreline fishes: baseline patterns of diversity, abundance and size. RECOVER Assessment Team meeting, Broward County Cooperative Extension Office. Davie, Florida.
- Serafy, J.** 2007. Monitoring Biscayne Bay's mangrove shoreline fishes. Coral Reef Fish Monitoring Workshop, Florida Fish and Wildlife Research Institute, South Florida Regional Laboratory. Marathon, Florida. April 3 - 4, 2007.
- Smith, S., J. Ault, J. Luo, **J. Bohnsack**, and **G.T. Kellison**. 2007. Regression analysis of habitat use by reef fish species and life stages in the Florida Keys. American Fisheries Society Symposium 50: Linking estuarine-marine habitats.
- Stoffle, B.** 2007. Community Profiling and Social Impact Assessments in the USVI: Developing Strategies for Creating Sound Fishery Policy. A Presentation for the University of Miami's Rosenstiel School Lecture Series. September 8, 2007.
- Stoffle, B.** 2007. Profiling Fishing in St Croix: An Examination of the Social, Cultural and Economic Value of the St Croix Fisheries and the Community Designation Process. Presented at the MARFIN Conference, St. Petersburg, Florida. December 11-12, 2007.
- Whitcraft, S.** et al. 2007. Developing Site Fidelity and essential habitat assessment tools for juvenile snappers (1685-2007). Tagging Training Report Connectivity Outreach Presentation.
- Whitcraft, S.** et al. 2007. Developing Site Fidelity and essential habitat assessment tools for juvenile snappers (1685-2007). Florida Atlantic Coast Tracking Project (FACT) Meeting.
- Whitcraft, S.** et al. 2007. Developing Site Fidelity and essential habitat assessment tools for juvenile snappers (1685-2007). NOAA-DC Presentation.
- Whitcraft, S.** et al. 2007. Developing Site Fidelity and essential habitat assessment tools for juvenile snappers (1685-2007). Poster Presentation. American Fisheries Society Symposium 50: Linking estuarine-marine habitats.
- Whitcraft, S.** et al. 2007. Developing Site Fidelity and essential habitat assessment tools for juvenile snappers (1685-2007). FIU Graduate Student Symposium.

Williams, D., M. Miller, and K.L. Kramer. 2007. 'Effects of Multiple Hurricanes on *Acropora palmata* in the Florida Keys (U.S.A.)'. Oral presentation. Assoc. of Marine Labs of the Caribbean Meeting, St. Thomas USVI, June 07.

2008

Hourigan, T., **J.A. Bohnsack**, and R. Schroeder. 2008. Science to Support Coral Reef Fisheries Management: Lessons from the U.S. Coral Reef Conservation Program. 11th International Coral Reef Symposium. Ft. Lauderdale, FL. July 2008.

Agar, J., and M. Valdes-Pizzini. 2008. The Quest for the Real and Authentic Fishing Community: Ethnography, Economic and Policies in the Case of St. Croix, United States Virgin Islands. Society for Applied Anthropology. Memphis, Tennessee.

Bohnsack, J. A. 2008. Influence of Florida Coastal No-Take Marine Protected Areas on International Gamefish Association (IGFA) World Records for Black Drum, Red Drum, Spotted Seatrout, and Common Snook. Recreational Fishing Symposium, IGFA, Dania Beach, FL. November, 2008.

Bruckner, A.W., R.J. Bruckner, and **R. Hill.** 2008. Survivorship of *Acropora palmata* fragments over 10 years at the Fortuna Reefer restoration site. 11th International Coral Reef Symposium. Ft. Lauderdale. Florida. July 2008

Doerr, J.C., and **R.L. Hill.** Movement patterns of queen conch, *Strombus gigas*, and utilization of coral reef-associated habitats in St. John, U.S. Virgin Islands. Poster presentation. 11th International Coral Reef Symposium. Ft. Lauderdale, Florida. July 2008.

Gasca, R. 2008. Zooplankton de aguas profundas. Semana de Intercambio Académico ECOSUR. San Cristobal de las Casas, Chiapas.

Gerard, T. and **J. Lamkin.** 2008. Fisheries oceanography in the Virgin Islands: preliminary results from a collaborative research endeavor. Poster presentation. 32nd Annual Larval Fish Conference. Kiel, Germany. August 4-7, 2008.

Gerard, T., A.Wright, **E. Malca**, and **J. Lamkin.** 2008. The use of otolith microchemistry to determine sources of Lutjanid recruits to the Dry Tortugas Ecological Reserve. Florida Bay and Adjacent Marine Systems Science Conference. Naples, FL. December 2008.

Gleason, A., P. Reid, and **T. Kellison.** 2008. Single beam acoustic remote sensing for coral reef mapping. Association of American Geographers annual conference. Boston, MA.

Gleason, A. P. Reid, and **T. Kellison.** 2008. Single beam acoustic remote sensing for coral reef mapping. International Coral Reef Symposium, Ft. Lauderdale, FL

Harter, S.L. 2008. Oral presentation to South Atlantic Fisheries Management Council. Orlando, FL. June 2008.

Harter, S.L., and **A.W. David.** 2008. South Atlantic proposed MPAs MPAs: three years of pre- closure data on habitat and fish assemblages. South Atlantic Fisheries Managment Council Meeting. June 2008.

Harter, S.L., and **A.W. David** and **M.M. Ribera.** 2008. Pre-closure evaluation of habitat and fish assemblages in five proposed Marine Protected Areas off the U.S. southeastern coast. 11th International Coral Reef Symposium. Ft. Lauderdale, FL. July 2008.

Hill, R., M. Schärer, M.Nemeth, and A. Bruckner. 2008. Restoration -- more than corals: Reef fish habitat use measures coral reef restoration success at the Fortuna Reefer grounding site, Mona Island, Puerto Rico. 11th International Coral Reef Symposium. Ft. Lauderdale, Florida. July 2008.

Johnston, L., I.B. Baums, and **M.W. Miller.** 2008.. Plasticity of the corallivorous gastropod *Coralliophila abbreviata*: Implications for imperiled Caribbean coral. 11th International Coral Reef Symposium. Ft. Lauderdale, Florida. July 2008.

Karras, C., and **J. Agar.** 2008. Cruzan Fishermen's Perspectives on the Performance of the Buck Island Reef National Monument and the Red Hind Seasonal Closure. 61st Annual Meeting of the Gulf and Caribbean Fisheries Institute. Gosier, Guadeloupe French West Indies.

Kellison, T., V. McDonough, **D. Harper**, and J. Tilmant. 2008. Changes in reef fish community structure in the upper FL Keys, USA. American Fisheries Society Annual Meeting. Ocala, FL.

- Kellison, T., V. McDonough, D. Harper,** and J. Tilmant. 2008. Coral reef fish community shifts and declines in abundance and species richness in the upper Florida Keys, USA. American Fisheries Society symposium. Ottawa, Canada.
- Kellison, T., V. McDonough, D. Harper,** and J. Tilmant. 2008. Comparative evaluation of reef fish resources adjacent to densely-populated southeastern FL, USA: anthropogenic impacts and implications for management. 11th International Coral Reef Symposium. Ft. Lauderdale, Florida. July 2008.
- Kellison, T., V. McDonough, D. Harper,** and J. Tilmant. 2008. Temporal and spatial trends in reef fish community structure and fishery-targeted species in the FL Keys. Invited seminar, UNC-Chapel Hill Institute of Marine Sciences
- Kramer, K.L., D. E. Williams, M. W. Miller, C. Bégin, J. Fry,** and **A. Valdivia.** 2008. 'Demographic comparison of the Threatened Coral Species, *Acropora palmata*, in the Eastern Caribbean'. 11th International Coral Reef Symposium. Ft. Lauderdale, Florida. July 2008.
- Lamkin J.T., E. Malca, N. Davis,** E.M. Jones, R.H. Smith, L. Carillo Birbriezca, L. Vasques-Yeomans, and E. Sosa Cordero. 2008. Spawning aggregations on the Northern Meso-American reef and connectivity of the Gulf of Mexico and South Florida with upstream waters of the western Caribbean. 32nd Annual Larval Fish Conference. Kiel, Germany. August 4-7, 2008.
- Lamkin, J.T., S. Whitcraft, T. Gerard, E. Malca, B. Muhling,** and **F. Fuenmayor.** 2008. Ecosystem-Scale Connectivity and Management of Coral Reefs: Applications of Larval Reef Fish Research. Oral presentation to the Caribbean Fisheries Management Council, St. Thomas, USVI. December 2008.
- Liese, C..** 2008. Fishery Management for Artisanal Reef Fisheries in Developing Countries: A Holistic Economic Approach. 11th International Coral Reef Symposium. Ft. Lauderdale, Florida. July 2008.
- Malca, E.,** and **T. Gerard.** 2008. Larval abundance and settlement of reef fish in St. Thomas, USVI in 2007 and 2008. Poster presentation at 32nd Annual Larval Fish Conference. Kiel, Germany. August 4-7, 2008.
- Miller, MW.** 2008. Status of reefs and fisheries of Navassa Island. Invited presentation at Caribbean Fishery Management Council workshop, Ponce, PR. March 2008.
- Miller, M.W.** 2008. Aquarius Coral Restoration/Resilience Experiments. Florida Keys National Marine Sanctuary Advisory Council meeting, Ocean Reef Club, FL. October 2008.
- Miller, MW.** 2008. Caribbean *Acropora* spp.: Population Ecology and US Endangered Species Management. Invited Presentation at Coral Experts Meeting for development of Mexican *Acropora* coral recovery plan. Cancun, Mexico. December 2008.
- Miller, M.,** et al. 2008. Alternate benthic assemblages on artificial reef restoration structures and their effects on coral larval Settlement. 11th International Coral Reef Symposium. Ft. Lauderdale, Florida. July 2008.
- Morgan, A., T. Gerard, B. Muhling, E. Malca,** and **J. Lamkin.** 2008. Variations in Carbon and Oxygen Stable Isotopes Snapper (*Lutjanidae*) in Florida Bay and Florida Keys. Florida Bay and Adjacent Marine Systems science conference. Naples, FL. December 2008.
- Ribera, M.M., S.L. Harter,** and **A.W. David.** 2008. Efficacy testing of MPAs: The West Florida Shelf and the South Atlantic Bight. American Fisheries Society, Florida Chapter, Annual Meeting . February 2008
- Serafy, J.** 2008. Biscayne Bay, Salinity Regimes & Fish Communities. Biscayne Bay Regional Restoration Coordination Team, Southeast Fisheries Science Center. Miami, Florida. June 13, 2008.
- Serafy, J.** 2008. Development of habitat suitability models for Biscayne Bay area fishes: assessing salinity affinity from abundance data. South Florida Water Management District, West Palm Beach, Florida. May 14, 2008.
- Shärer M.T., M. Nemeth, **A. Valdivia, D. Williams, M. Miller,** and C. Diez. 2008. Elkhorn coral distribution and condition throughout the Puerto Rican archipelago. 11th International Coral Reef Symposium. Ft. Lauderdale, Florida. July 2008.
- Smith, R., E. Johns, **J.T. Lamkin, T. Gerard,** N. Melo, **E. Malca,** and **A. Shiroza.** 2008. Fisheries Oceanography in the Virgin Islands: Preliminary Results from a Collaborative Research Endeavor. Poster Presentation at American Geophysical Union Joint Assembly. Ft. Lauderdale, FL. May 27-30, 2008.

Stoffle, B. 2008. At the Sea's Edge: An Examination of the Barbados Littoral Zone. Presented at the International Symposium on Society and Natural Resource Management. University of Vermont, Burlington, Vermont. June 2008.

Whitcraft, S. et al. 2008. Understanding Ecosystem-scale Connectivity: Methods to Track Fish from Open-ocean to Nursery Habitats to Adjacent Reefs and Back Again. Florida Bay and Adjacent Marine Systems Science Conference. Naples, FL. December 2008.

Whitcraft, S. et al. 2008. Developing Site Fidelity and essential habitat assessment tools for juvenile snappers. Florida International University Biology Symposium.

Whitcraft, S. et al. 2008. Developing Site Fidelity and essential habitat assessment tools for juvenile snappers. Tag 2008 Conference. New Zealand.

Whitcraft, S. et al. 2008. Developing Site Fidelity and essential habitat assessment tools for juvenile snappers. Poster Presentation. 11th International Coral Reef Symposium. Ft. Lauderdale, Florida. July 2008.

Williams, D.E., and M.W. Miller, K.L. Kramer, and A.Valdivia. 2008. Recruitment failure in *Acropora palmata*, a threatened Caribbean coral. 11th International Coral Reef Symposium. Ft. Lauderdale, Florida. July 2008.

Valdivia, A., and M.W. Miller et al. 2008. Post-settlement development of the scleractinian corals *Acropora palmata*, *Montastrea faveolata* and *Diploria strigosa*. 11th International Coral Reef Symposium. Ft. Lauderdale, Florida. July 2008.

Vardi T., D.E. Williams, and K.L. Kramer. 2008. What is the future of the threatened *Acropora palmata*? Population projections and management recommendations. 11th International Coral Reef Symposium. Ft. Lauderdale, Florida. July 2008.

Vásquez-Yeomans, L., L. Carrillo, and I. Castellanos. 2008. Cruceros por el Caribe: Proyecto ECOSUR-NOAA Meso-American System transport and ecology research (MASTERSemana de Intercambio Académico). ECOSUR. San Cristobal de las Casas, Chiapas.

2009

Acevedo, D., S. Morales, L. Vásquez-Yeomans, L. Carrillo, and J.T. Lamkin. 2009. Riqueza de especies y distribución de larvas leptocefalas en la parte norte del Sistema Arrecifal Mesoamericano en marzo 2006. Poster presentation at XV Reunion Nacional de la Sociedad Mexicana de Planctología A.C y VIII [International Meeting of the Mexican Society of Planktology]. Tlalnepantla de Baz, Mexico. April 21-24, 2009.

Bohnsack, J. A. 2009. Public Earth Day Lecture on coral reef conservation. University of Miami. Miami, FL. May 2009.

Bohnsack, J. A. Ten year responses of FKNMS SPAs. National Coral Reef Institute (NCORE) Symposium. RSMAS, University of Miami, Miami, FL. September 2009.

Bohnsack, J.A. 2009. Multi-agency collaboration on spatial monitoring in the Florida Keys. NOAA Science for Marine Spatial Planning Symposium in Silver Spring, MD. Invited Presentation for National webinar. November 2009.

Bohnsack, J.A. 2009. Florida Keys reef fishery conceptual model. MARES meeting. Invited presentation. December 2009.

Carrillo, L., L. Vásquez-Yeomans, E. Sosa-Cordero, R. Gasca-Serrano, I. Castellanos-Osorio, J. Lamkin, and W.J. Richards. 2009. Dispersión larval y oceanografía en la parte norte del Sistema Arrecifal Mesoamericano Congreso de la Sociedad Mexicana de Planctología. México, D.F.

Castellanos-Osorio, I., U. Ordóñez-López, L. Carrillo, L. Vásquez-Yeomans, E. Malca, and J. Lamkin. 2009. Distribución de la biomasa zooplanctónica en la región norte del Sistema Arrecifal Mesoamericano. Congreso de la Sociedad Mexicana de Planctología. México, D.F.

Fuenmayor, F., T. Gerard, E. Malca, B. Muhling, L.Vasquez-Yeomans, L.Carrillo, and E. Sosa. 2009. Chemical Signature of Habitats in the Mexican Caribbean. Poster Presentation at the Fourth International Otolith Symposium, Monterey, California. August 2009.

- Gerard, T., J.T. Lamkin, B. Muhling, E. Malca, A. Shiroza, S. Whitcraft,** E. Johns, R. Smith, N. Idrissi, and K. Brown. 2009. An evaluation of larval transport and distribution in the US Caribbean, British Virgin Islands and Leeward Islands. 34th Annual Larval Fish Conference. Santa Fe, New Mexico. May 30-June 3, 2009.
- Gerard, T., E. Malca, B. Muhling, J.T. Lamkin,** and L. Vasquez-Yeomans. 2009. Evaluation of recruitment connectivity between the Florida Keys and Mesoamerican reefs using otolith microchemistry. Fourth International Otolith Symposium. Monterey, California. August 2009.
- Gerard, T., R. Smith, E. Malca, B. Muhling,** L. Johns, and **J.T. Lamkin.** 2009. The USVI Larval Distribution and Supply Study. Oral Presentation to the British Virgin Islands Conservation and Fisheries Department. April 2009.
- Lamkin, J.T., S. Whitcraft, T. Gerard, E. Malca, B. Muhling,** and **F. Fuenmayor.** 2009. Ecosystem-Scale Connectivity and Management of Coral Reefs: Applications of Larval Reef Fish Research. Oral presentation to the CRCP Headquarters staff in Washington, D.C.
- Malca, E., T. Gerard, B. Muhling,** and **J.T. Lamkin.** 2008. Analyzing habitat linkages for snapper (Lutjanidae) using otolith microchemistry in Southern Florida. Fourth International Otolith Symposium. Monterey, California. August 2009.
- Miller, M.W.** 2009. Status of in- situ Caribbean *Acropora* populations. Smithsonian *Acropora* Conservation Workshop. Ft. Pierce, FL. February 2009.
- Miller, M.W.,** et al. 2009. Aquarius Coral Restoration/Resilience Experiments. Marine Benthic Ecology Meetings. Corpus Christi, TX. March 2009.
- Miller, M.W., D.E. Williams,** L. Johnston, et al. 2009. Testing coral transplant performance. Linking Science to Management Conference. October 2009.
- Ruttenberg, B. I.** 2009. A case for the positive effects of marine protected areas and marine reserves. Southeast Coastal and Ocean Stewardship Meeting, U.S. National Park Service, Miami, FL. Invited presentation. November 2009.
- Ruttenberg, B. I.** 2009. Demographic and life history variation in reef fish across environmental and anthropogenic gradients. Invited Seminar, Marine Sciences Seminar Series, Florida International University. Miami, FL. November 2009.
- Serafy, J.** 2009. Freshwater flows into Biscayne Bay: insights from its fish communities. 24th Annual Everglades Coalition Conference: New Opportunities, New Challenges. Miami, Florida. January 10, 2009.
- Serafy, J.** 2009. Mangrove Shoreline Fishes of Biscayne Bay and Adjacent waters. Marine Science Seminar Series. Florida International University. North Miami, FL. December 4, 2009.
- Serafy, J.** 2009. Monitoring Biscayne Bay's Mangrove Shoreline Fishes – Challenges and Choices. Marine Biology and Fisheries Division, Faculty Seminar Series. University of Miami, RSMAS. Miami, FL. December 11, 2009.
- Serafy, J.** 2009. Stiltsville as a platform for research and education. Palmer-Trinity High School. Miami, FL. February 9, 2009.
- Stoffle, B.** 2009. Women's Power and Community Resilience: Rotating Credit Associations in Barbados and the Bahamas. Sir Arthur Lewis Institute of Social and Economic Studies Conference, University of the West Indies. Cave Hill, Barbados. April 2009.
- Tonioli, F. and J. Agar.** 2009. Extending the Bajo de Sico Seasonal Closure (Puerto Rico): Fishermen's perceptions of possible socio-economic impacts on fishing practices, families and communities. National Center for Coral Reef Research (NCORE). Miami, Florida.
- Vásquez-Yeomans, L., L. Carrillo-Bibriezca, and I. Castellanos. 2009. Cruceros por el Caribe: Proyecto ECOSUR-NOAA Meso-American System Transport and Ecology Research (MASTER). Poster presentation at XV Reunion Nacional de la Sociedad Mexicana de Planctología A.C y VIII [International Meeting of the Mexican Society of Planktology]. Tlalnepantla de Baz, Mexico. April 21-24, 2009.
- Whitcraft, S., E. Malca,** F. Sosa, M. González, and **J.T. Lamkin.** 2009. Larval fishes, connectivity, and management: A Mesoamerican reef case study. Poster presentation, 34th Annual Larval Fish Conference. Santa Fe, New Mexico. May 30-June 3, 2009.

Williams, D.E. and M.W. Miller. 2009. Drivers of population decline in *Acropora palmate* in the Florida Keys National Marine Sanctuary. Linking Science to Management Conference. October 2009.

2010

Ault, J.S. 2010. Modeling U.S. coral reef ecosystems: developing decision support systems to build sustainable multispecies fisheries. NSF National Institute for Mathematical and Biological Synthesis. Knoxville, TN. Invited presentation. July 2010.

Ault, J.S. 2010. Fishery Dynamics of the South Florida Marine Ecosystem. "Present State and Change Over time of the Keys Ecosystem. Florida Keys Science Conference. Duck Key, FL. October 2010.

Ault, J.S., S.G. Smith, and **G.T. Kellison**. 2010. Coral reef fish-habitat modeling to support ecosystem-based management. Gulf & Caribbean Fisheries Institute Annual Meeting. San Juan, Puerto Rico. November 2010.

Acevedo D., S, Morales, L. Vásquez Yeomans, y Carrillo, L. 2010. Riqueza de especies y distribución de larvas leptocéfalas en la parte norte del Sistema Arrecifal Mesoamericano (Marzo 2006). XII Congreso Nacional de Ictiología. Nayarit, México.

Binder, B., A. Acosta, **G.T. Kellison**, C. Taylor, M. Feeley, D. Morley, and A. Gleason. 2010. Estimating Fishing Intensity on Spawning Aggregation Sites by Means of Aerial Survey. FL Keys Marine Ecosystem Conference.

Bohnsack, J.A. 2010. Effective multi-agency collaboration improves spatial monitoring and planning in the Florida Keys. John Pennekamp State Coral Reef Park Delicate Balance of Nature Lecture Series. Invited presentation. January 2010.

Bohnsack, J.A. 2010. Science Board, National Marine Fisheries Service. SEFSC advances in fishery-independent, spatially-explicit, ecosystem-based coral reef assessments. Invited Presentation. March 2010.

Bohnsack, J.A., B. Ruttenberg, D.B. McClellan, J.S. Ault, and S.G. Smith. 2010. National Habitat Assessment Workshop (NHAW). Advances in fishery-independent, spatially-explicit, and ecosystem-based approaches to assess coral reef fishes and habitat. Invited presentation. May 2010.

Bohnsack, J.A., J.S. Ault, S.G. Smith, **D.B. McClellan, D.E. Harper, J. Javech** and N. Zurcher. 2010. Impacts of the 1997 FKNMS management zones on coral reef fish populations over 10 years. Florida Keys Science Conference. Duck Key, FL. October 2010.

Brock, R.J., J.S. Ault, and **J.A. Bohnsack**. 2010. Ecological Scorecards: a powerful communication tool capable of distilling complex technical information into a format useable by many. Theme: Science Related to Spatial Management of the Florida Keys Marine Ecosystem. Florida Keys Science Conference. Duck Key, FL. October 2010.

Gómez-Gutiérrez, J. and I. Castellanos-Osorio. 2010. Dos significativas ampliaciones en el rango de distribución de *Heterophryxus appendiculatus* G.O. Sars, 1885 (Isopoda, Dajidae) en el Pacífico y el Caribe de México. Congreso de la Sociedad Mexicana de Planctología. La Paz, Baja California.

Hereu, C., E. Suárez-Morales, and B.E. Lavaniegos. 2010. Enjambres y diversidad de salpas (Tunicata, Thaliacea) en aguas mexicanas del Pacífico y el Atlántico. Congreso de la Sociedad Mexicana de Planctología. La Paz, Baja California.

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“Half the coral reefs are still in pretty good shape, a jeweled belt around the middle of the planet. There’s still time, but not a lot, to turn things around.”

~ Sylvia Earle