



NOAA Technical Memorandum NMFS-SEFSC-628

# SEFSC Coral Reef Program: FY 2010 Project Accomplishments Report

Compiled by:  
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

March 2012





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NOAA Fisheries  
Southeast Fisheries Science Center  
75 Virginia Beach Drive  
Miami, Florida 33149

U.S. DEPARTMENT OF COMMERCE  
John E. Bryson, Secretary

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION  
Jane Lubchenco, Undersecretary for Oceans and Atmosphere

NATIONAL MARINE FISHERIES SERVICE  
Eric Schwaab, Assistant Administrator for Fisheries

March 2012

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

or

National Technical Information Service  
5825 Port Royal Road  
Springfield, Virginia 22161  
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FAX: (703) 321-8547  
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Cover photograph: Dana Williams and Rachel Wilburn survey Elkhorn coral (*A. palmata*) colonies in the Florida Keys in 2010. Photo Credit: Allan Bright

**SEFSC Coral Reef Program: FY 2010 Project Accomplishments Report  
Table of Contents**

<b>I. INTRODUCTION</b> .....	1
<b>II. PROGRAM COORDINATION</b>	
1250-2010: Data Management, Assessment and Outreach .....	3
<b>III. ASSESS AND CHARACTERIZE U.S. CORAL REEFS – CORAL REEF ECOSYSTEM</b>	
1064-2010: Assess and Monitor Coral Reef MPAs. ....	6
<b>IV. REDUCE IMPACTS OF COASTAL USES</b>	
1066-2010: Evaluation of <i>Acropora</i> Status for Management, Recovery and Climate Response.....	10
20200 – 2010: Aquarius Coral Restoration/Resilience Experiments. ....	13
<b>V. REDUCE ADVERSE IMPACTS OF FISHING</b>	
20505-2010: Coupling of Passive and Active Acoustics to Assess Grouper Aggregations in the Tortugas Ecological Reserve. ....	16
1068-2010: Assess/Monitor Effects of MPA Status on Reef Fish Populations and Spawning Aggregations in the Tortugas Ecological Reserves .....	19
1317-2010: Assessing the Locations and Status of Reef Fish Spawning Aggregations in the Florida Keys .....	21
20439 -2010: USVI Commercial Fishermen Census. ....	24
1244-2009: Monitoring Coral Reef Fish Use of MPAs and Recruitment Connectivity between the Florida Keys and Meso-American Reefs. ....	27
20607-2010: Improving Trap Designs to Reduce Bycatch Mortality of Reef Herbivores. ....	30
<b>VI. IMPROVE EFFECTIVENESS OF MPAS</b>	
1693-2010: South Atlantic MPAs: Pre-closure Evaluation of Habitat and Fish Assemblages in Five Proposed No Fishing Zones. ....	33
10233-2010: USVI Larval Reef Fish Distribution and Supply Study. ....	36
<b>VII. REDUCE THREATS TO INTERNATIONAL CORAL REEFS</b>	
20528-2010: Applying Bio-Physical Monitoring and Capacity Assessments to Mesoamerican Reef MPAs .....	39
<b>VIII. REDUCE IMPACTS OF CLIMATE CHANGE</b>	
20513-2010: Evaluating Climate Effects on a Coral Reef Fish Community: Analysis of a 30-year Ecological Monitoring Effort .....	42



## I. INTRODUCTION

The NOAA Coral Reef Conservation Program (CRCP) is administered by NOAA's National Ocean Service (NOS) and is a matrix program operating across four NOAA line offices (NOS, National Marine Fisheries Service (NMFS), National Environmental Satellite, Data, and Information Service (NESDIS), and Oceanic and Atmospheric Research (OAR). The program supports all coral reef regions of the US, has an international component, and is integrated with other federal agencies, state and local governments, territories and commonwealths. In February 2004, SEFSC conducted an external program review of its coral reef program activities and valuable recommendations from that review have helped shape and improve the design, performance, and results of the Center's coral reef investments. In September 2007, CRCP conducted an external program review for an independent assessment of the CRCPs effectiveness in achieving its mandates and to provide recommendations for improving its impact and performance in the future. Recommendations from this review, including the advent of a new CRCP director (Kacky Andrews) in 2007, have shaped the recent history of the CRCP.

The Southeast Fisheries Science Center (SEFSC) has had a leadership role in coral reef conservation science since 1978. Congress passed the Coral Reef Conservation Act in 2000 and SEFSC was able to dovetail its management relevant coral reef science with the developing directives of the NOAA CRCP. SEFSC has maintained a strong coral reef science program since inception of the CRCP in 2001, and has continues to deliver high-caliber, peer-reviewed science in support of coral reef conservation and management and other NMFS mandates to conserve the nation's fisheries, essential fish habitat and protected species.

In Fiscal Year 2010, SEFSC submitted 23 proposals for funding, 15 of which were funded for a total of \$1.6M. While the SEFSC was successful in securing funding for a number of new initiatives, 2010 was notable for the termination of several long-term initiatives as the CRCP implemented a new paradigm focusing on three threat areas, more restrictive geographies, and state and territory managers' needs. SEFSC's award from the CRCP was the smallest since the inception of the CRCP, representing a 30% decrease from the 2009, and 30% below funding average since 2001.

As part of NMFS, SEFSC plays a critical role in the Southeast, Caribbean and Gulf regions in providing the science to support the agency's regulatory responsibilities. Despite the financial setbacks in FY10, SEFSC's coral reef program executed a strong science program this year, focusing its efforts on reef fish population monitoring, MPA effectiveness; coral survival, recovery and restoration; biological oceanography and connectivity; spawning aggregations; and investing in some unique projects linking the climate and biological systems. SEFSC has made significant advancements in outreach with Federal, state, territorial and university partners, resulting in a high degree of leverage and collaboration. SEFSC will continue to be responsive to the new direction of the CRCP in subsequent years, and we are confident we will continue to be a valuable and productive center for excellence in coral reef management relevant science.

This annual accomplishments report provides information on the activities and accomplishments of our coral reef projects funded by the CRCP, organized by FY10 CRCP theme category. This will be the last year this report is organized as such, as FY11 will usher in the new CRCP programmatic categories.





## II. PROGRAM COORDINATION

<b>Project ID#:</b>	1250-2010
<b>Title:</b>	Data Management, Assessment and Outreach
<b>PIs and co-PIs:</b>	Jennifer Schull (NOAA SEFSC)
<b>Duration of Project:</b>	Year 9
<b>Project Category:</b>	Program Coordination

### Brief description of activities conducted in FY2010

This project supports coordination of SEFSC's strategic involvement in the CRCP for FY10, including coordination of SEFSC projects and PIs (i.e. drafting of proposals, accomplishments reporting, CORIS submissions, and fleet and budget requests), participation in CRCP working groups and activities, management of budget information, and responding to all data requests from CRCP. This project covers coordination of both shallow water and deep water coral activities.

In FY10, the PI coordinated the development and submission of SEFSC's FY10 proposals, consisting of 14 projects by 13 PIs, and developed the FY11 proposal package which consisted of 32 pre-proposals and 18 full proposals (three being submitted via the Council Cooperative Agreement process). Three small deep water coral proposals were also submitted and fully funded in FY10. The PI published the FY09 SEFSC accomplishments report "SEFSC Coral Reef Program: FY 2009 Project Accomplishments Report" NOAA Technical Memorandum NMFS-SEFSC-614; and is finalizing the 2010 SEFSC Accomplishments Report (NOAA Technical Memorandum) entitled "SEFSC Coral Reef Program: FY 2010 Project Accomplishments Report" which will be available by January 2012. The PI was also responsible for CRCP budget, fleet, and information requests.

The PI participated in the USVI working group. The PI is one of two SEFSC representatives participating in the National Status and Trends working group (NCRMP), as well as the Spend plan redevelopment, database redesign, data management planning process, and outreach and communications initiatives. The PI hosted CRCP personnel in Miami (including teams discussing International CRCP, CORIS, Database, Data management, and NMFS Strategy); attended meetings in support of CRCP goals/objectives; supported CRCP reporting to NOAA, Congress, and various constituents; and coordinated SEFSC's participation on working groups, grant proposal reviews, and planning document reviews. The PI ensured SEFSC participation in NOAA initiatives that involve coral reef regions or issues (i.e. NOAA in the Caribbean, NOAA Ocean Acidification Plan, SOUTHCOM Caribbean Leadership Meetings, NMFS International Affairs, etc). PI increased communication within and external to NOAA partners as well as local jurisdictions, fishery management councils, and other regional, national and international partners.

This project increases strategic communication, collaboration and accountability within SEFSC and among SEFSC PIs, the CRCP, CR managers, academic partners and the coral reef community at large (both nationally and internationally). This project continues to ensure that SEFSC projects are fully aligned and integrated with the CRCP's goals and objectives, are responsive to management needs, and contribute towards the understanding and conservation of coral reef ecosystems.

### **Description of accomplishments & results**

This project increases strategic communication, collaboration and accountability within SEFSC and among SEFSC PIs, the CRCP, CR managers, academic partners and the coral reef community at large (both nationally and internationally). This project continues to ensure that SEFSC projects are 1) fully aligned and integrated with the CRCP's goals and objectives, 2) are responsive to management needs, and 3) contribute towards the understanding and conservation of coral reef ecosystems.

### **How project supports goals & objectives of CRCP**

This project ensures that the SEFSC is fully engaged in CRCP related programs and generates projects and outputs that meet the needs of the coral reef management community. This project ensures that SEFSC PIs' are responsive to CRCP needs and that SEFSC speaks with one voice. Additionally, this project ensures that SEFSC's coral related activities are communicated to a wide variety of audiences.

### **How project supports management of coral reef resources**

This project synthesizes the expert advice and scientific outputs of SEFSC coral reef related projects so they can be incorporated into scientifically sound management actions. This project integrates CRCP related outputs with those from other NMFS activities related to habitat, sustainable fisheries, and protected species.

### **List of project Partners and their roles**

None

### **Communications, media exposure, capacity building, education and outreach activities**

The PI hosted several CRCP staff at SEFSC. The PI completed the 2009 SEFSC Accomplishments Report for wide dissemination. The PI hosted a group of 21 masters' level students from Trinidad and Tobago at SEFSC, and represented coral related activities at the annual "bring your child to work" event at SEFSC. The PI maintained active dive status to assist PIs with field work needs. The PI continues to represent SEFSC on a variety of CRCP working groups.

The PI also developed and executed the Deep Water Coral Teacher Workshop at the North Carolina Museum of Natural Science. The workshop included a laboratory component and lecture components by regional experts from academic and local and federal government backgrounds. 29 teachers attended the workshop and 100% of teacher evaluations were positive. It is anticipated that information from this workshop will reach at least 1800 students.

### **Submissions to CoRIS**

SEFSC Coral Reef Program: FY 2009 Project Accomplishments Report. Compiled by Jennifer Schull. NOAA Technical Memorandum NMFS-SEFSC-614, 61 p.

### **FY2010 Publications**

SEFSC Coral Reef Program: FY 2009 Project Accomplishments Report. Compiled by Jennifer Schull. NOAA Technical Memorandum NMFS-SEFSC-614, 61 p.

### **FY2010 Presentations**

None

### **Setbacks or challenges encountered in FY2010**

None

### **Comments on future direction of project**

This project will continue into the foreseeable future, providing support and linkages between SEFSC and CRCP.

Dr. Martha Nizinski (NMFS Smithsonian National Systematics Laboratory) works with educators on a crustacean laboratory exercise as part of the Deep Coral Teacher Workshop.



### III. ASSESS AND CHARACTERIZE U.S. CORAL REEFS – CORAL REEF ECOSYSTEMS

<b>Project ID#:</b>	1064-2010
<b>Title:</b>	Assess and Monitor Coral Reef MPAs
<b>PIs and co-PIs:</b>	Jim Bohnsack (NOAA SEFSC) Benjamin Ruttenberg (NOAA SEFSC) Jerry Ault (UM-RSMAS) Steven Smith (UM-RSMAS)
<b>Duration of Project:</b>	Year 10
<b>Project Category:</b>	Reduce Adverse Impacts of Fishing Improve Use and Effectiveness of MPAs

#### **Brief description of activities conducted in FY2010**

The FY10 goals of this project were to continue long-term monitoring efforts of coral reef fish and habitat in the FL Keys and the Dry Tortugas region. Results are used to (1) assess the effects of marine reserves and other management zones in the FL Keys and Tortugas regions, and (2) improve understanding of ecosystem dynamics and guide ecosystem management, including the maintenance of sustainable fisheries. Sampling uses non-destructive visual assessments based on a stationary-diver technique deployed in a two-stage, stratified random sampling design.

Sampling in the FL Keys has occurred since 1979. Beginning in FY08, the State of Florida's Fish and Wildlife Research Institute (FWRI) and the National Park Service (NPS) agreed to perform cooperative sampling and subsequent data sharing with NOAA SEFSC. This collaboration began in earnest in FY09. Sampling in the Dry Tortugas region occurred irregularly from 1994-1999, and has occurred every two years since 2000. However, a no-take marine reserve was implemented in Dry Tortugas National Park in early 2007, with an agreement to evaluate its effectiveness in 5 years. Sampling for FY10 began in May, and included 393 sites and over 1500 research dives in the Florida Keys and Biscayne National Park, and around 390 sites and over 1500 research dives in the Dry Tortugas Region. Staff from NOAA SEFSC, NPS, FWRI, UM-RSMAS, and FIU participated in field research efforts

All data have been entered and passed through the initial quality assurance/quality control procedures, and we are in the final stages of QA/QC procedures. Data will be distributed to all partners, and we will use FY10 data to generate sampling points for FY11 surveys by late April or early May 2011.

#### **Description of accomplishments & results**

In FY10, divers conducted photo-documentation, Reef Visual Census (RVC) fish surveys, and habitat assessments at ~400 sites in the Florida Keys and ~400 sites in the Dry Tortugas ( 4 divers/site). NOAA SEFSC divers collaborated with the University of Miami and RSMAS, FKNMS,

Florida Fish and Wildlife Department/FWRI, and the National Park Service (South Florida and Caribbean Network). Approximately 1000 RVC dives were made by NOAA divers and 1800 by contractors, university, National Park Service, and Florida FWRI divers to complete the 2010 mission to monitor reef fish community composition, habitat composition, and abundance and size structure for over 300 reef fish species on Florida's coral reef tract. Data are used to assess population and habitat trends (e.g., whether species are overfished) and ecosystem responses to fisheries management actions, including determining the effectiveness of no-take MPAs.

### **How project supports goals & objectives of CRCP**

Monitoring of coral reef fish and habitat resources is critical to the assessment of ecosystem status and the effectiveness of management actions, particularly as they relate to MPAs and the effects of fishing on coral reef ecosystems.

### **How project supports management of coral reef resources**

Data and analytical results are shared with State of Florida, the National Park Service, and FKNMS managers to support and guide management decisions within Florida's coral reef ecosystems.

### **List of project Partners and their roles**

Rosenstiel School of Marine and Atmospheric Science, University of Miami: create survey design, assist with data collection, and assist with data analyses and writing technical reports.

State of Florida, Fish and Wildlife Research Institute of the Florida Fish and Wildlife Conservation Commission: assist with data collection.

U.S. National Park Service: permitting and assist with data collection.

### **Communications, media exposure, capacity building, education and outreach activities**

Partnerships with the State of Florida and the National Park Service has resulted in a significant increase in sampling power and project benefits to NOAA, the State of Florida, the National Park Service, and FKNMS managers. FY10 monitoring efforts in the Dry Tortugas resulted in a number of articles in the popular press. In addition, the Miami Public Broadcast station (WPBT) produced a documentary for their series *Changing Seas*. Filming occurred during a 2009 research cruise to the Dry Tortugas and aired in June, 2010.

### **Submissions to CoRIS**

Copies of papers below and metadata on QA/QC databases have been submitted to CoRIS.

## **FY2010 Publications**

Ault, J.S., S.G. Smith and J.T. Tilmant. 2010. Are the coral reef finfish fisheries of south Florida sustainable? Proceedings of the 11<sup>th</sup> International Coral Reef Symposium 11: 989-993.

Ault, J.S. and J.A. Bohnsack. Benefits of no-take marine reserves for exploited reef stocks in southern Florida. In press. *In* South Florida Marine Environments: An ecological synthesis. B. Kruczyiski and P. Fletcher, eds. Florida Sea Grant.

Bohnsack, J.A. In press. Reef Fishes in the Florida Keys. *In* South Florida Marine Environments: An ecological synthesis. B. Kruczyiski and P. Fletcher, eds. Florida Sea Grant.

Ault, J.S., S.G. Smith, J.A. Bohnsack, M. Patterson, B.I. Ruttenberg, and J. Hunt. Fishery-independent visual assessment of resource status of the reef fish community in Dry Tortugas National Park. RNA Performance Topic 1. Pages 2-3 in Hallac, D.E. and J. Hunt (eds.). 2010. Implementing the Dry Tortugas National Research Natural Area Science Plan: The 3-Year Report 2010. South Florida Natural Resources Center, Everglades and Dry Tortugas National Parks, Homestead, FL and the Florida Fish and Wildlife Conservation Commission, Tallahassee, FL. 37 pp.

## **FY2010 Presentations**

Bohnsack, J.A. "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. Nov. 2009.

Ruttenberg, B. I. "Demographic and life history variation in reef fish across environmental and anthropogenic gradients." Marine Sciences Seminar Series, Florida International University, Miami, FL. Invited seminar. Nov. 2009.

Ruttenberg, B. I. "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. Nov. 2009.

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

Bohnsack, J.A. "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. Jan. 2010.

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

Bohnsack, J.A., B. Ruttenberg, D.B. McClellan, J.S. Ault, and S.G. Smith. 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.

Ruttenberg, B. I. "Coral reef ecology and the Florida Keys." Digital Wave Program, Miami Museum of Science, Miami, FL. Invited presentation. June 2010.

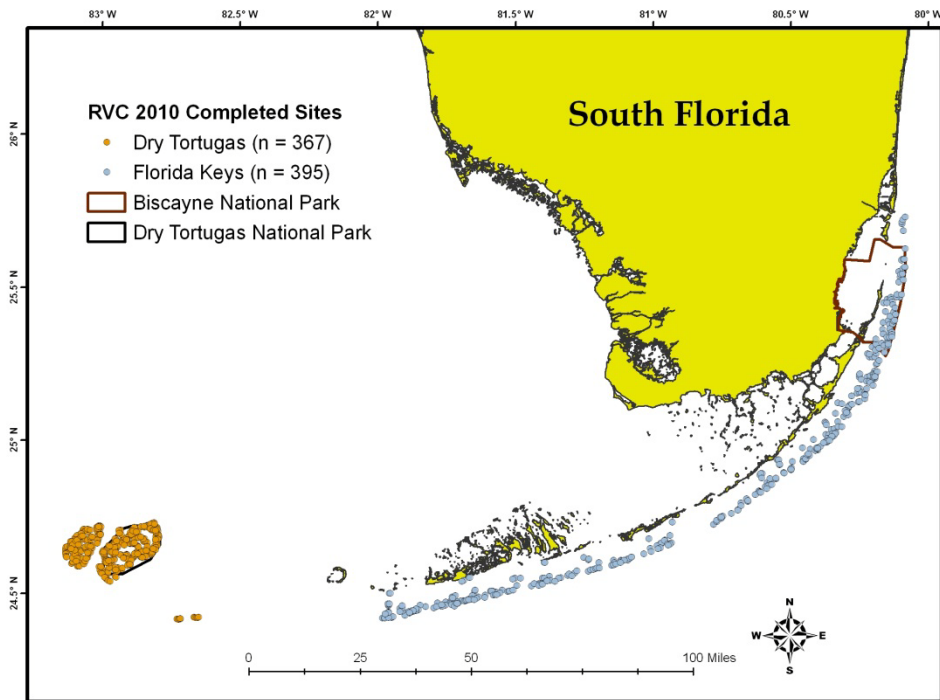
Ault, J.S. "Modeling U.S. coral reef ecosystems: developing decision support systems to build sustainable multispecies fisheries." NSF National Institute for Mathematical and Biological Synthesis. Knoxville, TN. Invited presentation. July 2010.

### Setbacks or challenges encountered in FY2010

None.

### Comments on future direction of project

This project will continue to provide data to assess effects of natural and anthropogenic impacts to FL coral reef ecosystems, with an emphasis on the effects of MPAs and the effects of fishing on target species, the fish community in general, and on ecosystem resilience. Future work will include sampling north of Biscayne National Park (i.e. SEFCRI) region for seamless coral reef fish monitoring across the entire Florida Reef Tract.



Survey locations along the Florida Keys reef tract during FY10, including the Dry Tortugas region. Sites include all those surveyed by NOAA, the State of Florida, and the National Park Service. Four data collection dives occurred at each site.

#### IV. REDUCE IMPACTS OF COASTAL USES

<b>Project ID#:</b>	1066-2010
<b>Title:</b>	Evaluation of <i>Acropora</i> Status for Management, Recovery, and Climate Response
<b>PIs and co-PIs:</b>	Margaret W. Miller (NOAA SEFSC) Dana E. Williams (UM CIMAS)
<b>Duration of Project:</b>	Year 10
<b>Project Category:</b>	Reduce Impacts of Pollution & Coral Diseases Reduce Threats to International Coral Reefs Reduce Impacts of Climate Change Address Emerging Issues

#### Brief description of activities conducted in FY2010

As of 2010, this project consisted of thirty-one 150 m<sup>2</sup> study plots at 9 reef sites designed to characterize survivorship and recruitment of ESA listed *Acropora palmata* in the Florida Keys. Goals of this project included quantifying status and recovery of protected corals as well as contributing towards population modeling by collaborators in support of the ESA recovery plan. We completed full surveys of all 25 study plots (Dec 2009 and May 2010). Five new study plots were established at 4 sites (Carysfort, Grecian Rocks, and Key Largo Dry Rocks and French Reef) in the upper keys in August 2010. We also tagged new colonies at existing sites to compensate for mortality over the course of the study. Tissue samples were collected and analyzed for genotyping at each of the 5 new study plots and for all colonies that were not present at the 2006 sampling. Lastly, in May 2010, annual surveys (3 sites, 9 study plots) of comparison sites in Curaçao were accomplished as planned.

#### Description of accomplishments & results

Since 2004 when our monitoring began there has been a loss of 45% of the *A. palmata* from our study plots. Most of this decline occurred as a result of the 2005 hurricane season and since then there has been a modest (10%) recovery. The total number of colonies has declined by only 10%; however, the average dimension of the colonies declined by nearly 25% and after 5 years is nearly back to the 2005 dimension. Additionally, colonies lost on average more than 20% of their live tissue cover, further compounding the decline in number of colonies. Analysis of threats facing *A. palmata* has revealed that in the absence of hurricane impacts, disease is the primary cause of tissue loss to standing colonies and accounts for more than one third (35%) of lost tissue followed by corallivorous snail (*Coralliophila abbreviate*) predation (25%) and skeletal breakage (21%).

The new sites established under this permit do not yet have enough data to allow for meaningful analysis of their performance with the exception of White Bank. Three study plots were established there with a total of 135 monitored colonies in Spring 2009 and following the



extreme cold weather in January 2010, there were no live colonies remaining. Our team was instrumental in monitoring the extent of the cold water event's deleterious impacts on corals.

### **How project supports goals & objectives of CRCP**

"Florida's top mapping and monitoring needs to support management" (1 of 5) is "*Acropora* monitoring and mapping" (Morgan & Waddell (eds) 2009, p.2) as stated in CREIOS Workshop Report. Endangered species recovery and reef restoration both appear as Florida management priorities (p.19). More generally, Florida managers identified a need to better assess coral recruitment (including *Acropora* spp.) within their region (p.22).

CRCP Performance Measures F2.1: "Stable or increasing biomass of key taxa in Marine Protected Areas." 5 of 7 of our demographic monitoring sites are within no-take reserves. *A. palmata* is surely a 'key taxa' in reef crest environments. Demographic monitoring provides means to assess stability or increase in *A. palmata* abundance in these areas.

CRCP Performance Measures C4.1: Developing intervention strategies to preserve coral/increase resilience in priority areas.

### **How project supports management of coral reef resources**

Listed species require status review every 5 years. Status must be evaluated across the entire species range for invertebrates. Florida Keys and Curaçao populations represent some degree of 'end members' (worst and best) in our understanding of *A. palmata* species status.

ESA listing mandates recovery. The draft *Acropora* Recovery Plan indicates demographic monitoring, snail predator removal (including development of a guidance document), and the development of disease mitigation tools as priority actions for *Acropora* recovery.

### **List of project Partners and their roles**

In 2010 we partnered with Florida Fish and Wildlife Conservation Commission as they initiated an *A. palmata* monitoring project in the middle and lower Keys and Biscayne National Park utilizing consistent methods (Williams et al 2006 NOAA Tech Memo) under funding from the Protected Resources Section 6 program. Academic partner at UCSD/Scripps (T. Vardi) is utilizing monitoring data in predictive population modeling (see poster presentation below).

### **Communications, media exposure, capacity building, education and outreach activities**

In July 2010 a workshop was held to train the partners (described above) in field methods to improve comparability of the data collected across regions. Further training and collaboration with project partners in USVI is anticipated in FY11.

## Submissions to CoRIS

FKNMS Permit Report

Williams et al. "Status of *Acropora palmata* in Curaçao: comparison with Florida Keys."  
SEFSC/PRBD Division Report 11-01

## FY2010 Publications

Williams et al. "Status of *Acropora palmata* in Curaçao: comparison with Florida Keys."  
SEFSC/PRBD Division Report 11-01

## FY2010 Presentations

Florida Keys 'Linking Science to Management' Conference, Oct 2009.

D.E. Williams and M.W. Miller. Drivers of population decline in *Acropora palmata* in the Florida Keys National Marine Sanctuary. (Oral Presentation)

<http://conference.ifas.ufl.edu/floridakeys/Presentations/Thursday/AM/0900%20Williams%20.pdf>

T. Vardi and D.E. Williams. Will *Acropora palmata* be around in 20 years? (Poster Presentation)

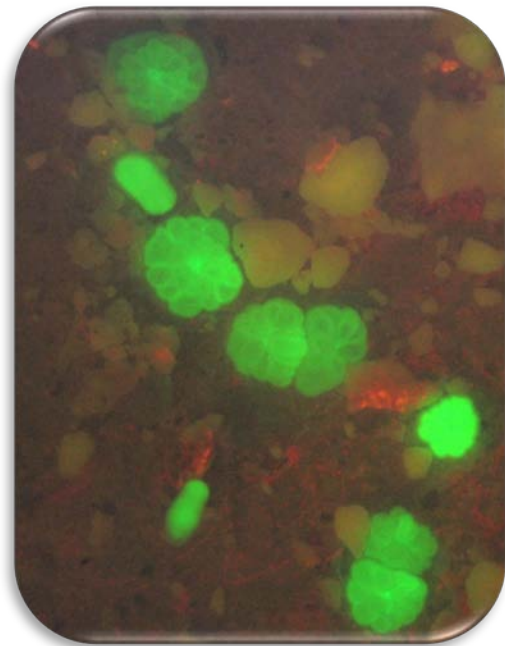
<http://www.conference.ifas.ufl.edu/FloridaKeys/Presentations/PDFS/Session%201/Vardi%20Acropora%20palmata%20in%2020%20years%20Session%201.pdf>

## Setbacks or challenges encountered in FY2010

None.

## Comments on future direction of project

In FY11, the monitoring plots (and known corallivore dynamics) will serve as a platform for a pilot corallivore removal experiment as a means to test effectiveness of a proposed proactive conservation measure, which might be implemented as part of ESA Recovery actions.



A collection of recently settled *A. palmata* primary polyps (pre-skeleton).

<b>Project ID#:</b>	20200 - 2010
<b>Title:</b>	Aquarius Coral Restoration/Resilience Experiments
<b>PIs and co-PIs:</b>	Margaret W. Miller (NOAA SEFSC)
<b>Duration of Project:</b>	Year 4
<b>Project Category:</b>	Reduce Impacts of Coastal Uses Reduce Impacts of Pollution & Coral Diseases Reduce Impacts of Climate Change Address Emerging Issues

### **Brief description of activities conducted in FY2010**

Though field components of this project (both execution of Aquarius saturation mission in June and dayboat sampling event in October) were disrupted or prevented by sudden NOAA - OSHA related issues, we completed field sampling of transplants in March and June 2010. We also completed pilot experiments on disease transmission by corallivorous fire-worms, as disease and predation have both been noted as significant sources of tissue loss on transplanted corals.

### **Description of accomplishments & results**

This project involved a large coral transplant experiment designed to compare the performance of corals from different sources. Ancillary experiments have focused on better characterizing corallivore dynamics and impacts as predation has been observed as a major source of mortality for the *Acropora cervicornis* transplants. Overall, survivorship of the transplants has been poor, but highly variable across different source populations and across different outplant sites.

Scientific sampling and analyses for this project are ongoing; however, results and recommendations have already been provided directly to managers and permitting officials. Direct management reporting on the interim results from this project included 1) a comprehensive progress report (including data results to date) provided to all permitting agencies in April 2010, 2) an oral presentation at the Florida Keys Linking Science to Management conference (Oct 2010), and 3) an invited presentation on corallivore considerations in designing coral outplant procedures at the ARRA Coral Nursery Outplanting Workshop (2 Oct). In addition, one peer-reviewed publication product (Baums et al. 2010.) was specifically cited by State of Florida officials at this workshop as providing essential information for the determination by Florida FWC that the ARRA nursery outplants could proceed under a 'low genetic risk' permitting designation.

### **How project supports goals & objectives of CRCP**

This research project contributes toward generating the scientific basis (an identified priority by both FKNMS and the Draft *Acropora* Recovery Plan) to inform management/permitting decisions regarding design of coral transplant/restocking actions and to improve successful

outcomes of these projects, such as the ARRA coral nursery project, with which we are closely coordinating.

### **How project supports management of coral reef resources**

Products from this project are being directly applied by management in the design and ongoing permitting process for the outplanting phase of the ARRA Coral Nursery project. This input has been provided both in the form of scientific publication (Baums et al., 2010) and in direct presentations and discussions at the 3-4 Nov ARRA Outplanting Workshop and the Florida Keys 'Linking Science to Management' conference 20-22 Oct. This work helps develop and test best management practices for restoring imperiled corals.

### **List of project Partners and their roles**

George Mason University: collaboration on disease characterization & transmission experiments

Penn State University: collaboration on coral and zooxanthellae genotyping

FAU/Harbor Branch: collaboration on coral micro-arrays

UNCW/Aquarius Reef Base: logistic support and collaboration on PAM fluorometry

FKNMS: permitting and advice

### **Communications, media exposure, capacity building, education and outreach activities**

Dr. Miller accompanied Dr. Lubchenco on a tour of the ARRA Nursery sites in the Florida Keys and shared information about her projects and how they encourage best practices in restoration science and explore bottlenecks to *Acropora* maintenance and recovery.

### **Submissions to CoRIS**

Baums, IB, ME Johnson, MK Devlin-Durante, and MW Miller. 2010. Host population genetic structure and zooxanthellae diversity of two reef-building coral species along the Florida Reef Tract and wider Caribbean. *Coral Reefs* 29: 835-842

### **FY2010 Publications**

Baums, IB, ME Johnson, MK Devlin-Durante, and MW Miller. 2010. Host population genetic structure and zooxanthellae diversity of two reef-building coral species along the Florida Reef Tract and wider Caribbean. *Coral Reefs* 29: 835-842

### **FY2010 Presentations**

Miller, MW, DE Williams, L Johnson, M Durako, C Woodley, I Baums. Testing Coral Transplant Performance: Aquarius Coral Restoration/Resilience Experiments (ACRRE). Linking Science to Management: A conference & Workshop on the Florida Keys Marine Ecosystem. Duck Key, FL.

## Setbacks or challenges encountered in FY2010

Sudden OSHA driven decisions by NOAA impaired or precluded field operations for this project both in June 2010 (Aquarius saturation diving mission) and Oct 2010 (dayboat mission). Potential to complete planned field assessments in 2011 under NURC auspices as contracted is still in question.

## Comments on future direction of project

FY11 will be the final project year and field work will focus on characterizing and comparing disease dynamics in outplanted, wild, and nursery populations of *A. cervicornis*. In addition, pilot mitigation techniques (e.g., placing epoxy band over the disease/tissue margin and excising healthy branch sections and transplanting at a distance from the diseased colony) will be experimentally tested to determine effectiveness in arresting disease losses in outplanted populations.



Dr. Lubchenco (accompanied by Tom Moore) visits *A. palmata* colonies that were outplanted as larvae at the Wellwood Restoration Site (Florida Keys) in 2004 by Dr. Miller's group. Photo credit: Frazier Nivens

## V. REDUCE ADVERSE IMPACTS OF FISHING

<b>Project ID#:</b>	20505-2010
<b>Title:</b>	Coupling of Passive and Active Acoustics to Assess Grouper Aggregations in the Tortugas Ecological Reserve
<b>PIs and co-PIs:</b>	Michael L. Burton (NOAA SEFSC) Chris Taylor (NOAA NCCOS) James Locascio (University of South Florida)
<b>Duration of Project:</b>	Year 1
<b>Project Category:</b>	Reduce Adverse Impacts of Fishing Improve Use and Effectiveness of MPAs

### Brief description of activities conducted in FY2010

January and March 2010 cruises were delayed due to acquisition difficulties related to the late release of CRCP funding. Cruises were conducted in both April and June, but inclement weather shortened the June survey. One cruise was conducted in January 2011.

### Description of accomplishments & results

Our first 3-day research cruise was planned for January 2010, but did not occur until April 29-May 1, 2010 due to acquisition difficulties. During this cruise we deployed three digital spectrum recorders, passive acoustic recording devices capable of recording for more than a year, at programmable intervals (i.e., 1 minute every hour, etc.). DSRs were deployed at originally planned stations where previous dive surveys had noted increased numbers of groupers, making them likely spawning aggregation sites. Fish census transects and cylinder point counts were done at each of these stations as well. At two stations we deployed cameras in housings for overnight recording of any fish activity near the DSRs. After the first day of dive operations, we conducted active acoustic split beam sonar transects from 1630-1900 hrs, completing two complete mappings of the Station 12-12A complex. Later in the trip, researchers recovered the two cameras deployed the first day. While some cruise time was lost to weather, we were able to accomplish three key goals of this research: 1) deployment of long term passive acoustic recorders on all three key stations; 2) completion of fish counts (transects and pt. counts) within proximity of recorders; and 3) deployment and recovery of overnight cameras to record fish behavior.

The second cruise, originally planned for February 2010, was conducted June 27-28, 2010. Inclement weather made diving conditions treacherous so the dive safety officers canceled the cruise for safety reasons.

The third and final cruise, originally planned for either March or April 2010, was delayed until January 2011 to be temporally consistent with grouper spawning season. We confirmed the presence of the three previously deployed DSRs and deployed three more at newly selected

stations (part of the FY11 proposal). Fish transects and point counts were conducted and sonar transects were done in the evenings. This was a highly successful cruise, as 2 DSRs were retrieved and downloaded, 6 DSRs were deployed, three nights of sonar transects were accomplished, black grouper courtship behavior was observed on one station, and lionfish were collected and returned to the Beaufort Laboratory for biological research.

### **How project supports goals & objectives of CRCP**

This research supports CRCP Fishing Impacts Goal and Performance Measure (FIG-PM) F1 PM1.1 and FIG-PMs F2 PM2.1 and PM 2.2. This project and the partnership with NCCOS, FWC and FKNMS to monitor the living marine resources of the TSER and TNER will contribute toward an overall goal of 85% of all jurisdictions monitored by the year 2012, as well as ensuring that 100% of coral reef regions have improved coral reef living marine resources by 2015. The active acoustic technology we are using (split beam sonar) is an exciting tool to assess the recovery of exploited fish stocks and characterize both the coral reef habitat as well as the associated fish community.

### **How project supports management of coral reef resources**

Research plans are articulated to managers in the proposal development process, as they are partners in this project. Progress and accomplishments are provided in annual reports and at appropriate meeting venues, whenever possible. This project uses acoustics to effectively identify and monitor spawning sites and events in the TER in support of the MPA, as well as monitoring the effectiveness of the MPA to maintain or increase biomass of economically important species. This project is also documenting the arrival and proliferation of lionfish within the TER.

### **List of project Partners and their roles**

Dr. Chris Taylor: NCCOS, CCFHR - Acoustics  
Dr. Jim Locasio: University of South Florida - Acoustics  
FKNMS –Planning and research prioritization

### **Communications, media exposure, capacity building, education and outreach activities**

Oral communication of the cruise plan and survey results was conducted during the active field components of this project.

### **Submissions to CoRIS**

None.

### **FY2010 Publications**

None yet, peer review publication planned for CY 2012 upon completion of two year project.

## **FY2010 Presentations**

Presentations planned for CY 2012 upon final analysis of two year project.

## **Setbacks or challenges encountered in FY2010**

Late arrival of budget and bottlenecks with procurement. Weather challenges.

## **Comments on future direction of project**

Work continues on analysis of first year of data collection, and recording devices are currently deployed collecting year two data.



Co-PI Jim Locascio, USF, and Ken Brennan, NMFS Beaufort Laboratory, deploy underwater cameras with hydrophones at selected stations to study acoustics of grouper spawning aggregations. (Photo credit: Mike Judge, NMFS, SEFSC, Miami Laboratory).



<b>Project ID#:</b>	1068-2010
<b>Title:</b>	Assess/Monitor Effects of MPA Status on Reef Fish Populations and Spawning Aggregations in the Tortugas Ecological Reserves
<b>PIs and co-PIs:</b>	Michael L. Burton (NOAA SEFSC)
<b>Duration of Project:</b>	Year 9
<b>Project Category:</b>	Reduce Adverse Impacts of Fishing Improve Use and Effectiveness of MPAs

### **Brief description of activities conducted in FY2010**

The project has evolved into to a biennial sampling/monitoring strategy. No sampling was conducted in FY2010. This entry is a placeholder.

### **Description of accomplishments & results**

N/A

### **How project supports goals & objectives of CRCP**

N/A

### **How project supports management of coral reef resources**

This project is providing much needed scientific evidence that even severely exploited species, once protected from excessive fishing pressure, may indeed recover. The documentation of mutton snapper spawning after years of heavy overexploitation should further justify and advance the use of marine protected areas as a viable management tool to protect both coral reef fishes and coral reef habitat. Documentation of the recovery of exploited species once they are protected from fishing benefits coral reef ecosystems (reef fish populations plus the coral reef habitat they use) by showing the effectiveness and utility of using MPAs as a management tool to protect these ecosystem components. Documentation of the effectiveness of MPAs in recovering exploited fish populations is of great relevance to the fisheries management community (South Atlantic Fishery Management Council, Gulf of Mexico Fishery Management Council) as well as to the Florida Keys National Marine Sanctuary. Presentations will be given to the FKNMS Advisory Panel on this year's results and future research plans , and findings will be presented as well to the Councils in the form on non-technical summary reports. These results will be shared with the Caribbean Fishery Management Council as well as the territorial fishery management agencies since spawning aggregation management is an important issue in these areas as well.

### **List of project Partners and their roles**

FWC Marathon Laboratory (Alejandro Acosta/John Hunt): partners in research cruises.  
NOAA FKNMS (Scott Donahue): partners in research coordination/planning.

**Communications, media exposure, capacity building, education and outreach activities**

None.

**Submissions to CoRIS**

None.

**FY2010 Publications**

None.

**FY2010 Presentations**

None.

**Setbacks or challenges encountered in FY2010**

None.

**Comments on future direction of project**

Plans exist for biennial summer aggregations cruise in July 2011.

<b>Project ID#:</b>	1317 - 2010
<b>Title:</b>	Assessing the Locations and Status of Reef Fish Spawning Aggregations in the Florida Keys
<b>PIs and co-PIs:</b>	Todd Kellison (NOAA SEFSC) Chris Taylor (NOAA NCCOS)
<b>Duration of Project:</b>	Year 1
<b>Project Category:</b>	Reduce Adverse Impacts of Fishing

### **Brief description of activities conducted in FY2010**

In FY10, we continued efforts to identify and assess reported reef fish spawning aggregations (FSAs) in the Florida Keys. Building on research in the upper FL Keys, in FY10 we focused on multiple sites in the lower Keys to accomplish two objectives: (1) assess whether reported FSA sites are characterized by similar habitat characteristics, with a focus on geomorphological features, and (2) assess fish utilization patterns of reported FSA sites.

We used a commercial single-beam acoustic seabed classification system to map FSA sites. Previous results from the upper FL Keys indicated that drowned ridges, known locally as outlier reefs, are features found in proximity to all FSA sites studied (n = 6 sites). In FY10 we mapped reef areas associated with four reported FSA sites in the lower FL Keys. For the fish utilization component, fisheries sonar and diver surveys were performed in 2010 at reported gray snapper (n = 3 sites) aggregation sites in the lower FL Keys during predicted full-moon spawning periods.

We also initiated Keys-wide aerial surveys to identify potential FSA sites via observations of concentrated fishing vessels during predicted spawning moons.

### **Description of accomplishments & results**

As with the upper Keys aggregation sites, all four sites in the lower Keys were in proximity to outlier reefs, further supporting a conceptual model we have developed associating outlier reefs with FSA sites (Gleason et al. In press).

For the fish utilization component, positive signs of aggregated gray snapper were observed at multiple locations near Key West, including one site where relatively large (~ 35-50 cm FL) gray snapper were observed over multiple days in aggregations totaling many hundreds of fish (one diver estimated ~ 800 fish in his field of view, and the aggregation appeared to extend well beyond his field of view; suggesting the probable presence of thousands of fish). These sites are planned for additional focus during FY11 surveys.

### **How project supports goals & objectives of CRCP**

This project addresses Objective F2.4. Our results will help managers in the Florida Keys meet their Jurisdictional Objective A1.2 in developing a comprehensive zoning plan in terms of

evaluation of the location, size and rezoning of Sanctuary Preservation Areas (i.e., no-take areas).

### **How project supports management of coral reef resources**

Reef fish spawning aggregations (FSAs) are a vital part of the life cycle of many reef fishes. Unfortunately, the act of aggregation makes aggregating species particularly vulnerable to overfishing. The protection and conservation of FSAs is critical to the sustainable management of grouper, snapper and other reef fish fisheries, from both fisheries and ecosystem perspectives. Results from this ongoing research effort will help to identify aggregation locations and thus facilitate sustainable management for the aggregating species. Florida Keys National Marine Sanctuary managers are kept abreast of research results (via direct communication from project PIs) and directly support the research through making resources available for use (e.g., vessels and docking facilities).

### **List of project Partners and their roles**

University of Miami (Dr. Art Gleason) – mapping component  
State of Florida Fish and Wildlife Conservation Commission (multiple personnel) – cooperative field sampling and data analysis

### **Communications, media exposure, capacity building, education and outreach activities**

None.

### **Submissions to CoRIS**

None.

### **FY2010 Publications**

Gleason, A, T Kellison & P Reid. In press. Geomorphology of grouper and snapper aggregation sites in the upper FL Keys, USA. Professional Geographer. (note: this publication will be submitted to CoRIS once it is fully published)

### **FY2010 Presentations**

Kellison T, A Gleason, C Taylor, A Acosta & M Feeley. Assessment of geomorphological characteristics and reef fish utilization of reported reef fish aggregation sites in the Florida Keys, USA. NMFS National Stock / Habitat Assessment Workshop.

D Morley, T Kellison, C Taylor, A Acosta, M Feeley & A Gleason. Assessment of geomorphological characteristics and reef fish utilization of reported reef fish aggregation sites in the Florida Keys, USA. Poster Presentation. Linking Science to Management: A conference & Workshop on the Florida Keys Marine Ecosystem. Duck Key, FL.

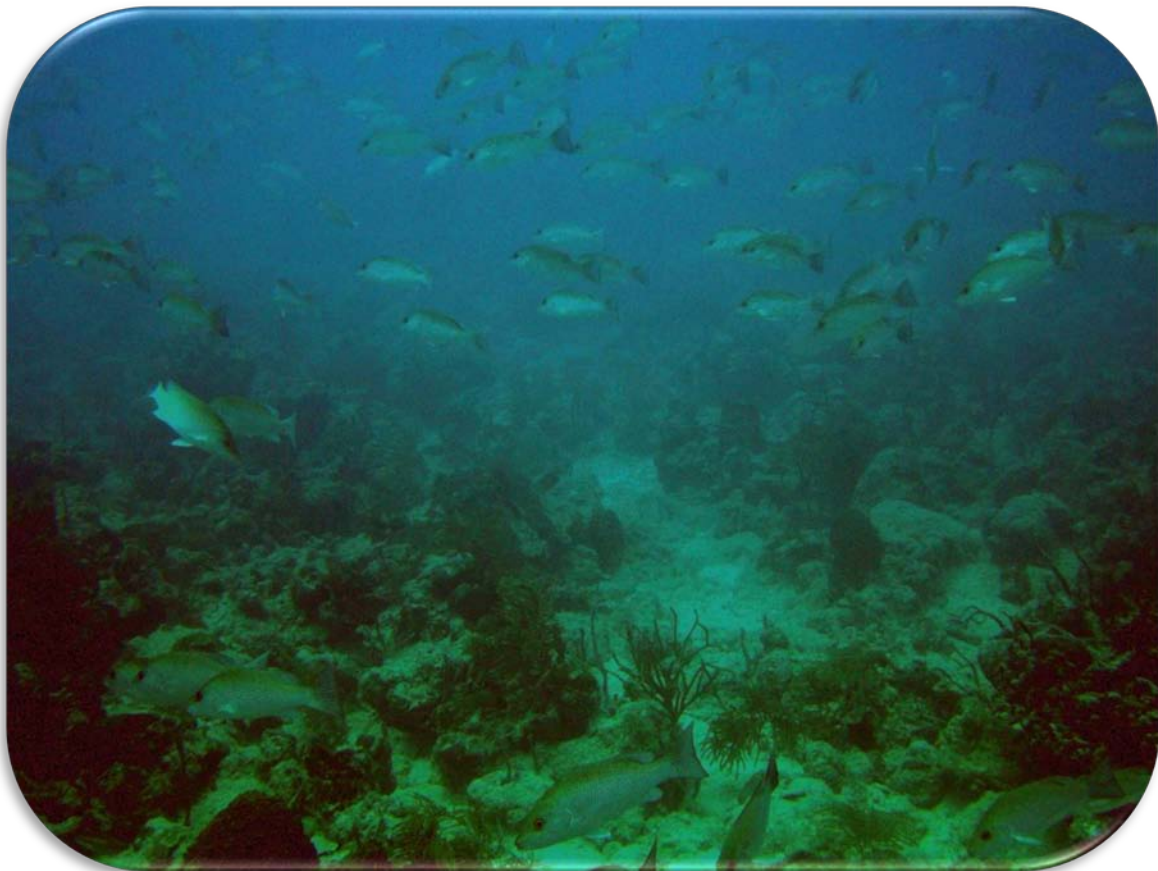
B Binder, A Acosta, **T Kellison, C Taylor**, M Feeley, D Morley & A Gleason. Estimating Fishing Intensity on Spawning Aggregation Sites by Means of Aerial Survey. Poster Presentation. Linking Science to Management: A conference & Workshop on the Florida Keys Marine Ecosystem. Duck Key, FL.

### **Setbacks or challenges encountered in FY2010**

None.

### **Comments on future direction of project**

We plan to continue to use integrated mapping, diving and acoustics approaches to assess the location and status of reef fish spawning aggregations in the Florida Keys in support of fisheries and marine protected area management.



Aggregated gray snapper (*Lutjanus griseus*) observed during a predicted spawning period at a site near Key West in June 2010 (photo credit: NOAA).

<b>Project ID#:</b>	20439-2010
<b>Title:</b>	USVI Commercial Fishermen Census
<b>PIs and co-PIs:</b>	Juan Agar (NOAA SEFSC)
<b>Duration of Project:</b>	Year 3
<b>Project Category:</b>	Reduce Adverse Impacts of Fishing

### **Brief description of activities conducted in FY2010**

Survey work was completed and the data were cleaned and entered into an excel database for subsequent analytical work. The database contains information on fishermen’s demographic characteristics, capital investment on vessels, gear and fishing equipment, fishing and marketing practices, and perceptions about the health of local fisheries and coral reefs.

### **Description of accomplishments & results**

A total of 259 commercial fishermen were interviewed, 102 in St. Thomas/St. John District (85% of the local licensed fishermen) and 157 in St. Croix District (89% of the local licensed fishermen). The data will be used to describe the current state of the fishery for regulatory work (e.g., Amendments), to monitor socio-economic trends over time, and as an input to models that evaluate the performance of management proposals.

### **How project supports goals & objectives of CRCP**

The development of sound coral reef conservation policies requires current descriptions of resource users and their communities and an understanding of how management proposals will likely impact the various resource users. Because this work updates an earlier USVI fishermen census conducted in 2003, managers and analysts will have better information to examine the performance of past conservation actions and to develop models that investigate the likely socio-economic impacts of management proposals.

### **How project supports management of coral reef resources**

The findings of this project support the management and conservation of coral reef resources by providing current description of fishermen and their communities which will be the basis of future regulatory analyses. This project will likely benefit coral reef ecosystems by refining a set of best management practices (adaptive management), and by helping develop culturally sensitive policies, which can promote regulatory acceptance and compliance, and improve the success of management actions.

## **List of project Partners and their roles**

Dr. Barbara Kojis (contractor): responsible for co-developing the survey instrument (in collaboration with Dr. Juan Agar from the SEFSC), coordinating the data collection, entering and cleaning the data, and writing the final report.

## **Communications, media exposure, capacity building, education and outreach activities**

Data are still being analyzed, however the final report will be shared with many of our partners, including Caribbean Fishery Management Council, U.S. Virgin Islands Fish and Wildlife Division, and Southeast Regional Office. Project personnel will make a presentation to the Caribbean Fisheries Management Council in 2011. Sea Grant has expressed interest in producing an abridged publication detailing the main findings of this work similar to what was done for the Puerto Rican fishermen census (<http://www.seagrantpr.org/catalog/files/fuete/vol4num2.pdf>).

## **Submissions to CoRIS**

The final report is expected to be provided to CoRIS by March 2012.

## **FY2010 Publications**

Matos-Caraballo, D. and J. Agar, 2011. Census of Active Fishermen in Puerto Rico: 2008. Marine Fisheries Review, Vol. 73(1):13-27

## **FY2010 Presentations**

Project personnel have submitted two abstracts to the 64<sup>th</sup> Annual Gulf and Caribbean Fisheries Institute (GCFI) meeting (Puerto Morelos, Mexico) dealing with safety at sea and the evolution of fisheries management in the U.S. Virgin Islands, which will draw from selected results of the 2010 fishermen census. It is anticipated that once the report is finalized the contractor will present key findings of this work in next year's GCFI meeting. Additionally, results from this project will be presented to the Caribbean Fishery Management Council.

## **Setbacks or challenges encountered in FY2010**

The cleaning and validation of the fishermen census data is taking longer than anticipated, delaying the publication of these results.

## **Comments on future direction of project**

The final report is expected to be completed by March 2012. The results of this study closely align with CRCP priorities because they provide useful background information for conducting socio-economic assessments of priority sites and/or management actions such as the proposed studies on the gillnet and trammel net ban (invited to submit a full proposal this FY) and the evaluation of the socio-economic performance of MPA (not invited to submit a full proposal

this FY). These socio-economic research activities support the conservation and management of valuable coral reef ecosystems.



St. Thomas fisherman mending his net (Photo credit: B. Kojis, 2011)



<b>Project ID#:</b>	1244-2010
<b>Title:</b>	Monitoring Coral Reef Fish Use of MPAs and Recruitment Connectivity between the Florida Keys and Meso-American Reefs
<b>PIs and co-PIs:</b>	John Lamkin (NOAA SEFSC)
<b>Duration of Project:</b>	Year 8
<b>Project Category:</b>	Improve Use and Effectiveness of MPAs Reduce Threats to International Coral Reefs

### **Brief description of activities conducted in FY2010**

All samples collected during 2006 and 2007 cruises have been sorted. Samples included depth stratified collections to 100 m using a MOCNESS (multiple opening and closing with an environmental sensing system) net. Analysis of the data (both biological and oceanographic) has been ongoing with the collaboration of our international partners in Mexico.

### **Description of accomplishments & results**

Cruise samples from 2007 yielded 51,361 individual fish from 119 families, representing at least 283 species. In addition, oceanographic processes and patterns are currently being analyzed and preliminary findings will be presented at the Gulf and Caribbean Conference in 2011 in Mexico.

These studies on coastal ichthyoplankton in the Mexican Caribbean provided a first approximation of the composition and abundance of fish larvae in this region. Ichthyoplankton abundance data from 2006 and 2007, showed a gradation from high abundance in the south to a lower abundance further north at the Yucatan Channel, and the distribution and abundance of groupers (Serranidae) mirrored this pattern. However, other reef fish such as wrasses (Labridae), showed peak abundances both in the north and south. Inshore larval reef fish collections from 2003 to 2008 suggest that local recruitment in some areas was strongly influenced by small scale circulation patterns; however, the known distribution of spawning aggregations along the Yucatan coast suggests a potentially larger role for the Caribbean Current.

### **How project supports goals & objectives of CRCP**

The eastern coast of the Yucatan Peninsula contains 39 known sites where spawning aggregations occur, located along a strong western boundary current flowing northward into the Gulf of Mexico. The Florida Keys and Dry Tortugas coral reef systems lie downstream of these spawning areas. Results from these cruises and ancillary data show that the study areas – coastal Mesoamerica and the Florida Keys reef tract – are oceanographically connected, with relatively rapid transport time-scales. Furthermore, eddies and gyres may play an important role in establishing the relevant time and distance scales of connectivity. Such direct physical connectivity by means of ocean currents between the coral reef biota of these geographically separated spawning grounds may have an important influence on the degree of biological

connectivity between regional populations of ecologically and economically important tropical marine species.

### **How project supports management of coral reef resources**

The synthesis of larval fish and physical oceanography data will help us determine the location and relative importance of spawning sites specific to coral reef fish. The incorporation of this information into fisheries oceanographic models assists local resource managers in making decisions for siting and managing marine protected areas (MPAs) and optimal seasonal closures. Managers have been informed of progress and results yearly. The Comision Nacional de Areas Naturales Protegidas (CONANP) is the local management entity equivalent to the National park Service in Mexico. Meetings with Director Maria del Carmen Garcia have been conducted in Chetumal with our ECOSUR partners to continue fostering her support in management relevant scientific research. Spawning aggregations occur in the MPAs that Ms. Garcia manages and she and her staff have participated in various workshops and meetings to consider sound science in management decisions that directly affect Xcalak Reef National Park and Chinchorro Natural Reserve in the Yucatan.

### **List of project Partners and their roles**

ECOSUR is an academic partner and provided personnel for processing and identification of samples. CONANP has provided logistical support to carry out scientific research.

### **Communications, media exposure, capacity building, education and outreach activities**

A capacity-building workshop in otolith microstructure was held with Mexican colleagues in May 2010.

### **Submissions to CoRIS**

Metadata for Ichthyoplankton (biological) data collected aboard the NOAA Ship Gordon Gunter during cruise 0701 was submitted.

### **FY2010 Publications**

B. C. Victor, L. Vasquez-Yeomans, M. 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.

Olivares-Escobedo, J. Ingreso mensual de poslarvas de langosta *Panulirus argus* en el Parque Nacional Arrecifes de Xcalak: Variación estacional y comparación de dos tipos de colector. (*translation: Monthly ingress of post-larval lobster Panulirus argus, in Xcalak Reef National Park: Seasonal variability and comparison between two collectors.* (Senior Thesis)

## FY2010 Presentations

JT Lamkin, BA Muhling, E Malca, L John. 2010. Larval transport and small scale gyres along gyres along the Yucatan coast of Mexico. (Oral presentation). 34<sup>th</sup> Annual Larval Fish Conference. Santa Fe, New Mexico.

E Malca, L Vázquez-Yeomans, E Sosa-Cordero, J Cohò, J Lamkin. 2010. Description of newly settled *Mycteroperca bonaci* (Serranidae: Epinephelini) using genetic identification in the Quintana Roo, Mexico. (Poster Presentation). 34<sup>th</sup> Annual Larval Fish Conference. Santa Fe, New Mexico.

## Setbacks or challenges encountered in FY2010

A planned science workshop did not take place due late receipt of funds and the DWH oil spill event – Our laboratory was called to respond to the event which interfered with travel. Instead, teleconferences and web-conferences took place to discuss and review data with our partners.

## Comments on future direction of project

This is the last year of this project.

Common Name	Family	Abundance
Lanternfish	Myctophidae	10046
Parrotfish	Scaridae	5337
Wrasses	Labridae	2844
Sleeper gobies	Eleotridae	2218
Bristlemouth	Gonostomatidae	1971
Gobies	Gobiidae	1943
Lightfishes	Phosichthyidae	1283
Lefteye flounder	Bothidae	1125
Jacks	Carangidae	912
Codlets	Bregmacerotidae	817
Surgeonfishes/tangs	Acanthuridae	793
Greeneyes	Chlorophthalmidae	729
Barracudinas	Paralepididae	679
Groupers and basses	Serranidae	568
Snake mackerels	Gempylidae	469

Most abundant families of fishes collected during the 2007 research survey aboard NOAA R/V Gordon Gunter.

<b>Project ID#:</b>	20607 - 2010
<b>Title:</b>	Improving Trap Designs to Reduce Bycatch Mortality of Reef Herbivores
<b>PIs and co-PIs:</b>	Ron Hill, PhD (NOAA SEFSC) Jennifer Doerr (NOAA SEFSC)
<b>Duration of Project:</b>	Year 1
<b>Project Category:</b>	Reduce Adverse Impacts of Fishing

### **Brief description of activities conducted in FY2010**

Coral reefs of the Caribbean have been changed by the loss of herbivores such as diademid urchins, parrotfishes, and surgeonfishes. Concurrent coastal development practices have increased run-off of excess nutrients, increasing the competitive advantage of macroalgae on reefs and increasing the chance of overgrowth of corals. Recently completed studies in the USVI have demonstrated that much of the bycatch in the trap fisheries consists of reef herbivores (Acanthuridae – surgeonfishes were 24% of by-catch) and butterflyfishes (4%) and both taxa suffered high mortality rates. This project focused on Fishing Impacts F1.1 by testing measures to improve fishery management plans and F1.4 by reducing fishing mortality on bycatch species, leaving them free to fulfill their ecological roles in the coral reef ecosystem.

We worked with local fishermen (primarily through the St. Thomas Fishermen’s Association) to experimentally test the effectiveness of escape vents for traps to reduce bycatch of reef herbivores. Our fishing industry partners built 2 strings of fish traps, nine traps each, representative of the traps used in USVI. We used divers and video to observe fish behavior in traps to determine optimum placement options. We recorded various species caught in the traps, noting where they swam and where they tried to find exits from the traps. Diver observations were supplemented by video, taken over 8 days, covering all daylight hours. Much of this field work and filming was done in conjunction with a collaborative study of traps as marine debris, on-going, with the Marine Debris Program, NCCOS, NMFS-SEFSC, and UVI. Additionally we surveyed fish in local markets to build up a database of fish morphometrics (fish “widths and heights”). The combination of observations of fish behavior and knowledge of fish dimensions and sizes was used to determine escape vent sizes and initial placements for further testing.

As a first step in our field testing, we examined the question of when fish escape from traps. Fishermen tend to believe that fish escape while traps are being hauled. We installed 4 sizes of escape vents in replicate traps then daily stocked these traps with fish fin-clipped for identification (n=1285). Traps were set in two different depth ranges. The following morning, divers surveyed the traps identifying all fish inside, estimating sizes and noting whether fish were fin-clipped or not. After all traps on the string were surveyed, the traps were hauled and all fish were identified and measured on the boat. Comparisons between fish stocked in the trap, fish observed by divers, and final tally on the boat allowed us to conclude that fish that escape do so while the trap is set, not while it is being hauled. Final evaluation of vent

placement in traps was conducted by divers studying traps with multiple vents placed at a variety of locations around the trap. Time to escape was monitored for all trapped species and optimum locations recommended for long-term testing.

While this CRCP project was in progress, additional funding was secured through NMFS's Cooperative Research Program for extended testing of the recommended vents in commercial trap operations in order to confirm effectiveness at reducing by-catch without undue loss of target species. This effort, with the St. Thomas Fishermen's Association, will foster compliance and increase awareness of vent utility.

### **Description of accomplishments & results**

1. Research was conducted to define the sizes of targeted species. Species lengths were equated to other size measurements, e.g., height and width. Data were used to select experimental escape vent sizes.
2. Fish behavior observations were undertaken in May 2010 to see if particular species spend more time in one area of the trap than in another. Data were used to select escape vent locations in trap walls.
3. Experimental trapping/diving was completed. Fish were stocked into the traps and observed underwater after 24 hours. After hauling traps, catch was compared with diver observations and catches from traps with different -sized escape vent sizes were compared.
4. Project was leveraged with a Cooperative Research Program (SEFSC) project by the St. Thomas Fishermen's Association for long-term testing (18 months) of the selected escape vents to confirm effects on fish escapement.

### **How project supports goals & objectives of CRCP**

This project reduces the impact of fishing on non-target species with particular emphasis on herbivores; which play a critical ecological role on Caribbean reefs. One reported effect of fishing is that loss of herbivores for the reef shift the ecological advantage to macroalgae in being able to out-compete corals for space. The results of this study will provide recommendations to resource agencies, and foster compliance in the fishing community, that can reduce the incidental mortality of herbivorous fish species and result in more sustainable coral assemblages on coral reefs of the US Caribbean. These results may also make fishing practices more efficient by capturing more of the target species and reducing the amount of bycatch.

### **How project supports management of coral reef resources**

Through this work we have been able to identify escape vent designs that, when properly placed in Caribbean fish traps, will allow small fishes, particularly herbivores (surgeonfishes and small parrotfishes) and other bycatch species to escape while the trap is still on the bottom. Further testing will define the effects of escapement on populations and on overall bycatch in the fishery. Healthy herbivore populations should aid control of algae on Caribbean reefs.

## **List of project Partners and their roles**

St. Thomas Fishermen's Association (Dr. David Olsen, Chief Scientist): coordination with fishermen, trap construction and vent installations, collection of data from fishermen's experiments with vents.

University of Virgin Islands (Gabby Folger Renchen): support field work and trap video work.

## **Communications, media exposure, capacity building, education and outreach activities**

Olsen presented an overview of our work combined with the work from STFA to the CFMC (March 2011).

## **Submissions to CoRIS**

Report on field work will be submitted during spring/summer 2011, peer-reviewed papers will follow as published.

## **FY2010 Publications**

None.

## **FY2010 Presentations**

None.

## **Setbacks or challenges encountered in FY2010**

None.

## **Comments on future direction of project**

None.

## VI. IMPROVE EFFECTIVENESS OF MPAS

<b>Project ID#:</b>	1693-2010
<b>Title:</b>	South Atlantic MPAs: Evaluation of Habitat and Fish Assemblages in Five No Fishing Zones
<b>PIs and co-PIs:</b>	Andy David (NOAA SEFSC) Stacey Harter (NOAA SEFSC)
<b>Duration of Project:</b>	Year 6
<b>Project Category:</b>	Improve Use and Effectiveness of MPAs

### Brief description of activities conducted in FY2010

The South Atlantic Fishery Management Council (SAFMC) closed several areas along the outer continental shelf for protection of seven reef fish species in February 2009. A robust study of habitat and fish assemblages within and adjacent to these marine protected areas (MPAs) will provide an efficacy test of this management tool. Survey initiation prior to the closures will obviate criticisms of MPA studies comparing populations inside and outside closed areas rather than single locations pre and post-closure. Thus far, four years of pre-closure data (2004, 2006-2008) and two years of post-closure data have been collected including that which was collected in FY2010. Remotely operated vehicle (ROV) dives were conducted and have been analyzed to compare habitat and fish assemblages inside and outside the MPAs, and a final report has been provided to the SEFSC for submission to the SAFMC.

### Description of accomplishments & results

The survey was completed in May 2010 on the M/V Spree, a 100 ft diving support vessel chartered out of Key West, FL. Seventeen ROV dives were completed resulting in approximately 17 hours of underwater footage covering area both inside and outside the Florida, Edisto, and Northern South Carolina MPAs. The ROV dives have been analyzed and a final report has been written and submitted to the SAFMC. All dives consisted primarily of hardbottom reef habitat from pavement to high relief ledges, which are all habitat types the targeted grouper species exploit. Four of the targeted species were observed including speckled hind, yellowedge grouper, snowy grouper, and blueline tilefish. While not all of the target species were observed, numerous other members of the snapper-grouper complex were present including seven different species of grouper, which is more than any year prior to the implementation of the fishery closures in early 2009. While lionfish abundances were down from 2009, they still remain relatively high and were more abundant than the most common grouper (scamp) at all surveyed MPAs. Gag grouper are an important species in the snapper-grouper complex and, while not targeted by these MPAs, were more abundant in 2010 than in any other survey year.

## **How project supports goals & objectives of CRCP**

This project supports several of the goals and objectives of the CRCP. It provides information useful for understanding coral reef ecosystems and researches the impacts of management actions by monitoring fish assemblages inside the MPAs and in the surrounding adjacent areas. This project also works to reduce the adverse impacts of human activities by improving the use of MPAs.

## **How project supports management of coral reef resources**

The results of our monitoring program have been and are expected to continue to be used by the SAFMC during their evaluation of these MPAs, as cited in the monitoring section of Amendment 14 of the Reef Fish Management Plan. Continuation of our monitoring program will insure the SAFMC remains well informed of changes within reef fish populations and coral habitats associated with these MPAs. Over time, our research should detect changes in epifaunal species as well and produce data on the benefits derived by coral reef ecosystems from area closures. A report is submitted to the SAFMC after each cruise displaying the results from each year's sampling. Also, a presentation was given to the Council in June 2008 on results from all years of pre-closure monitoring collectively.

## **List of project Partners and their roles**

NURC/UNCW - ROV services

Harbor Branch Oceanographic Institution/FAU/CIOERT - epifaunal invertebrate identification

## **Communications, media exposure, capacity building, education and outreach activities**

Results of our monitoring program have been communicated to the SAFMC via a report.

## **Submissions to CoRIS**

A report was submitted to CoRIS in FY11

## **FY2010 Publications**

A report was submitted to the SAFMC entitled "South Atlantic marine protected areas: year six of an evaluation of habitat and fish assemblages in a network of reserves".

## **FY2010 Presentations**

None.

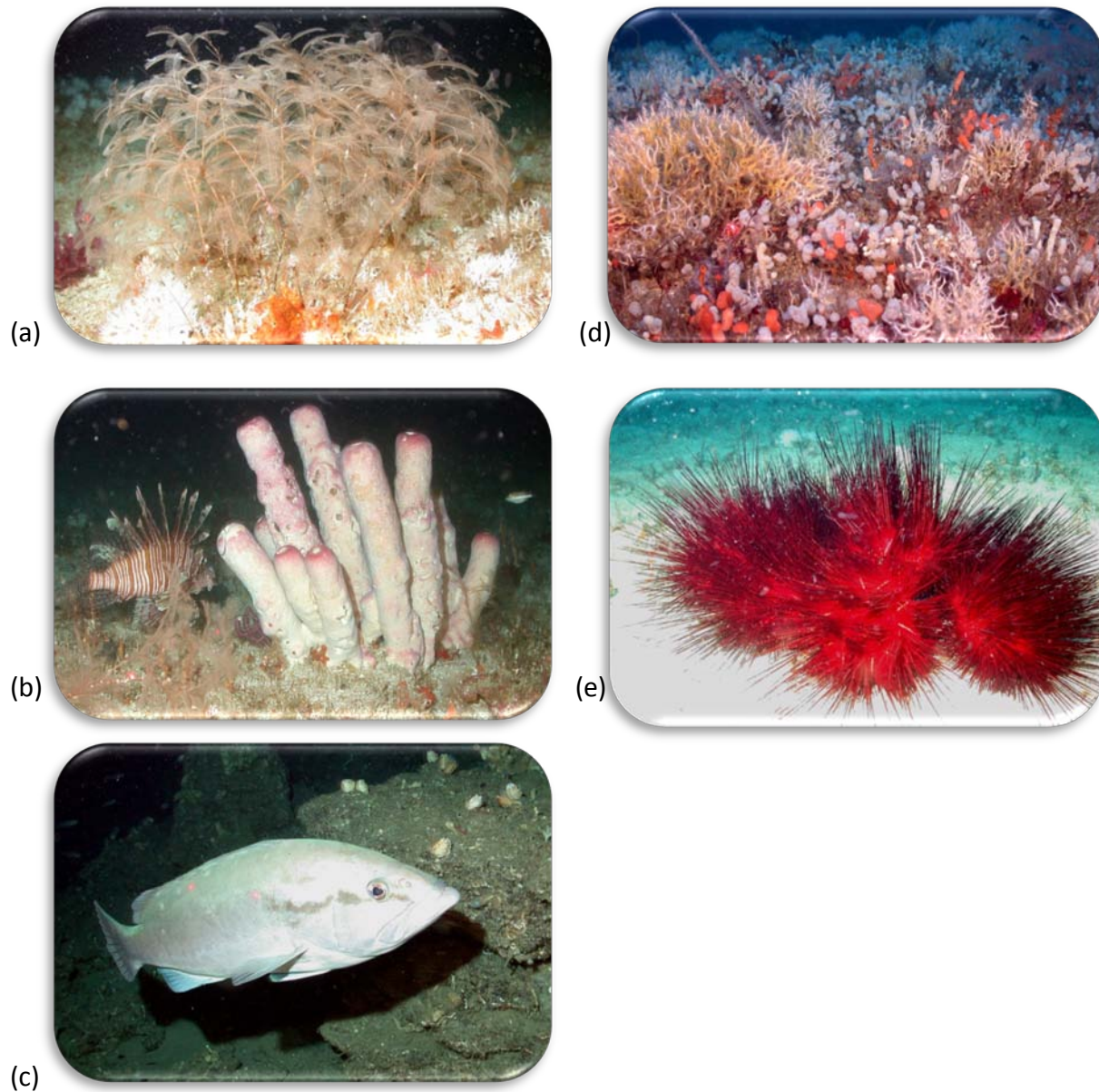
## **Setbacks or challenges encountered in FY2010**

Inclement weather precluded us from performing several of our planned ROV dives. NOAA ship time was not granted, therefore, the project required the services of a charter vessel.



## Comments on future direction of project

We plan to continue examining the fish assemblages and habitat characteristics inside and outside the closed areas to investigate MPA effectiveness. The MPAs were implemented in February 2009, so as of early 2011, we have only collected two years of post-closure data and several more years are required to look at changes over time. Due to the new geographic boundaries of the CRCP, we did not receive funding for work to be performed in FY2011. We have received initial approval for CRCP funds passed through the SAFMC to conduct work in FY2012 but, a year of data will be missing.



Photographs of South Atlantic MPA inhabitants. (a) black coral; (b) tube sponges and invasive lionfish; (c) snowy grouper; (d) dense epifauna; (e) red sea urchins (photo credits: UNCW/NURC, Lance Horn and Glenn Taylor).

<b>Project ID#:</b>	10233-2010
<b>Title:</b>	USVI Larval Reef Fish Distribution & Supply Study
<b>PIs and co-PIs:</b>	Trika Gerard (NOAA SEFSC)
<b>Duration of Project:</b>	Year 4
<b>Project Category:</b>	Improve Use and Effectiveness of MPAs

### **Brief description of activities conducted in FY2010**

The USVI larval distribution and supply study completed its fourth research survey February 23 – March 15, 2010. This large-scale ichthyoplankton sampling entailed multiple opening and closing net environmental sampling system (MOCNESS), and Bongo tows, south and north of the US and British Virgin Islands, the Anegada passage, and along the Leeward Islands toward Montserrat. Sampling tracks were designed to sample near shore, at the shelf break, and offshore, with intense sampling around the Grammanik and Red Hind Banks, well-known spawning aggregations for various species of groupers. Physical oceanography data were collected using a conductivity, temperature, and depth (CTD) device, lowered acoustic Doppler current profiler, (LADCP), and Lagrangian drifters. Ichthyoplankton sampling yielded 331 samples (232 mocness and 99 bongo) from 156 stations.

### **Description of accomplishments & results**

All samples collected in 2010 have been sorted and yielded 61,611 fish from MOCNESS and Bongo net tows. Fish are currently being identified to the lowest taxonomic level possible. Families of commercial importance were: Serranidae, Albulidae, Acanthuridae, Carangidae, Labridae, and Monacanthidae. A cruise report was completed: Smith R., Lamkin J.T., Gerard T., Muhling B, Malca, E. Privoznik S, Johns L, Melo N, 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.

This year the circulation patterns in the area differed in that they were dominated by a southward flow from the Atlantic into the Caribbean, resulting in easterly currents around St. Croix and south of St. Thomas. In previous years, average circulation was from east to west, then to the northeast through Virgin Passage into the Atlantic. Data were collected to help determine if this is a typical flow pattern for this time of year or simply variance in the average flow. It was determined that the net result is transport to the east away from Buck Island toward Saba Bank, a local fishing area for the Leeward Islands. In addition there appears to be a weak gyre formed between St Thomas and St. Croix, which may encourage larval reef fish retention. Dive operations were completed to deploy substrate-mounted ADCP's in the passages to the east of St. Thomas between Vieques and Culebra, and Culebra and St. Thomas to help determine long-term regional flow/transport patterns.

## **How project supports goals & objectives of CRCP**

This project focuses on the ecology of larval reef fish that depend on coral reefs as a habitat. The synthesis of larval fish and physical oceanography data will help us determine the location and relative importance of spawning sites specific to coral reef fish. The incorporation of this information into fisheries oceanographic models assists local resource managers in making decisions regarding marine protected areas (MPAs) and optimal seasonal closures. Additionally, this project will lead managers to developing an integrated ecosystem assessment of coral reef-based fisheries for the USVI.

## **How project supports management of coral reef resources**

This project illuminates the source/sink dynamics of larval fish regionally, which helps managers design effective strategies for conducting successful place based (MPA) and fisheries management.

## **List of project Partners and their roles**

University of the Virgin Islands- actively participates in the design of study and ichthyoplankton analysis.

## **Communications, media exposure, capacity building, education and outreach activities**

Study presented at a seminar class for graduate students at the Center for Marine and Environmental Studies at University of the Virgin Islands

## **Submissions to CoRIS**

Biological data of abundance and composition of larval fish from 2009 fisheries oceanography survey and physical oceanography data was submitted.

## **FY2010 Publications**

Smith R., Lamkin J.T., Gerard T., Muhling B, Malca, E. Privoznik S, Johns L, Melo N, 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.

## **FY2010 Presentations**

Effects of an anomalous low salinity, high chlorophyll plume from the Orinoco River on larval fish distribution and abundances in the Caribbean Basin. Oral Presentation. 2010 Larval Fish Conference, Santa Fe, New Mexico.

An evaluation of larval transport and distribution in the US Caribbean, British Virgin Islands and Leeward Islands. Oral Presentation. 2010 Larval Fish Conference, Santa Fe, New Mexico.

### Setbacks or challenges encountered in FY2010

None.

### Comments on future direction of project

FY10 was the last year of this project.

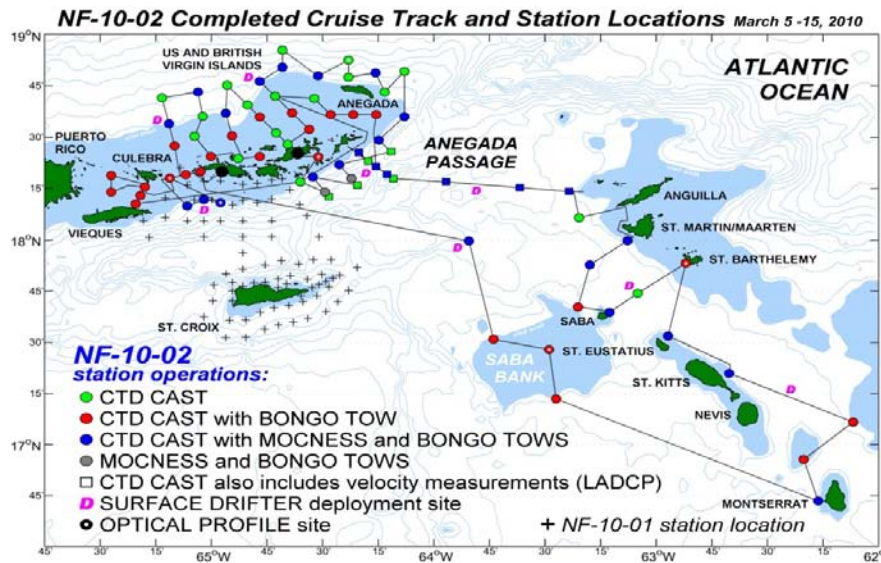


Figure 1. Cruise track and station locations for the 2010 cruise aboard the NOAA Ship Nancy Foster

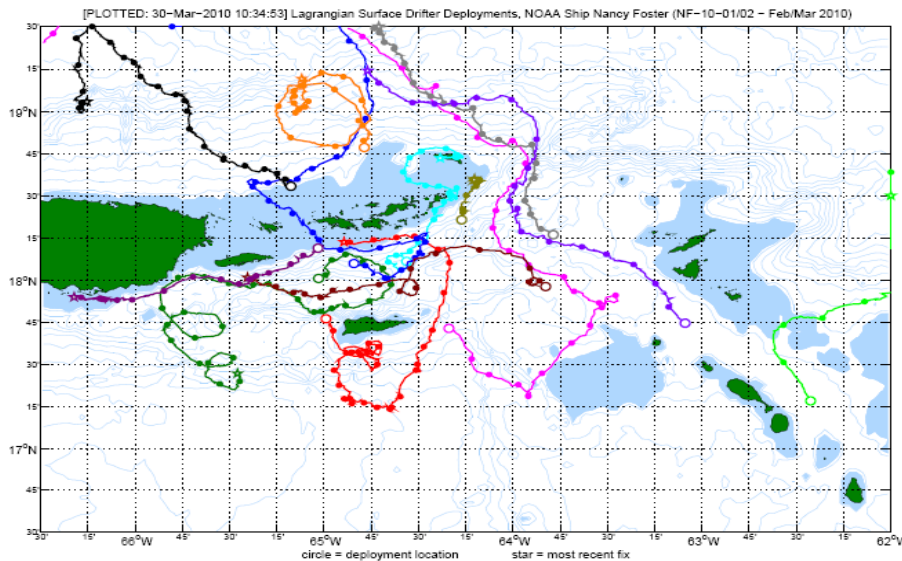


Figure 2. Lagrangian surface currents as tracked by various drifter deployments during cruise aboard NOAA Ship Nancy Foster. Circle indicates deployment location; star indicates most recent coordinates.

## VII. REDUCE THREATS TO INTERNATIONAL CORAL REEFS

<b>Project ID#:</b>	20528-2010
<b>Title:</b>	Applying Bio-physical Monitoring and Capacity Assessments to Mesoamerican Reef MPAs
<b>PIs and co-PIs:</b>	John Lamkin (NOAA SEFSC) Samantha Whitcraft (UM CIMAS) Estrella Malca (UM CIMAS)
<b>Duration of Project:</b>	Year 1
<b>Project Category:</b>	Improve Use and Effectiveness of MPAs Reduce Threats to International Coral Reefs

### Brief description of activities conducted in FY2010

The MPA Capacity-Building and Mesoamerican Reef Connectivity Workshop was conducted in Chetumal, Mexico from May 17-19, 2010. In addition, in August 2010, we conducted a 10 day larval fish and oceanography collection effort to examine larval fish assemblages and recruitment of valuable fishery resources at Isla Contoy National Park (an MPA) in the Mexican Caribbean.

### Description of accomplishments & results

The workshop was a success in that the following goals were achieved, via consensus by the managers and/or staff-representatives of 13 priority MPAs identified by MAR Fund as comprising a regional network including protected areas in Mexico, Belize, Guatemala, and Honduras:

**Goal 1:** Enhanced regional capacity by creating a MAR Connectivity Coalition of managers and scientists; provided a mechanism and timeline for on-going communications and collaborations between MPA managers/staff, ECOSUR, MAR Fund and NOAA-UM/CIMAS.

**Goal 2:** Identified 4 common regional connectivity goals as directly applied to integrated local management plans and priorities across the MPA network: invasive species, commercially important species, ecologically important species, and migration & productivity.

**Goal 3:** Agreement to identify data sources that can be shared and applied currently. Compile workshop information and provide participants with an initial workshop summary.

More information on the workshop, participants, goals and results can be found at:  
<http://www.ecosur.mx/unidades/chetumal/ofe/ocean/mpa/workshop.html> or  
[http://www.marfund.org/en/new\\_projects/first\\_connectivity\\_regional\\_workshop.html](http://www.marfund.org/en/new_projects/first_connectivity_regional_workshop.html)

The field effort was a success. We were able to carry out the scheduled August 2010 collections which included the use of various collecting methodologies. Continuous transects were also executed using an acoustic doppler current profiler to develop a time series to resolve daily

variability in the oceanic currents that influence the recruitment patterns of larval fishes to the island. This work was done in collaboration from ECOSUR's Department of Ecology & Aquatic Systematics, and CONANP staff.

### **How project supports goals & objectives of CRCP**

This project formed a coalition between MPA managers/staff, ECOSUR, MAR Fund and NOAA-UM/CIMAS, whereby communication and coordination of workshops, defined regional priorities, and specific initiatives will be maintained. A free listserv has been created via (Google) 'Gmail' in order to distribute calls for data and data-sharing. NOAA-generated regional ichthyoplankton distribution/abundance products, as available, and physical oceanography map tools/links are available on the ECOSUR website.

The field component assesses the larval fish assemblages in critical shallow coral reef habitats and associated nursery habitats at an MPA (Isla Contoy National Park) that is strategically located in the Mexican Caribbean and is influenced by the Yucatan Current before it turns into the Loop Current in the Gulf of Mexico. The data collected will serve as a baseline in order to utilize ecosystem-scale management in the Mexican Caribbean as it will complement previous larval fish collections upstream in the Mesoamerican barrier reef tract with previous NOAA ELH/ECOSUR/CONANP projects as well as ongoing NOAA/INAPESCA/ECOSUR projects in 2011.

### **How project supports management of coral reef resources**

#### **List of project Partners and their roles**

ECOSUR is an academic partner and provided scientific and leadership support in carrying out the workshop. MAR Fund provided logistic and administrative support to organize workshop and steered the conversation with a management oriented focus. NOAA/UM-CIMAS provided funding, logistical planning and conducted workshop.

#### **Communications, media exposure, capacity building, education and outreach activities**

MPA Capacity –Building and Mesoamerican Reef Connectivity Workshop was held in Chetumal, Mexico. (Media coverage included interviews and local article on the web ).

Project websites: <http://www.ecosur.mx/unidades/chetumal/ofe/ocean/mpa/workshop.html> or [http://www.marfund.org/en/new\\_projects/first\\_connectivity\\_regional\\_workshop.html](http://www.marfund.org/en/new_projects/first_connectivity_regional_workshop.html)

Project personnel participated in the International Coral Reef Initiative (ICRI) Regional Lionfish workshop held in Cancun, Mexico in August 2010. The workshop's goal was to develop a strategic plan for the control of lionfish in the Wider Caribbean. As a team-member, E. Malca participated and represented the connectivity network that was formed during the MPA capacity building workshop.

## Submissions to CoRIS

A Scientific poster and associated metadata were submitted to CORIS: Larval fishes, connectivity, and management: A Mesoamerican reef case study.

## FY2010 Publications

None.

## FY2010 Presentations

1. Larval fishes, connectivity, and management: A Mesoamerican reef case study. 34<sup>th</sup> Annual Larval Fish Conference, May 30-June 3<sup>rd</sup> in Santa Fe, New Mexico (oral)
2. Larval fishes, Connectivity, and Management: A Mesoamerican Reef case study. Linking Science to Management: A conference & workshop on the FL Keys Marine Ecosystem, October 19-22, Duck Key, FL (poster)

## Setbacks or challenges encountered in FY2010

None.

## Comments on future direction of project

This is a one-year project.



Workshop participants at the MPA Capacity–Building and Mesoamerican Reef Connectivity Workshop in Chetumal, Mexico held at the ECOSUR campus.

## VIII. REDUCE IMPACTS OF CLIMATE CHANGE

<b>Project ID#:</b>	20513-2010
<b>Title:</b>	Evaluating Climate Effects on a Coral Reef Fish Community: Analysis of a 30-year Ecological Monitoring Effort
<b>PIs and co-PIs:</b>	Joe Serafy (NOAA SEFSC) Peter Glynn (University of Miami, RSMAS)
<b>Duration of Project:</b>	Year 1
<b>Project Category:</b>	Reduce Impacts of Climate Change

### Brief description of activities conducted in FY2010

This project examines the impact of climate variability on coral reef fish community dynamics via analysis of one of the longest-running coral reef studies ever conducted (30 consecutive years). The study is located off Panama's western coast within the boundaries of Coiba National Park. A feature that makes this study conducive for examining climate impacts is the area that has received little or no fishing pressure or watershed development over the study's duration. The project comprised four major activities: (1) Site Visit; (2) Data Collation and Quality Control; (3) Data Analyses; and (4) Report, Manuscript, and Oral Presentation Preparation. All the elements are now complete, with a peer-reviewed manuscript in preparation.

### Description of accomplishments & results

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. This project examines an eastern Pacific fish assemblage associated with a 2.5 hectare coral reef located within the boundaries of Coiba National Park, Panama. From 1980 to 2010, consistent, quantitative coral reef and fish survey monitoring methods have been applied at Uva Island reef, which lies in an area that has received virtually no fishing pressure or watershed development over the past 80 years. Concurrent coral and fish monitoring spanned the 1982-83 and 1997-98 El Niño (ENSO) disturbances, anomalous warming events that selectively killed reef-building corals.

While no fish mortalities were observed at the time of the 1982-83 El Niño event, live coral cover was reduced to near 0% at Uva reef. From 1984 to 1990, live coral (*Pocillopora* spp.) cover was extremely low (< 5%), but demonstrated steady recovery to ~ 70% by 2006. By quantifying disturbance-related, long-term changes in coral reef resources and relating these to fish trophic group responses, several functional relationships became apparent. Over the entire study period, a total of 63 fish taxa were observed and reef fish density (all taxa combined) remained relatively stable. Fish diversity (taxonomic richness) increased significantly as coral cover rose from near 0% to 20-30% then demonstrated a decreasing trend to 70% cover. Reef herbivore densities showed a similar significant parabolic relationship with highest abundances at 20-30% coral cover. Benthic invertivores showed a significant asymptotic increase in density



to about 10% live coral cover. Mixed diet feeders and facultative corallivores demonstrated significant linear trends with increasing coral cover, with the former trophic group decreasing and the latter increasing as recovery progressed. Piscivores and planktivores did not demonstrate significant variations in abundance with increasing coral cover. The varying responses of herbivore, invertivore, corallivore and mixed diet feeding guilds demonstrated strong associations with coral cover, likely reflecting changes in availability of trophic resources during reef recovery. Further monitoring combined with manipulative studies is clearly warranted to validate the correlative relationships revealed in the present study.

### **How project supports goals & objectives of CRCP**

We have produced a report which presents overall assemblage structure and trophic information for the fishes of Uva reef, Panama, over the 30 year duration of the study. This work will contribute to coral reef conservation by providing managers with quantitative relationships with which to gauge the relative resilience and recovery times of generalist and specialist fish feeders to coral cover changes, which are driven by ENSO events.

### **How project supports management of coral reef resources**

Project results will be communicated to managers via delivery of our final report and, when completed, peer-reviewed articles that stem from this work.

### **List of project Partners and their roles**

Peter Glynn (University of Miami, Professor) Co-PI; J.A. Afflerbach (University of Miami, Undergraduate Research Assistant1, V.W. Brandtneris (University of Miami, Laboratory and Field Technician), I.C. Enochs (University of Miami, Graduate Student). All the above were actively involved in all elements of this project, from data collection, to data analysis to report writing.

### **Communications, media exposure, capacity building, education and outreach activities**

Aspects of this project were incorporated into the Ph.D. research of now graduated UM graduate student I. Enochs. This project also formed the basis of an undergraduate thesis by UM undergraduate J. Afflerbach.

### **Submissions to CoRIS**

Final report entitled “Long-term patterns of diversity and abundance in a eastern Pacific reef fish assemblage: reef fish response to coral recovery”.

## **FY2010 Publications**

We have generated a report entitled “Long-term patterns of diversity and abundance in a eastern Pacific reef fish assemblage: reef fish response to coral recovery”. A peer-review publication is in preparation.

## **FY2010 Presentations**

None.

## **Setbacks or challenges encountered in FY2010**

We experienced delays in the data analysis and report generation elements due to inconsistencies in the database that only became apparent in the final stages of data compilation and quality control. However, these inconsistencies were overcome by changing the focus of the analysis from a time series approach to one that examined relationships between the densities of specific fish feeding guilds and coral cover.

## **Comments on future direction of project**

This is a one year project.