



NOAA Technical Memorandum NMFS-SEFSC-614

SEFSC Coral Reef Program: FY 2009 Project Accomplishments Report

Compiled by:
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Cover photograph: Traditional fishing boats ("yolas") in front of a fish cooperative ("villa pesquera"), Aguadilla, Puerto Rico, October 2008. Photo Credit: Flavia Tonioli

**SEFSC Coral Reef Program: FY 2009 Project Accomplishments Report
Table of Contents**

I. INTRODUCTION	1
II. PROGRAM COORDINATION	
1250-2009: Data Management, Assessment and Outreach	2
III. ASSESS AND CHARACTERIZE U.S. CORAL REEFS – CORAL REEF ECOSYSTEM	
1064-2009: Assess and Monitor Coral Reef MPAs.	4
1056-2009: Status and Exploitation of Reef Resources at Navassa Island	8
10051-2009: U.S. Caribbean Comprehensive Coral Reef Ecosystem Assessment and Monitoring.	11
IV. REDUCE IMPACTS OF COASTAL USES	
1066-2009: Ecological Approach to Reef Restoration	14
V. REDUCE ADVERSE IMPACTS OF FISHING	
10299-2009: Coral Reef Fish-Habitat Modeling to Support Ecosystem-Based Management.	17
1317-2009: Acoustic Seabed Classification and Quantification of Reef Fish	19
1242-2009: Hydroacoustic Biomass Assessment of Reef Fish Spawning Aggregations.	21
1068-2009: Assess/Monitor Effects of MPA Status on Reef Fish Populations and Spawning Aggregations in the Tortugas Ecological Reserves	23
1668-2009: Socio-Economic Profiles of Fishing Communities in Culebra and Vieques and U.S. Caribbean.	26
10401-2009: Reef Fish Recruitment Dynamics: Integration and Analysis of Long-Term Visual Fish Surveys to Examine Environmental Influences	29
1873-2009: Recovery of Conch Populations in the U.S. Virgin Islands.	31
1244-2009: Monitoring Coral Reef Fish Use of MPAs and Recruitment Connectivity between the Florida Keys and Meso-American Reefs.	34
1067-2009: Monitoring Coral Reef Fish Utilization of Marine Protected Areas and Inshore Habitats in Florida Bay	37
10292-2009: Productivity of <i>Acropora cervicornis</i> habitat and impacts from natural and human disturbance.	39
20385-2009: Development of Cooperative Fishery Independent Surveys in the US Caribbean	43
VI. IMPROVE EFFECTIVENESS OF MPAS	
10202-2009: Survey of Coral and Fish Assemblages at Pulley Ridge, SW Florida ..	46

10012-2009: Multibeam Mapping of Pulley Ridge, SW Florida.	48
1693-2009: South Atlantic MPAs: Pre-closure Evaluation of Habitat and Fish Assemblages in Five Proposed no Fishing Zones.	50
10233-2009: USVI Distribution and Larval Supply Study.	52
 VII. REDUCE THREATS TO INTERNATIONAL CORAL REEFS	
10038-2009: Acropora spp. Monitoring in the Eastern Caribbean	55
 VIII. ADDRESS EMERGING ISSUES	
2133-2009: Assessment of Candidate Corals	57
10306-2009: Assessment of ESA Threatened Corals – Supplemental.	60

I. INTRODUCTION

Fiscal year 2009 marks the ninth year since the inception of the Coral Reef Conservation Program (CRCP). The CRCP is administered by NOAA Headquarters and is matrixed across four NOAA line offices, including NMFS. The program operates in the Atlantic and Pacific basins and is integrated with other federal agencies, state and local governments, territories and commonwealths. While coral reef research and monitoring at the Southeast Fisheries Science Center predates the inception of the CRCP, we have been active participants in the CRCP since it was implemented in 2001, with projects in the South Atlantic, Gulf of Mexico, and Caribbean regions. In February 2004, SEFSC conducted an external program review of its coral reef program activities. Results of this review provided valuable comments and recommendations which have helped improve the design, performance and results of the program. In September 2007, the CRCP conducted an external program review. The Panel Report was released in November 2007, followed by a suite of new planning documents by the CRCP, taking into consideration the recommendations of the external panel review. SEFSC has been an active participant and contributor towards influencing the direction of the program and is working internally with our Principal Investigators to be responsive to the changes that are being implemented as the CRCP follows through with the ongoing planning strategy.

In Fiscal Year 2009, SEFSC was awarded 23 CRCP funded projects, representing a CRCP investment of \$2.17 million. SEFSC continues to maintain a focus on monitoring reef fish populations, the benthic habitats they depend on, and the connectivity of organisms within reef habitats and across time and space. SEFSC has also made significant contributions to the science underlying the decline of corals in the Atlantic, including the threatened *Acroporid* corals, and will continue to be a leader in restoration science. SEFSC was awarded one new project this year, an innovative fishery independent survey of reef fish on the St. Croix shelf.

This annual accomplishments report provides information on the activities that were undertaken, results and products produced, leverage and partnerships, management relevance, summaries of issues related to implementation of the projects, and notes on future directions. The accomplishments are organized by FY09 CRCP theme category.

II. Program Coordination

Project ID#: 1250-2009

Title: Data Management, Assessment and Outreach

Names of PIs and co-PIs: Jennifer Schull, NOAA/SEFSC

Duration of Project: Ongoing

Project Category:

➤ Program Coordination

Brief description of activities conducted in FY2009:

This project supports coordination of SEFSC's strategic involvement in the CRCP, including coordination of SEFSC projects for the CRCP, accomplishments reporting, drafting of proposals, CORIS submissions, management of budget information, and responding to all data requests from CRCP. The PI hosted CRCP personnel and attended meetings in support of CRCP goals/objectives and implementation of the roadmap; supported CRCP reporting to NOAA, Congress, and various constituents; and coordinated SEFSC's participation on the threat based goals/objectives working groups and grant proposal reviews. The PI had a significant role in the Atlantic & Caribbean Mapping/Monitoring (CREIOS) workshop and was part of the away team in charge of interviewing managers regarding needs for mapping/monitoring (29 individuals during 12 meetings over 3 days). The PI co-chaired the biological monitoring expert working group, sat on the data dissemination panel, drafted the Florida and biological monitoring presentations, and edited the CREIOS final report. The PI served on the data management working group for CRCP; served on outreach, education and communications strategic plan development group; and oversaw development of FY10 coral reef proposals under new guidance protocols. The PI oversaw two CRCP projects and finalized the 2008 SEFSC Accomplishments Report (NOAA Technical Memorandum (NMFS-SEFSC-594) "SEFSC Coral Reef Program: FY2008 Project Accomplishments Report").

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 fully aligned and integrated with the CRCP's goals and objectives, that our projects are responsive to management needs, and 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 including John Boreman, Jessica Morgan, Kacky Andrews, Dana Wusinich Mendez, and NMFS SEA Team reps. The PI completed the 2008 SEFSC Accomplishments Report for wide dissemination. The PI wrote a NOAA World article on the launch of the Deep Water Coral Program, and hosted a TV crew from WLRN who did a story on science at SEFSC. The PI also represented SEFSC coral reef scientist engagement in Bring Your Child to Work Day and the Fairchild Challenge (an environmental education program that reaches over 25,000 students a year). The PI continues to represent SEFSC on a variety of CRCP working groups.

Submissions to CoRIS: FY2008 Project Accomplishments Report, NOAA Technical Memo NMFS-SEFSC-594**Publications during FY2009:**

SEFSC Coral Reef Program: FY2008 Project Accomplishments Report, NOAA Technical Memo: NMFS-SEFSC-594

Brusher, J. and **J. Schull**. 2008. Non-lethal age determination for juvenile goliath grouper *Epinephelus itajara* from southwest Florida. *Endangered Species Research*. doi: 10.3354/esr00146.

Murie, D., D. Parkyn, C. Koenig, F. Coleman, **J. Schull**, S. Frias-Torres. 2008. Evaluation of finrays as a non-lethal ageing method for protected goliath grouper *Epinephelus itajara*. *Endangered Species Research*. doi: 10.3354/esr00146.

Lara, M.R., **J. Schull**, D.L. Jones, R. Allman. 2009. Early life history stages of goliath grouper *Epinephelus itajara* from Ten Thousand Islands, Florida. *Endangered Species Research*. Doi: 10.3353/esr00193.

Delivered Nassau grouper video to CORIS to finalize 2005 USVI project 5/09

Presentations at professional meetings: None**Setbacks or challenges encountered in FY09:** None

Comments on future direction of project: This project will continue into the foreseeable future, providing support and linkages between SEFSC and CRCP.

III. Assess and Characterize U.S. Coral Reefs – Coral Reef Ecosystem

Project ID#: 1064-2009

Title: Assess and monitor coral reef MPAs

Names of PIs and co-PIs:

Jim Bohnsack (NOAA SEFSC)

Benjamin Ruttenberg (NOAA SEFSC)

Jerry Ault (UM-RSMAS)

Steven Smith (UM-RSMAS)

Duration of Project: Ongoing

Project Category:

- Reduce Adverse Impacts of Fishing
- Improve Use and Effectiveness of MPAs

Brief description of activities conducted in FY2009:

The FY09 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, and this collaboration began in earnest in FY09. Sampling for FY09 began in May, and included 521 sites (over 2032 research dives) in the Florida Keys and Biscayne National Park. 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. Because of this urgency, a multiagency team, including staff from NOAA SEFSC, NPS, FWRI, and UM-RSMAS surveyed reef fish communities and collected habitat data at over 200 sites (over 858 research dives) during a 10 day cruise to the Dry Tortugas in July 2009.

As of late November 2009, all data have been entered and passed through the initial quality assurance/quality control procedures.

Description of accomplishments & results:

In FY09, divers conducted photo-documentation, RVC fish surveys, and habitat assessments at ~510 sites in the Florida Keys and ~210 sites in the Dry Tortugas (4 divers/site). Miami, SEFSC divers collaborated with the University of Miami and RSMAS, FKNMS, UNCW, Florida Fish and Wildlife Department/FWRI, and the National Park Service (BNP and South Florida and Caribbean Network). Additional fish counts were obtained during the mutton snapper spawning cruise in July at Riley's

Hump. Approximately 1000 RVC dives were made by NOAA divers and 1800 by contractors, university, National Park Service, and Florida FMRI divers to complete the 2009 mission to monitor reef fish community composition, habitat composition, and abundance and size structure for more 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

This collaborative effort produced a multiagency monitoring protocol document, published late in FY09, and all partners are now using this formal document to guide sampling. This document is the result of many years of work by all partners and collaborators, and is the first multiagency monitoring document of its kind.

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, assist with data analyses and writing of 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: assist with data collection

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

Partnered 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.

FY09 monitoring efforts in the Dry Tortugas were the subject of a documentary produced by the Miami Public Broadcast station (WPBT) for their series *Changing Seas*. Staff from WPBT and *Changing Seas* accompanied the cruise and filmed all aspects of the research and its importance. They are currently producing the 30 minute documentary, which is scheduled to air in 2010.

The multiagency monitoring protocol document was published this year, the result of a many years of collaborative work between NOAA, the State of Florida, and the National Park Service. It is the first monitoring document of its kind used by multiple agencies.

Participated in initial planning workshops for the Biscayne National Park Fishery Management Plan, Spring 2009.

Submissions to CoRIS:

Metadata for monitoring data from 1998-2006 were submitted to CoRIS.

Publications during FY2009: * Peer reviewed

- Ault, J.S., S.G. Smith, D.B. McClellan, N. Zurcher, E.C. Franklin, and J.A. Bohnsack. 2008. An Aerial Survey Method for Estimation of Boater Use in Biscayne National Park during 2003-2004. *NOAA Technical Memorandum NMFS-SEFSC-577*. 87 p.
- Ault, J.S., S.G. Smith, D.B. McClellan, N. Zurcher, A. McCrea, N.R. Vaughan, and J.A. Bohnsack. 2008. Aerial survey of boater use in Everglades National Park Marine Waters – Florida Bay and Ten Thousand Islands. *NOAA Technical Memorandum NMFS-SEFSC-581*. 183 p.
- Ault, J.S., S.G. Smith, J.A. Bohnsack, J. Luo, N. Zurcher, N.R. Vaughan, N.A. Farmer, D.E. Harper, and D. B. McClellan. 2008. Fishery-independent monitoring of coral reef fishes, coral reefs, and macro-invertebrates in the Dry Tortugas. Final Report: Sustaining Dry Tortugas National Park Coral Reef Resources. PRBD-08/09-04. 122 p.
- * Bartholomew, A., J.A. Bohnsack, S.G. Smith, J.S. Ault, D.E. Harper, D.B. McClellan. 2008. Influence of marine reserve size and boundary length on the initial response of exploited reef fishes in the Florida Keys National Marine Sanctuary, USA. *Landscape Ecol* 23(Suppl.1):55-65. Final publication.
- * Brandt, M.E., N. Zurcher, A. Acosta, J.S. Ault, J.A. Bohnsack, M.W. Feeley, D.E. Harper, J. Hunt, T. Kellison, D.B. McClellan, M.E. Patterson, S.G. Smith. 2009. A Cooperative Multi-agency Reef Fish Monitoring Protocol for the Florida Keys Coral Reef Ecosystem. Natural Resource Report NPS/SFCN/NRR—2009/150. National Park Service, Ft. Collins, Colorado.
- Bohnsack, J.A., D.E. Harper, D.B. McClellan, G.T. Kellison, J.S. Ault, S.G. Smith, N. Zurcher. 2009. Coral reef fish response to FKNMS management zones: the first ten years (1997-2007). Progress Report to the Florida Keys National Marine Sanctuary. PRBD 08/09-10.
- * Grober-Dunsmore, R., L. Wooninck, J. Field, C. Ainsworth, J. Beets, S. Berkeley, J. Bohnsack, R. Boulon, R. Brodeur, J. Brodziak, L. Crowder, D. Gleason, M. Hixon, L. Kaufman, B. Lindberg, M. Miller, L. Morgan, C. Wahle. 2009. Vertical Zoning in Marine Protected Areas: Ecological Considerations for Balancing Pelagic Fishing with Conservation of Benthic Communities. *Fisheries* 33(12): 598-610.
- Ingram, Jr., G.W. and D.E. Harper. 2009. Patterns of annual abundance of black and red grouper in the Florida Keys and Dry Tortugas based on reef fish visual census conducted by NOAA NMFS. PRBD-08/09-13. 85 p.
- * Paddack, M.J., J.D. Reynolds, C. Anguilar, R.S. Appeldoorn, J. Beets, E.W. Burkett, P.M. Chittaro, K. Clarke, R. Esteves, A.C. Fonseca, G. E. Forrester, A.M. Friedlander, J. García-Sais, G. González-Sansón, L.K.B. Jordan, D.B. McClellan, M.W. Miller, P. Molloy, P.J. Mumby, I. Nagelkerken, M. Nemeth, R.Navas-Camacho, J. Pitt, N.V.C. Polunin, M.C. Reyes-Nivia, D.R. Robertson, A.R. Ramírez, E. Salas, S.R. Smith, R.E. Spieler, M.A. Steele, I.D. Williams, C.L. Wormald, A.R. Watkinson, and I.M. Côté. 2009. Recent region-wide declines in Caribbean reef fish abundance. *Current Biology* 19:590-595 + Supplemental Data.

Presentations at professional meetings:

Bohnsack, J. A. 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. Nov. 2008.

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

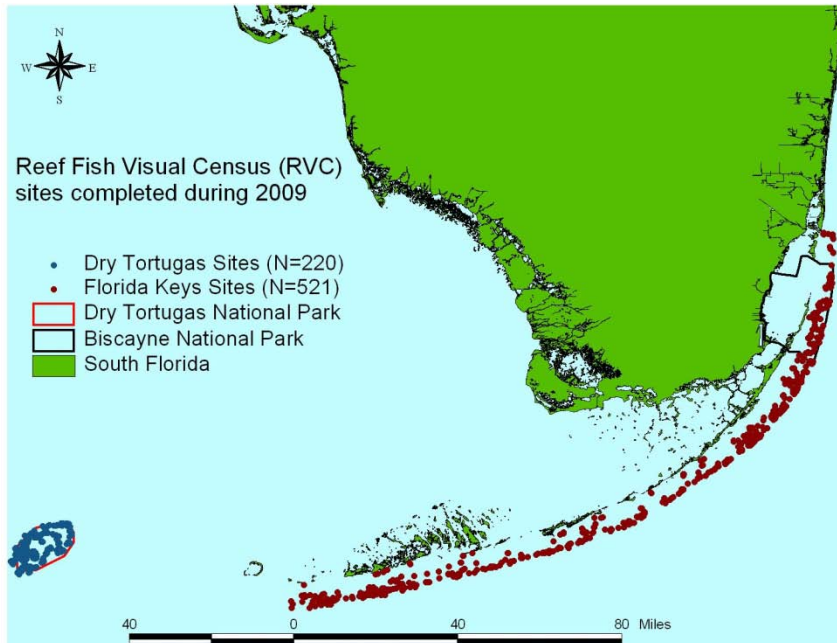
Bohnsack, J. A. Ten year responses of FKNMS SPAs. National Coral Reef Institute (NCORE) Symposium at RSMAS, University of Miami, Miami, FL. Sep 2009

Setbacks or challenges encountered in FY09: N/A in FY09

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.

Figure 1: This figure shows the location of survey locations along the Florida Keys reef tract during FY09, 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.



Project ID#: 1056-2009

Title: Status and Exploitation of Reef Resources on Navassa Island

Names of PIs and co-PIs: Margaret W. Miller (NOAA – SEFSC)

Duration of Project: ~ 6 yrs

Project Category:

- Assess and Characterize US Coral Reefs – Coral Reef Ecosystem Integrated Observing System (CREIOS)

Brief description of activities conducted in FY2009:

We completed the fourth reef assessment cruise aboard the NOAA Ship *Nancy Foster* in Apr-May 2009. Additional contract work in Haitian fishing villages further characterized the fishing communities which exploit Navassa reefs.

Description of accomplishments & results:

We completed reef assessment objectives during the FY09 cruise aboard the NOAA Ship *Nancy Foster* including reef fish visual census at 69 stratified random sites with photo-quadrats at 36 of these sites to characterize benthic cover. Among these random sites, only 7 were observed to host ESA listed staghorn coral (small, isolated colonies) while invasive Pacific lionfish were observed at three. Of the almost 29000 individual fish recorded in visual censuses, only 15 individuals were of large grouper species (Nassau, yellowmouth, and hind). Permanently tagged ESA listed elkhorn coral colonies were re-surveyed and all colonies along the southwest coast were mapped. This population remains in excellent condition. For the first time, the project (in collaboration with FoProBIM) was able to obtain pilot catch data (two boat-days worth were identified and measured) from the Haitian fishers who frequent Navassa waters. Reef temperature data was also retrieved from two logging sensors deployed in 2006.

How project supports goals & objectives of CRCP:

This project constitutes the only reef assessment/monitoring activities for US coral reef resources in the US National Wildlife Refuge at Navassa Island. These reefs are subject to fishing and global change pressures, but land-based human activities are absent at Navassa and so it provides a ‘control site’ for the impacts of anthropogenic Land-Based Sources of Pollution.

How project supports management of coral reef resources:

Project products are provided directly to management partners including Caribbean Islands National Wildlife Refuge (USFWS) and Caribbean Fishery Management Council.

List of project Partners and their roles:

US Fish and Wildlife Service: coordination and prioritization of sampling activities, participant on the cruise

Fondation pour la Protection de la Biodiversité Marine (FoProBIM): Haitian NGO has been indispensable partner in facilitating constructive interactions with the fishers.

Univ of Miami/RSMAS/MBF: Academic colleagues continue to collaborate in fish and fishery assessment including two cruise participants.

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

All cruise participants contributed to a real-time cruise reporting blog which was updated daily during the cruise. This tool allowed us to address the public about a range of coral reef and other management issues including problems related to exotic species, feral wildlife, and coral decline as well as positive observations such as healthy elkhorn coral populations and prolific sponge spawning that we observed. The cruise blog garnered over 700 unique visitors during the cruise, and, as of Nov 2009, showed over 1500 unique visitors

Submissions to CoRIS:

FoProBIM (2009) Rapid Survey of Haitian Fishing Villages Exploiting Resources at Navassa Island. Contract Report to NMFS/SEFSC

Paddack M, Reynolds JD, Aguilar C, Appeldoorn RS, Beets J, Burkett E, Chittaro PM, Clarke K, Esteves R, Fonseca AC, Forrester GE, Friedlander AM, García-Sais J, González-Sansón G, Jordan LKB, McClellan DB, Miller MW, Molloy PP, Mumby PJ, Nagelkerken I, Nemeth M, Navas-Camacho R, Pitt J, Polunin NVC, Reyes-Nivia MC, Robertson DR, Rodríguez-Ramírez A, Salas E, Smith SR, Spieler RE, Steele MA, Williams ID, Wormald CL, Watkinson AR, Côté IM (2009) Recent region-wide declines in Caribbean reef fish abundance. *Current Biology* 19: 590-595.

Publications during FY2009: See CoRIS submissions above

Presentations at professional meetings:

Contributed to 'Biological Monitoring' presentation and discussions at CREIOS meeting in Puerto Rico in spring 2009

Setbacks or challenges encountered in FY09:

Working with the unreliable nature of NOAA ship scheduling and logistics was a big challenge, but ended with a successful cruise.

Comments on future direction of project:

Navassa is not considered a geographic priority for CRCP and, as such, will no longer be included in US Coral Reef monitoring efforts via the CRCP. This will be the last year for this project unless priorities are reevaluated.

Figure 1: Researchers identify and measure catch from Haitian fishers' traps in May 2009



Project ID#: 10051 - 2009

Title: U.S. Caribbean Comprehensive Coral Reef Ecosystem Assessment and Monitoring (C-CCREMP)

Names of PIs and co-PIs: Dr. Ron Hill (NOAA-SEFSC), Dr. Mark Monaco (NOAA - NOS)

Duration of Project: Year 4

Project Category:

- Assess and Characterize US Coral Reefs – Coral Reef Ecosystem Integrated Observing System (CREIOS)

Brief description of activities conducted in FY2009:

Assessment and monitoring of U.S. coral reef ecosystems remain national priorities for the USCRTF and the CRCP. Managers of coral reef resources need data to track ecosystem conditions over time and manage in a timely manner. Currently NOAA conducts or funds many projects that monitor ecological, environmental, and socio-economic conditions at specific locations but efforts are not spatially comprehensive, limiting managers' abilities to assess resources region-wide and to evaluate management effects. The US Caribbean Comprehensive Coral Reef Ecosystem Monitoring Project (C-CCREMP) is a CRCP supported project led by NMFS SEFSC and NOS NCCOS intended to enhance coordination of existing or planned monitoring projects by federal, territorial, commonwealth, academic, and private sector partners thereby advancing the national goals of implementing standardized monitoring protocols and developing meaningful biological and environmental parameters and indicators of ecosystem condition. The overarching goal is to document and understand resource conditions of coral reef ecosystems across the US Caribbean. In FY09 we completed improvements to the database, increased manpower dedicated to collecting and entering data from a wide array of projects, and supported the efforts of CRCP in CREIOS workshops and national needs assessments.

Description of accomplishments & results:

During FY09, with guidance from local coordinators newly established in both Puerto Rico and the Virgin Islands (leverage funding), the project's on-line database was populated with information on coral reef research and monitoring projects that can guide both managers and scientists in evaluating spatial and temporal coverage of past and existing projects and quickly identifying needs for additional study. The local coordinators enhanced interactions with local coral reef managers, fishers, and researchers. They hastened data collection and entry into the C-CCREMP database and conducted preliminary spatial analysis of coral reef projects. Data entry was brought virtually up-to-date. The utility of the on-line database and linked GIS system as a data management and gap analysis tool was highlighted in posters and side-discussions at the Atlantic CREIOS workshop held in San Juan, PR, May 2009.

Work is continuing to improve database design, data entry and report-generating capabilities, and to demonstrate utility to researchers and program managers. The project, at this stage, can contribute directly to the development of a data management plan and the dissemination of information to managers and policy makers, and provide a powerful tool for understanding the gaps/needs in current research and monitoring programs. The on-line database is constantly being assessed and improved, as needed.

The PIs and partners of the C-CCREMP project were integrally involved in the CRCP-sponsored CREIOS workshop in San Juan, Puerto Rico in May 2009. They took part in presentations of NOAA capabilities, discussions of local and regional priorities, and publication of the workshop report. They also directly supported the analysis of national needs for coral reef monitoring conducted by Dr. Boreman.

How project supports goals & objectives of CRCP:

One of the CRCP Programmatic performance measures in the category of Ecosystem Condition and Management is “100% of coral reef regions with improved condition of shallow coral reef resources by 2015 (water quality, habitat condition, living marine resources)” (NOAA Corporate Measure). C-CCREMP provides access to the collection of data needed to achieve this goal. Currently, data sets are not comparable due to the many different methods utilized for data collection and the diversity locations data are stored.

This project addresses several of the action areas of the National Coral Reef Action Strategy. Under “Understand Coral Reef Ecosystems” the project addresses the need to *Assess and Monitor Reef Health: Monitor Coral, Fish, and Other Living Resources, and Assess Water and Substrate Quality*. It catalogs the research and monitoring that has occurred or is on-going and seeks to provide a mechanism to draw together pertinent data for analysis and understanding of current coral reef ecosystem conditions. In its original incarnation, the project included a component to conduct standardized monitoring activities across the US Caribbean but funding levels have never been provided to completely implement the project. Even in its current form C-CCREMP provides the means to support several other actions under this category: *Conduct Strategic Research* (Research Impacts of Management Actions), *Understand Social and Economic Factors* (Monitor Human Uses) as well as under the action item of “Reduce Adverse Impacts of Human Activities” such as: *Improve Coordination and Accountability* (Improve Coordination and Accountability)

How project supports management of coral reef resources:

This project drew various managers and researchers together for the exchange of data, plans, and needs delineation. Local, regional, and federal representatives had a chance to contribute metadata, discuss research and gaps, and on-going research or monitoring. This sharing allows researchers and managers to plan a way forward to better reef management. A fully-implemented C-CCREMP will enable CRCP and other coral reef managers, both local and federal, to have a comparative assessment capability across the US Caribbean. Without C-CCREMP or a similar program the effectiveness of management actions at the regional level will not be easily assessed. Efficient and effective expenditure of funds for research, monitoring, conservation and management rely on effective tracking of efforts and outcomes and rapid sharing of assessment results.

List of project Partners and their roles:

NOAA NMFS SEFSC (R. Hill): coral reef monitoring
NOAA NOS NCCOS (M. Monaco): coral reef monitoring
NOAA SERO Protected Resources (J. Moore): acroporid status
PR Dept. of Natural and Environmental Resources (A. Rosario): PR monitoring program
VI Div. of Fish and Wildlife (W. Tobias): VI monitoring program
Caribbean Fisheries Management Council (M. Rolón): CFMC monitoring
Univ of Puerto Rico-Mayagüez (Appeldoorn, J. García, E. Weil): PR monitoring/research

Univ of the Virgin Islands (R. Nemeth, T. Smith): VI monitoring/research
National Park Service (R. Boulon, Z. Hillis-Starr): NPS monitoring and needs
USGS (C. Rogers): coral monitoring
US EPA (B. Fisher): EPA monitoring projects
--other local and federal researchers and managers participated in workshops and supplied data for database.

Communications, media exposure, capacity building, education and outreach activities: none

Submissions to CoRIS: metadata on project

Publications during FY2009: none

Presentations at professional meetings: none

Setbacks or challenges encountered in FY09:

As in previous years, this project was funded at a minimal level, reducing the ability of PIs to fully accomplish stated goals. The planned workshop was preempted by the CRCP plans to hold CREIOS workshops of a similar nature in the Atlantic and Pacific.

Comments on future direction of project:

The C-CCREMP project provides a means to coordinate on-going monitoring efforts and enable analyses to efficiently use resources. The CRCP is undertaking efforts to evaluate the same types of needs, develop a separate monitoring plan, and develop a data management plan. If utilized, the C-CCREMP mechanism could provide a means to advance all of those efforts.

IV. Reduce Impacts of Coastal Uses

Project ID#: 1066-2009

Title: Ecological Approach to Reef Restoration

Names of PIs and co-PIs: Margaret Miller (NOAA-SEFSC)

Duration of Project: ~ 8 yrs

Project Category:

- Reduce Impacts of Coastal Uses
- Reduce Impacts of Climate Change
- Address Emerging Issues

Brief description of activities conducted in FY2009:

This project has two components. In Aug 2009 we successfully collected, cultured, and conducted experiments with spawned coral larvae. Also, we continued execution of the Aquarius Coral Restoration/Resilience Experiment (ACRRE, co-funded with OAR) in performing three sampling missions (Oct/Nov, March, and July 2009) and additional transplants in July 2009.

Description of accomplishments & results:

Experiments with *A. palmata* larvae in 2009 included effects of enhanced CO₂ levels on fertilization and substrate conditioning on settlement. Under collaboration with colleagues at RSMAS (Albright and Langdon), we showed impaired fertilization rates under 50-yr and 100yr projected CO₂ levels. Also, substrates that were conditioned in high CO₂ seawater yielded significantly lower rates of settlement. Survivorship experiments with *A. palmata* and *M. faveolata* settlers indicated that the density of settlers did not have a strong impact on survivorship, but the site and orientation of the substrates did (Mfav survived much better in a vertical position while Ap survived better in a horizontal position). 32 colonies of *A. palmata* and over 150 individual *M. faveolata* settlers survived in the field as of Nov 2009.

The ACRRE project conducted 3 major sampling events during 2009, including during a disease outbreak in July 09 (both Acerv and Mfav transplants were affected by disease). Mortality rates have been quite high in this experiment, with notable variation between fragment sources and between genets within fragment sources (as hypothesized). Growth and survivorship data by genet is under analysis, as are zooxanthellae types and mucous microbial assemblages over the course of the experiment. Due to disease impacts, supplemental transplants in July 2009 (from the BNP nursery and Grassy Key) were spread out to a shallower depth at Conch and an alternate site (Molasses).

How project supports goals & objectives of CRCP:

The project develops and evaluates tools for enhancing coral populations. This is a crucial need as years of coral reef ‘management’ and ‘conservation’ have not stemmed the monotonic and catastrophic declines in Caribbean corals.

How project supports management of coral reef resources:

Given the immense losses of reef-building corals, particularly in the Caribbean in recent decades, research is needed to develop proactive and creative approaches to enhance coral recruitment and survivorship, particularly of reef-building (spawning) coral species. Such approaches should include both enhancement of larval recruitment (which maintains genotypic diversity of populations) and targeted transplantation/restocking strategies. This project focuses on active tool development for the former (coral larval culture and early life history studies) and evaluation of risks/benefits to enable better application of the latter (ACRRE study).

Real-time observations and progress on coral spawning and larval cultures are communicated directly to managers by email and list-serves. Interim research results are provided to FKNMS and other managers (FDEP, Biscayne National Park, Pennekamp State Park) in permit reports. A presentation on the ACRRE component was made to the FKNMS Advisory Council in Oct 2008.

List of project Partners and their roles:

UM/RSMAS (Langdon/Albright): academic collaborators on OA experiments

NURC/UNCW: ACRRE Project is logistically supported by Aquarius Reef Base program in Key Largo, FL

NCCOS/Charleston: Scientific collaboration in characterizing coral mucous microbial communities on ACRRE transplants

FKNMS: Logistic support for coral spawning and collaboration in ACRRE project

Communications, media exposure, capacity building, education and outreach activities:ACRRE component:

-Presentation to FKNMS Advisory Council: 21 Oct 2008

-featured in TOPSIDE: NOAA Diving Program Newsletter, Jan 2009,
http://www.ndc.noaa.gov/newsltr/ts_09_january.pdf

-featured in 'Earth Science Picture of the Day' website, 28 Oct 2008
<http://epod.usra.edu/archive/epodviewer.php3?oid=449568>

-Oral presentation at Marine Benthic Ecology Meetings; 4-7 March 2009, Corpus Christi, TX

-UM/RSMAS MBF Faculty seminar (Miller), 27 March 2009

Coral Spawning/Larval component:

- Collaborated with youth SCUBAnauts group during coral spawning. Documented spawning by nursery-cultured *A. cervicornis*. Resulted in extensive press coverage including:

<http://www.miamiherald.com/news/miami-dade/story/1199581-p2.html>

- Hosted site visits to coral spawning field lab (Key Largo) by educators and students from MarineLab Environmental Education (<http://marinelab.org/>) and SCUBAnauts

(<http://www.scubanautsintl.org/index.html>); researchers from NCCOS – Charleston SC and SUNY-Buffalo

Submissions to CoRIS:

Miller MW, Valdivia A, Kramer KL, Mason B, Williams DE, Johnston L (2009) Alternate benthic assemblages on reef restoration structures and cascading effects on coral settlement. Marine Ecology Progress Series 387:147-156.

Publications during FY2009: see above

Presentations at professional meetings:

Oral presentation at Marine Benthic Ecology Meetings; 4-7 March, Corpus Christi, TX

Setbacks or challenges encountered in FY09:

Aquarius saturation mission in FY09 was suspended during UNCW investigation but all intended transplants and sampling was accomplished via normal SCUBA.

Comments on future direction of project:

The capacity and expertise to culture and perform experiments with Caribbean larval spawning corals also provides the possibility, which will be further developed in FY10 and beyond, to perform experimental evaluation of climate change impacts (both temperature and acidification) on early life stages of corals which are likely to be most vulnerable and represent a profound threat to coral persistence on Caribbean reefs.

V. Reduce Adverse Impacts of Fishing

Project ID#: 10299-2009

Title: Coral reef fish-habitat modeling to support ecosystem-based management

Names of PIs and co-PIs: Todd Kellison (NOAA-SEFSC), Jerald Ault and Steve Smith (University of Miami/RSMAS)

Duration of Project: Year 3

Project Category:

- Reduce Adverse Impacts of Fishing

Brief description of activities conducted in FY2009:

In FY09 we continued developing and refining statistical models describing fish-habitat relationships in the FL Keys and Dry Tortugas coral reef ecosystems. Modeling approaches included (1) life-stage- (e.g., juvenile versus adult) specific analyses (generalized linear models and spatial-statistic models) focusing on economically and ecologically important species (predominantly snappers and groupers) for both the Dry Tortugas and FL Keys regions, and (2) multivariate community (multi-species) approaches for the Dry Tortugas region, with planned application to the FL Keys. One major goal of FY09 work has been to assess the consistency of important explanatory variables between the Dry Tortugas and FL Keys regions, with implications for the broader applicability of modeling results to other coral reef ecosystems. Results indicate that water depth and reef rugosity / complexity are important explanatory variables in both regions.

Description of accomplishments & results:

We have identified and are continuing to identify specific suites of habitat characteristics that, in combination, best explain the distribution of reef fish species (e.g., black grouper, hogfish, yellowtail snapper), species groups (e.g., all groupers), and community indices (e.g., species richness).

How project supports goals & objectives of CRCP:

The CRCP supports effective management and sound science to preserve, sustain and restore valuable coral reef ecosystem. Results from this project will facilitate effective fisheries and ecosystem management decisions by providing managers easy-to-interpret maps of species distributions, which can be used to guide zoning decisions in the Florida Keys National Marine Sanctuary.

How project supports management of coral reef resources:

Aside from providing direct information on fish-habitat correlations, this information has been and will continue to be used to guide reef fish sampling protocols in the closely related CRCP Project # 1064 – Assess and monitor coral reef MPAs. For example, the stratification system used to generate survey sites for FY09 CRCP-funded reef fish monitoring in the Dry Tortugas was altered (improved) based on results from the analyses described above. Since the monitoring efforts are used to assess the effectiveness of management actions (e.g., marine reserve establishment), this project has direct management utility. Additionally, project PIs have remained in close communication with Florida Keys

National Marine Sanctuary (FKNMS) managers regarding output of this project. Managers have indicated that project results will be used in upcoming reassessments of marine reserve size, number and location in the FKNMS. Finally, a workshop to present results and modeling capabilities to managers is planned for Spring 2010.

List of project Partners and their roles:

University of Miami – Rosenstiel School of Marine and Atmospheric Science: UM-RSMAS researchers (Drs. Jerald Ault and Steve Smith) are leading the analytical component of this project.

Communications, media exposure, capacity building, education and outreach activities: none

Submissions to CoRIS: none

Publications during FY2009:

Three manuscripts are in preparation.

Presentations at professional meetings: none

Setbacks or challenges encountered in FY09:

Because of the necessary time lag in moving funds to project co-PIs at the University of Miami (funds can only be moved from NMFS to UM in July of each year), UM co-PIs only received FY09 funds in July 2009, and thus are only ~ 5 months into work on FY09 objectives.

A workshop to communicate project results to regional and national managers (including the CRCP) was planned for late FY09 but has been rescheduled for spring FY10 to incorporate recent results.

Comments on future direction of project: This project will yield results that will significantly inform coral reef monitoring efforts, and predictive modeling capabilities to inform management.

Project ID#: 1317-2009

Title: Acoustic seabed classification and quantification of reef fish habitat

Names of PIs and co-PIs: Todd Kellison (NOAA NMFS), Chris Taylor (NOAA NOS), Art Gleason (University of Miami), Alejandro Acosta and Mike Feeley (Florida Fish and Wildlife Conservation Commission)

Duration of Project: Year 6

Project Category:

- Reduce Adverse Impacts of Fishing

Brief description of activities conducted in FY2009:

Hydroacoustic and diver surveys were performed at reported reef fish spawning aggregation sites in the upper FL Keys during three summer snapper "spawning moons". Surveys confirmed that the snapper aggregation sites continue to be targeted by commercial snapper-grouper vessels during known snapper spawning periods. Additionally, aggregations (i.e., elevated densities) of *Lutjanus analis* (mutton snapper) at two of the sites and cubera snapper (*L. cyanopterus*) at one site were observed on scuba surveys during predicted spawning moons, as were those of several non-snapper-grouper species. Acoustic data on fish biomass and abundance will be linked with habitat data collected at the same sites in FY08. Acoustic and scuba surveys during grouper spawning periods (i.e., winter full moons) are planned for winter 2010.

Description of accomplishments & results:

This project has resulted in the development of a habitat-mapping technology to facilitate assessment of reef fish-habitat utilization patterns, and in the preliminary generation of data to guide spatial management decisions in the Florida Keys National Marine Sanctuary. Evidence of continued reef fish aggregations and observations of commercial and recreational fishing pressure at reported spawning reef fish spawning sites during predicted spawning periods were obtained. Two sites were immediately adjacent to areas protected from fishing by the FL Keys National Marine Sanctuary. Results were communicated to FKNMS managers for consideration in an ongoing review of FKNMS management practices.

How project supports goals & objectives of CRCP:

This project is resulting in better assessments of the FL Keys coral reef ecosystem and in the identification of critical locations for management protection.

How project supports management of coral reef resources:

This project has indicated the likely ecological importance of reef habitats that are predominantly unmapped within the FL Keys National Marine Sanctuary due to their depth (> 20m). This project continues to result in the identification of critical locations (reef fish spawning aggregations) for management protection.

List of project Partners and their roles:

Art Gleason (University of Miami – Rosenstiel School of Marine and Atmospheric Science) has performed the mapping analytical component of this project. Chris Taylor (NOAA NOS) has led the reef fish acoustic survey component. Alejandro Acosta and Mike Feeley (FL Fish and Wildlife Conservation Commission) have provided expertise and logistical support. The FL Keys National Marine Sanctuary has provided vessel and staff support.

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

Outreach has involved communication of results to FKNMS managers.

Submissions to CoRIS:

N/A.

Publications during FY2009:

Gleason, ACR, RP Reid, GT Kellison (in press) Single beam acoustic remote sensing for coral reef mapping. Proceedings of the 11th International Coral Reef Symposium, Ft. Lauderdale, FL.

Gleason, ACR, GT Kellison, RP Reid (in review; revised and resubmitted) Geomorphology of grouper and snapper spawning aggregation sites in the upper Florida Keys, USA. Professional Geographer.

Presentations at professional meetings:

N/A.

Setbacks or challenges encountered in FY09:

Acoustic mapping of sites in the lower FL Keys was planned for completion by October FY09. Due to staffing limitations with State of FL cooperators, the mapping efforts are partially completed and planned for completion by Spring 2010.

Comments on future direction of project:

This project is segueing into a new CRCP FY10 project (“Assessing the locations and status of reef fish spawning aggregations in the Florida Keys”) to continue reef fish spawning aggregation research in the FL Keys.

Project ID#: 1242-2009

Title: Hydroacoustic Biomass Assessment of Reef Fish Spawning Aggregations

Names of PIs and co-PIs: Todd Kellison (NOAA)

Duration of Project: Year 6

Project Category:

- Reduce Adverse Impacts of Fishing

Brief description of activities conducted in FY2009:

Work planned with FY09 funds has yet to occur at the time of submission of the FY09 accomplishments report (see “Setbacks or challenges encountered in FY09” section).

In addition to work proposed for FY09, hydroacoustic reef fish surveys to document aggregations of reef fish at three sites off of southwestern Puerto Rico (Mona Island, Desecheo and Bajo de Sico) continued in FY09 using remaining FY08 funds (based on a contract awarded in FY08). Surveys occurred at one or more of the sites in all months of FY08 except December.

Description of accomplishments & results:

Hydroacoustic reef fish surveys were performed during 11 of 12 months at 2-3 sites per month; analyses are underway. Data were generated to support assessments of reef fish spawning aggregations and to be utilized in habitat utilization research. A report of spatiotemporal variability in reef fish aggregations based on surveys at Mona Island, Desecheo and Bajo de Sico from FY09 and previous years is in preparation, as is metadata that is planned for submission to CoRIS in December 2009.

How project supports goals & objectives of CRCP:

The CRCP supports effective management and sound science to preserve, sustain and restore valuable coral reef ecosystem. Results from this project continue to facilitate the assessment of reef fish spawning aggregations in Puerto Rico waters and the effectiveness of temporal and spatial closures in protecting those aggregations.

How project supports management of coral reef resources:

Results generated from this project have been widely distributed to and used by managers, guiding multiple management actions, described below:

- Management actions initiated by the Puerto Rico DNER (Feb 10, 2004, Fishing Regulation No. 6768) which included closures to commercial and recreational fishing on the entire shelf of PR jurisdictional waters during the red hind (*Epinephelus guttatus*) spawning season (December 1st to February 28th).
- Mona Island, Puerto Rico, 2007: project results provided data that resulted in changing the protected area boundary to the 600m contour (versus more shallow) to protect deeper-water reef fish spawning aggregations.
- Based in part on output from previous years of this study which identified high densities of aggregating fishes at Bajo de Sico (BDS), a number of management actions (seasonal closures and the prohibition of bottom gear such as traps) were enacted. Additional protections are being

considered which would only allow targeted pelagic fishing, and no bottom fishing. In September 2008, the NMFS Southeast Regional Office, which is coordinating with the CFMC on the BDS management actions, requested data collected at BDS from our research project to guide the management process.

List of project Partners and their roles:

Jose Rivera, an independent contractor, performed the hydroacoustic surveys. Planned work with FY09 funds (to occur in winter 2010) will occur in collaboration with Dr. Richard Appeldoorn and graduate students at the University of Puerto Rico – Mayaguez.

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

Direct and frequent communication of project updates to Puerto Rico and Caribbean Fishery Management Council representatives.

Submissions to CoRIS:

N/A in FY09; submission of project metadata is planned for December 2009.

Publications during FY2009: None

Presentations at professional meetings: None

Setbacks or challenges encountered in FY09:

Planned work with FY09 funds has yet to occur due to the timing of funding delivery and the ability to transfer funds to the project co-PI at University of Puerto Rico-Mayaguez (UPRM). The work proposed with FY09 funds involves surveys of winter grouper spawning aggregations in Puerto Rico waters. Since FY09 funds were not awarded until Spring 2009, funding was transferred to UPRM in Summer 2009 and work with FY09 funds will occur in early (Jan. - March) 2010.

Comments on future direction of project:

Efforts in winter 2010, and perhaps subsequent years, will focus on determining optimal combinations of methods (passive and active hydroacoustics and diver observations) to assess abundance and biomass of reef fish during spawning aggregations.

Project ID#: 1068-2009

Title: Assess/monitor affects of MPA status on reef fish populations and spawning aggregations in the Tortugas Ecological Reserves.

Names of PIs and co-PIs: Michael L. Burton (NOAA-SEFSC)

Duration of Project: Year 8

Project Category:

- Reduce Adverse Impacts of Fishing
- Improve Use and Effectiveness of MPAs

Brief description of activities conducted in FY2009:

The project's research cruise was conducted in July 2009 with 21 divers from a variety of scientific and academic institutions throughout the southeast. We successfully conducted visual transects for fish abundance on all 16 stations in the Tortugas South Ecological Reserve and eight of nine planned stations in the Tortugas North Ecological Reserve. Mutton snapper spawning was observed and documented for the first time since implementation of the reserve.

Description of accomplishments & results:

During the July 2009 research cruise, researchers, for the first time, were successful in finding, documenting and filming mutton snapper (*Lutjanus analis*) actually spawning, proof that the south reserve is serving the purpose for which it was set aside. Timing of spawning with respect to the lunar calendar was approximately where we had always thought it should be, location of spawning sites on the reef were exactly where we thought they should be, but time of day of spawning was substantially earlier in the day than we had always assumed it took place and this could explain our inability to locate spawning fish during previous cruises. We successfully retrieved two of three temperature loggers we deployed last year (one was fiercely guarded by an intolerant moray eel so we left it.) and one logger that had been deployed two years ago and subsequently lost. We deployed new temperature loggers on the three sites for retrieval next year. We successfully completed all planned photographic habitat transects for the south reserve.

For the first time, we deployed overnight cameras that record all activity in the range of their wide angle view for up to 20 hours (but realistically only as long as there is some available light). This allows us to record fish activity in the absence of divers up until dusk, long after the scientific party has exhausted its dive time. We had two successes with these cameras this summer; one time we recorded spawning mutton snapper, and one dusk time recording captured what we believe to be a great white shark swimming through the spawning aggregation of mutton snapper.

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 valuable marine protected areas in the southeastern U.S. 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 will be 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. Research plans are articulated to managers in the proposal development process, as the management community are partners in this project. Progress and accomplishments are provided in annual reports and at appropriate meeting venues, whenever possible.

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 occurring again after years of 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 of non-technical summary reports. Results will be made available to the Caribbean Fishery Management Council as well as the territorial fishery management agencies, as spawning aggregation management and monitoring MPAs to document their effectiveness in recovering exploited stocks is an important issue in these areas. .

List of project Partners and their roles:

FWC Marathon Lab - cruise participants, research collaborator in fish census. NCCOS, CCFHR - research collaborator in habitat/aggregation characterization. Florida Keys National Marine Sanctuary - research collaborator, user of data in marine spatial planning/zoning effort.

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

Direct contact with management partners (FWC and FKNMS) on results of cruises.

Submissions to CoRIS: None

Publications during FY2009: None published, one collaborative manuscript submitted for publication.

Presentations at professional meetings: None

Setbacks or challenges encountered in FY09: Difficulty getting the vessel charter contract in place until one week before the planned trip.

Comments on future direction of project: Plans are to go to a biennial monitoring scheme for data collection, and to continue cooperation with other CRCP PIs to integrate our work together and continue to assist with each others' projects. Some economy of funding can be gained across the board with this strategy.

Figure 1:



Mutton snapper aggregation, June 2009, Riley's Hump, TSER.
Photo Credit: Don Demaria

Project ID#:1668-2009

Title: Socio-economic profiles of fishing communities in Culebra and Vieques and US Caribbean

Names of PIs and co-PIs:

Juan Agar, NOAA/NMFS – SEFSC/Miami

James R. Waters, NOAA/NMFS – SEFSC/Beaufort

Duration of Project: 2 years

Project Category: Reduce Adverse Impacts of Fishing

Brief description of activities conducted in FY2009:

We conducted three main activities during FY09:

- a) The fieldwork component of the Puerto Rican hook and line, net, and dive fisheries costs and earnings study was completed;
- b) Completion of data entry and validation of the Puerto Rican commercial fishermen census data; and.
- c) Conducted a rapid socio-economic assessment of the possible impacts of extending the Bajo de Sico seasonal closure in Puerto Rico.

Description of accomplishments & results:

- a) Puerto Rican hook and line, net, and dive fisheries costs and earnings study: interviewed 350 commercial fishermen.
- b) Puerto Rican fishermen census: the data was entered and validated.
- c) Rapid socio-economic assessment: 65 interviews with fishermen operating in the Bajo de Sico seamount area. The results of this study provided the basis for the socio-economic analysis used in the development of the “Regulatory amendment to the reef fish fishery FMP of Puerto Rico and the U.S. Virgin Islands modifying the Bajo de Sico Seasonal Closure, including the a regulatory impact review and environmental assessment”.

How project supports goals & objectives of CRCP:

The development of sound coral reef protection policies requires understanding how management proposals will likely impact the various resource users. This project advances protection actions by providing managers with an understanding of how fishing communities will likely adjust to regulations. In the past, failure to understand and incorporate the human dimension into coral reef conservation strategies, often led to failed policies, because they lacked sensitivity to the local cultural, economic, political and social environment.

How project supports management of coral reef resources:

The results of these projects support the management and protection of coral reef resources by providing current information on the fishermen and their communities. This information not only helps describe these communities but also provide the basis for regulatory analysis. These projects 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 biological conservation. This study directly contributed to the development of the

“Regulatory amendment to the reef fish fishery FMP of Puerto Rico and the U.S. Virgin Islands modifying the Bajo de Sico Seasonal Closure, including the a regulatory impact review and environmental assessment”.

List of project Partners and their roles:

Mr. Manoj Shivilani, Thomas Murray and Associates, pre-testing of costs and earnings survey instrument (contractor).

Mr. Daniel Matos, PR DNER, worked on data entry and validation of the data in the commercial fishermen census (contractor).

Ms. Flavia Tonioli, University of Miami/Cooperative Institute for Marine and Atmospheric Studies, research and report writing (contractor)

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

These projects help train new scientists interested in coral reef socioeconomic issues.

Submissions to CoRIS: None

Publications during FY2009:

Tonioli, F. and J. Agar, 2009. Extending the Bajo de Sico, Puerto Rico, Seasonal Closure: An Examination of Small-scale Fishermen’s Perceptions of Possible Socio- economic Impacts on Fishing Practices, Families and Community. *Marine Fisheries Review*, Vol. 71, No. 2, pp. 15-23.

Karras, C. and J.J. Agar, 2009. Cruzan fisher’s perspectives on the performance of the Buck Island Reef National Monument and the red hind seasonal closure. *Ocean and Coastal Management*, Vol. 52, pp. 578–585.

Presentations at professional meetings:

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.

Setbacks or challenges encountered in FY09:

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

Comments on future direction of project:

We are working on the development of a commercial fishermen census for the U.S. Virgin Islands. This proposed census will enhance our ability to understand socio-economic consequences of regulatory actions in the U.S. Virgin Islands, and provide comparisons among Caribbean jurisdictions.

Figure 1: Traditional fishing boats ("yolas") in front of a fish cooperative ("villa pesquera"), Aguadilla, Puerto Rico, October 2008. Photo Credit: Flavia Tonioli



Project ID#: 10401-2009

Title: Reef Fish Recruitment Dynamics: Integration and Analysis of Long-Term Visual Fish Surveys to Examine Environmental Influences

Names of PIs and co-PIs: John Walter (NOAA-SEFSC), David Jones (NOAA-SEFSC)

Duration of Project: Year 3

Project Category:

- Assess and Characterize US Coral Reefs – Coral Reef Ecosystem Integrated Observing System (CREIOS)
- Reduce Impacts of Coastal Uses
- Reduce Adverse Impacts of Fishing

Brief description of activities conducted in FY2009:

We evaluated mangroves as functional nurseries for reef fishes in Biscayne National Park (BNP) in southeastern Florida, USA. The aim of this work was to evaluate connectivity between mangrove and reef habitat by testing the null hypothesis of no connectivity.

Based upon data collected from ten years of visual surveys of mangroves and coral reefs in Biscayne National Park, this study takes a novel approach of following individual cohorts of fish and testing for correlations between these cohorts over time. This longitudinal approach to documenting connectivity through ontogeny between the two habitats is made possible by the multiple years of data spanning high and low recruitments and the ability to identify individual year classes of fish from the length frequencies. Annual age-specific indices of abundance were calculated for fish estimated to be age 0 to 4 years in both habitats, and correlation analyses, with appropriate temporal lags, were performed. Statistically significant correlations between juvenile abundances in mangrove habitats and adult abundances on the reef tract one to two years later emerged for sergeant major (*Abudefduf saxatilis*), schoolmaster snapper (*Lutjanus apodus*) and gray snapper (*L. griseus*). Schoolmaster and gray snapper, in particular are desired targets of fisheries and important predatory fishes on coral reefs.

Description of accomplishments & results:

Four main conclusions can be drawn from the results of this study. First, there is spatial segregation of life history stages in a number of species of reef fishes that reside in BNP, with juveniles occupying mangroves in the bay and adults inhabiting the reef. Second, habitats within the bay and on the reef are connected through ontogenetic migrations of certain fishes from their juvenile to their adult habitats. Third, for some species of reef fishes this linkage results in the propagation of year-class strength of bay populations to adjacent reef populations one or two years later. Fourth, this congruence of year-class strength among bay and reef populations is indicative of the nursery role of mangroves and annual population replenishment.

The results of this study, summarized in an article published in the journal Marine Ecology Progress Series, highlight the importance of mangrove forests as an intermediary habitat for coral reef fishes. Our work suggests that mangroves serve as nurseries for reef fishes within BNP.

How project supports goals & objectives of CRCP:

This critical analysis helps underscore the linkages between important habitats that help maintain coral reef ecosystems. By solidifying this link, this work provides rationale for including a mosaic of habitats (especially mangrove estuaries) in marine protected areas to ensure a source of recruits to reefs.

How project supports management of coral reef resources:

Since there are demonstrable long-term linkages between inshore mangrove nurseries with adult habitats on adjacent reefs, “reef-centric” habitat and fishery conservation measures that fail to include mangrove resources are likely to be ineffective. These results provide managers with: (1) a means to predict reef fish relative abundance 1–2 years into the future; and (2) validated, fishery-independent recruitment indices which can be essential elements of stock assessments. Specifically, this work will underscore the call for protecting mangrove habitats that are demonstratively linked to BNP reef resources. Park management is currently formulating their first fishery management plan.

List of project Partners and their roles:

SEFSC’s ongoing reef and mangrove fish assemblage monitoring programs provided the data essential to this analysis.

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

Results were delivered to BNP in the form of an annual report. Results have been communicated personally with Park managers and the broader fish management community through seminars and presentations at scientific meetings.

Submissions to CoRIS: none

Publications during FY2009:

Jones, David L., John F. Walter, Elizabeth N. Brooks, and Joseph E. Serafy. 2009. Connectivity through ontogeny: Fish population linkages among mangrove and coral reef habitats. *Marine Ecology Progress Series*. 401: 245–258

Presentations at professional meetings:

Jones, D. L., J. Walter, and J. E. Serafy. Contribution of Mangrove Nursery Habitats to Replenishment of Adult Reef Fish Populations in Southern Florida. *Florida Bay and Adjacent Ecosystems*. Dec 2008, Naples, FL.

Jones, D. L., J. Walter, and J. E. Serafy. Contribution of mangrove nursery habitats to replenishment of adult reef fish populations in southern Florida. Presented at the 11th International Coral Reef Symposium, 7–11 July 2008, Fort Lauderdale, FL.

Setbacks or challenges encountered in FY09: None

Comments on future direction of project: This was the last year of the project

Project ID#: 1873 -2009

Title: Recovery of Conch Populations in the U.S. Virgin Islands

Names of PIs and co-PIs:

Jennifer C. Doerr - NMFS/SEFSC Galveston

Dr. Ronald L. Hill, NMFS/SEFSC Galveston

Dr. Thomas J. Minello, NMFS/SEFSC Galveston

Duration of Project: Year 5

Project Category:

- Reduce Adverse Impacts of Fishing

Brief description of activities conducted in FY2009:

Research activities this year were conducted during three field expeditions to St. John, U.S. Virgin Islands, in May, July, and November 2009. Mark-and-recapture, acoustic tracking, and habitat utilization studies continued in Brown Bay (within VI National Park boundaries, no commercial and restricted recreational/subsistence fishing), Princess Bay, Otter Creek, and Water Creek (in VI Coral Reef National Monument waters, no-take reserve). Extensive visual searches were conducted in all study sites. Queen conch encountered during these surveys were measured (shell length and lip thickness), tagged (if not previously tagged), and released. Environmental parameters, including spatial coordinates, were recorded at each conch location. Benthic composition, expressed as percent cover, was documented by centering a 1-m² quadrat directly over each conch and quantifying each organism (plant or sessile animal) or substrate.

Maintenance of hydrophone arrays at each site was completed during field expeditions. This included replacing batteries and downloading sonic data received from conch bearing acoustic tags. Bottom and surface temperature loggers were also downloaded and replaced in their original locations on each hydrophone and at various surface sites throughout the bays.

We continued to analyze downloaded acoustic data sets using ArcView GIS software and updated digital maps of long-term movements of individuals. Spatial coordinates of recaptured conch were mapped and analyzed with benthic habitat data to estimate site fidelity and home range sizes for juvenile and adult tagged conch in Fish Bay. Mark-and-recapture data from 2009 were added to the existing database to add robustness to the Jolly-Seber analysis of recruitment, growth, and survival that is the subject of planned manuscript. A manuscript using recapture data to estimate site fidelity and home ranges for queen conch in Fish Bay was submitted for publication.

Description of accomplishments & results:

During tag-and-recapture studies this year, 1223 queen conch were located, measured, and tagged using Floy T-bar tags (657 in Brown Bay, 80 in Princess Bay, 232 in Otter Creek, and 254 in Water Creek). Throughout the first five years of this project we have tagged 4286 conch in six different bays around the island of St. John. Tagged conch included juveniles and adults ranging from 5 to 28 cm in length. Quantification of benthic habitats showed that queen conch in Brown Bay utilized mainly seagrass beds of *Syringodium filiforme*, *Thalassia testudinum*, and *Halodule wrightii*. Queen conch in Princess Bay,

Water Creek, and Otter Creek were predominantly found in shallow reef habitats (rubble, *Porites spp.*, *Millepora spp.*, sponges) with sparse macroalgae (*Penicillus spp.*, *Caulerpa spp.*, *Dictyota spp.*) and bordered by mangroves.

Recapture rates for tagged conch between May and November were 21% for Brown Bay, 22% for Princess Bay, and 39% each for Otter and Water Creeks. Size-class comparisons between new and previously tagged conch suggest Brown Bay's low recapture rate is due to strong recruitment of small conch coupled with fishing activity. The low recapture rate for Princess Bay, located within the no-take National Monument, may be evidence of fishing as this bay is easily accessible by land. Higher recapture rates, mostly of larger juveniles and adults in Otter and Water Creeks (also within the no-take reserve), suggest a stable resident populations with lower fishing, but low reproductive recruitment may be a management concern.

Recapture surveys continued in one of our historic study sites, Fish Bay. Over several days of visual surveys, we located a total of 436 conch, only 8 of which were tagged. This low recapture rate may indicate that large numbers of previously tagged conch have matured and moved out of the bay into deeper-water adult habitats, while increased recruitment of small juveniles has continued as initially discovered during field surveys completed in 2007.

As in previous years we discovered and quantified piles of recently-discarded shells on the shores of our study areas indicating poaching of under-sized conch. For example, in Brown Bay we found 15 previously tagged conch among 50 fished shells, only 2 of which were legal size. Discoveries of recently discarded shells from exploited conch also continued along the shoreline of Fish Bay, with 92 total shells recovered. All of these were undersized juveniles, except for 1 previously tagged adult. These data were shared with VI National Park Service Enforcement personnel.

How project supports goals & objectives of CRCP:

The queen conch is an important cultural component and an extremely valuable coral reef fishery resource throughout the Caribbean, second only to the spiny lobster. Conch are grazers that once were abundant in these reef ecosystems. Comparisons of past studies with current densities from these areas continue to show that queen conch populations are depleted, although we may be seeing small signs of increase. This project's goals of understanding habitat needs, movement rates and migration corridors, and population trends through the use of traditional mark-and-recapture techniques and innovative sonic tracking technologies in bays around St. John that undergo different levels of fishery management directly addresses one of the primary goals of the CRCP of reducing adverse impacts of fishing. Additional research on population dynamics, habitat use, fine-scale movement patterns, and long-term migrations completed during the course of this project also supports the objectives listed under the goals of refining the identification and assessment of essential fish habitat for this important species.

How project supports management of coral reef resources:

Continued funding of this project has allowed expansion of research to protected areas within the VI National Park (no commercial and restricted fishing) and the VI Coral Reef National Monument (no-take reserve), thereby increasing available information regarding the issues surrounding local queen conch populations. This permits direct comparisons of conch densities, growth and survival rates, and movement and migration rates between fished and non-fished areas, as well as the evaluation of the MPA/no-take reserve. There have been few studies to judge the success of past management actions on

conch populations in the region. These data are needed to assess the effectiveness of current and future management practices.

Steady declines in populations of queen conch have been reported in all areas of its distribution; however, stock information on this important coral reef inhabitant in the U.S. Caribbean is insufficient and possibly unavailable to managers throughout the region. In 2007, SEDAR 14 (Southeast Data, Assessment and Review) undertook the task of assessing queen conch and several other reef species in the U.S. Virgin Islands and Puerto Rico. Population size estimates and natural and fishing mortality data collected directly under this project were presented at the initial SEDAR 14 data collection workshop, supplementing historical information from the SEAMAP-C surveys. The data we presented subsequently became the primary data source used by scientists and managers in their queen conch stock assessment report to the Caribbean Fishery Management Council estimating population sizes (standing stock biomass) for the U.S. Virgin Islands. While it was judged that the densities of conch for the USVI were low but possibly showing signs of some improvement, the need for more fishery-independent data has been identified by SEDAR as a high priority in order to reevaluate conch stocks.

List of project Partners and their roles:

NOAA/NMFS Apex Predator Program, Narragansett Laboratory - With our assistance, researchers from the Apex Predator Program are conducting acoustic monitoring of juvenile shark utilization of nursery areas in Fish Bay and Coral Bay, sharing our acoustic array and exchanging tag detection data. They have also installed additional receivers in Coral Bay (near our VI Coral Reef National Monument study areas), expanding detection coverage for acoustically tagged conch within Monument waters.

NCCOS Biogeography Team - Additional hydrophone arrays maintained by the NCCOS Team are also passively monitoring for acoustic tags deployed on queen conch around St. John, expanding spatial coverage of local populations. We have provided them with several tag returns to augment their detections in their reef fish study.

USVI National Park Service - Continued logistical support from the NPS includes equipment storage and assistance in identifying alternate areas with historical queen conch populations. Enforcement personnel provide notification when tagged conch, typically fished individuals, are found around our sites or in other areas of the island.

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

In a companion NMFS Educational Project, classroom visits were completed and educational materials were distributed to students at the Giffit Hill School (2nd, 7th, and 10th grades). Information on NOAA, queen conch biology and ecology, fisheries management, and our coral reef projects was presented. In a field trip to Fish Bay the high school class learned about habitat types, field survey methods, environmental data collection, and tagged and measured conch. The students are assisting with on-going shoreline surveys of fished conch and have already developed a campaign to “Stop Killing Baby Conch.” An article chronicling the students’ activities and our involvement was published in a local newspaper.

Submissions to CoRIS:

Educational materials developed for distribution to students at the Giffit Hill School were submitted to CoRIS. These included lesson plans, magnets, “Regulation Rulers,” and project sheets.

Publications during FY2009:

A manuscript entitled “Movement patterns of queen conch, *Strombus gigas*, and utilization of coral reef habitats in St. John, U.S. Virgin Islands,” was completed and submitted for publication in the Caribbean Journal of Science.

Presentations at professional meetings: None

Setbacks or challenges encountered in FY09: None

Comments on future direction of project:

We plan to complete the field portion of the project in FY2010, with possible partial funding in FY2011 to complete data analysis, reporting, outreach, and publication efforts. This will give us a complete 3-year data set within the Park and Monument waters. That is the minimum needed for the Jolly-Seber analysis of demographic rates (survival and growth) and population size for a robust comparison between protected and fished areas. However, there is a strong need for continued monitoring of reef species like queen conch, in order to assess the effectiveness of management measures and adapt management as needed.

Project ID#:1244-2009

Title: Monitoring Coral Reef Fish Use of MPAs and Recruitment Connectivity between the Florida Keys and Meso-American Reefs

Names of PIs and co-PIs: John Lamkin, NOAA/SEFSC

Duration of Project (For multi-year project, indicate number of years project has been under implementation in FY09): format: Year 8

Project Category:

- Reduce Adverse Impacts of Fishing

Brief description of activities conducted in FY2009:

Ongoing activities for FY09 and FY10 are focusing on synthesis of data collected from 2004 – 2007. To date, zooplankton samples through 2007 have been sorted and 50% identified. Total number of larval reef fish to be identified is approximately 58,000. Inshore data will continue to be summarized, and the extensive larval reef fish collections from the previous cruises will be sorted and characterized. Physical oceanographic data from both inshore and ship observations is being compiled and analyzed. Shipboard Acoustic Doppler Current Profiler (ADCP) data is being processed to describe current fields. Work will continue on developing larvae transport models. Collaborations with institutions in Mexico have been strengthened and work plans for manuscripts have been identified.

Description of accomplishments & results:

Field work is completed for this project; we are in the synthesis and data analysis stage. Understanding connections of regional populations of coral reef fish are important for management of reef fish stocks.

How project supports goals & objectives of CRCP:

The Florida Keys and Mesoamerican reef ecoregions are hydrographically connected by the Caribbean Current which flows north along the Yucatan Peninsula shelf into the Gulf of Mexico, then along the Florida shelf via the Loop Current. Understanding the extent to which they are linked biologically is an important biological and sociological question. This study is designed to map the distribution and abundance of larval reef fish and oceanographic currents along the shelf and inshore, develop comparative baseline recruitment data for snapper and groupers, and provide data to examine the biological linkage between these two eco-regions. This information is necessary for management of these species, evaluating the effectiveness and connectivity of marine reserves, and developing sustainable fishing practices in both the U.S. and Mexico.

How project supports management of coral reef resources:

This project will provide new information for management on two important coral reef fish families, snappers and groupers. These two groups are the primary food and commercial species throughout the south Florida and Mesoamerican reef systems. Management of fisheries resources and marine reserves requires data on baseline recruitment and larval transport. By better understanding these processes, managers can develop guidelines for both recovery and sustainable management. We will provide tools in the form of recruitment indices for measuring spawning success. In addition, we are characterizing

the larval reef fish assemblages in both South Florida, and the Mesoamerican reef. This contributes directly to the goal of characterizing marine ecosystems for management.

List of project Partners and their roles:

Atlantic Oceanographic and Meteorological Laboratory - physical oceanography analysis
El Colegio de La Frontera Sur (ECOSUR) in Chetumal - inshore recruitment

Centro de Investigación y de Estudios Avanzados (CINVESTAV) in Mérida, and Centro de Investigación – larval fish identification

Científica y de Educación Superior de Ensenada (CICESE) in Baja California, México, - long term analysis of current trajectories

University of Belize - Ichthyoplankton analysis

Boston University – recruitment studies on grouper, collaboration with Conservation International

Communications, media exposure, capacity building, education and outreach activities: none

Submissions to CoRIS: none

Publications during FY2009:

Lamkin, J.T., E. Johns, L. Vasquez-Yeomans, L. Carillo, R. Smith, J. Ochoa, E. Malca, E. Sosa, S. Whitcraft, B. Muhling, T. Gerard, N. Melo. (*in press*). Connectivity and larval transport pathways between Mesoamerican barrier reef and the Florida Keys reef tract. *Eos, Transactions, American Geophysical Union*.

Va´squez-Yeomans, Lourdes, Eloy Sosa-Cordero, Monica R. Lara, A.J. Adams, J.A. Cohuo. 2009. Patterns of distribution and abundance of bonefish larvae *Albula spp. (Albulidae)* in the western Caribbean and adjacent areas. *Ichthyol. Res.* 56 (3): 266-275.

Presentations at professional meetings: none

Setbacks or challenges encountered in FY09: none

Comments on future direction of project:

Next year will be the final year of this project as data collection ends and manuscripts are finalized.

Project ID#: 1067-2008

Title: Monitoring Coral Reef Fish Utilization of Marine Protected Areas and Inshore Habitats in Florida Bay

Names of PIs and co-PIs:

Trika Gerard and John Lamkin - NOAA/SEFSC

Duration of Project: 6 years

Project Category:

- Reduce Adverse Impacts of Fishing

Brief description of activities conducted in FY2009:

This study analyzes the juvenile portion of adult gray snapper (*Lutjanus griseus*) otoliths collected within the Florida Keys National Marine Sanctuary in order to potentially match them to one of five previously assigned nursery regions (Gerard, PhD dissertation). Adult (n = 194) *L. griseus* and yellowtail snapper (*Ocyurus chrysurus*) were collected from nine sites along the Florida reef tract in 2004 (see figure 1). All field collections and lab analysis has been completed.

Description of accomplishments & results:

We have successfully removed the juvenile portion of 194 adult otoliths, and sample and statistical analyses have been completed. We are in the process of writing up results for submission to a peer-reviewed journal.

How project supports goals & objectives of CRCP:

Commercially, recreationally and ecologically important snapper species migrate to reefs from juvenile nursery areas such as seagrass and mangrove habitats including those in Florida Bay and the lower Florida Keys. Many of these nursery areas face declining water quality, shoreline development and other anthropogenic threats. Understanding the ontogenetic migration corridors that exist between nursery and reef, and the timing of these migrations is critical to building sustainable populations and effective MPA's. Ecosystem research on the links between habitats and particularly their function as sources and destinations of recruits is key to the long-term monitoring and effective management of these areas. The South Florida Coral Reef Initiative calls for the establishment of no-take reserves within these MPA's and we believe that only with effective identification and protection of sources of recruits can we ensure the effective function of MPA s as reef fish sanctuaries.

How project supports management of coral reef resources:

High levels of fish density and biomass on reefs are largely due to the reef's connection with adjacent seagrass and mangrove systems. Many western Atlantic fish species appear to make ontogenetic migrations that follow the sequence of utilization from seagrass to mangrove to reef habitats. This project is designed to map the source of recruits of snapper species in south Florida to further to understand the large to small scale processes governing reef fish recruitment. Technological developments have recently become available to detect these microchemical constituents of fish otoliths and determine trace "elemental signatures". These signatures can differ among stocks exposed to different water masses and environmental conditions allowing them to serve as natural tags for tracking

fishes. The ability to reconstruct the environmental history of individual fish is a significant advancement and offers a new tool to fisheries management. Commercially important snapper and grouper communities in the Keys are believed to recruit to the reef from seagrass and mangrove habitats of Florida Bay, where they spend their juvenile phase before migrating to the coral reefs as young adults. This source of recruits is of particular importance given the recent efforts to restore Florida Bay and the establishment of MPA's and the Tortugas Ecological Reserve. Protected coral reef areas need an established and protected source of recruits to maintain and improve reef fish populations. Otolith microchemical analysis perfected during this research endeavor paved the way for further studies that have the potential for identifying essential sources of recruits to established MPA's and those under consideration for protection. This project will provide new methods of managing coral reef fish for long term sustainability.

List of project Partners and their roles:

Florida Keys National Marine Sanctuary - sampling design and management applications.
University of Miami, RSMAS, Stable Isotope Laboratory - otolith sample analysis.

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

Part of this project was submitted and accepted as a Senior Thesis by Anne Morgan to the Biology Department at the University of Miami.

Submissions to CoRIS:

Manuscript publication.. Gerard, T. and B. Muhling. 2010. Variation in the isotopic signatures of juvenile gray snapper (*Lutjanus griseus*) from five southern Florida regions. Fisheries Bulletin. Vol. 104:98-105.

Publications during FY2009:

Gerard, T. and B. Muhling. 2010. Variation in the isotopic signatures of juvenile gray snapper (*Lutjanus griseus*) from five southern Florida regions. Fisheries Bulletin. Vol. 104:98-105.

Presentations at professional meetings:

One oral presentation given at the Fourth International Otolith Symposium, Monterey, California, August 2009.

Setbacks or challenges encountered in FY09: none

Comments on future direction of project:

We have developed methodologies to look at habitat linkages between nursery areas and coral reefs. We intend to apply our expertise to the US Virgin Islands targeting reef fish species such as snappers, groupers and parrotfishes.

Project ID#: 10292 - 2009

Title: Productivity of *Acropora cervicornis* habitat and impacts from natural and human disturbance

Names of PIs and co-PIs: Ron Hill

Duration of Project: Year 3

Project Category:

- Assess and Characterize US Coral Reefs – Coral Reef Ecosystem Integrated Observing System (CREIOS)
- Reduce Impacts of Coastal Uses
- Reduce Adverse Impacts of Fishing
- Reduce Impacts of Pollution & Coral Diseases
- Address Emerging Issues (Caribbean acroporid coral)

Brief description of activities conducted in FY2009:

Studies show *Acropora cervicornis*, listed as threatened under ESA, serves as a reef builder and a key reef fish habitat. Anecdotal evidence suggests that colonies flourish and decline repeatedly on decadal scales but no research has documented these trends, identified their causes, or documented the effect on reef ecosystems. Our study sites range across western Puerto Rico and the northern Virgin Islands and are exposed to a variety of impacts. We set-up permanent transects at sites showing different stages of growth or decline and are monitoring changes in coral growth and vitality and effects on associated fish assemblages. Sample sites have been established at Mona Island (2 sites) and La Parguera (2 sites) in Puerto Rico and Thatch Cay, Lovango Cay, and No-name Bay, St. John in the USVI. Each site consists of 2-4 permanent transects (10 x 2 m) that have been surveyed repeatedly, collecting data on coral cover, colony height and width, incidence of disease or predators, and fish assemblages. Conditions were documented with photo-quadrats for further analysis in the lab. Our methods combine those developed for assessment and mapping of *A. palmata* (SEFSC) and those used by NCRI in SE Florida to evaluate changes in community structure and productivity.

In FY-09 (year 3), we surveyed all transects in all sites and are analyzing data on habitat use and coral growth. In year 3, with partners from UVI, we deployed a continuously monitoring nitrate analyzer to supplement water quality data collection.

Description of accomplishments & results:

Seasonal cruises to all study sites were accomplished in FY-09, working collaboratively with other NOAA Coral Reef Conservation Program (CRCP) projects [conch research (Doerr) and coral disease/resilience (Bruckner)]. At Mona Island, in FY-08, we worked with a CRCP grant-funded researcher (Univ. of Houston) to transplant *A. cervicornis* coral fragments to a nearby area, adjacent to one of our transects, to compare with natural colony growth. When the sites were resurveyed in FY09, we documented the transplants were generally less successful than expected. Surveys in FY-08 documented effects from a net in one of the Thatch Key transects. The net was removed and recovery is being studied as part of the design. Continued signs of slow growth in the injured colonies in FY-09 suggest longer-term impacts than expected. Signs of seasonal variations in coral growth and algal competition were evident at Thatch Cay and No-name Bay; signs of decline were evident at Lovango

Cay, San Cristobal and Coral Gardens (La Parguera). The remaining sites seem stable but with increased signs of predators and/or disease. Continuous nutrient monitoring was instigated to evaluate correlation between changes in water quality parameters and colony vitality. Juvenile habitat use of *A. cervicornis* (as EFH) by snappers and grunts and parrotfishes has been well documented in this research.

How project supports goals & objectives of CRCP:

One of the objectives of CRCP is Ecosystem Characterization with a goal of increasing the number of coastal and marine ecosystems adequately characterized for management. (NOAA Corporate Measure). This project is characterizing shallow water reef habitats across PR and the USVI, monitoring biological habitats, living marine resources and water quality. It will provide mapping of *A. cervicornis*, distributions and status, and some input on recovery metrics. It has provided metadata records to CoRIS and to the C-CCREMP database.

How project supports management of coral reef resources:

At present we do not understand all the ways coral reef ecosystems vary under natural conditions making it hard to differentiate natural and anthropogenic changes. This project focuses on the threatened staghorn coral (*A. cervicornis*) and documents its growth patterns and its function as reef fish habitat, particularly for juvenile snappers, grunts, and parrotfishes. Additional surveys of damage from fishing gear will help distinguish impacts from natural damage (e.g., storms) and human-induced damage.

We are also attempting to link environmental measurements with changes in coral vitality and growth and subsequent changes in fish habitat value to improve capabilities to manage coral reef environments. Parameters such as site-specific nutrient loading and temperature variations will be correlated with adverse changes in coral colonies, like algal overgrowth or coral disease. We are looking to link cycles in environmental conditions with cycles in coral decline or rejuvenation. This will help us identify conditions under which staghorn corals can flourish and those under which they decline. By knowing which conditions are important, various human activities (e.g., land-use practices, climate change) can be managed to prevent further coral loss and degradation.

Restoration activities can be guided by the study's findings, providing input on locations, conditions, and target colony configurations to maximize long-term ecological productivity. For example, habitats to benefit replenishment of coral reef grazers (e.g., EFH for parrotfishes) can be designed.

By identifying natural variations and the timeframe over which changes occur, it will also give us a better understanding of which conditions should be of concern to managers (e.g., ESA, CZM). Understanding the ways in which *A. cervicornis* communities change in support of healthy reef systems will allow managers to more fully address the impacts to these habitats, improving capacities for both coral reef management and reef fisheries management.

We are researching the contribution *A. cervicornis* makes to productivity of shallow coral reefs and its function as EFH for Caribbean reef fishes across seasonal and interannual timeframes. Data will support valuation studies of coral reefs and by linking environmental parameters to positive or negative changes in growth and productivity it can guide conservation actions. The proposal and updates of the project are provided to the Caribbean Fisheries Management Council which includes coral reef managers from the Virgin Islands and Puerto Rico. Documentation of habitat use will be used to improve EFH descriptions in management plans. This study also can provide needed insight into recent basin-wide

loses that have resulted in the listing of *A. cervicornis* as “threatened” under the ESA with supporting data and publications being shared with coral managers in NOAA Fisheries’ (SERO) Protected Resources Division.

List of project Partners and their roles:

University of Puerto Rico- Mayaguez (R. Appeldoorn): field logistics and grad students

University of Virgin Islands (K. Brown): nutrient analysis

VI National Park (R. Boulon): equipment storage and logistics

Mona Aquatics (P. Garcia): dive boat and support

Awesome Powerboat Rentals: dive boat

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

With our collaboration with university partners, we maximize our interaction with graduate students, providing them opportunity to increase their research skills. We provide guidance on field techniques, data management and experimental design. These are the future researchers and managers that will continue to benefit coral reef ecosystems in the future.

Submissions to CoRIS: Metadata on project

Publications during FY2009: none

Presentations at professional meetings: none

Setbacks or challenges encountered in FY09: none

Comments on future direction of project:

Studies of acroporid corals in the Caribbean offer a chance to examine obvious changes in the ecosystem that can provide the key to improved management. This project is attempting to link coral vitality with fish habitat use over decadal time scales, realistic time periods over which changes can be understood. The results will interest a wide range of managers. By providing linkages to environmental factors, we are providing the scientific basis managers need to reverse the degradation in the nearshore environment and make significant improvement in conditions for coral reef ecosystems and the communities that depend on them.

Figure 1:



Acropora cervicornis (staghorn coral) grows as extensive ridges off Mona Island, Puerto Rico. Reef fish assemblages are impressive (Photo credit: A. Bruckner)

Project ID#: N/A

Title: Development of a Cooperative Fishery Independent Survey in the US Caribbean

Names of PIs and co-PIs: Todd Gedamke, NOAA/SEFSC

Duration of Project: 1 year

Project Category:

- Reduce Adverse Impacts of Fishing

Brief description of activities conducted in FY2009:

FY09 began implementation of the pilot project by engaging resource managers, academic and NGO partners, and fishers in St. Croix, our chosen study site. This project will be the first comprehensive fishery independent, cooperative survey of an entire island shelf in the US Caribbean in support of fisheries management in the region. FY09 activities included site selection, coordination, and the beginning phases of implementation. St. Croix was chosen as the pilot project location for a variety of reasons: Support and interest from multiple resource managers, support from the fishing community, relatively small size of the continental shelf, existence of pre-existing and useful mapping and socio-economic products (many funded by previous CRCP funded projects), and co-location with relevant on-going visual surveys. Fish traps were chosen as the survey method because of their consistency of design, wide variety of species caught, ability to keep fish alive, and ability to fish them in the same manner.

Two trips were made to the USVI in support of this project. The first trip solidified support from the NPS and DPNR (both FWS and CZM). NMFS regulatory managers have also pledged verbal support. Meetings with academic partners at the University of the Virgin Islands and Simon Pittman (NCCOS/Bioge) yielded fruitful collaboration on survey design and logistics. Preliminary survey design maps were generated and will be refined with additional stratification input from co-located visual surveys and fisher input. Informal interviews were held with potential collaborators and partners on-island. Fisher engagement has been high, and we have identified fishers willing and able to participate in the survey. We have begun the process of designing and building the trap gear, which will yield the highest and most systematic output for our survey dollar. PI's have awarded contracts for project personnel (a project manager and field coordinator), and contracts for analytical support (NOS/Bioge & UVI). Permit applications are in process while PIs finalize the survey methodology. The survey will commence in late Summer/early Fall 2010, based on input from fishers and scientists and logistics and is anticipated to take between 30-60 days. Surveys will be conducted across the entire St. Croix shelf including all managed and protected areas.

Description of accomplishments & results:

The survey design has been finalized. It will be a combination of systematic, fixed, and stratified trap stations using both classic design-based techniques and a new spatial model-based allocation strategy developed by John Walter (SEFSC). We will sample ~600 samples over a 30-60 day period (fishable shelf ~110 nm²). Fish traps will be baited, deployed, and recovered after 24 hour soak times. Fish caught consistent with USVI fishing regulations may be kept, while those caught in protected areas will be vented and released at depth using release cages. Contracts have been awarded and permits are in

progress, and fishers are working with project personnel to finalize the sampling methodology and data collection procedures.

How project supports goals & objectives of CRCP:

This project addresses the current fishery data-limitations in the US Caribbean and the need for a paradigm shift in data collection strategies. This work will provide the first comprehensive spatial evaluation of fish abundance for any US Caribbean territory and will provide a model for developing similar programs in other locations. By incorporating our understanding of coral reef ecosystems and utilizing existing CRCP products, we are designing a program that is both efficient and intensive. This project will provide essential information on reef fish that can lead to effective management via both MPAs and more traditional fishery management tools.

How project supports management of coral reef resources:

Fishery information in the US Caribbean is lacking and this project aims to fill that gap. Spatially comprehensive fish data will yield information that can be used for stock assessment, fisheries management, and assessment and siting of MPAs.

List of project Partners and their roles:

NOS/Biogeography program – survey design and GIS support
University of the Virgin Islands – survey design, methods, and GIS support
St. Croix Fisherman’s Association – trap design, vessel and fishing
NPS/DPNR/NMFS-SERO – permits and coordination
NOAA/NOS – Biogeography Program
Caribbean Fishery Management Council – project support

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

Informal meetings with managers, project partners and stakeholders were conducted to keep those interested in the project abreast of the project’s progress.

Submissions to CoRIS: none

Publications during FY2009: none

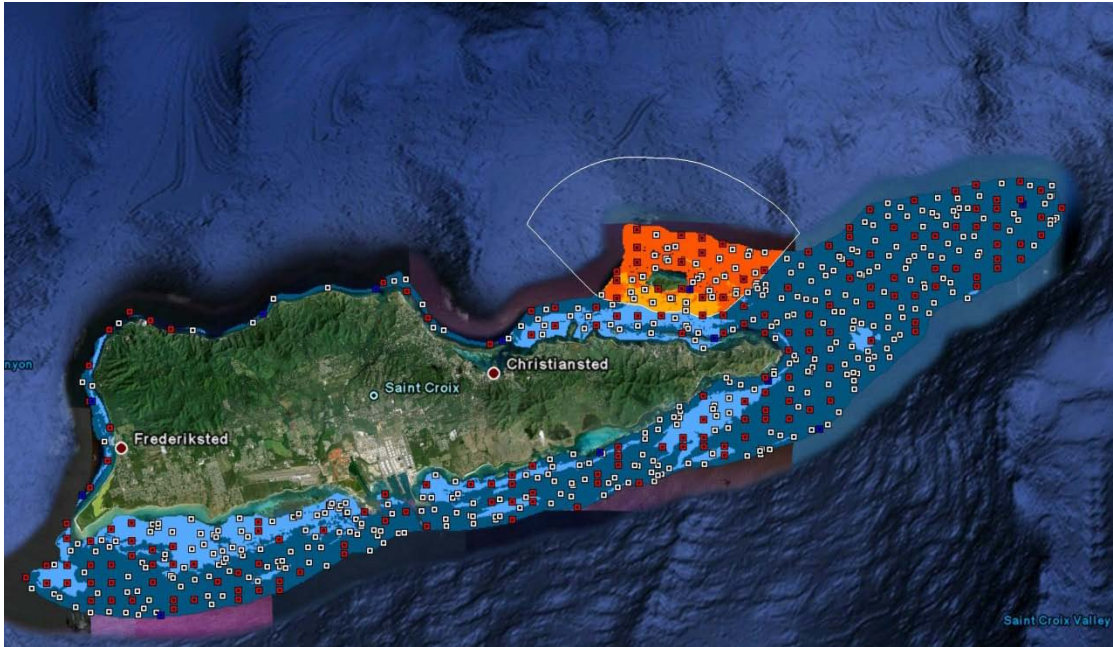
Presentations at professional meetings: none

Setbacks or challenges encountered in FY09: none

Comments on future direction of project:

This project was designed as a one year “proof of concept” project. Its successful completion will result in tangible evidence that it can be used as a model for future Caribbean fish surveys.

Figure 1. Sampling design for St. Croix trap study. The sampling design is a combination of a systematic grid and stratified-random protocol, overlaid with a geostatistical analysis technique developed by John Walter (SEFSC).



VI. Improve Effectiveness of MPAS

Project ID#: 10202-2009

Title: Survey of coral and fish assemblages at Pulley Ridge, SW Florida

Names of PIs and co-PIs: Andy David & Stacey Harter, NOAA SEFSC

Duration of Project: Year 2

Project Category:

- Improve Use and Effectiveness of MPAs

Brief description of activities conducted in FY2009:

The deepest hermatypic coral reef in the continental U.S is located on Pulley Ridge off the southwest coast of Florida. This monitoring survey assesses coral and fish assemblages and gathers qualitative and quantitative data on habitat. The general approach is to use a remotely operated vehicle (ROV) deployed in a purposefully selected survey design to quantify abundance and distribution of corals, other invertebrates, and targeted reef fish species in the HAPC. The CRCP has funded two years of this monitoring program, however, this is the third year of data to be collected from Pulley Ridge. ROV dives were conducted in September 2009, they have been analyzed, and a final report has been submitted to the Gulf of Mexico Fishery Management Council (GMFMC) and CoRIS.

Description of accomplishments & results:

The cruise was completed in September 2009 on the R/V Gordon Gunter. Fourteen ROV dives were completed resulting in approximately 14 hours of underwater footage from both within the Pulley Ridge HAPC and in the surrounding areas. Eight CTD casts were also made to collect environmental data. ROV dives have been analyzed for habitat and fish assemblages and a report has been submitted to the GMFMC and CoRIS. We observed distinct habitat differences inside and outside the HAPC and, therefore, distinct fish assemblages. Almost all of the *Agaricia* sp. coral was observed inside the boundaries of the HAPC. Several observations of fishing gear (monofilament line, longline, and fish traps) were made during the ROV dives along the entire ridge, both inside and outside the protected area.

How project supports goals & objectives of CRCP:

This project supports a couple of CRCP goals and objectives. It is useful in understanding coral reef ecosystems by monitoring fish assemblages and the abundance and health of the coral. This project also supports the goal of reducing adverse effects of human activities by understanding impacts of the current level of protection for the area and providing information on whether additional management actions are required.

How project supports management of coral reef resources:

A report is provided to the GMFMC after each cruise describing results of our monitoring program. The primary benefits of this project which will lead to reef protection are the delineation of the portions of the Pulley Ridge platform harboring living coral reefs, the quantification of extant corals, and the

evaluation of coral damage caused by bottom tending fishing gear. The GMFMC recognizes the value of this area and is actively seeking additional information of the type this project is designed to gather. Current regulations restrict certain bottom impacting fishing activities, and additional protections may be provided to these reefs if these surveys indicate current protections are not affording sufficient safeguards against habitat destruction.

List of project Partners and their roles:

NURC/UNCW: ROV services

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

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

Submissions to CoRIS:

A final report was submitted to CoRIS describing results from the cruise.

Publications during FY2009:

Survey of coral and fish assemblages on Pulley Ridge, SW Florida: Year 3. This report was submitted to the GMFMC in February, 2010.

Presentations at professional meetings: None

Setbacks or challenges encountered in FY09:

NOAA ship time was lost so the project was piggy-backed on a plankton cruise, so our time was limited to only 4 sampling days. We were unable to bring a teacher-at-sea as planned to fulfill the outreach and education component of the project.

Comments on future direction of project:

Pulley Ridge was designated a HAPC in 2005 and some fishing restrictions were implemented, but growing concern for corals in the area may lead to additional future management actions. Therefore, we plan to continue our monitoring program on the fish assemblages and coral within Pulley Ridge and the surrounding area.

Project ID#: 10012-2009

Title: Multibeam mapping of Pulley Ridge, SW Florida

Names of PIs and co-PIs: Andy David & Stacey Harter, NOAA/SEFSC

Duration of Project: Year 4

Project Category:

- Improve Use and Effectiveness of MPAs

Brief description of activities conducted in FY2009:

The deepest hermatypic coral reef in the continental U.S is located on Pulley Ridge off the southwest coast of Florida. Fishing activities in this area can damage these coral reefs as well as deplete productive fishery stocks. The Gulf of Mexico Fishery Management Council is concerned about these activities and has designated Pulley Ridge as a Habitat Area of Particular Concern (HAPC). Further protections are likely to be approved, however the Gulf of Mexico Fishery Management Council (GMFMC) requires more data on the nature and extent of the coral formations on the ridge to make more informed decisions of the type and location of subsequent actions. A five year IDIQ mapping contract has been established with the University of South Florida to conduct multibeam mapping of Pulley Ridge. To date the southern end and western edge of the ridge platform have been mapped. The goal of this project is to extend the mapping coverage northward in hope of determining the full extent of the reef formations. Delays in getting the contract awarded lead to missed ship time and the cruise is now set for July/July 2010.

Description of accomplishments & results:

The cruise is planned for 26 June – 2 July 2010 on the R/V Nancy Foster. We have chosen areas north of the HAPC to be mapped during that time. Data processing is scheduled to be complete by August 2010 and the final incorporation of data into GIS is set to be completed by October 2010.

How project supports goals & objectives of CRCP:

This project supports a couple of CRCP goals and objectives. It improves our understanding of coral reef ecosystems by mapping a deep coral reef. This, in turn, leads to the monitoring of corals and fish and to reducing the adverse effects of human activities by researching impacts of management actions through a parallel project monitoring the Pulley Ridge area.

How project supports management of coral reef resources:

Acoustic mapping of Pulley Ridge will provide multibeam bathymetric and acoustic backscatter data of use to several scientific and management entities. Fishery managers have shown increased interest in the coral reefs growing on Pulley Ridge in recent years and have named the area a Habitat Area of Particular Concern (HAPC). However the full extent of the reefs growing on this drowned barrier reef carbonate platform is not known. Once this multiyear mapping project is completed, this question should be answered. Accurate maps will allow managers to correctly delineate the protected area while allowing commercial and recreational activities to continue in areas where reef damage will not occur.

List of project Partners and their roles:

IDIQ mapping contract for data collection and processing with David Naar, University of South Florida.

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

We will have two teachers-at-sea on the cruise in June/July 2010 and the mapping products will be posted on the Panama City Laboratory MPA webpage.

Submissions to CoRIS:

Once the data has been collected, metadata will be provided to CoRIS. The new deadline for this product is October 2010.

Publications during FY2009: None.

Presentations at professional meetings: None.

Setbacks or challenges encountered in FY09:

Delays in the contracting process shifted the dates of the cruise to June/July 2010.

Comments on future direction of project:

The mapping IDIQ contract was established for 5 years; therefore, the final year of mapping in this area will be FY10.

Project ID#: 1693-2009

Title: South Atlantic MPAs: Evaluation of habitat and fish assemblages in five no fishing zones.

Names of PIs and co-PIs: Andy David & Stacey Harter, NOAA/SEFSC

Duration of Project: Year 5

Project Category:

- Improve Use and Effectiveness of MPAs

Brief description of activities conducted in FY2009:

The South Atlantic Fishery Management Council (SAFMC) closed several areas along the outer continental shelf to protect 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. After having collected four years of pre-closure data (2004, 2006-2008), the first year of post-closure data was collected in November 2009. Remotely operated vehicle (ROV) dives were conducted and are currently being analyzed to compare habitat and fish assemblages inside and outside the MPAs.

Description of accomplishments & results:

The cruise was completed in November 2009 on the R/V Pisces. Ten ROV dives were completed resulting in approximately 10 hours of underwater footage along with 6 CTD casts and several hours of multibeam mapping covering area both inside and outside the Florida MPA. The ROV dives are currently being analyzed and a final report will be written once analysis is complete (May/June 2010). All dives consisted primarily of hardbottom reef habitat from pavement to high relief ledges, all habitat types the targeted grouper species exploit. Based on preliminary observations, several species of grouper and snapper were identified and abundances of the invasive lionfish were extremely high, possibly higher than the previous year.

How project supports goals & objectives of CRCP:

This project supports a couple of 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 will 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

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

Hosted 2 teachers-at-sea during the cruise in November 09. Results of our monitoring program have been communicated to the SAFMC via a report.

Submissions to CoRIS:

None yet. ROV dives are in the process of being analyzed and a report is scheduled for submission to CoRIS as soon as analysis is complete (May/June 2010).

Publications during FY2009:

None yet. Once analysis of ROV dives is accomplished, a report to the SAFMC will be completed, most likely in May/June 2010.

Presentations at professional meetings: None.

Setbacks or challenges encountered in FY09:

A hurricane delayed the ship from leaving port on time and, therefore, our sampling days were severely cut back to only three dive days.

Comments on future direction of project:

We plan on continuing to examine the fish assemblages and habitat characteristics inside and outside the closed areas to investigate MPA effectiveness. The MPAs were just recently implemented in February 2009, so as of this year, we have only collected one year of post-closure data and several more years are required to look at changes overtime.

Project ID#: 10233 - 2009

Title: USVI Distribution and Larval Supply Study

Names of PIs and co-PIs: Trika Gerard, NOAA/SEFSC

Duration of Project: 2 years

Project Category:

- Improve Use and Effectiveness of MPAs

Brief description of activities conducted in FY2009:

The USVI larval distribution and supply study completed its third research cruise during April 7-20, 2009. This large-scale ichthyoplankton sampling entailed multiple opening and closing net environmental sampling system (MOCNESS), and Bongo tows, south and north of the British Virgin Islands, St. Thomas, and St. John, north of St. Croix, the Anegada passage, and along the Leeward Islands toward St. Kitts. Sampling tracks were designed as such to sample near shore, at the shelf break, and off shore, with intense sampling around the Grammanik and Red Hind Banks, well known spawning aggregations for various species of groupers. Physical oceanography data was also collected using a conductivity, temperature, and depth (CTD) device, lowered acoustic Doppler current profiler, (LADCP), and Lagrangian drifter devices. Ichthyoplankton sampling yielded 314 samples (217 mocness and 97 bongo) from 105 stations.

Description of accomplishments & results:

All samples collected in 2009 have been sorted and have yielded 24,806 fish from MOCNESS tows 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*, *monacanthidae*.

Flow-through and CTD data revealed areas of low surface salinity and very high surface chlorophyll across parts of the study area. 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. In situ observations of this remote riverine outflow revealed a surface layer approximately 20 meters thick, relatively high in temperature, low in salinity, and rich in plankton and other biological content.

From April 15-20 (leg II), the plume continued to elongate northward. Once outside the Caribbean (via Anegada Passage), this riverine signal was advected towards the northwest with the wind-driven circulation of the North Atlantic subtropical gyre. Additionally, the cyclonic Atlantic inflow eddy, west of the plume and northeast of St. Croix, continued to grow in size and extend farther to the south.

Though observed in the general area during most years, Orinoco and Amazonian riverine signals typically appear farther west, south of Puerto Rico, advected by Atlantic inflow through the Caribbean Island passages. However, the plume observed this April extended farther to the northeast, surrounding the US and British Virgin Islands. Eye witness reports from fishermen and charter dive boats, as well as islands residents, described this green water event as something that they had never seen in the area before.

Previously, these river plumes have been primarily studied using remote sensing techniques. Fortunately, the NF-09-03 survey was able to capture this unusual, transient event with a full suite of oceanographic and biological sampling methods. The additional in situ data gathered during this cruise will aid in understanding the extent of this event and its effect on the region.

How project supports goals & objectives of CRCP:

This project focuses on the biology 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, and the source/sink dynamics of the resulting larvae. The incorporation of this information into fisheries oceanographic models assists local resource managers in making decisions as to the positioning and management of 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.

List of project Partners and their roles:

University of the Virgin Islands- actively participates in the design of study and ichthyoplankton and inshore sampling. Virgin Islands Department of Planning and Natural Resources actively participates in the design and sampling of larval fishes near shore in St. Thomas, VI.

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

Physical oceanography Lagrangian satellite drifter track data is the basis for a master's thesis of a University of the Virgin Islands graduate student.

Submissions to CoRIS:

We have submitted biological data of abundance and composition of larval fish from 2008 fisheries oceanography survey and physical oceanography data.

Publications during FY2009:

CRER 0903 Nancy Foster cruise report

Presentations at professional meetings:

One presentation to the CRCP Headquarters staff in Washington, D.C., and another presentation to the Caribbean Fisheries Management Council.

Setbacks or challenges encountered in FY09: None.

Comments on future direction of project:

This pilot study will complete a cruise in its upcoming 4th year. This cruise will maintain the same sampling track, with the addition of samples from the south of St. Croix. The project will be expanded to fit the new CRCP goals and objectives and the priorities from local managers.

Figure 1.

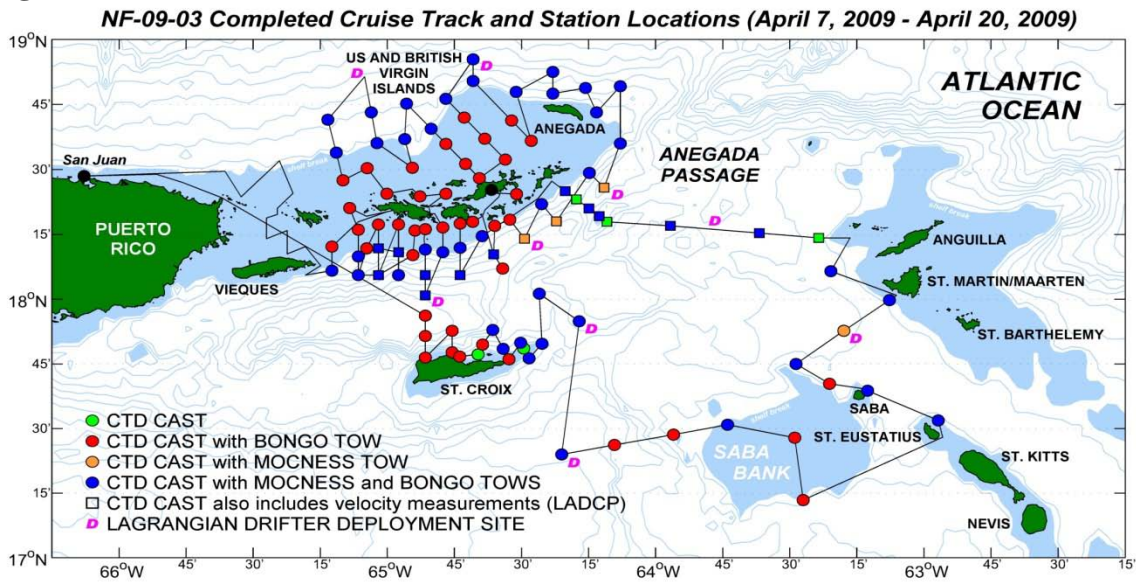
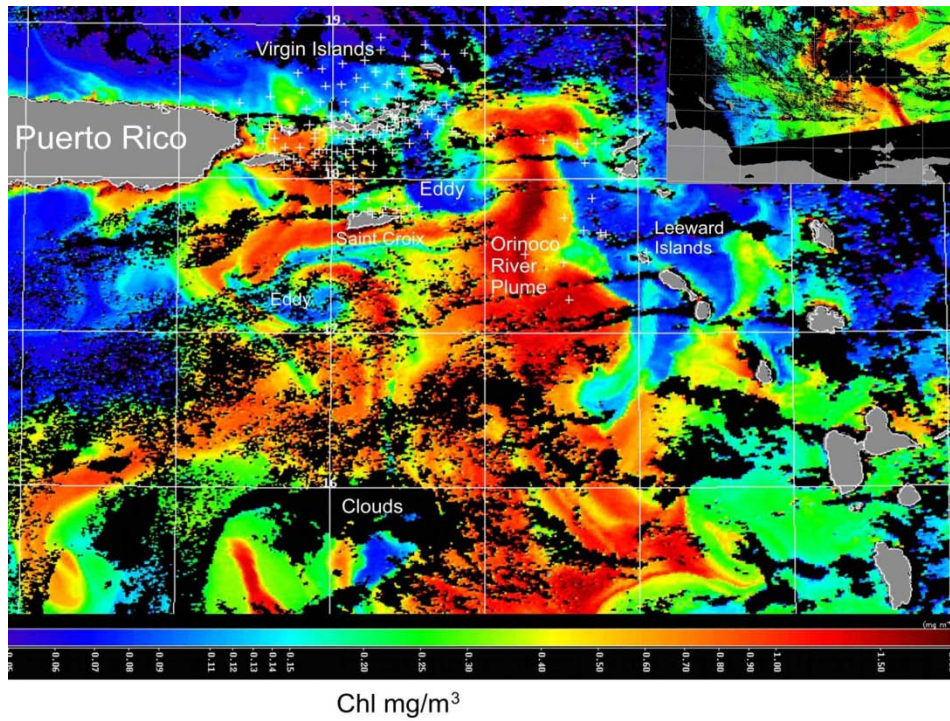


Figure 2. Satellite imagery of the Orinoco River Plume



VII. Reduce Threats to International Coral Reefs

Project ID#: 2133-2009

Title: *Acropora spp.* Monitoring in the Eastern Caribbean

Names of PIs and co-PIs: Margaret W Miller, NOAA/SEFSC; Dana Williams, UM/RSMAS/CIMAS

Duration of Project: Year 3

Project Category:

- Reduce Threats to International Coral Reefs

Brief description of activities conducted in FY2009:

Completed survey of all 9 study plots in Curacao. Surveys planned to be conducted through partnership with Seamester were not possible due to changes in their staff.

Description of accomplishments & results:

Due to Hurricane Omar in Fall 2008 the *Acropora* population suffered substantial losses of live tissue cover to fragmentation. Many new fragments successfully recruited. In contrast to Florida study plots, the Curacao population appears to have less mortality to disease and more successful recruitment.

Analysis of tissue samples from genotyping reveal that this population is genotypically more diverse than Florida suggesting that sexual recruitment is more successful than in Florida.

Manuscript summarizing the trends in the 4 Eastern Caribbean monitored sites (British Virgin Islands, Antigua, Saint Vincent, and Curacao) was published in the 11th International Coral Reef Symposium Proceedings (see publication below)

How project supports goals & objectives of CRCP:

Data support conservation of and recovery planning for a threatened reef-building coral by providing comparison of *Acropora* population status and trends outside of the US.

How project supports management of coral reef resources:

This research supports ESA recovery plan actions through collection and reporting of data on the current status of *Acropora* and collaboration in development of a population viability assessment model that is integral to NMFS recovery planning.

List of project Partners and their roles:

Seamester Semester at Sea Program: Incorporate surveys in remote locations using our protocol into their lesson plans. They were unable to participate due to changes in their staff.

Scripps Inst Oceanography (Tali Vardi): Using our demographic monitoring data to create an *Acropora* population viability model aimed at projecting response to recovery actions.

Penn State University (Iliana Baums): Analysis of tissue samples for genotyping to document genetic diversity and determine the impact on population performance.

Communications, media exposure, capacity building, education and outreach activities: none

Submissions to CoRIS: none

Publications during FY2009:

Kramer KL, Williams DE, Miller MW, Bégin C, Fry J, Valdivia A (2009) Demographic comparison of threatened Elkhorn coral, *Acropora palmata*, in the Caribbean: A case study in successful volunteer partnerships in a regional-scale monitoring program. Proc 11th ICRS Pp. 765-769.

Presentations at professional meetings: none

Setbacks or challenges encountered in FY09:

Staff turnover. The onsite staff biologist trained in our methods left the program and we were not able to train her replacement in time.

Comments on future direction of project:

The Curacao monitoring effort will continue as part of a new project focused on continued monitoring of the Florida population. The portion made possible through partnership with Seamester has been discontinued.

VIII. Address Emerging Issues

Project ID#: 2133-2009

Title: Assessment of Candidate Corals

Names of PIs and co-PIs: Margaret W Miller, NOAA/SEFSC, Dana Williams, UM/RSMAS/CIMAS

Duration of Project: Year 8

Project Category:

- Address Emerging Issues

Brief description of activities conducted in FY2009:

Completed 3 surveys of all 16 study plots in Dec 2008, May and Sept 2009. Nine new study plots were established at 3 sites (White Bank, Turtle Rocks and Sand Island) in the upper keys in June 2009. These plots will be surveyed 3-4 times per year along with the original 16 study plots. We also established 3 study plots (to be surveyed annually) at Looe Key in the lower keys. Tissue samples were collected and analyzed for genotyping at each of the 12 new study plots. Additionally, all sites were visited in July 2009 for a quick look following observations of disease outbreak among *Acropora* at other reefs. This project is now monitoring 28 150m² study plots at 9 reef sites in the Florida Keys for survivorship and recruitment to be used in population modeling to support the ESA recovery plan. Twenty-four of these plots at 8 sites are to be re-surveyed at least 3 times per year to assess the condition and growth of a subset of tagged colonies.

Description of accomplishments & results:

The annual plot surveys in Spring 2009 revealed that 44 colonies have died or were removed through fragmentation from the 16 study plots surveyed in Spring 2008. 54 new colonies appeared in these plots since Spring 2008, however, all were the product of fragmentation of larger colonies rather than new sexual recruits. Since an initial 53% drop in live area associated with the 2005 hurricane season there has been a slow but steady increase of ~3% per year. Approximately 14 of the 47 unique genotypes that were present in 2006 are now gone from the study plots. No bleaching in *Acropora* spp. was observed in spite of a moderate bleaching event affecting other corals in September 2009. However some (~6 of the 28) study plots suffered substantial losses in live tissue to disease over the Summer of 2009. Analysis of the demographic data collected over 5 years of monitoring has revealed that acute disease is responsible for more loss of live tissue than more chronic sources such as predation. Genotypic diversity is lower in the upper Florida Keys than other regions of the Caribbean.

How project supports goals & objectives of CRCP: Data support conservation of and recovery planning for a threatened reef-building coral.

How project supports management of coral reef resources:

This research supports ESA recovery plan actions through collection and reporting of data on the current status of *Acropora* and collaboration in development of a population viability assessment model that is integral to NMFS recovery planning. Additionally observations and results from this monitoring are

reported directly to FKNMS managers through permit reports and communication with section 6 proposal recipients.

List of project Partners and their roles:

Scripps Inst Oceanography (Tali Vardi): Using our demographic monitoring data to create an *Acropora* population viability model aimed at projecting response to recovery actions.
Coral Disease and Health Consortium (Cheryl Woodley): analysis of microbial community on *Acropora palmata* to identify potential pathogens.
Penn State University (Iliana Baums): Analysis of tissue samples for genotyping to document genetic diversity and determine the impact on population performance.

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

Oral presentation to Florida Keys civic group on *Acropora* spawning and conservation (Williams August 2009).
Invited lecturer for Florida Keys Comm College ‘Sanctuary Science’ course (Williams Oct 2009).
Workshop Instructor for Coral Disease and Health Consortium Field Response training (Williams Aug 2009)
Smithsonian *Acropora* Conservation Workshop

Submissions to CoRIS: see below

Publications during FY2009:

Williams DE Miller MW (in press) Stabilization of Fragments to Enhance Asexual Recruitment in *Acropora Palmata*, a Threatened Caribbean Coral DOI: 10.1111/j.1526-100X.2009.00579.x

Presentations at professional meetings:

Smithsonian *Acropora* Conservation Workshop (Miller, Feb 2009)

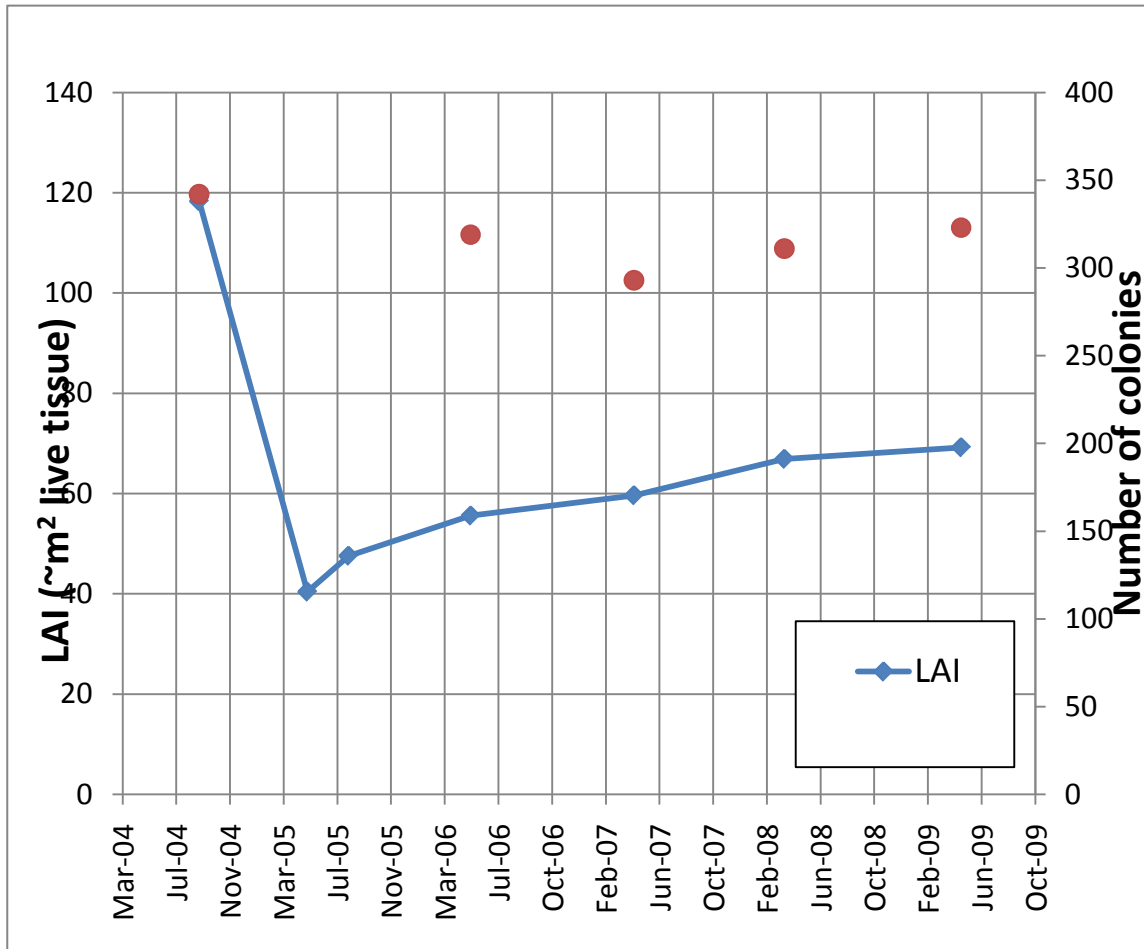
Setbacks or challenges encountered in FY09:

Staff turnover. Two technicians were replaced resulting in an unexpected training burden.

Comments on future direction of project:

Future plans include continued monitoring with potential for further expansion depending on resources. Reefs are suffering loss of live coral & structural complexity due largely to disease, bleaching related mortality & local impacts. OA has the potential to result in further losses to live tissue & structural complexity via increased breakage during storms, decreased coral growth rates, and dissolution of reef framework. It is also hypothesized to decrease coral growth which will decrease both tissue cover & structural complexity. As a major reef-building coral, *Acropora* is at the center of these issues and documenting response to these threats through consistent & frequent field observations is key to partitioning causes of coral loss and identifying appropriate management actions or resilient areas.

Figure 1. Live area index (LAI) and total number of colonies in of all 15 150m² *Acropora palmata* study plots in the upper Florida Keys. There has been slow but steady increases in live area following the dramatic decline associated with the 2005 hurricane season. The number of colonies has not decreased dramatically because of fragmentation of larger colonies resulting in more numerous but smaller colonies.



Project ID#: 10306-2009

Title: Assessment of ESA Listed Corals - Supplemental

Names of PIs and co-PIs: Margaret Miller, NOAA/SEFSC

Duration of Project: ~ 2 yrs

Project Category:

- Address Emerging Issues

Brief description of activities conducted in FY2009:

This project enabled continued demographic monitoring for *Acropora palmata* populations in both Puerto Rico (3 sites via direct partnership between SEFSC and PR-DNER) and in USVI (St Thomas [2 sites] and St. John [3 sites] via contract with UVI). It also enabled continued sample collection (Florida Keys and Puerto Rico) and analyses of *A. palmata* mucous microbial screening in relation to colony condition for development as a diagnostic tool.

Description of accomplishments & results:

Two monitoring trips (including recruitment mapping) were accomplished in Puerto Rico and 10 monitoring trips (colony condition only – no recruitment mapping) were conducted at the USVI sites during FY09. Ongoing characterization of colony status in Puerto Rico and USVI in relation to specific events has elucidated several patterns of threats and impacts to *A. palmata*. For example, the environmental factors of warm temperatures and previous physical damage to a colony are both predictive of higher disease prevalence in the monitored USVI populations.

How project supports goals & objectives of CRCP:

This project helps fill US territory’s monitoring gaps for ESA-listed corals. This information provides context for understanding the status of coral populations relative to various threats including disease, predation, and physical damage.

How project supports management of coral reef resources:

Important geographic gaps in ESA-Listed coral monitoring were filled by this project in USVI and Puerto Rico in partnership with local managers and academics. This information provides insight on the relationship of listed coral status with various threats including disease, predation, temperature, and physical damage. Results are communicated directly to ESA managers at NMFS/SERO. Project partners include local management interests including DNER in Puerto Rico and USGS/Park Service in USVI.

List of project Partners and their roles:

NCCOS/Charleston: Scientific collaboration in characterizing coral mucous microbial communities on monitored *A. palmata* colonies for potential diagnostic tool

Puerto Rico DNER: Collaborating partner in demographic monitoring activities in PR

Univ. of the Virgin Islands: Contracted for demographic monitoring activities in USVI

USGS: Advise/consent on demographic monitoring work in USVI (project initiated by Dr. Caroline Rogers)

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

- A UVI Masters Student was trained in the Virgin Islands monitoring component

Submissions to CoRIS: none

Publications during FY2009:

Schärer M, Nemeth M, Valdivia A, Miller MW, Williams DE, and Diez C (Pending) Elkhorn coral distribution and condition throughout the Puerto Rican Archipelago. Proc 11th ICRS.

Bright A “Monitoring of disease, snail predation and physical damage of the elkhorn coral, *Acropora palmata*, on St. Thomas and St. John, USVI”, Contract Report from USVI.

Presentations at professional meetings: None

Setbacks or challenges encountered in FY09: None

Comments on future direction of project: None