

The National Coral Reef Institute (NCRI) was established by Congressional mandate in 1998. NCRI's primary objective is the assessment, monitoring, and restoration of coral reefs through research and education. NCRI operates at the Nova Southeastern University Oceanographic Center near Fort Lauderdale, Florida.

NATIONAL CORAL REEF INSTITUTE CONTINUES WORK IN SOUTH FLORIDA AND ACROSS THE GLOBE



Center of Excellence for Coral Reef Ecosystems Science Breaking Ground

Construction of the Center of Excellence for Coral Reef Ecosystems Science (CoE CRES) Research Facility at the NSU Oceanographic Center and NCRI campus will start in fall 2010. The activities in this multi-disciplinary research building will address national and international priorities in coral reef research in five thematic areas: 1) Impacts of global and local stressors; 2) Geospatial analysis and mapping; 3) Deep sea coral reefs and biodiversity; 4) Genetic and genomic connectivity; and 5) Hydrodynamics. The CoE will include space for offices, laboratories, collaboration, research training, and fieldwork staging. It is designed to promote high quality and impactful research by current and new faculty, researchers, visiting scientists, post-doctoral fellows, and graduate students.

To be completed by January 2012, the 86,000-square-foot CoE will be located on the ocean side of Port Everglades in Ft. Lauderdale, Florida. Funded in part by a grant from the National Institute of Standards and Technology (NIST) at a cost of over \$30 million, the research facility is expected to create 22 new academic jobs and 300 construction jobs; employ 50 graduate students; and preserve 22 existing academic jobs. The CoE CRES will be the only research facility in the nation dedicated entirely to coral reef ecosystem science. Major goals include not only fundamental research, but also finding management and conservation solutions to pressing coral reef issues.

As one of NOAA's external Coral Reef Institute partners, NCRI has long supported NOAA's mission by providing outstanding scientific

research to support federal, state, and local management and conservation in providing local, regional, national, and international research products that can offer solutions to the coral reef crisis. The new CoE provides both urgently needed state-of-the-art research facilities, and consequently expanded scientific capacity.



Perspective sketch of Center of Excellence for Coral Reef Ecosystems Science Research Facility looking west from Port Everglades.

NCRI Celebrates Earth Day

NCRI scientists spent Earth Day with NOAA Administrator Jane Lubchenco, Ph.D., and other partners in a coral recovery and restoration project in southeast Florida. The day included a tour of one of eight underwater nurseries where threatened *Acropora cervicornis*, or staghorn corals, are being grown and prepared to be planted on nearby coral reefs—increasing the diversity and restoring the health of these areas. The project, led by the Nature Conservancy, is funded through NOAA by the American Recovery and Reinvestment Act. NCRI is spearheading the project in Broward County, where it is maintaining offshore staghorn nurseries.



Left: NOAA Administrator Jane Lubchenco, Ph.D. discusses coral restoration with NCRI researcher Dave Gilliam, Ph.D. and research assistant Liz Larson. Right: Lubchenco, Ph.D., with NCRI Executive Director Richard Dodge, Ph.D.

NCRI Studies Climate Change in Maldives

In June 2010, NCRI's Associate Director, Bernhard Riegl, Ph.D., travelled to the Maldives in the Indian Ocean upon invitation of this country's government to take part in the inaugural meeting for ReefFORM, an initiative spearheaded by Chris Perry, Ph.D., of Manchester Metropolitan University and Paul Kench, Ph.D., of the University of Auckland.

ReefFORM will study the effects of climate change on the geomorphology and functioning of coral reefs and reef islands. Such studies are of great value to archipelagic nations such as the Maldives, whose highest elevation is less than 5m above sealevel. Since the Maldives were also badly hit in the 2004 tsunami, their interest in focusing research on their country is understandable.

Research by Dr. Kench and Dr. Webb of SOPAC has shown that so far, islands in the Maldives and in other Pacific locations, such as Kiribati and Tuvalu that are usually considered at great risk from sea-level rise, have not shrunk, but actually increased in size over the past century. Also, the tsunami has not led to net erosion of islands. Thus hope may exist for the future of these island nations, even if sealevel continues to rise. NCRI's Dr. Riegl will attempt to link how changes in climate may or may not cascade to changes in sediment production via changes in coral community structure. Sediment production is key to maintaining reef islands. Therefore, a line of research at which NCRI has excelled for a long time can now be harnessed to help predict the future of human island communities. ReefFORM plans a research cruise in the Maldives in 2011, and a later one in the Pacific in 2012.

NCRI Assesses Accuracy of Florida Keys Benthic Habitat Maps for NOAA

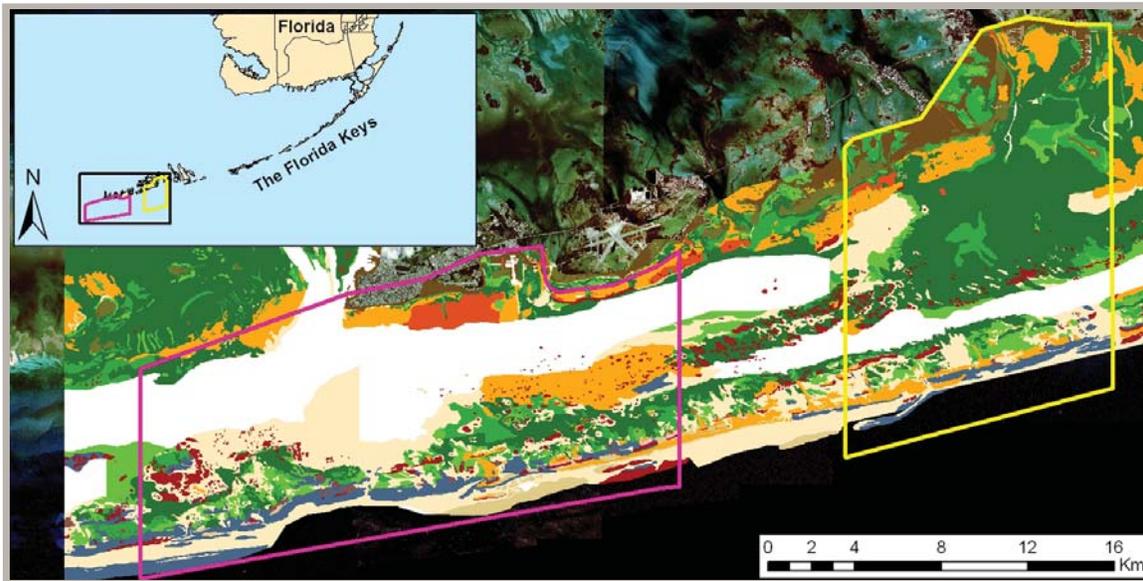
As part of a regional mapping and monitoring effort in the Florida Keys led by Steve Rohmann, Ph.D. (NOAA), NCRI scientists Brian Walker, Ph.D. and Greg Foster, Ph. D. conducted an independent accuracy assessment to statistically test the accuracy of the GIS-based benthic habitat map recently produced for the Lower Keys. Resources, budgets, and logistical constraints precluded a comprehensive assessment of the entire mapped area, thus biogeographically-representative corridors within the total benthic habitat map area were selected for performing the accuracy assessment. The corridors not only captured a wide diversity of habitats, but were also characterized by frequent transitions between habitat types ensuring a well-distributed, representative set of survey locations.

Two accuracy assessment corridors have been conducted to-date between Cudjoe Key and Sand Key that extended from the shoreline intertidal zone, through Hawk Channel and the reef tract, before terminating on the outer bank/shelf escarpment at a depth of approximately 33m. A total of 1036 sampling stations were visited, of which 957 were used in the accuracy assessment. The sites were selected using a stratified random sampling protocol that equally distributed sampling points amongst the detailed structure categories. Most sites were sampled by deploying a weighted drop camera with the vessel drifting in idle and recording 30-120 seconds of dGPS-referenced video. The shallowest sites were sampled by snorkel, waverunner, or kayak, using a hand-held dGPS for navigation and a housed camera to record video. Each sampling station was assigned a classification in the field. These field classifications were reevaluated post-survey during a systematic review of video and photographic data.

The efficacy of the benthic habitat map was assessed by a number of classification metrics derived from error matrices of the Major and Detailed levels of Geomorphological Structure and Biological Cover. The known map proportions were used to remove the bias introduced to the producer's and user's accuracies by differential sampling intensity. The overall, producer's, and user's accuracies were computed directly from the error matrices. Corridors were evaluated separately and combined. The regional map accuracy of the combined accuracy assessments was 91.3% and 84.5% at the Major and Detailed levels of Structure respectively, and 74.4% and 70.5% at the Major and Detailed levels of Biological Cover. Adjusting to the map proportions improved the overall accuracies to 94.0% and 86.5% at the Major and Detailed levels of Structure, and to 80.2% and 78.0% at the Major and Detailed levels of Cover. The Tau coefficients of the combined efforts were 0.827 ± 0.036 and 0.828 ± 0.025 at the Major and Detailed levels of Structure, and 0.701 ± 0.032 and 0.688 ± 0.031 at the Major and Detailed levels of cover.

The true error of non-sampled portions of the map is ultimately unknown and further sampling in these areas of the map would allow for a better understanding of the entire map accuracy, however, the combined accuracy assessments ensured that a well-distributed, representative set of monitoring locations were surveyed that closely represented the entire mapped region. Comparison of accuracy results between corridors showed that map accuracy is different throughout the region, therefore as the Florida Keys benthic habitat mapping effort proceeds, it is important to evaluate new areas to understand both local and regional map accuracies. With NOAA support, NCRI is planning to conduct at least two more assessments of newly mapped areas; one in the middle Keys, and one in the upper Keys.

The results of this study are being presented at the upcoming "Linking Science to Management: A Conference & Workshop on the Florida Keys Marine Ecosystem" in October 2010.



Accuracy Assessment Area 1 (ROI-1) (yellow) and Area 2 (ROI-2) (magenta), within the overall NOAA mapped region of the Lower FL Keys. ROI-1 included the seaward seafloor south of Cudjoe and Sugarloaf Keys including American Shoals. ROI-2 included the region between Sand Key and Eastern Sambo from the shoreline intertidal zone to the outer bank/shelf escarpment at a depth of approximately 33m.



Sampling methodologies used for data collection. The primary sampling method was to drop a video camera from a boat (right). Shallow-water sites were visited by either kayak, waverunner (left), or snorkel to collect site data with a portable underwater camera.

NCRI Scientists Conduct Sediment Survey Offshore Vieques, Puerto Rico

NCRI scientists Sam Purkis, Ph.D., and Alexandra Dempsey travelled to the island of Vieques, Puerto Rico, in February 2010 to conduct fieldwork on their latest project, an extension of ongoing work in the territory that will support the development of a 3-D GIS-based sedimentary model of the coastal zone of Vieques. On the trip, sediments were sampled from depositional environments that had previously been identified through mapping conducted from LiDAR and satellite. The work will serve as a validation to the degree to which these remote-sensing technologies can be used to characterize the seabed. The overall objective of this campaign is to better-develop geologic models for coral reef systems that existed during the Miocene, an epoch that extended from 23 to 5 million years ago. In geological terms, this can be considered comparatively young and the Modern reefs of the Caribbean provide a useful morphological analog to the expansive coral-dominated systems that flourished at that time.



Alexandra Dempsey swims atop the wreck of a wooden trading vessel encountered offshore Vieques during field sampling.



Sam Purkis prepares to dive to collect sediments.

Coral Reef Communities of the Veracruz Coral Reef System National Park



Researchers in Veracruz marine park.

In July 2010 NCRI investigators Dave Gilliam, Ph.D., Brian Walker, Ph.D. and graduate research assistants traveled to the Sistema Arrecifal Veracruzano National Park in Veracruz Mexico. This was the fourth research trip a NCRI group has made to the Park as part of a cooperative effort between NCRI and the National Marine Park in Veracruz, Mexico (Comision Nacional de Areas Naturales Protegidas, Parque Nacional (CONANP), Sistema Arrecifal Veracruzano.

Located in the southwest Gulf of Mexico, the park was established in 1992 as one of Mexico's first national marine parks. It covers a territory of more than 52,000 hectares in two main areas. The first area lies in front of the Port of Veracruz, which is one of Mexico's busiest commercial ports, and includes seven reefs. The second area is offshore of Punta Antón Lizardo, 20 kilometers southeast of Veracruz and includes 12 reefs.

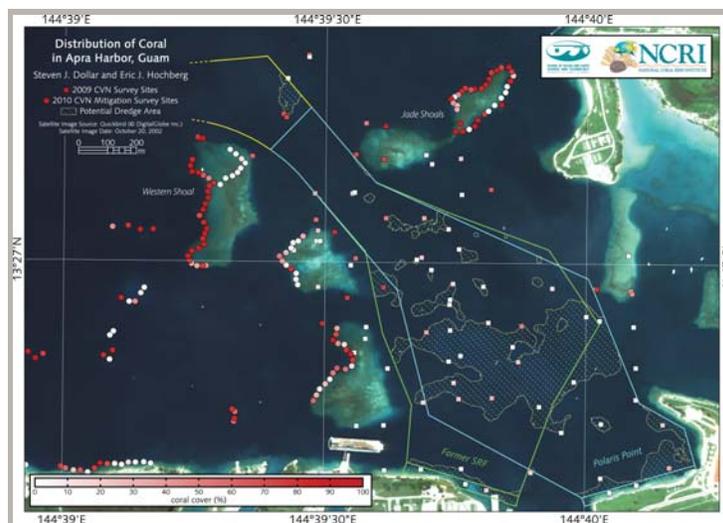
In 2007 a group of NCRI researchers began a comprehensive assessment of the reef fish and coral reef benthic communities in the Park. The effort continued in the summer of 2008 and 2009, and by the end of the 2010 effort, sites within all reefs in the Park had been visited and some sites were revisited to begin observing year-to-year changes. NCRI plans to continue this coral reef assessment effort with the Sistema Arrecifal Veracruzano National Park and expand research efforts to address additional management priorities within the Park. In 2009, this project received First Place in the EPA's prestigious Gulf Guardian Awards.

NCRI and University of Hawaii Collaborate in Guam's Apra Harbor

One component of the planned move of the Navy's Marine Expeditionary Force from Okinawa to Guam is the provision to provide safe access and new berthing facilities for nuclear aircraft carriers (CVN) in Apra Harbor. To accomplish this task, areas of the entrance channel and turning basin in the southeastern part of the Harbor, as well as areas selected for berthing, would require dredging to a depth of 51.5 ft. below MLLW. Much of this area was previously dredged in 1946 during the creation of the present configuration of Apra Harbor. The proposed dredging to accommodate the CVN would result in removal of existing benthic marine communities within the dredge footprint. In addition, there is potential for indirect effects to benthic communities adjacent to the footprint from environmental changes associated with the dredging operation.

In April-May 2009, researchers from the University of Hawaii and the National Coral Reef Institute conducted surveys to evaluate the benthic communities within the area that will be affected by the proposed CVN operation. In May 2010, further surveys were conducted to establish existing conditions and provide an initial assessment of potential effectiveness at potential mitigation sites in Apra Harbor and in southwestern Guam.

The figure to the right shows results from the Apra surveys. There are two main proposed CVN berthing areas, one at the former site of the Naval Ship Repair Facility (SRF), and one at Polaris Point. Reef area within and near the footprint was categorized by percent cover to estimate potential direct and indirect impacts to coral communities. This information was provided to the Navy for use in preparation of the Draft and Final Environmental Impact statements.



Coral distribution in Apra Harbor.

| Area | n | Coral | Algae | Sediment |
|--------------------|----|------------|-------------|-------------|
| Fomer SRF | 35 | 6.4 (16.0) | 40.4 (40.7) | 32.0 (40.8) |
| Polaris Point | 40 | 3.8 (13.5) | 39.8 (42.5) | 32.0 (41.4) |
| Potential Indirect | 57 | 8.0 (23.4) | 28.4 (36.2) | 30.0 (36.5) |

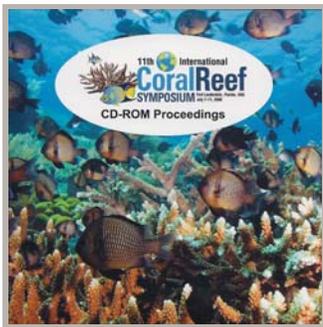
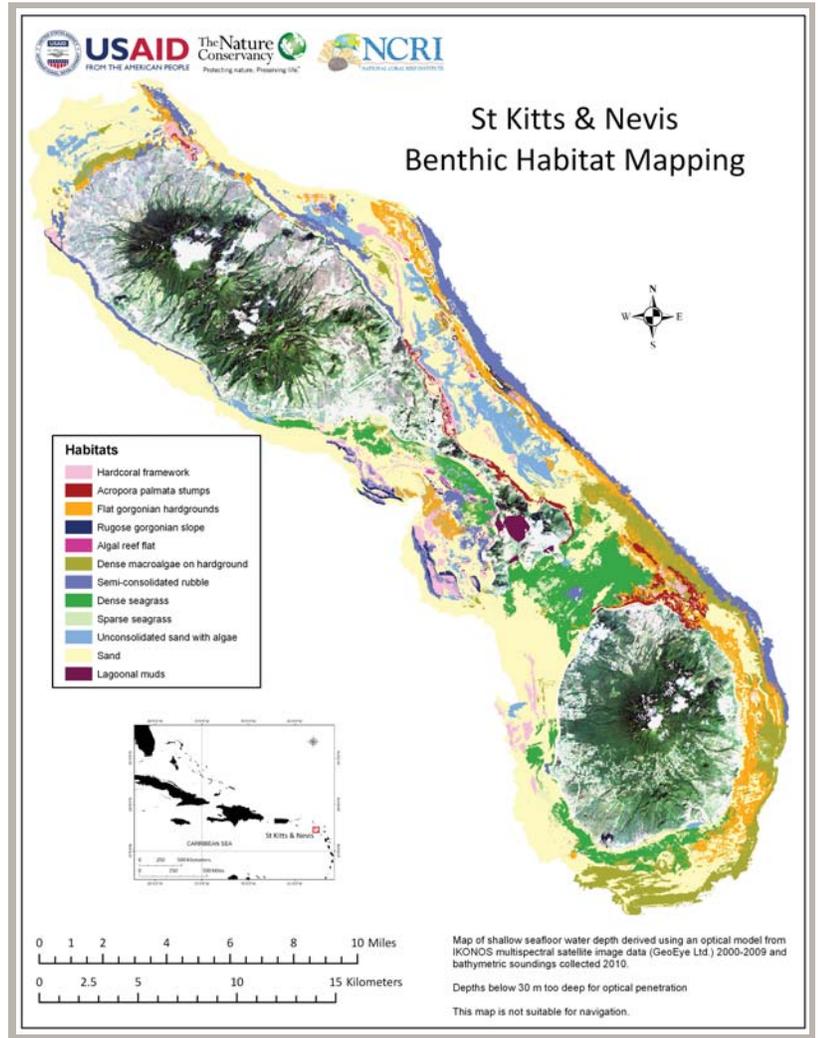
Table: Benthic community cover in proposed CVN area. Numbers are median values for percent cover of three main benthic types, with mean percent cover provided in parentheses.

NCRI Partners with The Nature Conservancy in the Caribbean

NCRI scientists Sam Purkis, Ph.D. and research assistants Gwilym Rowlands and Alexandra Dempsey recently completed a benthic marine mapping project in the Caribbean island state of St Kitts and Nevis. Following an extensive field survey, benthic habitat and water height were characterized across the entire 260 km² coastal system down to ~30 m depth. The project is part of an ongoing collaboration with The Nature Conservancy, in this case on a project sponsored by USAID.

An extensive field survey was carried out - over four hundred geographically positioned underwater video captures representing the twelve major benthic habitats found in the coastal waters of St. Kitts and Nevis, as well as the collection of several hundred thousand bathymetric soundings. Drawing on a comprehensive high-resolution (<4 m pixel) satellite image data set, the entire 260 km² coastal seascape was characterized. Water height was derived using an optical model trained using the field depth soundings, down to ~30 m depth. A benthic habitat map was produced from the satellite imagery using algorithms trained on the unique optical, textural and contextual properties of the different habitat classes. The final map consists of twelve habitat classes covering reef, algae, seagrass, and sediment systems.

The marine environments of St Kitts and Nevis, like many Caribbean states and provinces, face a mounting list of pressures including heightened fishing pressure, sedimentation, and coastal development. Maintenance of healthy reef systems, clean waters, and a functioning coastal system are invaluable for islands dependent on tourism. Local resource managers are charged with finding solutions that balance both the economic and environmental needs of the state. The NCRI map products form the foundation of an endeavor to provide a federation-wide marine zoning plan and management structure. The output of the field survey provides an important reference point for monitoring future changes in the system. Coupled to other data sets for the region, they play an important role for establishing marine zones, helping to determine critical nursery grounds exist for local fish, lobster, and conch fisheries, and guiding the establishment of marine protected areas.



11th ICRS Proceedings Now Available

The official Proceedings for the 11th International Coral Reef Symposium (11th ICRS) are now available. Electronic copies, via CD, were sent to all registered attendees in February 2010 and hard copies for those who requested, are shipping in March 2010.

The official 11th ICRS Proceedings can also be accessed at <http://www.nova.edu/ncri/11icrs/proceedings/index.html>. Orders for additional copies of both the CD and hard copy can be placed from the 11th ICRS website, from the same link.



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