

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.

## 2009: NATIONAL CORAL REEF INSTITUTE BEGINS EXCITING NEW YEAR IN CORAL REEF RESEARCH



### NCRI Coral Software CPCe V3.6 Is Now Available

NCRI is pleased to announce Version 3.6 of CPCe (Coral Point Count with Excel extensions). CPCe is a Windows-based program that provides for the determination of coral cover and diversity using transect photographs and the random point count method. Image calibration and area analysis are also program functions.

Improvements from V3.5 include:

- Two additional Excel sheets
- Ability to assemble accumulated lengths in area analysis
- Excel files have greater Office 2007 compatibility
- File sequencer allows bulk image renaming
- User option for expanding small images
- Help file is now Vista compatible
- Reference images for supplied data codes



CPCe is provided free for use.

More information is available at <http://www.nova.edu/ocean/cpce/>

### NCRI Meets With Congressional Staff to Highlight Southeast Florida Coral Reefs

In celebration of International Year of the Reef 2008, NOAA's Coral Reef Conservation Program (CRCP) and Office of Legislative Affairs brought a group of nine Congressional staff to south Florida. While Tropical Storm Fay interfered with plans for a field trip to the reefs of Broward County and the NCRI labs, NCRI researchers were still able to meet with the aides and highlight the important research of NCRI. The trip offered an unique opportunity for Congressional staff to experience the suite of efforts conducted in the area to understand, conserve, and sustain these complex and sensitive marine ecosystems. Over the course of the tour, participants met with NCRI researchers and FL DEP staff to learn about resource management challenges and successes in the region.

Staff members include representation of the Senate Commerce Committee majority and minority, House Resources Committee majority, House Science Committee majority and minority, Senate Appropriations Committee and personal staff of Senators Shelby and Cochran. The trip will raised visibility for NCRI's conservation efforts in Florida and reinforce the urgency for reauthorization of the Coral Reef Conservation Act of 2000. After departing Ft. Lauderdale, the aides continued south to Biscayne Bay and the Florida Keys, including the Dry Tortugas.



Congressional staff and aides and representatives from NCRI, Florida Department of Environmental Protection, NOAA and Broward County

### NCRI Director Recognized by USCRTF

NCRI executive director, Dr. Richard Dodge, received an award from the United States Coral Reef Task Force (USCRTF) at their biannual meeting in Kona, HI, in August 2008. Celebrating its first ten years, the USCRTF recognized Dr. Dodge's participation and contributions in all but one of the twenty meetings of the Task Force and his leadership of the 11th International Coral Reef Symposium, which he spear-headed in Ft. Lauderdale in July 2008. As part of the "USCRTF Member and Partner Initiative Updates", Dr. Dodge presented "International Coral Reef Symposium: Science to Management" to the USCRTF.

Dr. Dodge, along with NCRI Associate Director, Dr. Bernhard Riegl, and NCRI Administrative Coordinator, Wendy Wood, also participated in the "Managers' Workshop with Scientists: Increasing Science in the Management of Coral Reef Ecosystems", where Dr. Dodge presented on NCRI's research partnerships with local coral reef management bodies including the Florida Department of Environmental Protection, Broward County, and Port Everglades.



USCRTF co-chairs, Lyle Laverty, Assistant Secretary of DOI, and Tim Keeney, NOAA Deputy Assistant Secretary, with NCRI Executive Director, Dr. Richard Dodge (center)

### Coral Reefs of the USA Wins Book Award

The book *Coral Reefs of the USA*, published in the summer of 2008, was edited by NCRI Executive Director, Dr. Richard Dodge and NCRI Associate Director, Dr. Bernhard Riegl, and is the first in the series *Coral Reefs of the World*. *Coral Reefs of the USA* was included in the list of Outstanding Academic Titles by Choice Current Reviews for Academic Libraries, which was published in January 2009.

Choice is the premier source for reviews of academic books, electronic media, and Internet resources of interest to those in higher education. More than 35,000 librarians, faculty, and key decision makers rely on Choice magazine and Choice Reviews Online for collection development and scholarly research. Choice reaches almost every undergraduate college and university library in the United States.

This prestigious Choice list is chosen from books that choice reviewed during the previous calendar year and reflects the best in scholarly titles reviewed by Choice

## NCRI Monitoring Network Publishes Work on Population Dynamics and Refuge Concept

Climate change, especially increased heat anomalies, are considered a major threat to coral reef ecosystems because corals live close to their upper physiological temperature limits. Therefore, predictive modeling of coral survivability in a changed climate is important for proactive management of the resource. Predictions of coral reef ecosystem dynamics undertaken within the NCRI Monitoring Network show that climate change is likely to exert increased mortality on components of Atlantic and Indo-Pacific coral communities that will lead to strong oscillations in population levels and the potential disappearance of susceptible *Acropora* species.

Work published in the journal *Ecological Modelling* suggests that increasingly frequent bleaching events with associated mortality will strongly disadvantage *Acropora* species over faviids and poritids with likely shifts in community structure. The modelling work also provides evidence that the bleaching events at the turn of the century (1996, 1998, 2002) were unusual in their severity and could not be sustained by coral communities if recurring repeatedly. However, given enough fertility and available settling substratum for larvae, some coral communities are capable of withstanding serious mortality during bleaching events at 15-20 year recurrence. Using this model, it was possible to explain observed differences in community structure in the Arabian Gulf and relate them to the recurrence of disturbance events, rather than to other environmental variables, like habitat quality.

Modelling work on Atlantic coral population dynamics, with specific reference to the endangered *Acropora cervicornis*, gave clear evidence about the existence and location of refugia for corals. If, as is widely predicted, coral mortality will be widespread and frequent in the future, then it will be increasingly important to understand whether refugia can indeed exist and what determines their existence. The NCRI monitoring network site at Roatan, from which a 10-year coral monitoring baseline as well as a 170-year temperature record exists was used to evaluate coral habitats nearshore and offshore for refuge potential.

Offshore banks are removed from run-off that can cause significant coral mortality when acting as an additional stressor to bleaching and hurricanes. Offshore banks in Honduras had significantly better coral populations than fringing reefs under higher terrigenous influence. Although both reef types had similar large-scale stressors (bleaching, hurricanes), the offshore banks escaped 17 run-off events in the last 170 years that could have damaged their corals. These high-intensity and high-recurrence stress events lead to oscillations in coral specific dominance, suggesting that community patterns are not stable. The offshore refuge worked best, as it was assumed to have preferential larval settlement. Again, the importance of sufficient opportunity for larval settlement was key to the persistence of the coral community and this could be best maintained in the absence of strong terrestrial influence.

This work is published in the *Marine Pollution Bulletin*. Riegl B, Purkis SJ, Keck J, Rowlands GP (2009) Monitored and modelled coral population dynamics and the refuge concept. *Mar. Poll. Bull.* 58:24-38 and Riegl B, Purkis J (2009) Model of coral population response to accelerated bleaching and mass mortality in a changing climate. *Ecological Modelling* 220: 192-208



Bleached staghorn coral, *Acropora cervicornis*, in South Bight, Andros, Bahamas. Image taken during bleaching event of 1998.

## NCRI Conducts Study to Minimize Coral Reef Impacts from Anchoring at Florida Ports

In fall 2008, NCRI was contracted by the FL DEP to conduct a study as part of the South Florida Coral Reef Initiative's Maritime and Marine Industry Impacts working group. Funded by NOAA, the goal of this project is to minimize or eliminate damage to coral reefs and associated resources from impacts associated with anchor damage and groundings within and adjacent to anchorages in southeast Florida. This project specifically aims to evaluate anchorages located in the vicinity of nearshore reefs at the Ports of Miami and Palm Beach.

In Broward County, located between Miami and Palm Beach, ten (10) known ship groundings and six (6) known ship anchor drags occurred between 1994 and 2006 on the coral communities directly adjacent to the designated Port Everglades anchorage areas, impacting almost 11 acres of reef and spurring a wave of activity to evaluate the anchorage configuration and look at possible alternatives. An emergency rule went into effect in March 2008 to change the configuration to create a safer anchorage and minimize ship impacts on local reef communities. The same methods used in Port Everglades are now being used for Palm Beach and Miami-Dade to eliminate large ships from anchoring on or near reef communities.

High-resolution hillshaded images of the seafloor using LADS bathymetry acquired by Miami-Dade and Palm Beach Counties were accompanied by many datasets from multiple agencies including NCRI benthic habitat mapping data, NOAA nautical charts, USGS and SFWMD aerial photography in a GIS to evaluate the spatial relationship between benthic habitats and the anchorage boundaries.



NCRI scientist examining damage from ship grounding to a coral reef in Broward County, FL.

The preliminary evaluation shows that the Port of Palm Beach anchorages do not contain significant reef resources, but there are some small areas on the borders. This may call for a slight modification of the areas to create larger buffers between the coral reef habitat and the anchorage.

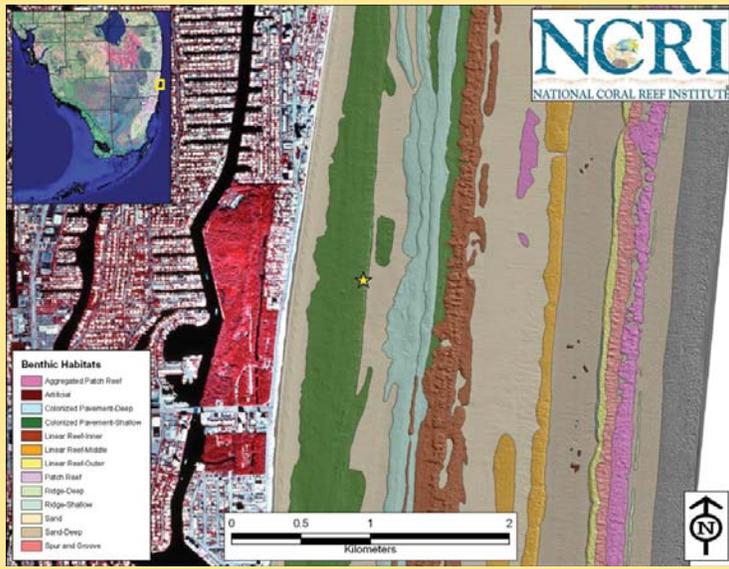
A preliminary evaluation of the Port of Miami anchorage indicates this anchorage requires immediate attention. Preliminary GIS analysis of the draft NCRI Miami-Dade benthic habitat map confirms that the Port of Miami anchorage contains approximately 644 acres of coral reef habitat, approximately 25% of the anchorage area. Furthermore, much of this habitat was recently included in a NOAA fisheries proposal as critical habitat for two species of corals, *Acropora cervicornis* and *A. palmata*, recently listed as threatened in the Endangered Species Act. Initial studies indicate that the Port of Miami anchorage must be immediately reconfigured to avoid further impacts to a threatened species, its critical habitat, and to living coral reef ecosystems.

In November 2008, the Port of Miami Harbor Safety Committee Anchorage Working Group met for the first time to discuss the issues regarding the preliminary analysis of the Miami-Dade anchorage and to outline a plan for proceeding with the formal analysis. Agencies represented included Port of Miami, US Coast Guard, Miami Pilots, Miami-Dade Environmental Resource Management, US Army Corps of Engineers, FL DEP Coral Reef Conservation Program, NCRI, NOAA, Florida Fish and Wildlife Conservation Commission. The group discussed several key issues regarding the GIS analyses of the area including the location of Fish Havens, Artificial reef sites, and Miami River boat usage.

The formal GIS evaluation and reconfiguration proposals will commence after the Miami-Dade habitat maps are finalized, which is forecasted for the first quarter of 2009.

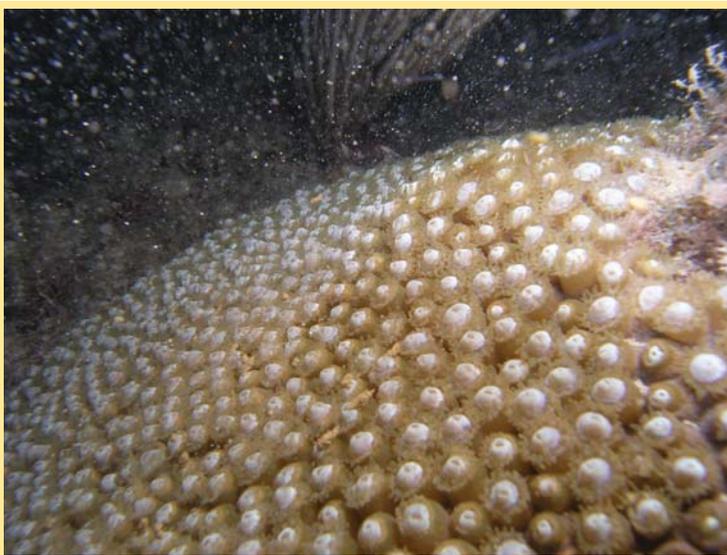
# Restoring Coral Reefs, One Gamete at a Time

A few days after the August full moon, corals off the coast of heavily populated Broward County, FL began their annual spawning period, releasing sperm and eggs (also known as gametes), into the water column. Scientists from NCRI, along with scientists and managers from Florida's DEP were there to catch the action. During several night dives, divers collected gametes as they were being released from colonies of the great star coral *Montastraea cavernosa*. This species is one of the most important reef-building Caribbean and Atlantic coral species, particularly in Florida.



Yellow star indicates location in Broward County where coral spawning was observed.

Departing at dusk on August 23 from Nova Southeastern University Oceanographic Center, the scientists anchored at pre-selected sites and entered the water around 6:00 pm. A couple of weeks before the predicted spawning date, tissue samples were taken from several large, tagged colonies to determine which were male and which were female. These colonies were then targeted for gamete collection. Large mesh nets topped with plastic collection cups were tented over the female colonies to catch the buoyant eggs as they floated to the surface after being released. Collection of sperm is a bit trickier since sperm quickly disperse in the water upon release instead of floating to the surface like the positively buoyant eggs. Thus, divers equipped with plastic bags were stationed near the male colonies, poised to scoop up as much as they could as clouds of sperm



A star coral, *Montastraea cavernosa*, releases its gametes into the water.

were released. “Imagine stumbling around in the dark with a small flashlight trying to collect fruit flies in a ziplock bag while the entire room is swaying back and forth. That’s the closest I could come to describing what collecting coral gametes by hand is like” commented NCRI research assistant and graduate student Adam St. Gelais. “When it all comes together though, it is a very special thing for a coral researcher to witness.”

The divers’ long hours of waiting were rewarded when the male colonies released their gametes around 9 pm, and the female colonies followed about 20 to 30 minutes later. The collected gametes were brought to the surface and placed in buckets on the dive boat to mix and fertilize. Back at the laboratory, the fertilized eggs were placed in a controlled aquarium environment where development of the eggs into free-swimming larvae occurred over the next several days. Several colonies of *M. cavernosa* that were being maintained in outdoor tanks at NCRI also spawned for the first time, and gametes were collected and transferred to aquaria inside. Once the larvae matured, they were ready to settle onto natural limestone plates placed in the aquaria. After settlement, the larvae metamorphose into a primary polyp, the building block of the coral animal. Other polyps bud off from the primary polyp as the coral grows into a juvenile colony.



Collected coral gametes being transported back to the boat.

The resulting juvenile corals will be nurtured and grown in the protected laboratory environment until large enough to be moved to the outside coral husbandry system. After they have reached a size large enough for field transplantation, they will be returned to the reef with the goal of developing techniques and methods for aiding restoration of damaged reefs.

“This outstanding research is consistent with NCRI’s mission of providing management related research output on assessment, monitoring, and especially restoration of coral reefs” stated Dr. Richard Dodge, Executive Director of NCRI and Dean of the Nova Southeastern University Oceanographic Center.

With coral reefs worldwide experiencing degradation and loss of corals due to pollution, overfishing, climate change and coastal development, tools are sought to help restore the health of the reefs. Practical solutions for restoring and reinvigorating coral reefs are urgently needed, and the transplantation of healthy corals is one option for doing this.

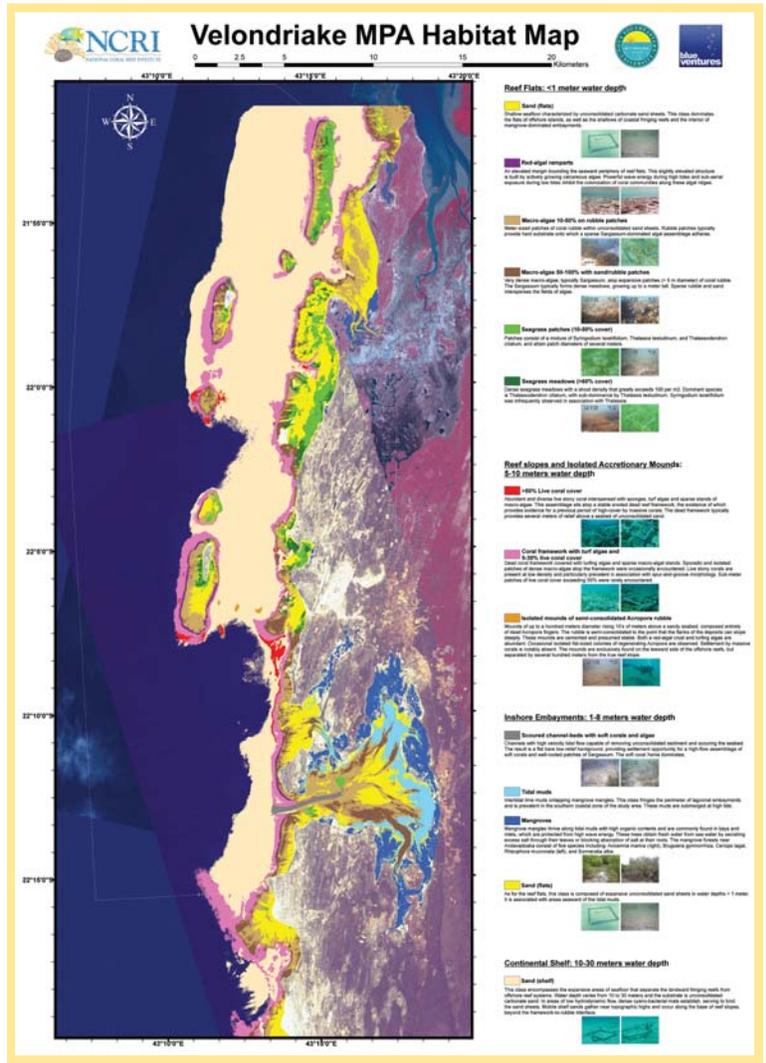
“The use of sexually reproduced, juvenile corals grown in the laboratory has great potential to provide a viable alternative in coral reef restoration” says NCRI research scientist Dr. Alison Moulding. “This research aims to develop and provide a useful tool in the manager’s toolbox to help address critical issues facing coral reefs in the US and worldwide.”

# NCRI Researcher Contributes to J. P. Getty Award Winning Project

A research study contributed to by National Coral Reef Institute (NCRI) research scientist Dr. Sam Purkis has received the international J. Paul Getty award for conservation. Funded by Blue Ventures, a British non-governmental organization, the project took place in a remote corner of Madagascar. The prize, described by former President Ronald Reagan as the Noble Prize for conservation, is awarded by global conservation organization World Wildlife Fund (WWF), and is one of the world's most prestigious environmental accolades.

In collaboration with Blue Ventures, which is dedicated to marine conservation in Madagascar, Purkis conducted fieldwork in the waters of Andavadoaka, an isolated village in southwest of the country. These data were used to create a region-wide map of the coastal zone using high-resolution satellite data. NCRI graduate student researcher Shanna Dunn led the mapping component of the project. This work is a precursor to the development of the 'Velondriake' community-managed protected area network. Protection from this effort will encompass pristine terrestrial and marine habitats, including vast tracts of coral reef. Purkis was joined in the field by a team of researchers from the World Wildlife Fund.

In addition to the J. P. Getty award, the project's success has led the government of Madagascar to use it as a model to create similar protected areas across the country. Though the coral reef off the southwest coast of Madagascar is the third largest in the world, its isolation means that it is relatively unstudied. The use of satellite remote sensing allowed a vast area (>5,000 km<sup>2</sup>) to be assessed without the demand for exhaustive field study. In addition to mapping the distribution of habitats, the topographic profile of the seabed was also charted using a combination of bathymetric soundings conducted in the field and processing of the satellite imagery. The momentum gathered from the success of the initial pilot project has led to a proposal to expand the mapping campaign further south into areas that are at greater risk from unregulated fishing pressure. The NCRI looks forward to contributing further to the critical preservation of the reef resources of Madagascar.



Above. The seabed map used to designate the Velondriake Marine Protected Area. This habitat map was created by NCRI researchers using high-resolution satellite data, coupled with field survey and acoustic bathymetry. The data from this work will be housed on a web-portal for public access. The work complements NCRI's ongoing presence in the Indian Ocean and companions a similar study recently conducted in the Chagos archipelago (British Indian Ocean Territory).

Left. NCRI scientist, Dr. Sam Purkis, with NSU Oceanographic Center graduate student and Fulbright Scholar, Ms. Volanirina (Vola) Ramahery, beside a traditional Madagascan fishing canoe in the remote village of Andavadoaka. In recognition of Vola's outstanding conservation work in the area, the vessel is named the 'Volanirina'.



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