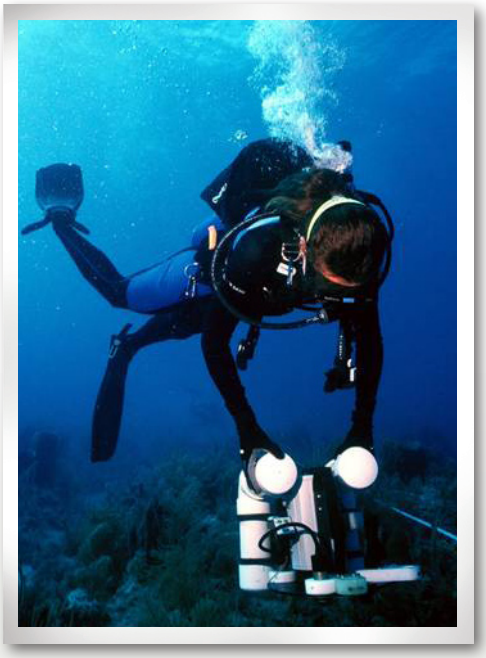
Coral Reef Evaluation & Monitoring

Florida Keys National Marine Sanctuary

Sanctuary Managers Rely on Research to Protect Coral Reef

North America's only barrier coral reef lies within the Florida Keys National Marine Sanctuary. Located on the ocean side of the Florida Keys island chain, the reef tract is bathed by the warm, clear waters of the Florida Current flowing from the south. In recent years, corals in the Keys, as well as elswhere in the Caribbean, have experienced impacts from hurricanes and storms, disease and bleaching, coastal pollution, overfishing and climate change. Sanctuary managers rely on the findings from scientific research and monitoring programs to aid them in protecting and managing this world-renowned coral reef for future generations.

To collect valuable information about the reef ecosystem, scientists from Florida's Fish and Wildlife Conservation Commission began systematically monitoring coral reefs throughout the sanctuary in 1996. This research program, called the Coral Reef Evaluation & Monitoring Project (CREMP), studies various aspects of reef ecology and health and employs numerous survey methods and analyses. CREMP is part of the Water Quality Protection Program, which was established by Congress to track the status of natural resources within sanctuary waters and is jointly managed by the U.S. Environmental Protection Agency and the state of Florida.



A scientist digitally records benthic species.
Photo: Florida Fish and Wildlife Conservation Commission

Systematic Monitoring of Coral Reef Ecosystem Reveals Trends

CREMP scientists have conducted systematic inventories of stony coral species richness and recorded digital video at sampling stations throughout the Florida Keys since 1996. The sampling stations fall into three habitat types: patch reefs, offshore shallow reefs and offshore deep reefs. The sampling stations are spread through four regional areas: Upper Keys, Middle Keys, Lower Keys and Dry Tortugas. As of 2009, CREMP was collecting data at 37 locations in the Florida Keys and Dry Tortugas, with each location consisting of two to four sampling stations, for a total of 109 stations currently being assessed by CREMP. The data collected allow scientists to determine mean stony coral species richness (the number of species per station), and the digital video is used to quantify the organisms comprising the benthic (bottom) community, including stony corals, octocorals or soft corals, sponges, and macroalgae.

Unbleached elkhorn coral growing next to bleached fire coral.
Photo: FKNMS

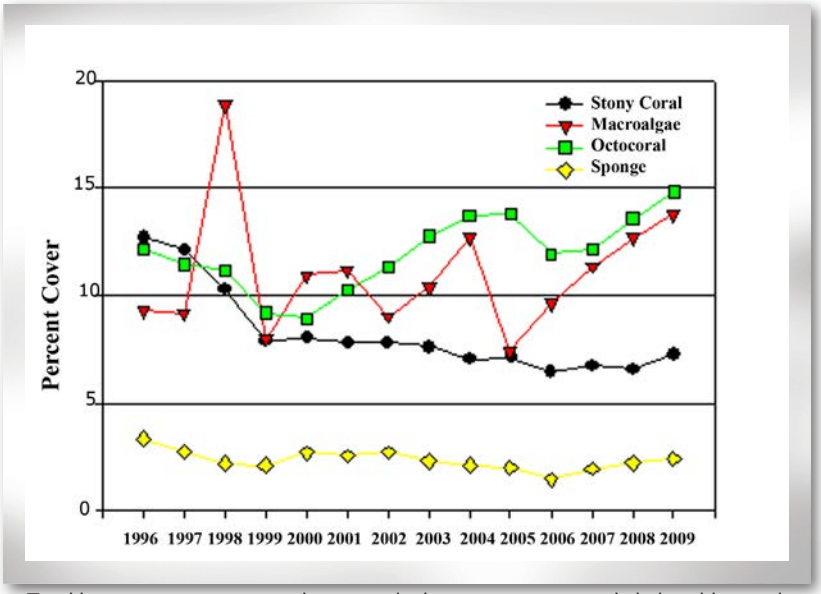
Since monitoring began in 1996, mean stony coral species richness has decreased by 2.3 species per sampling station throughout the Florida Keys. Seventy-five percent of all stations show a decrease in species richness between 1996 and 2008. Of the 43 coral species initially recorded in 1996, 29 have decreased in presence while seven species have increased in presence. Mean species richness changed very little between 2008 and 2009 but is higher than in 2006, which was the low point since the program began. In 2009, benthic cover values in the Florida Keys were 14.8% for octocorals, 13.8% for macroalgae, 7.3% for stony corals and 2.4% for sponges. A statistical analysis comparing benthic cover values between 2008 and 2009 revealed an increase in the cover of octocorals, macroalgae, and stony corals, while cover remained similar for sponges. This marked the first time since project inception that CREMP recorded an annual increase in stony coral cover (from 6.5% to 7.3%).

http://floridakeys.noaa.gov/

National Marine Sanctuaries

Bleaching and Disease Impact Florida Keys Corals

CREMP records the incidence of four coral conditions, including bleaching and three disease categories: black band disease (BBD), white diseases (e.g. white plague, white band, and white pox), and other diseases (e.g. dark spot, yellow band, and red blotch). Bleaching events have impacted corals in the Florida Keys since the 1970s; however, one of the worst bleaching events on record was in 1997-1998 when corals bleached around the world. Bleaching is a stress response to high seawater temperatures and takes place when corals expel the beneficial microscopic algae living within their coral polyps. These microscopic algae, called zooxanthellae, provide nutrition for the coral colony and give the coral its characteristic color. Without zooxanthellae, stony corals appear white, or "bleached." Corals that have bleached are more susceptible to disease and mortality, but some do regain their zooxanthellae and recover from bleaching.



Tracking percent cover over time reveals the most recent trends in benthic species.
Photo: Florida Fish and Wildlife Conservation Commission

Coral disease has also contributed to declines in coral cover. Throughout the CREMP project, BBD has been the least observed of the three disease categories. BBD primarily attacks large boulder and brain corals and peaked in 1998, but has not been recorded at more than 10% of stations within a single year since. Peak incidence of white diseases and other diseases occurred in 2002 but since that time both disease categories have declined. The decreasing prevalence of white syndromes may be partially linked to the decline of staghorn coral (*Acropora cervicornis*) and elkhorn coral (*A. palmata*) across CREMP stations. Both species of acroporid corals are commonly targeted by white diseases, which have dramatically reduced their populations.

Multiple Stressors Affect Coral Cover and Species Richness

In response to their declining population, staghorn coral and elkhorn coral were listed as threatened species under the Endangered Species Act in 2007. Based on CREMP surveys, staghorn cover has been low throughout the Florida Keys since 1996, but elkhorn coral cover was much higher at project inception than it is today. Since 1999, elkhorn cover has declined significantly due to disease, resulting in ~93% lower cover than in 1996. Declines in staghorn coral in the Tortugas were observed between 2002 and 2005 and were due to multiple events including a disease outbreak and the 2004 and 2005 hurricane season.

Reductions in coral cover and species richness in the Florida Keys have been largely attributed to multiple stressors, including coral bleaching, disease outbreaks, harmful algal blooms, hurricanes, and anomalies in major weather patterns (e.g., cold water events), all of which can cause coral mortality. For example, the El Niño weather pattern of 1997-1998 that elevated sea surface temperatures caused widespread bleaching in corals. Severe losses of coral cover were subsequently documented in 1998 and 1999. At the other end of the spectrum, the winter of 2010 brought record breaking cold to the Florida Keys and depressed water temperatures below the critical threshold for stony corals. Although CREMP results are preliminary, they indicate many of the large boulder and brain corals on patch reefs, especially those close to shore, suffered mass mortalities. Both of these events, the 1997-1998 El Niño and the 2010 winter freeze, are responsible for the largest declines in coral cover CREMP has recorded. Disease outbreaks, hurricanes, and harmful algal blooms have acted at a more localized scale, impacting specific regions and reefs during different times of the project.

Research and Monitoring are Critical to Managing Reefs for the Future

In addition to the many observed stressors impacting Florida Keys corals, deterioration in water quality can be stressful to the reef. CREMP scientists have begun to analyze water quality data, also collected since 1996 under the Water Quality Protection Program, in conjunction with coral data to tease out connections and correlations between water quality and coral health whenever possible. Continued study into the causes and nature of disease outbreaks, along with rigorous monitoring of coral reefs and their inhabitants, will facilitate management of coral reefs for the future. Coral reef research and monitoring are especially important for tracking the effects of increasing ocean temperatures and sea level rise associated with climate change and are also critical in evaluating the impacts of changing freshwater flows on the Florida mainland as part of the Comprehensive Everglades Restoration Plan. For more CREMP results, visit http://ocean.floridamarine.org/fknms_wqpp/pages/cremp.html.

Principal Investigator: Mr. Rob Ruzicka, Florida Fish and Wildlife Conservation Commission
Written by: Nancy Diersing, Florida Keys National Marine Sanctuary
Published: August 2011