Florida Fish And Wildlife Conservation Commission
Fish And Wildlife Research Institute
Coral Reef Evaluation & Monitoring Project

2004 CREMP Executive Summary, May 2005

In cooperation with NOAA, the US Environmental Protection Agency and the State of Florida implemented a Water Quality Protection Program in 1994 to monitor sea grass habitats, coral reefs, hard bottom communities, and water quality. The Coral Reef Evaluation and Monitoring Project (CREMP) sampling strategy and methods were developed in conjunction with EPA, FKNMS, Continental Shelf Associates, and the Principal Investigators. The major criteria for coral reef monitoring included Sanctuary-wide spatial coverage, repeated sampling, and statistically valid findings to document status and trends of the coral communities. Forty sampling sites were selected using a stratified random sampling procedure (USEPA E-map) and permanent station markers were installed. Annual sampling began in 1996 and has continued through 2004. Three additional sites were selected and stations installed in the Dry Tortugas in 1999. In 2002, additional sampling techniques were incorporated including a bio-eroding sponge survey, an expanded stony coral disease survey, and a stony coral abundance survey.

Results are reported both Sanctuary-wide and for regions defined as Upper Keys (north Key Largo to Conch Reef), Middle Keys (Alligator Reef to Moser Channel), Lower Keys (Looe Key to Smith Shoal), and Dry Tortugas (Dry Tortugas to Tortugas Banks)(Figure 1).

Sanctuary-wide from 1996 to 2004, for a total of 105 stations, the number of stony coral species declined at 83 (79%) stations, increased at 15 (14%) stations, and remained unchanged at 7 (6%) stations. Between 1996 and 2004, stony coral cover declined from 11.9% to 6.6% Sanctuary-wide. The changes observed from 1996 to 1997, and 1999 to 2003 were determined to be statistically insignificant. Sanctuary-wide, in 2004, the benthic community cover within CREMP sites was composed of 63% substrate, 13.6% octocoral, 12.7% macroalgae, 6.6% stony coral, 2.0% sponge, 1.8% zooanthids, and 0.3% seagrass. In 2004, the most common stony coral species were *Montastraea annularis* (2.6%), *M. cavernosa* (1.0%), *Siderastrea siderea* (0.8%), *Porites astreoides* (0.5%), *Colpophyllia natans* (0.4%) and, *Millepora complanata* (0.3%).

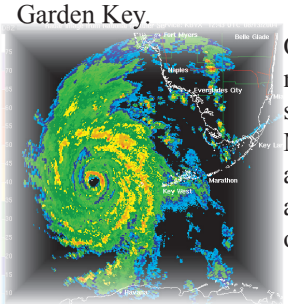
Between 2003 and 2004, both the number of stations with diseased coral and the number of infected species decreased. In 2004, black band disease was observed at three stations, down from 7 in 2003, while "white" disease was observed at 54 stations, down from 72 stations in 2003. "Other" disease was recorded at 74 stations in 2004. "Other" disease was reported at 89 stations the previous year. Incidence of coral bleaching was also down in 2004. Bleaching was reported at 57 stations in 2003 and 37 stations in 2004. CREMP data indicates that coral disease is not impacting stony coral cover Sanctuary-wide.

The decreases in stony coral cover and species richness documented by the CREMP are evidence that multiple stressors acting at local, regional, and global scales are continuing to have negative impacts on coral reefs in the Florida Keys National Marine Sanctuary.

A Season of Hurricanes

In 2004, Floridians experienced one of the worst hurricane seasons on record. Four storms hit Florida in the months of August and September. On August 13, 2004 Hurricane Charley passed directly over the Dry Tortugas with maximum winds near 95 kts. The reefs and islands of the Dry Tortugas National Park were subjected to tropical storm and/or hurricane force winds and waves for nearly 10 hours. The CREMP team sampled the Dry Tortugas sites approximately 54 days post hurricane Charley.

Shallow water sites sustained the greatest storm damage at the Dry Tortugas. Broken Acroporid colonies, dettached octocorals, sponges, algae, and clean bare substrate were observed at shallow reef sites near Garden Key.



On deeper reefs in the Dry Tortugas, the most obvious sign of Hurricane Charley was fine sediment, which covered many corals and sponges. Occasionally a large toppled coral colony was observed lying in the sediment between the spurs or on top of adjacent colonies. Colonies that were toppled were often bleached as well.

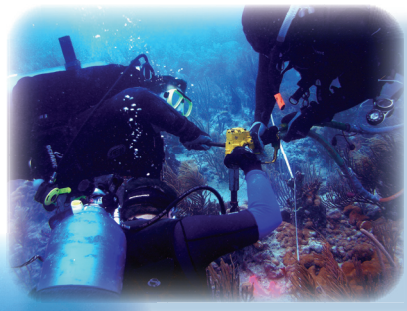
Many sponges appeared to have been impacted by the storm. One observer counted 18 tube sponges that had presumably been broken off by the storm and deposited in the sand in the between two spurs. Scattered octocorals and fleshy algae collected in the grooves between spurs. CREMP sites in other regions of the Florida Keys reportedly incurred only minor damage.

A report of the Florida Fish and Wildlife Conservation Commission and the University of Georgia pursuant to USEPA grant award X-97468002-0, and NOAA grant award NA160P2554

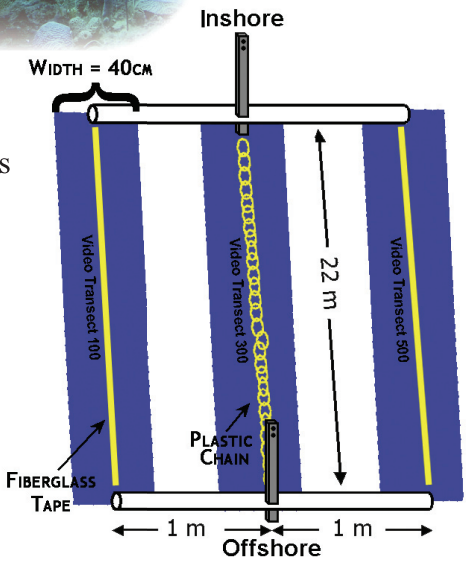
CREMP Methods

Setup

Each site is permanently marked with stainless steel stakes epoxied in the bottom. The relocation process is the true search for "a needle in the haystack".

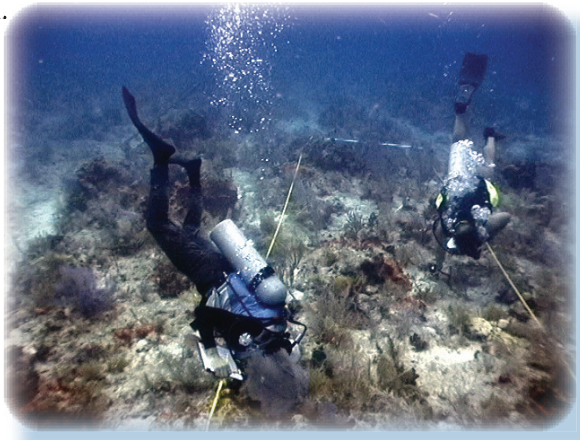


The Set-up Team carries 2 sets of poles, 6 chains, and 6 fiberglass tapes from the support vessel to the site. They are responsible for locating the site, establishing the station transcects, moving the transects along the site with the sampling team, and breaking down the setup.



Station Species Inventory

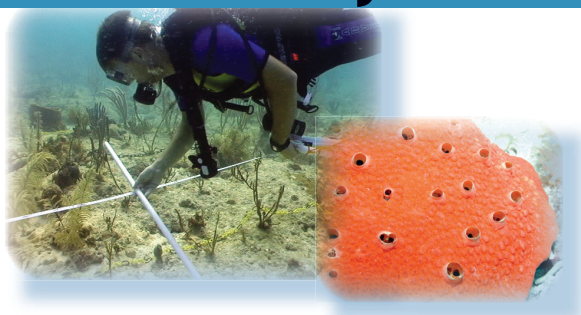
A pair of observers records stony coral species presence, coral disease, and bleaching within a 2m x 22m area at each station.



Benthic Cover Survey

Percent cover of live coral, selected sessile benthic biota, and substrate is determined annually from video transects filmed at each station. Abutting frames with minimal overlap are extracted from a mosaic and analyzed using a custom software application called Point Count '99 for coral reefs.

Bio-eroding Sponge Survey



Three clionid sponge species (*Cliona delitrix, C. lampa,* and *C. caribbaea*) are known to be aggressive coral bioeroders. The sponge survey area is designated by three one-meter wide belt transects. The location, species, and size of each sponge colony is recorded, as well as the species of stony coral affected by the clionid colony.

Stony Coral Disease Survey

The Disease Coral Survey (DCS) was designed to determine whether or not coral diseases significantly influence the survival of stony coral in the Florida Keys. This study quantifies the abundance and distribution of diseases/conditions on coral species. Colonies are assessed by annually photographing individual coral colonies at the nine Value-Added Sites in the Florida Keys CREMP.

Figure 1. Coral Reef Evaluation and Monitoring Project site locations and region boundaries.

Station Species Inventory

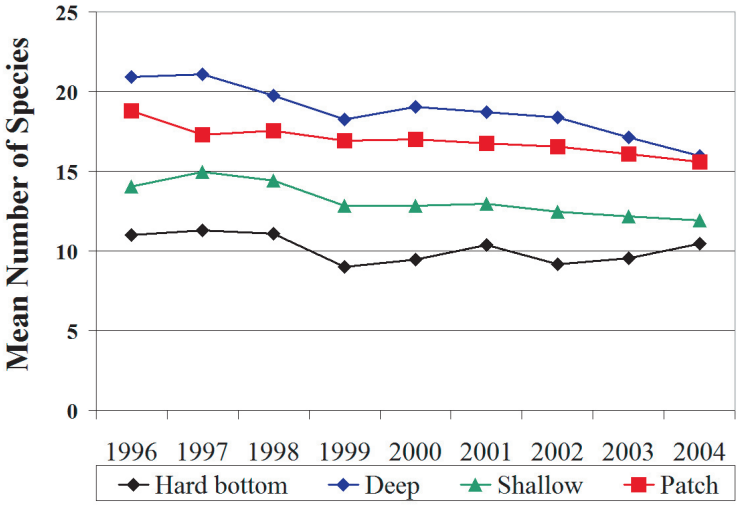


Figure 2. Mean number of stony coral species per year by habitat type.

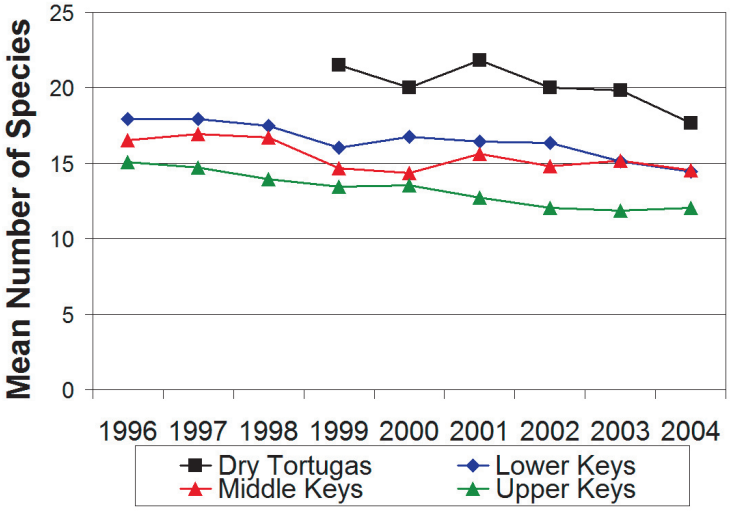
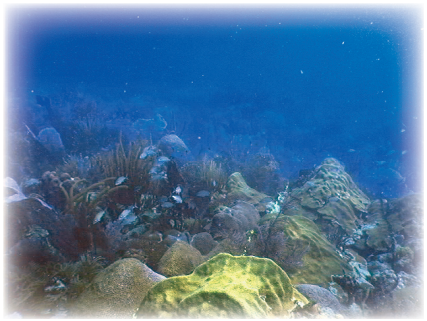


Figure 3. Mean number of stony coral species per year by region.

Sanctuary-wide from 1996 to 2004, for a total of 105 stations, the number of stony coral species declined at 83 (79%) stations, increased at 15 (14%) stations, and remained unchanged at 7 (6%) stations. A decline in the number of stony coral species was recorded in all habitat types except hardbottoms. The offshore deep and patch reef stations had the greatest numbers of stony coral taxa with a mean of 16 and 15 species, respectively. Hardbottom stations had the fewest number of stony coral species, averaging 11 species per station (Fig 2).



Between 2003 and 2004, the CREMP documented a decrease in the mean number of species per station at Middle and Lower Keys stations. In the Middle Keys, mean species richness declined from 15.2 in 2003 to 14.5 in 2004. A similar decrease was observed in the Lower Keys where species richness declined from 15.1 in 2003 to 14.4 in 2004. At Upper Keys stations, species richness remained essentially unchanged. The greatest decrease in species richness was seen at the Dry Tortugas where the mean number of species per station decresed from 19.8 in 2003 to 17.7 in 2004 (Fig. 3).

Benthic Cover Survey

FKNMS Stony Coral Cover

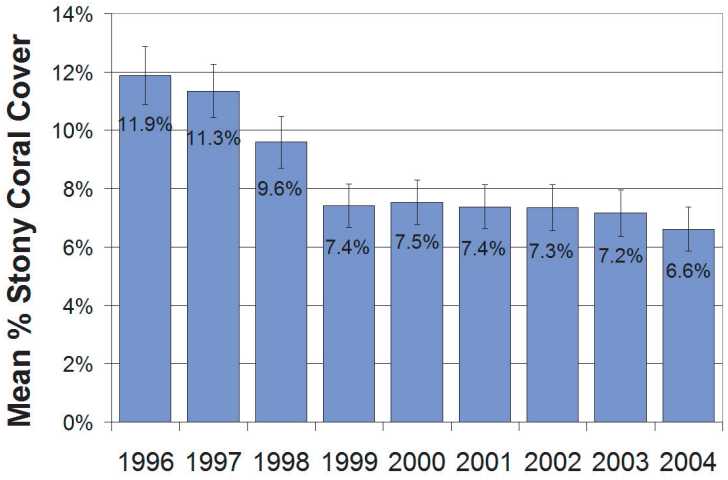


Figure 4. Stony coral cover Sanctuary-wide (1996-2004).

Between 1996 and 2004, stony coral cover declined from 11.9% to 6.6% Sanctuary-wide (Fig. 4). The decline in mean percent stony coral cover from 1997 to 1998 and from 1998 to 1999 was significant with a p-value of 0.03 or less for the Wilcoxon rank-sum test. Between 1997 and 1998, stony coral cover declined from 11.4% to 9.6%. The downward trend continued between 1998 and 1999 when stony coral cover declined from 9.6% to 7.4%. The changes observed from 1996 to 1997, and 1999 to 2003 were determined to be statistically insignificant. Sanctuary-wide, stony coral cover in 2004 was 6.6%.

Patch Reefs

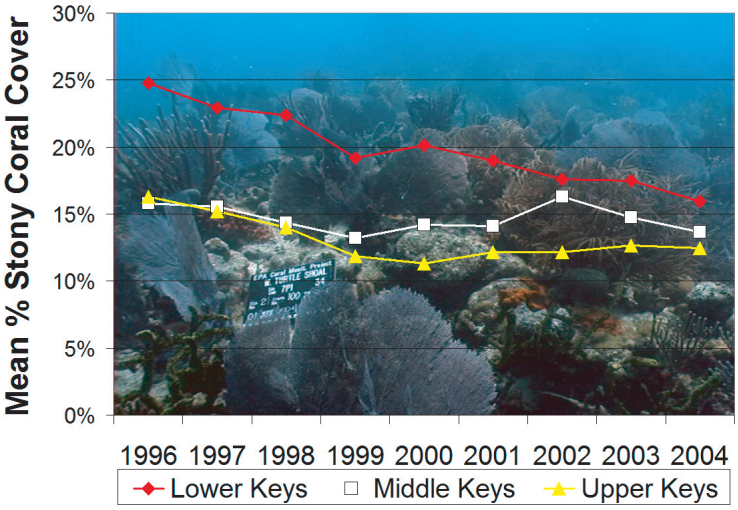


Figure 5. Stony coral cover at patch reef sites (1996-2004).

While patch reef sites in all regions displayed a decrease in stony coral cover, the Lower Keys patch reef sites showed the largest continual decrease in stony coral cover. Between 1996 and 2004, mean percent stony coral cover at Lower Keys patch reef sites decreased from 24.8% to 16.0% (Fig 5).

Stony Coral Cover

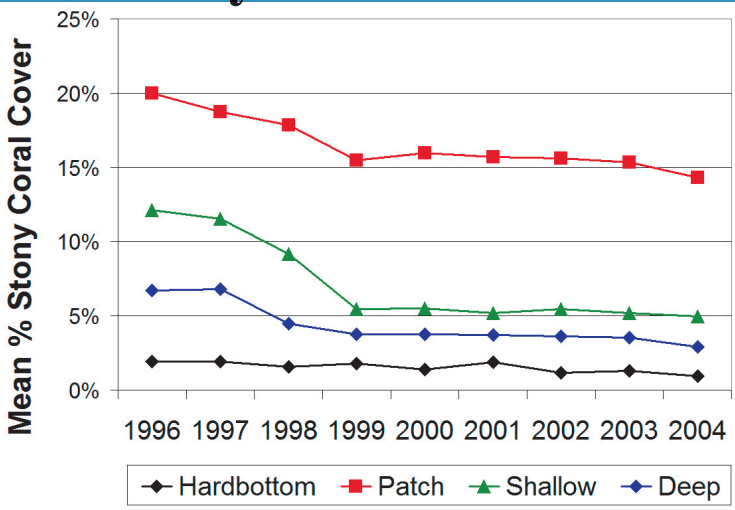


Figure 6. Stony coral cover for all habitat types (1996-2004).

All four habitat types showed a decrease in mean percent stony coral cover between 1996 and 2004 (Fig. 6). Patch reef stations had the highest mean percent stony coral cover. Hardbottom stations had the lowest mean percent stony coral cover; however, those stations have been the most stable between 1996 and 2004.

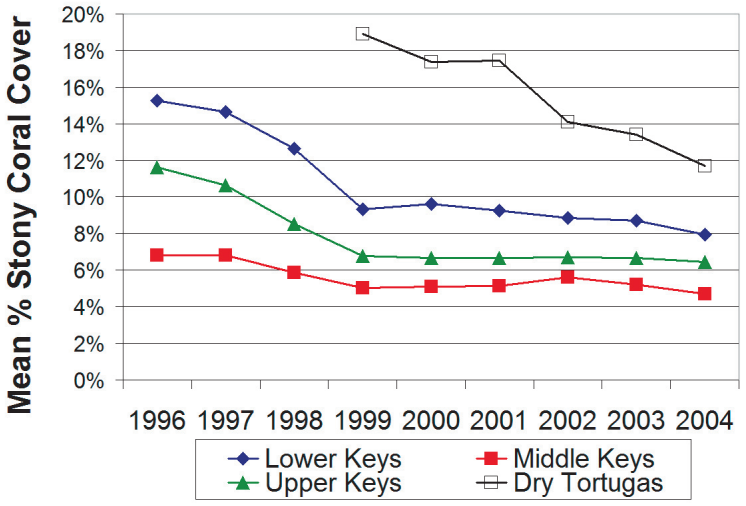


Figure 7. Stony coral cover for all regions (1996-2004).

Decreases in stony coral cover at Upper and Middle Keys sites were less than 0.5%. At Lower Keys sites stony coral cover decreased by 0.8%. The greatest decrease for any region was seen at the Dry Tortugas where stony coral cover decreased from 13.4% in 2003 to 11.7% in 2004 (Fig. 7). Between 2003 and 2004, percent stony coral cover at Dry Tortugas deep reef sites decreased from 18.0% to 16.6%, while cover at patch reefs sites decreased from 4.2% to 1.9%. These decreases offer further evidence of a trend of declining coral cover at Dry Tortugas sites since the CREMP began monitoring efforts there in 1999.

Stony Coral Species Cover

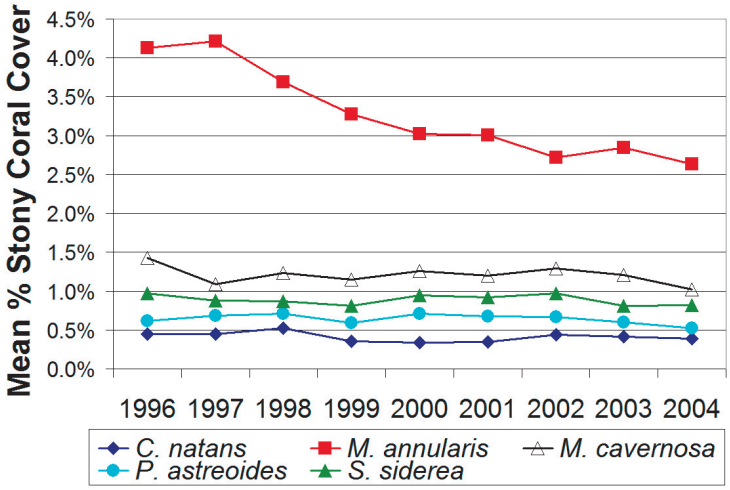


Figure 8. Sanctuary-wide stony coral cover for five most common stony coral species.

An understanding of the overall trend in stony coral cover can be gained by analyzing the changes in percent cover of the most common species. The six coral species with the greatest mean percent cover Sanctuary-wide in 1996 were *Montastraea annularis, Montastraea cavernosa, Acropora palmata, Siderastrea siderea, Millepora complanata*, and *Porites astreoides* . *M. annularis* represented approximately 35% of the stony coral cover at CREMP stations in 1996. *M. annularis* decreased from 4.1% in 1996 to 2.6% in 2004. *M. cavernosa* decreased from 1.4% in 1996 to 1.0% in 2002. Although *Acropora palmata* (elkhorn coral) only occurs in shallow reef habitats comprising 1.1% of the mean stony coral cover in 1996, it is well recognized as a primary framework species. Striking changes were documented for this species. The mean percent cover of *A. palmata* decreased 91% from 1.1% in 1996 to 0.3% in 2004. *Siderastrea siderea* decreased from 1.0% in 1996 to 0.8% in 2004. *Millepora complanata* decreased from 1.0% in 1996 to 0.4% in 2004 while *Porites astreoides* decreased only slightly from 0.6% in 1996 to 0.5% in 2004 (Fig. 8).

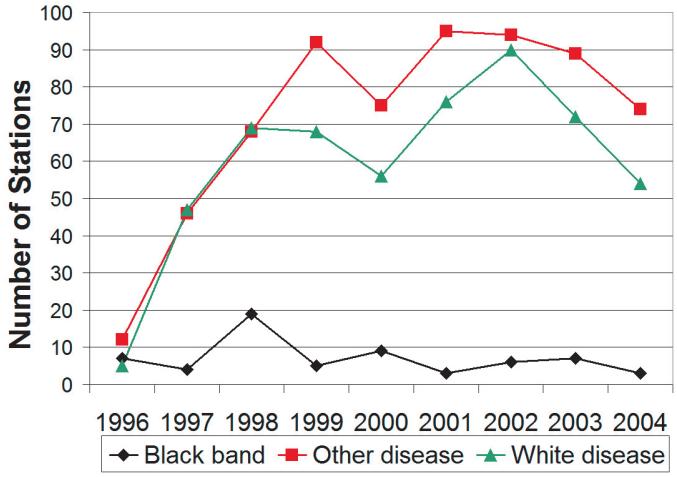


Figure 10. Number of stations with a presence of disease conditions.

Functional Group

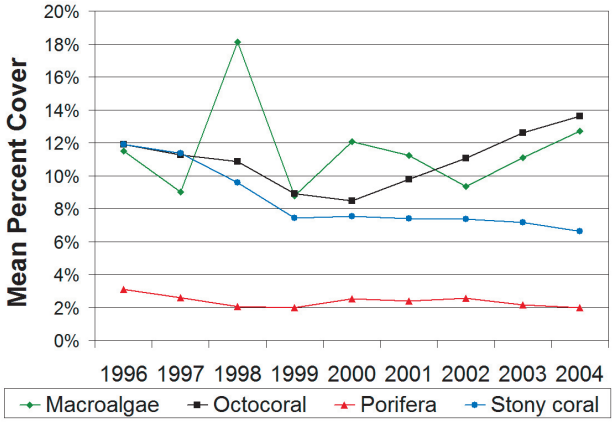


Figure 9. Functional group cover Santuary-wide (1996-2004).

Percent cover data for functional groups in the geographic regions studied from 1996 to 2004 were analyzed. Functional groups included: stony corals, octocorals, zoanthids, sponges, macroalgae, seagrass, and substrate (rock, rubble and sediments). In the Upper Keys from 2003 to 2004, functional group cover remained essentially unchanged. The Middle Keys had a decrease in macroalgal cover and an increase in octocoral cover. All other components of the Middle Keys benthic community remained unchanged. The Lower Keys had a increase in macroalgal cover and a decrease in substrate cover. Stony coral cover at Lower Keys sites decreased slightly while other groups remained unchanged. Sanctuary-wide, in 2004, the benthic community within CREMP sites was composed of 63% substrate, 13.6% octocoral, 12.7% macroalgae, 6.6% stony coral, 2.0% sponge, 1.8% zooanthids, and 0.3% seagrass (Fig. 9). Sanctuary-wide there has been an annual increase in octocoral cover between 2000 and 2004.

Stony Coral Condition

Diseases are recorded as either present or absent for each species at a station. Between 1996 and 1999, the number of stations with diseased coral exhibited an increasing trend. However, since 2002 the number of stations with diseased coral has decreased. Stony coral diseases can be sorted into three categories: black band, white diseases (including white plague, white band and white pox), and other (including dark spot, yellow band, and idiopathic diseases). White disease occurred at 90 stations in 2002, but decreased to 54 stations in 2004. While "other" disease has declined from 94 stations in 2002 to 74 stations in 2004. Since 1996 black band disease has occurred at a low number of stations (< 10 stations) with a peak in 1998 (19 stations)(Fig. 10).

Bio-Eroding Sponge Survey

FKNMS Clionid Cover

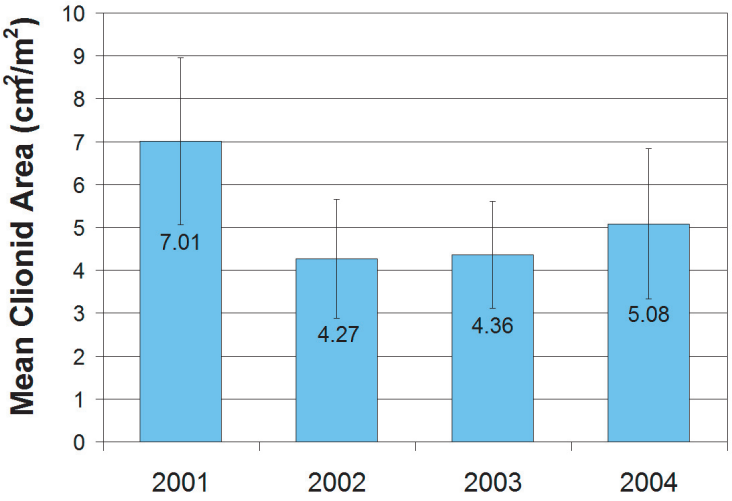


Figure 11. Clionid area Sanctuary-wide (2001-2004).

Clionid sponge area can be highly variable between locations and years. In the Florida Keys, mean clionid area decreased from 7.0 cm^2/m^2 in 2001 to 4.3 cm^2/m^2 in 2002. However, from 2002 to 2004 mean clionid area increased from 4.3 cm^2/m^2 to 5.1 cm^2/m^2 (Fig. 11).

Patch Reefs

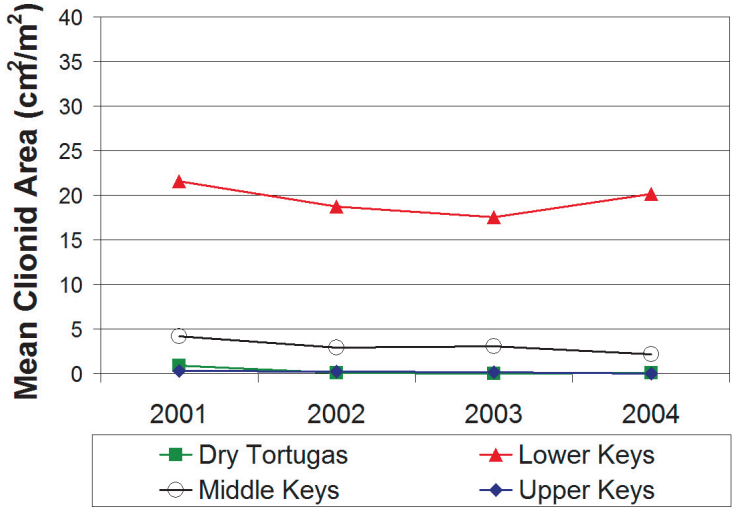


Figure 12. Clionid area for patch reefs (2001-2004).

Of the four habitat types, the patch reef stations contained the highest mean clionid area. Within the patch reef stations the majority of clionid area occurred in the Lower Keys. Between 2001 and 2004, mean clionid area in the Lower Keys patch reef stations ranged between 21.5 cm^2/m^2 to 17.5cm^2/m^2. The Middle Keys patch reef stations contained the second highest mean clionid area ranging from 4.25cm^2/m^2 to 2.9cm^2/m^2. The Upper Keys patch reef stations contained the lowest amount of clionid area, less than 0.3 cm^2/m^2. (Fig. 12).

Clionid Cover

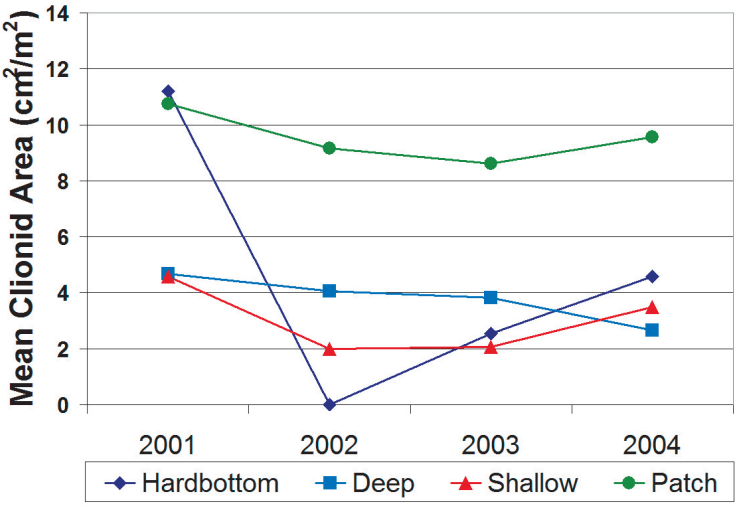


Figure 13. Clionid area among all habitat types (2001-2004).

Mean clionid area is well stratified among the different habitats (Fig. 13). Patch reef stations generally contained the highest mean clionid area. The large decrease in hardbottom habitats from 2001 to 2002 may be a result of a blackwater event (Hu et al, 2003).

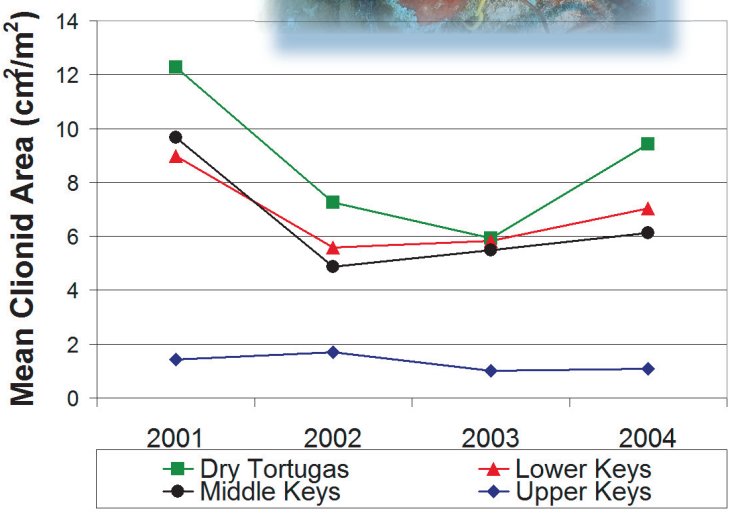


Figure 14. Clionid area by region (2001-2004).

Of the four regions surveyed, Upper Keys continually had the lowest mean clionid area while the Dry Tortugas had the highest mean area. The Middle and Lower Keys showed similar mean clionid area values. Dry Tortugas, Lower Keys, and Middle Keys all decreased from 2001-2002 (Fig. 14).

Value Added Stations (VAS)

Stony Coral Disease Survey

A total of 238, 157, and 299 colonies were identified as diseased in 2002, 2003, and 2004 respectively, in all 14 stations surveyed. During 2003 and 2004, the number of diseased colonies included both relocated colonies which continued to express signs of disease, as well as newly diseased colonies.

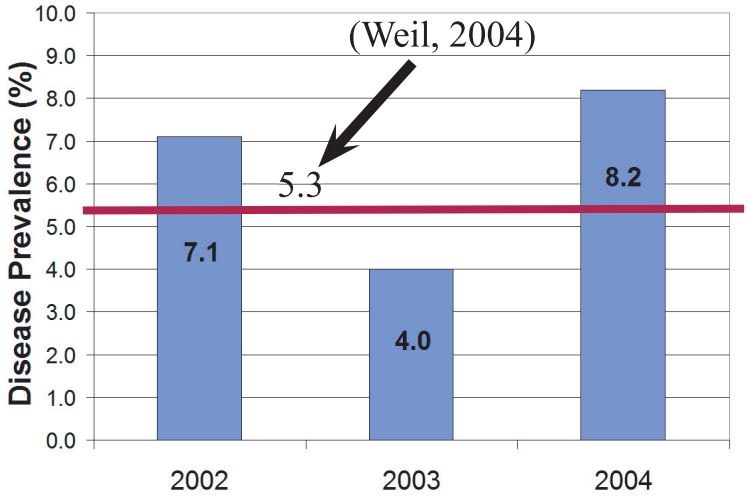


Figure 15. Disease prevalence Sanctuary-wide (2002-2004).

The prevalence of disease among all species was 0.4 diseased coral colonies per m^2 or 7.1% of the population in 2002, 0.3 diseased coral colonies per m^2 or 4.0% of the population in 2003, and 0.5 diseased coral colonies per m^2 or 8.2% of the population in 2004 (Fig. 15). Weil, (2004) calculated an average disease prevalence for 28 reefs in the wider Caribbean between 1999 and 2002 to be 5.3% of the population.

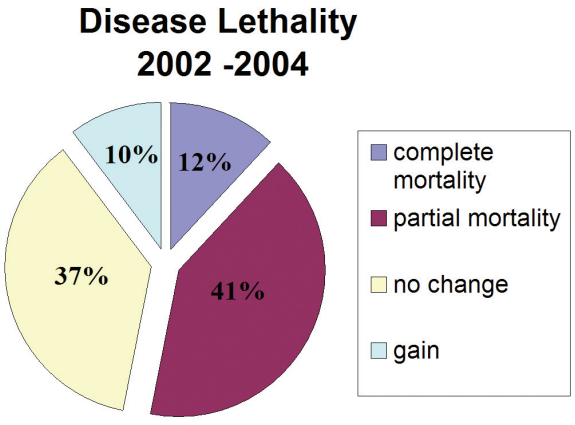
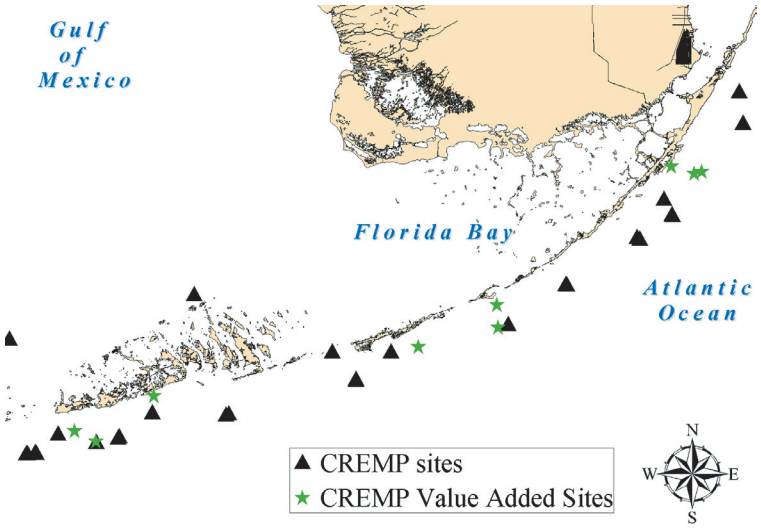


Figure 16. Disease lethality Sanctuary-wide (2002-2004).

Of the coral colonies marked as diseased in 2002 and 2003, 12% of the colonies experienced total mortality by 2004 which represents approximately 1% of the population. While 41% suffered partial mortality, 37% showed no change in live tissue, and 10% had a gain in tissue cover (Fig. 16).

Temperature

In 2002, small *in situ* temperature loggers were installed at all VAS to document possible trends of changing water temperatures within the FKNMS. These data-loggers record water temperature hourly and are downloaded quarterly. Loggers were recovered, downloaded and re-deployed quarterly. During the period September 2003-August 2004, water temperature ranged from 14.3° to 33.1° C. Mean water temperature at the 18 CREMP VAS sites was 26.0° C.



Stony Coral Population Abundance Survey

Coral abundance was assessed at 18 VAS. Species richness per site ranged from three at El Radabob to 28 at West Turtle Shoal. Abundance values also varied greatly ranging from 28 colonies at Grecian Rocks to over 400 colonies at West Turtle.

The typical coral community at a CREMP VAS contained 173 colonies representing eleven coral species. Size classes for colonies were 0-10 cm, 10-50 cm and greater than 50 cm. Seventy percent of coral colonies were in the 0-10 cm size class while 24% of colonies were 10-50 cm, and 5% were over 50 cm.

Sidereastrea sidereastrea had the greatest mean number of colonies in the 0-10 cm, and 10-50 cm size classes. Other common corals in the 3-10 cm size class include *M. cavernosa, Stephanocoenia michelinii, and Millepora alcicornis*. In addition to *Siderastraea sp*., common corals in the 10-50 cm size class included *S. michelinii, Porites astreoides, and M. alcicornis*. The most common coral species over 50 cm include *Montastraea annularis, Copolphyllia natans and M. cavernosa*.

Dry Tortugas

Stony Coral Cover

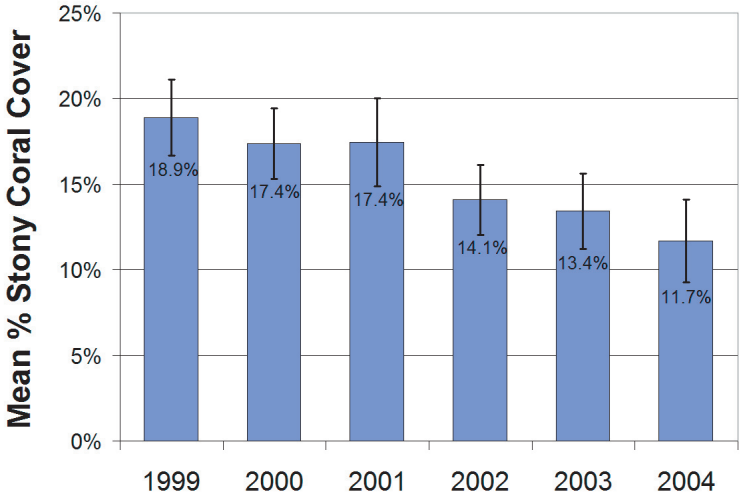


Figure 17. Stony coral cover in the Dry Tortugas (1996-2004).

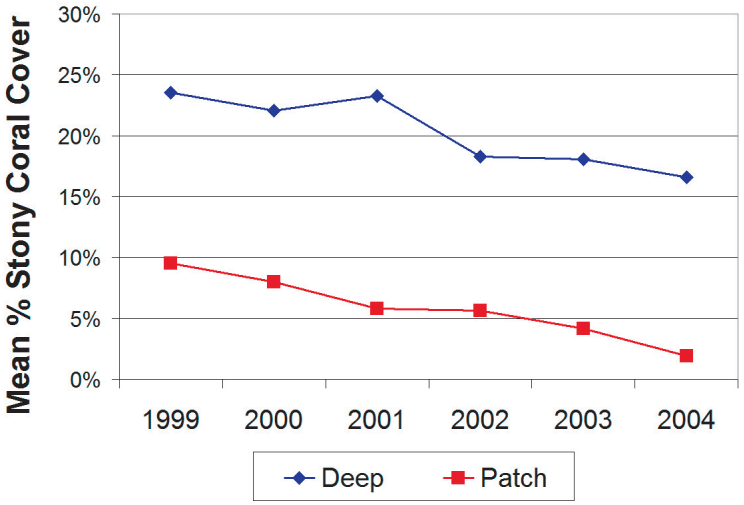
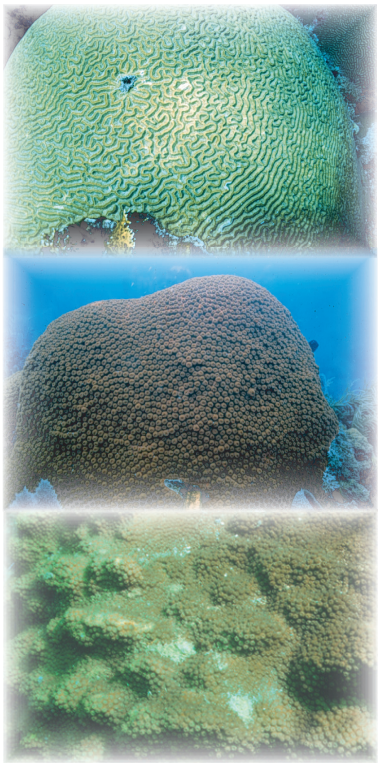


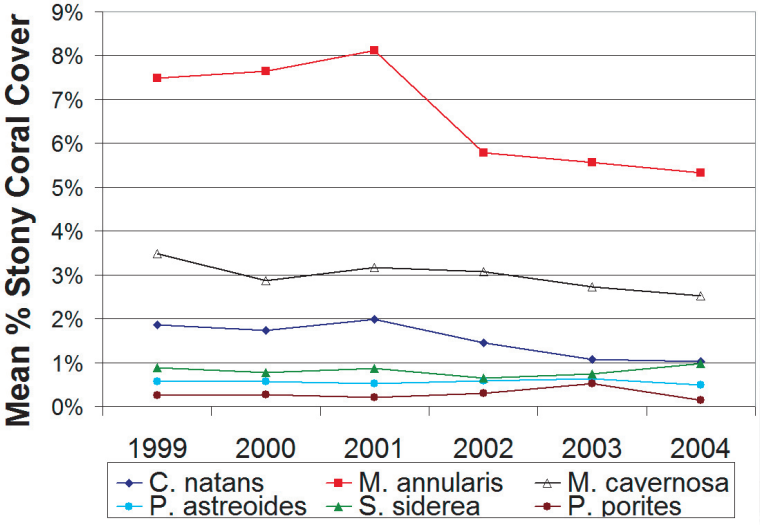
Figure 18. Stony coral cover for two habitat types in the Dry Tortugas (1996-2004).

Mean stony coral cover for the twelve Dry Tortugas stations was 18.9% in 1999. By 2004, the mean stony coral cover decreased to 11.7%. The largest single year decrease in mean stony coral cover occured between 2001 (17.4%) and 2002 (14.1%), a decrease of 3.4%. Between 2003 and 2004, stony coral cover at the Dry Tortugas decreased 1.7% from 13.4% to 11.7% (Fig. 17).

Both patch and deep reef habitat types in the Dry Tortugas showed a decrease in mean percent stony coral cover between 1999 and 2004. Deep reef stations hava consistently had the highest mean percent stony coral cover. Stony coral cover at deep stations decreased from 23.6% in 1999 to 16.6% in 2004 with a 1.4% drop from 2003 to 2004 (Fig. 18). Stony coral cover at patch reef stations decreased from 9.5% in 1999 to 1.9% in 2004 with a 2.3% decrease from 2003 to 2004 (Fig. 18).

Stony Coral Species Cover





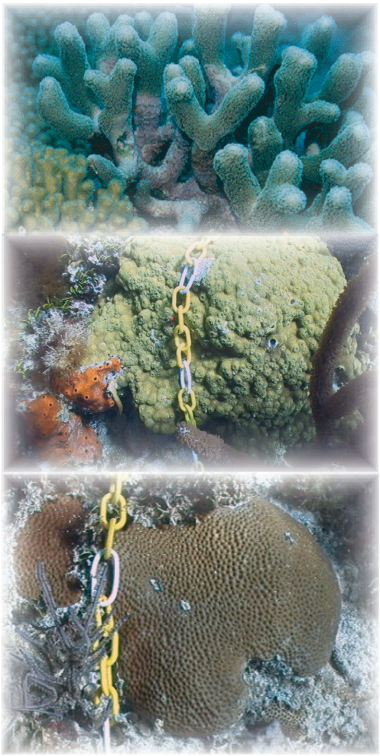


Figure 19. Stony coral cover for six species with the highest mean percent cover in the Dry Tortugas (1999-2004).

The six coral species with the greatest mean percent cover in the Dry Tortugas were *Colpophyllia natans, Montastraea annularis, Montastraea cavernosa, Porites astreoides, Siderastraea siderea, and Porites porites* (Fig. 19).

Dry Tortugas

Functional Group Cover

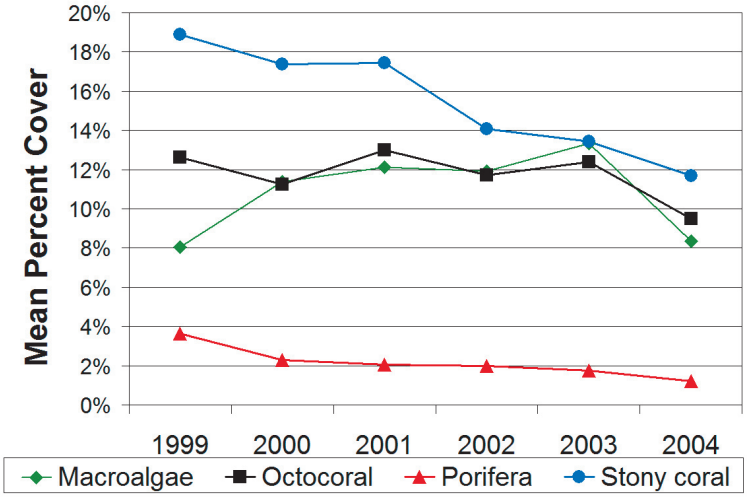


Figure 20. Functional group cover at Dry Tortugas (1999-2004).

Between 2003 and 2004, mean percent cover decreased for all functional group categories except substrate. Mean percent macroalgae cover decreased from 13.3% in 2003 to 8.4% in 2004. Mean octocoral cover decreased from 12.4% to 9.5% for the same period. Mean percent cover of substrate increased more than 10% from 59.1% in 2003 to 69.2% in 2004 (Fig. 20).

Bio-Erosion Sponge Survey

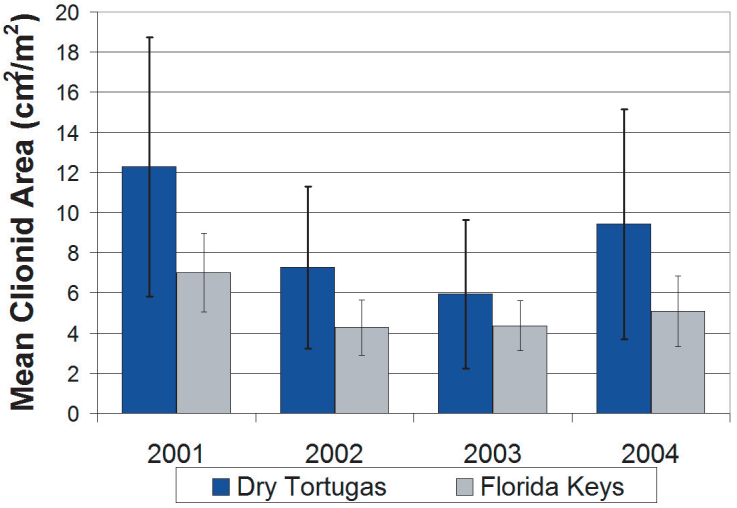


Figure 21. FKNMS and Dry Tortugas mean clionid area from 2001 to 2004.

CREMP stations in the Dry Tortugas had consistently higher mean clionid area than stations in the Florida Keys. In the Dry Tortugas, mean clionid area decreased from 12.3 cm^2/m^2 in 2001 to 5.9 cm^2/m^2 in 2003. In 2004, mean clionid area increased to 9.4 cm^2/m^2 (Fig. 21).

Stony Coral Condition

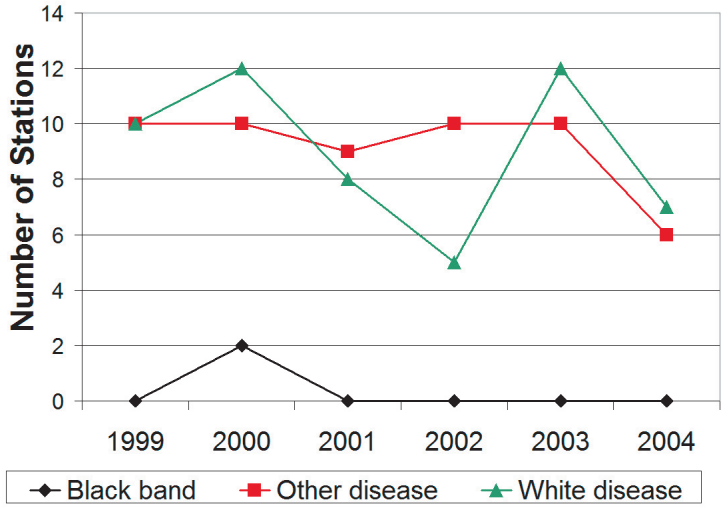


Figure 22. Number of stations with a presence of disease conditions in the Dry Tortugas.

At Dry Tortugas CREMP stations, coral disease incidence decreased between 2003 and 2004. Incidence of "White" disease decreased from 12 stations in 2003 to 7 in 2004. Likewise, for the same period, "Other" disease decreased from 10 incidences to six. Black band disease was not observed at the Dry Tortugas stations. Coral bleaching increased slightly from 9 observations in 2003 to 11 in 2004. (Fig. 22).

Discussion

The significant declines in mean percent stony coral cover between 1997 and 1999 were largely due to losses in *M. annularis*, *A. palmata*, and *M. complanata*. The large decline in mean stony coral cover was evident in all three regions in the Florida Keys (Lower, Middle, and Upper Keys), as well as three habitat types (offshore deep, offshore shallow, and patch reef stations). While no significant changes were reported on a Sanctuary-wide level between 1999 and 2003, dramatic changes are still occurring. Between 2003 and 2004, stony coral cover declined from 7.2% to 6.6%. The difference in stony coral cover between individual years is not statistically significant; however, preliminary analysis indicates that the cumulative difference in stony coral cover between 2000 and 2004 is statistically significant ($p=0.12$). The Sanctuary-wide decrease in stony coral cover is reflected regionally in data from the Lower Keys patch reef sites where stony coral cover decreased by 1.5% between 2003 and 2004. This decrease was primarily due to a continued loss in cover of *Montastraea annularis* which declined from 11.0% in 1997 to 4.5% in 2004.

The decrease in stony coral cover observed at the Dry Tortugas between 2003 and 2004 occurred at both deep and patch reef sites. Although it is probable that some loss of stony coral cover occurred at shallow patch reef sites as the result of Hurricane Charley, the losses at Black Coral Rock were observed prior to the storm. The loss documented by the CREMP between 2003 and 2004 is not the result of declines in percent cover of any one species, but rather the result of small incremental decreases in cover of ten different stony coral species. Stony corals were not the only functional group for which the CREMP documented a decline in 2004. Every functional group category at Dry Tortugas sites, except substrate, decreased in mean percent cover for the period 2003-2004. The decreases in percent cover of macroalgae, sponge and octocoral were likely due to the effects of Hurricane Charley as evidenced by numbers of dettached organisms observed on certain areas of the reef.

The continued decline of stony coral cover at the Dry Tortugas sites is alarming. The CREMP has recorded a decline in stony coral cover at the Dry Tortugas every year since sampling began in 1999. Although the Dry Tortugas sites still have greater species diversity and greater stony coral cover than the Keys, Dry Tortugas reefs appear to be declining at a greater rate than the Keys. The recent addition of monitoring sites in the Dry Tortugas National Park may help define the causes of the decline.

CREMP data shows a continued loss of stony coral species richness in the FKNMS. Since 2002, mean number of stony coral species per site has decreased at patch reef, shallow reef and deep reef habitats while hardbottom habitats showed an increase in mean number of species per site. Between 1996 and 1999, the number of stations with diseased coral exhibited an increasing trend. However, since 2002 the number of stations with diseased coral has decreased. CREMP data indicates that at the 18 VAS stations, only 12% of the coral colonies marked as diseased in 2002 and 2003 experienced total mortality by 2004. 88% of the coral colonies marked as diseased in 2002 and 2003 only experienced partial tissue loss, no change in tissue, or an increase in tissue. In addition, Torres (2004) calculated the net coral tissue loss caused by disease to be only $0.4m^2$ between 2002 and 2003. This data indicates that coral diseases are not having a major impact on the declines of percent coral cover seen at CREMP sites (Torres, 2004).

Results from the bio-eroding sponge survey show distinct trends between habitat types as well as between regions. Monitoring stations in the Upper Keys have much lower clionid area than the stations in the Middle or Lower Keys. Within the habitats, the patch reef stations generally contain the highest mean clionid area. Clionid area also exhibits a distinct pattern within the regions patch reef stations. The Lower Keys patch reefs contain the majority of clionid area compared to the Middle and Upper Keys. The difference can possibly be attributed to levels of nutrients in waters surrounding Lower Keys patch reefs (Callahan, 2005).

Coral reefs in Florida and the wider Caribbean face a number of stressors including coral bleaching, disease, water pollution, physical impacts (such as groundings), and others. Reef related tourism is responsible for considerable economic benefits to coastal communities, but the associated increase in population and demand on resources often increases stress on the reefs through increased sedimentation, nutrient pollution, and over-use of reef resources. Water quality has markedly deteriorated in the Keys over the last 30 years. Changes of water flow patterns in Florida Bay (due to the causeways connecting the islands to the mainland), increases in sedimentation (from recreational boat traffic, dredging, historical infilling, and wetland removal), and of nearshore nutrient concentrations (from local wastewaters, and fertilizers from the agricultural fields of southern Florida), plus industrial pollutants from Miami, have probably all contributed to the decline in water quality (Lang et al., 1998). Although recent analysis of water quality data for the waters of the Florida Keys and Florida Bay has defined several sources of pollution (Wilkinson et al, 2004), much work remains to be done to stem the flow of pollutants to the reefs. Florida's reefs are still affected by run-off from the Everglades via Florida Bay and from the Keys themselves (Boyer and Jones, 2002).

Currently efforts are underway to address water quality issues at the local and regional level. The National Pollution Discharge Elimination System (NPDES) is a federal program designed to eliminate point source and storm water discharges to receiving waters. Mandated in the federal Clean Water Act, the NPDES permit program controls water pollution by regulating point sources that discharge pollutants into waters of the State. The program has been effective in requiring many private small wastewater package plants to eliminate raw sewage discharges (Andrews et al, 2004).

Additional efforts are being made to respond to specific stressors facing Florida's coral reefs. The scientists and managers from FKNMS, Mote Marine Laboratory, FWRI, FDEP, University of Miami and others recently held a workshop to develop a mass coral bleaching impact assessment protocol that will permit an effective and coordinated response by research and management officials in case of a mass bleaching event in the sanctuary. Additionally, scientists and managers from FWRI, FDEP, The National Coral Reef Institute and FKNMS have joined forces with The Nature Conservancy and the Great Barrier Reef Marine Park Authority in the Florida Reef Resilience Program. The program has the long-term goals of identifying specific high and low risk reef areas and defining localized vs. regional/global influences on reef community structure.

In response to continued declines in the condition of coral reef ecosystems world-wide, the US Coral Reef Task Force, Global Coral Reef Monitoring Network, Pew Commission on Ocean Policy, and the International Coral Reef Initiative have all called for increased coral reef monitoring. The data reported herein documents similar declines in species richness and stony coral cover in the Florida Keys and Dry Tortugas. Protection of this valuable cultural, economic and ecological resource will require wise management decisions supported by the best available information on the status and trends of the resource. This information can only be provided by a spatially expansive, statistically rigorous, scientific monitoring program such as the CREMP.

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