Southeast Florida Coral Reef Evaluation and Monitoring Project
2006 Year 4 Final Report
June 2007

A report of the

Florida Fish and Wildlife Conservation Commission, Fish & Wildlife Research Institute and the National Coral Reef Institute, Nova Southeastern University Oceanographic Center pursuant to FDEP contract number # G0099

for

Florida Department of Environmental Protection
Office of Coastal & Aquatic Managed Areas
Coral Reef Conservation Program
1277 N.E. 79th Street Causeway
Miami, FL 33138

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INTRODUCTION

The coral reef ecosystem in Florida extends beyond the Florida Keys northward through Miami-Dade, Broward, and Palm Beach counties and into Martin County; however, until recently, the primary focus for coral reef research and long-term monitoring has long been limited to the Florida Keys and Dry Tortugas in Monroe County. Coral reef monitoring efforts in the Keys grew with the establishment of the Florida Keys National Marine Sanctuary (FKNMS). Since 1996, the Coral Reef Evaluation and Monitoring Project (CREMP) has documented changes in reef resources throughout the Florida reef tract from Key West to Carysfort. In 1999, the project was expanded to include 3 sites in the Dry Tortugas.

In 2003, CREMP was further expanded to include 10 sites offshore southeast Florida in Miami-Dade, Broward, and Palm Beach counties. The Project was expanded again in 2006 with the establishment of 3 sites in Martin County. This CREMP expansion, named the Southeast Florida Coral Reef Evaluation and Monitoring Project (SECREMP), will assist in filling gaps in coverage of knowledge and monitoring of coral reef ecosystems nationwide and complement the goals of the National Monitoring Network to monitor a minimum suite of parameters at sites in the network. In addition, these efforts will assist the National Monitoring Network in building its capacity to archive biotic attributes of coral reef ecosystems nationwide. Four years (2003, 2004, 2005, and 2006) of SECREMP sampling have been completed.

The southeast Florida reef system extends north of the Florida Keys reef tract, approximately 170 km from Miami-Dade into Martin County. From Cape Florida (Miami-Dade County), north to central Palm Beach County, in particular offshore Broward County, the southeast Florida reef system is described as having linear reef complexes (referred to as reefs, tracts or terraces) running parallel to shore (Moyer et al. 2003; Banks et al. In press; Walker et al. In Press) (Figure 1). Inshore of the reef complex, there are nearshore hardbottom ridges and colonized pavements. The Inner Reef (also referred to as the “First Reef”) crests in 3 to 7 m depths. The Middle Reef (“Second Reef”) crests in 6 to 8 m. A large sand area separates the Outer and Middle Reef complexes. The Outer Reef (“Third Reef”) crests in 15 to 21 m depths. The Outer Reef is the most continuous reef complex, extending from Cape Florida to northern Palm Beach County.

Most previous monitoring efforts (Dodge et al. 1995; Gilliam et al. 2005) along the southeast coast originated as impact and mitigation studies from adverse environmental impacts to specific sites (dredge impacts, ship groundings, pipeline and cable deployments, and beach renourishment). Monitoring efforts that are part of marine construction activities are generally of limited duration (1–3 years) and focus on monitoring for project effects to the specific reference areas.

Beginning in 1997, in response to beach renourishment efforts in Broward County, annual collection of environmental data (sedimentation quantities and rates and limited temperature

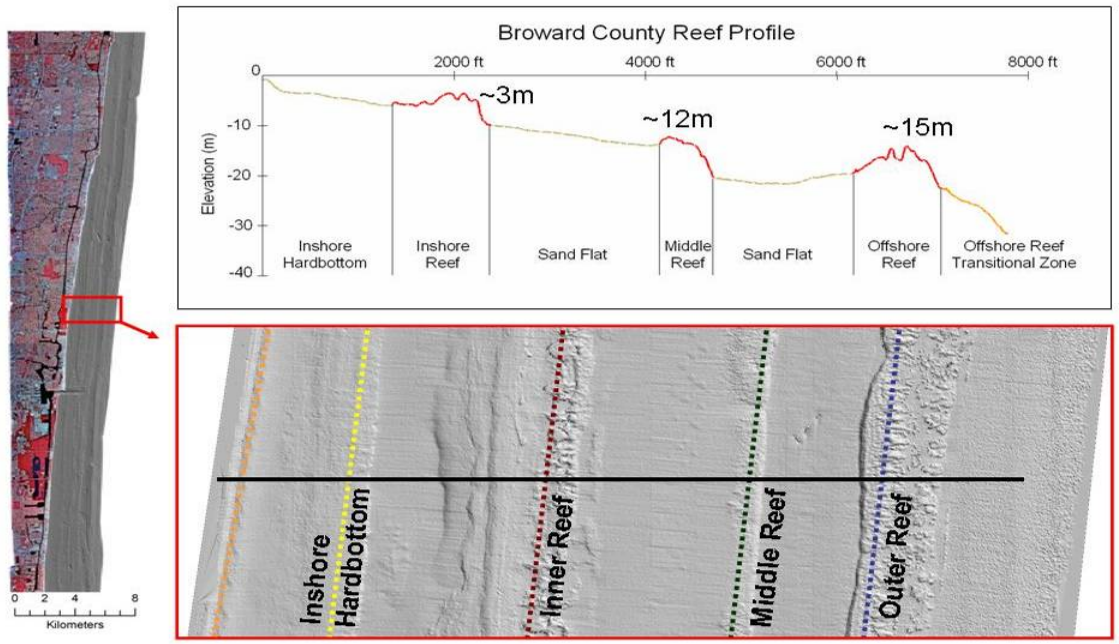

Figure 1. *Panel A (at left): View of the southeast Florida coastline of Broward County, showing the land area in red and offshore reef tracts in gray. Panel B (bottom right): The sea floor shown is bathymetry from LIDAR data. The red square is enlarged in Panel B, showing the LIDAR bathymetry in greater detail. The black line shows the location of a bathymetric profile illustrated in Panel C (top right).*

measurements), and coral, sponge, and fish abundance/cover data has been conducted at 18 sites. In 2000, Nova Southeastern University (NSU) assumed this monitoring responsibility from the County. During that year, five new sites were added. In 2003, two additional sites were added. Monitoring of these 25 sites is ongoing and is scheduled to continue through 2009 (Gilliam et al. 2005).

Previous monitoring of reef habitats off Miami-Dade and Palm Beach Counties has been short term and localized, and of little use in evaluating the overall health and condition of the northern extension of the Florida reef tract. Estimates of functional group (stony coral, octocoral, sponge, macroalgae, etc.) cover are available from some local areas such as those in Broward County, but to a large extent, cover throughout the southeast Florida reefs is poorly defined. Because the area has few long-term data sets on abundance and/or cover for benthic components, it is difficult to provide scientifically valid information on status and trends for this system.

In 2003, the Florida Department of Environmental Protection (FDEP) proposed and was awarded funding for inception of coral reef monitoring along the southeast Florida coast. To ensure that this monitoring is of the highest scientific quality, and consistent with National Monitoring Network protocols, the FDEP contracted this work *en toto* to the Florida Fish and Wildlife Conservation Commission's Fish and Wildlife Research Institute (FWC-FWRI). The Coral Reef Research Group at FWC-FWRI has a long history of monitoring reefs in the FKNMS. Their on-going FKNMS Coral Reef Evaluation & Monitoring Project (CREMP) dates back to 1996 and has included parameters (e.g., depth, habitat delineation, and/or percent live/dead cover of corals,

submerged aquatic vegetation, macroalgae, sponges) for benthic habitat characterization since its inception.

Project Planning

Planning for Year 1 fieldwork began in early 2003. Year 1 fieldwork included locating, installing, and monitoring sites in Miami-Dade, Broward, and Palm Beach Counties. Principal investigators from FWRI supplied to, and discussed with researchers from the National Coral Reef Institute (NCRI) the CREMP Standard Operating Procedures for site selection and installation. Representatives from Miami-Dade County Department of Environmental Resource Management (DERM), Broward County of Environmental Protection Department (EPD), and Palm Beach County Environmental Resource Management (ERM) were kept informed on the progress of the project and invited to participate in site selection and sampling. On 16 June 2003, a workshop was held at Nova Southeastern University Oceanographic Center to discuss the purpose, background, and methods of CREMP and SECREMP. Participants included personnel from NCRI, FWRI (St. Petersburg and Tequesta), EPD, DERM, and ERM.

During Year 1 (2003) of the project, NCRI worked closely with FWRI on site selection, methods training, and site sampling. NCRI was responsible for communicating with FWRI and FDEP and for managing and completing the sampling efforts for Years 2 (2004) through 4 (2006). Planning for all years began in January. Prior to sampling, FWRI and FDEP were notified of the proposed sampling dates and invited to participate.

In 2004, discussions were initiated to expand SECREMP into Martin County, offshore the St. Lucie Inlet Preserve State Park (http://www.floridastateparks.org/stlucieinlet/default.cfm). In addition to expanding upon the overall SECREMP goal of providing reef monitoring data for the southeast Florida reef system, expanding SECREMP to include sites offshore the St. Lucie Inlet Preserve State Park will provide coral community monitoring data in this area as the St. Lucie River water discharge changes occur associated with Everglades restoration efforts. Researchers and managers from NCRI, FWC-FWRI, FWC, FDEP, and the Park system were involved in all discussions.

Monitoring Site Selection and Sampling

Initially (2003), three sites were proposed to be installed and sampled in each of three southeast Florida counties (Miami-Dade, Broward, and Palm Beach). For Miami-Dade and Broward Counties one site was to be selected on each of the three reef tracts from nearshore to offshore. Because Palm Beach does not have three separate reef tracts, one site was selected on a nearshore hardbottom patch and two sites were selected on the offshore reef tract. Additionally, because of the unique *Acropora cervicornis* patches located off Broward County, a fourth site was added to the project to monitor one of these patches. These initial 10 sites (Figure 2) include four standard CREMP stations. In 2003, during the initial SECREMP site selection process, personnel from NCRI, FWC-FWRI, and each of the Counties were present. Each county assisted by providing vessel support. Industrial Divers Corporation (IDC) of Fort Lauderdale, FL was subcontracted to install the reference stakes.

In 2005, site selection efforts began in Martin County. Researchers and managers from NCRI, FWC-FWRI, FWC, FDEP CAMA, and the Park system met several times in 2005 with the purpose of selecting sites, but each time, conditions (rough seas or very poor water visibly) did not permit fieldwork. Martin County site selection was completed in February 2006. Three sites (sites MC1, MC2, and MC3) were selected within the offshore boundaries of the St. Lucie Inlet Preserve State Park (Figure 2). Researchers and managers from NCRI, FWC-FWRI, FWC, FDEP, and the Park system were present during site selection. The total number of SECREMP sites, beginning with the Year 4 event (2006), is currently 13.

Project Year 1 sampling was conducted between 17 June and 20 August 2003. Project Year 2 sampling was conducted between 3 June and 22 July 2004, and Year 3 sampling was conducted between 27 May and 10 August 2005. Table 1 provides depths and locations of each of the SECREMP sites, and Table 2 provides the Year 1, Year 2, and Year 3 work dates including the date sampling was completed at each site.

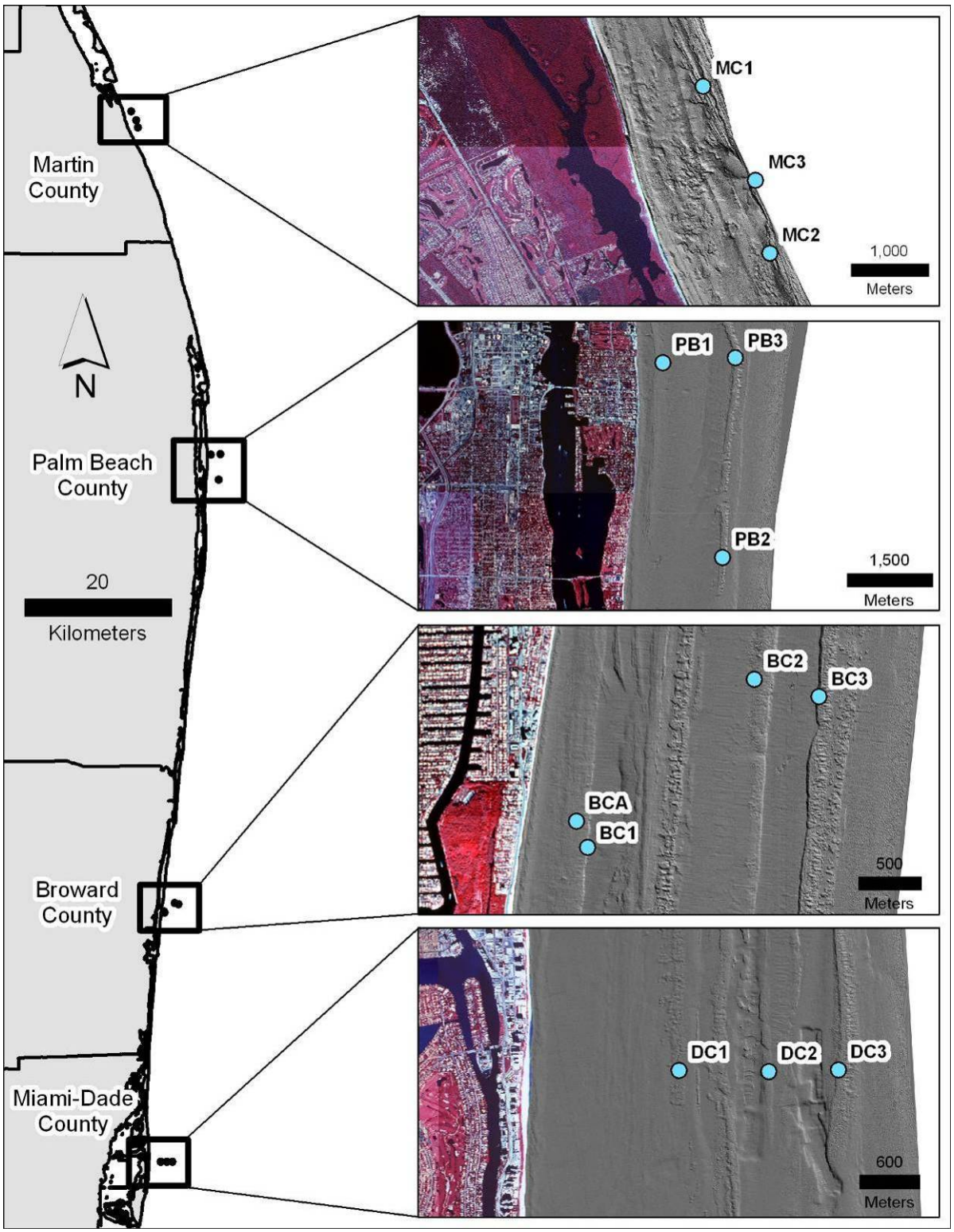

Figure 2. Map of the 13 SECREMP sites illustrating their location off Miami-Dade, Broward, Palm Beach, and Martin Counties.

Table 1. Location and depth for the 13 SECREMP monitoring sites (BC = Broward County; DC = Miami-Dade County; PB = Palm Beach County; MC = Martin County).

Site Code	Depth (ft)	Latitude (N)	Longitude (W)
BCA	25	26° 08.985’	80° 05.810’
BC1	25	26° 08.872’	80° 05.758’
BC2	40	26° 09.597’	80° 04.950’
BC3	55	26° 09.518’	80° 04.641’
DC1	25	25° 50.530’	80° 06.242’
DC2	45	25° 50.520’	80° 05.704’
DC3	55	25° 50.526’	80° 05.286’
PB1	25	26° 42.583’	80° 01.714’
PB2	55	26° 40.710’	80° 01.095’
PB3	55	26° 42.626’	80° 00.949’
MC1	15	27° 07.900’	80° 08.042’
MC2	15	27° 06.722’	80° 07.525’
MC3	15	27° 07.236’	80° 07.633’

Table 2. Site selection and sample dates (BC = Broward County; DC = Miami-Dade County; PB = Palm Beach County; MC = Martin County).

Site Code	Date Selected	Yr 1 Date Sampled	Yr 2 Date Sampled	Yr 3 Date Sampled	Yr 4 Date Sampled
BCA	5-06-2003	6-19-2003	6-11-2004	6-08-2005	6-16-2006
				6-30-2005	
BC1	5-06-2003	6-17-2003	6-14-2004	5-27-2005	6-16-2006
BC2	5-12-2003	6-18-2003	6-03-2004	6-30-2005	6-18-2006
BC3	5-06-2003	6-18-2003	6-09-2004	6-08-2005	6-27-2006
DC1	5-16-2003	6-24-2003	6-15-2004	7-15-2005	7-07-2006
				8-10-2005	8-04-2006
DC2	5-16-2003	6-24-2003	6-15-2004	7-15-2005	8-04-2006
DC3	4-30-2003	6-23-2003	6-04-2004	8-10-2005	7-07-2006
PB1	5-05-2003	8-20-2003	7-21-2004	7-29-2005	6-21-2006
PB2	5-05-2003	8-18-2003	7-21-2004	7-28-2005	6-21-2006
PB3	5-05-2003	8-19-2003	7-22-2004	7-27-2005	6-22-2006
MC1	2-22-2006	NA	NA	NA	5-31-2006
MC2	2-22-2006	NA	NA	NA	5-31-2006
MC3	2-23-2006	NA	NA	NA	9-28-2006

METHODS

Twelve of the 13 SECREMP monitoring sites consist of four monitoring stations delineated by permanent stainless steel markers (the thirteenth site, MC3, is described below). Stations are approximately 2 x 22 meters. The SECREMP stations have a north-south orientation, which is generally parallel to the reef tracts of southeast Florida. Within each station, field sampling consists of a station species inventory (SSI), three video transects (100, 300, and 500), and a bio-eroding sponge survey (Figure 3). The SECREMP sampling protocols generally follow standard CREMP sampling protocols.

Video Transects

Video was selected as the method for cover evaluation because it is a rapid and efficient means of field data collection that provides a permanent data record. Percent cover of live stony coral, sessile benthic biota, and selected substrates are determined annually from video transects filmed at each station. The videographer films a clapperboard prior to filming each transect. This provides a complete record of date and location of each segment recorded. Three video transects are filmed at a constant distance (40cm) above the substrate at each station.

Two lasers converge 40 cm from the camera lens and guide the videographer in maintaining the camera at a uniform distance above the reef surface. Filming is conducted perpendicular to the substrate at a constant swim speed of about 4 meters per minute.

All transects are filmed with a SONY TRV 900 digital video camcorder. The minimum number of digital images necessary to represent each station are framegrabbed and then written to, and archived on, CD-ROM.

Analysis of benthic cover images is predicated on selecting video frames that abut, with minimal overlap between images. At a filming distance of 40 cm above the reef surface, the field of view is approximately 40 cm wide. A set of abutting images that best covers the station is grabbed directly from the video tape.

The image analyses are conducted using a custom software application, PointCount ‘99, for coral reefs. The software places ten random points on each image. Under each point, selected benthic taxa (stony coral species, octocoral, zoanthid, sponge, seagrass, and macroalgae) and substrate are identified. The software has a “point and click” feature that feeds the identification data into a backend spreadsheet. After all images are analyzed, the data are converted to an ASCII file for Quality Assurance and entry into a master ACCESS data set.

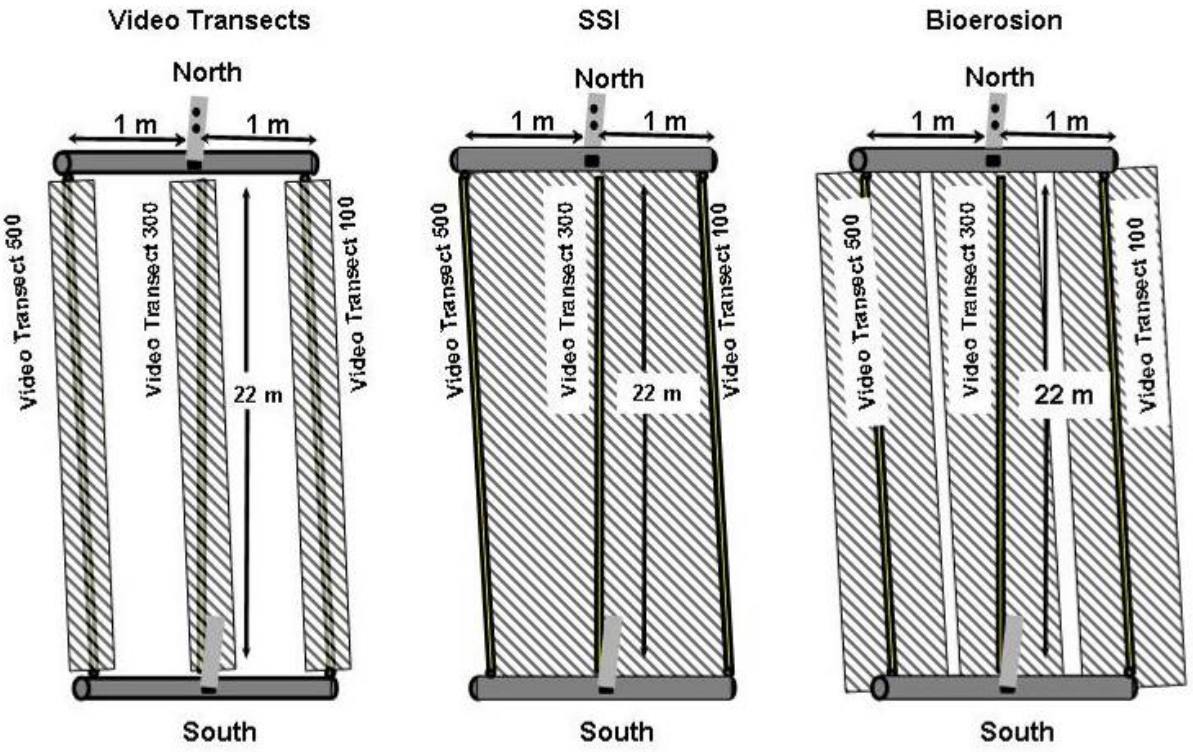

Figure 3. Typical layout of each SECREMP station showing the areas (hatch areas) within which the video, station species inventory (SSI), and bioerosion data are collected.

Standard video protocol is modified slightly for site BCA (Broward County nearshore *A. cervicornis* patch), and the Palm Beach County sites. Standard protocol calls for a plastic chain to be laid across the substrate to delineate the transect, and act as a guide for the videographer. At site BCA, extensions are added to the transect end stakes in order to raise transect lines above the coral. Fiberglass tapes are used to delineate the transects and guide the videographer instead of chains. All transect videos are taken on the east side of the transect tapes. These modifications reduce the potential for damage to the *A. cervicornis* colonies during sampling.

Off Palm Beach County, there is generally a strong north-flowing current present at offshore sites (PB2 and PB3). This current adds safety risk and greatly increases the effort required to complete the sampling. In order to reduce risk, fiberglass tapes are used in lieu of chains to mark transects and guide the videographer. Transect videos at all Palm Beach County sites are taken on the east side of the transect tapes. Additionally, all transects are videotaped with the diver swimming into the current to slow the divers speed (all stations in Miami-Dade and Broward Counties are sampled north-south).

Station Species Inventory (SSI)

Stony coral species (Milleporina and Scleractinia) presence is recorded at each station. Two observers conduct simultaneous, timed (15 minute) inventories within the SSI area and enter the data on underwater data sheets. Each observer records all stony coral taxa and enumerates long-

spined urchins (*Diadema antillarum*) within the station boundaries. During the species inventory, any species within a station that exhibits specific signs of either bleaching or disease is documented on the data sheet. Diseases are sorted into three categories: black band, white complex (including white plague, white band, white pox), and other (dark spot, yellow band, and idiopathic diseases). After conducting the survey, the observers compare data (5 minutes) underwater and each confirms the species recorded by each observer. Data sheets are verified aboard the vessel and entered into the database. All data and data sheets are then forwarded to Fish & Wildlife Research Institute for quality assurance checks. This method facilitates robust data collection with broad spatial coverage at optimal expenditure of time and labor.

Bio-eroding Sponge Survey

Three clionid sponge species (*Cliona delitrix*, *C. lampa*, and *C. caribbaea*) recorded by CREMP are known to be aggressive coral bio-eroders and over-growers. Three 1 meter wide belt transects provide the maximum spatial coverage within each station. A 22-meter survey tape marks the center of reference for each transect. A diver delineates the survey area by swimming directly above the tape holding a meter stick perpendicular to the tape and parallel to the reef surface. The location, species, and size of each clionid sponge colony and species of stony coral affected by the clionid colony is recorded. Area is measured by means of a 40 cm^2 quadrat frame subdivided into 5 cm squares. The area occupied by the clionid colony is recorded to the nearest half square.

Site MC3 Stony Coral Colony Condition

Limited appropriate reef area within the Martin County sampling area did not permit the establishment of 3 standard SECREMP sites. After discussions with project colleagues from FDEP and FWRI, it was decided that a third site (MC3) would be established but this site will be used to fate track a representative sample of stony coral colonies. Stony coral cover and density is low in this area which limits the ability of the standard SECREMP sampling protocol to track changes in the stony coral assemblage. Five stakes were deployed in a reef area near MC1 and MC2. These stakes mark the center point from which stony coral colonies were identified and recorded. The distance and bearing from these center stakes to the colonies was recorded. These measurements will permit the same colony to be located and sampled each year. Total colony size (length and width) and colony condition (presence of bleaching, disease, etc.) were recorded *in situ*. In addition to the *in situ* measurements, a digital image was taken of each colony. The images were taken with a digital camera attached to a PVC framer (0.38m^2). Date and colony tag numbers were included within each image. The framer allows all images from each monitoring event to be a consistent planar view of the colony. These consistent planar view images permit changes in tissue area between monitoring events to be measured. National Coral Reef Institute (NCRI) developed software (Coral Point Count with Excel Extensions, CPCe, http://www.nova.edu/ocean/cpce/index.html) (Kohler and Gill, 2006) will be used to trace the tissue area (cm^2) in each colony planar image. The software automatically calculates the area (cm^2) encompassed by the traced portion of the image (Figure 4). If dead areas were present within the living area of a colony, these dead areas were also traced; the dead area subtracted from the previously traced living tissue area provides a more accurate measure of the living tissue area.

Figure 4. Example of a site MC3 mapped colony, *Diploria clivosa*, Tag # 24, with the live tissue area traced and area (721 cm^2) determined using NCRI CPCe.

YEAR 4 (2006) RESULTS

Stony Coral Species Richness

Stony coral species richness was summarized from SSI data. In 2006, a total of 29 stony coral species were identified within the 12 standard SECREMP sites (Table 3). The mean number of species identified per site was 8.6. Seven species were identified in all 4 counties (*Dichocoenia stokesii*, *Diploria clivosa*, *Millepora alcicornis*, *Montastraea cavernosa*, *Porites astreoides*, *Siderastrea siderea*, and *Solenastrea bournoni*), and 12 species were identified in Miami-Dade, Broward, and Palm Beach counties. One species was identified in all site stations (48 total stations) (*Siderastrea siderea*), and 4 species were identified in 47 stations (*Dichocoenia stokesii*, *Millepora alcicornis*, *Porites astreoides*, and *Solenastrea bournoni*). Broward County had the most species identified (24) followed by Miami-Dade County (21), Palm Beach County (17), and then Martin County (10). Figure 5 shows the number of species identified for each site 2003-2006. Only one species, *Scolymia lacera*, identified in previous years (2003, 2004, and 2005) was not identified in 2006. *S. lacera* can be difficult to distinguish from *S. cubensis*, and it is possible that a colony identified as *S. lacera* in previous years may have been identified as *S. cubensis* in 2006. No new species were identified in Broward, Miami-Dade, or Palm Beach Counties, but with the addition of the Martin County sites, one new species was added to the SECREMP list, *Isophyllia sinuosa.*

Miami-Dade County had a mean 11.2 stony coral species per station (n=12 stations), Broward County had 8.8 species per station (n=14 stations), Palm Beach had 6.8 species per station (n-12 stations), and Martin County had 5.8 species per station (n=8 stations). Counts at Broward County sites were slightly skewed by site BCA, which is dominated by *Acropora cervicornis*. Without site BCA, Broward County had a greater mean number (10.0) of species per station.

Table 3. Stony coral species presence/absence for the 12 standard SECREMP sites in Broward, Miami-Dade, Palm Beach, and Martin Counties for 2006. Key: A, 1, 2, 3 = species present at sites; 0 = species absent.

Species List	Broward	Miami-Dade	Palm Beach	Martin
Acropora cervicornis	A	1	0	0
Agaricia agaricites	1	1,2	2,3	0
Agaricia fragilis	1,2	2	0	0
Agaricia lamarki	2,3	0	0	0
Cladocora arbuscula	0	0	1	0
Colpophyllia natans	1	1,2	0	0
Dichocoenia stokesii	A,1,2,3	1,2,3	2,3	1,2
Diploria clivosa	A	1	1	1,2
Diploria labyrinthiformis	1	1,3	0	0
Diploria strigosa	0	2	2	0
Eusmilia fastigiata	2	2	2	0
Madracis decactis	1,2	2,3	2,3	0
Isophyllia sinuosa	0	0	0	1,2
Madracis mirabilis	0	0	2	0
Meandrina meandrites	1,2,3	1,2,3	2,3	0
Millepora alcicornis	1,2,3	1,2,3	1,2,3	1,2
Montastrea annularis complex	1,2	1,2	0	0
Montastrea cavernosa	A,1,2,3	1,2,3	1,2,3	1
Mycetophyllia aliciae	0	0	2,3	0
Mycetophyllia lamarckiana	2	0	0	0
Oculina diffusa	1	0	0	1,2
Phyllangia americana	1	0	0	1,2
Porites astreoides	A,1,2,3	1,2,3	1,2,3	1
Porites porites	A,1,2	1,3	0	0
Scolymia cubensis	2,3	3	3	0
Siderastrea radians	2	1	0	0
Siderastrea siderea	A,1,2,3	1,2,3	1,2,3	1,2
Solenastrea bournoni	A,1,2,3	1,2,3	1,2,3	2
Stephanocoenia intersepta	1,2,3	1,2,3	2,3	0

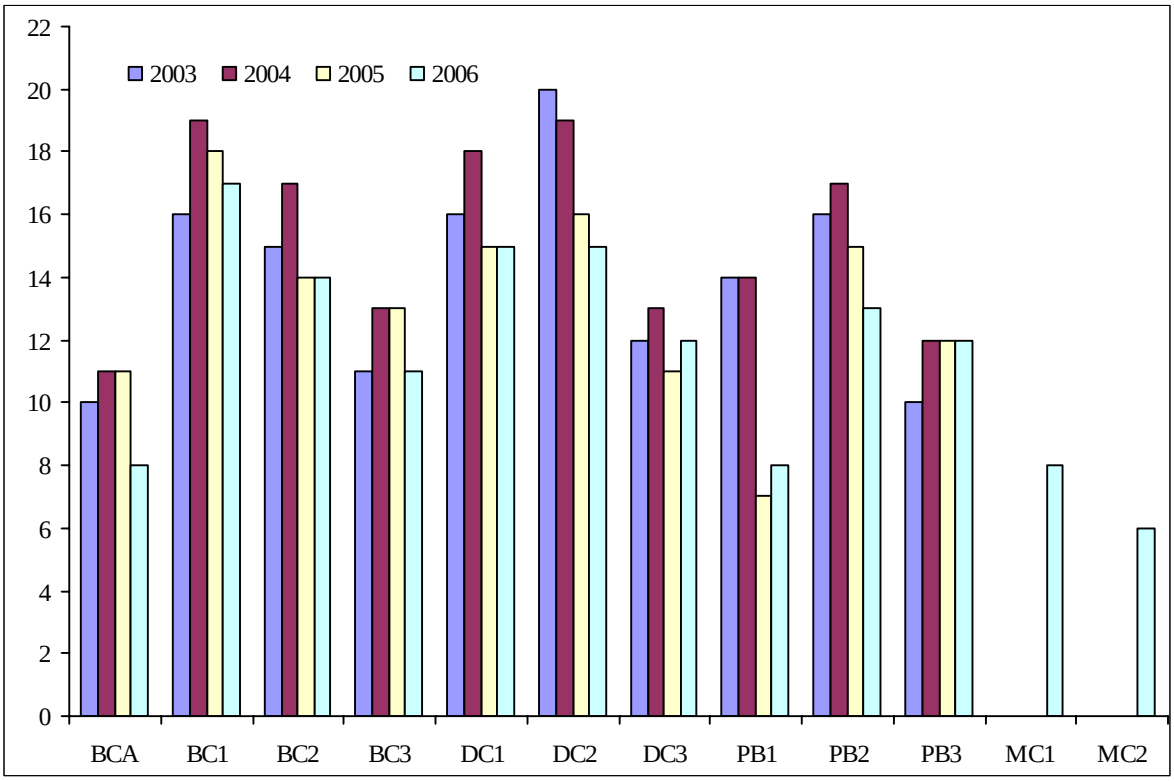

Figure 5. Stony coral species richness for the Broward (BC), Miami-Dade (DC), Palm Beach (PB), and Martin (MC) County sites for 2003, 2004, 2005 and 2006 (n= 3 sites, 12 stations, for Miami-Dade and Palm Beach Counties; n= 4 sites, 16 stations, for Broward County; n = 2 sites, 8 stations for Martin County).

Stony Coral Condition

In addition to recording stony coral species presence, the SSI protocol also includes an assessment of stony coral condition, the presence or absence of bleaching and diseases. Disease categories included black band, white complex (white plague, white band, white pox), and "other" (dark spot, yellow band, and idiopathic diseases). Starting in 2004, images were taken of most diseased colonies in order to track the fate of these colonies.

Partially bleached colonies (no completely bleached colonies were observed) were observed more frequently (more sites with bleaching) than diseased colonies (Table 4). Bleaching was recorded at all sites except PB1 and PB2 with BC1, BC2, BCA, DC1, and DC2 having the greatest incidence of bleaching (all 4 stations). In 2006, diseased colonies were identified at 6 sites (BCA, BC1, BC2, BC3, DC1, and DC2). "Other" diseases were seen at four sites (BC2, BC3, DC1, and DC2), while "white complex" diseases were identified at six sites (BC1, BC2, BC3, BCA, DC1, and DC2) (Tables 4 and 5). Table 4 compares stony coral species with the presence of disease and partial bleaching at each of the sites in 2003, 2004, 2005, and 2006. Quantitative data (number of diseased colonies) was not collected in 2003. Bleaching data is qualitative only (presence/absence) for each station. Disease (probably white band) and bleaching was present within site BCA, *A. cervicornis* thicket, however, due to the "thicket" growth form of *A. cervicornis* it is not possible to quantify the number of affected colonies

within a station. Most of the "Other" diseased colonies were *Siderastrea siderea* with Dark Spot. One *S. bournoni* colony in site DC2 was identified with what appeared to be Dark Spot (Other category). Table 5 lists the number of colonies of each stony coral species that displayed symptoms of disease at each site and station in 2004, 2005 and 2006.

Beginning in 2004, diseased colonies were mapped at each station and images were taken of most diseased colonies. This permits the condition of these colonies to be tracked over time. During each sampling event, mapped colonies from the previous year were located, and if the colonies remained diseased new images were taken. In 2006, the colonies mapped in 2005 were re-assessed for disease. New colonies identified with disease were also mapped in 2006. Table 6 summarizes the condition of the 2005 diseased colonies in 2006, and Table 7 lists the new diseased colonies mapped in 2006. Of the 21 diseased colonies identified in 2005, only 4 were still identified with disease in 2006. All 4 colonies were in site BC2 and were *S. siderea* colonies; 2 colonies were categorized with "other" disease (dark spot) and 2 with "white complex".

In 2006, 18 diseased colonies were mapped and images were taken of most colonies. Fourteen of these colonies were not categorized as diseased in 2005. In 2006, 5 sites had identified diseased colonies compared to 6 sites in 2005. Similar to 2005, most of the diseased colonies were *S. siderea* (14 of the 18 colonies). Ten of these *S. siderea* diseased colonies were categorized with "other" (Dark Spot). Four of the 14 *S. siderea* colonies were categorized with "white complex" disease.

Sea Urchin (*Diadema antillarum)* Abundance

Diadema antillarum sea urchin abundance was recorded for each station during the SSI sampling. No *Diadema* were seen at any of the 10 sites in 2003. In 2004, a total of 6 individuals were counted within 4 sites; in 2005, the total sites with *Diadema* increased to 6 and the total individuals increased to 15. Although the distribution changed, in 2006, within the original 10 sites, the total number of *Diadema* stayed at 15, and were identified in 6 sites (Table 8). It appears that *Diadema* may be more abundant in the Martin County sites. Seven *Diadema* were identified in MC1 and 2 were identified in MC2.

Table 4. Stony coral species within each site with the presence of disease or partial bleaching (A = absence of bleaching or disease; H = bleaching, O = other disease, W = white complex disease) (Disease and bleaching were not recorded in 2003 and 2004 for site BCA).

Site	Species	2003	2004	2005	2006
DC1	*A. cervicornis*	A	A	A	W
DC1	*A. agaricites*	A	A	A	H
DC1	*D. stokesii*	A	W	A	A
DC1	*M. meandrites*	A	A	H	H
DC1	*M. annularis*	A	O	A	A
DC1	*M. cavernosa*	A	A	W	A
DC1	*P. astreoides*	H	H	H	H
DC1	*P. porites*	A	A	H	H
DC1	*S. siderea*	O	H, O	H, O, W	H, O
DC1	*S. bournoni*	A	A	A	W
DC2	*A. agaricites*	A	A	A	H
DC2	*E. fastigiata*	A	A	A	H
DC2	*M. annularis*	O	A	A	A
DC2	*M. cavernosa*	A	A	H	A
DC2	*P. astreoides*	A	A	A	H
DC2	*S. bournoni*	A	H	H	O, W
DC2	*S. intersepta*	A	A	H	H, W
DC2	*S. siderea*	A	A	H	H, O, W
DC3	*M. annularis*	A	H	A	A
DC3	*S. bournoni*	A	A	H	H
DC3	*St. intersepta*	A	H	H	A
BC1	*D. stokesii*	A	A	H	H, W
BC1	*M. annularis*	A	A	A	H
BC1	*M. cavernosa*	O	H	A	H, W
BC1	*P. astreoides*	H	A	A	A
BC1	*S. siderea*	H	H,O	O, W	H
BC1	*S. intersepta*	A	A	A	H
BC2	*D. stokesii*	A	H	A	H
BC2	*M. meandrites*	A	H	A	A
BC2	*M. cavernosa*	A	H	A	A
BC2	*P. astreoides*	A	H	H	A
BC2	*S. radians*	A	A	A	H, W
BC2	*S. siderea*	H	H, O	H, W	H, O, W
BC2	*S. bournoni*	W	A	A	A
BC2	*S. intersepta*	A	H	A	A
BC3	*A. fragilis*	A	A	H	
BC3	*D. stokesii*	H	A	A	
BC3	*M. meandrites*	A	H	A	H
BC3	*M. cavernosa*	A	A	H	
BC3	*S. siderea*	H	H	H, O, W	H, O, W
BC3	*S. intersepta*	A	A	A	H
BCA	*A. cervicornis*	NA	NA	H, W	H, W

Table 4. Continued.

Site	Species	2003	2004	2005	2006
PB1	*D. clivosa*	A	H	A	A
PB1	*M. meandrites*	H	A	A	A
PB1	*O. diffusa*	H	A	A	A
PB1	*S. bournoni*	H, O, W	H	A	A
PB1	*S. radians*	H	H	H	A
PB1	*S. siderea*	A	O	A	A
PB2	*D. strigosa*	A	A	O	A
PB2	*M. meandrites*	A	H	A	H
PB2	*M. cavernosa*	A	H	H	H
PB2	*P. astreoides*	A	H	H	A
PB2	*S. michelinii*	A	H	A	A
PB2	*S. radians*	A	H	A	A
PB2	*S. siderea*	A	H	H, W	A
PB3	*D. stokesii*	A	H	A	A
PB3	*M. cavernosa*	A	A	H	A
MC1	*D. clivosa*	NA	NA	NA	H
MC1	*M. cavernosa*	NA	NA	NA	H
MC1	*S. siderea*	NA	NA	NA	H
MC2	*D. clivosa*	NA	NA	NA	H
MC2	*O. diffusa*	NA	NA	NA	H
MC2	*S. siderea*	NA	NA	NA	H

Table 5. List of all sites and stations with diseased stony corals and the stony coral species affected (O = other disease, W = white complex disease; only presence, P, is noted for site BCA).

		Species	2004		2005		2006	
Site	**Station**	**Affected**	**No. Colonies**	**Condition**	**No. Colonies**	**Condition**	**No. Colonies**	**Condition**
DC1	1	*S. siderea*	3	O	0	---	1	O
DC1	1	*M. cavernosa*	0	---	1	O	0	---
DC1	2	*S. siderea*	1	O	2	O	0	---
DC1	3	*S. siderea*	1	O	0	---	0	---
DC1	3	*M. annularis*	1	O	0	---	0	---
DC1	3	*A. cervicornis*	0	---	0	---	P	W
DC1	4	*A. cervicornis*	0	---	P	O	0	---
DC1	4	*S. siderea*	2	O	1	O	0	---
DC1	4	*S. bournoni*	0	---	0	---	1	W
DC1	4	*D. stokesii*	1	W	0	---	0	---
DC2	1	None	0	---	0	---	0	---
DC2	2	*S. intersepta*	0	---	0	---	1	W
DC2	3	*S. siderea*	0	---	0	---	1	W
DC2	3	*S. bournoni*	0	---	0	---	1	W
DC2	4	None	0	---	0	---	0	---
DC3	1	*S. siderea*	0	---	0	---	1	O
DC3	2	None	0	---	0	---	0	---
DC3	3	None	0	---	0	---	0	---
DC3	4	*S. siderea*	0	---	0	---	1	O
BCA	1,2,3,4	*A. cervicornis*	NA	NA	P	O	P	O
BC1	1	*S. siderea*	1	O	2	O	0	---
BC1	2	*S. siderea*	1	O	2	O	0	---
BC1	3	*S. siderea*	1	O	1	O	0	---
BC1	4	None	0	---	0	---	0	---
BC2	1	*S. siderea*	0	---	1	W	1	O
BC2	2	*S. siderea*	0	---	0	---	1	O
BC2	3	*S. siderea*	1	O	1	W	1	O
BC2	3	*S. siderea*	0	---	0	---	1	O
BC2	3	*S. siderea*	0	---	0	---	1	O
BC2	4	*S. siderea*	0	---	0	---	1	O
BC2	4	*S. siderea*	0	---	2	W	4	W
BC3	1	*S. siderea*	0	---	0	---	1	O
BC3	2	*S. siderea*	0	---	1	O	0	---
BC3	3	None	0	---	0	---	0	---
BC3	4	*S. siderea*	0	---	0	---	1	O
PB1	1	*S. siderea*	2	O	0	---	0	---
PB1	1	*S. bournoni*	1	W	0	---	0	---
PB1	2	None	0	---	0	---	0	---
PB1	3	*S. siderea*	1	O	0	---	0	---
PB1	4	*D. clivosa*	1	O	0	---	0	---

Table 5. Continued

Site	Station	Species Affected	2004 No. Colonies	Condition	2005 No. Colonies	Condition	2006 No. Colonies	Condition
PB2	1	*S. siderea*	0	---	1	W	0	---
PB2	1	*D. strigosa*	0	---	1	O	0	---
PB2	2	None	0	---	0	---	0	---
PB2	3	None	0	---	0	---	0	---
PB2	4	None	0	---	0	---	0	---
PB3	1	None	0	---	0	---	0	---
PB3	2	None	0	---	0	---	0	---
PB3	3	None	0	---	0	---	0	---
PB3	4	None	0	---	0	---	0	---
MC1	1	None	NA	NA	NA	NA	0	---
MC1	2	None	NA	NA	NA	NA	0	---
MC1	3	None	NA	NA	NA	NA	0	---
MC1	4	None	NA	NA	NA	NA	0	---
MC2	1	None	NA	NA	NA	NA	0	---
MC2	2	None	NA	NA	NA	NA	0	---
MC2	3	None	NA	NA	NA	NA	0	---
MC2	4	None	NA	NA	NA	NA	0	---

Table 6. List of all 2005 mapped diseased stony corals and the condition of these colonies in 2006 (O = other disease, W = white complex disease; B = Black band).

Site	Station	Species	2005 Condition	2006 Condition
BC1	1	*S. siderea*	O	Not Diseased
BC1	1	*S. siderea*	O	Not Diseased
BC1	2	*S. siderea*	O	Not Diseased
BC1	2	*S. siderea*	O	Not Diseased
BC1	3	*S. siderea*	O	Not Diseased
BC2	1	*S. siderea*	W	O
BC2	3	*S. siderea*	W	O
BC2	4	*S. siderea*	W	W
BC2	4	*S. siderea*	W	W
BC3	1	*S. siderea*	W	Not Diseased
DC1	1	*M. cavernosa*	B	Not Diseased
DC1	2	*S. siderea*	O	Not Diseased
DC1	2	*S. siderea*	O	Not Diseased
DC1	4	*S. siderea*	O	Not Diseased
DC1	4	*S. siderea*	O	Not Diseased
DC1	4	*A. cervicornis*	W	Not Diseased
PB1	1	*S. siderea*	O	Not Diseased
PB1	1	*S. siderea*	O	Not Diseased
PB1	3	*S. siderea*	O	Not Diseased
PB2	1	*S. siderea*	W	Not Diseased
PB2	1	*D. strigosa*	O	Not Diseased

Table 7. List of new mapped diseased stony corals identified in 2006 (O = other disease, W = white complex disease).

Site	Station	Species	2006 Condition
BC2	2	*S. siderea*	O
BC2	3	*S. siderea*	O
BC2	3	*S. siderea*	O
BC2	4	*S. siderea*	W
BC2	4	*S. siderea*	W
BC2	4	*S. siderea*	O
BC3	1	*S. siderea*	O
BC3	4	*S. siderea*	O
DC1	1	*S. siderea*	O
DC1	3	*A. cervicornis*	W
DC1	4	*S. bournoni*	W
DC2	2	*S. intersepta*	W
DC2	3	*S. bournoni*	W
DC2	1	*S. siderea*	O

Table 8. *Diadema* sea urchin abundance at each of the 12 standard SECREMP sites in 2003, 2004, 2005, and 2006.

Site	2003	2004	2005	2006
BCA	0	0	0	4
BC1	0	2	6	0
BC2	0	1	2	3
BC3	0	2	0	0
DC1	0	0	3	4
DC2	0	1	2	1
DC3	0	0	1	2
PB1	0	0	1	0
PB2	0	0	0	1
PB3	0	0	0	0
MC1	NA	NA	NA	7
MC2	NA	NA	NA	2

Stony Coral Cover

Figures 6 and 7 (sites BCA and BC1) illustrate the mean stony coral coverage for each of the standard SECREMP sites, 2003-2006; and Table 9 lists the mean (±SD) cover for each site. Two sites, PB1 (Figure 6) and BCA (Figure 7), have shown reduced stony coral cover since the start of this monitoring effort in 2003. The loss of stony coral cover within site PB1 is attributable to the movement of sand between the 2004 and 2005 sampling events which covered stations 2 and 4. These 2 stations remained covered in sand in 2006. Site BCA is the only site with significantly reduced cover in 2006 ($p < 0.05$, Kruskal-Wallis ANOVA, multiple comparisons of mean ranks). BCA cover is dominated by *A. cervicornis*, contributing on average 98% of stony coral cover at this site since 2003. In 2006, *A. cervicornis* dropped to 25% from 39% in 2005. None of the remaining 9 sites had significant changes in cover between the sample years (2003-2006).

Table 10 lists the 5 species for each site which contributed most to stony coral cover 2003-2006. The mean (±SD) cover for each species over this 4 year span is presented.

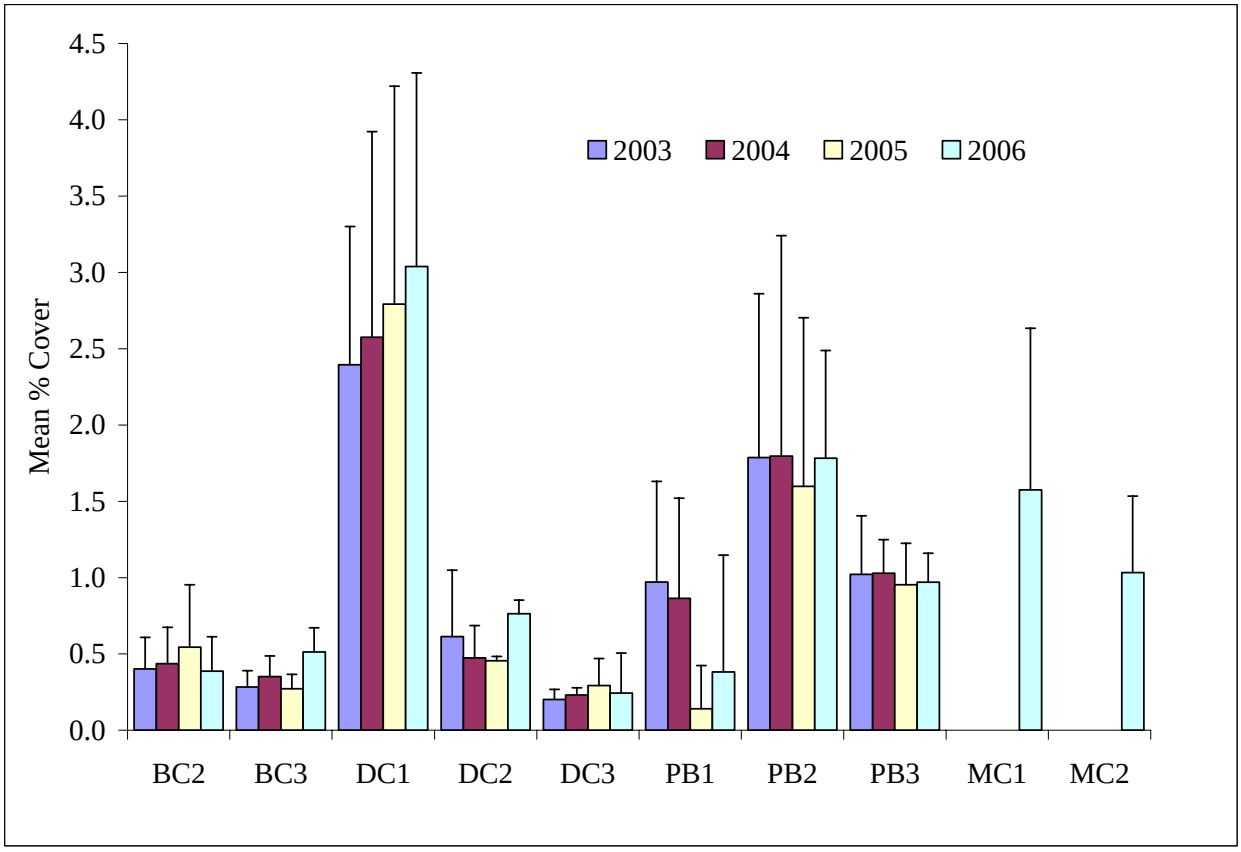

Figure 6. Mean (±SD) percent stony coral cover at 10 SECREMP sites for 2003, 2004, 2005, and 2006. Martin County sites were not sampled prior to 2006.

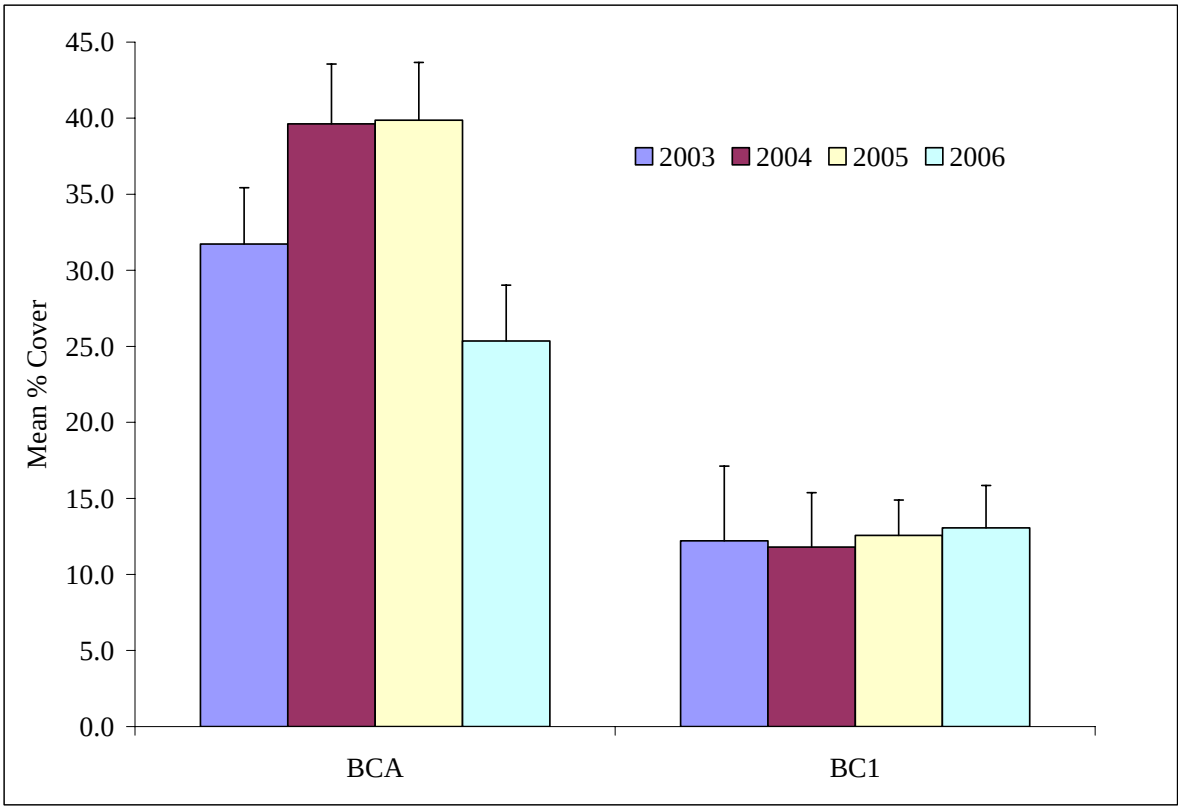

Figure 7. Mean (±SD) percent stony coral cover at BCA and BC1 sites for 2003, 2004, 2005, and 2006.

Table 9. Mean (±SD) stony coral cover for each site from 2003-2006 (n = 4 stations).

	2003		2004		2005		2006	
Site	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
BC1	12.2	3.7	11.8	3.9	12.6	3.8	13.1	3.7
BC2	0.4	0.2	0.4	0.2	0.5	0.4	0.4	0.2
BC3	0.3	0.1	0.4	0.1	0.3	0.1	0.5	0.2
BCA	31.7	4.9	39.6	3.6	39.9	2.3	25.4	2.8
DC1	2.4	0.9	2.6	1.3	2.8	1.4	3.0	1.3
DC2	0.6	0.4	0.5	0.2	0.5	0.0	0.8	0.1
DC3	0.2	0.1	0.2	0.0	0.3	0.2	0.2	0.3
PB1	1.0	0.7	0.9	0.7	0.1	0.3	0.4	0.8
PB2	1.8	1.1	1.8	1.4	1.6	1.1	1.8	0.7
PB3	1.0	0.4	1.0	0.2	1.0	0.3	1.0	0.2
MC1	NA	NA	NA	NA	NA	NA	1.6	1.1
MC2	NA	NA	NA	NA	NA	NA	1.0	0.5

Table 10. The mean (±SD) percent coverage for the 5 species for each site which contributed most to total stony coral cover from 2003-2006 (n = 4 years).

	BCA		**BC1**		**BC2**		**BC3**	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
A. cervicornis	33.61	6.02						
M. cavernosa	0.24	0.04	11.06	0.43	0.04	0.02	0.15	0.04
M. annularis complex			0.59	0.23				
S. siderea			0.27	0.04	0.14	0.05	0.05	0.03
M. meandrites					0.10	0.05	0.03	0.01
P. astreoides	0.12	0.08			0.04	0.02	0.05	0.01
M. alcicornis					0.04	0.03	0.03	0.02
D. clivosa	0.12	0.10						
S. bournoni			0.24	0.07				
D. strigosa	0.04	0.07						
C. natans			0.10	0.12				
	DC1		**DC2**		**DC3**			
	Mean	SD	Mean	SD	Mean	SD		
A. cervicornis	0.21	0.08						
M. cavernosa	1.31	0.16	0.07	0.03	0.09	0.01		
M. annularis complex	0.21	0.12						
S. siderea	0.27	0.07	0.05	0.02				
M. meandrites			0.14	0.04	0.01	0.01		
P. astreoides	0.37	0.08	0.05	0.01				
M. alcicornis			0.10	0.04	0.10	0.01		
S. bournoni					0.02	0.02		
S. intersepta					0.01	0.01		
	PB1		**PB2**		**PB3**			
	Mean	SD	Mean	SD	Mean	SD		
M. cavernosa	0.11	0.11	1.24	0.11	0.44	0.08		
S. siderea			0.06	0.03				
M. meandrites	0.04	0.05	0.21	0.04	0.26	0.08		
P. astreoides			0.03	0.01	0.09	0.03		
M. alcicornis			0.16	0.11	0.14	0.03		
D. clivosa	0.21	0.14						
S. bournoni	0.03	0.03						
D. strigosa	0.12	0.10						
D. stokesii					0.02	0.02		
	MC1		**MC2**					
	Mean	SD	Mean	SD				
S. siderea			0.03	0.00				
P. astreoides	0.06	0.00						
M. alcicornis	0.28	0.00	0.06	0.00				
D. clivosa	0.61	0.00	0.57	0.00				
D. strigosa	0.45	0.00	0.18	0.00				
O. diffusa	0.13	0.00	0.13	0.00				

Functional Group Benthic Cover

Tables 11, 12, 13 and 14 list the mean functional group cover for each site. Functional groups included substrate (rock, rubble, and sediments), stony corals, octocorals, zoanthids, sponges, macroalgae, and 'other biota' (since 2003 this category has included hydroids, cyanobacteria and sabellid worms). Substrate dominated benthic cover at all sites (>50%), ranging from 76% at BC2 (Table 11) to 53% at MC2 (Table 13). Macroalgae was the second most dominant group for 9 of the remaining sites and was generally followed by octocoral.

Sites DC2, PB2, and PB3 had significantly greater coverage of macroalgae in 2006 ($p < 0.05$, Kruskal-Wallis ANOVA, multiple comparisons of mean ranks). Site PB1 had significantly reduced octocoral and sponge cover in 2006 (due to 2 of the 4 stations covered in sand). All sites had reduced octocoral cover in 2006 as compared to 2005, but only two sites, DC3 and PB3, in addition to PB1 had significantly reduced octocoral cover in 2006.

Table 11. Functional group mean percent coverage for the Broward County sites.

Broward	Co.	Substrate	Stony Coral	Octocoral	Macroalgae	Sponges	Zoanthid	Other
BCA	2003	64.96	31.7	2.34	0.03	0.27	0.68	0.0
	2004	55.85	39.6	2.03	0.96	0.47	0.84	0.2
	2005	55.6	39.9	1.54	1.78	0.42	0.78	0.0
	2006	64.95	25.4	1.35	6.75	1.10	0.50	0.0
BC1	2003	77.37	12.2	6.46	0.43	1.84	1.68	0.0
	2004	73.21	11.8	6.41	4.04	1.99	1.4	1.4
	2005	63.97	12.6	6.76	11.89	3.1	1.38	0.3
	2006	66.72	13.1	6.70	8.07	3.62	1.74	0.1
BC2	2003	86.58	0.4	6.63	3.7	2.67	0	0.0
	2004	87.09	0.4	6.89	1.92	3.27	0.14	0.2
	2005	80.39	0.5	9.43	5.41	4.08	0.08	0.1
	2006	76.03	0.4	6.37	12.13	5.05	0.03	0.0
BC3	2003	79.76	0.3	13.54	3.62	2.79	0	0.0
	2004	78.2	0.4	15.99	1.74	3.64	0.03	0.0
	2005	70.52	0.3	17.9	7.01	4.18	0	0.1
	2006	46.46	0.5	14.06	34.64	4.30	0.00	0.0

Table 12. Function group mean percent coverage for the Miami-Dade County sites.

Miami-Dade	Co.	Substrate	Stony Coral	Octocoral	Macroalgae	Sponges	Zoanthid	Other
DC1	2003	72.21	2.4	5.86	13.32	0.85	5.36	0.0
	2004	53.04	2.6	7.31	31.44	1.08	4.57	0.0
	2005	69.1	2.8	7.96	12.8	1.54	5.77	0.0
	2006	71.02	3.0	7.67	10.25	2.09	5.89	0.1
DC2	2003	69.56	0.6	14.67	9.97	5.14	0.03	0.0
	2004	79.5	0.5	11.54	3.26	4.02	0.05	1.2
	2005	78.46	0.5	15.9	1.12	4.03	0.01	0.0
	2006	61.69	0.8	12.15	20.50	4.81	0.01	0.1
DC3	2003	78.48	0.2	15.48	2.25	3.5	0	0.1
	2004	78.2	0.2	12.25	3.92	2.74	0	2.7
	2005	76.72	0.3	15.04	3.2	3.08	0.01	1.7
	2006	70.01	0.2	10.38	16.41	2.57	0.01	0.4

Table 13. Functional group mean percent coverage for the Palm Beach County sites.

Palm Beach	Co.	Substrate	Stony Coral	Octocoral	Macroalgae	Sponges	Zoanthid	Other
PB1	2003	83.54	1.0	2.7	0.1	10.29	0.55	1.8
	2004	82.55	0.9	2.88	1.39	9.82	0.78	1.7
	2005	98.09	0.1	0.03	0.84	0.17	0.02	0.7
	2006	45.44	0.4	0.00	3.85	0.14	0.00	0.0
PB2	2003	67.23	1.8	27.32	0	3.53	0.09	0.1
	2004	61.92	1.8	31.2	0.26	4.15	0.05	0.6
	2005	67.13	1.6	27.49	0.72	2.89	0.08	0.1
	2006	57.28	1.8	23.40	12.39	4.90	0.24	0.0
PB3	2003	55.37	1.0	30.34	0.27	10.46	1.36	1.2
	2004	55.69	1.0	29.84	2.54	8.87	1.2	0.8
	2005	61.12	1.0	24.98	1.45	9.51	1.02	1.0
	2006	61.18	1.0	19.61	7.55	9.32	1.20	0.2

Table 14. Functional group mean percent coverage for the Martin County sites.

Martin	Co.	Substrate	Stony Coral	Octocoral	Macroalgae	Sponges	Zoanthid	Other
MC1	2003	NA	NA	NA	NA	NA	NA	NA
	2004	NA	NA	NA	NA	NA	NA	NA
	2005	NA	NA	NA	NA	NA	NA	NA
	2006	61.89	1.6	0.01	34.54	1.06	0.66	0.0
MC2	2003	NA	NA	NA	NA	NA	NA	NA
	2004	NA	NA	NA	NA	NA	NA	NA
	2005	NA	NA	NA	NA	NA	NA	NA
	2006	53.20	1.0	0.01	41.99	2.63	1.08	0.0

Bio-eroding Sponge

Cliona delitrix was the only bio-eroding sponge species identified at the SECREMP sites. *C. delitrix* was seen in all four counties (Table 15). Only site BCA did not have bio-eroding sponge present. BC1 was the site with the greatest coverage of *C. delitrix* in 2003, 2004, 2005, and 2006. The area of sponge at 5 sites increased in 2006. Table 16 lists the coral species infected with *C. delitrix* in 2003, 2004, 2005, and 2006 and the total area of sponge coverage in Miami-Dade, Broward, and Palm Beach counties (Martin County sites are not included because these sites were not part of the project prior to 2006). *M. cavernosa* and *S. siderea* appeared to have the greatest increase in sponge area from 2005. In Martin County (sites MC1 and MC2), only one stony coral colony (*M. meandrites* in MC1) was identified with *C. delitrix*. All the remaining *C. delitrix* area was identified on substrate.

Table 15. Clionid sponge, *C. delitrix*, total colony area (cm^2/m^2) for each site in 2003, 2004, and 2005. Note: Site BCA had no *C. deletrix* present all years.

Site	2003	2004	2005	2006
BC1	98.86	98.48	46.97	127.56
BC2	1.89	2.23	2.84	5.96
BC3	6.25	4.73	5.21	5.87
DC1	4.36	5.49	4.54	8.55
DC2	15.15	11.46	14.30	13.40
DC3	1.14	0.57	1.52	1.70
PB1	27.08	35.80	6.82	5.20
PB2	17.80	6.25	14.39	11.55
PB3	3.79	1.70	4.26	2.76
MC1	NA	NA	NA	103.89
MC2	NA	NA	NA	16.86

Table 16. Clionid sponge, *C. delitrix*, total colony area (cm^2/m^2) (all 10 sites) for each infected coral species in 2003, 2004, and 2005. NA refers to sponge growing on unidentified coral or on substrate. Martin County sites are not included because these sites were not part of the project prior to 2006.

Coral Species	2003	2004	2005	2006
M. cavernosa	36.93	36.36	37.12	103.31
M. meandrites	4.73	4.36	3.13	2.55
D. clivosa	0.95	4.73	0.00	1.89
P. asteroids	0.95	0.57	0.09	0.00
C. natans	0.76	1.33	2.94	4.73
S. michelinii	0.57	0.00	0.00	1.61
S. siderea	0.57	0.57	1.52	14.68
A. agaricites	0.38	0.00	0.38	0.00
D. strigosa	0.00	0.00	6.82	3.31
NA	130.49	118.84	48.86	50.47

Site MC3 Stony Coral Colony Condition

Within the 5 staked locations at MC3, 49 colonies were mapped and data (including images) collected (Table 17). Although 10 stony coral species were recoded within sites MC1 and MC2 (Table 3), only 6 species were included in this effort (colonies of *D. stokesii* and *I. sinuosa* were not present within this site area and colonies of *P. americana* and *M. alcicornis* were not targeted for imaging).

No diseased colonies were identified. Eight colonies were noted as partially bleached (having one or more bleached polyps). Fishing line was noted entangling 7 of the 15 *O. diffusa* colonies mapped.

Images were taken of all 49 mapped colonies, 4 colonies did not have images of appropriate quality to permit image analysis to be completed (blurry images or colony edges obstructed). The live tissue area measured from the images taken in 2006 will be compared to tissue areas measured from images taken during subsequent monitoring events. Growth rates will be determined from differences in tissue areas.

Table 17. Site MC3 mapped stony coral species, colony size, and live tissue area.

		Colony Size		Traced Area	Condition
Colony #	Species	L (cm)	W (cm)	(cm^2)	Notes
101	*O. diffusa*	20	13	113.12	Fishing line on colony
102	*S. siderea*	8	7	25.62	
103	*O. diffusa*	30	25	248.32	Fishing line on colony
104	*D. clivosa*	18	15	176.10	
105	*S. bournoni*	14	12	115.65	Partially bleached
106	*S. siderea*	5	4	12.61	
107	*S. siderea*	9	6	15.01	
201	*D. clivosa*	28	20	412.88	
202	*S. siderea*	6	5	8.20	
203	*D. clivosa*	35	28	352.89	
204	*D. clivosa*	35	32	618.45	
205	*D. clivosa*	22	16	172.76	
206	*S. siderea*	6	6	12.95	
207	*D. clivosa*	35	30	437.84	
208	*D. clivosa*	20	19	242.62	
209	*O. diffusa*	20	15	56.63	Fishing line on colony
210	*M. cavernosa*	15	14	128.98	
211	*O. diffusa*	16	11	49.22	Fishing line on colony
212A	*S. siderea*	4	4	2.01	
212B	*S. siderea*	6	5	5.00	
212C	*S. siderea*	5	5	4.73	
213	*M. cavernosa*	12	8	56.70	

Table 17. Continued

Colony #	Species	Colony Size L (cm)	Colony Size W (cm)	Traced Area (cm^2)	Condition Notes
301	*S. siderea*	7	7	33.11	
302	*O. diffusa*	20	20	127.80	Partially bleached
303	*O. diffusa*	10	10	43.79	
304	*M. cavernosa*	15	12	112.65	
305	*O. diffusa*	25	18	166.71	Partially bleached
306	*D. clivosa*	20	20	369.07	
307	*M. cavernosa*	18	17	NA	
308	*S. siderea*	6	5	12.42	
309	*M. cavernosa*	10	10	62.41	
310	*M. cavernosa*	43	28	266.93	
311	*O. diffusa*	19	14	159.53	Fishing line/P. bleached
312	*M. cavernosa*	80	70	657.10	
401	*D. clivosa*	60	55	974.84	
402	*O. diffusa*	28	27	380.09	
403	*O. diffusa*	13	10	83.48	
404	*S. siderea*	9	7	42.31	
405	*D. clivosa*	55	35	NA	
406	*O. diffusa*	19	15	118.37	Partially bleached
407	*O. diffusa*	13	11	71.57	Partially bleached
408	*P. astreoides*	14	12	NA	
409	*O. diffusa*	35	35	819.52	Fishing line on colony
410	*M. cavernosa*	25	22	270.20	
501	*M. cavernosa*	35	30	224.84	
502	*O. diffusa*	22	22	338.40	Fishing line/P. bleached
503	*O. diffusa*	15	14	94.37	
504	*M. cavernosa*	55	50	928.22	
505	*S. siderea*	40	25	NA	Partially bleached

DISCUSSION

The coral reef ecosystem off southeast Florida is a marginal system near the environmental threshold for significant reef growth. Southeast Florida reefs generally have reduced stony coral species richness and stony coral cover compared to the Dry Tortugas or Florida Keys coral reefs. Benthic cover by octocorals is, interestingly, similar throughout the Florida reef system (Beaver et al. 2006).

With 4 years of data, in general, the status of the southeast Florida reef system has changed little from 2003 to 2006 (except for PB1 and in some respects BCA). Stony coral species richness (Table 3; Figure 5) and cover are very similar between years (Tables 9 and 10; Figure 6 and 7). The incidence of bleaching and disease in 2006 is similar to 2005. With only 19 infected colonies identified in 2004, 21 identified in 2005, and 18 in 2006, diseases do not appear to be a major factor affecting stony coral condition or cover in the SECREMP sites. Other than the reduced cover for PB1, there do not appear to be any consistent trends in temporal changes in functional group cover between 2003 and 2006 (Tables 11-14). Macroalgae and octocorals remain the two functional groups with the most cover for the region. In 2006, there was a significant increase in macroalgae cover in 4 of the 10 sites and a decrease in octocoral cover in 3 (includes PB1) sites. The importance and impact of these changes in cover will become more evident following the 2007 monitoring event.

In 2005, site PB1 was greatly affected by sand movement. Stations 2 and 4 were completely covered with sand more than several centimeters in depth (Figure 8). In 2006, stations 2 and 4 remained buried in sand. The cause of this sand movement is unknown although the 2004 hurricanes, Jeanne and Frances, may have contributed to this significant sand movement. SSI, bio-eroding sponge, and video data was collected and included in this analysis. This impact on these stations greatly influenced summary data for PB1, and therefore, the between year comparisons. The loss of reef habitat at these two stations reduced the number of coral species identified in Palm Beach, the percent stony coral cover, reduced functional group coverage data, and reduced the total bio-eroding sponge coverage area. PB1 will continue to be re-visited and included in subsequent sampling periods.

Site BCA was added to the project as the fourth site in Broward County for the purpose of monitoring one of the unique southeast Florida *Acropora cervicornis* patches. With the recent listing of *A. cervicornis* as a Threatened species under the Endangered Species Act (http://www.nmfs.noaa.gov/pr/pdfs/fr/fr71-26852.pdf), it is important to make special note of site BCA. *A. cervicornis* cover decreased from a high of 39% in 2004 and 2005 to a low of 25% in 2006. The reason(s) for this decline, measured within the permanent transects, is unknown. The site has been sampled during the same time of year each year (June in 2004-2006, Table 2). The passing of Hurricane Wilma over the area in October 2005 may have contributed to some of the decline. The cyanobacteria, *Lyngbya* spp., bloom seen in previous years (2004) appeared to be in decline between 2005 and 2006 (personal observation). SECREMP is a monitoring project designed with the use of permanent transects. This permanent transect design may not provide all the data appropriate for monitoring the condition of a large *A. cervicornis* patch. Since asexual reproduction is an important mechanism structuring *A. cervicornis* populations, these larger patches may be in a dynamic state with changing boundaries and relative cover within the patch. The SECREMP research team has noted that the larger *A. cervicornis* patch, within which the BCA transects were deployed, appears to be generally healthy (qualitative observations), but the patch also appears to be moving away (south and west) from the permanent transect locations. This patch “behavior” needs to be addressed in order to confidently document changes in the condition of this *A. cervicornis* population. Discussions with the SECREMP partners (NCRI, FWC, and FDEP) are planned.

Despite their reduced diversity and coral cover compared to reefs in the Florida Keys, the coral reefs of southeast Florida represent a significant economic resource to the region. Between June 2000 and May 2001 visitors spent 28 million person-days enjoying artificial and natural reefs in southeast Florida. During the same period, reef related expenditures amounted to some 1.81 billion dollars and generated 61,300 jobs in Miami-Dade, Broward, and Palm Beach Counties (Johns et al. 2003).

These important economic and recreational benefits are threatened because the coral reef environments of southeast Florida are under varied and chronic stressors. This area is highly urbanized along the coast. Dredging for beach renourishment, inlet and port channel deepening, and maintenance can have significant impacts on water quality. Chronic turbidity and deposition of silt can smother sessile invertebrates and result in barren areas. Nearshore reef areas are at risk from diversion of millions of gallons of fresh water into the ocean, and the resultant reduction in salinity, introduction of agricultural and industrial chemical contamination, and excess nutrients.

Impacts from boating and fishing activities are a significant threat to reef areas as damage from fishing gear and anchoring can be severe. Adverse impacts from SCUBA divers can also occur. Traffic from large ports (Miami, Port Everglades, and Palm Beach) including cruise and container ships, military vessels, and oil tankers, can conflict with reef resources. Ships occasionally run aground and anchor on reefs causing extensive and often long-lasting damage. Other recent impacts include those of the installation of fiber optic cables deployed across the reefs, which may cause abrasion and detachment of corals and sponges (Jaap 2000).

The chronic nature of disturbances to, and the significant economic value of, the southeast Florida reefs requires comprehensive, long-term monitoring be conducted to define change and help identify threats to the ecosystem. Scientifically valid monitoring of reefs will help local resource managers understand the implications of actions occurring in terrestrial and adjacent marine habitats. This knowledge is necessary if resource managers are to develop sound management plans for coral reefs that permit continued use, and realization of the economic value, of these fragile marine ecosystems.

The expansion of the Coral Reef Evaluation and Monitoring Project to include sites in Broward, Miami-Dade, Palm Beach, and Martin Counties has insured that this minimum suite of parameters is being monitored for the full extent of the Florida coral reef ecosystem. One of the goals of the NOAA Coral Ecosystem Monitoring Program is monitoring with an explicit link to assessing the efficacy of "coastal" management strategies. While a true effects study designed to assist resource managers gauge potential effects from past or future impacts (e.g., beach renourishment, pipelines, etc.) is not possible with our limited sample size, local resource managers (County) were directly involved in choosing the sample sites and were present during the site selection field work. Site BCA (Broward County *Acropora cervicornis* patch) is an example of a site specifically chosen by State and County resource managers in order to monitor potential changes to this unique area.

The partnership with Nova Southeastern University Oceanographic Center and its constituent National Coral Reef Institute has worked to expand local capacity for maintaining long-term monitoring sites, complementing those being sampled as part of the National Coral Reef

Monitoring Network. As a monitoring project under the Coral Reef Conservation Grant Program for the Florida east coast, the SECREMP will continue characterization of baseline ecosystem condition, inventory/mapping of biotic resources, and data base development, providing resource managers with the critical information required to manage this valuable natural resource.

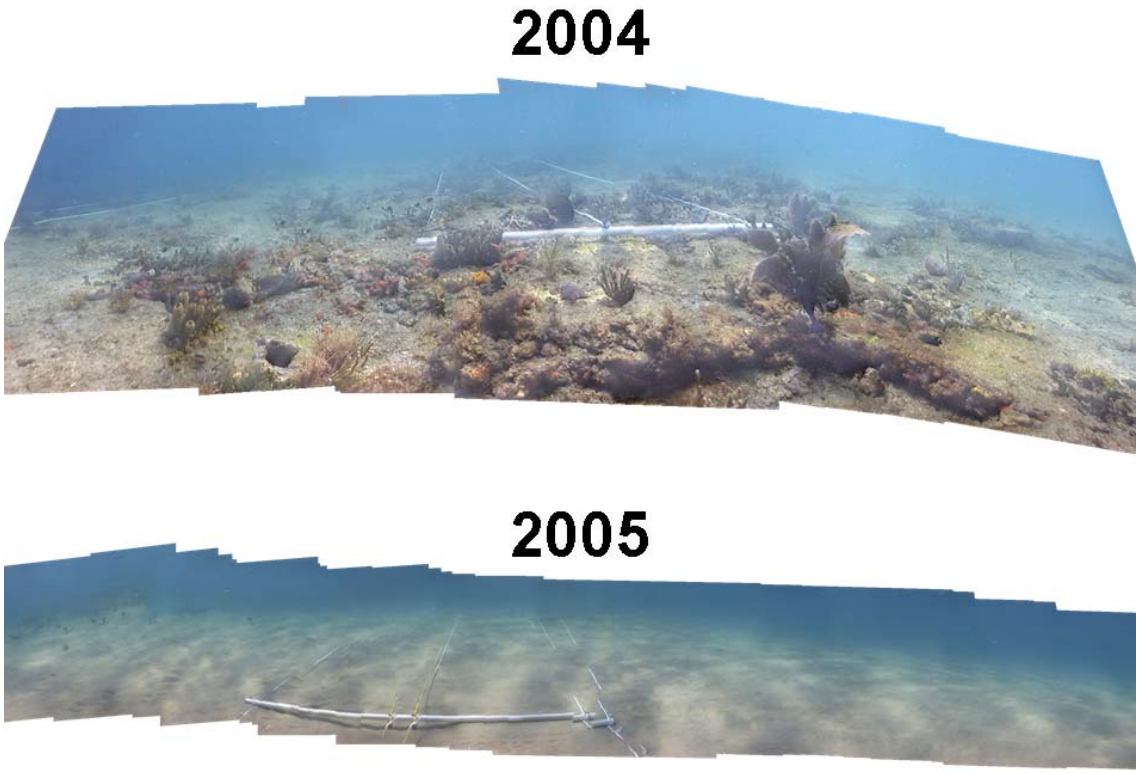

Figure 8. Photo mosaic of the north pin, Station 2, site PB1 in 2004 and 2005. Image clearly shows the station covered with sand in 2005. Stations 2 and 4 remained buried in sand in 2006.

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