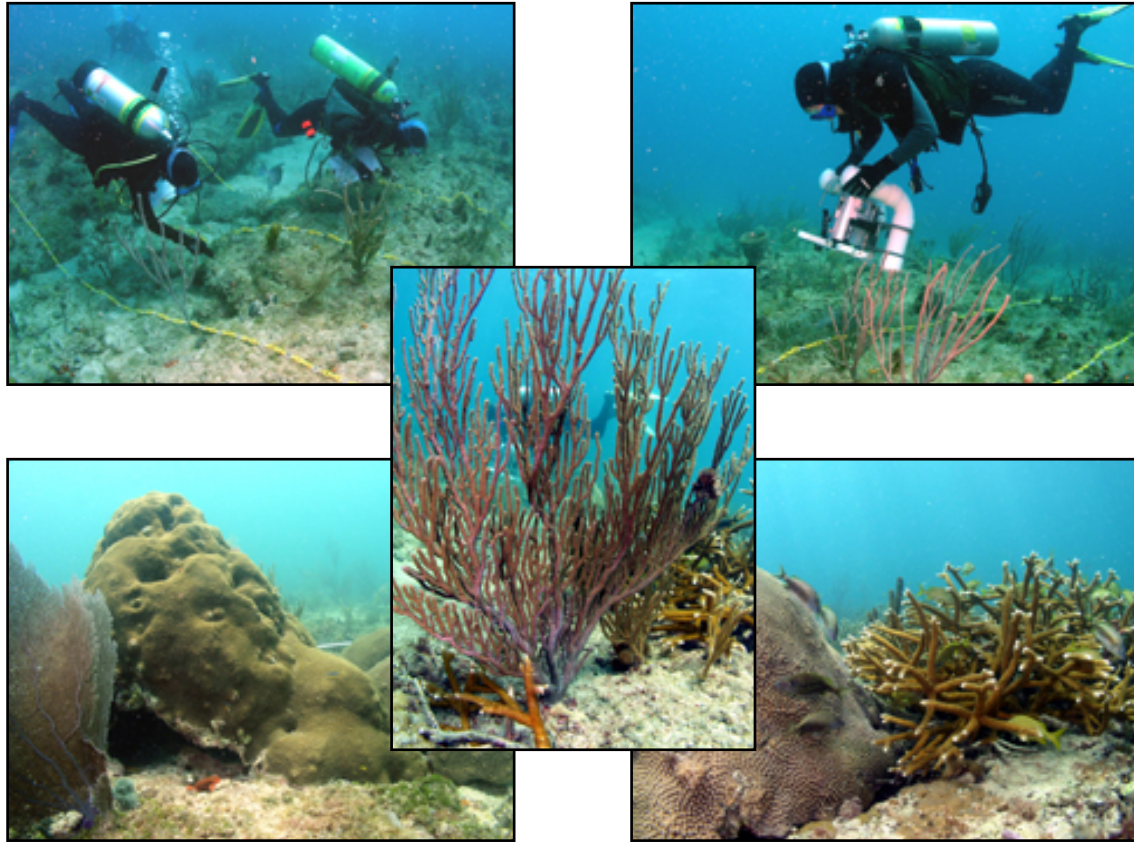


**Southeast Florida Coral Reef Evaluation and Monitoring
Project
2004 Year 2 Final Report
June 2005**



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
Biscayne Bay Environmental Center
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, Palm Beach, and Martin Counties; however, the primary focus for coral reef research and long-term monitoring has long been in the Florida Keys and Dry Tortugas. Coral reef monitoring efforts in the Keys grew exponentially 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. Two years (2003 and 2004) of sampling have been completed. 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.

The reef system from northern Monroe County to Palm Beach County can be characterized as a series of discontinuous reef lines that parallel the shoreline. As an example, in Broward County there are generally three lines of reef (terraces) present that crest in 3 to 5 m (First Reef), 7 to 9 m (Second Reef), and 16 to 23 m (Third Reef) water depths (Figure 1).

Most previous monitoring efforts (Dodge et al., 1995; Gilliam et al., 2001, 2002) along the southeast coast originated as impact and mitigation studies from adverse environmental impacts to specific sites (dredge insults, ship groundings, pipeline and cable deployments, and beach renourishment). Studies like these are generally of limited duration (1–3 years) and focus on restoration with some baseline data collection at 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 measurements), and coral, sponge, and fish abundance/cover data was conducted at 18 sites. In 2000 Nova Southeastern University (NSU) assumed the 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 2007.

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 cover are available from some local areas such as those in Broward County but, to a large extent, stony coral 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 these reefs.

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 Florida Department of Environmental Protection 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.

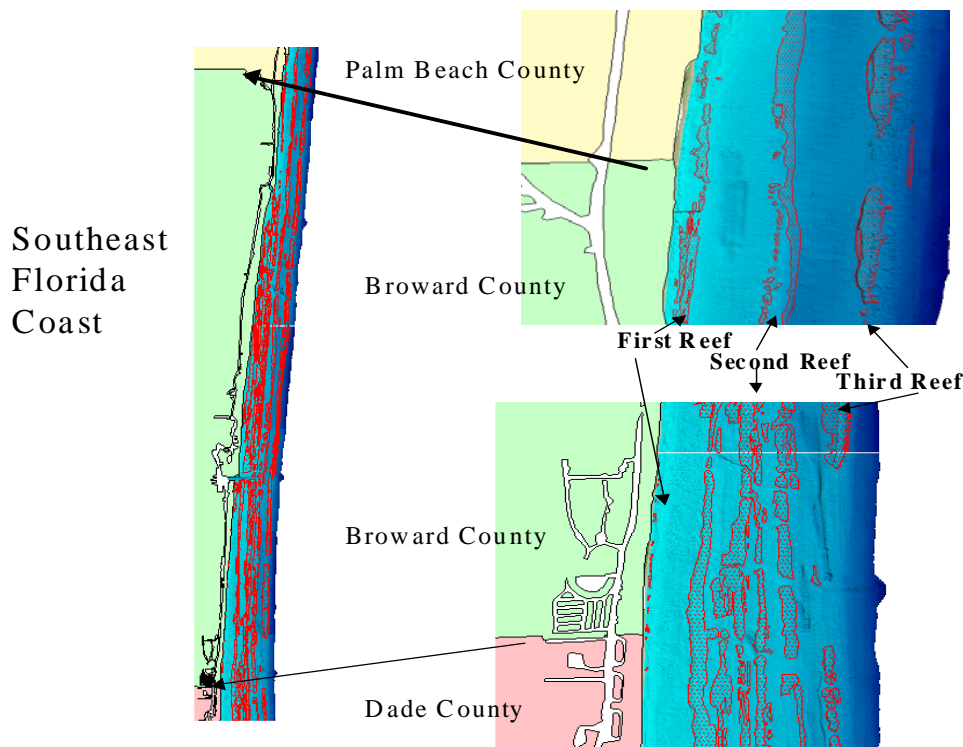


Figure 1. View of reef tracts along the southeast Florida coast.

Project Planning

Planning for the 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 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 the site selection and sampling. On 16 June 2003 a workshop

was held at Nova Southeastern University 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.

Planning for the Year 2 fieldwork began in early 2004. NCRI managed all the Year 2 planning and fieldwork. Prior to sampling, FWRI, EPD, DERM, and ERM were notified of the proposed sampling dates and invited to participate.

Monitoring Site Selection and Sampling

The project initially required three sites 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 and installed on each off the three reef tracts from nearshore to offshore. Because Palm Beach does not have three separate reef tracts, one site was selected on a patch of nearshore hardbottom 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 in Broward to monitor one of these patches. All 10 sites include four standard CREMP stations.

Personnel from NCRI, FWRI, and each of the Counties were present during site selection. Each county assisted by providing vessel support. Industrial Divers Corp. (IDC) was subcontracted to install the reference stakes. 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. Table 1 provides depths and locations of each of the SECREMP sites, and Table 2 provides the Year 1 and Year 2 work dates including the date sampling was completed at each site.

Table 1. Location and depth for the 10 SECREMP monitoring sites (BC = Broward County; DC = Miami-Dade County; PB = Palm Beach 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'

Table 2. Location and Year 1 and 2 work dates (BC = Broward County; DC = Miami-Dade County; PB = Palm Beach County).

Site Code	Date Selected	Date Installed	Yr 1 Date Sampled	Yr 2 Date Sampled
BCA	5-06-2003	5-30-2003	6-19-2003	6-11-2004
BC1	5-06-2003	5-30-2003	6-17-2003	6-14-2004
BC2	5-12-2003	5-29-2003	6-18-2003	6-03-2004
BC3	5-06-2003	5-28-2003	6-18-2003	6-09-2004
DC1	5-16-2003	6-2-2003	6-24-2003	6-15-2004
DC2	5-16-2003	6-4-2003	6-24-2003	6-15-2004
DC3	4-30-2003	6-6-2003	6-23-2003	6-04-2004
PB1	5-05-2003	6-12-2003	8-20-2003	7-21-2004
PB2	5-05-2003	6-11-2003	8-18-2003	7-21-2004
PB3	5-05-2003	6-11-2003	8-19-2003	7-22-2004

METHODS

Each of the 10 SECREMP monitoring sites consists of four monitoring stations delineated by permanent stainless steel markers. Stations are approximately 2 x 22 meters. The SECREMP stations have a north-south orientation, which is generally parallel to the reef terraces of southeast Florida. Within each station, field sampling consists of a station species inventory (SSI), three video transects (100, 300 & 500), and a bio-eroding sponge survey (Figure 2). 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. Traditional transect and quadrat methods used in terrestrial environments are often too time consuming for underwater use, in addition to being less accurate and precise.

Percent cover of live coral, sessile benthic biota, and selected substrates is 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 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.

Station Layout

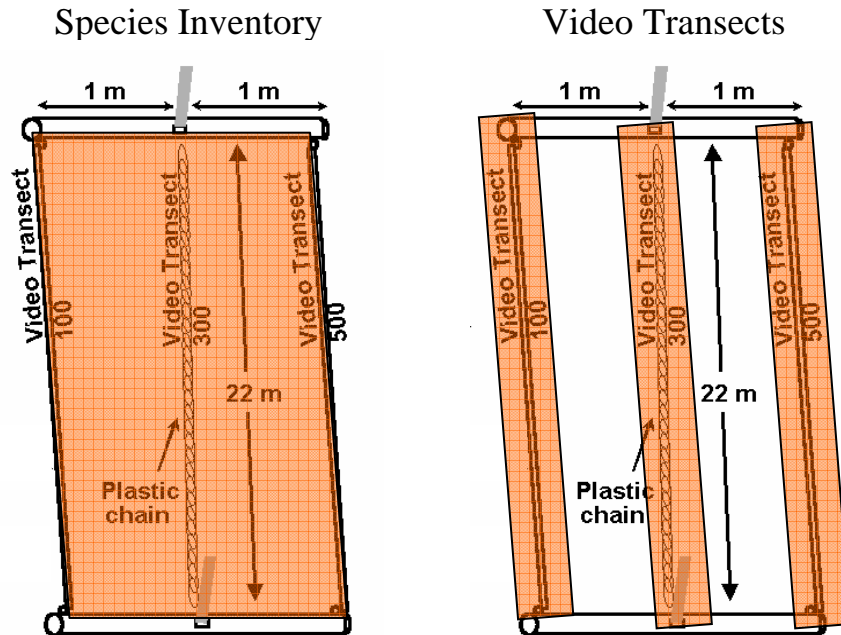


Figure 2. Typical layout of SECREMP station.

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 Year 1 and 2 image analyses were conducted using a custom software application, PointCount, 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 the master ACCESS data set.

Standard video protocol is modified slightly for site BCA (Broward County nearshore *Acropora 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, the use of fiberglass tapes is 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 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 cm² quadrat frame subdivided into 5 cm squares. The area occupied by the clionid colony is recorded to the nearest half square.

YEAR 2 (2004) RESULTS

Stony Coral Species Richness

Stony coral species richness were summarized from SSI data. In 2004, a total of 29 stony coral species were identified within the 10 SECREMP sites (Table 3). These 29 species were also identified in 2003. The mean number of species identified per site was 10.34. Three species, *Montastraea cavernosa*, *Porites astreoides* and *Dichocoenia stokesii* were identified at all 10 sites, and 15 species were identified in all three counties. Miami-Dade and Broward Counties had 23 stony coral species identified and Palm Beach County had 22 (Figure 3).

Miami-Dade County had a mean 11.58 stony coral species per station while Broward County had 9.88 species per station and Palm Beach had 9.83 species per station. Stony coral species 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 (11.17) of species per station. The offshore sites (third reef sites DC3, BC3, and PB3) had lower species richness than the first and second reef sites.

Table 3. Stony coral species presence/absence for all SECREMP sites in Broward, Miami-Dade, and Palm Beach Counties for 2004. Key: A, 1, 2, 3 = species present at sites; O = species absent.

Species List	Broward	Miami-Dade	Palm Beach
	Present/Absent	Present/Absent	Present/Absent
<i>Acropora cervicornis</i>	A	1	O
<i>Agaricia agaricites</i>	A, 1, 2	1	2, 3
<i>Agaricia fragilis</i>	1, 2, 3	1, 2, 3	O
<i>Agaricia lamarki</i>	2, 3	O	O
<i>Cladocora arbuscula</i>	O	O	1
<i>Colpophyllia natans</i>	A, 1	1, 2	1, 2
<i>Dichocoenia stokesii</i>	A, 1, 2, 3	1, 2, 3	1, 2, 3
<i>Diploria clivosa</i>	A	1	1
<i>Diploria labyrinthiformis</i>	1	1, 3	O
<i>Diploria strigosa</i>	O	2	1, 2
<i>Eusimilia fastigiata</i>	1, 2	2	O
<i>Madracis decactis</i>	1, 3	2, 3	2, 3
<i>Madracis mirabilis</i>	O	O	2
<i>Meandrina meandrites</i>	1, 2, 3	1, 2, 3	1, 2, 3
<i>Millepora alcicornis</i>	A, 1, 2, 3	1, 2, 3	1, 2, 3
<i>Montastrea annularis</i> complex	1, 2	1, 2, 3	3
<i>Montastrea cavernosa</i>	A, 1, 2, 3	1, 2, 3	1, 2, 3
<i>Mycetophyllia aliciae</i>	O	O	2, 3
<i>Mycetophyllia lamarckiana</i>	O	2	O
<i>Oculina diffusa</i>	1	O	1
<i>Phyllangia americana</i>	1, 2	1, 2	1, 2
<i>Porites astreoides</i>	A, 1, 2, 3	1, 2, 3	1, 2, 3
<i>Porites porites</i>	A, 2	1, 2	O
<i>Scolymia cubensis</i>	2, 3	2, 3	2
<i>Scolymia lacera</i>	O	O	3
<i>Siderastrea radians</i>	A, 1, 2, 3	1, 2	1, 2
<i>Siderastrea siderea</i>	1, 2, 3	1, 2, 3	1, 2, 3
<i>Solenastrea bournoni</i>	A, 1, 2, 3	1, 2, 3	1
<i>Stephanocoenia michelinii</i>	1, 2, 3	1, 2, 3	2, 3

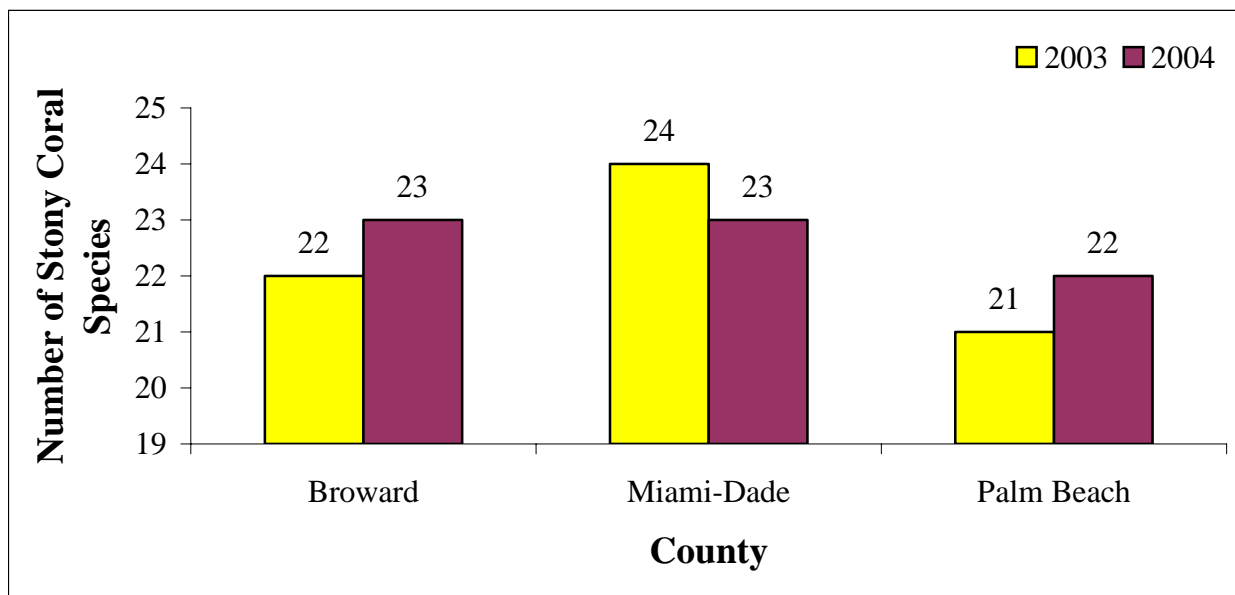


Figure 3. Stony coral species richness at SECREMP sites for Broward, Miami-Dade, and Palm Beach Counties for 2003 and 2004 (n= 12 stations for Miami-Dade and Palm Beach Counties, n= 16 for Broward County).

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). In 2004, images were taken of each diseased colony. In order to track the fate of these colonies, images will also be taken of them in 2005.

Partially bleached colonies (no completely bleached colonies were observed) were observed more frequently than diseased colonies. Bleaching was recorded at sites DC3, DC2, DC1, BC1, BC2, BC3, PB3, PB2, and PB1, with BC2 and PB2 having the greatest incidence of bleaching.. Diseased colonies were identified at four sites (10 stations). “Other” diseases were seen at four sites (11 stations), while “white complex” diseases were identified at one site (one station). Most of the “other” diseased colonies were *Siderastrea siderea* with Dark Spot. Black band disease was not seen within any of the 10 sites. Table 4 lists all stony coral species that displayed symptoms of disease. Table 5 compares stony coral species with the presence of disease and partial bleaching at each of the stations in 2003 and 2004. Quantitative data (number of diseased or partially bleached 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.

Table 4. List of all sites and stations with diseased stony corals and the stony coral species affected (O = other disease, W = white complex disease).

County	Site	Station	Species Affected	No. of Colonies	Condition	
Miami-Dade	DC1	1	<i>Siderastrea siderea</i>	3	O	
		2	<i>Siderastrea siderea</i>	1	O	
		3	<i>Siderastrea siderea</i>	1	O	
		3	<i>Montastrea annularis</i>	1	O	
		4	<i>Siderastrea siderea</i>	2	O	
		4	<i>Dichocoenia stokesii</i>	1	W	
	DC2	1	None	0	---	
		2	None	0	---	
		3	None	0	---	
		4	None	0	---	
	DC3	1	None	0	---	
		2	None	0	---	
		3	None	0	---	
		4	None	0	---	
	Broward	BC1	1	<i>Siderastrea siderea</i>	1	O
			2	<i>Siderastrea siderea</i>	1	O
3			<i>Siderastrea siderea</i>	1	O	
4			None	0	---	
BC2		1	None	0	---	
		2	None	0	---	
		3	<i>Siderastrea siderea</i>	1	O	
		4	None	0	---	
BC3		1	None	0	---	
		2	None	0	---	
		3	None	0	---	
		4	None	0	---	
Palm Beach	PB1	1	<i>Siderastrea siderea</i>	2	O	
		2	None	0	---	
		3	<i>Siderastrea siderea</i>	0	---	
		4	<i>Diploria clivosa</i>	1	O	
	PB2	1	None	0	---	
		2	None	0	---	
		3	None	0	---	
		4	None	0	---	
	PB3	1	None	0	---	
		2	None	0	---	
		3	None	0	---	
		4	None	0	---	

Table 5. Stony coral species within each site and station with the presence of disease or partial bleaching (A = absence of bleaching or disease; H = bleaching, O = other disease, W = white complex disease).

County	Site	Station	Species	2003	2004	
Miami-Dade	DC1	1,3,4	<i>Siderastrea siderea</i>	A	H	
		2	<i>Porites astreoides</i>	H	H	
		2, 3	<i>Siderastrea siderea</i>	A	O	
		4	<i>Dichocoenia stokesii</i>	A	W	
		4	<i>Siderastrea siderea</i>	O	O	
	DC2	1	None	A	A	
		2	<i>Montastrea annularis</i>	O	A	
		2	<i>Solenastrea bournoni</i>	A	H	
		3	None	A	A	
		4	None	A	A	
	DC3	1	None	A	A	
		2	None	A	A	
		3	None	A	A	
		4	<i>Montastrea annularis</i>	A	H	
	Broward	BC1	1, 2, 3	<i>Siderastrea siderea</i>	A	O
			2	<i>Montastrea cavernosa</i>	A	O
3			<i>Siderastrea siderea</i>	A	H	
3			<i>Montastrea cavernosa</i>	O	A	
3			<i>Porites astreoides</i>	H	A	
4			None	A	A	
BC2		1	<i>Siderastrea radians</i>	H	A	
		1	<i>Dichocoenia stokesii</i>	A	H	
		2	<i>Meandrina meandrites</i>	A	H	
		2	<i>Stephanocoenia michelini</i>	A	H	
		3	<i>Porites astreoides</i>	A	H	
		3, 4	<i>Montastrea cavernosa</i>	A	H	
		3, 4	<i>Siderastrea siderea</i>	A	H, O	
		4	<i>Solenastrea bournoni</i>	W	A	
BC3		1	<i>Dichocoenia stokesii</i>	H	A	
		1	<i>Siderastrea siderea</i>	A	H	
		2	<i>Siderastrea siderea</i>	H	H	
		3	<i>Meandrina meandrites</i>	A	H	
		4	None	A	A	

Table 5. Continued.

County	Site	Station	Species	2003	2004
Palm Beach	PB1	1	<i>Solenastrea bournoni</i>	H, O	H
	PB1	1, 2	<i>Siderastrea radians</i>	H	H
	PB1	1, 3	<i>Siderastrea siderea</i>	A	O
	PB1	2	<i>Meandrina meandrites</i>	H	A
	PB1	2	<i>Solenastrea bournoni</i>	H	A
	PB1	3	<i>Siderastrea radians</i>	H	A
	PB1	3	<i>Diploria clivosa</i>	A	H
	PB1	3	<i>Oculina diffusa</i>	H	A
	PB1	4	<i>Diploria clivosa</i>	A	H
	PB1	4	<i>Siderastrea radians</i>	H	A
	PB1	4	<i>Solenastrea bournoni</i>	H, W	H
	PB2	1	<i>Meandrina meandrites</i>	A	H
	PB2	1	<i>Meandrina meandrites</i>	A	H
	PB2	1, 2	<i>Porites astreoides</i>	A	H
	PB2	1, 2, 3, 4	<i>Siderastrea siderea</i>	A	H
	PB2	3	<i>Siderastrea radians</i>	A	H
	PB2	4	<i>Stephanocoenia michelini</i>		H
	PB2	4	<i>Montastrea cavernosa</i>	A	H
	PB3	1	None	A	A
	PB3	2	<i>Dichocoenia stokesii</i>	A	H
	PB3	3	None	A	A
	PB3	4	None	A	A

Sea Urchin *Diadema* Abundance

Diadema sea urchin abundance was recorded for each station during the SSI sampling. No *Diadema* were seen at any of the 10 sites (40 stations) in 2003. In 2004, six individuals were counted, one each at of the following stations: DC2 station 4, BC1 stations 1 and 2, BC2 station 1, BC3 stations 3 and 4.

Stony Coral Cover

Mean stony coral cover for the 10 SECREMP sites was 5.9%. Broward County (13.04%) had the greatest mean stony coral cover followed by Palm Beach (1.23%) and Miami-Dade (1.09%) Counties (Figure 4). The disparity between the Broward sites and both the Miami-Dade and Palm Beach sites was due to the significantly greater coral cover at site BCA which had 39.63% stony coral cover, and site BC1 which had 11.76% stony coral cover. Site BCA is dominated by *Acropora cervicornis* with a cover of 39%. The remaining Broward sites BC3 and BC2 had stony coral cover similar to that at Miami-Dade and Palm Beach sites. Mean stony coral coverage for all sties is presented in Table 6.

The offshore Miami-Dade (DC3) and Broward (BC3) sites had reduced coral cover compared to both second (DC2 and BC2) and first reef (DC1 and BC1) sites. Table 7 lists the mean cover for stony coral species at each site.

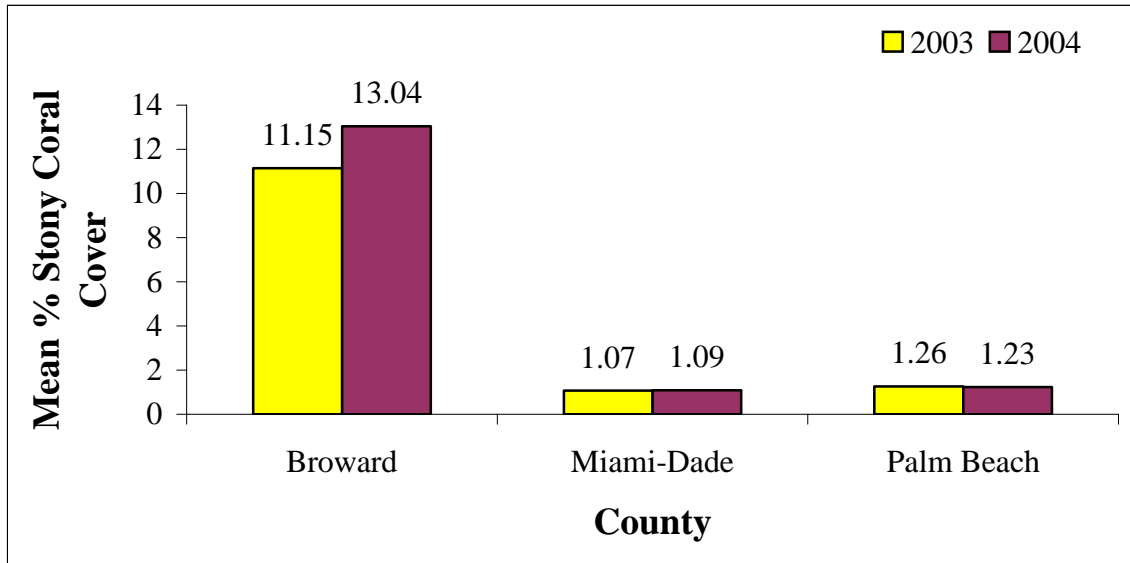


Figure 4. Mean percent stony coral cover at SECREMP sites in Broward, Miami-Dade, and Palm Beach Counties for 2003 and 2004.

Functional Group Benthic Cover

Tables 8, 9, and 10 list the mean functional group cover for each County (Broward, Miami-Dade, and Palm Beach, respectively) and site. Functional groups included substrate (rock, rubble, and sediments), stony corals, octocorals, zoanthids, sponges, and macroalgae. Substrate dominated benthic cover at all sites (>50%), ranging from 86.58% at BC2 to 53.37% at PB3 (Figure 5). Octocoral was generally the second most common functional group. Offshore (third reef) sites tended to have greater octocoral cover than inshore sites. Macroalgae cover was greatest at the Miami-Dade sites, while sponge cover was greatest at Palm Beach sites

Table 6. Mean stony coral cover for SECREMP sites by county and habitat for 2003 and 2004.

County	Site Code	Habitat	2003 Mean % Coral Cover	2004 Mean % Coral Cover
Broward	All	All	11.15	13.04
	BCA	Nearshore	31.72	39.63
	BC1	First Reef	12.21	11.76
	BC2	Second Reef	0.40	0.44
	BC3	Third Reef	0.28	0.35
Miami-Dade	All	All	1.07	1.09
	DC1	First Reef	2.40	2.57
	DC2	Second Reef	0.61	0.47
	DC3	Third Reef	0.20	0.23
Palm Beach	All	All	1.26	1.23
	PB1	First Reef	0.97	0.86
	PB2	Third Reef	1.79	1.80
	PB3	Third Reef	1.02	1.03

Table 7. Mean percent cover of stony coral species at SECREMP sites for 2004. BC = Broward County, DC = Miami-Dade County, and PB = Palm Beach County.

Stony Coral Species	Percent Cover												
	BC	BCA	BC1	BC2	BC3	DC	DC1	DC2	DC3	PB	PB1	PB2	PB3
<i>Acropora cervicornis</i>	9.75	38.99	0.00	0.00	0.00	0.10	0.31	0.00	0.00	0.00	0.00	0.00	0.00
<i>Colpophyllia natans</i>	0.02	0.00	0.09	0.00	0.00	0.02	0.04	0.03	0.00	0.00	0.01	0.00	0.00
<i>Dichocoenia stokesii</i>	0.01	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.02	0.01	0.05
<i>Diploria clivosa</i>	0.05	0.19	0.00	0.00	0.00	0.02	0.06	0.00	0.00	0.05	0.16	0.00	0.00
<i>Diploria labyrinthiformis</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
<i>Diploria strigosa</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.28	0.00	0.00
<i>Eusmilia fastigiata</i>	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.03	0.00	0.00	0.00	0.00	0.00
<i>Meandrina meandrites</i>	0.05	0.00	0.03	0.17	0.01	0.08	0.04	0.19	0.00	0.17	0.12	0.20	0.19
<i>Millepora alcicornis</i>	0.02	0.00	0.01	0.03	0.05	0.06	0.04	0.05	0.10	0.09	0.01	0.08	0.16
<i>Montastraea annularis</i> complex	0.13	0.00	0.52	0.00	0.00	0.10	0.29	0.00	0.00	0.00	0.00	0.00	0.00
<i>Montastraea cavernosa</i>	2.74	0.2	10.59	0.06	0.12	0.41	1.10	0.04	0.10	0.69	0.17	1.34	0.57
<i>Porites astreoides</i>	0.09	0.26	0.04	0.01	0.05	0.15	0.39	0.05	0.00	0.03	0.00	0.02	0.06
Scleractinia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
<i>Siderastrea radians</i>	0.01	0.00	0.00	0.00	0.02	0.03	0.10	0.00	0.00	0.00	0.01	0.00	0.00
<i>Siderastrea siderea</i>	0.08	0.00	0.21	0.07	0.04	0.08	0.17	0.06	0.01	0.04	0.01	0.10	0.00
<i>Solenastrea bournoni</i>	0.05	0.00	0.17	0.01	0.01	0.02	0.04	0.01	0.00	0.02	0.06	0.01	0.00
<i>Stephanocoenia michelinii</i>	0.04	0.00	0.04	0.08	0.05	0.00	0.00	0.01	0.00	0.01	0.00	0.02	0.00

Table 8. Mean percent cover of functional groups in Broward County for SECREMP sites in 2003 and 2004. Mean values are based on n = 16 for Broward County (BC).

Functional Group	Percent Cover 2003					Percent Cover 2004				
	BC	BCA	BC1	BC2	BC3	BC	BCA	BC1	BC2	BC3
Substrate	73.59	55.85	73.21	87.09	78.2	77.17	64.96	77.37	86.58	79.76
Stony Coral	13.04	39.63	11.76	0.44	0.35	11.15	31.72	12.21	0.40	0.28
Octocoral	7.83	2.03	6.41	6.89	15.99	7.24	2.34	6.46	6.63	13.54
Macroalgae	2.16	0.96	4.04	1.92	1.74	1.94	0.03	0.43	3.70	3.62
Porifera	2.34	0.47	1.99	3.27	3.64	1.89	0.27	1.84	2.67	2.79
Zoanthidea	0.60	0.84	1.40	0.14	0.03	0.59	0.68	1.68	0.00	0.00
Other Biota	0.38	0.23	1.00	0.25	0.05	0.01	0.00	0.00	0.01	0.01

Table 9. Mean percent cover of functional groups in Miami-Dade County for SECREMP sites in 2003 and 2004. Mean values are based on n = 12 stations for Miami-Dade County (DC).

Functional Group	Percent Cover 2003				Percent Cover 2004			
	DC	DC1	DC2	DC3	DC	DC1	DC2	DC3
Substrate	70.25	53.04	79.50	78.20	73.42	72.21	69.56	78.48
Stony Coral	1.09	2.57	0.47	0.23	1.07	2.40	0.61	0.20
Octocoral	10.36	7.31	11.54	12.25	12.00	5.86	14.67	15.48
Macroalgae	12.87	31.44	3.26	3.92	8.51	13.32	9.97	2.25
Porifera	2.61	1.08	4.02	2.74	3.16	0.85	5.14	3.50
Zoanthidea	1.54	4.57	0.05	0.00	1.80	5.36	0.03	0.00
Other Biota	1.27	0.00	1.16	2.66	0.04	0.00	0.03	0.09

Table 10. Mean percent cover of functional groups in Palm Beach County for SECREMP sites in 2003 and 2004. Mean values are based on n = 12 stations for Palm Beach County (PB).

Functional Group	Percent Cover 2003				Percent Cover 2004			
	PB	PB1	PB2	PB3	PB	PB1	PB2	PB3
Substrate	66.72	82.55	61.92	55.69	68.71	83.54	67.23	55.37
Stony Coral	1.23	0.86	1.80	1.03	1.26	0.97	1.79	1.02
Octocoral	21.30	2.88	31.20	29.84	20.12	2.70	27.32	30.34
Macroalgae	1.40	1.39	0.26	2.54	0.12	0.10	0.00	0.27
Porifera	7.61	9.82	4.15	8.87	8.10	10.29	3.53	10.46
Zoanthidea	0.68	0.78	0.05	1.20	0.67	0.55	0.09	1.36
Other Biota	1.06	1.71	0.63	0.83	1.02	1.84	0.05	1.17

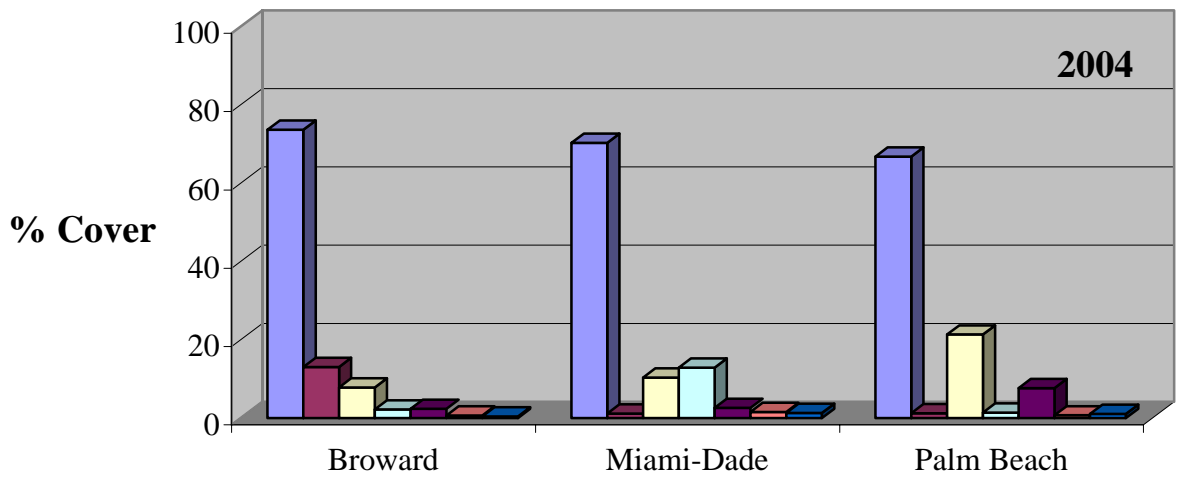
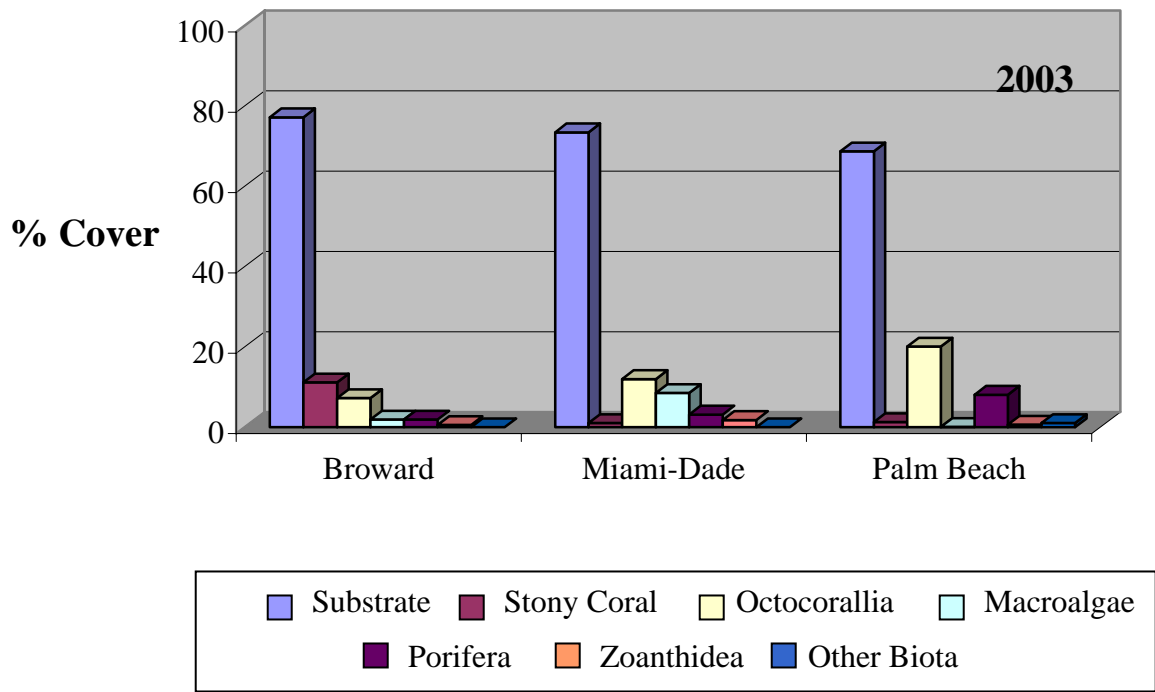


Figure 5. Mean percent cover of functional groups by county at SECREMP sites for 2003 and 2004.

Bio-eroding Sponge

Cliona delitrix was the only bio-eroding sponge species identified at any SECREMP site. *C. delitrix* was seen in all three Counties (Table 11). Only site BCA did not have bio-eroding sponge present. Broward County had the greatest coverage of *C. delitrix*, while Palm Beach County had the greatest number of *C. delitrix* colonies. The first reef sites tended to have greater cover and more colonies than offshore (third reef) sites.

Table 11. Clionid sponge, *C. delitrix*, total colony area (cm²), habitat type and number of colonies for 2003 and 2004. Note: Site BCA had no *C. delitrix* present during both years.

County	Site Code	Habitat Type	2003		2004	
			Colony Area (cm ²)	# of Colonies	Colony Area (cm ²)	# of Colonies
Broward	All	All	7,062.5	14	5,465.6	53
	BC1	First Reef	6,525	9	5,102.5	44
	BC2	Second Reef	125.0	1	117.8	4
	BC3	Third Reef	412.5	3	245.3	5
Miami-Dade	All	All	1,362.5	7	907.7	8
	DC1	First Reef	287.5	4	284.6	4
	DC2	Second Reef	1,000.0	2	593.7	3
	DC3	Third Reef	75.0	1	29.4	1
Palm Beach	All	All	3,212.5	16	2,266.7	25
	PB1	First Reef	1,787.5	4	1,854.6	19
	PB2	Third Reef	1,175.0	9	323.8	5
	PB3	Third Reef	250.0	3	88.3	1

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 than the Dry Tortugas or Florida Keys coral reefs. Benthic cover by octocorals is, interestingly, very similar throughout the Florida reef system while southeast Florida reefs appear to have reduced macroalgae cover compared to reefs in the Dry Tortugas and the Florida Keys.

Although it is not possible to identify trends with only two years of data, in general, the status of the southeast Florida reef system has changed little from 2003 to 2004. Stony coral species richness (Table 3; Figure 3) and cover are very similar between years (Figure 4; Tables 6 and 7). There appears to have been a greater incidence of bleaching and disease in 2004 compared to 2003. The fate of the diseased colonies will be tracked through the use of images taken of each colony in 2004. The percent cover of the major functional groups has also remained similar between years (Tables 8, 9, and 10; Figure 5). Substrate and octocorals remain the two groups with the most cover for the region. Site BCA was added to the project as the fourth site in Broward County for the purpose of monitoring one of the unique *Acropora cervicornis* patches. With the recent interest in listing *A. cervicornis* as a protected species, it is important to note that BCA *A. cervicornis* cover increased slightly from 31% in 2003 to 39% in 2004.

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 as 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, channel deepening, and channel 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 diverting of millions of gallons of fresh water into the ocean, and the resultant reduction in salinity and 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 Monitoring Project to include sites in Broward, Miami-Dade, and Palm Beach 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 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.

ACKNOWLEDGMENTS

The following Fish & Wildlife Research Institute personnel assisted with project planning, management, site selection, and data collection and management and analysis: Jennifer Wheaton, Carl Beaver, Walter Jaap, Mike Callahan, Selena Kupfner, Shannon Wade, Jim Kidney, Stopher Slade, Erin McDevitt, Eric Ault, and Fred Voss.

The following NCRI personnel assisted with project planning, management, data collection, analysis, and report writing: David S. Gilliam, Brian E. Ettinger, Daniel Fahy, Elizabeth Fahy, Shaun Gill, Jamie A. Monty, Lauren Shuman, Brian Walker, and Richard E. Dodge.

The following Miami-Dade County Department of Environmental Resources Management personnel assisted with project planning, and site selection: Tim McIntosh and Steven Blair.

The following Broward County Environmental Protection Department personnel assisted with project planning, site selection, and data collection: Ken Banks, Lou Fisher, Dave Stout, and Joe Ligas.

The following Palm Beach County Environmental Resources Management personnel assisted with project planning and site selection: Janet Phipps.

This report was prepared by the National Coral Reef Institute, Nova Southeastern University Oceanographic Center under award (NA03NOS4260114) from the National Oceanic and Atmospheric Administration, U.S. Department of Commerce. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of the National Oceanic and Atmospheric Administration or the Department of Commerce.

LITERATURE CITED

Dodge, R.E., W. Goldberg, G.G. Messing and S. Hess. 1995. Final report Biological monitoring of the Hollywood-Hollandale beach renourishment. Prepared for the Broward County (BC) Board of County Commissioners, BC Dep. of Natural Resources (DNR), Biological Resources Division (BRD). 103 pp.

Gilliam, D.S., R.E. Dodge, R.E. Spieler, S.T. Thornton and L.K.B. Jordan. 2001 Marine Biological monitoring in Broward County, Florida: Year 1 Annual Report. Technical Report 01-08. Prepared for the BC Board of County Commissioners, BC DNR, BRD. 62 pp.

Gilliam, D.S., R.E. Dodge, R.E. Spieler, S.T. Thornton and L.K.B. Jordan. 2002 Marine Biological monitoring in Broward County, Florida: Year 2 Annual Report. Technical Report 02-01. Prepared for the BC Board of County Commissioners, BC DNR, BRD. 67 pp.

Jaap, W.C. 2000. Coral reef restoration. *Ecological Engineering*. Vol.15:345-364.

Johns, G.M., V.R. Leeworthy, F.W. Bell, and M.A. Bonn. 2003. Socioeconomic study of reefs in southeast Florida October 19, 2001 as revised April 18, 2003. Silver Spring MD: Special Projects NOS 255 pp.