FLORIDA KEYS NATIONAL MARINE SANCTUARY
WATER QUALITY PROTECTION PLAN
CORAL REEF AND HARDBOTTOM MONITORING PROJECT
ANNUAL REPORT (10/1/95-9/30/96)

submitted by

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Background

Coral reefs are by far the most diverse environments on earth (Sebens, 1994). Twenty-two of the twenty-three animal phyla are found on coral reefs worldwide (Table 1), whereas only eight phyla of animals are found in tropical rainforests. If insects are excluded from the analysis, then even the species diversity of coral reefs rivals that of rainforests. Within this coral reef biodiversity, particularly among cnidarians with symbiotic algae, a variety of compounds useful to humans are found. These include antibacterial compounds from Plexaura crassa (Ciereszko, 1962); anticancer agents, such as prostaglandin, identified first from in the Floridian octocoral Plexaura homomalla (Isay, Kafanova, and Zviagintseva, 1994); and bone-replacement compounds, such as Porites coral skeletons (Weindling, Robinette, and Wesley, 1992). The symbiotic relationship between the alga Symbiodinium and their coral host contributes to their novel chemistry that confers such great medicinal potential to humans (Ciereszko, 1962) and also to the extraordinary productivity of these environments.

Coral reefs are one of the oldest, most complex, and most productive communities on earth (Table 1) and are extremely efficient ecosystems. In general, tropical oceanic water is nutrient poor, which confers its highly-touted water clarity. Coral reefs thrive under these conditions; however, they have a relatively narrow set of requirements that define the physical oceanographic conditions under which they will flourish. These generalized requirements are presented in Table 1. Unfortunately, many of these physical oceanographic parameters, such as water clarity, nutrient load, and salinity are influenced by man in systems adjacent to urbanized areas.

Broad-scale long-term ecological data are virtually non-existent for many communities, but are especially lacking for oceanic communities. Satellite imagery, typically the source of this kind of information for terrestrial communities, is currently uninformative for sub-tidal communities. The scarce information regarding coral reef change through time for the Florida Keys, comes from either anecdotal photographs taken in the same place over a number of years (Greenberg and Ward, 1990; Shinn, 1993), or from more formal line-transect or photographic surveys from exactly the same place through time (Dustan and Halas, 1987; Porter and Meier, 1992; Jaap and Wheaton, in prep). All of these studies encompass only a small area and are from only a few coral reefs. In the Porter and Meier studies, the original photographic stations surveyed were few in number (8) and small in size but were located throughout the Florida Keys in Biscayne National Park, Key Largo National Marine Sanctuary, Looe Key National Marine Sanctuary, and off Key West.

Most (but not all) of these specific surveys recorded a reduction of living coral. On one reef, nearly half (46%) of the coral surveyed within the sampling site, between 1984 and 1991, died. The average rate of decline was 4% per year, but some sites at some reefs lost live coral cover a rate of 10% per year (Porter and Meier, 1992). Every reef site surveyed lost coral biodiversity, including the two reef sites that increased slightly in percent coral cover. These data lead to an overall impression of coral reef decline in the Florida Keys. Data from reef sites at Dry Tortugas (Jaap and Wheaton, in preparation) have indicated that these reef habitats have been relatively stable during the years sampled (1989 to present).

We need to document (1) if the pattern of decline is actually ecosystem-wide, or just a property of the few reefs surveyed, and (2) if the pattern of decline is continuing in its downward trajectory or has leveled off or reversed. The only reef site where coral cover increased during the survey was in Biscayne National Park, at the northern-most point of reef development in the continental U.S. Reefs in the lower Keys have more species and are better developed than most reefs in the upper Keys and therefore, presumably, reefs in the lower Keys are living under conditions more favorable to coral growth. Enigmatically, according to Porter and Meier (1992), these lower Keys reefs have exhibited the highest rates of coral decline.

Data on coral mortality attributed to Hurricane Andrew (Meier and Porter, in prep.) supports this pattern. Many northern reefs, even those in the eye of the storm, suffered less coral mortality than those completely isolated from the storm in the lower Keys. The post-hurricane survey on Ball Buoy Reef in Biscayne National Park indicated that “stresses” of an undetermined nature experienced by southern reefs are more deleterious to coral reef survival than a direct hit from a Class 4 hurricane. All of the reefs with documented declines in coral cover are inside established marine parks and sanctuaries (Figure 1). Drawing a political boundary around these reefs has clearly not prevented their deterioration.

The Florida Keys National Marine Sanctuary and Protection Act (HR5909) designated over 2,800 square nautical miles of coastal waters as the Florida Keys National Marine Sanctuary. The Act requires the US Environmental Protection Agency and the State of Florida to implement a Water Quality Protection Program in cooperation with NOAA. Programs in monitoring seagrass habitats, coral reefs and hardbottom communities, and water quality were instituted with the intent of integrating information with water quality as the central focus. A team of coral reef researchers from the College of Charleston, South Carolina (COC) (Dr. Phillip Dustan, Primary Investigator); University of Georgia (UGA) (Dr. James Porter, Primary Investigator) and Florida Department of Environmental Protection Marine Research Institute (FMRI) (Walter Jaap, Primary Investigator; Jennifer Wheaton, QA/QC officer) with a combined 80+ years of field experience were asked to collaborate on the design and implementation of the coral reef/hardbottom community monitoring project. The team considers this to be more than a simple monitoring project that will produce a general characterization of the Florida Keys Reefs. To answer if and how the reefs are changing, requires knowledge about the ecology of reef corals. It is a problem that needs to be grounded in the theory of population biology.

The general objective of the coral reef/hardbottom monitoring program is to measure the status and trends of these communities to assist managers in understanding, protecting, and restoring the living marine resources of the Florida Keys National Marine Sanctuary. Starting with the first principles of population biology we chose a simple model of population growth which states that the growth rate of a population is equal to the population’s instantaneous birth rate - instantaneous death rate integrated over all age groups.

We are operating from a set of unproven but testable hypotheses (Table 2). The null hypothesis (H_o) is that the coral communities are at dynamic equilibrium (no net change in percent cover or species richness over certain time scales). Alternative hypotheses (H_a) include: (1) overall net reef decline in percent cover, species richness, and other measurable community parameters, (2) overall net increase in measurable reef community parameters, (3) significant changes observed in individual reefs with no overall change on a landscape scale (decreases in one location balanced by increases elsewhere) or changes that are linked to specific regions of the landscape. Each of these potential mechanisms of change will result in different spatial patterns of change. These hypotheses demonstrate that a Sanctuary-wide, rather than a single-location survey, is necesary to detect ecosystem change. Even the first hypothesis, the “Null Hypothesis” requires system-wide monitoring.

Our team initiated a Sanctuary-wide coral reef and hardbottom monitoring program that will document the status of reef habitats at 40 different sites located within 5 of the 9 EPA Water Quality Segments in the Florida Keys National Marine Sanctuary (Figure 1). The randomly located reefs in this project may show no decline. Alternatively, if adverse global processes are functioning, then all the reefs may show decline. Pollution from Florida Keys sources or damage from divers will also give relatively precise signals. Two of our Sanctuary monitoring sites are located in proposed FKNMS replenishment areas. Data from the stations may provide information regarding controlled access. Furthermore, because the coral reef monitoring is integrated with the seagrass and water quality programs, the results can be used to focus research on determining causality and can be used to inform and evaluate management decisions. The Coral Reef Monitoring Project provides the first real opportunity in the Florida Keys to address these questions at the spatial scales required to detect large-scale patterns and discriminate between hypotheses.

Table 1. Generalized ecological characteristics and physical requirements of worldwide coral reef environments.

ECOLOGICAL CHARACTERISTICS OF CORAL REEFS

1. Most diverse (22 of 23 animal phyla)
2. Most complex (prevalence of symbiosis)
3. Most productive (2,000 $^{o}C\ m^{-2}\ y^{-1}$)
4. Oldest fossils (400 x 10^{6} yr. BP)

PHYSICAL REQUIREMENTS OF CORAL REEFS

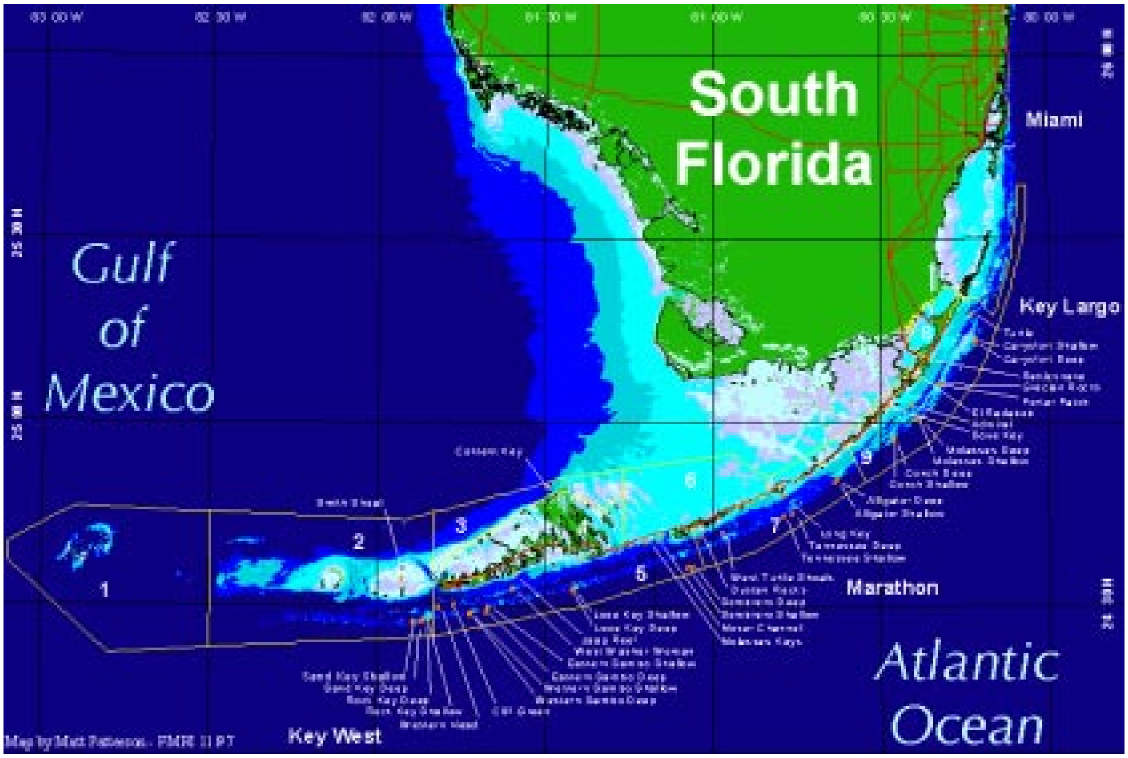
1. High Light (surface irradiance of 2,000 $\mu E\ m^{-2}\ s^{-1}$)
2. High Oxygen (5.0 - 7.0 mg $O_2\ l^{-1}$)
3. Low Turbidity (0.01 to 0.10 mg l^{-1})
4. Low Nutrients (0.10 to 1.0 μm [N or P])
5. Stable T^{o} (23 - 30 ^{o}C)
6. Stable Salinity (33 - 36 ppt)

Table 2. Hypotheses relative to status and trends of Florida's coral reefs.

Coral Reef Hypotheses

	Hypothesis	Emergent Pattern
Ho	Null Hypothesis - Dynamic Equilibrium	No net change
H^{a}_{1}	World wide ecosystem decline in coral reefs	Overall net decline
H^{a}_{2}	Worldwide ecosystem increase in coral reefs	Overall net increase
H^{a}_{3}	Landscape related changes	Localized changes
	A. Florida Bay water flow impact	Reefs near passes decline
	B. Florida Keys pollution impact	Reefs near inhabited islands decline and/or Reefs near-shore decline
	C. Diver/Fisherman impact	Reefs visited by divers/fishermen decline

(Non-mutually exclusive, testable alternative hypotheses)



Link to table of site codes, locations and coordinates.

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Table 1. Site/Station Data, Coral Reef / Hardbottom Monitoring Project

Site Code	Type	Site Name	Segment	Longitude (N)	Latitude (W)	Station	Depth (ft)	Date Installed	Reference
9P1	P	Turtle	9	80 13.1481	25 17.6647	1&2	11-18	5/24/95	Buoy T6
				80 13.0505	25 17.7448	3&4	13-23	5/24/95	
9D1	O D	Carysfort Deep	9	80 12.5915	25 13.2481	1&2	41-53	5/23/95	Bouy CF3
				80 12.5218	25 13.3599	3&4	40-47	5/23/95	Buoy CF6
9S1	O S	Carysfort Shallow	9	80 12.628	25 13.205	1	8-9	5/23/95	Bouy CF1
				80 12.643	25 13.245	2	5-8	5/23/95	Bouy CF2
				80 12.5851	25 13.3339	3&4	8-14	5/23/95	Bouy CF5
9H1	H B	Rattlesnake	9	80 20.850	25 10.415	1-4	5-6	5/17/95	
9S2	O S	Grecian Rocks	9	80 18.410	25 06.450	1&2	8-11	5/25/95	Bouy G1
				80 18.4155	25 06.4528	3&4	14-25	5/25/95	Bouy G12
9P3	P	Porter Patch	9	80 19.4586	25 06.1899	1-4	13-17	5/25/95	
9H2	H B	El Radabob	9	80 22.6937	25 07.2068	1-4	9	5/15/95	
9D3	O D	Molasses Deep	9	80 22.5338	25 00.4311	1&2	40-44	5/16/95	Bouy M26
				80 22.4558	25 00.4405	3&4	45-49	5/15/95	Bouy M27
9S3	O S	Molasses Shallow	9	80 22.5850	25 00.5181	1	13-19	5/16/95	Bouy M4
				80 22.5042	25 00.5508	2	15-22	5/16/95	Bouy M6
				80 22.4371	25 00.5521	3	20-23	5/16/95	Bouy M9
				80 22.4365	25 00.5795	4	17-28	5/16/95	Bouy M11
9P4	P	Admiral	9	80 23.685	25 02.684	1-4	3-6	5/17/95	
9H3	H B	Dove Key	9	80 28.1025	25 02.6793	1-4	8	5/17/95	
9D4	O D	Conch Deep	9	80 27.0807	24 57.1114	1-4	46-54	6/12/95	
9S4	O S	Conch Shallow	9	80 27.4373	24 57.3188	1&2	16-19	6/12/95	Bouy CO2
				80 27.4544	24 57.3995	3&4	16-21	6/12/95	Bouy CO3
7D1	O D	Alligator Deep	7	80 37.2563	24 50.7100	1-4	34-38	6/14/95	
7S1	O S	Alligator Shallow	7	80 37.3812	24 50.7723	1&2	13-16	6/14/95	Bouy A2
				80 37.3393	24 50.7792	3&4	10-12	6/14/95	Bouy A3
7D2	O D	Tennessee Deep	7	80 45.4696	24 45.1621	1-4	43-44	6/16/95	
7S2	O S	Tennessee Shallow	7	80 46.8683	24 44.7058	1-4	17-21	6/16/95	
7H2	H B	Long Key	7	80 47.040	24 47.834	1-4	12-13	9/29/95	ATON 44
7P1	P	W. Turtle Shoal	7	80 58.0127	24 41.9572	1-4	16-24	3/25/95	ATON 47
7P2	P	Dustan Rocks	7	81 01.8101	24 41.3676	1-4	12-21	3/27/95	W. Bouy
5D1	O D	Sombrero Deep	5	81 06.7040	24 37.3347	1&2	45-52	12/6/94	Bouy #20
				81 06.6315	24 37.3854	3&4	47-48	12/7/94	Bouy #21
5S1	O S	Sombrero Shallow	5	81 06.6240	24 37.5310	1	17-18	12/8/94	Bouy #5
				81 06.6950	24 37.5178	2	16-20	12/8/94	Bouy #1
				81 06.5569	24 37.5609	3	13-20	12/8/94	Bouy #22
				81 06.5543	24 37.6080	4	8-9	12/8/94	Bouy #12
5H1	H B	Moser Channel	5	81 10.0502	24 41.3450	1-4	12-13	3/30/95	ATON 4
5H2	H B	Molasses Keys	5	81 11.4294	24 40.5371	1-4	12-14	3/30/95	
5D2	O D	Looe Key Deep	5	81 24.9178	24 32.5230	1&2	41-44	6/20/95	Bouy L53
				81 24.7671	24 32.5582	3&4	38-42	6/20/95	Bouy L51
5S2	O S	Looe Key Shallow	5	81 24.4766	24 32.7157	1	12-24	6/20/95	Bouy L7
				81 24.424	24 32.714	2	21-24	6/20/95	Bouy L8
				81 24.38	24 32.720	3&4	15-25	6/24/95	Bouy L24
5P1	P	W. Washer Women	5	81 35.1934	24 32.8480	1-4	15-25	6/19/95	
5H3	H B	Jaap Reef	5	81 34.9568	24 35.1421	1-4	6-9	7/14/95	
5D3	O D	Eastern Sambo Deep	5	81 39.9514	24 29.3029	1-4	43-48	7/13/95	
5S3	O S	Eastern Sambo Shallow	5	81 39.8139	24 29.5013	1-4	43-48	7/13/95	
5D4	O D	Western Sambo Deep	5	81 43.0275	24 28.6808	1&2	38-40	7/18/95	
				81 42.8665	24 28.7830	3&4	24-29	7/18/95	Bouy #10
5S4	O S	Western Sambo Shallow	5	81 43.0293	24 28.7708	1&2	11-17	7/18/95	Bouy #13
				81 42.9702	24 28.7594	3&4	7-9	7/18/95	Bouy #11
5P2	P	Western Head	5	81 48.3343	24 29.8625	1-4	26-35	7/18/95	ATON 3A
5P3	P	Cliff Green	5	81 46.059	24 30.216	1-4	20-26	7/18/95	
5D5	O D	Rock Key Deep	5	81 51.4076	24 27.1929	1-4	37-42	7/13/95	
5S5	O S	Rock Key Shallow	5	81 51.5674	24 27.2856	1	6-15	7/13/95	Bouy #9
				81 51.5890	24 27.2852	2-3	16-17	7/13/95	Bouy #8
				81 51.4213	24 27.2853	4	6-9	7/13/95	Bouy #3
3H1	H B	Content Keys	3	81 29.335	24 49.323	1-4	17-19	7/10/95	
2D1	O D	Sand Key Deep	2	81 52.7875	24 27.0836	1-4	24-35	7/12/95	Bouy #17
2S1	O S	Sand Key Shallow	2	81 52.6190	24 27.1108	1-4	10-21	7/14/95	Bouy #12
2P1	P	Smith Shoal	2	81 55.1757	24 43.1895	1-4	19-26	7/10/95	

HB: Hardbottom OD: Offshore Deep OS: Offshore Shallow P: Patch Revised 6/99 MEP

Methods

During 1995, a variety of sampling methods were tested underwater to assess the feasibility of their use in the program. These were presented in the CRMP First Annual Report (November, 1995). Dustan Lab prepared a presentation of justification for methods changes and a follow-up that addressed specific points raised by individuals from the 5-member CRMP Peer Review Panel.

Video Sampling

Several tests were conducted relating to video sampling: video configurations (distance from reef surface; artificial light versus ambient light; automatic versus manual focus controls); and 8-mm video cameras versus others. The Sony CCD-VX3 camera (Figure 2) was selected for the project. This camera, with three color processing chips (red, green, blue) provided better resolution and color than the single-chip video cameras. In tests and evaluations (with and without lights, at different distances from the reef surface, and with manual and automatic focusing), the Sony camera functioned best with full automatic settings and two 50 watt lights (Figure 2). The closer the camera is to the substrate, the easier it is to identify coral colonies to species. Distances ranging from 40 cm to 60 cm were tested. The optimum height of the camera above the substrate was determined to be 40 cm. At distances less than 40 cm, the area sampled was too small to be representative of the reef; distances greater than 60 cm were too great to allow for accurate coral identification. All sampling for 1996 was conducted with the Sony CCD-VX3 with artificial lights at 40 cm above the benthos.

The Porter Lab and the UGA Instrument Shop, in collaboration with the Dustan Lab, designed and manufactured accessory video field equipment: clapperboard for filming date and site information for video transects and a convergent laser light system for videocamera guidance. Dustan Lab also modified the lighting system for the videocamera by integrating the two 50-Watt lamps and a wiring harness, and fabricated a frame for the lights to ensure uniform lighting of the surface area. A buoyant frame for the videocamera housing (which holds the battery and renders the housing neutrally buoyant in seawater) was designed and constructed by the Dustan Lab. This frame orients the camera, helping point the lens downward to maintain the camera in a vertical position for filming.

The protocol for video sampling is presented in detail in the Standard Operating Procedures. In brief, the videographer focuses on a “clapper board” (Figure 3a). The clapper board is videoed on the film leader just prior to the beginning of each transect. The original film therefore contains the complete record of the date and location of each film segment. During sampling, the distance from the benthos is maintained constant by focusing the cross-beam of paired laser lights (Figure 2, 3b). Video sampling was designed to be conducted in a transect format. We sampled 40 reef sites, (4 video units each), for a total of 160 video units (3 transects/unit yielding a total of 480 individual transects).

Results from this first sampling year (1996) will be used to determine if an increase or a decrease in sampling intensity is warranted. The video will also allow “retro-sampling” to be accomplished due to the archival nature of stored video imagery.

Species Inventory

Methods to verify video image analysis and provide supplemental species identification and enumeration data were researched the first year. Detailed discussion/protocols were presented in the CRMP First Annual Report (November, 1995). Counts representing the presence of coral species in plots formed by the video units (stations) with enumeration of selected “disease” conditions were selected as the optimum method.

The video unit census method (station species inventory) is described in detail in the Standard Operating Procedures. Principal investigators and qualified observers (Dustan, Jaap, and Porter; Meier, K. Patterson and Wheaton) collected stony coral species presence data within all stations, at all sites during 1996. To summarize, two observers conducted simultaneous 15-20 minute inventories within the roughly 22 x 2 m video stations (Figure 3 c) and entered the data on pre-printed underwater data sheets (Figure 5). Each observer recorded all scleractinian corals, fire corals (*Millepora* spp.), and long spined urchins (*Diadema antillarum*) within the station boundaries. After recording the data, observers compared counts and resolved any taxonomic differences. Data were again verified aboard the vessel.

In addition to “on site” training by principal investigators, a set of close-up photographic images of corals were taken by Dustan Lab, identifications were confirmed among investigators and a draft CRMP stony coral species identification guide was compiled. Photos from Reef Coral Identification (Humann, 1993) were also used for reference. Verified data was submitted to the senior scientist to forward to FMRI for data entry and processing. This method provided data to estimate stony coral species richness (“S”) and facilitated data collection with broad spatial coverage at optimal expenditure of time and labor.

Figure 2. Sony CCD-VX3 camera in Housing.

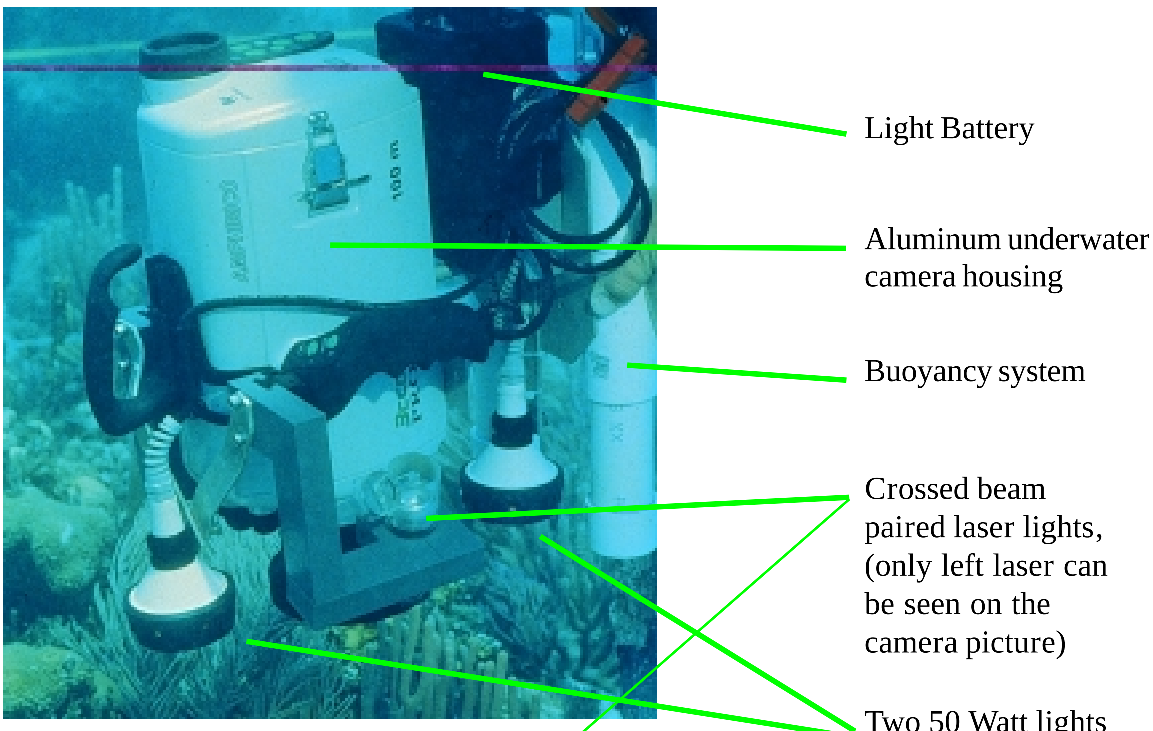

Figure 3b. Lasers on a brain coral.

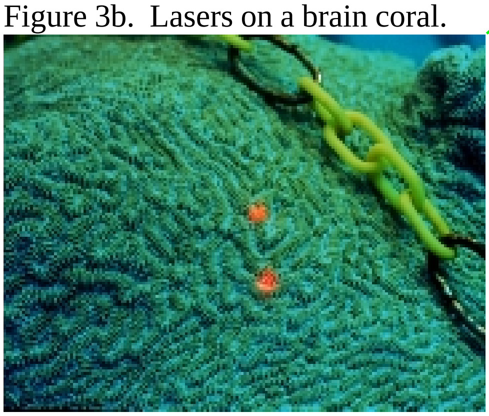

Figure 3a. Video clapper board.

Figure 3c. Station Species Inventory data collection. The Scientist takes a census on a pre-printed underwater data sheet.

Station Species Inventory Data Form

Coral Reef Monitoring Project

Mark an X in the small box right of species code to indicate presence.
Use codes to characterize conditions and diseases in species subbox.

H=Bleaching B=Black Band W= White Diseases O=Other Disease C=Confirmed Observation

A.cer		A.pal		A.agar		A.frag		A.lam		C.arb	
C.nat		D.cyl		D. sto		D.cliv		D.lab		D.str	
E.fas		F.frag		I.rig		I.sin		L.cuc		M.dec	
M.mir		M.areo		M.mean		Mp.alc		Mp.com		M.ann	
M.cav		My.ali		My.dan		My.fer		My.lam		M. ang	
Mussid juv		O.dif		P.ame		P.ast		P.bran		P.por	
S.cub		S.lac		S.bour		S.hyad		S.rad		S.sid	
S.mich		Diadema									
		(#)									

Site Code ____________ **Site Name** ______________________________ **Station** 1 2 3 4

Date___________ **Collector** __________________ **Start Time (hh:mm)** _____ : _____ **Stop** ____ : ____

Cross-Ref (name) ___________________________ **Data Entry (init.)** _________ **Date** _______

Table 9. Taxonomic List* of Hydrozoan and Scleractinian Corals from Species Inventories.

PHYLUM CNIDARIA
- **CLASS HYDROZOA**
  - **ORDER ATHECATE**
    - **Family Milleporidae**
      - *Millepora alcicornis* Linne, 1758
      - *Millepora complanata* Lamarck, 1816
- **CLASS ANTHOZOA**
  - **SUBCLASS ZOANTHARIA**
    - **ORDER SCLERACTINIA**
      - **SUBORDER ASTROCOENIINA**
        - **Family Astrocoeniidae**
          - *Stephanocoenia michelinii* Milne Edwards and Haime, 1848
        - **Family Pocilloporidae**
          - *Madracis decactis* (Lyman, 1859)
          - *Madracis mirabilis* sensu Wells, 1973
        - **Family Acroporidae**
          - *Acropora cervicornis* (Lamarck, 1816)
          - *Acropora palmata* (Lamarck, 1816)
      - **SUBORDER FUNGIINA**
        - **Family Agaricidae**
          - *Agaricia agaricites* ((Linne, 1758) [COMPLEX]**
          - *Agaricia fragilis* (Dana, 1846)
          - *Agaricia lamarcki* Milne Edwards and Haime, 1851
          - *Leptoseris cucullata* (Ellis and Solander, 1786)
        - **Family Siderastreidae**
          - *Siderastrea radians* (Pallas, 1766)
          - *Siderastrea siderea* (Ellis and Solander, 1786)
        - **Family Poritidae**
          - *Porites astreoides* Lamarck, 1816
          - *Porites branneri* Rathbun, 1888
          - *Porites porites* (Pallas, 1766) [COMPLEX]**
      - **SUBORDER FAVIINA**
        - **Family Faviidae**
          - *Cladocora arbuscula* (Lesueur, 1821)
          - *Colpophyllia natans* (Houttuyn, 1772)
          - *Diploria clivosa* (Ellis and Solander, 1786)
          - *Diploria labyrinthiformis* (Linne, 1758)
          - *Diploria strigosa* (Dana, 1846)
          - *Favia fragum* (Esper, 1795)
          - *Manicina areolata* (Linne, 1758)
          - *Montastraea cavernosa* (Linne, 1767)
          - *Montastraea annularis* (Ellis and Solander, 1786) [COMPLEX]**
          - *Solenastrea bournoni* Milne Edwards and Haime, 1850
          - *Solenastrea hyades* (Dana, 1846)

Family Rhizangiidae

Astrangia poculata (Ellis and Solander, 1786)
Phyllangia americana Milne Edwards and Haime, 1849

Family Oculinidae

Oculina diffusa Lamarck, 1816

Family Meandrinidae

Dendrogyra cylindrus Ehrenberg, 1834
Dichocoenia stokesi Milne Edwards and Haime, 1848
Meandrina meandrites (Linne, 1758)

Family Mussidae

Isophyllastraea rigida (Dana, 1846)
Isophyllia sinuosa (Ellis and Solander, 1786)
Mussa angulosa (Pallas, 1766)
Mycetophyllia lamarckiana Milne Edwards and Haime, 1848
Mycetophyllia danaana Milne Edwards and Haime, 1849
Mycetophyllia aliciae Wells, 1973
Mycetophyllia ferox Wells, 1973
Scolymia cubensis Milne Edwards and Haime, 1849
Scolymia lacera (Pallas, 1766)

SUBORDER CARYOPHYLLIINA

Family Caryophylliidae

Eusimilia fastigiata (Pallas, 1766)

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*Systematics follows Wells and Lang, 1973 and Cairns *et. al.* 1991.

**Agaricia agaricites* COMPLEX may include:
agaricites (Linne, 1758)
carinata Wells, 1973
danai Milne Edwards and Haime, 1860
purpurea (Lesueur, 1821)

**Porites porites* COMPLEX may include:
porites (Pallas, 1766)
clavaria Lamarck, 1816
furcata Lamarck, 1816
divaricata Lesueur, 1821

**Montastraea annularis* COMPLEX may include:
annularis (Ellis and Solander, 1786)
faveolata (Ellis and Solander, 1786)
franksi (Gregory, 1895)

Disease Categories

Coral Reef Monitoring Project

Diploria strigosa

Montastrea annularis

Diploria labyrinthiformes

Montastrea annularis

Black Band Disease

Bleaching

White Diseases
(White Plague)

Other Diseases
(Ring Bleaching)

Montastrea annularis

Diploria labyrinthiformes

Leptoseris cucullata

Montastrea annularis

Results

Sanctuary-wide

Forty-three taxa (species and species complexes) were represented in the data set. A taxonomic list of these taxa is presented in Table 9. Those taxa that may include a complex of closely related forms are Agaricia agaricites, Porites porites, and Montastraea annularis. Based on field testing, determinations for these taxa varied among investigators. These taxa are also referred to in the literature inconsistently (as forma, species, or subspecies) (Vaughan 1901, Squires 1958, Wells 1973, Weil and Knowlton 1994, Van Veghel et al. 1996).

Two taxa (Millepora alcicornis and Porites porites complex) were observed at all sites (Table 10a). Millepora alcicornis also occurred most frequently (Table 10b). Another 11 taxa were observed at 30 (75%) of the 40 sites. Four of the most frequently occurring of these prior taxa included Porites astreoides, Siderastrea siderea, Porites porites, and Agaricia agaricites complex. At half the sites, seven additional taxa were recorded. Five taxa were observed at 10% or less of the sites. Of these five, Solenastrea hyades was restricted to hardbottom site types, Dendrogyra cylindrus occurred at only shallow offshore sites, and Porites branneri was primarily observed at patch reef sites and one deep offshore site. Astrangia poculata and Dendrogyra cylindrus were the least frequently occurring (0.63) of all 43 taxa recorded (Table 10b). A range of seven to 35 taxa were recorded per site with an overall mean of 21.9 taxa per site.

By Site Type

Of the 43 total taxa observed, 19 were recorded at all four site types (Table 11a). Only three species were restricted to a single site type (Acropora palmata and Dendrogyra cylindrus-offshore shallow reef, Solenastrea hyades-hardbottom). Dendrogyra cylindrus was also the least frequently observed (Table 11b). Patch reefs had the greatest total number of taxa (40), shallow and deep offshore reefs had an intermediate number of taxa (34 and 36) and hardbottom sites had the least taxa (25).

Variability was greatest at patch reef sites and least at offshore deep sites (Figure 10). Long Key (7H2) had the most taxa (19) of the hardbottom sites; Molasses Key (5H2) had the fewest taxa (7) (Tables 12a,b). Western Head (5P2) had the most taxa (35) and Admiral (9P4) had the fewest taxa (16) for the patch reef sites (Tables 13a,b). Sand Key (2S1) and Grecian Rocks (9S2) had the greatest number of taxa (28) and Eastern Sambo (5S3) had the fewest (12) of the offshore shallow reef sites (Tables 14a,b). For offshore deep reef sites (Tables 15 a,b), Eastern Sambo (5D3) and Tennessee (7D2) had the most taxa (32 and 31, respectively) and Alligator (7D1) had the fewest (21). Table 16 summarizes most and least taxa at individual sites by type. Mean taxonomic richness was greatest at offshore deep and patch reef site types and least at hardbottom sites (Table 17).

Bray Curtis Similarity classification pattern for hardbottom sites (Figure 11) documents that Rattle Snake Key (9 H1), El Radabob (9H2), Dove Key (9H3), and Molasses Keys (5H2) are similar. These sites are relatively close to shore. Long Key (7H2) and Moser Channel (5H1) are also closely linked; Jaap Reef was relatively similar; Content Keys were least similar (Figure 11). Rattlesnake Key and El Radabob Key sites (9H1 - 9H2) were most similar (82.76) and Molasses Key and Jaap Reef (5H2 - 5H3) were least similar (34.92) (Table 18). Hardbottom sites had the lowest mean site similarity and the greatest variability of all site groups (Figure 12). Variability was high because some sites had very few taxa, e.g., Dove Key (9) whereas other sites were much richer taxonomically (Long Key, 19).

West Turtle Shoal, Dustan Rocks, Turtle Reef, and Cliff Green exhibited high similarity among patch reef sites (Figure 13). Dustan Rocks and West Turtle Shoal were the most similar (84.69, Table 19). Admiral Reef and Western Head were least similar (54.61) to each other; however, Smith Shoal was least similar to all other patch reef sites.

Sombrero (5S1), Looe Key (5S2), Molasses (9S3) and Sand Key (2S1) were the most similar (Table 19, Figure 14) among shallow offshore sites. Carysfort (9S1), Western Sambo (5S4) and Rock Key (2S1) were also closely related. Conch (9S4) was least similar to most offshore shallow sites; however, Eastern Sambo (5S3) and Grecian Rocks ((9S2) had the lowest similarity value (54.46) (Table 20). The mean and standard deviation were similar to that of the previous patch reef sites (Figure 12).

Seven offshore deep reef sites (Carysfort, Sombrero, Looe Key, Eastern Sambo, Tennessee, Rock Key and Sand Key) clustered with greater than 80% similarity (Figure 15, Table 21). Molasses and Conch also had greater than 80% similarity (86.21); however, they were slightly less similar to the aforementioned sites. Alligator (7D1) and Western Sambo (5D4) were least similar (61.42) among offshore deep sites. Outer reefs exhibited highest intersite similarity among all site types; however, variability was quite similar to that for offshore shallow reef sites (Figure 12).

Classification of all sites (Figure 16) documents that seven of eight hardbottom sites clustered at slightly greater than 50% similarity. Jaap Reef (off Sugarloaf Key) is included as a hardbottom type; however it is more similar to a patch reef community. Although it is very close to shore, it has high relief massive Montastraea annularis colonies typical of patch reefs. Only Rattle Snake and El Radabob hardbottoms had greater than 80% similarity.

Five of the patch reef sites clustered at greater than 70% similarity. Again, Smith Shoal, Porter, and Admiral were least similar among patch reefs. Nine of twelve shallow offshore sites were linked at 70% similarity. Grecian Rocks and Tennessee shallow sites were linked outside the main group of shallow sites. Ten of eleven offshore deep reef sites were clustered at 75% similarity.

Multi-Dimensional Scaling ordination analysis for the hardbottom sites loosely clustered Long Key, Moser Channel, and Jaap Reef together (Figure 17). Rattle Snake, El Radabob and Dove were also loosely clustered. Content Keys and Molasses Keys sites were the least equivalent among hardbottom sites.

Turtle Reef, West Turtle Shoal, Dustan Rocks, and Cliff Green were most closely related in a larger cluster of patch reefs (Figure 18) which also included West Washer Woman, Western Head, and Porter Patch. Admiral and Smith Shoal were outside the primary cluster.

Among offshore shallow sites, Western Sambo, Rock Key, and Carysfort were closely clustered (Figure 19). Five other sites clustered loosely whereas Grecian Rocks, Eastern Sambo and Conch were outside these two clusters.

Tennessee, Rock Key, Sombrero, Looe Key, and Eastern Sambo offshore deep sites were grouped closely (Figure 20). Sand Key and Carysfort deep sites were proximal to the primary cluster of offshore deep sites. Conch and Molasses offshore deep stations were clustered together but separate from the primary cluster. Alligator and Western Sambo sites displayed the weakest linkage to the other offshore deep sites.

Figure 21 exhibits the pooled MDS ordination of hardbottom, patch reef, offshore shallow, and offshore deep sites. The patch reef and offshore deep sites were enmeshed in an overlapping cluster. The offshore shallow sites also clustered relatively closely. Proximity of the Looe Key Shallow site and Western Sambo deep site nearly linked the two clusters. The two Gulf sites (one patch and one hardbottom) were linked and were depicted as related to the loosely clustered remaining hardbottom sites.

Species Inventory Summary

Overall, a few species were restricted to particular site types, but the majority of species occurred throughout the Sanctuary. Both the Bray Curtis and Multi-Dimensional Scaling analyses provided similar results in relating sites within each site type and comparing among the four site types.

On a broad scale, the analyses indicated that although there were discernible differences among the stony coral taxa present at hardbottom and offshore shallow site types, there were few differences in stony coral taxa present at offshore deep and patch reef sites. There were also no major differences in stony coral taxa present among the same types in different water quality segments (on a Sanctuary-wide basis).

Disease and bleaching (condition) information were recorded during regular sampling at hardbottom, patch reef and offshore sites. 26 of 160 stations showed disease conditions in 1996. White diseases were seen at 7 stations, black band disease was seen at 7 stations, and other diseases were seen at 16 stations (Table 22a). Showing the highest frequency of disease conditions, Montastrea annularis complex was observed with disease conditions on 11 occasions (Table 22b).

Bleaching was the most often recorded abnormality (Figure 22). No more than one incidence of any abnormality was recorded for any species at a hardbottom site. At patch reefs, eight abnormalities was the maximum with seven of the eight bleached cases for Siderastrea siderea. At offshore shallow reefs, seven abnormalities were the maximum. Bleaching was again the abnormality recorded in six of seven cases for Favia fragum. The maximum number of abnormalities recorded for any one species overall was 11 (Siderastrea siderea and Montastrea annularis complex).

Figure 10. Taxonomic Richness by Site Type.

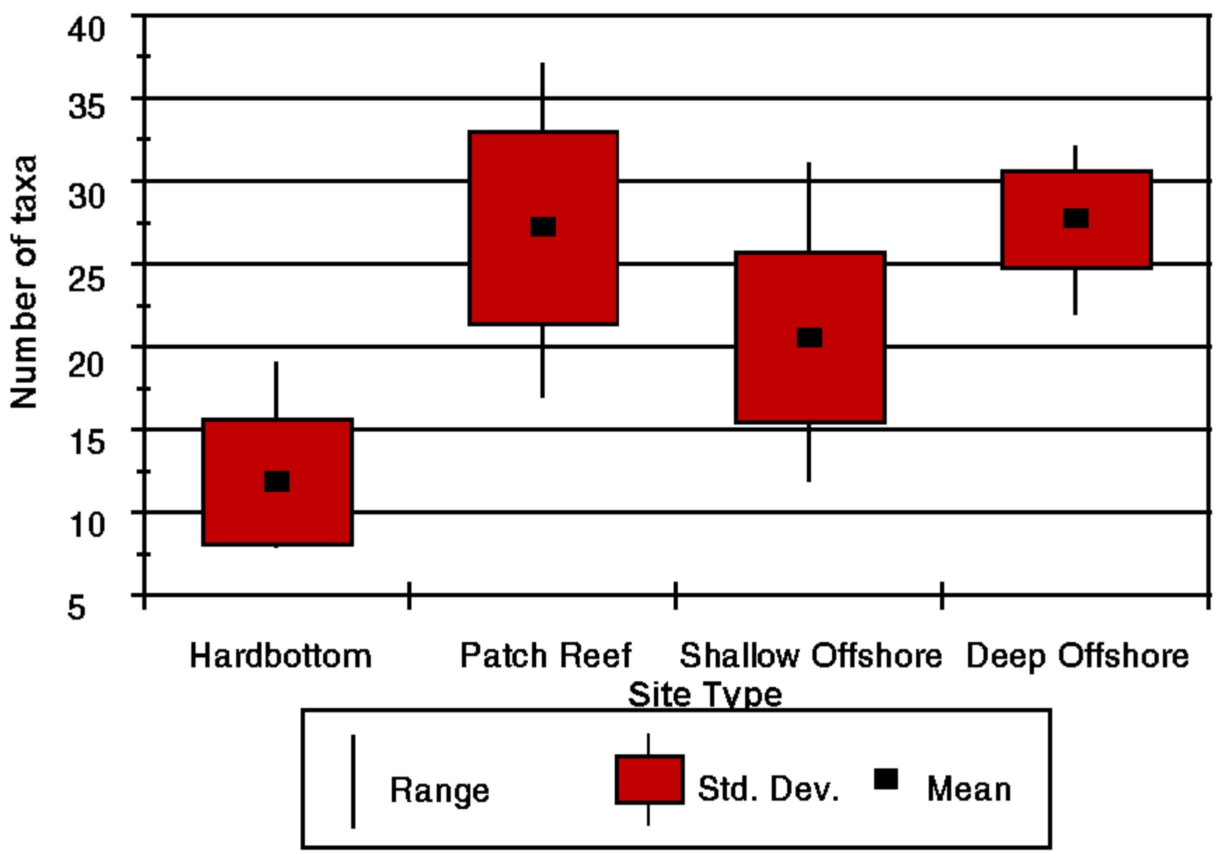


Figure 11.
Classification, Hardbottom Sites

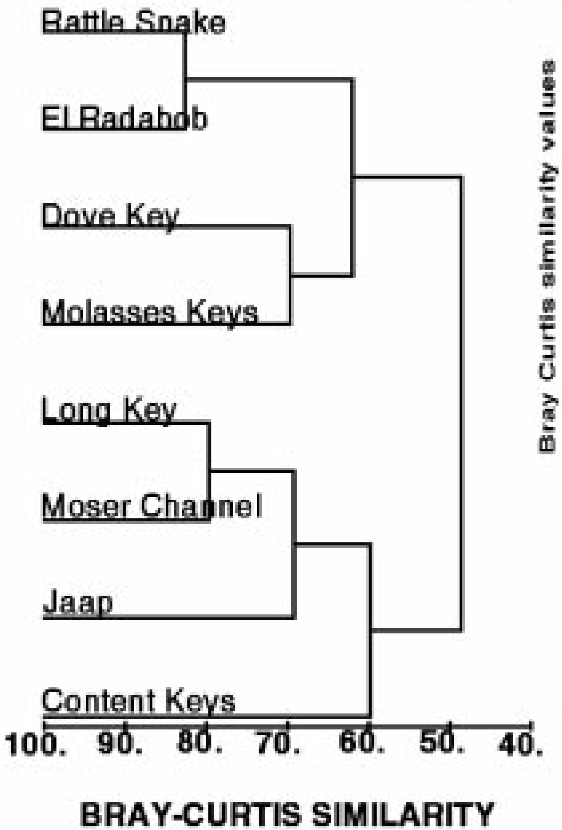


Figure 12.
Similiarity of Sites Within Site Types.

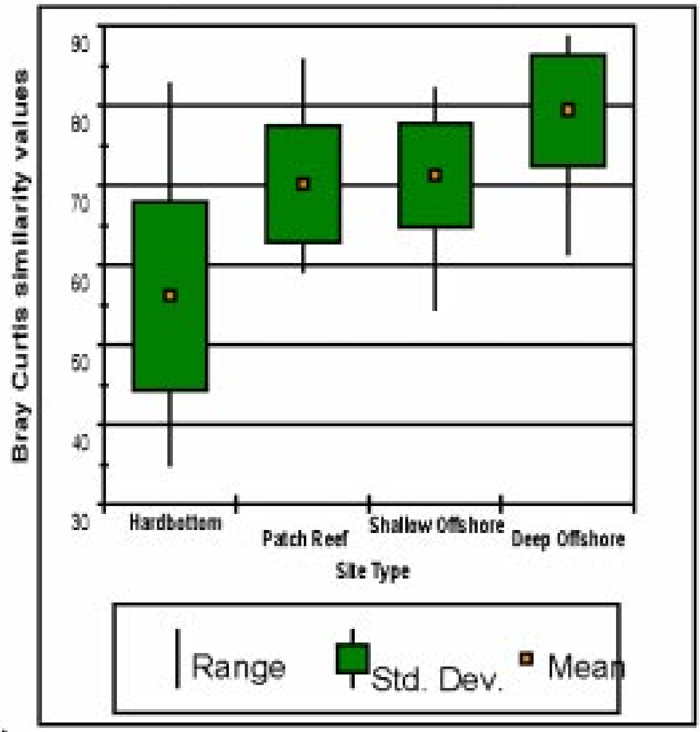


Figure 13.
Classification, Patch Reef Sites.

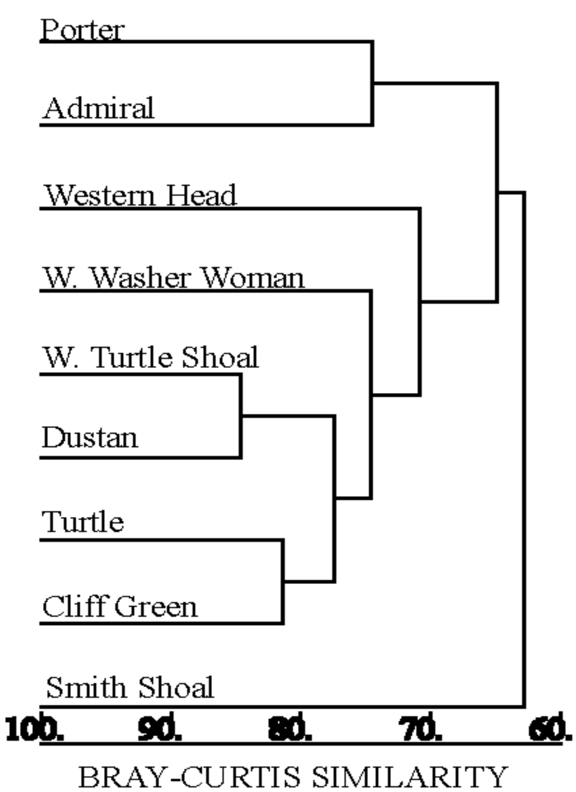


Figure 14.
Classification, Shallow Offshore Sites

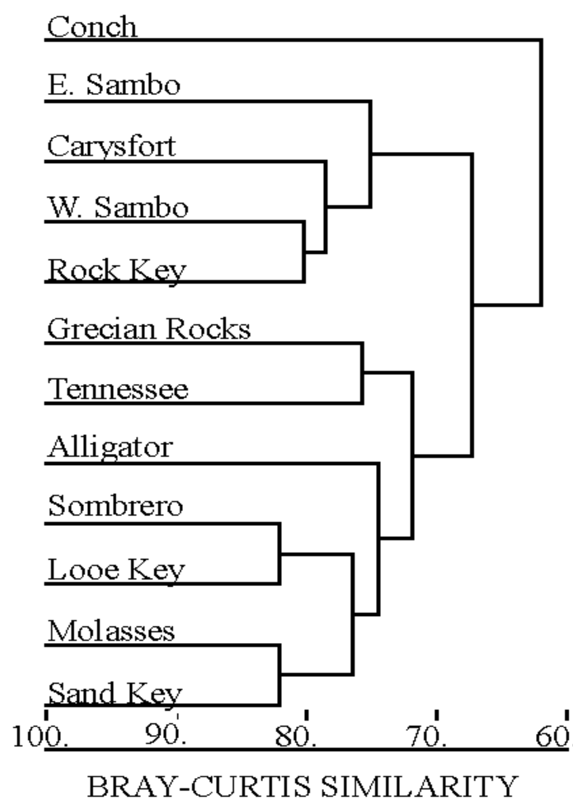


Figure 15.
Classification, Deep Offshore Sites

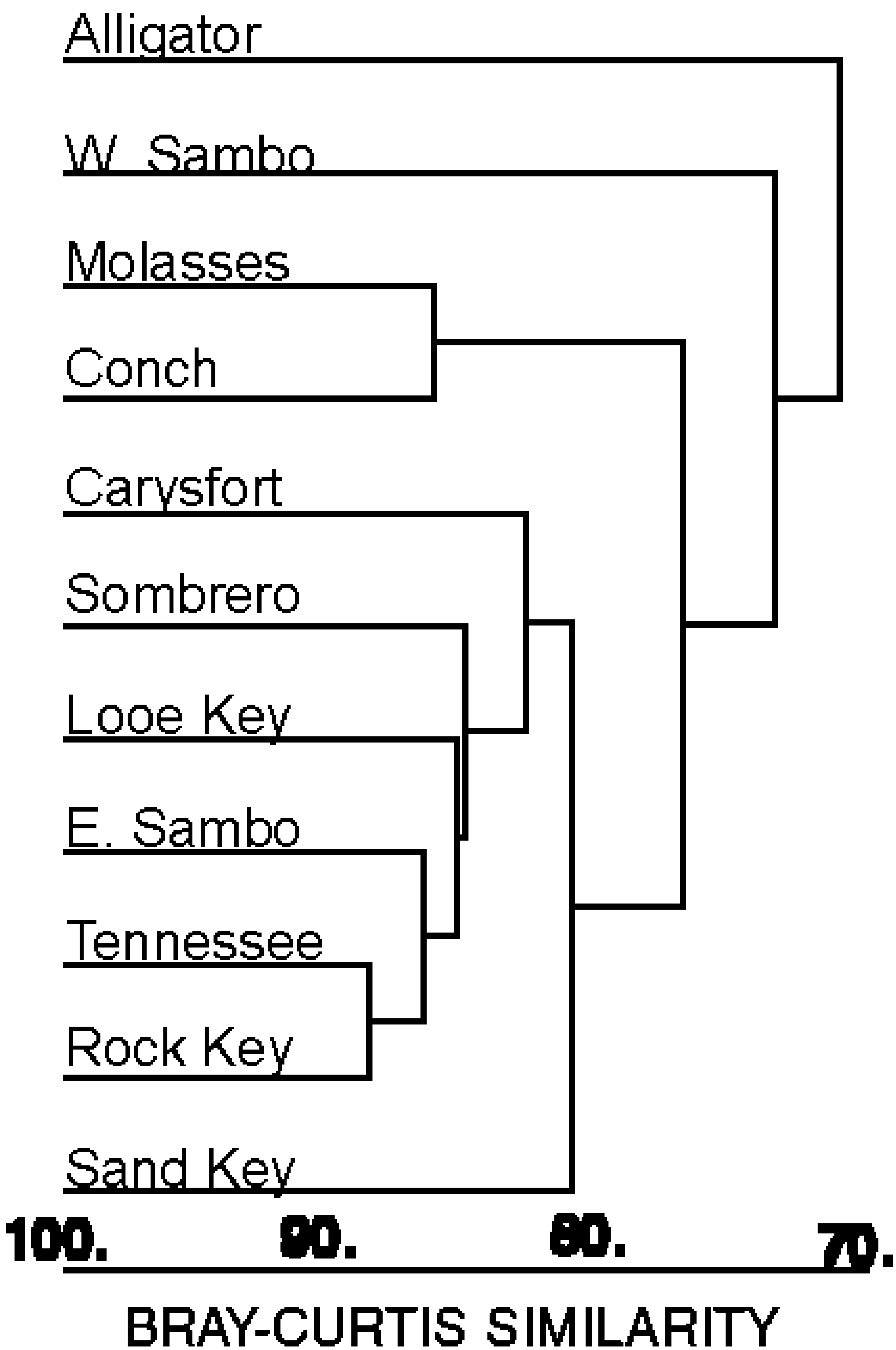


Figure 16. Classification, All Sites

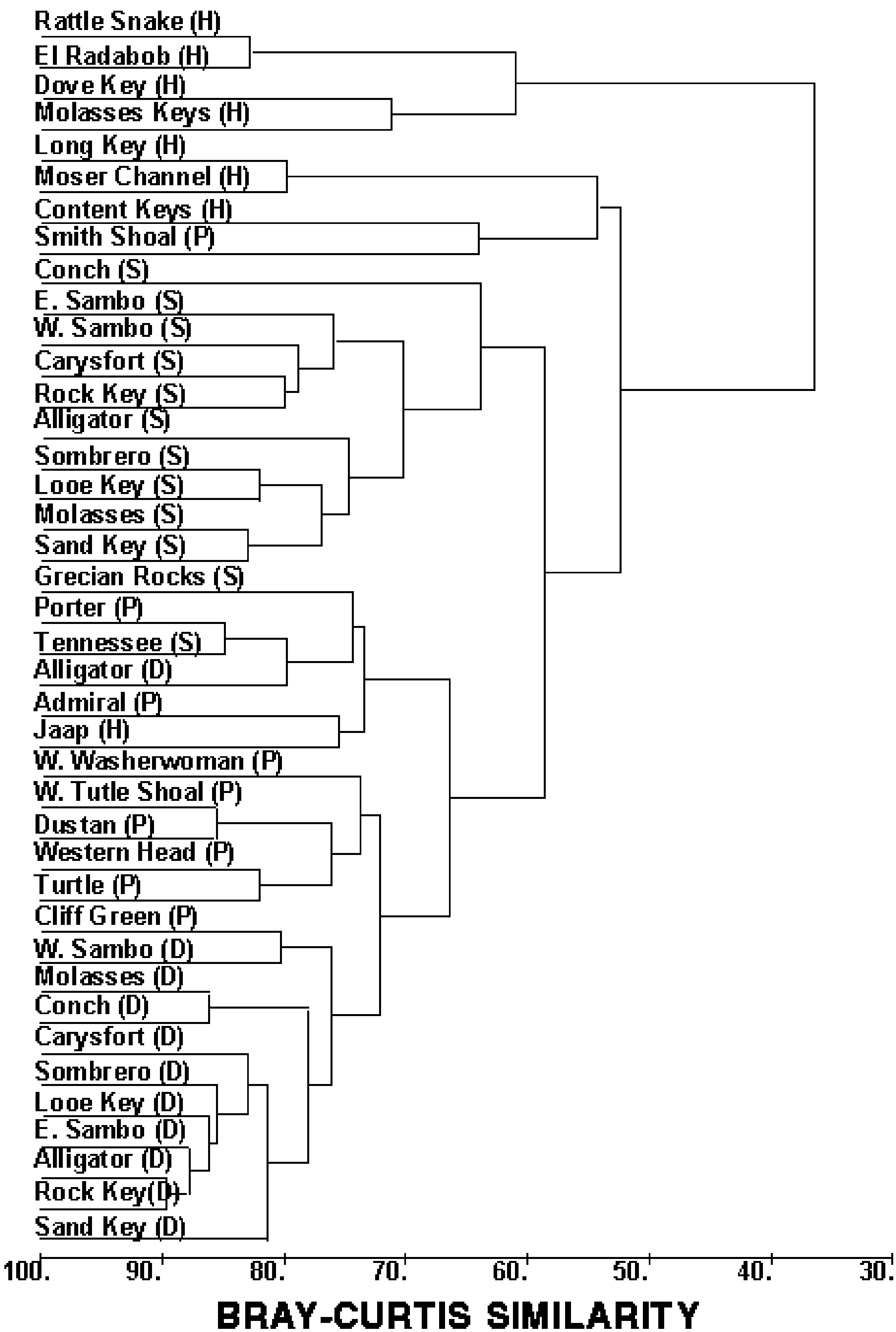


Figure 17.
MDS Ordination of Hardbottom Sites.

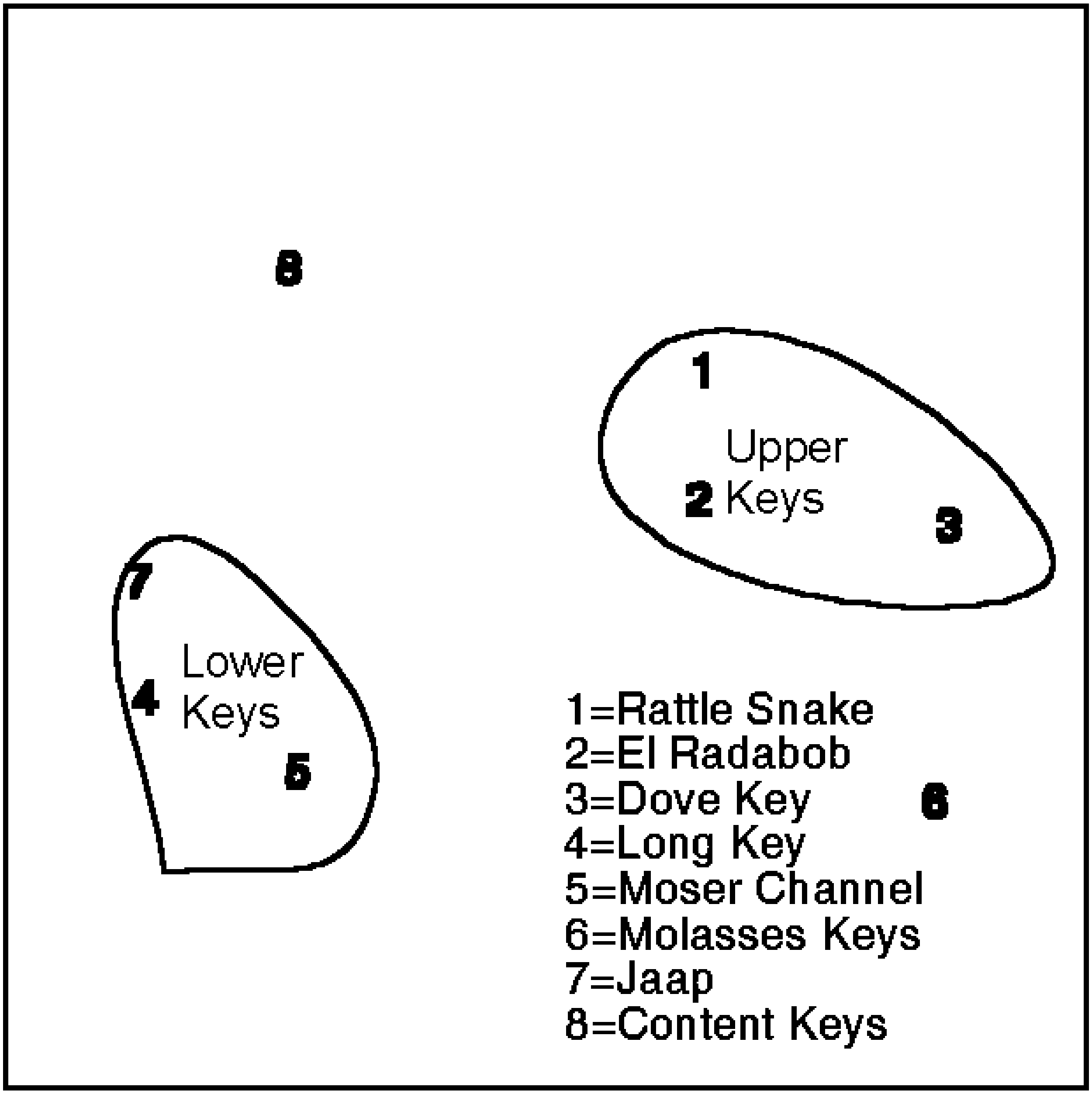


Figure 18.
MDS Ordination of Patch Reef Sites.

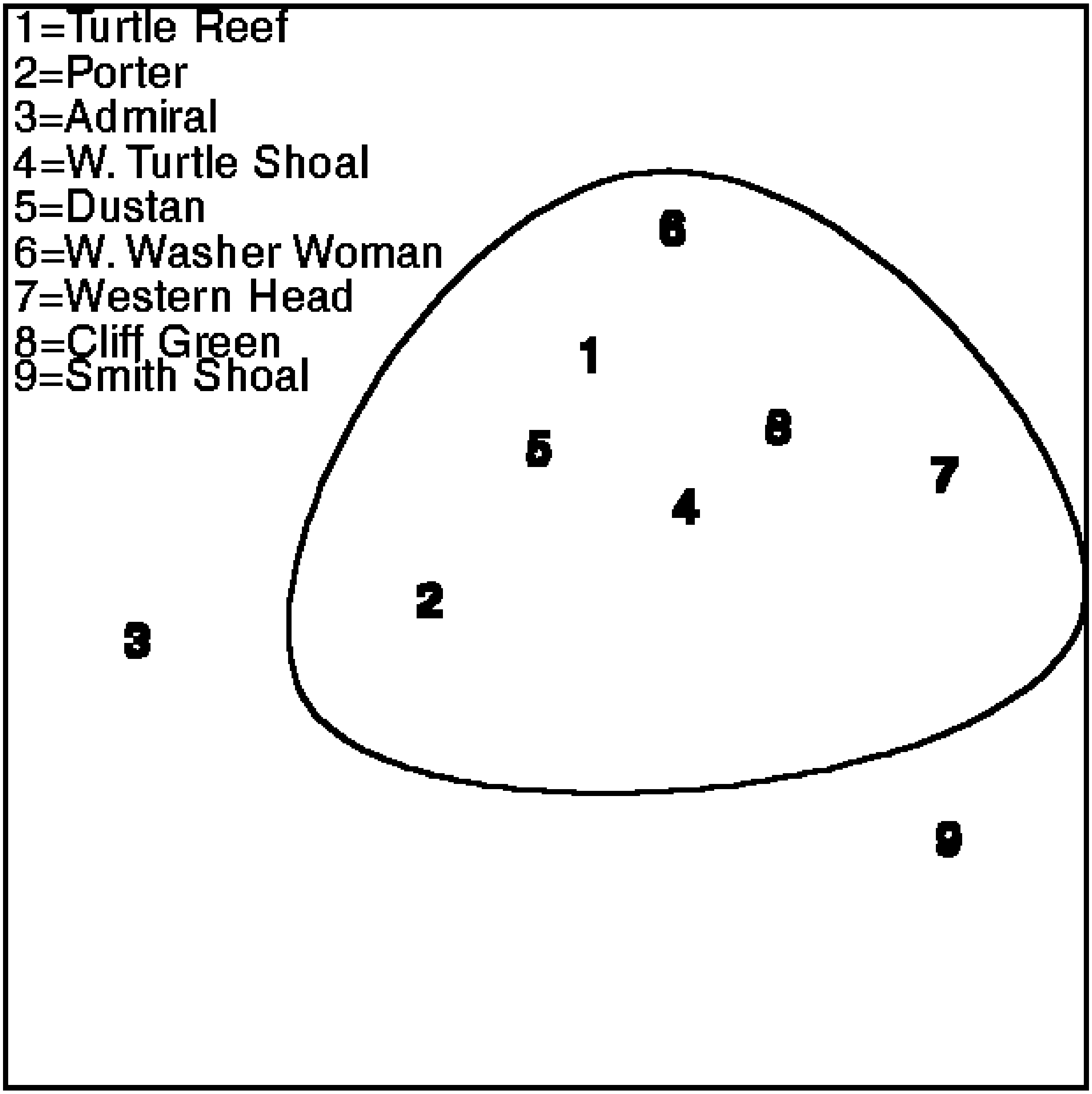


Figure 19.
MDS Ordination of Offshore Shallow Sites.

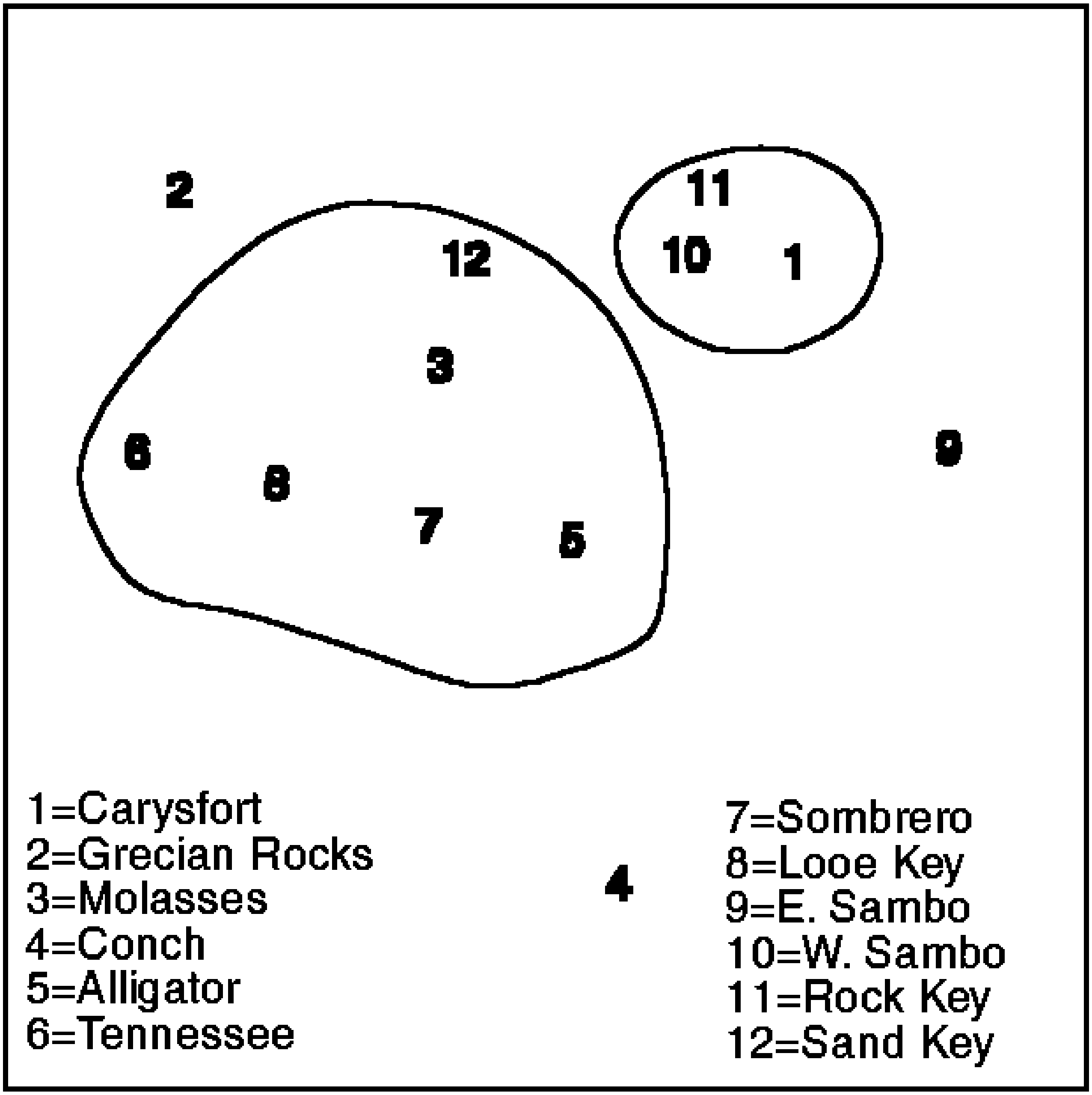


Figure 20.
MDS Ordination of Offshore Deep Sites.

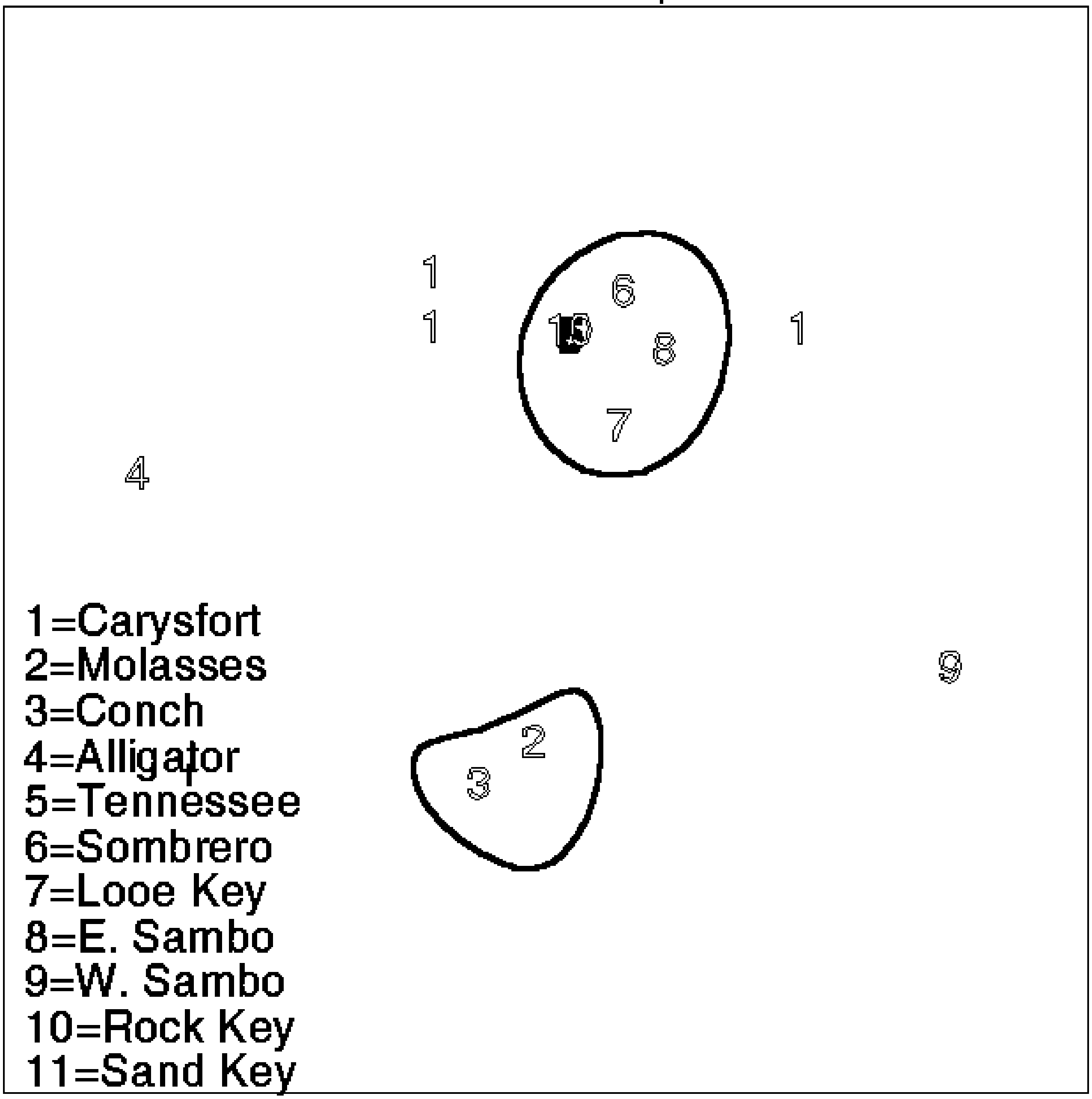
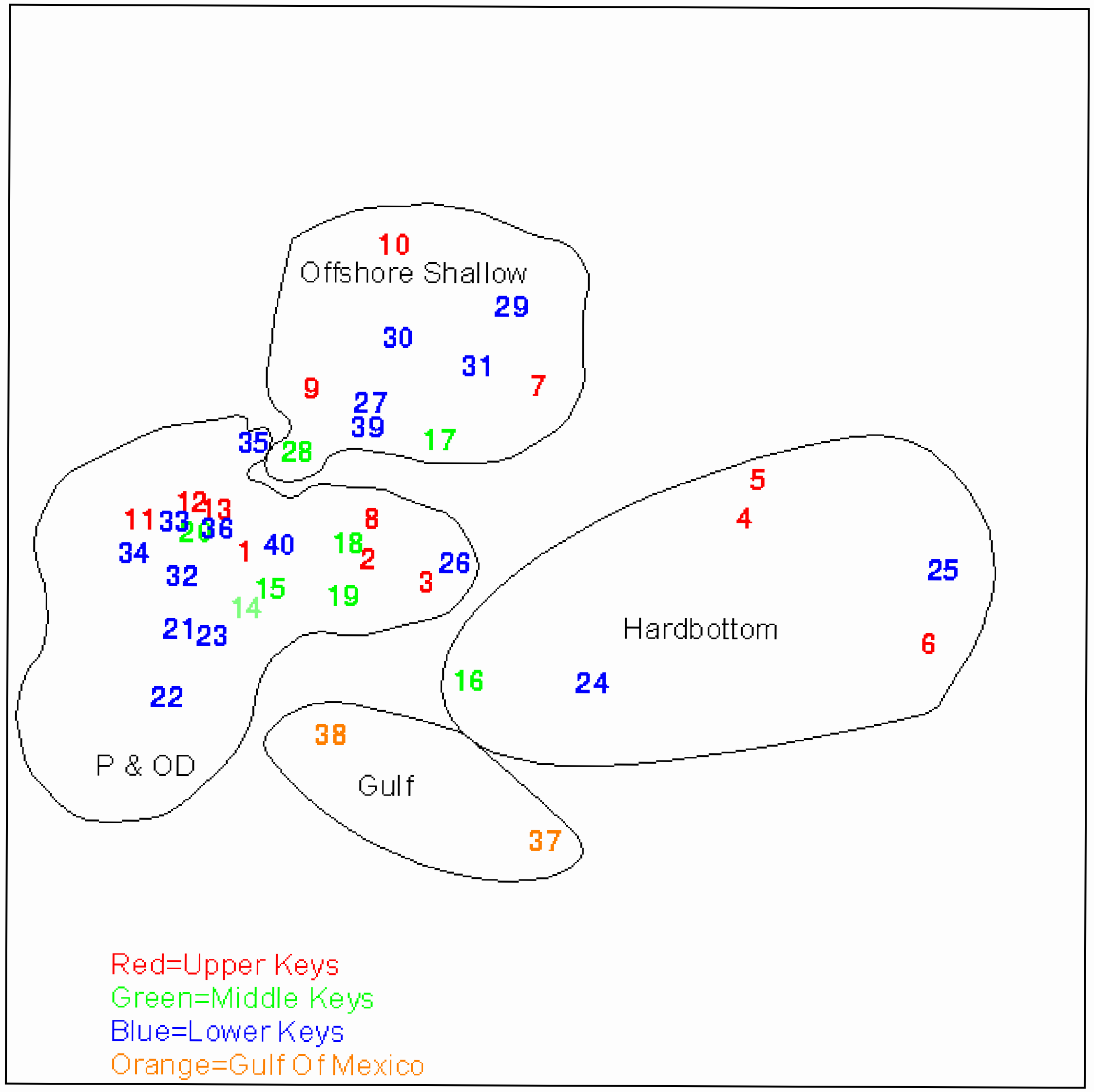


Figure 21. MDS Ordination of All Sites.

1=Turtle (P)
2=Porter (P)
3=Admiral (P)
4=Rattle Snake (H)
5=El Radabob (H)
6=Dove Key (H)
7=Carysfort (S)
8=Grecian Rocks (S)
9=Molasses (S)
10=Conch(S)
11=Carysfort (D)
12=Molasses (D)
13=Conch (D)
14=W. Turtle Shoal (P)
15=Dustan (P)
16=Long Key (H)
17=Alligator (S)
18=Tennessee (S)
19=Alligator (D)
20=Tennessee (D)
21=W. Washer Woman (P)
22=Western Head (P)
23=Cliff Green (P)



24=Moser Channel (H)
25=Molasses Keys (H)
26=Jaap (H)
27=Sombrero (S)
28=Looe Key (S)
29=E. Sambo (S)
30=W. Sambo (S)
31=Rock Key (S)
32=Sombrero (D)
33=Looe Key (D)
34=E. Sambo (D)
35=W. Sambo (D)
36=Rock Key (D)
37=Content Keys (H)
38=Smith Shoal (P)
39=Sand Key (S)
40=Sand Key (D)

Figure 22.
Example of a Bleached Stony Coral, *Montastraea annularis*.

Table 9. Taxonomic List* of Hydrozoan and Scleractinian Corals from Species Inventories.

PHYLUM CNIDARIA

CLASS HYDROZOA

ORDER ATHECATE

Family Milleporidae

Millepora alcicornis Linne, 1758
Millepora complanata Lamarck, 1816

CLASS ANTHOZOA

SUBCLASS ZOANTHARIA

ORDER SCLERACTINIA

SUBORDER ASTROCOENIINA

Family Astrocoeniidae

Stephanocoenia michelinii Milne Edwards and Haime, 1848

Family Pocilloporidae

Madracis decactis (Lyman, 1859)
Madracis mirabilis sensu Wells, 1973

Family Acroporidae

Acropora cervicornis (Lamarck, 1816)
Acropora palmata (Lamarck, 1816)

SUBORDER FUNGIINA

Family Agaricidae

Agaricia agaricites ((Linne, 1758) [COMPLEX]**
Agaricia fragilis (Dana, 1846)
Agaricia lamarcki Milne Edwards and Haime, 1851
Leptoseris cucullata (Ellis and Solander, 1786)

Family Siderastreidae

Siderastrea radians (Pallas, 1766)
Siderastrea siderea (Ellis and Solander, 1786)

Family Poritidae

Porites astreoides Lamarck, 1816
Porites branneri Rathbun, 1888
Porites porites (Pallas, 1766) [COMPLEX]**

SUBORDER FAVIINA

Family Faviidae

Cladocora arbuscula (Lesueur, 1821)
Colpophyllia natans (Houttuyn, 1772)
Diploria clivosa (Ellis and Solander, 1786)
Diploria labyrinthiformis (Linne, 1758)
Diploria strigosa (Dana, 1846)
Favia fragum (Esper, 1795)
Manicina areolata (Linne, 1758)
Montastraea cavernosa (Linne, 1767)
Montastraea annularis (Ellis and Solander, 1786) [COMPLEX]**
Solenastrea bournoni Milne Edwards and Haime, 1850
Solenastrea hyades (Dana, 1846)

Family Rhizangiidae

Astrangia poculata (Ellis and Solander, 1786)
Phyllangia americana Milne Edwards and Haime, 1849

Family Oculinidae

Oculina diffusa Lamarck, 1816

Family Meandrinidae

Dendrogyra cylindrus Ehrenberg, 1834
Dichocoenia stokesi Milne Edwards and Haime, 1848
Meandrina meandrites (Linne, 1758)

Family Mussidae

Isophyllastraea rigida (Dana, 1846)
Isophyllia sinuosa (Ellis and Solander, 1786)
Mussa angulosa (Pallas, 1766)
Mycetophyllia lamarckiana Milne Edwards and Haime, 1848
Mycetophyllia danaana Milne Edwards and Haime, 1849
Mycetophyllia aliciae Wells, 1973
Mycetophyllia ferox Wells, 1973
Scolymia cubensis Milne Edwards and Haime, 1849
Scolymia lacera (Pallas, 1766)

SUBORDER CARYOPHYLLIINA

Family Caryophylliidae

Eusimilia fastigiata (Pallas, 1766)

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*Systematics follows Wells and Lang, 1973 and Cairns *et.al.* 1991.

** *Agaricia agaricites* COMPLEX may include:
agaricites (Linne, 1758)
carinata Wells, 1973
danai Milne Edwards and Haime, 1860
purpurea (Lesueur, 1821)

** *Porites porites* COMPLEX may include:
porites (Pallas, 1766)
clavaria Lamarck, 1816
furcata Lamarck, 1816
divaricata Lesueur, 1821

** *Montastraea annularis* COMPLEX may include:
annularis (Ellis and Solander, 1786)
faveolata (Ellis and Solander, 1786)
franksi (Gregory, 1895)

Table 18a. Presence/Absence of Stony Coral Taxa - All Sites 1996

SITE CODES:	9P1	9P3	9P4	9H1	9H2	9H3	9S1	9S2	9S3	9S4	9D1	9D3	9D4	7P1	7P2	7H2	7S1	7S2	7D1	7D2	5P1	5P2	5P3	5H1	5H2	5H3	5S1	5S2	5S3	5S4	5S5	5D1	5D2	5D3	5D4	5D5	3H1	2P1	2S1	2D1	SUM	Segment9	Segment7	Segment5	Segment3	Segment2
STONY CORAL TAXA																																														
Acropora cervicornis	1	1	0	0	0	0	0	1	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	0	0	0	1	1	0	1	1	0	1	1	1	1	0	0	1	1	19	1	1	1	0	1
Acropora palmata	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	1	0	7	1	0	1	0	1
Agaricia agaricites (complex)	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	34	1	1	1	1	1
Agaricia fragilis	1	1	0	0	0	0	0	1	1	0	1	1	1	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0	0	1	0	1	1	1	1	1	0	1	1	1	19	1	1	1	0	1
Agaricia lamarcki	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	9	1	1	1	0	0
Astrangia poculata	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	1	0	0
Cladocora arbuscula	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	6	1	1	1	1	1
Colpophyllia natans	1	1	1	0	0	0	0	1	0	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	1	0	1	1	1	1	1	0	1	1	1	28	1	1	1	0	1
Dendrogyra cylindrus	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	3	1	0	1	0	1
Dichocoenia stokesii	1	1	1	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	35	1	1	1	1	1
Diploria clivosa	1	1	1	0	0	0	1	1	0	0	0	0	0	0	1	1	1	1	0	1	0	1	1	1	0	1	0	1	0	1	1	0	0	1	1	0	0	0	1	1	21	1	1	1	0	1
Diploria labyrinthiformis	1	1	1	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	1	0	1	1	1	1	1	0	0	1	1	30	1	1	1	0	1
Diploria strigosa	1	1	1	0	0	0	1	1	1	0	0	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	32	1	1	1	1	1
Eusmilia fastigiata	1	1	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	0	0	0	0	1	0	1	0	1	1	1	1	1	0	0	1	1	26	1	1	1	0	1
Favia fragum	1	1	0	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1	0	1	0	1	1	1	1	1	1	1	1	0	0	0	1	1	0	0	1	1	30	1	1	1	0	1
Isophyllastrea rigida	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	1	1	1	0	0
Isophyllia sinuosa	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0	1	1	10	1	1	1	0	1
Leptoseris cucullata	1	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	1	0	0	1	0	19	1	1	1	0	1
Madracis decactis	1	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	1	1	0	1	0	1	1	0	0	0	0	0	1	1	1	1	1	1	1	1	0	1	1	1	24	1	1	1	0	1
Madracis mirabilis	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1	1	0	1	1	1	1	1	0	0	0	1	13	1	1	1	0	1
Manicina areolata	0	1	0	1	1	1	0	0	0	0	1	1	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0	1	1	1	0	1	0	0	1	1	15	1	1	1	0	1
Meandrina meandrites	1	1	1	0	0	0	0	1	1	1	1	1	1	1	1	0	1	1	1	1	0	1	1	0	0	0	1	1	0	1	0	1	1	1	1	1	0	1	1	1	28	1	1	1	0	1
Millepora alcicornis	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	40	1	1	1	1	1
Millepora complanata	1	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	1	1	0	0	0	1	1	0	0	0	1	1	1	1	1	0	0	0	1	0	0	1	1	0	17	1	1	1	0	1
Montastraea annularis (complex)	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	34	1	1	1	0	1
Montastraea cavernosa	1	1	1	0	0	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	34	1	1	1	0	1
Mycetophyllia aliciae	1	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	0	1	0	0	0	0	13	1	1	1	0	0
Mycetophyllia danaana	1	0	0	0	0	0	0	1	1	0	1	0	0	0	1	0	0	0	0	1	1	1	1	0	0	0	1	1	0	0	0	1	0	1	1	1	0	0	1	1	17	1	1	1	0	1
Mycetophyllia ferox	1	0	0	0	0	0	1	0	1	0	1	0	1	0	1	0	0	0	0	1	1	0	1	0	0	0	1	1	0	1	0	1	1	1	1	1	0	0	0	1	18	1	1	1	0	1
Mycetophyllia lamarckiana	1	0	0	0	0	0	1	1	1	0	1	1	1	1	1	0	0	0	1	1	1	0	1	0	0	0	1	1	0	1	0	1	1	1	1	1	0	0	1	1	23	1	1	1	0	1
Mussa angulosa	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	14	1	1	1	0	1
Oculina diffusa	1	1	0	0	1	0	0	0	0	0	0	0	0	1	1	1	0	1	1	0	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	14	1	1	1	0	1
Phyllangia americana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	3	0	0	1	1	1
Porites astreoides	1	1	1	1	1	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	37	1	1	1	1	1
Porites branneri	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1	0	1	0	0
Porites porites (complex)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	40	1	1	1	1	1
Scolymia cubensis	1	0	0	0	0	0	0	1	0	0	1	0	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	1	0	1	0	1	0	1	0	1	15	1	1	1	0	1
Scolymia lacera	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	6	0	1	1	1	1
Siderastrea radians	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	36	1	1	1	1	1
Siderastrea siderea	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	37	1	1	1	1	1
Solenastrea bournoni	1	1	1	0	0	0	0	1	0	0	1	0	0	1	1	1	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	0	1	1	0	0	1	22	1	1	1	1	1
Solenastrea hyades	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	1	0	0	0
Stephanocoenia michelinii	1	1	1	0	0	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	33	1	1	1	1	1
Total number of taxa=43	31	24	16	9	9	9	16	28	22	15	27	25	25	26	26	19	18	22	21	31	24	35	34	13	7	16	21	21	12	23	18	27	27	32	27	28	13	22	28	28		41	38	42	13	37
Mean number of taxa =	21.875		Standard deviation =				7.29																																							
Mussid (juvenile)	8	0	0	0	0	0	0	0	2	0	6	0	0	7	0	0	0	0	2	8	6	0	0	0	2	0	0	0	0	0	0	6	8	0	0	0	0	0	0	4	59					
URCHIN TAXA																																														
Diadema antillarum	0	0	0	0	0	0	2	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1	1	0	0	0	0	0	0	0	0	0	12					

Table 10b. Frequency of Stony Coral Taxa - All Sites 1996

SITE CODES:	9P1	9P3	9P4	9H1	9H2	9H3	9S1	9S2	9S3	9S4	9D1	9D3	9D4	7P1	7P2	7H2	7S1	7S2	7D1	7D2	5P1	5P2	5P3	5H1	5H2	5H3	5S1	5S2	5S3	5S4	5S5	5D1	5D2	5D3	5D4	5D5	3H1	2P1	2S1	2D1	SUM
STONY CORAL TAXA																																									
Acropora cervicornis	1.00	0.25	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.25	0.00	0.00	0.50	0.00	0.00	0.00	1.00	0.00	0.75	0.00	0.25	0.25	0.00	0.00	0.00	0.25	0.63	0.00	0.50	0.50	0.00	0.50	0.38	1.00	0.50	0.00	0.00	0.25	0.50	9.75
Acropora palmata	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.25	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.88	0.00	4.88
Agaricia agaricites (complex)	1.00	1.00	1.00	0.00	0.00	0.00	1.00	0.75	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.50	0.88	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.25	1.00	1.00	1.00	32.38
Agaricia fragilis	0.88	0.25	0.00	0.00	0.00	0.00	0.00	0.13	0.25	0.00	1.00	0.50	0.38	0.00	0.00	0.00	0.25	0.00	0.00	0.63	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	1.00	0.75	1.00	0.75	0.50	0.00	0.13	0.13	0.38	9.13
Agaricia lamarcki	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.75	0.75	0.00	0.00	0.00	0.00	0.00	0.25	0.25	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.25	0.63	0.00	0.00	0.00	0.00	0.00	0.00	3.63
Astrangia poculata	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.63
Cladocora arbuscula	0.00	0.00	0.00	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.88	0.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.63	1.00	0.00	0.00	4.13
Colpophyllia natans	0.50	0.25	0.50	0.00	0.00	0.00	0.00	0.50	0.00	0.00	1.00	0.25	0.00	1.00	1.00	0.75	0.25	0.50	0.50	0.75	1.00	1.00	1.00	0.00	0.00	0.75	0.38	0.88	0.00	0.88	0.00	0.75	1.00	1.00	1.00	1.00	0.00	0.25	0.25	1.00	19.88
Dendrogyra cylindrus	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.63
Dichocoenia stokesii	1.00	1.00	1.00	0.25	0.00	0.50	0.00	1.00	0.50	0.63	1.00	1.00	1.00	1.00	1.00	1.00	0.75	1.00	1.00	1.00	0.75	1.00	1.00	1.00	0.50	0.25	0.50	0.63	0.00	0.00	0.00	1.00	1.00	1.00	0.50	0.88	0.25	0.13	0.63	1.00	27.63
Diploria clivosa	0.50	0.50	0.25	0.00	0.00	0.00	1.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.25	1.00	0.25	0.50	0.00	0.38	0.00	0.50	0.63	1.00	0.00	0.75	0.00	0.25	0.00	0.50	1.00	0.00	0.00	0.13	0.25	0.00	0.00	0.00	0.88	0.38	11.38
Diploria labyrinthiformis	0.75	1.00	0.75	0.00	0.00	0.00	0.00	0.50	0.75	0.25	0.75	1.00	0.25	1.00	0.88	0.50	0.25	1.00	0.63	0.88	0.50	0.50	0.75	0.00	0.00	0.25	0.75	1.00	0.00	0.25	0.00	0.50	0.75	0.75	0.75	0.75	0.00	0.00	0.25	1.00	19.88
Diploria strigosa	0.75	0.75	0.25	0.00	0.00	0.00	0.25	0.25	0.75	0.00	0.00	0.75	0.25	0.75	0.75	0.75	0.00	1.00	0.50	1.00	0.75	1.00	1.00	0.25	0.00	0.50	0.25	0.75	0.00	0.25	0.50	1.00	1.00	1.00	0.88	0.75	0.75	1.00	0.50	0.75	21.63
Eusmilia fastigiata	1.00	0.63	0.00	0.00	0.00	0.00	0.25	0.50	0.50	0.63	1.00	1.00	0.75	1.00	1.00	0.00	0.00	0.25	0.25	1.00	0.25	1.00	0.88	0.00	0.00	0.00	0.00	0.50	0.00	0.13	0.00	1.00	1.00	1.00	0.88	1.00	0.00	0.00	0.38	1.00	18.75
Favia fragum	0.75	1.00	0.00	1.00	1.00	1.00	1.00	0.63	1.00	1.00	0.25	0.00	0.13	0.50	0.25	0.88	0.75	0.25	0.00	0.38	0.00	0.13	0.00	1.00	1.00	0.25	1.00	0.75	1.00	1.00	1.00	0.00	0.00	0.00	0.75	1.00	0.00	0.00	1.00	0.50	22.13
Isophyllastrea rigida	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	1.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.38
Isophyllia sinuosa	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.00	0.00	0.00	0.00	0.00	0.13	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.38	0.25	0.00	0.00	0.00	0.38	0.25	2.88
Leptoseris cucullata	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.75	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.25	0.63	0.63	0.75	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	1.00	1.00	1.00	0.75	1.00	0.00	0.00	0.13	0.00	13.38
Madracis decactis	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.38	1.00	1.00	1.00	0.63	0.25	0.00	0.25	0.25	0.00	0.88	0.00	0.13	0.63	0.00	0.00	0.00	0.00	0.00	0.38	0.25	0.25	0.75	0.75	1.00	0.50	0.75	0.00	0.38	0.38	0.88	13.88
Madracis mirabilis	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.63	0.00	0.25	1.00	0.75	0.50	0.75	0.00	0.00	0.00	0.25	6.50
Manicina areolata	0.00	0.25	0.00	1.00	0.50	1.00	0.00	0.00	0.00	0.00	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.75	1.00	0.00	1.00	0.00	0.00	0.25	1.00	10.38
Meandrina meandrites	0.25	0.75	0.50	0.00	0.00	0.00	0.00	0.13	0.75	0.50	0.50	1.00	0.75	1.00	0.75	0.00	0.50	0.75	1.00	1.00	0.00	1.00	0.88	0.00	0.00	0.00	0.75	0.50	0.00	0.13	0.00	0.75	0.75	1.00	0.50	1.00	0.00	0.13	0.50	1.00	19.00
Millepora alcicornis	1.00	1.00	1.00	0.75	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.63	0.75	0.75	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	38.88
Millepora complanata	0.25	0.00	0.00	0.00	0.00	0.00	1.00	0.25	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.50	0.00	0.00	0.00	0.63	0.38	0.00	0.00	0.00	1.00	0.63	1.00	1.00	0.75	0.00	0.00	0.00	0.25	0.00	0.00	0.50	1.00	0.00	12.13
Montastraea annularis (complex)	1.00	0.75	1.00	0.00	0.00	0.00	0.25	0.75	1.00	0.25	1.00	0.75	1.00	1.00	1.00	0.50	0.25	0.75	0.63	1.00	1.00	1.00	1.00	0.00	0.00	1.00	0.75	1.00	1.00	1.00	0.50	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	29.13
Montastraea cavernosa	1.00	1.00	0.50	0.00	0.00	0.00	0.50	0.75	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.75	0.00	0.75	0.75	1.00	0.50	0.50	1.00	1.00	1.00	1.00	0.50	1.00	0.00	1.00	1.00	1.00	30.50
Mycetophyllia aliciae	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.25	0.25	0.75	0.00	0.00	0.00	0.00	0.00	0.25	0.50	1.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75	0.50	1.00	0.00	0.25	0.00	0.00	0.00	0.00	7.25
Mycetophyllia danaana	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.00	0.75	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.63	0.88	0.13	1.00	0.00	0.00	0.00	0.25	0.38	0.00	0.00	0.00	0.25	0.00	0.38	0.13	0.75	0.00	0.00	0.50	0.50	8.75
Mycetophyllia ferox	0.50	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.38	0.00	1.00	0.00	0.25	0.00	0.38	0.00	0.00	0.00	0.00	0.63	0.88	0.00	0.13	0.00	0.00	0.00	0.25	0.75	0.00	0.13	0.00	0.75	0.25	1.00	0.25	1.00	0.00	0.00	0.00	0.25	9.00
Mycetophyllia lamarckiana	1.00	0.00	0.00	0.00	0.00	0.00	0.25	1.00	0.50	0.00	1.00	0.25	0.25	1.00	1.00	0.00	0.00	0.00	0.25	0.25	1.00	0.00	1.00	0.00	0.00	0.00	0.25	0.38	0.00	0.25	0.00	0.13	1.00	0.88	0.88	0.50	0.00	0.00	0.88	0.25	14.13
Mussa angulosa	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.25	0.25	0.25	0.25	0.00	0.00	0.00	0.00	0.25	0.75	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.25	0.00	0.00	0.00	0.25	0.00	0.00	5.63
Oculina diffusa	0.63	0.75	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.63	0.50	0.00	0.25	0.13	0.00	0.50	1.00	1.00	0.50	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	8.63
Phyllangia americana	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.88	0.88	0.00	0.00	1.88
Porites astreoides	1.00	1.00	1.00	1.00	0.75	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	36.63
Porites branneri	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.88	0.50	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.13
Porites porites (complex)	1.00	1.00	0.25	1.00	1.00	0.50	1.00	1.00	1.00	0.88	1.00	1.00	1.00	1.00	0.50	0.88	1.00	1.00	1.00	1.00	1.00	0.13	1.00	1.00	0.25	1.00	0.75	0.75	1.00	1.00	1.00	0.75	0.75	1.00	1.00	1.00	0.50	0.75	1.00	1.00	34.63
Scolymia cubensis	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.63	0.00	1.00	1.00	0.50	0.00	0.00	0.00	0.00	0.75	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	0.25	11.75
Scolymia lacera	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.25	0.88	0.00	0.00	3.13
Siderastrea radians	0.75	1.00	1.00	1.00	1.00	1.00	0.75	1.00	0.13	0.00	0.00	0.50	1.00	1.00	1.00	1.00	0.50	1.00	1.00	0.25	0.25	0.50	0.88	1.00	1.00	1.00	0.00	0.00	0.25	0.25	0.38	0.75	0.38	0.25	0.38	0.63	1.00	1.00	0.50	1.00	26.25
Siderastrea siderea	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.25	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.75	1.00	1.00	0.88	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.75	1.00	1.00	1.00	35.63
Solenastrea bournoni	1.00	0.75	0.25	0.00	0.00	0.00	0.00	0.38	0.00	0.00	0.25	0.00	0.00	0.25	0.50	0.75	0.00	0.25	0.75	0.25	0.50	0.75	1.00	0.75	0.25	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.13	0.50	0.00	0.25	0.88	0.00	0.00	0.50	11.88
Solenastrea hyades	0.00	0.00	0.00	0.00	0.25	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.75
Stephanocoenia michelinii	1.00	0.75	0.25	0.00	0.00	0.25	0.00	0.50	0.00	0.50	1.00	1.00	1.00	1.00	1.00	1.00	0.50	0.75	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.63	0.75	0.75	0.00	0.00	0.25	1.00	1.00	1.00	0.38	1.00	1.00	1.00	0.38	0.88	26.50
Mussid (juvenile)	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.75	0.00	0.00	0.88	0.50	0.00	0.00	0.00	0.25	1.00	0.75	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.75	1.00	0.00	0.00	0.38	0.00	0.00	0.13	0.50	
URCHIN TAXA																																									
Diadema antillarum	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.13	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

Table 11a. Presence/Absence of Stony Coral Taxa-Site Types 1996

SITE TYPES:	HARDBOTTOM	PATCH	SHALLOW OFFSHORE	DEEP OFFSHORE
STONY CORAL TAXA				
Acropora cervicornis	0	1	1	1
Acropora palmata	0	0	1	0
Agaricia agaricites (complex)	1	1	1	1
Agaricia fragilis	0	1	1	1
Agaricia lamarcki	0	1	0	1
Astrangia poculata	1	1	0	0
Cladocora arbuscula	1	1	0	0
Colpophyllia natans	1	1	1	1
Dendrogyra cylindrus	0	0	1	0
Dichocoenia stokesii	1	1	1	1
Diploria clivosa	1	1	1	1
Diploria labyrinthiformis	1	1	1	1
Diploria strigosa	1	1	1	1
Eusmilia fastigiata	0	1	1	1
Favia fragum	1	1	1	1
Isophyllastrea rigida	1	1	1	0
Isophyllia sinuosa	1	1	1	1
Leptoseris cucullata	0	1	1	1
Madracis decactis	0	1	1	1
Madracis mirabilis	0	1	1	1
Manicina areolata	1	1	1	1
Meadrina meandrites	0	1	1	1
Millepora alcicornis	1	1	1	1
Millepora complanata	0	1	1	1
Montastraea annularis (complex)	1	1	1	1
Montastraea cavernosa	1	1	1	1
Mycetophyllia aliciae	0	1	0	1
Mycetophyllia danaana	0	1	1	1
Mycetophyllia ferox	0	1	1	1
Mycetophyllia lamarckiana	0	1	1	1
Mussa angulosa	0	1	0	1
Oculina diffusa	1	1	1	1
Phyllangia americana	1	1	0	0
Porites astreoides	1	1	1	1
Porites branneri	0	1	0	1
Porites porites (complex)	1	1	1	1
Scolymia cubensis	0	1	1	1
Scolymia lacera	1	1	0	1
Siderastrea radians	1	1	1	1
Siderastrea siderea	1	1	1	1
Solenastrea bournoni	1	1	1	1
Solenastrea hyades	1	0	0	0
Stephanocoenia michelinii	1	1	1	1
Total number of taxa	25	40	34	36
Mussid (juvenile)	0	0	0	1
Diadema antillarum	0	0	0	0

Table 11b. Frequency of Stony Coral Taxa - Site Types 1996

SITE TYPES:	HARDBOTTOM	PATCH	SHALLOW OFFSHORE	DEEP OFFSHORE
STONY CORAL TAXA				
Acropora cervicornis	0.00	0.25	0.30	0.35
Acropora palmata	0.00	0.00	0.41	0.00
Agaricia agaricites (complex)	0.16	0.93	0.98	1.00
Agaricia fragilis	0.00	0.15	0.07	0.63
Agaricia lamarcki	0.00	0.03	0.00	0.31
Astrangia poculata	0.06	0.01	0.00	0.00
Cladocora arbuscula	0.20	0.28	0.00	0.00
Colpophyllia natans	0.19	0.72	0.30	0.75
Dendrogyra cylindrus	0.00	0.00	0.05	0.00
Dichocoenia stokesii	0.47	0.88	0.47	0.94
Diploria clivosa	0.34	0.29	0.41	0.10
Diploria labyrinthiformis	0.09	0.68	0.42	0.73
Diploria strigosa	0.28	0.78	0.38	0.72
Eusmilia fastigiata	0.00	0.64	0.26	0.90
Favia fragum	0.77	0.29	0.86	0.27
Isophyllastrea rigida	0.09	0.17	0.01	0.00
Isophyllia sinuosa	0.05	0.10	0.06	0.08
Leptoseris cucullata	0.00	0.31	0.17	0.78
Madracis decactis	0.00	0.31	0.22	0.77
Madracis mirabilis	0.00	0.03	0.06	0.50
Manicina areolata	0.33	0.03	0.02	0.66
Meadrina meandrites	0.00	0.58	0.38	0.84
Millepora alcicornis	0.97	1.00	0.93	1.00
Millepora complanata	0.00	0.19	0.84	0.02
Montastraea annularis (complex)	0.19	0.97	0.71	0.94
Montastraea cavernosa	0.31	0.94	0.75	0.95
Mycetophyllia aliciae	0.00	0.33	0.00	0.39
Mycetophyllia danaana	0.00	0.36	0.18	0.31
Mycetophyllia ferox	0.00	0.21	0.15	0.49
Mycetophyllia lamarckiana	0.00	0.56	0.29	0.51
Mussa angulosa	0.00	0.44	0.00	0.15
Oculina diffusa	0.22	0.72	0.02	0.01
Phyllangia americana	0.11	0.11	0.00	0.00
Porites astreoides	0.72	0.99	0.92	1.00
Porites branneri	0.00	0.18	0.00	0.05
Porites porites (complex)	0.77	0.74	0.95	0.95
Scolymia cubensis	0.00	0.65	0.02	0.51
Scolymia lacera	0.03	0.31	0.00	0.01
Siderastrea radians	1.00	0.82	0.40	0.56
Siderastrea siderea	0.47	1.00	0.99	1.00
Solenastrea bournoni	0.33	0.56	0.05	0.33
Solenastrea hyades	0.22	0.00	0.00	0.00
Stephanocoenia michelinii	0.48	0.89	0.36	0.93
Mussid (juvenile)	0.03	1.13	0.03	0.42
URCHIN TAXA:				
Diadema antillarum	0.00	0.03	0.10	0.00

Table 12a. Presence/Absence of Stony Coral Taxa - Hardbottom 1996									
SITE CODES:	9H1	9H2	9H3	7H2	5H1	5H2	5H3	3H1	Sum
STONY CORAL TAXA									
Acropora cervicornis	0	0	0	0	0	0	0	0	0
Acropora palmata	0	0	0	0	0	0	0	0	0
Agaricia agaricites (complex)	0	0	0	0	0	0	1	1	2
Agaricia fragilis	0	0	0	0	0	0	0	0	0
Agaricia lamarcki	0	0	0	0	0	0	0	0	0
Astrangia poculata	0	0	1	0	0	0	0	0	1
Cladocora arbuscula	1	0	0	1	0	0	0	1	3
Colpophyllia natans	0	0	0	1	0	0	1	0	2
Dendrogyra cylindrus	0	0	0	0	0	0	0	0	0
Dichocoenia stokesii	1	0	1	1	1	1	1	1	7
Diploria clivosa	0	0	0	1	1	0	1	0	3
Diploria labyrinthiformis	0	0	0	1	0	0	1	0	2
Diploria strigosa	0	0	0	1	1	0	1	1	4
Eusmilia fastigiata	0	0	0	0	0	0	0	0	0
Favia fragum	1	1	1	1	1	1	1	0	7
Isophyllastrea rigida	0	0	0	0	1	0	0	0	1
Isophyllia sinuosa	0	0	0	1	0	0	0	0	1
Leptoseris cucullata	0	0	0	0	0	0	0	0	0
Madracis decactis	0	0	0	0	0	0	0	0	0
Madracis mirabilis	0	0	0	0	0	0	0	0	0
Manicina areolata	1	1	1	0	0	1	0	0	4
Meadrina meandrites	0	0	0	0	0	0	0	0	0
Millepora alcicornis	1	1	1	1	1	1	1	1	8
Millepora complanata	0	0	0	0	0	0	0	0	0
Montastraea annularis (complex)	0	0	0	1	0	0	1	0	2
Montastraea cavernosa	0	0	0	1	1	0	1	0	3
Mycetophyllia aliciae	0	0	0	0	0	0	0	0	0
Mycetophyllia danaana	0	0	0	0	0	0	0	0	0
Mycetophyllia ferox	0	0	0	0	0	0	0	0	0
Mycetophyllia lamarckiana	0	0	0	0	0	0	0	0	0
Mussa angulosa	0	0	0	0	0	0	0	0	0
Oculina diffusa	0	1	0	1	1	0	1	0	4
Phyllangia americana	0	0	0	0	0	0	0	1	1
Porites astreoides	1	1	0	1	1	0	1	1	6
Porites branneri	0	0	0	0	0	0	0	0	0
Porites porites (complex)	1	1	1	1	1	1	1	1	8
Scolymia cubensis	0	0	0	0	0	0	0	0	0
Scolymia lacera	0	0	0	0	0	0	0	1	1
Siderastrea radians	1	1	1	1	1	1	1	1	8
Siderastrea siderea	1	1	0	1	0	0	1	1	5
Solenastrea bournoni	0	0	0	1	1	1	0	1	4
Solenastrea hyades	0	1	1	1	0	0	0	0	3
Stephanocoenia michelinii	0	0	1	1	1	0	1	1	5
Total number of taxa	9.00	9.00	9.00	19.00	13.00	7.00	16.00	13.00	
Mean number of taxa=	11.88	Standard deviation =		4.12					
Mussid (juvenile)	0	0	0	0	0	2	0	0	
URCHIN TAXA									
Diadema antillarum	0	0	0	0	0	0	0	0	

Table 12b. Frequency of Stony Coral Taxa - Hardbottom 1996									
SITE CODES:	9H1	9H2	9H3	7H2	5H1	5H2	5H3	3H1	Frequency of Occurrence
STONY CORAL TAXA									
Acropora cervicornis	0	0	0	0	0	0	0	0	0.00
Acropora palmata	0	0	0	0	0	0	0	0	0.00
Agaricia agaricites (complex)	0	0	0	0	0	0	1	0.25	0.16
Agaricia fragilis	0	0	0	0	0	0	0	0	0.00
Agaricia lamarcki	0	0	0	0	0	0	0	0	0.00
Astrangia poculata	0	0	0.5	0	0	0	0	0	0.06
Cladocora arbuscula	0.75	0	0	0.25	0	0	0	0.625	0.20
Colpophyllia natans	0	0	0	0.75	0	0	0.75	0	0.19
Dendrogyra cylindrus	0	0	0	0	0	0	0	0	0.00
Dichocoenia stokesii	0.25	0	0.5	1	1	0.5	0.25	0.25	0.47
Diploria clivosa	0	0	0	1	1	0	0.75	0	0.34
Diploria labyrinthiformis	0	0	0	0.5	0	0	0.25	0	0.09
Diploria strigosa	0	0	0	0.75	0.25	0	0.5	0.75	0.28
Eusmilia fastigiata	0	0	0	0	0	0	0	0	0.00
Favia fragum	1	1	1	0.875	1	1	0.25	0	0.77
Isophyllastrea rigida	0	0	0	0	0.75	0	0	0	0.09
Isophyllia sinuosa	0	0	0	0.375	0	0	0	0	0.05
Leptoseris cucullata	0	0	0	0	0	0	0	0	0.00
Madracis decactis	0	0	0	0	0	0	0	0	0.00
Madracis mirabilis	0	0	0	0	0	0	0	0	0.00
Manicina areolata	1	0.5	1	0	0	0.125	0	0	0.33
Meandrina meandrites	0	0	0	0	0	0	0	0	0.00
Millepora alcicornis	0.75	1	1	1	1	1	1	1	0.97
Millepora complanata	0	0	0	0	0	0	0	0	0.00
Montastraea annularis (complex)	0	0	0	0.5	0	0	1	0	0.19
Montastraea cavernosa	0	0	0	1	0.75	0	0.75	0	0.31
Mycetophyllia aliciae	0	0	0	0	0	0	0	0	0.00
Mycetophyllia danaana	0	0	0	0	0	0	0	0	0.00
Mycetophyllia ferox	0	0	0	0	0	0	0	0	0.00
Mycetophyllia lamarckiana	0	0	0	0	0	0	0	0	0.00
Mussa angulosa	0	0	0	0	0	0	0	0	0.00
Oculina diffusa	0	0.25	0	0.5	0.5	0	0.5	0	0.22
Phyllangia americana	0	0	0	0	0	0	0	0.875	0.11
Porites astreoides	1	0.75	0	1	1	0	1	1	0.72
Porites branneri	0	0	0	0	0	0	0	0	0.00
Porites porites (complex)	1	1	0.5	0.875	1	0.25	1	0.5	0.77
Scolymia cubensis	0	0	0	0	0	0	0	0	0.00
Scolymia lacera	0	0	0	0	0	0	0	0.25	0.03
Siderastrea radians	1	1	1	1	1	1	1	1	1.00
Siderastrea siderea	1	1	0	0.25	0	0	0.75	0.75	0.47
Solenastrea bournoni	0	0	0	0.75	0.75	0.25	0	0.875	0.33
Solenastrea hyades	0	0.25	1	0.5	0	0	0	0	0.22
Stephanocoenia michelinii	0	0	0.25	1	1	0	0.625	1	0.48
Mussid (juvenile)	0	0	0	0	0	0.25	0	0	0.03
URCHIN TAXA									
Diadema antillarum	0	0	0	0	0	0	0	0	0.00

Table 13a. Presence/Absence of Stony Coral Taxa - Patch Reefs 1996										
SITE CODES:	9P1	9P3	9P4	7P1	7P2	5P1	5P2	5P3	2P1	Sum
STONY CORAL TAXA										
ACROPORA CERVICORNIS	1	1	0	1	0	0	1	1	0	5
Acropora palmata	0	0	0	0	0	0	0	0	0	0
Agaricia agaricites (complex)	1	1	1	1	1	1	1	1	1	9
Agaricia fragilis	1	1	0	0	0	0	0	1	1	4
Agaricia lamarcki	0	0	0	0	0	0	1	0	0	1
Astrangia poculata	0	0	0	0	0	0	1	0	0	1
Cladocora arbuscula	0	0	0	0	0	0	1	1	1	3
Colpophyllia natans	1	1	1	1	1	1	1	1	1	9
Dendrogyra cylindrus	0	0	0	0	0	0	0	0	0	0
Dichocoenia stokesii	1	1	1	1	1	1	1	1	1	9
Diploria clivosa	1	1	1	0	1	0	1	1	0	6
Diploria labyrinthiformis	1	1	1	1	1	1	1	1	0	8
Diploria strigosa	1	1	1	1	1	1	1	1	1	9
Eusmilia fastigiata	1	1	0	1	1	1	1	1	0	7
Favia fragum	1	1	0	1	1	0	1	0	0	5
Isophyllastrea rigida	0	0	0	1	1	0	1	0	0	3
Isophyllia sinuosa	1	0	0	0	0	0	1	1	0	3
Leptoseris cucullata	1	0	0	0	0	1	1	1	0	4
Madracis decactis	1	0	0	1	1	0	1	1	1	6
Madracis mirabilis	0	1	0	0	0	0	1	0	0	2
Manicina areolata	0	1	0	0	0	0	0	0	0	1
Meadrina meandrites	1	1	1	1	1	0	1	1	1	8
Millepora alcicornis	1	1	1	1	1	1	1	1	1	9
Millepora complanata	1	0	0	0	0	0	1	1	1	4
Montastraea annularis (complex)	1	1	1	1	1	1	1	1	1	9
Montastraea cavernosa	1	1	1	1	1	1	1	1	1	9
Mycetophyllia aliciae	1	0	0	1	0	1	1	1	0	5
Mycetophyllia danaana	1	0	0	0	1	1	1	1	0	5
Mycetophyllia ferox	1	0	0	0	1	1	0	1	0	4
Mycetophyllia lamarckiana	1	0	0	1	1	1	0	1	0	5
Mussa angulosa	1	1	0	1	1	1	1	1	1	8
Oculina diffusa	1	1	0	1	1	1	1	1	1	8
Phyllangia americana	0	0	0	0	0	0	0	1	1	2
Porites astreoides	1	1	1	1	1	1	1	1	1	9
Porites branneri	0	0	0	0	0	1	1	1	0	3
Porites porites (complex)	1	1	1	1	1	1	1	1	1	9
Scolymia cubensis	1	0	0	1	1	1	1	1	1	7
Scolymia lacera	0	0	0	1	0	0	1	1	1	4
Siderastrea radians	1	1	1	1	1	1	1	1	1	9
Siderastrea siderea	1	1	1	1	1	1	1	1	1	9
Solenastrea bournoni	1	1	1	1	1	1	1	1	0	8
Solenastrea hyades	0	0	0	0	0	0	0	0	0	0
Stephanocoenia michelinii	1	1	1	1	1	1	1	1	1	9
Total number of taxa	31	24	16	26	26	24	35	34	22	
Mean number of taxa=	26.44	Standard deviation =		6.04						
Mussid (juvenile)	1	0	0	1	1	1	0	0	0	4
URCHIN TAXA										
Diadema antillarum	0	0	0	1	0	0	0	0	0	1

Table 13b. Frequency of Stony Coral Taxa - Patch Reefs 1996										
SITE CODES:	9P1	9P3	9P4	7P1	7P2	5P1	5P2	5P3	2P1	Frequency of Occurrence
STONY CORAL TAXA										
Acropora cervicornis	1	0.25	0	0.5	0	0	0.25	0.25	0	0.25
Acropora palmata	0	0	0	0	0	0	0	0	0	0.00
Agaricia agaricites (complex)	1	1	1	1	1	1	0.5	0.875	1	0.93
Agaricia fragilis	0.875	0.25	0	0	0	0	0	0.125	0.125	0.15
Agaricia lamarcki	0	0	0	0	0	0	0.25	0	0	0.03
Astrangia poculata	0	0	0	0	0	0	0.125	0	0	0.01
Cladocora arbuscula	0	0	0	0	0	0	0.875	0.625	1	0.28
Colpophyllia natans	0.5	0.25	0.5	1	1	1	1	1	0.25	0.72
Dendrogyra cylindrus	0	0	0	0	0	0	0	0	0	0.00
Dichocoenia stokesii	1	1	1	1	1	0.75	1	1	0.125	0.88
Diploria clivosa	0.5	0.5	0.25	0	0.25	0	0.5	0.625	0	0.29
Diploria labyrinthiformis	0.75	1	0.75	1	0.875	0.5	0.5	0.75	0	0.68
Diploria strigosa	0.75	0.75	0.25	0.75	0.75	0.75	1	1	1	0.78
Eusmilia fastigiata	1	0.625	0	1	1	0.25	1	0.875	0	0.64
Favia fragum	0.75	1	0	0.5	0.25	0	0.125	0	0	0.29
Isophyllastrea rigida	0	0	0	1	0.25	0	0.25	0	0	0.17
Isophyllia sinuosa	0.25	0	0	0	0	0	0.125	0.5	0	0.10
Leptoseris cucullata	1	0	0	0	0	0.625	0.75	0.375	0	0.31
Madracis decactis	0.75	0	0	0.625	0.25	0	0.125	0.625	0.375	0.31
Madracis mirabilis	0	0.125	0	0	0	0	0.125	0	0	0.03
Manicina areolata	0	0.25	0	0	0	0	0	0	0	0.03
Meadrina meandrites	0.25	0.75	0.5	1	0.75	0	1	0.875	0.125	0.58
Millepora alcicornis	1	1	1	1	1	1	1	1	1	1.00
Millepora complanata	0.25	0	0	0	0	0	0.625	0.375	0.5	0.19
Montastraea annularis (complex)	1	0.75	1	1	1	1	1	1	1	0.97
Montastraea cavernosa	1	1	0.5	1	1	1	1	1	1	0.94
Mycetophyllia aliciae	0.25	0	0	0.75	0	0.5	1	0.5	0	0.33
Mycetophyllia danaana	1	0	0	0	0.25	0.875	0.125	1	0	0.36
Mycetophyllia ferox	0.5	0	0	0	0.375	0.875	0	0.125	0	0.21
Mycetophyllia lamarckiana	1	0	0	1	1	1	0	1	0	0.56
Mussa angulosa	0.25	0.25	0	0.25	0.25	0.75	1	1	0.25	0.44
Oculina diffusa	0.625	0.75	0	1	0.625	0.5	1	1	1	0.72
Phyllangia americana	0	0	0	0	0	0	0	0.125	0.875	0.11
Porites astreoides	1	1	1	1	1	0.875	1	1	1	0.99
Porites branneri	0	0	0	0	0	0.875	0.5	0.25	0	0.18
Porites porites (complex)	1	1	0.25	1	0.5	1	0.125	1	0.75	0.74
Scolymia cubensis	0.375	0	0	1	0.5	1	1	1	1	0.65
Scolymia lacera	0	0	0	0.25	0	0	1	0.625	0.875	0.31
Siderastrea radians	0.75	1	1	1	1	0.25	0.5	0.875	1	0.82
Siderastrea siderea	1	1	1	1	1	1	1	1	1	1.00
Solenastrea bournoni	1	0.75	0.25	0.25	0.5	0.5	0.75	1	0	0.56
Solenastrea hyades	0	0	0	0	0	0	0	0	0	0.00
Stephanocoenia michelinii	1	0.75	0.25	1	1	1	1	1	1	0.89
Mussid (juvenile)	8	0	0	0.875	0.5	0.75	0	0	0	1.13
URCHIN TAXA										
Diadema antillarum	0	0	0	0.25	0	0	0	0	0	0.03

Table 14a. Presence/Absence of Stony Coral Taxa - Shallow Offshore Reefs 1996													
SITE CODES:	9S1	9S2	9S3	9S4	7S1	7S2	5S1	5S2	5S3	5S4	5S5	2S1	SUM
STONY CORAL TAXA													
Acropora cervicornis	0	1	0	0	0	1	1	1	0	1	1	1	7.00
Acropora palmata	1	1	1	0	0	0	1	0	0	1	1	1	7.00
Agaricia agaricites (complex)	1	1	1	1	1	1	1	1	1	1	1	1	12.00
Agaricia fragilis	0	1	1	0	1	0	0	0	0	1	0	1	5.00
Agaricia lamarcki	0	0	0	0	0	0	0	0	0	0	0	0	0.00
Astrangia poculata	0	0	0	0	0	0	0	0	0	0	0	0	0.00
Cladocora arbuscula	0	0	0	0	0	0	0	0	0	0	0	0	0.00
Colpophyllia natans	0	1	0	0	1	1	1	1	0	1	0	1	7.00
Dendrogyra cylindrus	0	0	0	1	0	0	1	0	0	0	0	1	3.00
Dichocoenia stokesii	0	1	1	1	1	1	1	1	0	0	0	1	8.00
Diploria clivosa	1	1	0	0	1	1	0	1	0	1	1	1	8.00
Diploria labyrinthiformis	0	1	1	1	1	1	1	1	0	1	0	1	9.00
Diploria strigosa	1	1	1	0	0	1	1	1	0	1	1	1	9.00
Eusmilia fastigiata	1	1	1	1	0	1	0	1	0	1	0	1	8.00
Favia fragum	1	1	1	1	1	1	1	1	1	1	1	1	12.00
Isophyllastrea rigida	0	1	0	0	0	0	0	0	0	0	0	0	1.00
Isophyllia sinuosa	0	1	0	0	0	0	0	0	0	0	1	1	3.00
Leptoseris cucullata	0	1	1	1	0	0	0	0	0	0	1	1	5.00
Madracis decactis	0	0	1	1	1	1	0	0	1	1	1	1	8.00
Madracis mirabilis	0	0	0	0	0	0	0	0	1	1	0	0	2.00
Manicina areolata	0	0	0	0	0	0	0	0	0	0	0	1	1.00
Meandrina meandrites	0	1	1	1	1	1	1	1	0	1	0	1	9.00
Millepora alcicornis	1	1	1	1	1	1	1	1	1	1	1	1	12.00
Millepora complanata	1	1	1	1	1	1	1	1	1	1	1	1	12.00
Montastraea annularis (complex)	1	1	1	1	1	1	1	1	1	1	1	1	12.00
Montastraea cavernosa	1	1	1	0	1	1	1	1	1	1	1	1	11.00
Mycetophyllia aliciae	0	0	0	0	0	0	0	0	0	0	0	0	0.00
Mycetophyllia danaana	0	1	1	0	0	0	1	1	0	0	0	1	5.00
Mycetophyllia ferox	1	0	1	0	0	0	1	1	0	1	0	0	5.00
Mycetophyllia lamarckiana	1	1	1	0	0	0	1	1	0	1	0	1	7.00
Mussa angulosa	0	0	0	0	0	0	0	0	0	0	0	0	0.00
Oculina diffusa	0	0	0	0	0	1	0	0	0	0	0	0	1.00
Phyllangia americana	0	0	0	0	0	0	0	0	0	0	0	0	0.00
Porites astreoides	1	1	1	0	1	1	1	1	1	1	1	1	11.00
Porites branneri	0	0	0	0	0	0	0	0	0	0	0	0	0.00
Porites porites (complex)	1	1	1	1	1	1	1	1	1	1	1	1	12.00
Scolymia cubensis	0	1	0	0	0	0	0	0	0	0	0	0	1.00
Scolymia lacera	0	0	0	0	0	0	0	0	0	0	0	0	0.00
Siderastrea radians	1	1	1	0	1	1	0	0	1	1	1	1	9.00
Siderastrea siderea	1	1	1	1	1	1	1	1	1	1	1	1	12.00
Solenastrea bournoni	0	1	0	0	0	1	0	0	0	0	0	0	2.00
Solenastrea hyades	0	0	0	0	0	0	0	0	0	0	0	0	0.00
Stephanocoenia michelinii	0	1	0	1	1	1	1	1	0	0	1	1	8.00
Total number of taxa	16.00	28.00	22.00	15.00	18.00	22.00	21.00	21.00	12.00	23.00	18.00	28.00	
Mean number of taxa=	20.33	Standard deviation=		4.85									
Mussid (juvenile)	0	0	1	0	0	0	0	0	0	0	0	1	
URCHIN TAXA													
Diadema antillarum	1	1	0	0	0	0	0	0	1	1	1	0	

Table 14b. Frequency of Stony Coral Taxa - Shallow Offshore Reefs 1996													
SITE CODES:	9S1	9S2	9S3	9S4	7S1	7S2	5S1	5S2	5S3	5S4	5S5	2S1	Frequency of Occurrence
STONY CORAL TAXA													
Acropora cervicornis	0	0.5	0	0	0	1	0.25	0.625	0	0.5	0.5	0.25	0.30
Acropora palmata	0.5	0.25	1	0	0	0	0.25	0	0	1	1	0.875	0.41
Agaricia agaricites (complex)	1	0.75	1	1	1	1	1	1	1	1	1	1	0.98
Agaricia fragilis	0	0.125	0.25	0	0.25	0	0	0	0	0.125	0	0.125	0.07
Agaricia lamarcki	0	0	0	0	0	0	0	0	0	0	0	0	0.00
Astrangia poculata	0	0	0	0	0	0	0	0	0	0	0	0	0.00
Cladocora arbuscula	0	0	0	0	0	0	0	0	0	0	0	0	0.00
Colpophyllia natans	0	0.5	0	0	0.25	0.5	0.375	0.875	0	0.875	0	0.25	0.30
Dendrogyra cylindrus	0	0	0	0.25	0	0	0.25	0	0	0	0	0.125	0.05
Dichocoenia stokesii	0	1	0.5	0.625	0.75	1	0.5	0.625	0	0	0	0.625	0.47
Diploria clivosa	1	0.5	0	0	0.25	0.5	0	0.25	0	0.5	1	0.875	0.41
Diploria labyrinthiformis	0	0.5	0.75	0.25	0.25	1	0.75	1	0	0.25	0	0.25	0.42
Diploria strigosa	0.25	0.25	0.75	0	0	1	0.25	0.75	0	0.25	0.5	0.5	0.38
Eusmilia fastigiata	0.25	0.5	0.5	0.625	0	0.25	0	0.5	0	0.125	0	0.375	0.26
Favia fragum	1	0.625	1	1	0.75	0.25	1	0.75	1	1	1	1	0.86
Isophyllastrea rigida	0	0.125	0	0	0	0	0	0	0	0	0	0	0.01
Isophyllia sinuosa	0	0.125	0	0	0	0	0	0	0	0	0.25	0.375	0.06
Leptoseris cucullata	0	0.5	0.5	0.75	0	0	0	0	0	0	0.125	0.125	0.17
Madracis decactis	0	0	0.5	0.375	0.25	0.25	0	0	0.375	0.25	0.25	0.375	0.22
Madracis mirabilis	0	0	0	0	0	0	0	0	0.125	0.625	0	0	0.06
Manicina areolata	0	0	0	0	0	0	0	0	0	0	0	0.25	0.02
Meadrina meandrites	0	0.125	0.75	0.5	0.5	0.75	0.75	0.5	0	0.125	0	0.5	0.38
Millepora alcicornis	1	1	1	1	1	1	1	1	0.625	0.75	0.75	1	0.93
Millepora complanata	1	0.25	1	1	1	0.5	1	0.625	1	1	0.75	1	0.84
Montastraea annularis (complex)	0.25	0.75	1	0.25	0.25	0.75	0.75	1	1	1	0.5	1	0.71
Montastraea cavernosa	0.5	0.75	1	0	1	1	0.75	1	0.5	0.5	1	1	0.75
Mycetophyllia aliciae	0	0	0	0	0	0	0	0	0	0	0	0	0.00
Mycetophyllia danaana	0	0.5	0.5	0	0	0	0.25	0.375	0	0	0	0.5	0.18
Mycetophyllia ferox	0.25	0	0.375	0	0	0	0.25	0.75	0	0.125	0	0	0.15
Mycetophyllia lamarckiana	0.25	1	0.5	0	0	0	0.25	0.375	0	0.25	0	0.875	0.29
Mussa angulosa	0	0	0	0	0	0	0	0	0	0	0	0	0.00
Oculina diffusa	0	0	0	0	0	0.25	0	0	0	0	0	0	0.02
Phyllangia americana	0	0	0	0	0	0	0	0	0	0	0	0	0.00
Porites astreoides	1	1	1	0	1	1	1	1	1	1	1	1	0.92
Porites branneri	0	0	0	0	0	0	0	0	0	0	0	0	0.00
Porites porites (complex)	1	1	1	0.875	1	1	0.75	0.75	1	1	1	1	0.95
Scolymia cubensis	0	0.25	0	0	0	0	0	0	0	0	0	0	0.02
Scolymia lacera	0	0	0	0	0	0	0	0	0	0	0	0	0.00
Siderastrea radians	0.75	1	0.125	0	0.5	1	0	0	0.25	0.25	0.375	0.5	0.40
Siderastrea siderea	1	1	1	1	1	1	1	1	0.875	1	1	1	0.99
Solenastrea bournoni	0	0.375	0	0	0	0.25	0	0	0	0	0	0	0.05
Solenastrea hyades	0	0	0	0	0	0	0	0	0	0	0	0	0.00
Stephanocoenia michelinii	0	0.5	0	0.5	0.5	0.75	0.75	0.75	0	0	0.25	0.375	0.36
Mussid (juvenile)	0	0	0.25	0	0	0	0	0	0	0	0	0.125	0.03
URCHIN TAXA													
Diadema antillarum	0.25	0.25	0	0	0	0	0	0	0.5	0.125	0.125	0	0.10

Table 15a. Presence/Absence of Stony Coral Taxa - Deep Offshore Reefs 1996											
SITE CODES:	9D1	9D3	9D4	7D1	7D2	5D1	5D2	5D3	5D4	5D5	2D1	Sum
STONY CORAL TAXA												
Acropora cervicornis	1	0	0	0	1	0	1	1	1	1	1	7.00
Acropora palmata	0	0	0	0	0	0	0	0	0	0	0	0.00
Agaricia agaricites (complex)	1	1	1	1	1	1	1	1	1	1	1	11.00
Agaricia fragilis	1	1	1	0	1	1	1	1	1	1	1	10.00
Agaricia lamarcki	1	1	1	1	1	1	1	1	0	0	0	8.00
Astrangia poculata	0	0	0	0	0	0	0	0	0	0	0	0.00
Cladocora arbuscula	0	0	0	0	0	0	0	0	0	0	0	0.00
Colpophyllia natans	1	1	0	1	1	1	1	1	1	1	1	10.00
Dendrogyra cylindrus	0	0	0	0	0	0	0	0	0	0	0	0.00
Dichocoenia stokesii	1	1	1	1	1	1	1	1	1	1	1	11.00
Diploria clivosa	0	0	0	0	1	0	0	1	1	0	1	4.00
Diploria labyrinthiformis	1	1	1	1	1	1	1	1	1	1	1	11.00
Diploria strigosa	0	1	1	1	1	1	1	1	1	1	1	10.00
Eusmilia fastigiata	1	1	1	1	1	1	1	1	1	1	1	11.00
Favia fragum	1	0	1	0	1	0	0	0	1	1	1	6.00
Isophyllastrea rigida	0	0	0	0	0	0	0	0	0	0	0	0.00
Isophyllia sinuosa	0	0	0	0	0	0	0	1	1	0	1	3.00
Leptoseris cucullata	1	1	1	1	1	1	1	1	1	1	0	10.00
Madracis decactis	1	1	1	0	1	1	1	1	1	1	1	10.00
Madracis mirabilis	0	1	1	0	1	1	1	1	1	1	1	9.00
Manicina areolata	1	1	0	1	1	1	1	1	0	1	1	9.00
Meandrina meandrites	1	1	1	1	1	1	1	1	1	1	1	11.00
Millepora alcicornis	1	1	1	1	1	1	1	1	1	1	1	11.00
Millepora complanata	0	0	0	0	0	0	0	0	1	0	0	1.00
Montastraea annularis (complex)	1	1	1	1	1	1	1	1	1	1	1	11.00
Montastraea cavernosa	1	1	1	1	1	1	1	1	1	1	1	11.00
Mycetophyllia aliciae	1	1	1	0	1	1	1	1	0	1	0	8.00
Mycetophyllia danaana	1	0	0	0	1	1	0	1	1	1	1	7.00
Mycetophyllia ferox	1	0	1	0	1	1	1	1	1	1	1	9.00
Mycetophyllia lamarckiana	1	1	1	1	1	1	1	1	1	1	1	11.00
Mussa angulosa	1	1	1	0	1	0	1	1	0	0	0	6.00
Oculina diffusa	0	0	0	1	0	0	0	0	0	0	0	1.00
Phyllangia americana	0	0	0	0	0	0	0	0	0	0	0	0.00
Porites astreoides	1	1	1	1	1	1	1	1	1	1	1	11.00
Porites branneri	0	1	0	0	0	0	0	0	0	0	0	1.00
Porites porites (complex)	1	1	1	1	1	1	1	1	1	1	1	11.00
Scolymia cubensis	1	0	1	0	1	1	0	1	0	1	1	7.00
Scolymia lacera	0	0	0	0	0	0	0	1	0	0	0	1.00
Siderastrea radians	0	1	1	1	1	1	1	1	1	1	1	10.00
Siderastrea siderea	1	1	1	1	1	1	1	1	1	1	1	11.00
Solenastrea bournoni	1	0	0	1	1	1	1	1	0	1	1	8.00
Solenastrea hyades	0	0	0	0	0	0	0	0	0	0	0	0.00
Stephanocoenia michelinii	1	1	1	1	1	1	1	1	1	1	1	11.00
Total number of taxa	27.00	25.00	25.00	21.00	31.00	27.00	27.00	32.00	27.00	28.00	28.00	
Mean number of taxa =	27.09	Standard deviation =		2.95								
Mussid (juvenile)	1	0	0	1	1	1	1	0	0	1	1	7.00
URCHIN TAXA												
Diadema antillarum	0	0	0	0	0	0	0	0	0	0	0	0.00

Table 15b. Frequency of stony Coral Taxa - Deep Offshore Reefs 1996											
SITE CODES:	9D1	9D3	9D4	7D1	7D2	5D1	5D2	5D3	5D4	5D5	2D1	Frequency of Occurrence
STONY CORAL TAXA												
Acropora cervicornis	0.25	0	0	0	0.75	0	0.5	0.375	1	0.5	0.5	0.35
Acropora palmata	0	0	0	0	0	0	0	0	0	0	0	0.00
Agaricia agaricites (complex)	1	1	1	1	1	1	1	1	1	1	1	1.00
Agaricia fragilis	1	0.5	0.375	0	0.625	1	0.75	1	0.75	0.5	0.375	0.63
Agaricia lamarcki	0.25	0.75	0.75	0.25	0.25	0.25	0.25	0.625	0	0	0	0.31
Astrangia poculata	0	0	0	0	0	0	0	0	0	0	0	0.00
Cladocora arbuscula	0	0	0	0	0	0	0	0	0	0	0	0.00
Colpophyllia natans	1	0.25	0	0.5	0.75	0.75	1	1	1	1	1	0.75
Dendrogyra cylindrus	0	0	0	0	0	0	0	0	0	0	0	0.00
Dichocoenia stokesii	1	1	1	1	1	1	1	1	0.5	0.875	1	0.94
Diploria clivosa	0	0	0	0	0.375	0	0	0.125	0.25	0	0.375	0.10
Diploria labyrinthiformis	0.75	1	0.25	0.625	0.875	0.5	0.75	0.75	0.75	0.75	1	0.73
Diploria strigosa	0	0.75	0.25	0.5	1	1	1	1	0.875	0.75	0.75	0.72
Eusmilia fastigiata	1	1	0.75	0.25	1	1	1	1	0.875	1	1	0.90
Favia fragum	0.25	0	0.125	0	0.375	0	0	0	0.75	1	0.5	0.27
Isophyllastrea rigida	0	0	0	0	0	0	0	0	0	0	0	0.00
Isophyllia sinuosa	0	0	0	0	0	0	0	0.375	0.25	0	0.25	0.08
Leptoseris cucullata	1	1	1	0.25	0.625	1	1	1	0.75	1	0	0.78
Madracis decactis	1	1	1	0	0.875	0.75	0.75	1	0.5	0.75	0.875	0.77
Madracis mirabilis	0	0.5	0.5	0	1	0.25	1	0.75	0.5	0.75	0.25	0.50
Manicina areolata	0.25	0.25	0	1	1	1	0.75	1	0	1	1	0.66
Meadrina meandrites	0.5	1	0.75	1	1	0.75	0.75	1	0.5	1	1	0.84
Millepora alcicornis	1	1	1	1	1	1	1	1	1	1	1	1.00
Millepora complanata	0	0	0	0	0	0	0	0	0.25	0	0	0.02
Montastraea annularis (complex)	1	0.75	1	0.625	1	1	1	1	1	1	1	0.94
Montastraea cavernosa	1	1	1	1	1	1	1	1	0.5	1	1	0.95
Mycetophyllia aliciae	1	0.25	0.25	0	0.25	0.75	0.5	1	0	0.25	0	0.39
Mycetophyllia danaana	0.75	0	0	0	0.625	0.25	0	0.375	0.125	0.75	0.5	0.31
Mycetophyllia ferox	1	0	0.25	0	0.625	0.75	0.25	1	0.25	1	0.25	0.49
Mycetophyllia lamarckiana	1	0.25	0.25	0.25	0.25	0.125	1	0.875	0.875	0.5	0.25	0.51
Mussa angulosa	0.5	0.25	0.25	0	0.25	0	0.125	0.25	0	0	0	0.15
Oculina diffusa	0	0	0	0.125	0	0	0	0	0	0	0	0.01
Phyllangia americana	0	0	0	0	0	0	0	0	0	0	0	0.00
Porites astreoides	1	1	1	1	1	1	1	1	1	1	1	1.00
Porites branneri	0	0.5	0	0	0	0	0	0	0	0	0	0.05
Porites porites (complex)	1	1	1	1	1	0.75	0.75	1	1	1	1	0.95
Scolymia cubensis	0.625	0	1	0	0.75	1	0	1	0	1	0.25	0.51
Scolymia lacera	0	0	0	0	0	0	0	0.125	0	0	0	0.01
Siderastrea radians	0	0.5	1	1	0.25	0.75	0.375	0.25	0.375	0.625	1	0.56
Siderastrea siderea	1	1	1	1	1	1	1	1	1	1	1	1.00
Solenastrea bournoni	0.25	0	0	0.75	0.25	1	0.125	0.5	0	0.25	0.5	0.33
Solenastrea hyades	0	0	0	0	0	0	0	0	0	0	0	0.00
Stephanocoenia michelinii	1	1	1	1	1	1	1	1	0.375	1	0.875	0.93
Mussid (juvenile)	0.75	0	0	0.25	1	0.75	1	0	0	0.375	0.5	0.42
URCHIN TAXA												
Diadema antillarum	0	0	0	0	0	0	0	0	0	0	0	0.00

Table 16. Summary of Taxonomic Richness of Individual Sites by Site Type

Site Type	Hardbottom (N = 8)	Patch Reef (N = 9)	Offshore Shallow (N = 12)	Offshore Deep (N = 11)
Sites with most taxa	Long Key (19 taxa)	Western Head (35 taxa)	Sand Key (28 taxa) Grecian Rocks (28 taxa)	Eastern Sambo (32 taxa) Tennessee (31 taxa)
Site with least taxa	Molasses Key (7 taxa)	Admiral (16 taxa)	Eastern Sambo (12 taxa)	Alligator (21 taxa)

Table 17. Summary of Taxonomic Richness by Site Type

Site Type	Hardbottom (N = 8)	Patch Reef (N = 9)	Offshore Shallow (N = 12)	Offshore Deep (N = 11)
Mean taxonomic richness	11.88	26.33	20.33	27.09
Standard deviation	4.12	5.89	4.85	2.95
Range	7 to 19	16 to 35	12 to 28	21 to 32
Total taxa/type	25	40	34	36

Table 18. Bray Curtis Similarity Index Values for Hardbottom Sites.

	Rattle Snake						
El Radabob (EL)	82.759	**E L**					
Dove Key (DK)	68.966	62.963	**DK**				
Long Key (LK)	48.837	50.000	46.341	**LK**			
Moser Channel (MC)	53.333	56.338	47.887	79.798	**MC**		
Molasses Keys (MK)	55.670	60.674	69.663	41.379	52.033	**M K**	
Jaap Reef (JR)	52.288	55.172	35.862	72.637	65.922	34.921	**JR**
Content Keys (CK)	60.938	53.333	46.667	60.227	59.740	43.564	59.873

Table 19. Bray Curtis Similarity Index Values for Patch Reef Sites.

	Turtle							
Porter (P)	73.716	**P**						
Admiral (A)	57.348	74.576	**A**					
W .Turtle Shoal (WTS)	74.595	72.171	58.909	**W T S**				
Dustan (D)	78.338	76.190	69.421	84.685	**D**			
W . Washer Woman (WW)	73.256	65.116	59.438	72.941	76.221	**WW**		
Western Head (WH)	66.313	65.868	54.610	70.777	69.412	66.859	**W H**	
Cliff Green (CG)	81.443	70.145	56.655	79.167	77.493	75.978	80.818	**C G**
Smith Shoal (SS)	59.306	62.044	55.856	65.176	65.000	59.930	66.250	68.882

Table 20. Bray Curtis Similarity Index Values for Offshore Shallow Sites.

	Carysfort										
Grecian (G)	65.138	**G**									
Molasses (M)	68.807	68.750	**M**								
Conch (C)	60.000	55.769	67.308	**C**							
Alligator (A)	72.527	68.182	71.818	74.419	**A**						
Tennessee (T)	60.550	75.781	67.969	55.769	74.545	**T**					
Sombrero (S)	69.744	69.528	78.970	69.189	77.157	72.961	**S**				
Looe Key (L)	60.748	72.222	77.778	60.784	72.222	79.365	82.096	**L**			
Eastern Sambo (E)	75.610	54.455	67.327	62.338	72.289	55.446	67.039	57.576	**E**		
W estern Sambo (W)	77.387	66.667	73.418	56.085	69.652	64.135	71.963	69.528	76.503	**W**	
Rock Key (R)	79.787	64.602	70.796	56.180	72.632	66.372	66.995	63.964	73.256	80.193	**R**
Sand Key (S)	72.174	75.373	82.090	64.545	76.724	70.149	75.102	74.242	64.486	75.502	78.992

Table 21. Bray Curtis Similarity Index Values for Offshore Deep Sites.

	Carysfort										
Molasses (M)	73.846	**M**									
Conch (C)	74.608	86.207	**C**								
Alligator (A)	64.000	75.277	71.698	**A**							
Tennessee (T)	81.744	78.698	75.904	71.565	**T**						
Sombrero (S)	81.690	76.687	78.750	75.748	84.239	**S**					
Looe Key (L)	82.286	80.997	75.556	71.622	87.052	84.330	**L**				
Eastern Sambo (E)	85.789	79.202	77.681	68.712	86.005	86.614	85.106	**E**			
Western Sambo (W)	71.028	71.918	68.531	61.423	74.850	68.323	78.864	74.352	**W**		
Rock Key (R)	82.514	77.745	77.341	71.795	88.654	85.014	83.978	87.245	76.877	**R**	
Sand Key (SK)	74.783	76.582	73.548	79.038	86.034	80.347	79.765	79.784	76.282	85.714	

Table 22a. Disease Conditions by Station

Site Name	Station	Species Name	White Diseases	Black Band Disease	Other Diseases	Total # of disease/station
Admiral	2	Montastraea annularis complex	0	1	0	1
Admiral	3	Montastraea annularis complex	0	1	0	1
Alligator Deep	1	Dichocoenia stokesi.	1	0	0	1
Alligator Deep	4	Stephanocoenia michelinii.	0	0	1	1
Alligator Shallow	1	Porites astreoides	0	0	1	1
Alligator Shallow	2	Porites astreoides	0	0	1	1
Alligator Shallow	3	Montastraea cavernosa	0	0	1	1
Alligator Shallow	3	Porites astreoides	0	0	1	2
Alligator Shallow	4	Montastraea cavernosa	0	0	1	1
Carysfort Shallow	2	Acropora palmata	1	0	0	1
Content Keys	2	Diploria strigosa	0	0	1	1
Dustan Rocks	1	Montastraea annularis complex	0	0	1	1
Dustan Rocks	2	Montastraea annularis complex	0	0	1	1
Dustan Rocks	2	Siderastrea siderea	0	0	1	2
Grecian Rocks	1	Montastraea annularis complex	0	1	0	1
Grecian Rocks	2	Acropora palmata	1	0	0	1
Looe Key Deep	2	Acropora cervicornis	1	0	0	1
Looe Key Deep	2	Siderastrea siderea	0	0	1	2
Looe Key Shallow	1	Montastraea annularis complex	0	0	1	1
Looe Key Shallow	2	Montastraea annularis complex	0	0	1	1
Looe Key Shallow	3	Dichocoenia stokesi.	1	0	0	1
Looe Key Shallow	3	Diploria labyrinthiformis	0	0	1	1
Looe Key Shallow	3	Diploria strigosa	0	1	0	3
Looe Key Shallow	4	Montastraea annularis complex	0	1	1	2
Molasses Shallow	4	Acropora palmata	1	0	0	1
Smith Shoal	4	Montastraea annularis complex	0	1	0	1
Sombrero Shallow	4	Acropora palmata	1	0	0	1
Tennessee Deep	3	Montastraea annularis complex	0	1	0	1
W. Turtle Shoal	3	Stephanocoenia michelinii.	0	0	1	1
W. Washer Women	1	Mycetophyllia ferox	0	0	1	1
Western Sambo Deep	4	Montastraea annularis complex	0	0	1	1
			White Diseases	Black Band Disease	Other Diseases	
	Total Number of	Disease incidences	7	7	18	
	Total Number of	Stations with each Disease	7	7	16	
	Total number of	Stations with Disease	26			

Table 22b. Disease Conditions by Species					
Site Name	Station	Species Name	White Diseases	Black Band Disease	Other Diseases
Looe Key Deep	2	Acropora cervicornis	1	0	0
Carysfort Shallow	2	Acropora palmata	1	0	0
Grecian Rocks	2	Acropora palmata	1	0	0
Molasses Shallow	4	Acropora palmata	1	0	0
Sombrero Shallow	4	Acropora palmata	1	0	0
Alligator Deep	1	Dichocoenia stokesi	1	0	0
Looe Key Shallow	3	Dichocoenia stokesi	1	0	0
Looe Key Shallow	3	Diploria labyrinthiformis	0	0	1
Content Keys	2	Diploria strigosa	0	0	1
Looe Key Shallow	3	Diploria strigosa	0	1	0
Admiral	2	Montastraea annularis complex	0	1	0
Admiral	3	Montastraea annularis complex	0	1	0
Dustan Rocks	1	Montastraea annularis complex	0	0	1
Dustan Rocks	2	Montastraea annularis complex	0	0	1
Grecian Rocks	1	Montastraea annularis complex	0	1	0
Looe Key Shallow	1	Montastraea annularis complex	0	0	1
Looe Key Shallow	2	Montastraea annularis complex	0	0	1
Looe Key Shallow	4	Montastraea annularis complex	0	1	1
Smith Shoal	4	Montastraea annularis complex	0	1	0
Tennessee Deep	3	Montastraea annularis complex	0	1	0
Western Sambo Deep	4	Montastraea annularis complex	0	0	1
Alligator Shallow	3	Montastraea cavernosa	0	0	1
Alligator Shallow	4	Montastraea cavernosa	0	0	1
W. Washer Women	1	Mycetophyllia ferox	0	0	1
Alligator Shallow	1	Porites astreoides	0	0	1
Alligator Shallow	2	Porites astreoides	0	0	1
Alligator Shallow	3	Porites astreoides	0	0	1
Dustan Rocks	2	Siderastrea siderea	0	0	1
Looe Key Deep	2	Siderastrea siderea	0	0	1
Alligator Deep	4	Stephanocoenia michelinii	0	0	1
W. Turtle Shoal	3	Stephanocoenia michelinii	0	0	1