

SEMI-ANNUAL REPORT
SUSTAINED ECOLOGICAL RESEARCH ON CORAL REEF RESOURCES
FORT JEFFERSON NATIONAL MONUMENT
COOPERATIVE AGREEMENT CA-5000-8-8014
SUBMITTED TO THE NATIONAL PARK SERVICE
BY THE FLORIDA MARINE RESEARCH INSTITUTE
FOR THE PERIOD OF 1 JANUARY TO 31 JULY 1990

MEETINGS

The Florida Marine Research Institute hosted a meeting of the National Park Service Coral Reef Research Program April 5 - 6. Caroline Rogers (U.S. Virgin Islands National Park) coordinated the meeting which included presentations by researchers working at Biscayne National Park, Fort Jefferson National Monument, Buck Island National Monument, and Virgin Islands National Park. One-half day was devoted to working group discussions on standardizing methods.

A manuscript on sampling methodology was prepared by Walter Jaap, Jennifer Wheaton and Kelly Donnelly for presentation at the American Academy of Underwater Sciences Annual Meeting, October 4 - 7, 1990, St. Petersburg, Florida.

EQUIPMENT MODIFICATION

The photographic apparatus was modified to shoot a rectangular photographic configuration (previously it rotated providing a circular photographic mosaic). The area of coverage (2.56 m^2) is approximately the same. The change to a square format was made to minimize boundary problems between photographs in the photomosaic. Overlap across the x or y axis (parallax) is easier to resolve than are lines running diagonally between the x and y axes. Six unique photographs are taken using the modified apparatus.

FIELD WORK

Field studies were conducted at Fort Jefferson National Monument from 7 to 23 May. The field party included Kelly Boomer Donnelly, Peter Hood, Walter Jaap, Ron Matchok, Joe Kimmel, Jim Tilmant, and Jennifer Wheaton; with the exception of Tilmant (NPS) all individuals are employed by FMRI. The National Park Service staff at Fort Jefferson assisted during portions of the sampling. Diving operations were supported with a 34 ft diesel-powered boat. Additionally, Roy Zondervan (FMRI) collected toxic dinoflagellate algae from 8 to 17 May to replace last year's collected material lost due to an electrical failure at FMRI laboratories.

A single chain transect was sampled three times at each of the five sites. Twenty-five, $1.6 \text{ m} \times 1.6 \text{ m}$, quadrats were mapped and photographed to census hydrocoral, stony coral, octocoral, and other prominent benthos. One 15 to 25 m long video transect was sampled at each site. Two recruitment tiles were collected and replaced with new tiles at each of the stations (10 per site, 50 total). The fouled plates were bleached, air-dried, and stored in labeled

plastic bags. Four functioning thermographs were recovered from Pulaski Shoal and Bird Key Reef, downloaded into a portable computer, serviced, and redeployed. A new thermograph was placed off the SW channel in shall water (10 ft). Four sampling stations were installed at the *Mavro Vetrancic* site. The area is representative of crushing and fragmenting grounding damage. Significant algal proliferation was observed over the damaged area. The site was not sampled but was qualitatively videoed.

LABORATORY ACTIVITY

Field data were proofed and entered into computer files. Thirty-five mm film was processed and reviewed to insure acceptable quality. Both glazed and unglazed faces of the recruitment tiles were examined under a dissecting microscope, and stony corals were identified to genus or species and counted. Thermograph data from Bird Key (2 June 1989 to 30 April 1990) and Pulaski Shoal (9 August 1989 to 14 May 1990) were processed to determine the monthly minimum and maximum temperatures and their means and standard deviations.

SAMPLING RESULTS

TRANSECTS

Bird Key Reef

Biotic cover ranged from 1033.5 to 1193.4 cm for three successive samplings of a 20 m long chain transect in 1990 (Tables 1, 2, 3). The dead carbonate coverage ranged from 2561.0 to 2930.2 cm. Three octocoral species and 11 stony coral species (8 to 9 per transect) were counted. *Montastraea annularis*, *Montastraea cavernosa*, and *Colpophyllia natans* were the most abundant stony coral species, and the octocoral *Briareum asbestinum* was a major component in one transect sampling. A two-way analysis of variance (ANOVA) showed a significant difference among the three most abundant species; however, no difference was found among transect samplings. Differences in total biotic cover among the three transects (Figure 1) illustrates the habitat variability and some sampling bias. In 1989, the Bird Key Reef transect yielded 3 octocoral and 9 stony coral species. *Madracis pharensis* and *Mycetophyllia ferox* were not reported. Total coral cover during 1989 was 603.2 cm (Table 4). In 1990, the coral cover ranged from 989.3 to 1155.7 cm. The highest coral cover recorded was at meter 18 of the third transect for large colonies of *Montastraea annularis* and *Colpophyllia natans* (Figure 2).

Texas rock

Biotic cover ranged from 761.8 to 802.1 cm for three samplings of one 15 m long chain transect in 1990 (Tables 5, 6, 7). Dead carbonate coverage ranged from 1680.9 to 1894.1 cm. One octocoral species and 16 species of stony corals (7 to 12 per transect) were counted. *Montastraea cavernosa*, *Colpophyllia natans*, and *Siderastrea siderea*, provided the most coverage. Results of a two-way ANOVA revealed no significant differences among the most abundant species or transect samplings. Differences in total biotic cover (Figure 3) documents spatial variability and some sampling bias. Extreme habitat relief at Texas Rock (3 m on the north end of the transect) makes consistent data acquisition difficult or virtually impossible. Coral cover in 1989 was 613.6 cm (Table 8 - note that transect length was 13 m in 1989 and 15 m in 1990). During 1990, the cover for corals ranged from 369.2 to 569.4 cm.

✓ have to consider total cm counted each time

Coral cover of 100 cm or more was encountered in one meter of sampling in three locations; in two instances this was attributable to large colonies of *Colpophyllia natans* and *Montastraea cavernosa*, and in the third case large colonies of *M. cavernosa*, *M. annularis* and *Siderastrea siderea* contributed (Figure 4).

QUADRATS

Bird Key Reef

In 1990, six octocoral species (136 colonies) were observed in the five quadrats. *Pseudopterogorgia bipinnata* dominated the octocoral fauna. In comparison, the same six species with the addition of one colony of *P. americana* were recorded from 1989 (Table 9). Relatively little change occurred in octocoral species and their abundance in the quadrats over the year (Figure 5). The major differences reflect changes in numbers of *Pseudopterogorgia bipinnata*. In this reef zone at Bird Key, *P. bipinnata* recruits in clusters into cracks and crevices; many of the recruits are overgrown or outcompeted by algae and sponge between the time they become recognizable as a juvenile colony and are firmly established as a sub-adult.

In 1990, sixteen stony coral species and 140 colonies were counted in five quadrats. *Montastraea annularis*, *Siderastrea siderea*, and *Montastraea cavernosa* were the most abundant stony corals (Table 9). Although only 13 stony coral species were reported in 1989 and 16 were reported in 1990, the overall species composition was basically the same (Figure 6). For example, two new species *Favia fragum* and *Madracis mirabilis* added in 1990 were represented by only one colony, a third species *Madracis decactis* by only three colonies. In two other cases, identification is questionable with *Mycetophyllia ferox* and *M. lamarckiana* reported in 1990 but *M. lamarckiana* and *M. spp.* reported in 1989. In a similar case, *Scolymia lacera* was reported in 1990 whereas *Scolymia sp.* was reported in 1989.

Texas Rock

In 1990, four octocorals (13 colonies) were enumerated in the five quadrats. *Erythropodium caribaeorum* was most abundant due to the suitability of its encrusting growth form (Table 10). Few octocorals occupy the sampling station at Texas Rock where the individual quadrats are situated atop high relief pinnacles slightly off the shallower reef area. *Iciligorgia schrammi*, represented by only two colonies in the quadrats, is abundant on the horizontal sides of these pinnacles, where the large conspicuous fans face into the current. Several other octocoral species occur in the "groove" between the pinnacles and shallower reef zone. In comparison, 1989 sampling yielded only one additional species represented by a single colony documenting relatively little change in the sampled population (Figure 7).

In 1990, seventeen stony coral species (159 colonies) were counted in the five quadrats. *Siderastrea siderea*, *Montastraea annularis*, and *M. cavernosa* were the most abundant (Table 10). Although only fifteen species were recorded in 1989, the overall species composition was relatively unchanged (Figure 8). For example, *Mycetophyllia sp.* was reported in 1989 whereas *M. ferox* and *M. lamarckiana* were reported in 1990. In the case of two other species, their field identification could have been reversed. Colonies of *Stephanocoenia michelinii* from 1989 were likely recorded as *Madracis decactis* in 1990.

Changes in number of colonies of the encrusting *Millepora alcicornis* and the opportunistic *Porites astreoides* are not unusual.

RECRUITMENT

A total of six juvenile corals were found on the grooved, unglazed surface of tiles from Bird Key Reef. Two recruits were present on the glazed surface of one plate at one station at Texas Rock. All of the recruits were from the genera *Porites* and *Favia*. Counts did not include the tile edges because they did not fit under the microscope.

TEMPERATURE DATA

Bird Key Reef

Temperatures recorded at 9 m depth from June 1989 to May 1990 ranged from 20.0°C 27 December 1989 (01:00 EST) to 30.1°C reached on four occasions in 1989: 30 August (21:00) and on September 5th (19:00), 10th (19:00), and 22nd (15:00) (Table 11, Figure 9).

The thermograph installed at 18 m depth reported abnormally high, obviously inaccurate temperatures.

Pulaski Shoal

Temperatures recorded at 9 m depth from August 1989 to May 1990 ranged from 21.1°C 29 December 1989 (11:00) to 30.2°C reached on both 29 August (16:00) and 9 September (16:00) (Table 11, Figure 10).

Temperatures at 18 m depth recorded from August 1989 to May 1990 ranged from 21.1°C 29 December 1989 (15:00) to 30.5°C 9 August 1989 (11:00) (Table 12, Figure 11).

Figure 1

BIRD KEY REEF TRANSECTS 1990

Biotic cover per linear meter

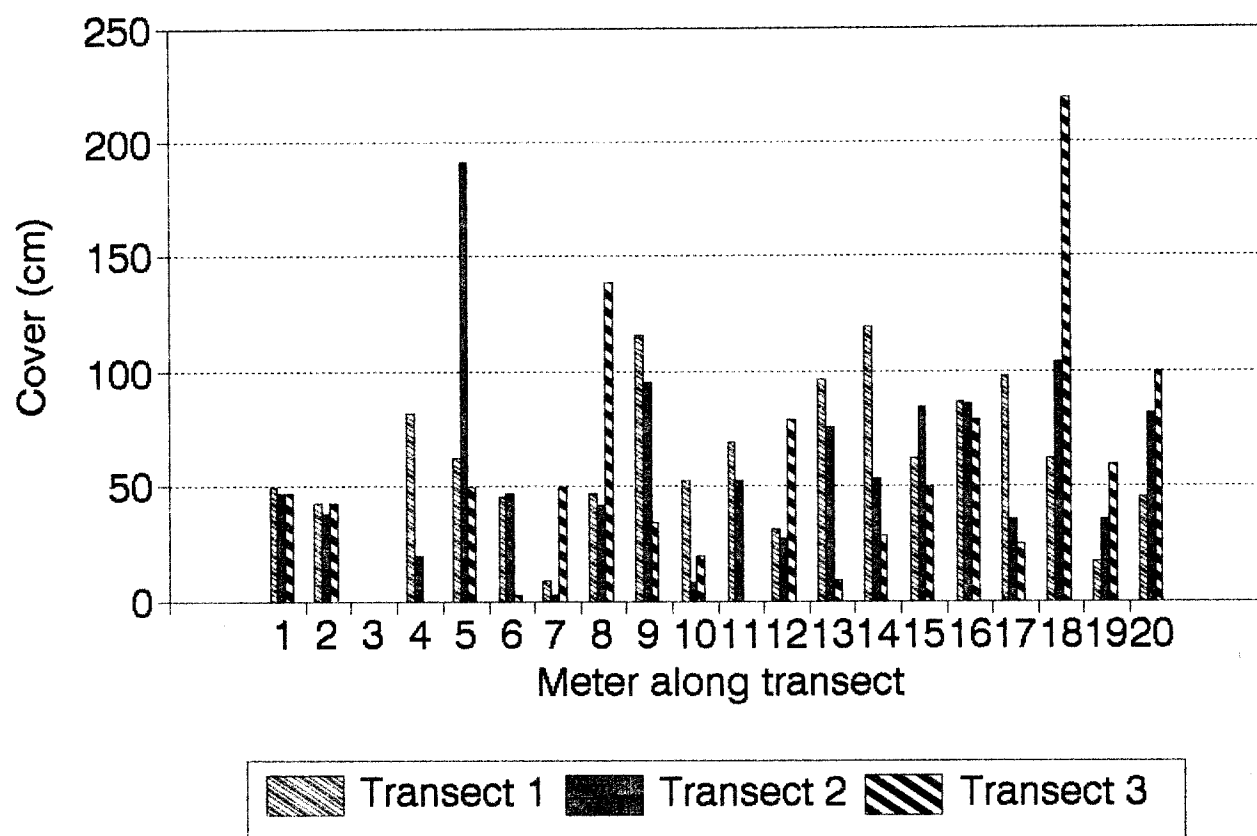


Figure 2

BIRD KEY REEF TRANSECTS 1990

Coral cover per linear meter

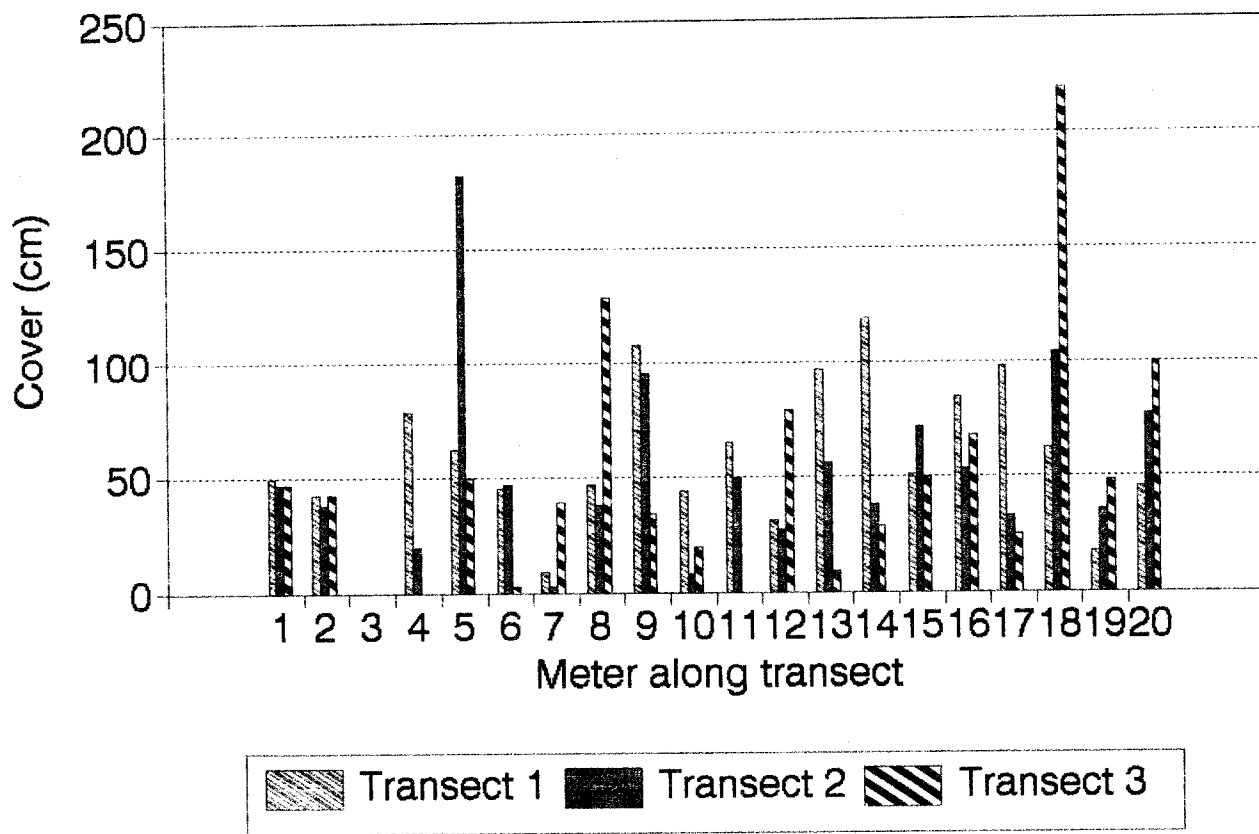


Figure 3

TEXAS ROCK TRANSECTS 1990

Biotic cover per linear meter

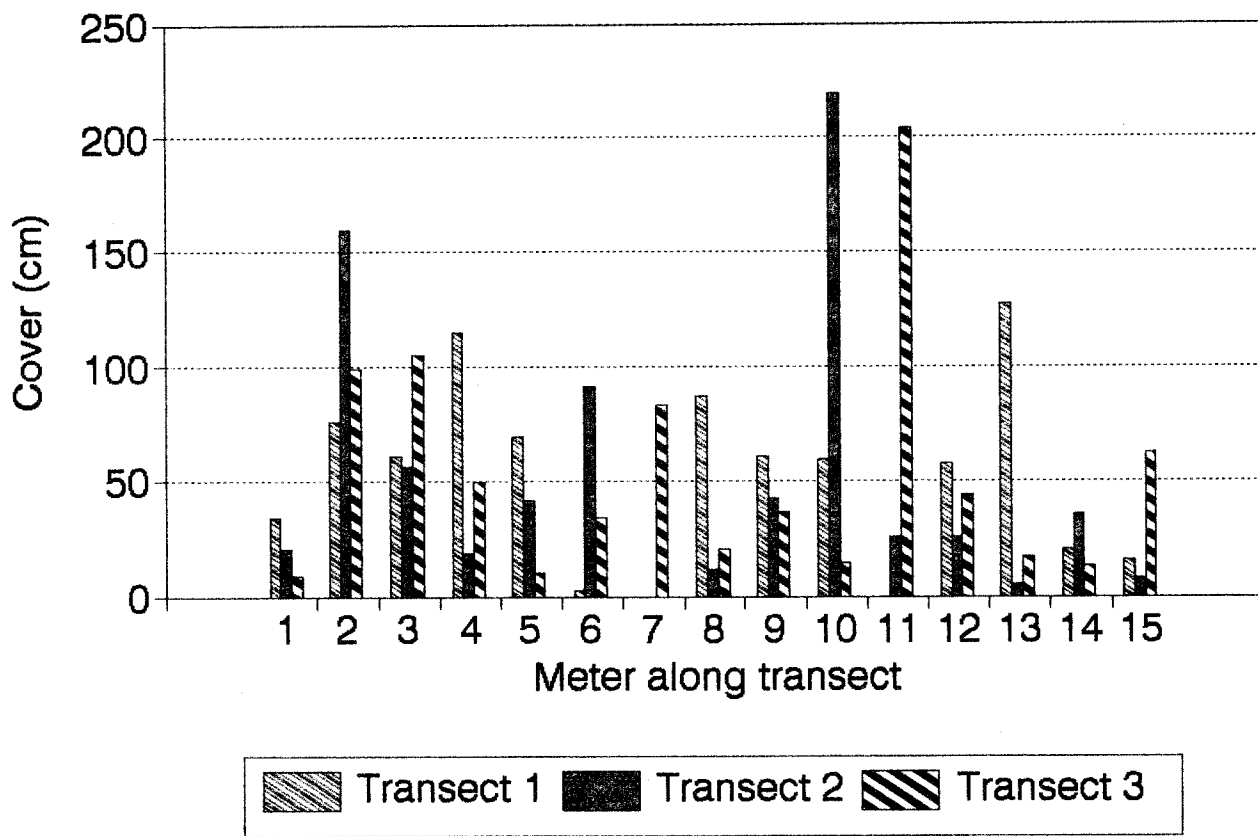


Figure 4

TEXAS ROCK TRANSECTS 1990

Coral cover per linear meter

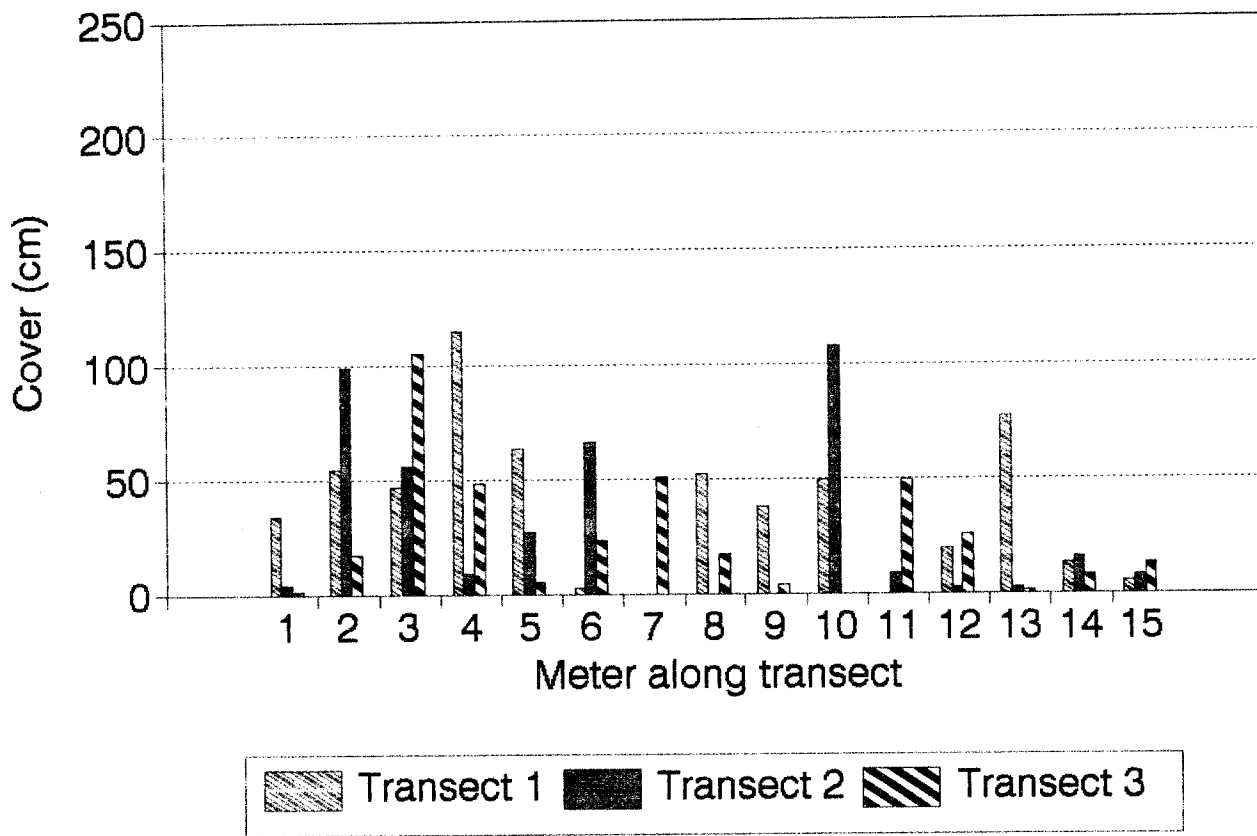


Table 9

Bird Key Reef - 1989 and 1990 Quadrat census data

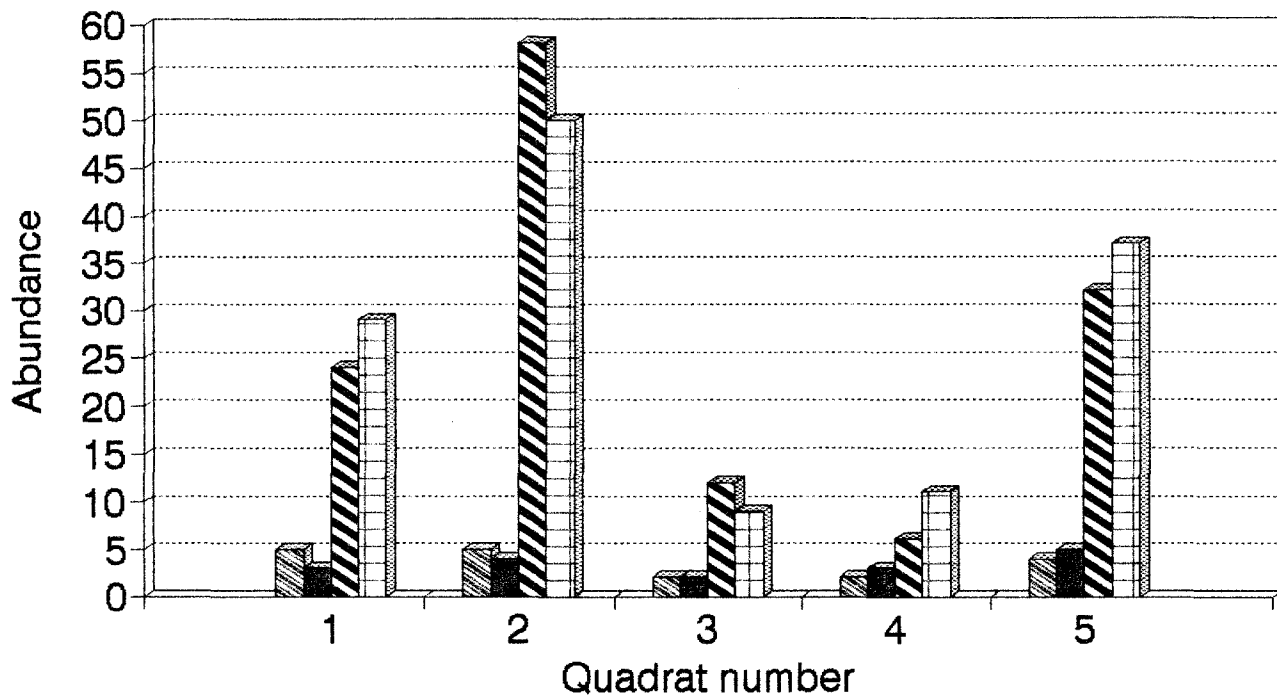
Abundance of hydrocorals, octocorals, and stony corals

	1989						1990					
	Quadrat Number						Quadrat number					
	1	2	3	4	5	Total	1	2	3	4	5	Total
=====												
OCTOCORALLIA												
Briareum asbestinum	2	1	1	1	9	14	3	3	2	1	4	13
Gorgonia ventalina	1	1			2	4	1	1			1	3
Erythropodium caribaeorum	1					1				1	1	2
Plexaura flexuosa		1			1	2		1				1
Plexaura homomalla	1					1					1	1
Pseudopterogorgia americana		1				1						
Pseudopterogorgia bipinnata	19	54	11	5	20	109	25	45	7	9	30	116
=====												
SCLERACTINIA & MILLEPORINA												
Acropora cervicornis		1				1		1				1
Agaricia agaricites	3	4	6	4		17	1	2	4	6		13
Colpophyllia natans	1	1	2			4	3		2			5
Favia fragum								1				1
Madracis decactis								1	1	1		3
Madracis mirabilis											1	1
Millepora alcicornis	1	3	1		1	6	2	4	2	1	1	10
Montastraea annularis	3	4	6	11	7	31	6	5	7	13	8	39
Montastraea cavernosa	2	3	12	1	3	21	4	3	9	2	1	19
Mussa angulosa			1			1			1			1
Mycetophyllia ferox									1			1
Mycetophyllia lamarckiana					1	1					1	1
Mycetophyllia sp.	1					1						
Porites astreoides	2	7	5			14	2	3	3	2	2	12
Porites porites	2		3		1	6			4	3	2	9
Scolymia lacera							1		2			3
Scolymia sp.		1	1			2						
Siderastrea siderea		7	7	5		19	1	6	7	7		21
=====												
No. of octocoral species	5	5	2	2	4	7	3	4	2	3	5	6
Octocoral abundance	24	58	12	6	32	132	29	50	9	11	37	136
Octocoral species density	1.95	1.95	0.78	0.78	1.56		1.17	1.56	0.78	1.17	1.95	
Octocoral colony density	9.38	22.66	4.69	2.34	12.50		11.33	19.53	3.52	4.30	14.45	
=====												
No. of stony coral species	8	9	10	4	5	13	8	9	12	8	7	16
Stony coral abundance	15	31	44	21	13	124	20	26	43	35	16	140
Stony coral species density	3.13	3.52	3.91	1.56	1.95		3.13	3.52	4.69	3.13	2.73	
Stony coral colony density	5.86	12.11	17.19	8.20	5.08		7.81	10.16	16.80	13.67	6.25	
=====												
Total number of species	13	14	12	6	9	20	11	13	14	11	12	22
Total abundance	39	89	56	27	45	256	49	76	52	46	53	276
Species density	5.08	5.47	4.69	2.34	3.52		4.30	5.08	5.47	4.30	4.69	
Colony density	15.23	34.77	21.88	10.55	17.58		19.14	29.69	20.31	17.97	20.70	

Figure 5

BIRD KEY REEF QUADRATS

Octocoral species and colonies

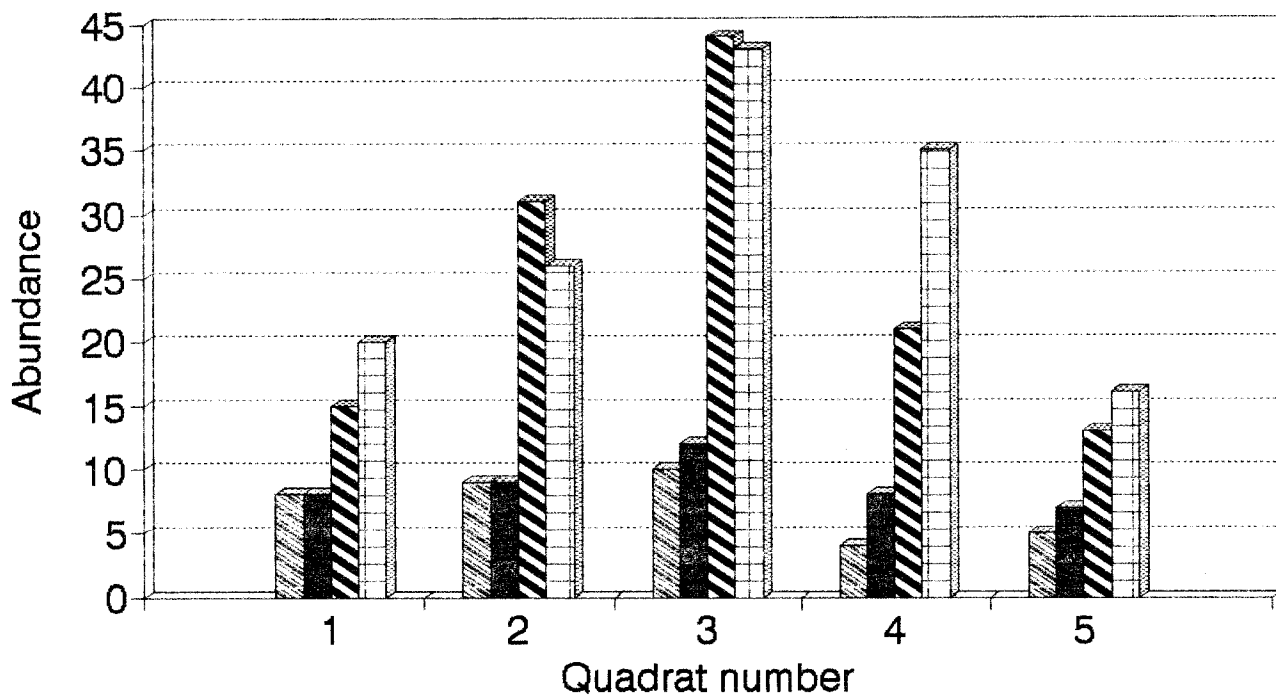


 # Species 89  # Species 90  Colonies 89  Colonies 90

Figure 6

BIRD KEY REEF QUADRATS

Stony coral species & colonies



Species 89 # Species 90 Colonies 89 Colonies 90

Table 10

Texas Rock - 1989 and 1990 Quadrat census data

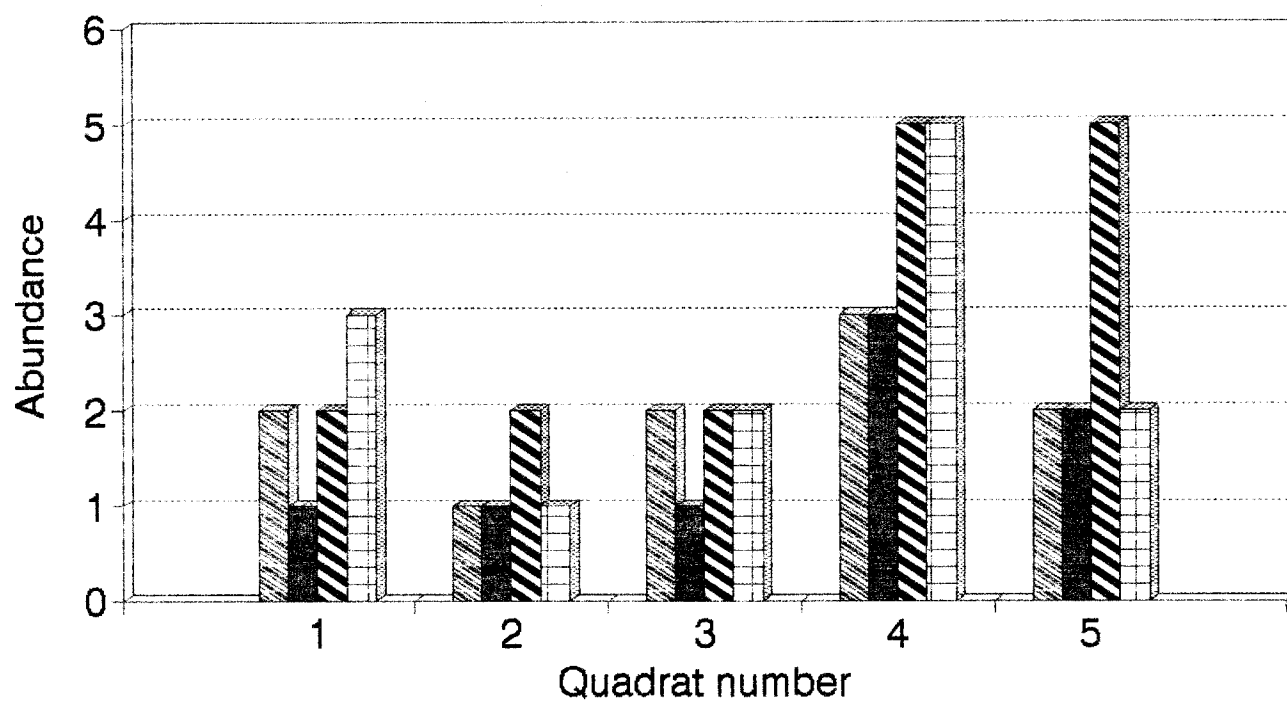
Abundance of hydrocorals, octocorals, and stony corals

	1989					Total	1990					Total
	Quadrat Number						Quadrat number					
	1	2	3	4	5		1	2	3	4	5	
=====												
OCTOCORALLIA												
Briareum asbestinum			1		1	2					1	1
Erythropodium caribaeorum	1	2		1	4	8	3	1	2	1	1	8
Iciligorgia schrammi	1			2		3				2		2
Plexaura flexuosa				2		2				2		2
Pseudopterogorgia americana			1			1						
SCLERACTINIA & MILLEPORINA												
Agaricia agaricites		1			2	3		1	1		3	5
Colpophyllia natans	4	7		4	2	17	2	6	3	3	1	15
Dichocoenia stokesii				1		1			1			1
Diploria sp.		1		2		3				2	1	3
Eusmilia fastigiata					3	3		1		2	1	4
Madracis decactis								1	3	1	3	8
Meandrina meandrites								1				1
Millepora alcicornis	7	4	3	3	8	25	5	3	3	3	4	18
Montastraea annularis	2	14	3	3	2	24	5	5	3	7	2	22
Montastraea cavernosa	2	1	4	2	12	21	4	1	4	3	10	22
Mussa angulosa				2	1	3				2	1	3
Mycetophyllia ferox									1			1
Mycetophyllia lamarckiana								1	2			3
Mycetophyllia sp.			2	1		3						
Oculina diffusa					2	2			1		2	3
Porites astreoides	3			2		5	6	1	4	3	2	16
Porites porites	1	1	2	3		7	2	1	2	5		10
Siderastrea siderea	3	5	3	3	3	17	3	9	3	3	6	24
Stephanocoenia michelinii	2	3	1	1	1	8						
=====												
No. of octocoral species	2	1	2	3	2	5	1	1	1	3	2	4
Octocoral abundance	2	2	2	5	5	16	3	1	2	5	2	13
Octocoral species density	0.78	0.39	0.78	1.17	0.78		0.39	0.39	0.39	1.17	0.78	
Octocoral colony density	0.78	0.78	0.78	1.95	1.95		1.17	0.39	0.78	1.95	0.78	
No. of stony coral species	8	9	7	12	10	15	7	12	13	11	12	17
Stony coral abundance	24	37	18	27	36	142	27	31	31	34	36	159
Stony coral species density	3.13	3.52	2.73	4.69	3.91		2.73	4.69	5.08	4.3	4.69	
Stony coral colony density	9.38	14.45	7.03	10.55	14.06		10.55	12.11	12.11	13.28	14.06	
Total number of species	10	10	9	15	12	20	8	13	14	14	14	21
Total abundance	26	39	20	32	41	158	30	32	33	39	38	172
Species density	3.91	3.91	3.52	5.86	4.30		3.13	5.47	5.47	5.47	5.47	
Colony density	10.16	15.23	7.81	12.50	16.02		11.72	12.89	12.89	15.23	14.84	

Figure 7

TEXAS ROCK QUADRATS

Octocoral species and colonies

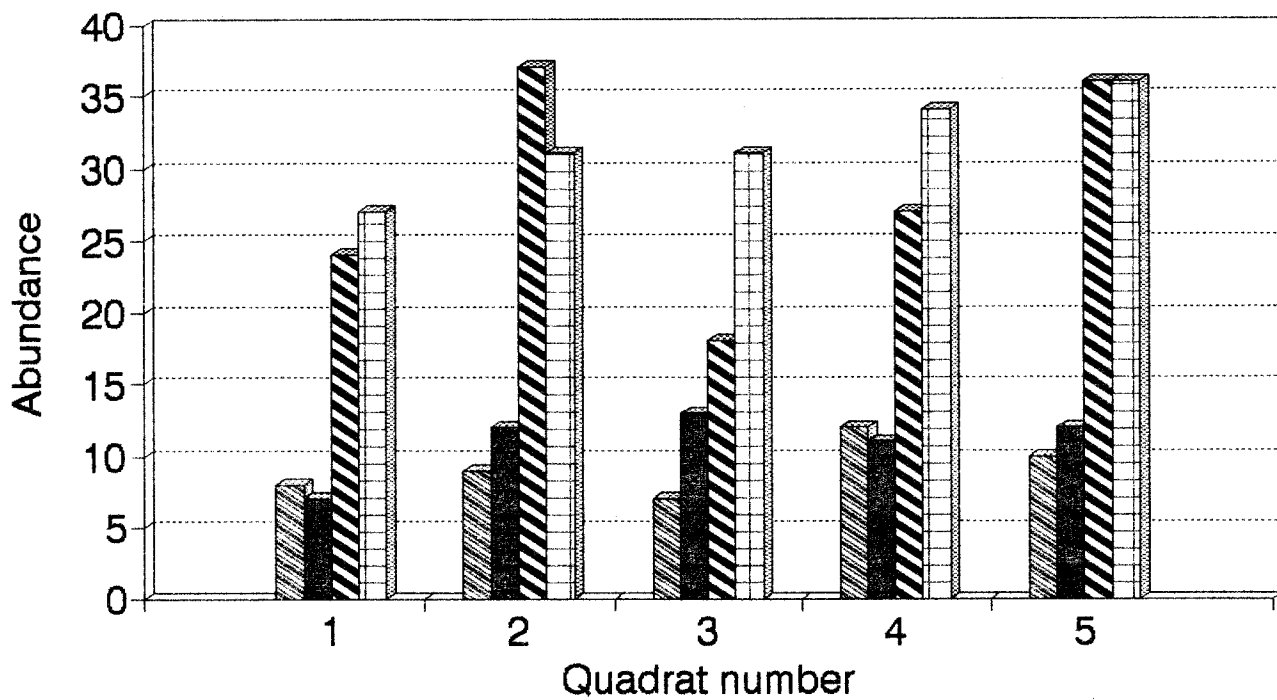


Species 89 # Species 90 Colonies 89 Colonies 90

Figure 8

TEXAS ROCK QUADRATS

Stony coral species & colonies



 # Species 89  # Species 90  Colonies 89  Colonies 90

Table 11

SEAWATER TEMPERATURE

BIRD KEY REEF, 9 M, 1989-1990

		Minimum	Maximum	Mean	Std dev
=====					
1989	June	26.5	28.2	27.55	0.38
	July	27.6	29.5	28.63	0.52
	August	28.9	30.1	29.46	0.23
	September	29.0	30.1	29.65	0.22
	October	25.5	29.5	28.18	1.27
	November	24.5	26.5	25.67	0.60
	December	20.0	24.6	22.53	1.00
1990	January	21.3	23.0	22.27	0.35
	February	21.9	24.6	22.90	0.63
	March	23.0	24.9	24.04	0.46
	April	23.1	25.5	24.40	0.28
	May	24.1	27.4	25.50	0.41

PULASKI SHOAL, 9 M, 1989-1990

		Minimum	Maximum	Mean	Std dev
=====					
1989	August	29.3	30.2	29.70	0.20
	September	29.1	30.2	29.82	0.20
	October	26.5	29.6	28.48	0.99
	November	24.6	26.9	25.98	0.63
	December	21.1	24.9	23.02	0.98
1990	January	21.5	23.0	22.34	0.32
	February	22.0	24.4	22.87	0.62
	March	22.7	24.8	24.01	0.35
	April	24.1	25.4	24.60	0.22
	May	24.9	26.2	25.67	0.31

Figure 9

Seawater Temperature

Bird Key Reef, 9 m, 1989-1990

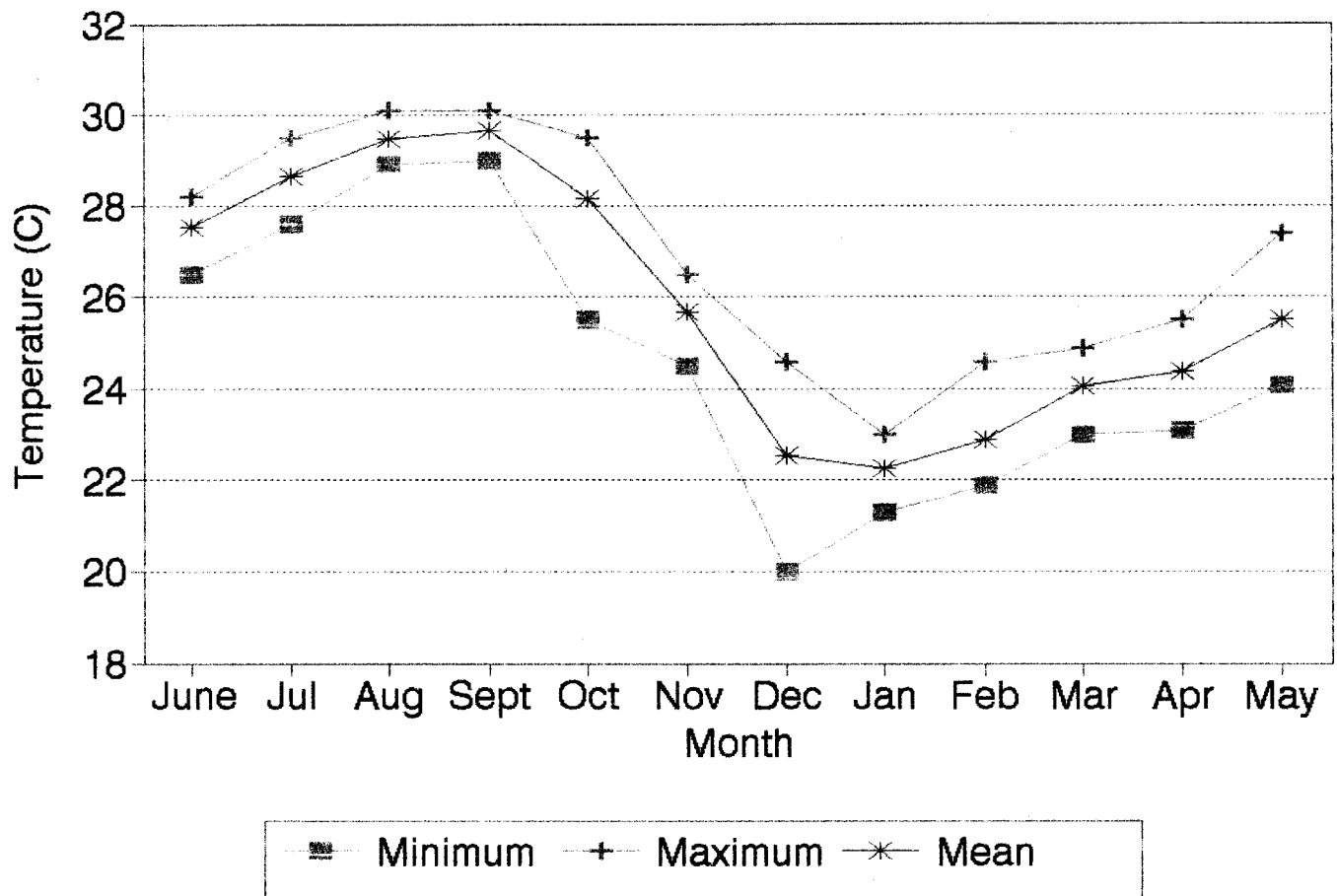


Figure 10

Seawater Temperature

Pulaski Shoal, 9 m, 1989-1990

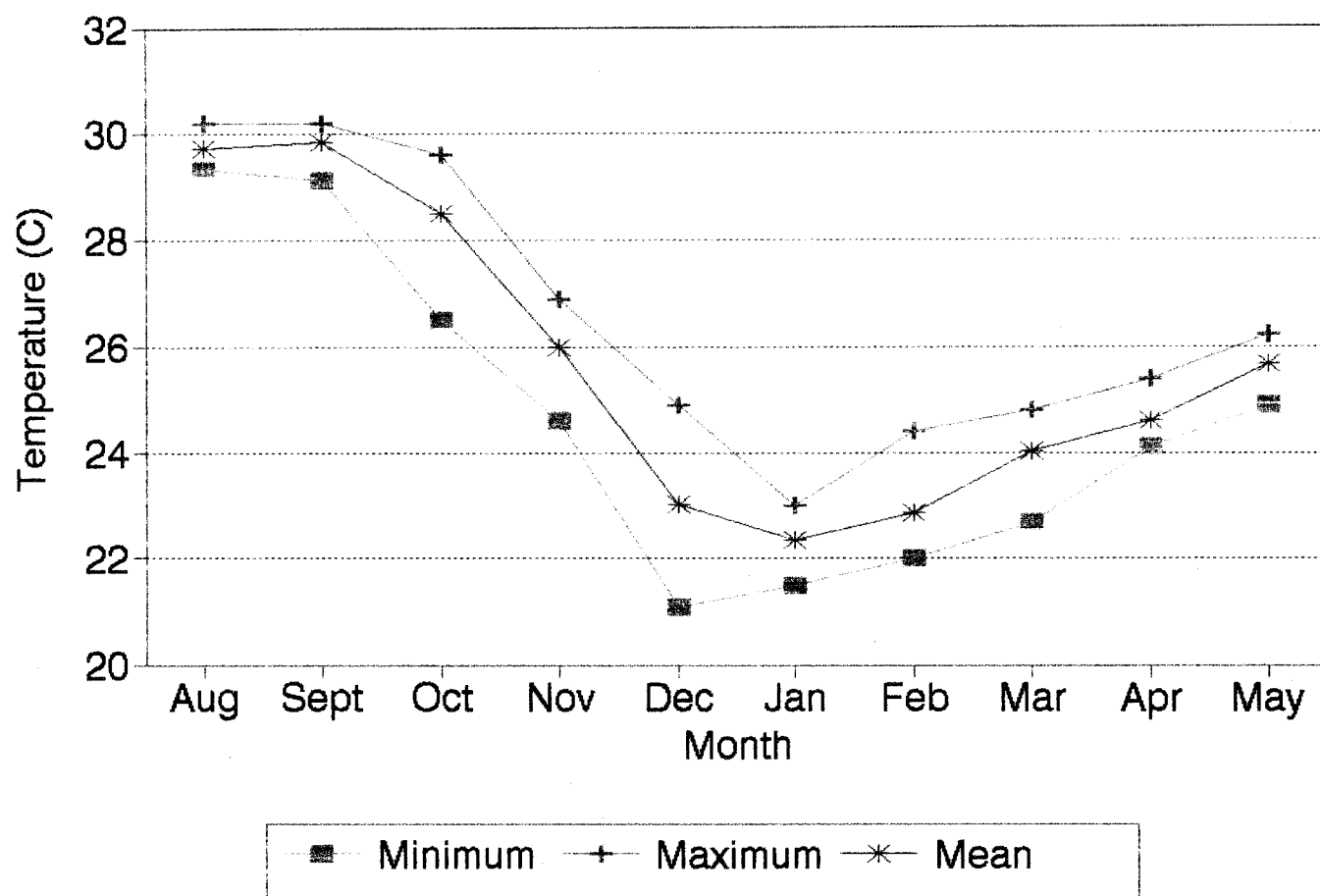


Table 12

SEAWATER TEMPERATURE

PULASKI SHOAL, 18 M, 1989-1990

		Minimum	Maximum	Mean	Std dev
		=====			
1989	August	27.9	30.5	29.60	0.30
	September	29.2	30.3	29.70	0.20
	October	26.5	29.7	28.50	1.00
	November	24.6	26.9	25.90	0.70
	December	21.1	24.8	23.00	1.00
1990	January	21.2	22.9	22.20	0.30
	February	21.9	24.2	22.70	0.60
	March	22.3	24.7	24.00	0.40
	April	24.0	25.0	24.50	0.20
	May	24.8	26.2	25.50	0.30

Figure 11

Seawater Temperature

Pulaski Shoal, 18 m, 1989-90

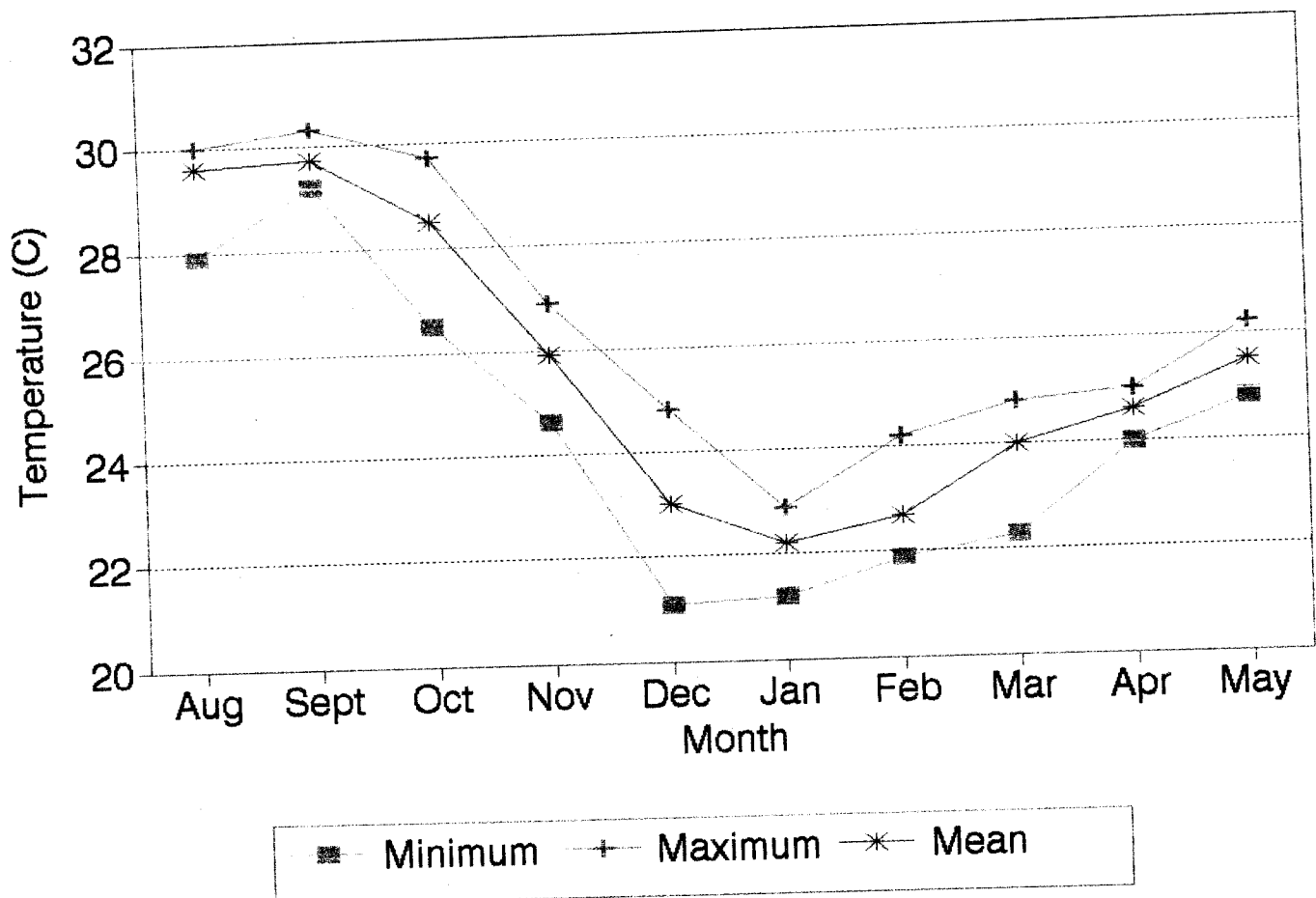


Table 1

Cover along transect (cm)																					
	Meter number																				
Species or component	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total
=====																					
OCTOCORALLIA																					
Briareum asbestinum				54.6	26.0																
Pseudopterogorgia bipinnata															7.8						88.4
Octocoral						3.9						2.6	2.6		2.6	10.4			7.8		20.8
=====																					
SCLERACTINIA & MILLEPORINA																					
Colpophyllia natans	37.7								16.9			20.8						33.8			109.2
Madracis decactis		27.3																			27.3
Millepora alcicornis	3.9				5.2				7.8						3.9						20.8
Montastraea annularis	7.8			23.4				36.4	83.2	28.6	57.2		76.7			39.0	97.5				449.8
Montastraea cavernosa					31.2	26.0				15.6											257.4
Porites astreoides							9.1				7.8	3.9	16.9	89.7	18.2	35.1			16.9	24.7	85.8
Porites porites												3.9			18.2						3.9
Siderastrea siderea		15.6				15.6		10.4										28.6		13.0	83.2
=====																					
OTHER BIOTIC BENTHIC COMPONENTS																					
Dictyota sp.									7.8												
Iotrochota birotulata										7.8	3.9				11.7						19.5
Sponge				3.9																	11.7
=====																					
CARBONATE SUBSTRATES																					
Dead coral and algae (DCA)	57.2	61.1		16.9	76.7	84.5	167.7	97.5	20.8	91.0	278.2	94.9	331.5	106.6	57.2	76.7	20.8	45.5	182.0	72.8	1939.6
Rock		42.9			29.9			14.3	57.2												144.3
Sand		7.8	87.1	87.1							22.1	49.4	166.4					46.8	29.9		496.6
=====																					
Total coral cover (cm)	49.4	42.9	0.0	78.0	62.4	45.5	9.1	46.8	107.9	44.2	65.0	31.2	96.2	119.6	50.7	84.5	97.5	62.4	16.9	45.5	1155.7
Total biotic cover (cm)	49.4	42.9	0.0	81.9	62.4	45.5	9.1	46.8	115.7	52.0	68.9	31.2	96.2	119.6	62.4	87.1	97.5	62.4	16.9	45.5	1193.4
Total carbonate cover (cm)	57.2	111.8	87.1	104.0	106.6	84.5	167.7	111.8	78.0	91.0	300.3	144.3	497.9	106.6	57.2	76.7	20.8	92.3	211.9	72.8	2580.5
=====																					
Total cm=																					3773.9

Table 2

Bird Key Reef, 11 May 1990 - Chain Transect #2

Cover along transect (cm)																					
	Meter number																				
Species or component	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total
=====																					
OCTOCORALLIA																					
Briareum asbestinum				19.5	93.6	23.4	2.6						2.6	2.6	13.0	6.5				31.2	195.0
Pseudopterogorgia bipinnata					1.3	6.5		1.3				1.3	2.6			1.3	5.2				19.5
Octocoral					39.0										1.3						40.3
SCLERACTINIA & MILLEPORINA																					
Agaricia agaricites					2.6			5.2													7.8
Colpophyllia natans	41.6								15.6			26.0									83.2
Millepora alcicornis								2.6	13.0												15.6
Montastraea annularis	5.2	20.8						20.8	66.3		39.0		44.2	35.1			13.0	104.0	6.5	28.6	383.5
Montastraea cavernosa					45.5					7.8					23.4	39.0	6.5			16.9	139.1
Mycetophyllia ferox															33.8	6.5	7.8				7.8
Porites astreoides											10.4										50.7
Porites porites													6.5								6.5
Siderastrea siderea		16.9				16.9		7.8											28.6		70.2
OTHER BIOTIC BENTHIC COMPONENTS																					
Dicytota sp.																32.5				5.2	37.7
Anemone								3.9													3.9
Sponge					9.1						2.6		19.5	15.6	13.0		2.6				62.4
CARBONATE SUBSTRATES																					
Dead coral and algae (DCA)	52.0	80.6		61.1	88.4	156.0	197.6	150.8	107.9	167.7	188.5	127.4	150.8	107.9	222.3	48.1	88.4	28.6	40.3	118.3	2182.7
Sand		42.9	88.4	84.5							39.0	6.5		57.2	41.6				18.2		378.3
=====																					
Total coral cover (cm)	46.8	37.7	0.0	19.5	182.0	46.8	2.6	37.7	94.9	7.8	49.4	27.3	55.9	37.7	71.5	53.3	32.5	104.0	35.1	76.7	1019.2
Total biotic cover (cm)	46.8	37.7	0.0	19.5	191.1	46.8	2.6	41.6	94.9	7.8	52.0	27.3	75.4	53.3	84.5	85.8	35.1	104.0	35.1	81.9	1123.2
Total carbonate cover (cm)	52.0	123.5	88.4	145.6	88.4	156.0	197.6	150.8	107.9	167.7	227.5	133.9	150.8	165.1	263.9	48.1	88.4	28.6	58.5	118.3	2561.0
																				Total cm=	3684.2

Table 3

Bird Key Reef, 19 May 1990 - Chain Transect #3

Cover along transect (cm)																						
	Meter number																					
Species or component	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total	
=====																						
OCTOCORALLIA																						
Briareum asbestinum																5.2					5.2	
Pseudoptergorgia acerosa						2.6						3.9					5.2				11.7	
SCLERACTINIA & MILLEPORINA																						
Colpophyllia natans	41.6							10.4				23.4						107.9			183.3	
Madracis pharensis		28.6																	24.7		53.3	
Millepora alcicornis																				2.6	2.6	
Montastraea annularis	5.2				11.7		27.3	101.4	29.9			48.1	9.1	28.6			11.7	111.8	23.4		408.2	
Montastraea cavernosa					37.7				3.9	10.4		3.9			22.1	49.4				54.6	182.0	
Mycetophyllia ferox																	7.8				7.8	
Porites astreoides										9.1					27.3	13.0				19.5	68.9	
Siderastrea siderea		14.3					11.7	16.9												23.4	66.3	
OTHER BIOTIC BENTHIC COMPONENTS																						
Dictyota sp.							5.2	10.4								11.7			11.7		39.0	
Padina sp.							5.2														5.2	
CARBONATE SUBSTRATES																						
Dead coral and algae (DCA)	122.2	45.5		23.4	165.1	236.6	235.3	110.5	153.4	192.4	117.0	137.8	107.9	206.7	208.0	66.3	91.0	91.0	175.5	57.2	2542.8	
Sand		26.0	92.3	117.0						15.6				85.8	50.7						387.4	
=====																						
Total coral cover (cm)	46.8	42.9	0.0	0.0	49.4	2.6	39.0	128.7	33.8	19.5	0.0	79.3	9.1	28.6	49.4	67.6	24.7	219.7	48.1	100.1	989.3	
Total biotic cover (cm)	46.8	42.9	0.0	0.0	49.4	2.6	49.4	139.1	33.8	19.5	0.0	79.3	9.1	28.6	49.4	79.3	24.7	219.7	59.8	100.1	1033.5	
Total carbonate cover (cm)	122.2	71.5	92.3	140.4	165.1	236.6	235.3	110.5	153.4	208.0	117.0	137.8	107.9	292.5	258.7	66.3	91.0	91.0	175.5	57.2	2930.2	
																					Total cm=	3963.7

Cover along transect (cm)																						
Meter number																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total (cm)	
=====																						
OCTOCORALLIA																						
Briareum asbestinum															19.5						19.5	
Erythropodium caribaeorum												18.2		28.6							46.8	
Pseudopterogorgia sp.											1.3									3.9	5.2	
=====																						
SCLERACTINIA & MILLEPORINA																						
Agaricia agaricites													20.8								20.8	
Colpophyllia natans	40.3																28.6	41.6	68.9		179.4	
Madracis decactis		61.1																			61.1	
Millepora alcicornis	3.9	1.3																			5.2	
Montastraea annularis				15.6		18.2	6.5	7.8	5.2	3.9		24.7	49.4	11.7						11.7	154.7	
Montastraea cavernosa				6.5	15.6				10.4	6.5											59.8	
Porites astreoides															11.7	9.1					7.8	
Porites porites						9.1									7.8						9.1	
Siderastrea siderea		23.4							2.6		7.8										33.8	
=====																						
OTHER BIOTIC BENTHIC COMPONENTS																						
Macroalgae		14.3											32.5								46.8	
Sponge															3.9						3.9	
Anemone													9.1								9.1	
=====																						
CARBONATE SUBSTRATES																						
Dead coral and algae (DCA)	50.7	65.0	49.4	54.6	68.9	79.3	204.1	37.7	149.5	5.2	245.7	92.3	106.6	68.9	91.0	111.8	81.9	89.7	119.6	137.8	1909.7	
Sand			201.5											40.3	29.9						271.7	
=====																						
Total coral cover (cm)	44.2	85.8	0.0	22.1	15.6	27.3	6.5	7.8	18.2	10.4	9.1	42.9	70.2	40.3	39.0	9.1	28.6	41.6	68.9	15.6	603.2	
Total biotic cover (cm)	44.2	100.1	0.0	22.1	15.6	27.3	6.5	7.8	18.2	10.4	9.1	42.9	111.8	40.3	42.9	9.1	28.6	41.6	68.9	15.6	663.0	
Total carbonate cover (cm)	50.7	65.0	250.9	54.6	68.9	79.3	204.1	37.7	149.5	5.2	245.7	92.3	106.6	109.2	120.9	111.8	81.9	89.7	119.6	137.8	2181.4	
																					Total cm=	2844.4

	Cover along transect (cm)																					
	Meter number																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total (cm)	
=====																						
OCTOCORALLIA																						
Briareum asbestinum															19.5						19.5	
Erythropodium caribaeorum												18.2		28.6							46.8	
Pseudopterogorgia sp.											1.3									3.9	5.2	
=====																						
SCLERACTINIA & MILLEPORINA																						
Agaricia agaricites														20.8							20.8	
Colpophyllia natans	40.3																28.6	41.6	68.9		179.4	
Madracis decactis		61.1																			61.1	
Millepora alcicornis	3.9	1.3																			5.2	
Montastraea annularis				15.6		18.2	6.5	7.8	5.2	3.9		24.7	49.4	11.7						11.7	154.7	
Montastraea cavernosa				6.5	15.6				10.4	6.5						11.7	9.1				59.8	
Porites astreoides															7.8						7.8	
Porites porites						9.1															9.1	
Siderastrea siderea		23.4							2.6		7.8										33.8	
=====																						
OTHER BIOTIC BENTHIC COMPONENTS																						
Macroalgae		14.3																				
Sponge													32.5								46.8	
Anemone															3.9						3.9	
													9.1								9.1	
=====																						
CARBONATE SUBSTRATES																						
Dead coral and algae (DCA)	50.7	65.0	49.4	54.6	68.9	79.3	204.1	37.7	149.5	5.2	245.7	92.3	106.6	68.9	91.0	111.8	81.9	89.7	119.6	137.8	1909.7	
Sand			201.5											40.3	29.9						271.7	
=====																						
Total coral cover (cm)	44.2	85.8	0.0	22.1	15.6	27.3	6.5	7.8	18.2	10.4	9.1	42.9	70.2	40.3	39.0	9.1	28.6	41.6	68.9	15.6	603.2	
Total biotic cover (cm)	44.2	100.1	0.0	22.1	15.6	27.3	6.5	7.8	18.2	10.4	9.1	42.9	111.8	40.3	42.9	9.1	28.6	41.6	68.9	15.6	663.0	
Total carbonate cover (cm)	50.7	65.0	250.9	54.6	68.9	79.3	204.1	37.7	149.5	5.2	245.7	92.3	106.6	109.2	120.9	111.8	81.9	89.7	119.6	137.8	2181.4	
																					Total cm=	2844.4

[illegible]

Cover along transect (cm)																
	Meter number															
Species or component	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
OCTOCORALLIA																
Briareum asbestinum											9.1			15.6		24.7
SCLERACTINIA & MILLEPORINA																
Colpophyllia natans		46.8	55.9													102.7
Madracis decactis												2.6				2.6
Millepora alcicornis										3.9						3.9
Montastraea annularis										45.5						45.5
Montastraea cavernosa		45.5		9.1		53.3				26.0						133.9
Mycetophyllia ferox										5.2						5.2
Porites astreoides		6.5														6.5
Siderastrea radians													2.6			2.6
Siderastrea siderea					27.3	13.0				27.3						75.4
Stephanocoenia michelinii	3.9														7.8	3.9
OTHER BIOTIC BENTHIC COMPONENTS																
Dictyota sp.		7.8		5.2					7.8	16.9						37.7
Haliclona viridis	13.0															13.0
Sponge	3.9	53.3		3.9	14.3	24.7		2.6	35.1	94.9	16.9	23.4	2.6	19.5		284.7
CARBONATE SUBSTRATES																
Dead coral and algae (DCA)	91.0	128.7	157.3	122.2	118.3	61.1	78.0	81.9	91.0	334.1	55.9	87.1	120.9	94.9	28.6	1651.0
Rock										58.5						58.5
Sand						20.8			18.2	145.6						184.6
TOTALS																
Total coral cover (cm)	3.9	98.8	55.9	9.1	27.3	66.3	0.0	0.0	0.0	107.9	9.1	2.6	2.6	15.6	7.8	406.9
Total biotic cover (cm)	20.8	159.9	55.9	18.2	41.6	91.0	0.0	11.7	42.9	219.7	26.0	26.0	5.2	35.1	7.8	761.8
Total carbonate cover (cm)	91.0	128.7	157.3	122.2	118.3	81.9	78.0	81.9	109.2	538.2	55.9	87.1	120.9	94.9	28.6	1894.1
															Total cm=	2655.9

Cover along transect (cm)																	
	Meter number																
Species or component	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total	
=====																	
OCTOCORALLIA																	
Briareum asbestinum											2.6	26.0		6.5	13.0	48.1	
SCLERACTINIA & MILLEPORINA																	
Colpophyllia natans			80.6	48.1												128.7	
Montastraea cavernosa		16.9	24.7		5.2		23.4	10.4			14.3		1.3			96.2	
Mussa angulosa											6.5					6.5	
Mycetophyllia sp.											5.2					5.2	
Siderastrea radians														1.3		1.3	
Siderastrea siderea						23.4	27.3	6.5	3.9		10.4					71.5	
Stephanocoenia michelinii	1.3										10.4					11.7	
OTHER BIOTIC BENTHIC COMPONENTS																	
Iotrochota birotulata		10.4					9.1					15.6	15.6	5.2		55.9	
Sponge	7.8	71.5		1.3	5.2	10.4	23.4	3.9	32.5	14.3	154.7	2.6			49.4	377.0	
CARBONATE SUBSTRATES																	
Dead coral and algae (DCA)	74.1	75.4	10.4	117.0	123.5	94.9	65.0	67.6	88.4	88.4	466.7	65.0	98.8	113.1	81.9	1630.2	
Sand										20.8	29.9					50.7	
=====																	
Total coral cover (cm)	1.3	16.9	105.3	48.1	5.2	23.4	50.7	16.9	3.9	0.0	49.4	26.0	1.3	7.8	13.0	369.2	
Total biotic cover (cm)	9.1	98.8	105.3	49.4	10.4	33.8	83.2	20.8	36.4	14.3	204.1	44.2	16.9	13.0	62.4	802.1	
Total carbonate substrate	74.1	75.4	10.4	117.0	123.5	94.9	65.0	67.6	88.4	109.2	496.6	65.0	98.8	113.1	81.9	1680.9	
																Total cm=	2483.0

Cover along transect (cm)														
Meter Number														
	1	2	3	4	5	6	7	8	9	10	11	12	13	Total (cm)
=====														
OCTOCORALLIA														
Briareum asbestinum												18.2	7.8	26.0
SCLERACTINIA & MILLEPORINA														
Colpophyllia natans	14.3		66.3	40.3							9.1			130.0
Madracis decatis										22.1				22.1
Millepora alcicornis	5.2													5.2
Montastraea annularis						11.7					26.0	76.7		114.4
Montastraea cavernosa		67.6	52.0				7.8				15.6	5.2	9.1	157.3
Porites astreoides											5.2			5.2
Porites porites	13.0													13.0
Scolymia sp.										5.2				5.2
Siderastrea siderea		32.5	9.1		42.9	27.3					7.8		9.1	128.7
Stephanocoenia michelinii				6.5										6.5
OTHER BIOTIC BENTHIC COMPONENTS														
Sargassum sp.								3.9						3.9
Macroalgae		61.1	3.9	41.6	44.2	22.1	52.0	40.3		41.6	275.6		171.6	754.0
Hydroid				16.9						6.5				23.4
Sponge	9.1					6.5		50.7		9.1	71.5	11.7		158.6
CARBONATE SUBSTRATES														
Dead coral and algae (DCA)	97.5	40.3		98.8	124.8	9.1	35.1		179.4			96.2		681.2
Rock											79.3	19.5		98.8
Sand					24.7	15.6								40.3
=====														
Total coral cover (cm)	32.5	100.1	127.4	46.8	42.9	39.0	7.8	0.0	0.0	27.3	63.7	100.1	26.0	613.6
Total biotic cover (cm)	41.6	161.2	131.3	105.3	87.1	67.6	59.8	94.9	0.0	84.5	410.8	111.8	197.6	1553.5
Total carbonate cover (cm)	97.5	40.3	0.0	98.8	149.5	24.7	35.1	0.0	179.4	0.0	79.3	115.7	0.0	820.3
													Total cm=	2373.8

Cover along transect (cm)																	
	Meter number																
Species or component	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total	
=====																	
OCTOCORALLIA																	
Briareum asbestinum									11.7	7.8				10.4		29.9	
=====																	
SCLERACTINIA & MILLEPORINA																	
Acropora cervicornis														2.6		2.6	
Agaricia agaricites													3.9			3.9	
Colpophyllia natans	22.1			53.3	10.4					41.6						127.4	
Dichocoenia stokesii													7.8			7.8	
Madracis decactis					26.0										5.2	31.2	
Millepora alcicornis		7.8														7.8	
Montastraea annularis						2.6							15.6			18.2	
Montastraea cavernosa		46.8	14.3	61.1				52.0	20.8			19.5	3.9			218.4	
Oculina diffusa									5.2							5.2	
Porites astreoides													3.9			3.9	
Porites porites	11.7															11.7	
Siderastrea siderea			32.5		27.3								41.6			101.4	
=====																	
OTHER BIOTIC BENTHIC COMPONENTS																	
Dictyota sp.		11.7	14.3														
Haliclona viridis					2.6											2.6	
Sponge		9.1			2.6			35.1	23.4	10.4		37.7	50.7	7.8	10.4	187.2	
=====																	
CARBONATE SUBSTRATES																	
Dead coral and algae (DCA)	70.2	74.1	2.6		163.8	162.5	114.4	31.2	58.5	24.7		165.1	440.7	106.6	96.2	1510.6	
Rock				11.7				9.1				22.1				42.9	
Sand							36.4			62.4	100.1	16.9	59.8		20.8	296.4	
=====																	
Total coral cover (cm)	33.8	54.6	46.8	114.4	63.7	2.6	0.0	52.0	37.7	49.4	0.0	19.5	76.7	13.0	5.2	569.4	
Total biotic cover (cm)	33.8	75.4	61.1	114.4	68.9	2.6	0.0	87.1	61.1	59.8	0.0	57.2	127.4	20.8	15.6	785.2	
Total carbonate cover (cm)	70.2	74.1	2.6	11.7	163.8	162.5	150.8	40.3	58.5	87.1	100.1	204.1	500.5	106.6	117.0	1849.9	
																Total cm=	2635.1

Cover along transect (cm)																	
	Meter number																
Species or component	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total	
=====																	
OCTOCORALLIA																	
Briareum asbestinum											9.1			15.6		24.7	
SCLERACTINIA & MILLEPORINA																	
Colpophyllia natans		46.8	55.9														
Madracis decactis																102.7	
Millepora alcicornis												2.6				2.6	
Montastraea annularis										3.9						3.9	
Montastraea cavernosa		45.5		9.1		53.3				45.5						45.5	
Mycetophyllia ferox										26.0						133.9	
Porites astreoides		6.5								5.2						5.2	
Siderastrea radians																6.5	
Siderastrea siderea													2.6			2.6	
Stephanocoenia michelinii	3.9				27.3	13.0				27.3					7.8	75.4	
																3.9	
OTHER BIOTIC BENTHIC COMPONENTS																	
Dictyota sp.		7.8		5.2													
Haliclona viridis	13.0								7.8	16.9						37.7	
Sponge	3.9	53.3		3.9	14.3	24.7		2.6			16.9					32.5	
								9.1	35.1	94.9		23.4	2.6	19.5		284.7	
CARBONATE SUBSTRATES																	
Dead coral and algae (DCA)	91.0	128.7	157.3	122.2	118.3	61.1	78.0	81.9	91.0	334.1	55.9	87.1	120.9	94.9	28.6	1651.0	
Rock										58.5						58.5	
Sand						20.8			18.2	145.6						184.6	
=====																	
Total coral cover (cm)	3.9	98.8	55.9	9.1	27.3	66.3	0.0	0.0	0.0	107.9	9.1	2.6	2.6	15.6	7.8	406.9	
Total biotic cover (cm)	20.8	159.9	55.9	18.2	41.6	91.0	0.0	11.7	42.9	219.7	26.0	26.0	5.2	35.1	7.8	761.8	
Total carbonate cover (cm)	91.0	128.7	157.3	122.2	118.3	81.9	78.0	81.9	109.2	538.2	55.9	87.1	120.9	94.9	28.6	1894.1	
																Total cm=	2655.9

Cover along transect (cm)																	
	Meter number																
Species or component	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total	
=====																	
OCTOCORALLIA																	
Briareum asbestinum											2.6	26.0		6.5	13.0	48.1	
SCLERACTINIA & MILLEPORINA																	
Colpophyllia natans			80.6	48.1												128.7	
Montastraea cavernosa		16.9	24.7		5.2		23.4	10.4			14.3		1.3			96.2	
Mussa angulosa											6.5					6.5	
Mycetophyllia sp.											5.2					5.2	
Siderastrea radians														1.3		1.3	
Siderastrea siderea						23.4	27.3	6.5	3.9		10.4					71.5	
Stephanocoenia michelinii	1.3										10.4					11.7	
=====																	
OTHER BIOTIC BENTHIC COMPONENTS																	
Iotrochota birotulata		10.4					9.1					15.6	15.6	5.2		55.9	
Sponge	7.8	71.5		1.3	5.2	10.4	23.4	3.9	32.5	14.3	154.7	2.6			49.4	377.0	
=====																	
CARBONATE SUBSTRATES																	
Dead coral and algae (DCA)	74.1	75.4	10.4	117.0	123.5	94.9	65.0	67.6	88.4	88.4	466.7	65.0	98.8	113.1	81.9	1630.2	
Sand										20.8	29.9					50.7	
=====																	
Total coral cover (cm)	1.3	16.9	105.3	48.1	5.2	23.4	50.7	16.9	3.9	0.0	49.4	26.0	1.3	7.8	13.0	369.2	
Total biotic cover (cm)	9.1	98.8	105.3	49.4	10.4	33.8	83.2	20.8	36.4	14.3	204.1	44.2	16.9	13.0	62.4	802.1	
Total carbonate substrate	74.1	75.4	10.4	117.0	123.5	94.9	65.0	67.6	88.4	109.2	496.6	65.0	98.8	113.1	81.9	1680.9	
																Total cm=	2483.0

Cover along transect (cm)														
Meter Number														
	1	2	3	4	5	6	7	8	9	10	11	12	13	Total (cm)
=====														
OCTOCORALLIA														
Briareum asbestinum												18.2	7.8	26.0
SCLERACTINIA & MILLEPORINA														
Colpophyllia natans	14.3		66.3	40.3							9.1			130.0
Madracis decatis										22.1				22.1
Millepora alcicornis	5.2													5.2
Montastraea annularis						11.7					26.0	76.7		114.4
Montastraea cavernosa		67.6	52.0				7.8				15.6	5.2	9.1	157.3
Porites astreoides											5.2			5.2
Porites porites	13.0													13.0
Scolymia sp.										5.2				5.2
Siderastrea siderea		32.5	9.1		42.9	27.3					7.8		9.1	128.7
Stephanocoenia michelinii				6.5										6.5
OTHER BIOTIC BENTHIC COMPONENTS														
Sargassum sp.								3.9						3.9
Macroalgae		61.1	3.9	41.6	44.2	22.1	52.0	40.3		41.6	275.6		171.6	754.0
Hydroid				16.9						6.5				23.4
Sponge	9.1					6.5		50.7		9.1	71.5	11.7		158.6
CARBONATE SUBSTRATES														
Dead coral and algae (DCA)	97.5	40.3		98.8	124.8	9.1	35.1		179.4			96.2		681.2
Rock											79.3	19.5		98.8
Sand					24.7	15.6								40.3
=====														
Total coral cover (cm)	32.5	100.1	127.4	46.8	42.9	39.0	7.8	0.0	0.0	27.3	63.7	100.1	26.0	613.6
Total biotic cover (cm)	41.6	161.2	131.3	105.3	87.1	67.6	59.8	94.9	0.0	84.5	410.8	111.8	197.6	1553.5
Total carbonate cover (cm)	97.5	40.3	0.0	98.8	149.5	24.7	35.1	0.0	179.4	0.0	79.3	115.7	0.0	820.3
													Total cm=	2373.8