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EVALUATION OF A NOVEL MATERIAL FOR RECYCLING TIRES INTO ARTIFICIAL REEFS SECOND YEAR ANNUAL REPORT

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**EVALUATION OF A NOVEL MATERIAL FOR
RECYCLING TIRES INTO
ARTIFICIAL REEFS**

Second Year Annual Report

EVALUATION OF A NOVEL MATERIAL FOR RECYCLING TIRES INTO
ARTIFICIAL REEFS
SECOND YEAR ANNUAL REPORT

BROWARD COUNTY DEPARTMENT OF NATURAL RESOURCE PROTECTION
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SUMMARY

Four artificial reefs were placed off Broward County in 20 ft of water on 29 March 1993. The reefs were constructed of concrete aggregate tetrahedrons. Each reef contains 25 small (3ft/side) and 25 large (4 ft/side) tetrahedrons in a random configuration.

Two types of concrete aggregate were used. One is a tire-concrete aggregate which uses tire shreds mixed into the concrete; the other is a standard gravel-concrete aggregate. Two reefs are composed of each type of aggregate. The purpose of the study is to evaluate the tire aggregate, in comparison to standard concrete, as a suitable reef building material. Specifically we are looking at the response of biological communities to the two types of reefs.

The reefs are being monitored periodically (intervals of one month or less) and the status of the biological communities assayed through various methodologies, i.e. visual census (fishes), uw-video taping and collection (invertebrates). The reefs have acquired a diverse community of fishes and invertebrates. We have noted 90 species of fishes and 116 taxa of invertebrates to date; these numbers compare favorable with a similar study in Southern Florida.

To this point, we have been unable to see significant differences among the biological communities between the two types of reefs that we can ascribe to difference in construction material. However, because we have only monitored the reefs for 17 months, the data are insufficient to draw valid conclusions concerning the suitability of the tire-concrete aggregate as an artificial reef construction material.

INTRODUCTION

Artificial reefs are effective fish attractants and important fisheries tools (Bohnsack and Sutherland, 1985). The underlying rationale for artificial reefs is that they provide critical habitat that increases abundance and biomass of reef fishes (Bohnsack, 1989). Fish densities, biomass, and sport fishing catch rates can be higher on artificial reefs than on the local natural reefs (Buckley and Hueckel, 1985; Matthew, 1985; Brock and Norris, 1989; Love and Westphal, 1990).

Artificial reefs have been placed in coastal waters around the globe. In Florida more than 600 artificial reefs (Approximately 70 in Broward County alone) have been established to enhance sport fisheries; and new construction is frequent (Pybas, 1990). Construction materials for these reefs have come from diverse sources: old cars and ships to PVC pipe, concrete and discarded automobile and truck tires. A number of studies have investigated the effectiveness of the different materials used in artificial reef construction (Bortone and Van Orman, 1985). Interpretation of these studies depends to a large extent on what aspects of reef function are being examined (i.e. colonization, aggregation, juvenile recruitment, physical stability etc.). In general, however, of the materials widely in use, preformed concrete appears to be among the most successful. In contrast, the use of discarded tires as an effective material for artificial reefs is in some question.

Discarded truck and automobile tires have been used extensively in the past (Myatt et.al., 1989). Tires have some distinct advantages as a construction material for artificial reefs: 1) they are extremely resistant to salt water breakdown 2) they are relatively light and easy to handle compared to some other materials (i.e. concrete) 3) they are abundant and inexpensive (in some areas, including Florida, government bodies will pay for their disposal) 4) artificial reefs offer a convenient, ecologically positive solution to an environmentally sensitive disposal problem. However reefs constructed from tires have had significant problems: 1) often they are unstable, occasionally to the point of being washed ashore (Broward County has had particularly bad experiences in this regard and tire reefs are no longer permitted); 2) the surface of tires is an extremely poor substrate for invertebrate fauna, in some studies corals were recruited to concrete reefs in less than a year yet none were found on the tire reefs even after three years; other invertebrate fauna was also lower on tires than concrete (see Fitzhardinge and Baily-Brock, 1989); (Thus, although a tire reef may function fine as an aggregating device, achieving the goal of a self supporting community is unlikely.) and further 3) in most configurations the tire reefs offer a limited variety of refugial openings, thus limiting diversity.

A new, patent pending, proprietary material, which may be used under license agreement, has been designed that uses both concrete and tires. Tire chips are mixed with concrete in place of gravel to form a tire-concrete aggregate. Several reefs of this material were placed off Broward County specifically to do a controlled study of the effectiveness of this new material in establishing a productive community.

This is the second annual report of a three year study to compare the biotic communities that recruit to, or are associated with, reefs composed of the tire-concrete aggregate with those communities that are associated with a standard gravel-concrete aggregate. The rationale for such a study is based, in part, on the possibility that materials may leach from the tire-concrete aggregate that differ from the gravel-concrete aggregate. This material may in turn affect the invertebrate communities and ultimately the fish communities that inhabit the reefs. Our study is designed to examine this possibility. Specifically, we will test the null hypothesis, that the tire-concrete aggregate does not differ from gravel-concrete in the ability over the short term (3 years) to recruit invertebrate and fish communities to an artificial reef.

MATERIALS AND METHODS

Construction:

The reef modules were constructed and donated to the project by Marin and Marin Inc. and the tire-aggregate patent holder (Benjamin J. Mostkoff). Construction of the reefs consisted of a random stacking of two sizes of tetrahedrons (a four-sided shape, each side with three apexes) that are composed of either standard gravel-concrete aggregate (control reefs) or the proprietary tire-concrete aggregate (experimental reefs).

According to the manufacturer, the tetrahedron shape was selected for module construction for several reasons: 1) they are hydrodynamically slippery, and their extremely stable shape makes them resistant to movement 2) they sink with a minimum of the lateral movement ("sailing") that is typical of other shapes (i.e. concrete pipes) and should therefore stack in a compact reef 3) the random stacked configuration of large and small tetrahedrons offers variable sized openings suitable for a diverse assemblage of fishes.

For the tire-concrete aggregate, shreds of tires (ca. 2-3 square inches each, photo. 1) were obtained from Tiregon Corporation and used in place of gravel in a concrete aggregate. The tire to concrete ratio can be altered in response to shred size or specific needs. The tire-concrete aggregate, in this study consisted of a mixture of 20 lbs. of tire chips to 104 lbs. of concrete, or 2.3 tires in a 3 ft. unit, and 5.5 tires in a 4 ft. unit.

On March 29, 1993 four reefs were deployed in 20 ft of water on sandy substrate off the coast of Broward County in an area permitted to Broward DNRP. The modules were placed on a 40x140 ft. barge (Maritime Tug and Barge Inc.) in four discrete piles and transported to the placement site. On site, the barge was spudded down and the modules were individually forklifted over the side from four marked spots on deck (photo. 2).

Immediately after deployment DNRP and NOVA personnel examined the reefs. In the water, the modules stacked in piles less than 15 ft. in diameter. The modules were in a relatively stable configuration, requiring only minor adjustment by hand or reconfiguration with the aid of an air bag (photo. 3). In the final configuration the reefs range in height to approximately 6 ft. and are separated from each other by 30-50 ft (photo. 4-7).

Two reefs are composed of a mix of 25 small (3 ft/side) and 25 large (4 ft/side) tire-concrete tetrahedrons each. These two structures function as replicate, experimental reefs (E1, E2). The other two reefs are composed of an identical mix of 25 small and 25 large tetrahedrons. But these two reefs are made of a

standard gravel concrete aggregate and function as replicate controls (C1, C2).

After the reefs were placed in their final configuration, we attached 110 miniature modules to each reef. These miniature modules consisted of tire-concrete or gravel-concrete aggregate cubes (ice cube trays functioned as forms) that were attached to the module lifting rings by plastic cable ties (no more than 3 miniatures per ring). The miniatures were removed at regular intervals for microscopic analysis of initial recruits to the two types of aggregate (see below).

Monitoring Schedule:

Fourteen visits were made to the reefs during the first four and a half months after deployment to monitor the initial colonization. During the second grant cycle (September 1993 - September 1994) we monitored the reefs monthly as a minimum with some additional special purpose dives (i.e. night, photography or VIP dives).

Microorganisms:

Three miniature modules from each reef were removed for scanning electron microscopy (SEM) and light microscopy analysis at 1,3,5,9,14,22, and 29 days after reef deployment.

The SEM technique used to identify the settled microorganisms and to calculate the percent coverage by these organisms followed the methods of Fell and Blackwelder (P. Blackwelder, pers. communication). The miniatures were removed from the reef and placed in gluteraldehyde buffered seawater. The miniatures were then taken through a standard marine fixation including changes in buffer and dehydration in a graded series of alcohols.

After fixation the miniature sections were coated with a thin film of Palladium in a sputter-coater to increase conductivity for SEM examination. To determine percent coverage on these blocks a clear acetate film containing 100 randomly oriented dots was placed on one of the two CRT screens on the SEM. This screen has a constant magnification (400x). A box which magnifies a small portion of this screen 10x is seen on the other CRT screen. The second screen with its higher magnification allows for the identification of the organisms seen under the dots at the lower magnification. SEM analysis was discontinued when the community of macroinvertebrates and algae covered 75% or more of the samples (22 days after deployment). Presumably, at this time the organic substrate will be more important than the inorganic concrete matrix in determining microorganism distribution.

Sessile invertebrates:

The succession of settlement and growth of macro, sessile invertebrates was followed by the examination of four previously chosen tetrahedron surfaces from each of the reefs. These surfaces were chosen based on their location on the reef and orientation to the ocean floor. Video taping of each of these surfaces was done at monthly, or shorter, intervals during the first grant cycle and quarterly during the second cycle.

As the study progressed it became apparent that the selected module faces were not representative of the entire invertebrate community. Therefore, a qualitative invertebrate census was initiated in July 1993 and continued biannually through the second grant cycle. Selected invertebrates were collected (not from videoed surfaces) and taken to the laboratory for identification.

Mobile macroinvertebrate and fish fauna:

Fishes and large, mobile macroinvertebrates were censused at monthly intervals or less. Using SCUBA, a single diver circled each reef twice recording species and numbers on a plastic slate (photo. 11). Fishes, in the water column within 6 ft. of a reef were included in the count. The small size of the individual reefs allowed us to census the entire population rather than using a timing or transect technique to obtain a representative subsample to extrapolate statistically. A single night dive was made in January to confirm that our counting methodology was not underestimating nocturnal species

*Note on identification: we attempted to take all organisms to the lowest readily identifiable taxon. It was not our intent to take each to the lowest known taxon.

Statistical analysis:

Diversity was determined by Shannon diversity indices and tested for difference by the Hutcheson *t*-test. Differences in percent coverage amongst miniature modules was tested by analysis of variance procedures (ANOVA) (Zar 1989).

RESULTS

Miniature modules:

SEM analysis of the miniature modules was completed during this grant cycle (Photos 17,18). As anticipated, the original colonizers were mainly diatoms and filamentous algae. Seventy-five percent, or greater, coverage was achieved by day 22 (22 days post deployment). No qualitative difference in colonizing organisms was apparent between concrete and tire-concrete minatures. A statistical analysis of percent coverage (all organisms combined) indicated a significant change through time ($P < 0.001$ ANOVA, Figure 7) but no statistical differences between replicates (E-1 vs. E-2, C-1 vs. C-2; $P > 0.05$) or between substrates (E-1,2 vs. C-1,2; $P > 0.05$).

Fishes:

Ninty different species of fishes have been recorded since the reefs were deployed (Tables 13-16). Fifty-six species were recorded on the reefs during the first grant cycle, 79 species during this cycle. We continue to record new species regularly; we recorded one, or more, new species each month but May during the last year. Thus, we expect the species list to continue to increase during coming months. On average, during this grant cycle, there were 20 species on each reef, this number declined slightly during the winter months (Figure 9) but the between month and between replicate variation (Table 17) make this decline questionable. Although the tire-concrete reefs together average a slightly higher number of species, the highest individual reef is C-2 and statistically there is no significant difference between tire and control reefs in the average number of fishes.

Because it was apparent that a single school of juvenile grunts (*Haemulon sp.*) could dramatically affect calculations, all computations, as well as figures and tables, dealing with total fishes (all species combined) exclude juvenile grunts. The total number of fishes on the reefs varied during the year with an overall mean of 62 fishes per reef. Graphically, it appears, however, that there continues to be an increasing trend in numbers throughout the duration of the study (Figure 13). Thus we anticipate the reefs can, and will, hold a larger number of fishes in the future. Surprisingly, with total numbers of fishes we do note a significant difference between the two types of reefs. The tire-concrete reefs hold a higher number of fishes than the concrete reefs ($P < 0.05$ ANOVA). We suspect, however, this is a function of structure rather than substrate. Control-1 is a low lying reef with minimal relief, routinely it has fewer species and total fishes than the other reefs (Table 13). The other three reefs are similar in species numbers and C-2 is essentially the same in total fishes as E-1. The reason(s) for the higher number of fishes on E-2 is not clear but may also relate to structure. In the coming grant cycle we hope to reduce

this variation in structure by restructuring the reefs (using air bags) so that all four have similar heights and footprints.

Diversity indices take into account both number of species as well as number of fish per species. Diversity indices were computed for each reef for each census date (Table 18). These indices were then compared by a paired t-test among the four reefs (Table 19). The results indicate a number of comparisons that are significant. However, the differences are not consistent between replicates or between experimental and control reefs. For example, for all but two months (January, August) control reefs differed from each other. On those two dates there were significant differences between the experimental replicates. This variation negates, in large measure, the statistical difference noted between experimental and control reefs. Thus, we are unable to refute our null hypothesis that fishes respond similarly to the tire-concrete and gravel-concrete aggregates.

Invertebrates:

One hundred and sixteen taxa of invertebrates have been recorded to date, 65-76 per reef (Table 20-23). Many of these are soft bodied sessile invertebrates, i.e. sponges, ascidians, bryozoans, polychaetes chaetes and the like. The first stony coral (Scleractinids) recruits were noted in November on C-1, since that time they have been recorded on all reefs but E-2. As regards, large mobile invertebrates, all reefs continue to build populations of diverse shrimps and crabs. Lobsters are abundant on the reefs when they are out of season, but are rapidly harvested when lobster season opens. In mid-July there were a total of 28 lobsters on the reefs, this number dropped to 4 a few days after the mini-season opened (29 July).

Video taping of the reefs highlighted the ephemeral nature of some aspects of the invertebrate assemblage. For example, in November the video faces were densely covered with barnacles, by July these were much reduced. Some bryozoan colonies apparent in November were completely eradicated by July. This type of temporal change would be missed in a qualitative inventory. Further, by video taping, growth can be determined in those organisms that remain over months. Thus, a Mussid hard coral on C-2 (tetrahedron 3) grew from a half centimeter to two centimeters in diameter between November and July. Regrettably, we have, as yet, not picked up similar species of large sessile invertebrates on the multiple, preselected modules being videoed. Therefore, we have been unable to determine if there are differential growth rates, for specific species, between concrete and tire-concrete substrates. This lack of quantitative data makes it difficult to support or refute the null hypothesis that invertebrates respond similarly to the two types of reef construction material. To correct this problem, during the next grant cycle we intend to follow selected coral colonies as well as the modules presently being taped.

DISCUSSION

It is interesting to compare our results to those of a study in Boca Raton, Florida. As part of a beach restoration project the City of Boca Raton constructed six reefs from the end of March to the beginning of April 1988 (completion 5 April). Each of these reefs consisted of stacked limestone boulders, in two layers, on sand covered rock substrate in 8 ft. of water. The individual reefs were approximately 4 ft. high and 14 ft. in diameter.

A three year environmental monitoring report was done on the beach restoration project by Coastal Planning and Engineering Inc. By late June of 1988, they found the number of fish species on all six reefs had reached 31, and this number of species (but not the specific species) remained fairly constant for the duration of the study (2 yr.). In contrast, during the second grant cycle, total species on our four reefs ranged from 32 to 49 during the year with a mean of 40 (Table 17). This is a substantial difference (23%) and may indicate that the reefs in our study are able to attract and hold a more diverse assemblage of fishes.

The Boca Raton project identified 80 invertebrates in eight phyla at three years post-construction. In 18 months we have identified 116 invertebrates in nine phyla (our methodology includes microscopic studies). They recorded a single hard coral. We have already noted three species of hard corals. The discrepancies between the two studies, in vertebrate and invertebrate assemblages, may be due to differences in research methodology, depth of water or site location as well as construction materials and methods. The reason(s) for the discrepancies is worth further investigation given the apparent increased biota attracted to the tetrahedron reefs.

In summary, with the possible exception of total number of fishes, our data continues to support the null hypothesis, that there are no biotic differences in response to the two types of reefs. We need, however, to reduce the possibility of seasonal as well as structural variation before reaching any conclusions. Further, we need to examine potential differences in growth rate of sessile invertebrates on the two substrates. This will be accomplished, in part, during the next grant cycle.

PUBLIC AWARENESS

Broward DNRP and NOVA Southeastern University contacted local news media prior to the deployment of the reefs resulting in excellent local coverage. Both the Sun-Sentinel and Miami Herald reporters were at the deployment and published articles on the work in their respective papers (30 March 1993). Community News reported the project in April (vol. 6: 10). CNN interviewed DNRP and NOVA personnel and aired, internationally, a three minute segment on the project, repeatedly, on their Science and Technology section of the news (13-18 April 1993). Underwater News published an article on the project in May 1993 and another in August 1993. Waterway Times published an article on the reefs in their August 1993 issue. Metro-Dade News completed a video presentation on artificial reefs that includes this project. This last spring, Steve Somerville and Ken Banks from DNRP discussed the project on CNN and BBC, respectively. Richard Spieler was interviewed for a short presentation on artificial reefs by Discovery channel this coming fall. In addition, Dr. Spieler made a short presentation of the work to the public and professionals at the Florida Artificial Reef Summit Conference in Tallahassee (5 May 1993). The material presented is scheduled for publication by the Florida Department of Environmental Protection.

To the best of our knowledge reaction to the project has been singularly positive.

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APPENDIX I (First Grant Cycle, March-August 1993)

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Photo 1: Shredded tire chips used in the tire-aggregate concrete reefs.



Photo 2: Forklift deploying individual tetrahedrons from the barge.

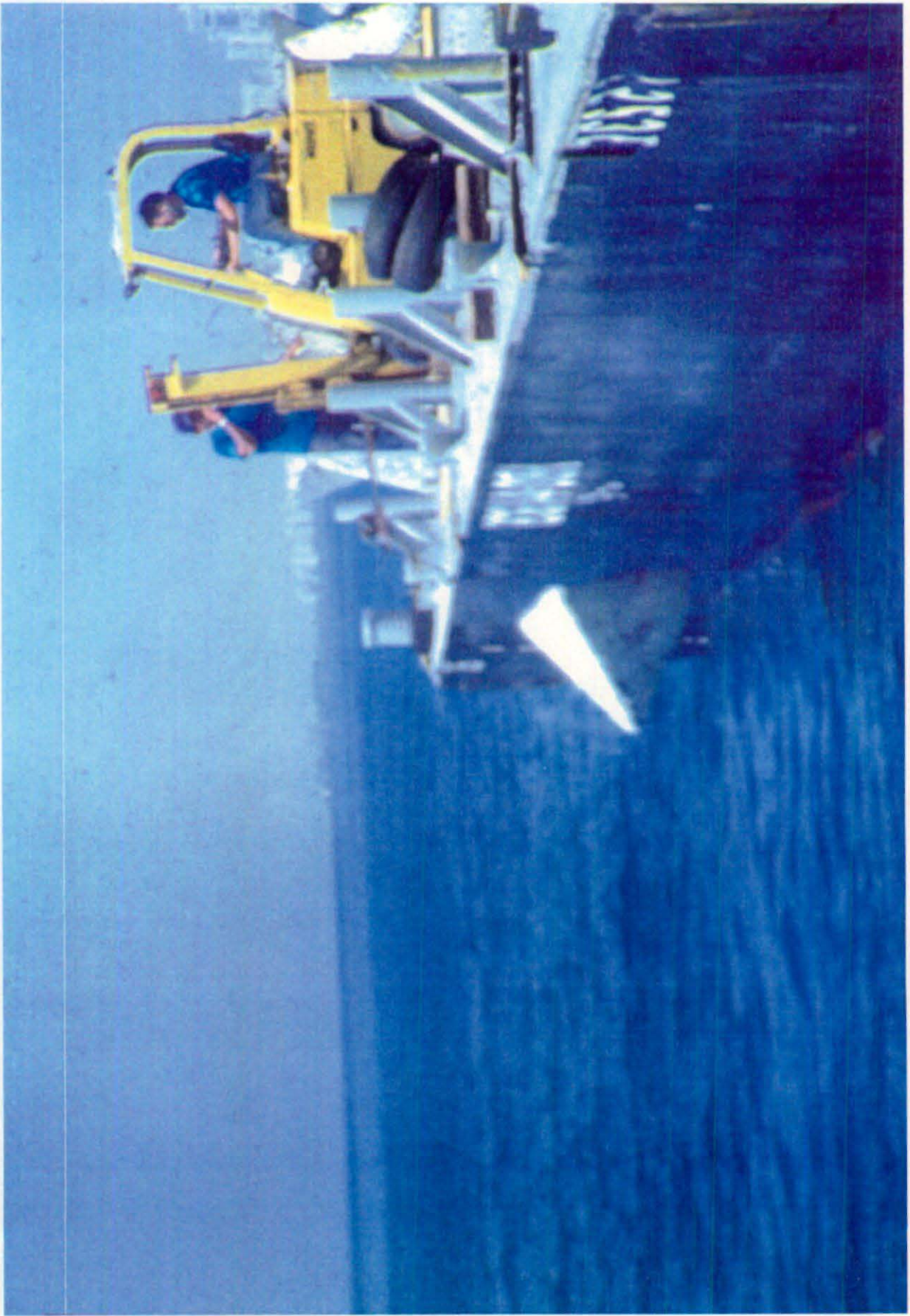


Photo 3: Movement of individual tetrahedrons into stable positions with an air-bag.



Photo 4: Example of a tire-aggregate reef.



Photo 5: Example of a tire-aggregate reef.

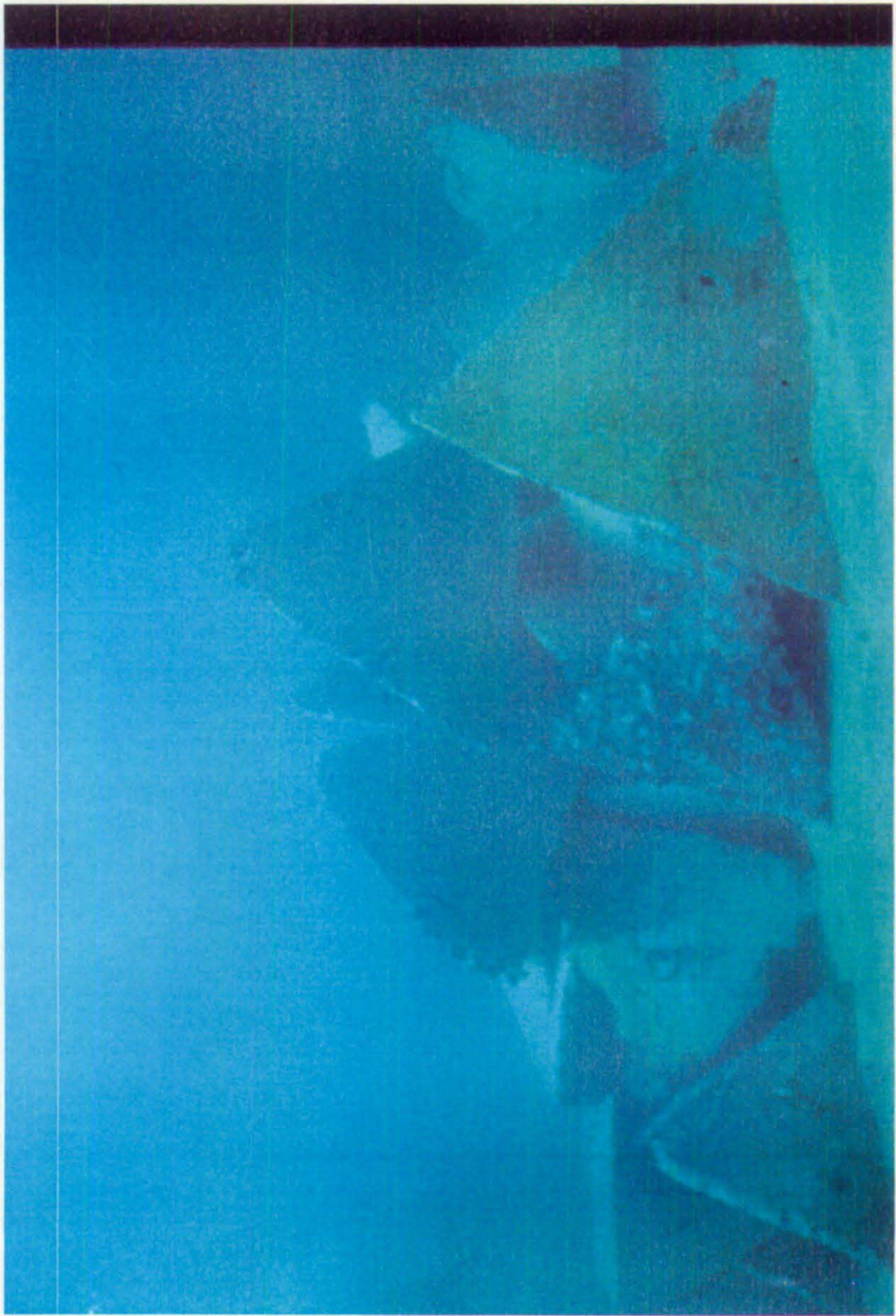


Photo 6: Example of a tire-aggregate reef.



Photo 7: Example of a gravel-aggregate reef.



Photo 8: Examples of scanning electron microscope images taken from Experimental Reef 1, three days after deployment.



Photo 9: Examples of scanning electron microscope images taken from Control reef 2, seven days after deployment.



Photo 10: Video-taping of a tetrahedron surface used for invertebrate sampling.

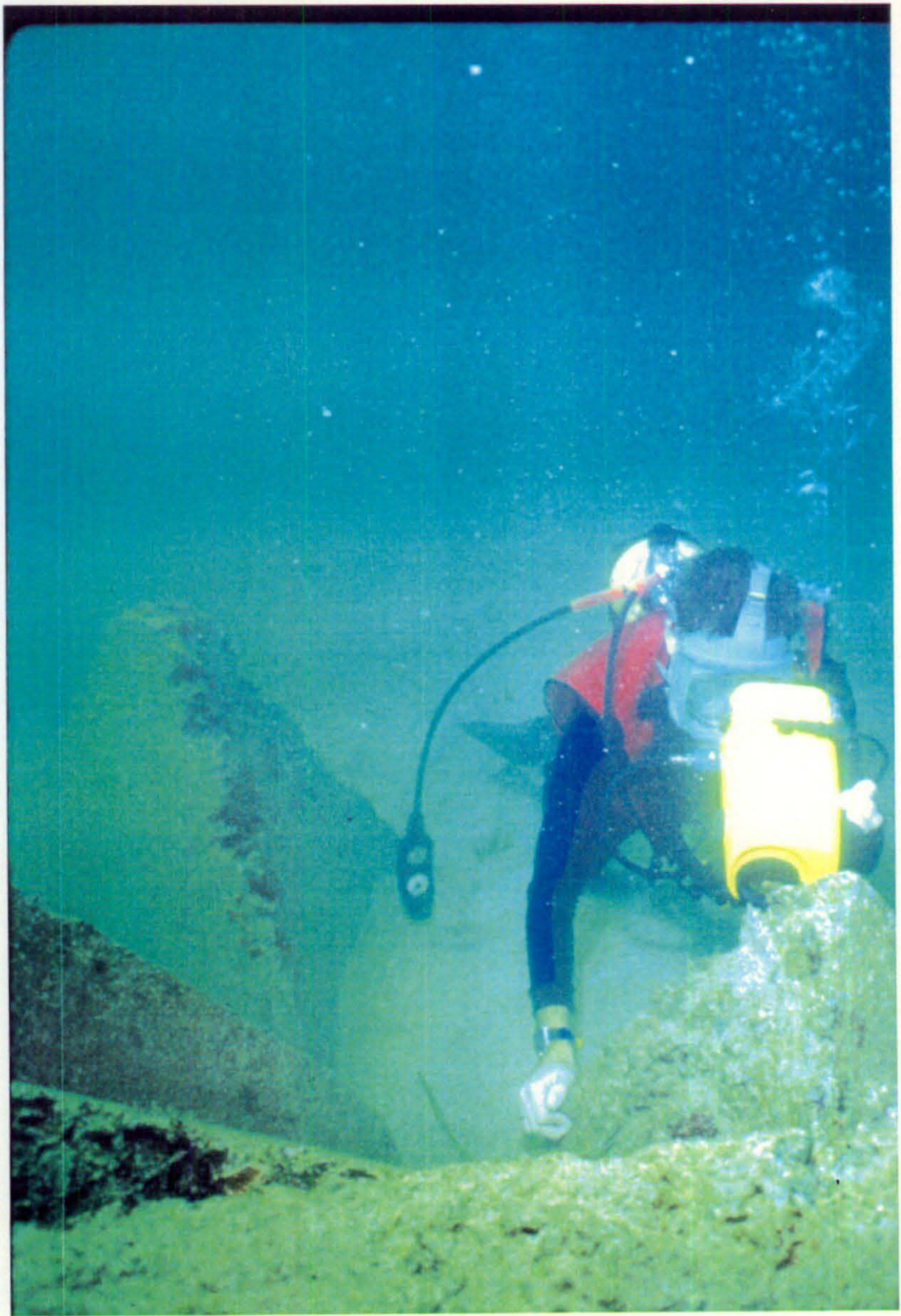


Photo 11: Recording fish counts on slates.

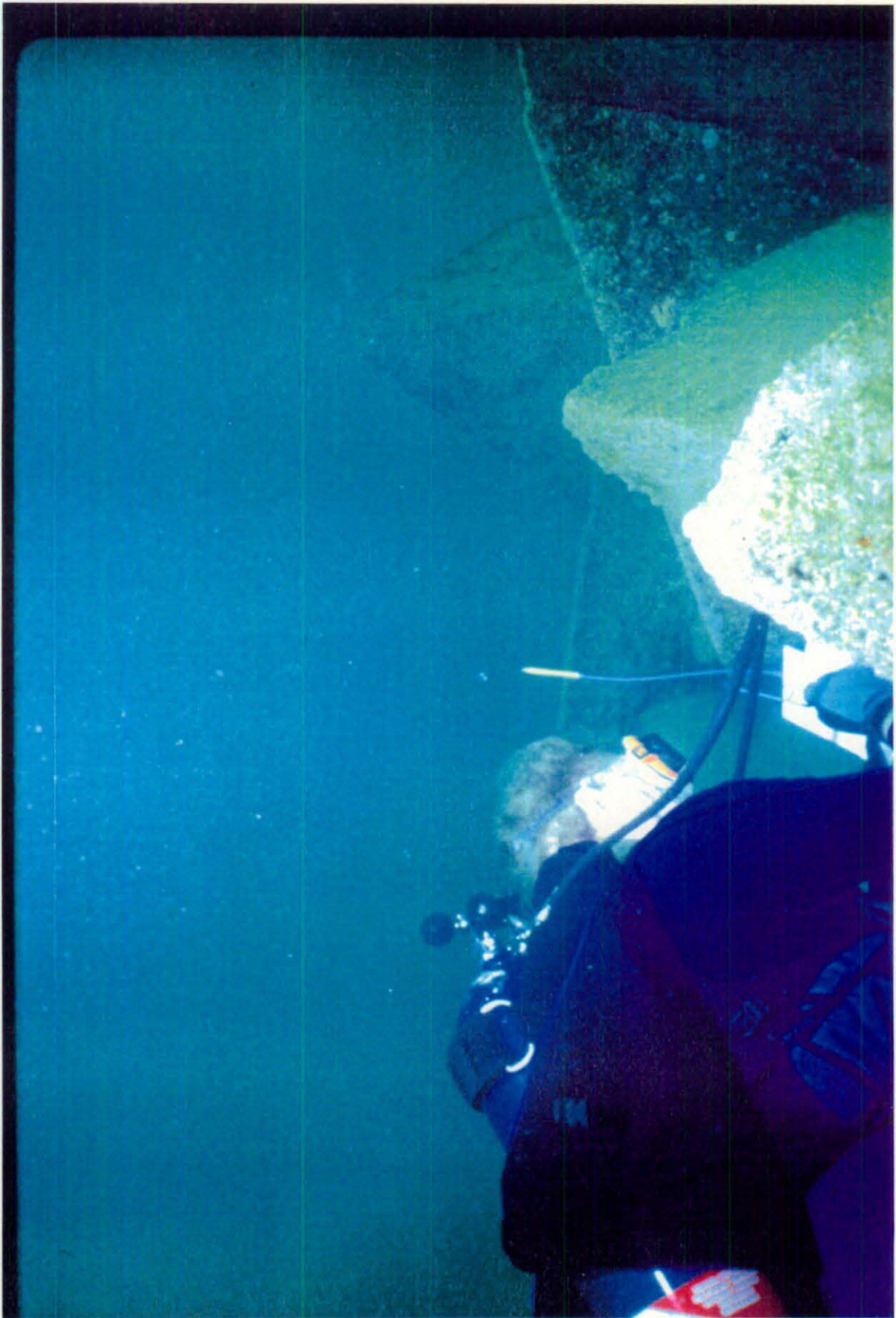
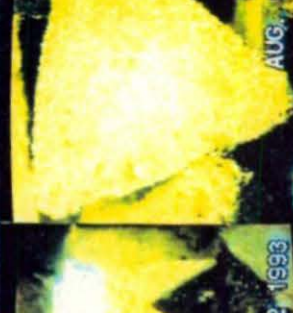
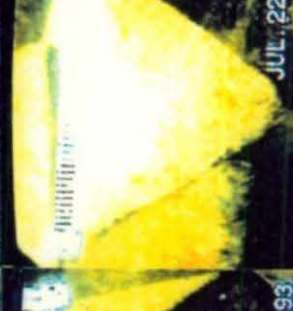
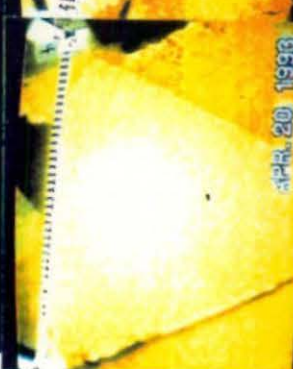
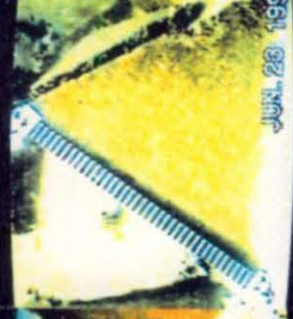
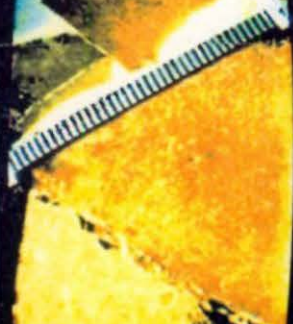
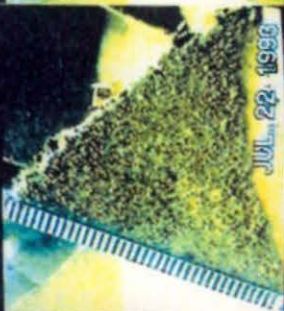
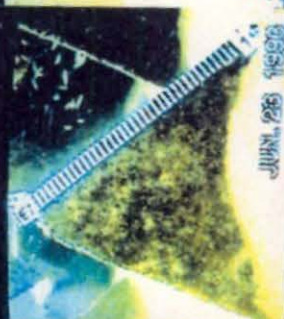


Photo 12: Examples of one monthly sequence of video-taped tetrahedron surfaces from each reef. (Rows of images are of reefs E1, E2, C1, and C2 from top to bottom.)



FISHES: CONTROL REEF 1		DATE SAMPLED										
COMMON NAME	SCIENTIFIC NAME	4-7-93	4-12-93	4-20-93	4-27-93	5-8-93	5-22-93	6-9-93	6-23-93	7-7-93	7-22-93	8-6-93
FAMILY: MORAY EELS												
MURAENIDAE												
Green Moray	<i>Gymnothorax funebris</i>	0	0	0	0	0	0	0	0	0	1	0
Spotted Moray	<i>Gymnothorax moringa</i>	0	0	0	0	0	0	0	0	0	0	1
FAMILY: SEA BASSES												
SERRANIDAE												
Juvenile Grouper	<i>Serranidae (juv.)</i>	0	0	0	0	0	0	0	3	1	1	2
Juvenile Grouper	<i>Serranidae (juv.) spotted</i>	0	0	0	0	0	0	0	0	0	0	0
Gag	<i>Mycteroperca microlepis</i>	0	0	0	0	0	0	0	0	1	0	0
Black Grouper	<i>Mycteroperca bonaci</i>	0	0	0	0	0	1	0	0	0	0	0
Sand Perch	<i>Diplectum formosum</i>	2	1	1	1	1	1	2	1	0	0	0
FAMILY: CARDINALFISHES												
APOGONIDAE												
Flamefish	<i>Apogon maculatus</i>	0	0	0	0	0	1	2	1	2	0	0
Twospot Cardinalfish	<i>Apogon pseudomaculatus</i>	0	0	0	0	0	0	0	0	0	2	1
FAMILY: JACKS												
CARANGIDAE												
Amberjack	<i>Seriola dumerili</i>	0	0	0	0	5	7	0	1	9	1	0
Blue Runner	<i>Caranx crysos</i>	0	0	0	0	0	0	0	0	0	0	0
Bar Jack	<i>Caranx ruber</i>	0	0	0	0	0	0	0	0	1	0	0
FAMILY: SNAPPERS												
LUTJANIDAE												
Yellowtail Snapper	<i>Ocyurus chrysurus</i>	0	0	0	0	0	1	0	1	1	0	0
Mahogany Snapper	<i>Lutjanus mahogani</i>	0	0	0	0	0	0	0	0	0	0	0
Grey Snapper	<i>Lutjanus griseus</i>	2	7	4	5	2	12	2	2	3	2	2
Lane Snapper	<i>Lutjanus synagris</i>	1	0	1	1	1	2	1	13	13	11	2
Mutton Snapper	<i>Lutjanus analis</i>	0	0	0	0	0	0	2	0	1	0	0
FAMILY: MOJARRAS												
GERREIDAE												
Yellowfin Mojarra	<i>Gerres cinereus</i>	0	0	0	0	0	0	0	0	0	0	0
FAMILY: GRUNTS												
HAEMULIDAE												
Cottonwick	<i>Haemulon melanurum</i>	0	0	0	0	0	0	0	0	0	2	0
White Grunt	<i>Haemulon plumieri</i>	2	1	1	1	1	1	1	3	3	2	1
Tomtates	<i>Haemulon aurolineatum (juv.)</i>	0	10	50	0	30	300	150	200	50	200	0
Margate	<i>Haemulon album</i>	0	0	0	0	0	0	0	0	0	0	0
French Grunt	<i>Haemulon flavolineatum</i>	0	0	0	0	0	0	0	0	0	2	0
Black Margate	<i>Anisotremus surinamensis</i>	0	0	0	0	0	0	0	0	0	0	0
Porkfish	<i>Anisotremus virginicus</i>	0	0	0	0	0	2	1	1	1	1	1
Pigfish	<i>Orthopristis chrysoptera</i>	0	0	0	0	0	0	0	0	0	0	0

Table 1: Fishes counted on Control Reef 1 at each sample date.

FISHES: CONTROL REEF 1		DATE SAMPLED										
COMMON NAME	SCIENTIFIC NAME	4-7-93	4-12-93	4-20-93	4-27-93	5-8-93	5-22-93	6-9-93	6-23-93	7-7-93	7-22-93	8-6-93
FAMILY: PORGIES	SPARIDAE											
Pinfish	<i>Lagodon rhomboides</i>	0	1	0	0	0	0	0	0	0	0	0
Saucereye Porgy	<i>Calamus calamus</i>	0	0	0	1	0	0	0	0	0	0	0
Grass Porgy	<i>Calamus arctifrons</i>	0	0	0	0	1	0	0	0	0	0	0
FAMILY: DRUMS	SCIAENIDAE											
Highhat	<i>Equetus acuminatus</i>	0	0	0	0	0	0	1	0	1	1	1
FAMILY: GOATFISHES	MULLIDAE											
Spotted Goatfish	<i>Pseudupeneus maculatus</i>	0	0	0	0	0	0	0	0	1	0	0
Yellow Goatfish	<i>Mulloidichthys martinicus</i>	0	0	0	0	0	0	0	0	0	0	0
FAMILY: SPADEFISHES	EPHIPPIDAE											
Spadefish	<i>Chaetodipterus faber</i>	0	0	0	0	0	0	1	0	0	0	0
FAMILY: ANGELFISHES	POMACANTHIDAE											
Angelfish Juvenile	<i>Holocanthus sp. (juv.)</i>	0	0	0	0	0	0	0	0	0	0	0
French Angelfish	<i>Pomacanthus paru</i>	0	0	0	0	0	0	0	0	0	1	0
Grey Angelfish	<i>Pomacanthus arcuatus</i>	0	0	0	0	0	0	0	0	0	0	0
Angelfish Juvenile	<i>Pomacanthus sp. (juv.)</i>	0	0	0	0	0	0	0	0	0	0	0
FAMILY: DAMSELFISHES	POMACENTRIDAE											
Dusky Damselfish	<i>Stegastes fuscus</i>	0	0	0	0	0	0	0	0	0	0	0
Blue Chromis	<i>Chromis cyanis</i>	0	0	0	0	0	0	0	0	0	0	0
FAMILY: WRASSES	LABRIDAE											
Spanish Hogfish	<i>Bodianus rufus (juv.)</i>	0	0	0	0	0	0	0	0	0	1	0
Clown wrasse	<i>Halichores maculipinna</i>	0	0	0	0	0	0	0	1	0	2	2
Slippery Dick	<i>Halichores bivittatus</i>	0	0	0	0	0	0	0	0	0	2	0
Yellowcheek wrasse	<i>Halichores cyanocephalus</i>	0	0	0	0	0	0	0	2	0	0	0
Puddingwife	<i>Halichores radiatus</i>	0	0	0	0	0	0	0	0	0	0	0
Bluehead Wrasse	<i>Thalassoma bifasciatum</i>	0	0	0	0	0	0	4	1	0	2	0
FAMILY: PARROTFISHES	SCARIDAE											
Parrotfish	SCARIDAE	0	0	0	0	0	0	0	0	0	0	0
Parrotfish	<i>Sparisoma sp. (juv.)</i>	0	0	0	0	0	0	0	0	0	0	0
FAMILY: BARRACUDAS	SPHYAENIDAE											
Barracuda	<i>Sphyræna barracuda</i>	0	0	0	0	0	0	0	0	0	0	0

Table 1: Continued

FISHES: CONTROL REEF 1		DATE SAMPLED										
COMMON NAME	SCIENTIFIC NAME	4-7-93	4-12-93	4-20-93	4-27-93	5-8-93	5-22-93	6-9-93	6-23-93	7-7-93	7-22-93	8-6-93
FAMILY: CLINIDS	CLINIDAE											
Clinid	Clinidae A	0	0	0	0	0	2	0	0	3	0	2
Clinid	Clinidae B	0	0	0	0	0	0	0	0	0	0	0
FAMILY: COMBTOOTH BLENNI	BLENNIDAE											
Redlip Blenny	<i>Ophioblennius atlanticus</i>	0	0	0	0	0	0	0	0	0	0	1
FAMILY: GOBIES	GOBIIDAE											
Neon Goby	<i>Gobiosoma oceanops</i>	0	0	1	0	0	1	0	0	0	0	0
Bridled Goby	<i>Coryphopterus glaucofraenum</i>	0	0	0	0	0	0	0	0	0	0	1
Goby	Gobiidae A	0	0	0	0	0	0	0	0	0	0	0
Goby	Gobiidae B	0	0	0	0	1	0	0	0	0	0	0
FAMILY: SURGEONFISHES	ACANTHURIDAE											
Ocean Surgeon	<i>Acanthurus bahianus</i>	6	0	6	3	24	9	4	4	1	15	6
Doctorfish	<i>Acanthurus chirurgus</i>	0	0	0	0	0	0	0	1	1	0	0
FAMILY: LEFT EYE FLOUNDERS	BOTHIDAE											
Gulf Flounder	<i>Paralichthys albigutta</i>	0	0	0	0	0	0	0	0	0	0	1
FAMILY: LEATHERJACKETS	BALISTIDAE											
Filefish	<i>Aluterus sp.</i>	0	0	0	0	0	0	0	0	0	0	0
Orangespotted Filefish	<i>Cantherhines pullus</i>	0	0	0	0	0	0	0	0	0	0	0
Whitespotted Filefish	<i>Cantherhines macrocerus</i>	0	0	0	0	0	0	1	0	0	0	0
Queen Trigger	<i>Balistes vetula</i>	0	0	0	0	0	1	2	1	0	1	1
FAMILY: PUFFERS	TETRAODONTIDAE											
Sharpnose Puffer	<i>Canthigaster rostrata</i>	0	0	0	0	0	1	0	1	0	2	1
Unidentified Juveniles	UNID. JUVENILES	0	0	0	0	0	115	0	0	0	0	200

Table 1: Continued

FISHES: CONTROL REEF 2		DATE SAMPLED										
COMMON NAME	FISHES	4-7-93	4-12-93	4-20-93	4-27-93	5-8-93	5-22-93	6-9-93	6-23-93	7-7-93	7-22-93	8-6-93
FAMILY: MORAY EELS	MURAENIDAE											
Green Moray	<i>Gymnothorax funebris</i>	0	0	0	0	0	0	0	0	0	0	0
Spotted Moray	<i>Gymnothorax moringa</i>	0	0	0	0	0	0	0	0	0	0	0
FAMILY: SEA BASSES	SERRANIDAE											
Juvenile Grouper	Serranidae (juv.)	0	0	0	0	0	1	0	1	0	0	1
Juvenile Grouper	Serranidae (juv.) spotted	0	0	0	0	0	0	0	0	0	0	0
Gag	<i>Mycteroperca bonaci</i>	0	0	0	0	0	0	0	0	0	0	0
Black Grouper	<i>Mycteroperca microlepis</i>	0	0	0	0	0	1	0	0	1	0	0
Sand Perch	<i>Diplectum formosum</i>	1	0	1	0	1	1	2	3	0	1	0
FAMILY: CARDINALFISHES	APOGONIDAE											
Flamefish	<i>Apogon maculatus</i>	0	0	0	0	0	1	0	0	0	0	0
Twospot Cardinalfish	<i>Apogon pseudomaculatus</i>	0	0	0	0	0	0	1	1	1	0	2
FAMILY: JACKS	CARANGIDAE											
Amberjack	<i>Seriola dumerili</i>	0	0	0	0	0	5	1	0	8	3	0
Blue Runner	<i>Caranx crysos</i>	0	0	5	0	0	0	0	1	0	0	2
Bar Jack	<i>Caranx ruber</i>	0	0	0	0	0	0	0	0	0	0	0
FAMILY: SNAPPERS	LUTJANIDAE											
Yellowtail Snapper	<i>Ocyurus chrysurus</i>	0	0	0	0	1	0	1	0	0	1	0
Mahogany Snapper	<i>Lutjanus mahogani</i>	0	0	0	0	0	0	0	0	0	0	0
Grey Snapper	<i>Lutjanus griseus</i>	0	3	9	2	6	2	9	2	4	7	20
Lane Snapper	<i>Lutjanus synagris</i>	1	0	0	1	6	4	1	3	2	15	5
Mutton Snapper	<i>Lutjanus analis</i>	0	0	0	0	0	0	0	0	1	0	0
FAMILY: MOJARRAS	GERREIDAE											
Yellowfin Mojarra	<i>Gerres cinereus</i>	2	0	0	0	0	0	0	0	0	0	0
FAMILY: GRUNTS	HAEMULIDAE											
Cottonwick	<i>Haemulon melanurum</i>	0	0	1	0	0	0	0	1	1	0	0
White Grunt	<i>Haemulon plumieri</i>	2	0	9	0	7	16	3	3	4	4	3
Tomtates	<i>Haemulon aurolineatum juvenile</i>	0	50	150	300	50	50	100	100	50	60	5
Margate	<i>Haemulon album</i>	0	0	0	0	0	0	0	0	0	1	1
French Grunt	<i>Haemulon flavolineatum</i>	0	0	0	0	0	0	0	0	0	0	0
Black Margate	<i>Anisotremus surinamensis</i>	0	0	0	0	0	0	0	0	0	1	0
Porkfish	<i>Anisotremus virginicus</i>	0	0	3	3	1	1	1	2	1	0	0
Pigfish	<i>Orthopristis chrysoptera</i>	0	0	0	0	0	0	0	0	0	1	1

Table 2: Fishes counted on Control Reef 2 at each sample date.

FISHES: CONTROL REEF 2		DATE SAMPLED										
COMMON NAME	FISHES	4-7-93	4-12-93	4-20-93	4-27-93	5-8-93	5-22-93	6-9-93	6-23-93	7-7-93	7-22-93	8-6-93
FAMILY: PORGIES	SPARIDAE											
Pinfish	<i>Logodon rhomboides</i>	0	0	0	0	0	0	0	0	0	0	0
Saucereye Porgy	<i>Calamus calamus</i>	0	0	0	0	0	0	0	0	0	0	0
Grass Porgy	<i>Calamus artifrons</i>	0	0	0	0	0	0	0	0	0	0	0
FAMILY: DRUMS	SCIAENIDAE											
Highhat	<i>Equetus acuminatus</i>	0	0	0	0	0	0	0	0	0	0	0
FAMILY: GOATFISHES	MULLIDAE											
Spotted Goatfish	<i>Pseudupeneus maculatus</i>	0	0	2	0	0	0	1	2	0	1	0
Yellow Goatfish	<i>Mulloidichthys martinicus</i>	0	0	0	0	0	0	0	0	0	0	0
FAMILY: SPADEFISHES	EPHIPPIDAE											
Spadefish	<i>Chaetodipterus faber</i>	2	0	0	0	0	0	0	0	1	0	0
FAMILY: ANGELFISHES	POMACANTHIDAE											
Angelfish Juvenile	<i>Holocanthus sp. (juv.)</i>	0	0	0	0	0	0	0	0	0	0	0
French Angelfish	<i>Pomacanthus paru</i>	0	0	0	0	0	0	0	0	0	1	0
Grey Angelfish	<i>Pomacanthus arcuatus</i>	0	0	0	0	0	0	0	0	0	1	0
Angelfish Juvenile	<i>Pomacanthus sp. (juv.)</i>	0	0	0	0	0	0	0	0	0	0	1
FAMILY: DAMSELFISHES	POMACENTRIDAE											
Dusky Damselfish	<i>Stegates fuscus</i>	0	0	0	0	0	0	1	1	1	1	1
Blue Chromis	<i>Chromis cyanis</i>	0	0	0	0	0	0	0	0	0	0	0
FAMILY: WRASSES	LABRIDAE											
Spanish Hogfish	<i>Bodianus rufus juvenile</i>	0	0	0	0	0	0	0	0	0	0	0
Clown wrasse	<i>Halichores maculipinna</i>	0	0	0	1	0	0	0	2	2	0	1
Slippery Dick	<i>Halichores bivittatus</i>	0	0	0	0	0	0	0	1	1	4	3
Yellowcheek wrasse	<i>Halichores cyanocephalus</i>	0	0	0	0	0	0	0	0	0	0	0
Puddingwife	<i>Halichores radiatus</i>	0	0	0	0	0	0	0	0	0	1	1
Bluehead Wrasse	<i>Thalassoma bifasciatum</i>	0	0	0	0	0	0	3	0	0	0	0
FAMILY: PARROTFISHES	SCARIDAE											
Parrotfish	SCARIDAE	0	0	0	0	0	0	0	0	0	0	0
Parrotfish	<i>Sparisoma sp. (juv.)</i>	0	0	0	0	0	0	0	0	0	0	0
FAMILY: BARRACUDAS	SPHYAENIDAE											
Barracuda	<i>Sphyaena barracuda</i>	0	0	0	0	0	0	0	0	0	0	0

Table 2: Continued

FISHES: CONTROL REEF 2		DATE SAMPLED										
COMMON NAME	FISHES	4-7-93	4-12-93	4-20-93	4-27-93	5-8-93	5-22-93	6-9-93	6-23-93	7-7-93	7-22-93	8-6-93
FAMILY: CLINIDS	CLINIDAE											
Clinid	Clinidae A	0	0	0	0	0	1	0	0	2	0	0
Clinid	Clinidae B	0	0	0	0	0	0	0	0	0	0	0
FAMILY: COMBTOOTH BLENNI	BLENNIDAE											
Redlip Blenny	<i>Ophioblennius atlanticus</i>	0	0	0	0	0	0	0	0	0	0	0
FAMILY: GOBIES	GOBIIDAE											
Neon Goby	<i>Gobiosoma oceanops</i>	0	0	0	0	0	0	0	0	0	0	0
Bridled Goby	<i>Corphopterus glaucofraenum</i>	0	0	0	0	0	0	0	0	0	0	0
Goby	Gobiidae A	0	0	0	0	0	0	0	0	0	0	0
Goby	Gobiidae B	0	0	0	0	0	0	0	0	0	0	0
FAMILY: SURGEONFISHES	ACANTHURIDAE											
Ocean Surgeon	<i>Acanthurus bahianus</i>	2	12	5	2	16	3	4	6	3	12	5
Doctorfish	<i>Acanthurus chirurgus</i>	0	0	0	0	0	0	0	0	3	0	0
FAMILY: LEFT-EYE FLOUNDERS	BOTHIDAE											
Gulf Flounder	<i>Paralichthys albigutta</i>	0	0	0	0	0	0	0	0	0	0	0
FAMILY: LEATHERJACKETS	BALISTIDAE											
Filefish	<i>Aluteus sp.</i>	0	0	0	0	0	0	0	0	0	0	0
Orangespotted Filefish	<i>Cantherhines pullus</i>	0	0	0	1	0	0	0	0	0	0	0
Whitespotted Filefish	<i>Cantherhines macrocerus</i>	0	0	0	0	1	0	0	0	0	0	0
Queen Trigger	<i>Balistes vetula</i>	0	0	0	0	0	1	1	0	4	1	0
FAMILY: PUFFERS	TETRAODONTIDAE											
Sharpnose Puffer	<i>Canthigaster rostrata</i>	0	0	0	0	0	0	0	0	0	0	0
Unidentified Juveniles	UNID. JUVENILES	0	0	0	0	0	0	0	0	0	0	0

Table 2: Continued

FISHES: EXPERIMENTAL 1		DATE SAMPLED										
COMMON NAME	SCIENTIFIC NAME	4-7-93	4-12-93	4-20-93	4-27-93	5-8-93	5-22-93	6-9-93	6-23-93	7-7-93	7-22-93	8-6-93
FAMILY: MORAY EELS	MURAENIDAE											
Green Moray	<i>Gymnothorax funebris</i>	0	0	0	0	0	0	0	0	1	0	0
Spotted Moray	<i>Gymnothorax moringa</i>	0	0	0	0	0	0	0	0	0	0	0
FAMILY: SEA BASSES	SERRANIDAE											
Juvenile Grouper	Serranidae (juv.)	0	0	0	0	0	0	1	1	2	5	3
Juvenile Grouper	Serranidae (juv.) spotted	0	0	0	0	0	0	0	0	0	1	0
Gag	<i>Mycteroperca microlepis</i>	0	0	0	0	0	0	0	0	0	0	0
Black Grouper	<i>Mycteroperca bonaci</i>	0	0	0	0	0	0	0	0	0	0	0
Sand Perch	<i>Diplectum formosum</i>	1	0	0	0	0	3	1	1	0	1	0
FAMILY: CARDINALFISHES	APOGONIDAE											
Flamefish	<i>Apogon maculatus</i>	0	0	0	0	1	0	2	0	1	0	0
Twospot Cardinalfish	<i>Apogon pseudomaculatus</i>	0	0	0	0	0	0	0	0	0	0	0
FAMILY: JACKS	CARANGIDAE											
Amberjack	<i>Seriola dumerili</i>	0	0	10	0	0	0	0	0	8	3	1
Blue Runner	<i>Caranx crysos</i>	0	0	17	0	0	0	0	0	0	0	0
Bar Jack	<i>Caranx ruber</i>	0	0	0	0	0	0	0	0	0	1	0
FAMILY: SNAPPERS	LUTJANIDAE											
Yellowtail Snapper	<i>Ocyurus chrysurus</i>	0	0	2	1	4	0	0	0	0	0	0
Mahogany Snapper	<i>Lutjanus mahogani</i>	0	0	0	0	0	0	0	0	0	0	0
Grey Snapper	<i>Lutjanus griseus</i>	1	8	7	8	5	5	4	12	0	13	25
Lane Snapper	<i>Lutjanus synagris</i>	0	1	1	0	0	4	1	1	0	0	1
Mutton Snapper	<i>Lutjanus analis</i>	0	0	0	0	0	0	2	0	1	0	0
FAMILY: MOJARRAS	GERREIDAE											
Yellowfin Mojarra	<i>Gerres cinereus</i>	0	0	0	0	0	0	3	0	0	0	0
FAMILY: GRUNTS	HAEMULIDAE											
Cottonwick	<i>Haemulon melanurum</i>	1	0	0	0	0	0	0	0	0	0	1
White Grunt	<i>Haemulon plumieri</i>	0	0	3	1	11	1	1	4	0	4	2
Tomtates	<i>Haemulon aurolineatum</i> (juv.)	0	0	10	200	150	300	200	500	1000	300	0
Margate	<i>Haemulon album</i>	0	0	0	0	0	0	0	0	1	0	0
French Grunt	<i>Haemulon flavolineatum</i>	0	0	0	0	0	0	0	0	0	0	0
Black Margate	<i>Anisotremus surinamensis</i>	0	0	0	0	0	0	0	0	0	0	0
Porkfish	<i>Anisotremus virginicus</i>	0	0	1	1	1	2	3	3	2	2	1
Pigfish	<i>Orthopristis chrysoptera</i>	0	0	0	0	0	0	0	0	0	0	2

Table 3: Fishes counted on Experimental Reef 1 at each sample date.

FISHES: EXPERIMENTAL 1		DATE SAMPLED										
COMMON NAME	SCIENTIFIC NAME	4-7-93	4-12-93	4-20-93	4-27-93	5-8-93	5-22-93	6-9-93	6-23-93	7-7-93	7-22-93	8-6-93
FAMILY: PORGIES	SPARIDAE											
Pinfish	<i>Lagodon rhomboides</i>	0	0	0	0	0	0	0	0	0	0	0
Saucereye Porgy	<i>Calamus calamus</i>	0	0	0	0	2	0	0	0	0	0	0
Grass Porgy	<i>Calamus arctifrons</i>	0	0	0	0	0	0	0	0	0	0	0
FAMILY: DRUMS	SCIAENIDAE											
Highhat	<i>Equetus acuminatus</i>	0	0	0	0	0	0	0	0	0	0	0
FAMILY: GOATFISHES	MULLIDAE											
Spotted Goatfish	<i>Pseudupeneus maculatus</i>	0	0	1	0	0	2	0	0	3	1	0
Yellow Goatfish	<i>Mulloidichthys martinicus</i>	0	0	0	0	0	0	0	0	0	0	0
FAMILY: SPADEFISHES	EPHIPPIDAE											
Spadefish	<i>Chaetodipterus faber</i>	1	2	3	3	4	5	4	5	3	2	1
FAMILY: ANGELFISHES	POMACANTHIDAE											
Angelfish Juvenile	<i>Holocanthus sp. (juv.)</i>	0	0	0	0	0	0	0	0	0	1	0
French Angelfish	<i>Pomacanthus paru</i>	0	0	0	0	0	0	0	0	0	0	0
Grey Angelfish	<i>Pomacanthus arcuatus</i>	0	0	0	0	0	0	0	0	0	0	0
Angelfish Juvenile	<i>Pomacanthus sp. (juv.)</i>	0	0	0	0	0	0	0	0	0	0	0
FAMILY: DAMSELFISHES	POMACENTRIDAE											
Dusky Damselfish	<i>Stegastes fuscus</i>	0	0	0	0	0	0	0	0	0	0	0
Blue Chromis	<i>Chromis cyanis</i>	0	0	0	0	0	0	0	0	0	0	0
FAMILY: WRASSES	LABRIDAE											
Spanish Hogfish	<i>Bodianus rufus (juv.)</i>	0	0	0	0	0	2	2	2	1	2	1
Clown wrasse	<i>Halichoeres maculipinna</i>	0	0	1	0	0	4	0	2	3	2	4
Slippery Dick	<i>Halichoeres bivittatus</i>	0	0	0	0	0	0	0	2	1	5	7
Yellowcheek wrasse	<i>Halichoeres cyanocephalus</i>	0	0	0	0	0	0	0	1	0	0	0
Puddingwife	<i>Halichoeres radiatus</i>	0	0	0	0	0	0	0	0	0	0	0
Bluehead Wrasse	<i>Thalassoma bifasciatum</i>	0	0	0	0	0	1	3	0	0	2	0
FAMILY: PARROTFISHES	SCARIDAE											
Parrotfish	SCARIDAE	0	0	0	0	0	0	1	0	0	0	0
Parrotfish	<i>Sparisoma sp. (juv.)</i>	0	0	0	0	0	0	0	0	0	1	0
FAMILY: BARRACUDAS	SPHYAENIDAE											
Barracuda	<i>Sphyraena barracuda</i>	0	0	0	0	0	0	0	0	1	0	0

Table 3: Continued

FISHES: EXPERIMENTAL 1		DATE SAMPLED										
COMMON NAME	SCIENTIFIC NAME	4-7-93	4-12-93	4-20-93	4-27-93	5-8-93	5-22-93	6-9-93	6-23-93	7-7-93	7-22-93	8-6-93
FAMILY: CLINIDS	CLINIDAE											
Clinid	Clinidae A	0	0	0	0	0	0	0	0	1	0	0
Clinid	Clinidae B	0	0	0	0	0	0	0	0	0	1	0
FAMILY: COMBTOOTH BLENNI	BLENNIDAE											
Redlip Blenny	<i>Ophioblennius atlanticus</i>	0	0	0	0	0	0	0	0	0	0	0
FAMILY: GOBIES	GOBIIDAE											
Neon Goby	<i>Gobiosoma oceanops</i>	0	0	0	0	0	0	0	0	0	0	0
Bridled Goby	<i>Coryphopterus glaucofraenum</i>	0	0	0	0	0	0	0	0	1	1	0
Goby	Gobiidae A	0	0	0	0	0	0	0	0	0	0	0
Goby	Gobiidae B	0	0	0	0	0	1	0	0	0	0	0
FAMILY: SURGEONFISHES	ACANTHURIDAE											
Ocean Surgeon	<i>Acanthurus bahianus</i>	18	0	6	10	7	2	5	1	10	0	8
Doctorfish	<i>Acanthurus chirurgus</i>	0	0	0	0	0	0	0	0	0	1	2
FAMILY: LEFT-EYE FLOUNDERS	BOTHIDAE											
Gulf Flounder	<i>Paralichthys albigutta</i>	0	0	0	0	0	0	0	0	0	0	0
FAMILY: LEATHERJACKETS	BALISTIDAE											
Filefish	<i>Aluterus sp.</i>	0	0	0	0	0	0	0	0	0	0	0
Orangespotted Filefish	<i>Cantherhines pullus</i>	0	0	0	0	0	0	1	0	0	0	0
Whitespotted Filefish	<i>Cantherhines macrocerus</i>	0	0	0	0	0	0	0	0	0	0	0
Queen Trigger	<i>Balistes vetula</i>	0	0	0	0	0	0	1	2	1	0	2
FAMILY: PUFFERS	TETRAODONTIDAE											
Sharppose Puffer	<i>Canthigaster rostrata</i>	0	0	0	0	1	0	0	0	2	0	1
Unidentified Juveniles	UNID. JUVENILES	0	0	0	0	0	50	200	0	0	0	0

Table 3: Continued

FISHES: EXPERIMENTAL 2		DATE SAMPLED										
COMMON NAME	SCIENTIFIC NAME	4-7-93	4-12-93	4-20-93	4-27-93	5-8-93	5-22-93	6-9-93	6-23-93	7-7-93	7-22-93	8-6-93
FAMILY: MORAY EELS		MURAENIDAE										
Green Moray	<i>Gymnothorax funebris</i>	0	0	0	0	0	0	0	0	0	0	0
Spotted Moray	<i>Gymnothorax moringa</i>	0	0	0	0	0	0	0	0	0	0	1
FAMILY: SEA BASSES		SERRANIDAE										
Juvenile Grouper	<i>Serranidae (juv.)</i>	0	0	0	0	0	0	1	0	2	1	1
Juvenile Grouper	<i>Serranidae (juv.) spotted</i>	0	0	0	0	0	0	1	0	0	0	0
Gag	<i>Mycteroperca microlepis</i>	0	0	0	0	0	0	0	0	1	0	1
Black Grouper	<i>Mycteroperca bonaci</i>	0	0	0	0	0	0	0	0	0	0	0
Sand Perch	<i>Diplectum formosum</i>	1	0	0	1	0	1	2	0	0	0	1
FAMILY: CARDINALFISHES		APOGONIDAE										
Flamefish	<i>Apogon maculatus</i>	0	0	0	0	0	2	2	0	1	0	0
Twospot Cardinalfish	<i>Apogon pseudomaculatus</i>	0	0	0	0	0	0	0	0	0	0	2
FAMILY: JACKS		CARANGIDAE										
Amberjack	<i>Seriola dumerilii</i>	0	0	8	9	0	0	0	0	0	0	1
Blue Runner	<i>Caranx crysos</i>	0	0	0	0	4	0	0	0	0	0	0
Bar Jack	<i>Caranx ruber</i>	1	0	0	0	0	0	0	0	0	0	0
FAMILY: SNAPPERS		LUTJANIDAE										
Yellowtail Snapper	<i>Ocyurus chrysurus</i>	0	0	1	1	5	3	0	0	0	0	0
Mahogany Snapper	<i>Lutjanus mahogani</i>	1	0	0	0	0	0	0	0	0	0	0
Grey Snapper	<i>Lutjanus griseus</i>	2	4	5	8	8	16	8	19	3	14	9
Lane Snapper	<i>Lutjanus synagris</i>	0	0	0	0	1	0	5	1	1	2	0
Mutton Snapper	<i>Lutjanus analis</i>	0	0	1	0	0	1	0	1	0	0	0
FAMILY: MOJARRAS		GERREIDAE										
Yellowfin Mojarra	<i>Gerres cinereus</i>	0	0	0	0	0	0	0	0	0	0	0
FAMILY: GRUNTS		HAEMULIDAE										
Cottonwick	<i>Haemulon melanurum</i>	0	0	0	1	0	0	0	1	1	3	4
White Grunt	<i>Haemulon plumieri</i>	2	0	0	1	1	1	2	2	21	4	1
Tomtates	<i>Haemulon aurolineatum (juv.)</i>	100	100	500	200	300	200	300	200	100	200	200
Margate	<i>Haemulon album</i>	0	0	0	0	0	0	0	0	1	1	0
French Grunt	<i>Haemulon flavolineatum</i>	0	0	0	0	0	0	0	0	0	0	0
Black Margate	<i>Anisotremus surinamensis</i>	0	0	0	0	0	0	0	0	0	0	0
Porkfish	<i>Anisotremus virginicus</i>	0	1	0	1	0	1	0	1	0	1	1
Pigfish	<i>Orthopristis chrysoptera</i>	0	0	0	0	0	0	0	0	0	30	13

Table 4: Fishes counted on Experimental Reef 2 at each sample date.

FISHES: EXPERIMENTAL 2		DATE SAMPLED										
COMMON NAME	SCIENTIFIC NAME	4-7-93	4-12-93	4-20-93	4-27-93	5-8-93	5-22-93	6-9-93	6-23-93	7-7-93	7-22-93	8-6-93
FAMILY: PORGIES	SPARIDAE											
Pinfish	<i>Lagodon rhomboides</i>	0	0	0	0	0	0	0	0	0	0	0
Saucereye Porgy	<i>Calamus calamus</i>	0	2	0	1	2	0	4	0	0	0	3
Grass Porgy	<i>Calamus arctifrons</i>	0	0	0	0	0	0	0	0	0	0	0
FAMILY: DRUMS	SCIAENIDAE											
Highhat	<i>Equetus acuminatus</i>	0	0	0	0	0	0	0	0	0	0	0
FAMILY: GOATFISHES	MULLIDAE											
Spotted Goatfish	<i>Pseudupeneus maculatus</i>	0	0	0	1	0	0	0	1	0	3	3
Yellow Goatfish	<i>Mulloidichthys martinicus</i>	0	0	0	0	0	0	0	0	0	0	1
FAMILY: SPADEFISHES	EPHIPPIDAE											
Spadefish	<i>Chaetodipterus faber</i>	0	0	0	0	0	0	0	0	0	0	0
FAMILY: ANGELFISHES	POMACANTHIDAE											
Angelfish Juvenile	<i>Holocanthus sp. (juv.)</i>	0	0	0	0	0	0	0	0	0	0	0
French Angelfish	<i>Pomacanthus paru</i>	0	0	0	0	0	0	0	0	0	0	0
Grey Angelfish	<i>Pomacanthus arcuatus</i>	0	0	0	0	0	0	0	0	0	1	0
Angelfish Juvenile	<i>Pomacanthus sp. (juv.)</i>	0	0	0	0	0	0	0	0	0	0	0
FAMILY: DAMSELFISHES	POMACENTRIDAE											
Dusky Damselfish	<i>Stegastes fuscus</i>	0	0	0	0	0	0	0	0	0	0	0
Blue Chromis	<i>Chromis cyanis</i>	0	0	0	0	0	0	1	0	0	0	0
FAMILY: WRASSES	LABRIDAE											
Spanish Hogfish	<i>Bodianus rufus (juv.)</i>	0	0	2	3	2	2	3	2	2	2	1
Clown wrasse	<i>Halichores maculipinna</i>	0	0	0	0	0	0	0	3	2	0	1
Slippery Dick	<i>Halichores bivittatus</i>	0	0	0	0	0	0	1	0	5	4	0
Yellowcheek wrasse	<i>Halichores cyanocephalus</i>	0	0	0	0	0	0	0	1	0	0	0
Puddingwife	<i>Halichores radiatus</i>	0	0	0	0	0	0	0	0	0	0	0
Bluehead Wrasse	<i>Thalassoma bifasciatum</i>	0	0	0	0	0	2	2	0	0	1	0
FAMILY: PARROTFISHES	SCARIDAE											
Parrotfish	SCARIDAE	0	0	0	0	0	0	0	0	0	0	2
Parrotfish	<i>Sparisoma sp. (juv.)</i>	0	0	0	0	0	0	0	0	0	0	0
FAMILY: BARRACUDAS	SPHYAENIDAE											
Barracuda	<i>Sphyræna barracuda</i>	0	0	0	0	0	0	0	0	0	0	0

Table 4: Continued

FISHES: EXPERIMENTAL 2		DATE SAMPLED										
COMMON NAME	SCIENTIFIC NAME	4-7-93	4-12-93	4-20-93	4-27-93	5-8-93	5-22-93	6-9-93	6-23-93	7-7-93	7-22-93	8-6-93
FAMILY: CLINIDS	CLINIDAE											
Clinid	Clinidae A	0	0	0	0	0	1	0	0	0	2	0
Clinid	Clinidae B	0	0	0	0	0	0	0	0	0	0	0
FAMILY: COMBTOOTH BLENNIE	BLENNIDAE											
Redlip Blenny	<i>Ophioblennius atlanticus</i>	0	0	0	0	0	0	0	0	0	0	0
FAMILY: GOBIES	GOBIIDAE											
Neon Goby	<i>Gobiosoma oceanops</i>	0	0	0	0	1	0	0	0	0	0	0
Bridled Goby	<i>Coryphopterus glaucofraenum</i>	0	0	0	0	0	0	0	0	0	0	6
Goby	Gobiidae A	0	0	1	0	0	0	0	0	0	0	0
Goby	Gobiidae B	0	0	0	0	0	0	0	0	0	0	0
FAMILY: SURGEONFISHES	ACANTHURIDAE											
Ocean Surgeon	<i>Acanthurus bahianus</i>	2	17	0	10	35	2	4	3	5	10	3
Doctorfish	<i>Acanthurus chirurgus</i>	0	0	0	0	0	0	2	0	1	0	2
FAMILY: LEFTEYE FLOUNDERS	BOTHIDAE											
Gulf Flounder	<i>Paralichthys albigutta</i>	0	0	0	0	0	0	0	0	0	0	0
FAMILY: LEATHERJACKETS	BALISTIDAE											
Filefish	<i>Aluterus sp.</i>	0	1	0	0	0	0	0	0	0	0	0
Orangespotted Filefish	<i>Cantherhines pullus</i>	0	0	0	0	0	0	0	0	0	0	0
Whitespotted Filefish	<i>Cantherhines macrocerus</i>	0	0	0	0	0	2	0	0	0	0	0
Queen Trigger	<i>Balistes vetula</i>	0	1	1	0	0	1	2	1	0	0	0
FAMILY: PUFFERS	TETRAODONTIDAE											
Sharpnose Puffer	<i>Canthigaster rostrata</i>	0	0	0	0	0	0	0	0	1	0	2
Unidentified Juveniles	UNID. JUVENILES	0	0	0	0	100	0	0	0	0	0	0

Table 4: Continued

REEFS	DATE SAMPLED										
	4-8-93	4-12-9	4-20-9	4-27-9	5-8-93	5-22-9	6-9-93	6-23-9	7-7-93	7-22-9	8-6-93
CONTROL 1											
NO. SPECIES	5	5	7	6	9	16	14	18	17	20	17
NO. FISH	13	20	64	12	66	457	174	237	93	252	226
DIVERSITY	0.6159	0.5052	0.3683	0.6687	0.5842	0.4512	0.3196	0.3445	0.7544	0.4382	0.2838
VARIANCE	0.0056	0.0058	0.0042	0.0077	0.0030	0.0006	0.0024	0.0018	0.0039	0.0019	0.0019
CONTROL 2											
NO. SPECIES	6	3	9	7	9	13	14	15	18	18	15
NO. FISH	10	65	185	310	89	87	129	129	90	116	52
DIVERSITY	0.7592	0.2848	0.3612	0.0856	0.6071	0.6504	0.4481	0.4721	0.7979	0.7761	0.9358
VARIANCE	0.0014	0.0017	0.0018	0.0005	0.0025	0.0037	0.0033	0.0036	0.0045	0.0030	0.0042
EXP. 1											
NO. SPECIES	5	3	12	7	10	15	18	14	19	21	16
NO. FISH	22	11	62	224	186	383	435	537	1043	350	62
DIVERSITY	0.3154	0.3299	0.9058	0.2125	0.3733	0.3802	0.4895	0.1747	0.1196	0.3399	0.9160
VARIANCE	0.0107	0.0094	0.0019	0.0010	0.0018	0.0009	0.0006	0.0005	0.0002	0.0013	0.0041
EXP. 2											
NO. SPECIES	7	7	8	12	11	14	16	13	15	16	22
NO. FISH	109	126	519	237	469	235	340	236	147	279	259
DIVERSITY	0.186	0.3232	0.0932	0.318	0.4621	0.3119	0.2853	0.3027	0.5483	0.5099	0.4942
VARIANCE	0.0023	0.0019	0.0003	0.0015	0.0005	0.0016	0.0012	0.0014	0.0027	0.0014	0.002

Table 5: Shannon index of diversity for each reef and sample date.

TESTS	DATES SAMPLED										
	4-8-93	4-12-93	4-20-93	4-27-93	5-8-93	5-22-93	6-9-93	6-23-93	7-7-93	7-22-93	8-6-93
C1-C2											
t	-1.703	2.540	0.092	6.454	-0.310	-3.048	-1.707	-1.733	-0.474	-4.813	-8.403
v (DF)	18.925	32.520	122.018	13.605	145.756	117.810	276.188	255.504	181.483	262.253	103.977
E1-E2											
t	1.138	0.063	17.409	-2.110	-1.842	1.366	4.787	-2.876	-7.966	-3.222	5.397
v (DF)	32.057	15.711	83.953	452.626	286.573	488.020	645.823	419.404	173.894	615.249	132.133
C1-E1											
t	2.355	1.421	-6.917	4.889	3.028	1.811	-3.102	3.508	9.863	1.721	-8.217
v (DF)	34.902	23.846	111.172	15.482	151.915	773.160	268.784	384.330	104.483	538.053	124.484
C1-E2											
t	4.837	2.077	4.110	3.672	2.070	2.977	0.574	0.734	2.542	-1.237	-3.367
v (DF)	25.078	34.166	73.800	16.963	88.286	419.457	348.670	467.369	203.210	511.800	484.812
C2-E1											
t	4.034	-0.428	-9.037	-3.229	3.565	3.990	-0.662	4.617	9.816	6.613	0.218
v (DF)	27.283	15.262	180.367	419.180	215.254	134.560	180.194	169.436	99.528	227.613	112.866
C2-E2											
t	9.404	-0.644	5.885	-5.257	2.679	4.677	2.431	2.383	2.942	3.990	5.605
v (DF)	53.643	175.944	252.851	391.550	126.008	166.806	229.099	232.374	187.082	231.711	110.320

Table 6: Hutcheson t-test comparisons of Shannon diversity indices by sample date. Comparisons listed in left column (i.e. C1-C2 compares Control Reef 1 to Control Reef 2). Statistically significant t values are bolded.

REEFS	DATES SAMPLED										
	4-7-93	4-12-9	4-20-9	4-27-9	5-8-93	5-22-9	6-9-93	6-23-9	7-7-93	7-22-9	8-6-93
CONTROL 1											
NO. SPECIES	5	5	7	6	9	16	14	18	17	20	17
NO. FISH	13	10	14	12	36	42	24	37	43	52	26
DIVERSITY	0.616	0.408	0.641	0.669	0.522	0.927	1.054	1.002	0.983	1.052	1.120
VARIANCE	0.006	0.015	0.008	0.008	0.008	0.004	0.002	0.005	0.005	0.004	0.003
CONTROL 2											
NO. SPECIES	6	3	9	7	9	13	14	15	18	18	15
NO. FISH	10	15	35	10	39	37	29	29	40	56	47
DIVERSITY	0.759	0.217	0.796	0.736	0.706	0.833	0.964	1.070	1.124	0.985	0.883
VARIANCE	0.001	0.004	0.002	0.004	0.003	0.006	0.005	0.002	0.002	0.003	0.005
EXP. 1											
NO. SPECIES	5	3	12	7	10	15	18	14	19	21	16
NO. FISH	22	11	52	24	36	33	35	37	43	50	62
DIVERSITY	0.315	0.330	0.851	0.603	0.826	1.044	1.132	0.955	1.091	1.133	0.916
VARIANCE	0.011	0.009	0.003	0.005	0.003	0.002	0.002	0.004	0.003	0.003	0.004
EXP. 2											
NO. SPECIES	7	7	8	12	11	14	16	13	15	16	22
NO. FISH	9	26	19	37	59	35	40	36	47	79	59
DIVERSITY	0.754	0.495	0.683	0.832	0.612	0.867	1.088	0.768	0.864	0.887	1.146
VARIANCE	0.002	0.008	0.007	0.004	0.004	0.007	0.002	0.008	0.005	0.003	0.003

Table 7: Shannon index of diversity for each reef and sample date.
Grunt juveniles have been excluded from the computations.

TESTS	DATES SAMPLED											
	4-8-93	4-12-93	4-20-93	4-27-93	5-8-93	5-22-93	6-9-93	6-23-93	7-7-93	7-22-93	8-6-93	
C1-C2												
t	-1.703	1.391	-1.569	-0.641	-1.764	0.937	1.087	-0.778	-1.709	0.774	2.573	
v (DF)	18.925	15.149	21.902	20.378	62.629	75.031	49.224	61.100	76.384	105.800	72.443	
E1-E2												
t	-3.859	-1.253	1.750	-2.469	2.594	1.899	0.752	1.704	2.399	3.149	-2.814	
v (DF)	29.076	28.712	34.810	55.565	94.959	50.068	74.992	64.616	87.266	119.239	116.844	
C1-E1												
t	2.355	0.503	-2.077	0.592	-3.020	-1.549	-1.267	0.485	-1.205	-0.932	2.364	
v (DF)	34.902	19.497	24.335	26.282	57.472	68.085	53.053	72.092	84.606	100.635	78.662	
C1-E2												
t	-1.552	-0.570	-0.353	-1.518	-0.821	0.564	-0.524	2.009	1.193	1.963	-0.345	
v (DF)	20.670	21.077	31.400	25.213	73.849	68.350	57.830	69.959	89.764	112.664	65.112	
C2-E1												
t	4.034	-0.977	-0.816	1.475	-1.586	-2.451	-2.113	1.462	0.435	-1.819	-0.343	
v (DF)	27.283	19.495	86.420	31.314	74.475	55.751	47.756	64.798	80.540	105.921	102.534	
C2-E2												
t	0.093	-2.556	1.206	-1.108	1.083	-0.296	-1.520	2.963	2.955	1.234	-2.996	
v (DF)	17.739	40.752	30.995	33.436	97.619	70.814	51.053	54.110	78.295	126.611	89.268	

Table 8: Hutcheson t-test comparisons of Shannon diversity indices by date. Statistically significant t values are bolded. Grunt juveniles have been excluded from the computations.

Phylum: Sarcomastigophora

Subphylum: Sarcodina

Order: Foraminiferida

White encrusting foram

White filamentous foram

Phylum: Porifera (Sponges)

Unidentified red encrusting sponge

Unidentified grey encrusting sponge

Unidentified black encrusting sponge

Phylum: Cnidaria

Class: Hydrozoa (Hydroids)

Order: Hydroida

Suborder: Leptomedusae (Thecate hydroid)

Phylum: Annelida (Segmented worms)

Class: Polychaeta

Family: Filogranidae

Filograna huxleyi (Sea Frost)

Family: Sabellidae

Family: Serpulidae

Family: Syllidae

Phylum: Arthropoda

Subphylum: Crustacea

Class: Maxillopoda

Subclass: Copepoda

Order: Harpacticoida

Subclass: Cirripedia (Barnacles)

Family: Balanidae

Balanus amphitrite

Balanus trigonus

Class: Malacostaca

Order: Decapoda

Family: Stenopodidea

Stenopus hispidus (Coral Banded shrimp)

Family: Palinuridae

Panulirus argus (Spiny lobster)

Family: Diogenidae (Hermit crab)

Family: Majidae

Stenorhynchus seticornis (Arrow crab)

Order: Tanaidacea

Order: Amphipoda

Table 9: Total list of invertebrates identified on Control Reef 1

Phylum: Mollusca (Molluscs)

Class: Gastropoda

Family: Crepidulidae

Crepidula aculeata (Slipper shell)

Class: Bivalvia

Family: Arcidae

Family: Pteriidae (Wing oysters)

Pteria colymbus

Pinctada imbricata

Family: Ostreidae (Oyster)

Phylum: Ectoprocta (Bryozoans)

Class: Gymnolaemata

Order: Cheilostomata

Family: Smittinidae

Parasmittina nitida

Family: Cheiloporinidae

Waterspipora subvoidae

Unidentified green encrusting bryozoan

Unidentified orange encrusting bryozoan

Phylum: Echinodermata

Class: Asteroidea

Family: Oreasteridae

Oreaster reticulatus (Cushion sea star)

Phylum: Chordata

Class: Ascidiacea (Tunicates)

Order: Enterogona

Family: Didemnidae (White encrusting)

Order: Pleurogona

Family: Ascidiidae

Ascidia nigra

Pyrura vitta

Family: Styelidae

Botrylus sp.

Orange colonial ascidian

Red colonial ascidian

Grey colonial ascidian

Tiny green solitary ascidian

Table 9: Continued

Phylum: Sarcomastigophora

Subphylum: Sarcodina

Order: Foraminiferida

White entrusting foram

White filamentous foram

Phylum: Porifera (Sponges)

Class: Demospongiae

Family: Aplysinellidae

Pseudoceratina crassa (Branching tube sponge)

Family: Niphatidae

Amphimedon compressa (Erect rope sponge)

Niphates sp.

Unidentified green sponge

Unidentified red encrusting sponge

Unidentified grey encrusting sponge

Unidentified black encrusting sponge

Phylum: Cnideria

Class: Hydrozoa (Hydroids)

Order: Hydroida

Suborder: Leptomedusae (Thecate hydroid)

Suborder: Anthomedusae (Athebate hydroid)

Phylum: Annelida (Segmented worms)

Class: Polychaeta

Family: Filogranidae

Filograna huxleyi (Sea Frost)

Family: Sabellidae

Family: Serpulidae

Family: Syllidae

Family: Nereidae

Phylum: Arthropoda

Subphylum: Crustacea

Class: Maxillopoda

Subclass: Ostracoda

Subclass: Copepoda

Order: Harpacticoida

Subclass: Cirripedia (Barnacles)

Family: Balanidae

Balanus amphitrite

Balanus trigonus

Table 10: Total list of invertebrates identified on Control Reef 2

Class: Malacostaca

Order: Decapoda

Family: Stenopodidea

Stenopus hispidus (Coral banded shrimp)

Family: Palinuridae

Panulirus argus (Spiny lobster)

Family: Diogenidae (Hermit crab)

Family: Majidae

Order: Tanaidacea

Order: Amphipoda

Order: Isopoda

Phylum: Mollusca (Molluscs)

Class: Bivalvia

Family: Arcidae

Family: Pteriidae (Wing oysters)

Pteria colymbus

Family: Ostreidae (Oyster)

Phylum: Ectoprocta (Bryozoans)

Class: Gymnolaemata

Order: Cheilostomata

Family: Schizoporellidae

Schizoporella unicornis

Unidentified green encrusting bryozoan

Unidentified orange encrusting bryozoan

Phylum: Chordata

Class: Ascidiacea (Tunicates)

Order: Enterogona

Family: Didemnidae (White encrusting)

Order: Pleurogona

Family: Ascidiidae

Ascidia nigra

Family: Pyuridae

Pyrura vitta

Boltenia achinata

Family: Styelidae

Brotrylus sp.

Orange colonial ascidian

Red colonial ascidian

Grey colonial ascidian

Tiny green solitary ascidian

Table 10: Continued

Phylum: Sarcomastigophora

Subphylum: Sarcodina

Order: Foraminiferida

White encrusting foram

White filamentous foram

Phylum: Porifera (Sponges)

Class: Demospongiae

Family: Niphatidae

Amphimedon compressa (Erect rope sponge)

Unidentified red encrusting sponge

Unidentified grey encrusting sponge

Unidentified black encrusting sponge

Unidentified blue encrusting sponge

Phylum: Cnideria

Class: Hydrozoa (Hydroids)

Order: Hydroida

Suborder: Leptomedusae (Thecate hydroid)

Phylum: Annelida (Segmented worms)

Class: Polychaeta

Family: Filogranidae

Filograna huxleyi (Sea Frost)

Family: Sabellidae

Family: Serpulidae

Family: Syllidae

Family: Nereidae

Phylum: Arthropoda

Subphylum: Crustacea

Class: Maxillopoda

Subclass: Copepoda

Order: Harpacticoida

Subclass: Cirripedia (Barnacles)

Family: Balanidae

Balanus amphitrite

Balanus trigonus

Class: Malacostaca

Order: Decapoda

Family: Stenopodidea

Stenopus hispidus (Coral Banded shrimp)

Table 11: Total list of invertebrates identified on Experimental Reef 1

-
- Family: Palinuridae
 - Panulirus argus* (Spiny lobster)
 - Family: Diogenidae (Hermit crab)
 - Family: Majidae
 - Mithrax sp.*
 - Stenorhynchus seticornis* (Arrow crab)
 - Family: Grapsidae
 - Percnon gibbesi* (Nimble spray crab)
 - Order: Tanaidacea
 - Order: Amphipoda
 - Order: Isopoda

 - Phylum: Mollusca (Molluscs)
 - Class: Bivalvia
 - Family: Arcidae
 - Family: Pectinidae (Scallop)
 - Lyropecten antillarum*
 - Family: Ostreidae (Oyster)

 - Phylum: Ectoprocta (Bryozoans)
 - Class: Gymnolaemata
 - Order: Cheilostomata
 - Unidentified green encrusting bryozoan
 - Unidentified orange encrusting bryozoan
 - Order: Ctenostomata
 - Family: Vesiculariidae
 - Amathia alternata*

 - Phylum: Chordata
 - Class: Ascidiacea (Tunicates)
 - Order: Enterogona
 - Family: Didemnidae (White encrusting)
 - Order: Pleurogona
 - Family: Ascidiidae
 - Ascidia nigra*
 - Symplegma viride*
 - Family: Styelidae
 - Brotylus sp.*
 - Orange colonial ascidian
 - Red colonial ascidian
 - Grey colonial ascidian
 - Tiny green solitary ascidian
-

Table 11: Continued

Phylum: Sarcomastigophora

Subphylum: Sarcodina

Order: Foraminiferida

White encrusting foram

White filamentous foram

Phylum: Porifera (Sponges)

Class: Demospongiae

Family: Desmacidonidae

Iotrochota birotulata (Green finger sponge)

Unidentified red encrusting sponge

Unidentified orange encrusting sponge

Unidentified black encrusting sponge

Unidentified blue encrusting sponge

Phylum: Cnidaria

Class: Hydrozoa (Hydroids)

Order: Hydroida

Suborder: Leptomedusae (Thecate hydroid)

Phylum: Annelida (Segmented worms)

Class: Polychaeta

Family: Filogranidae

Filograna huxleyi (Sea Frost)

Family: Sabellidae

Family: Serpulidae

Family: Syllidae

Family: Eunicidae

Family: Opheliidae

Armandia maculata

Family: Cirratulidae

Phylum: Arthropoda

Subphylum: Crustacea

Class: Maxillopoda

Subclass: Ostracada

Subclass: Copepoda

Order: Harpacticoida

Subclass: Cirripedia (Barnacles)

Family: Balanidae

Balanus amphitrite

Balanus trigonus

Table 12: Total list of invertebrates identified on Experimental Reef 2

Class: Malacostaca

Order: Decapoda

Family: Stenopodidea

Stenopus hispidus (Coral Banded shrimp)

Family: Palinuridae

Panulirus argus (Spiny lobster)

Family: Diogenidae (Hermit crab)

Family: Majidae

Mithrax sp.

Stenorhynchus seticornis (Arrow crab)

Order: Tanaidacea

Order: Amphipoda

Order: Isopoda

Phylum: Mollusca (Molluscs)

Class: Bivalvia

Family: Arcidae

Family: Ostreidae (Oyster)

Phylum: Ectoprocta (Bryozoans)

Class: Gymnolaemata

Order: Cheilostomata

Unidentified green encrusting bryozoan

Unidentified orange encrusting bryozoan

Phylum: Echinodermata

Class: Ophiuroidea (Brittle star)

Phylum: Chordata

Class: Ascidiacea (Tunicates)

Order: Enterogona

Family: Didemnidae (White encrusting)

Order: Pleurogona

Family: Ascidiidae

Ascidia nigra

Symplegma viride

Orange solitary ascidian

Red colonial ascidian

Grey colonial ascidian

Tiny green solitary ascidian

Table 12: Continued

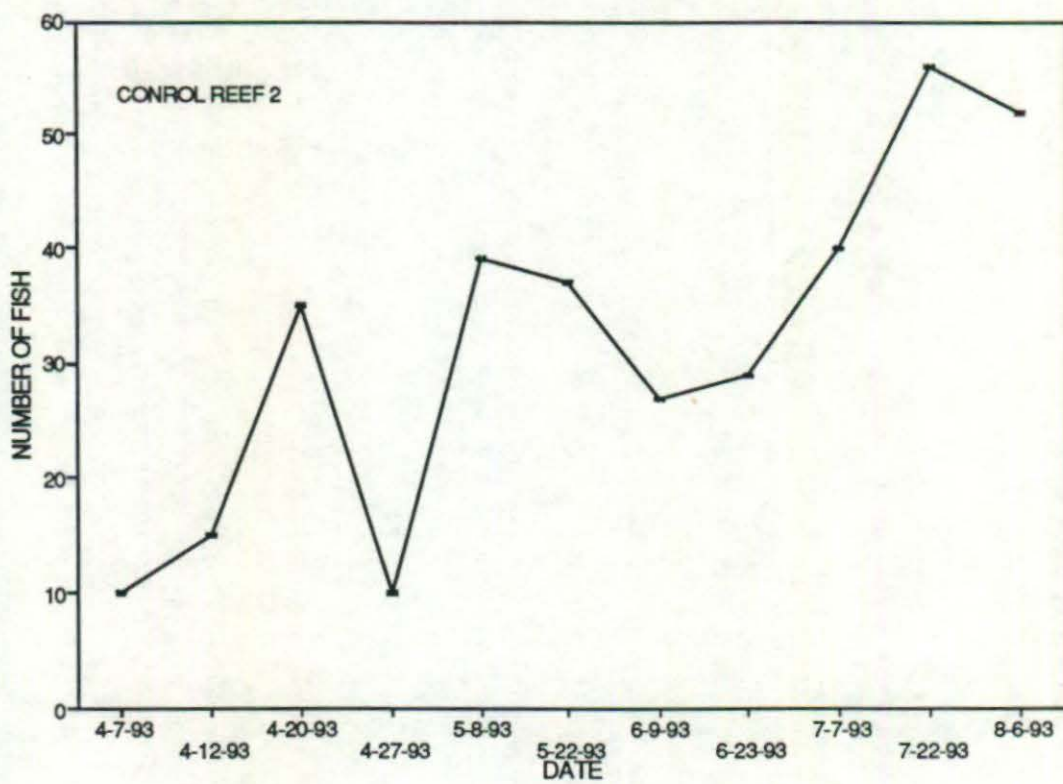
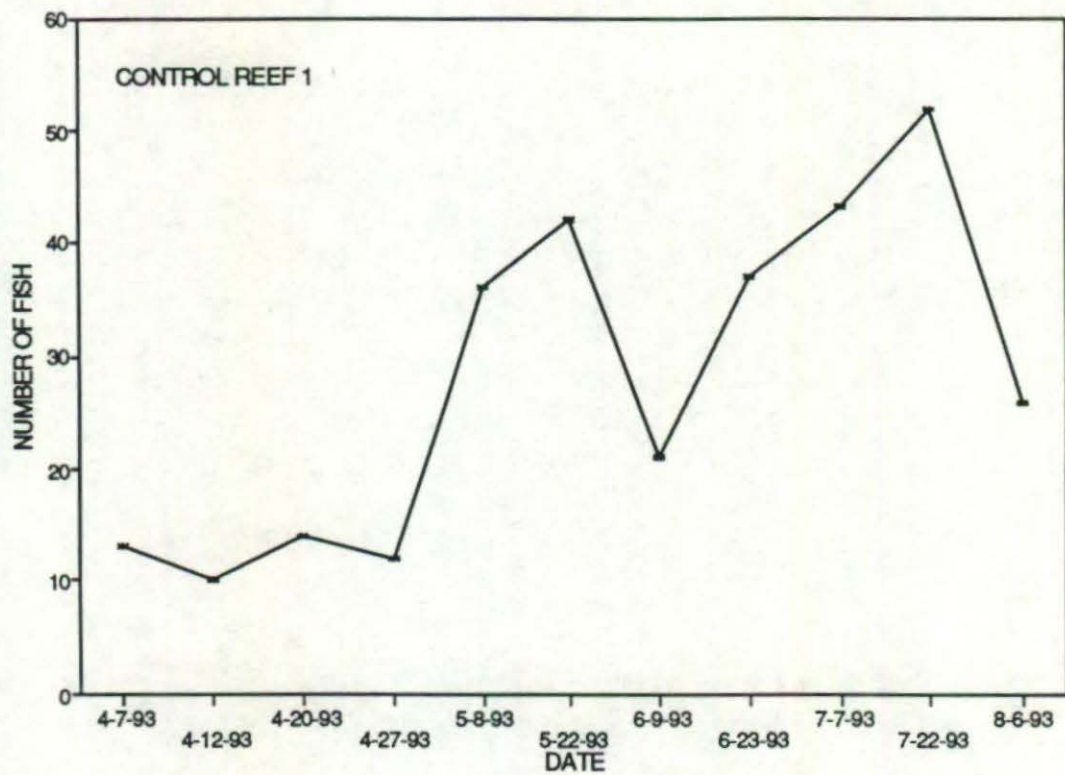


Figure 1: Total number of fishes counted on each reef and sampling date.

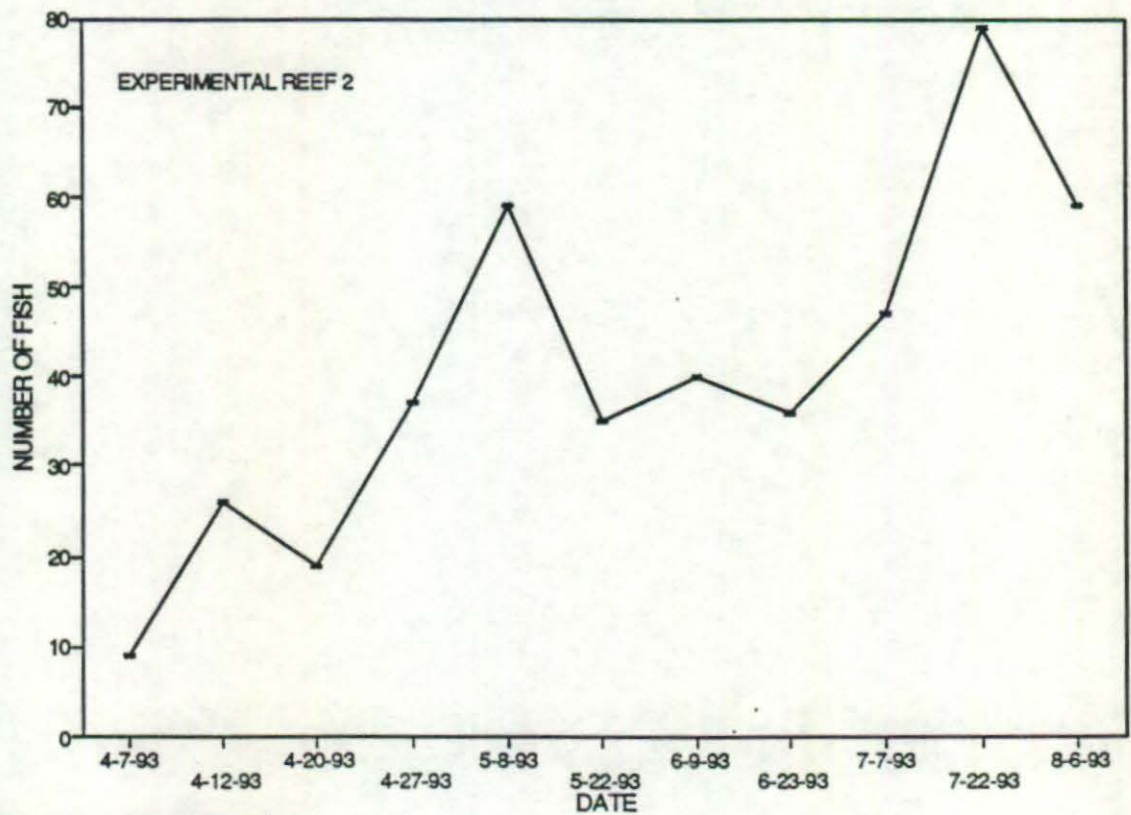
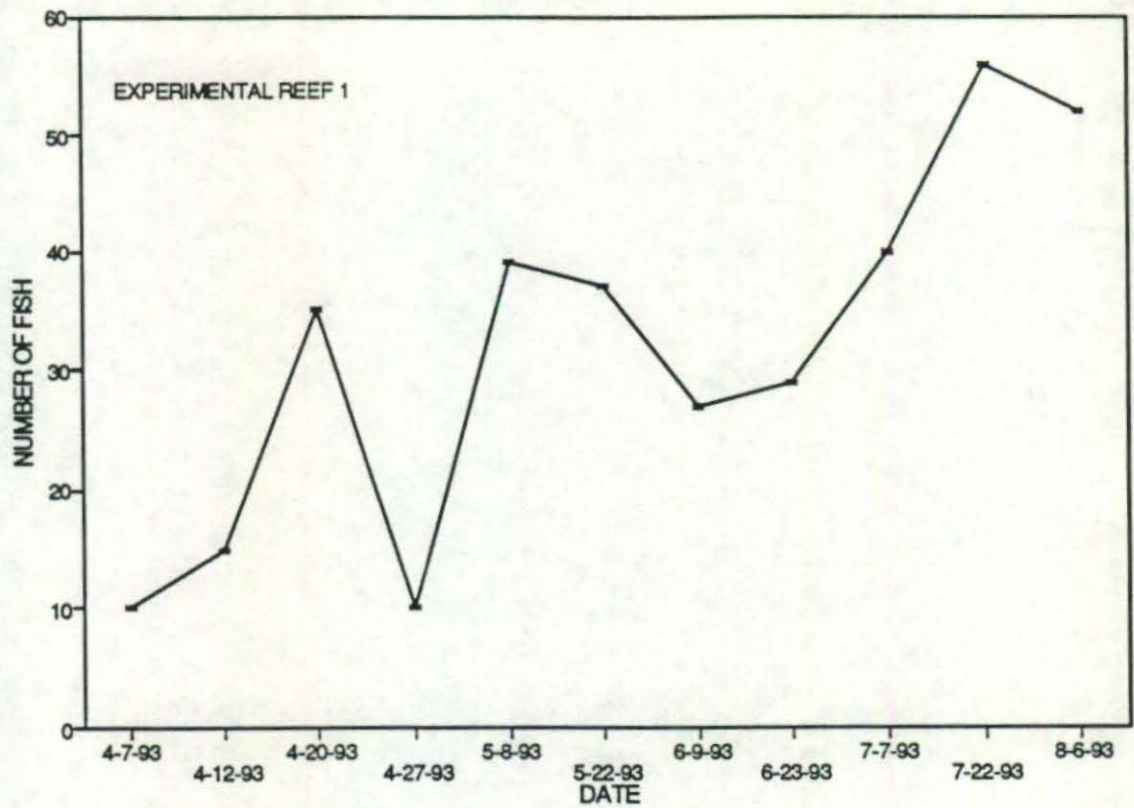


Figure 1: Continued

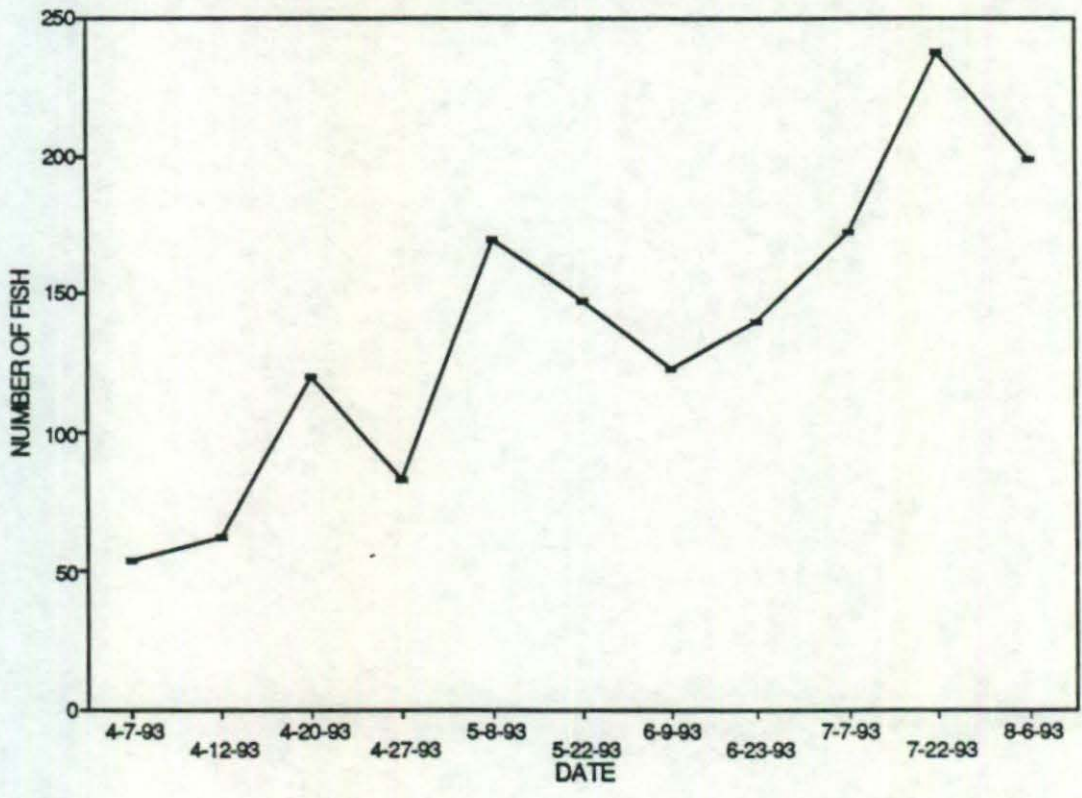


Figure 2: Total number of fishes (all species and reefs combined) on each sample date.

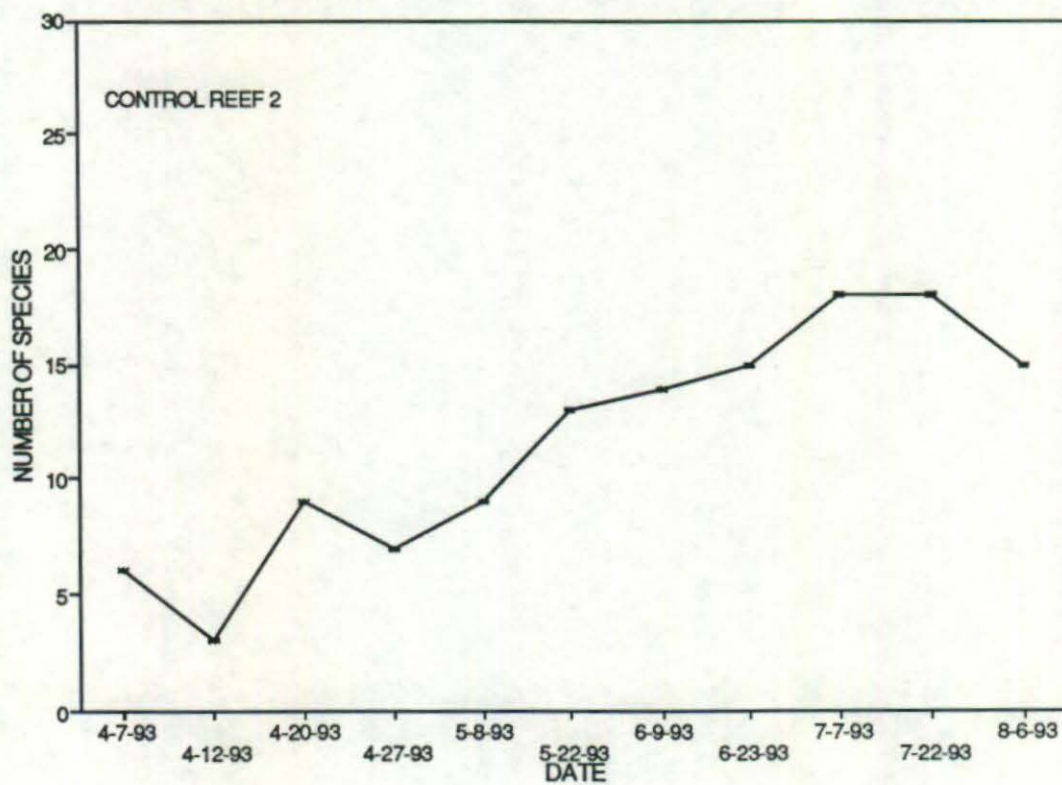
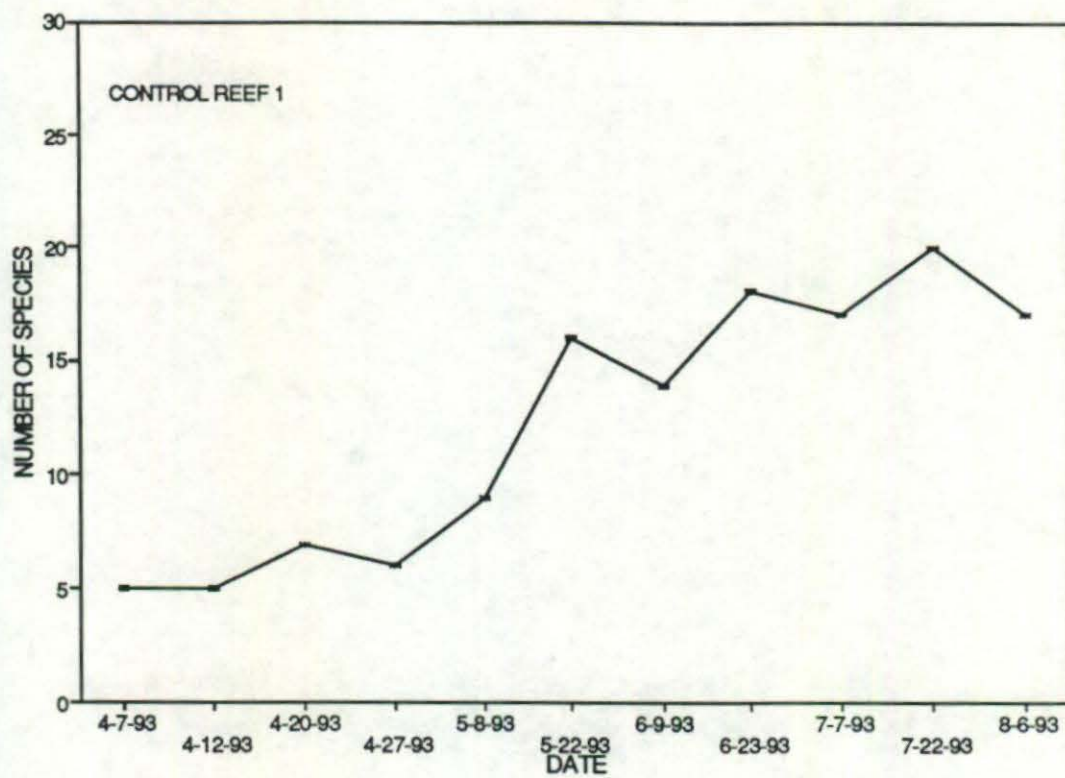


Figure 3: Number of species found on each reef and sample date.

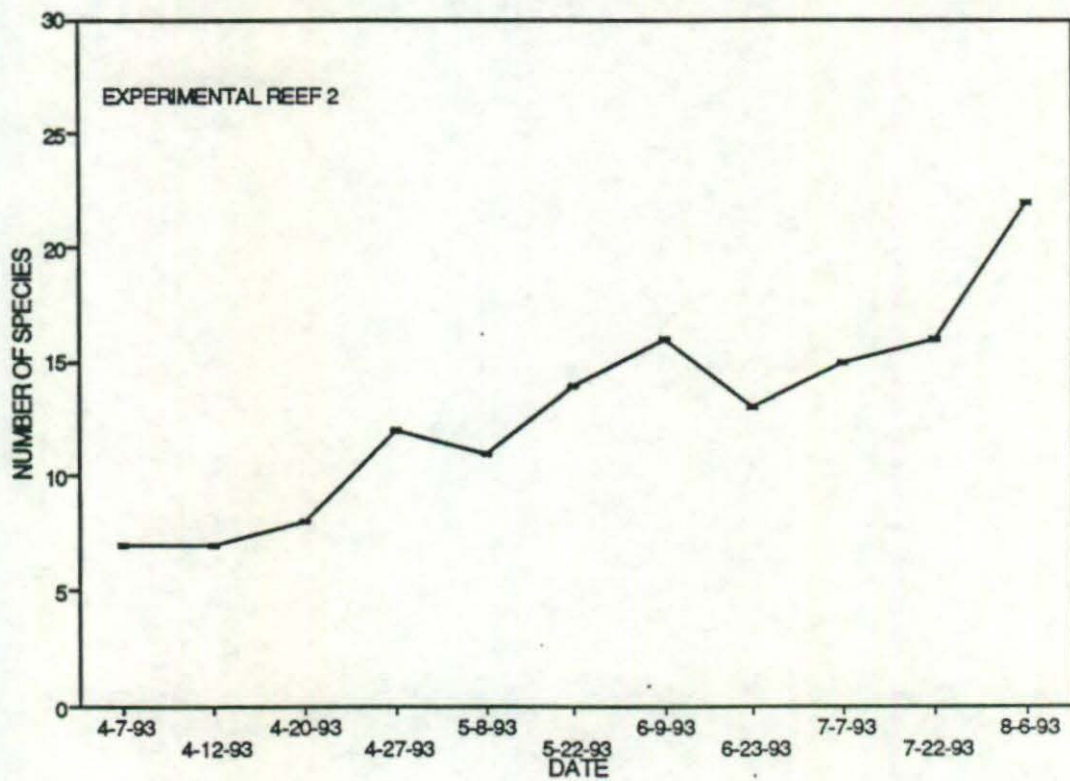
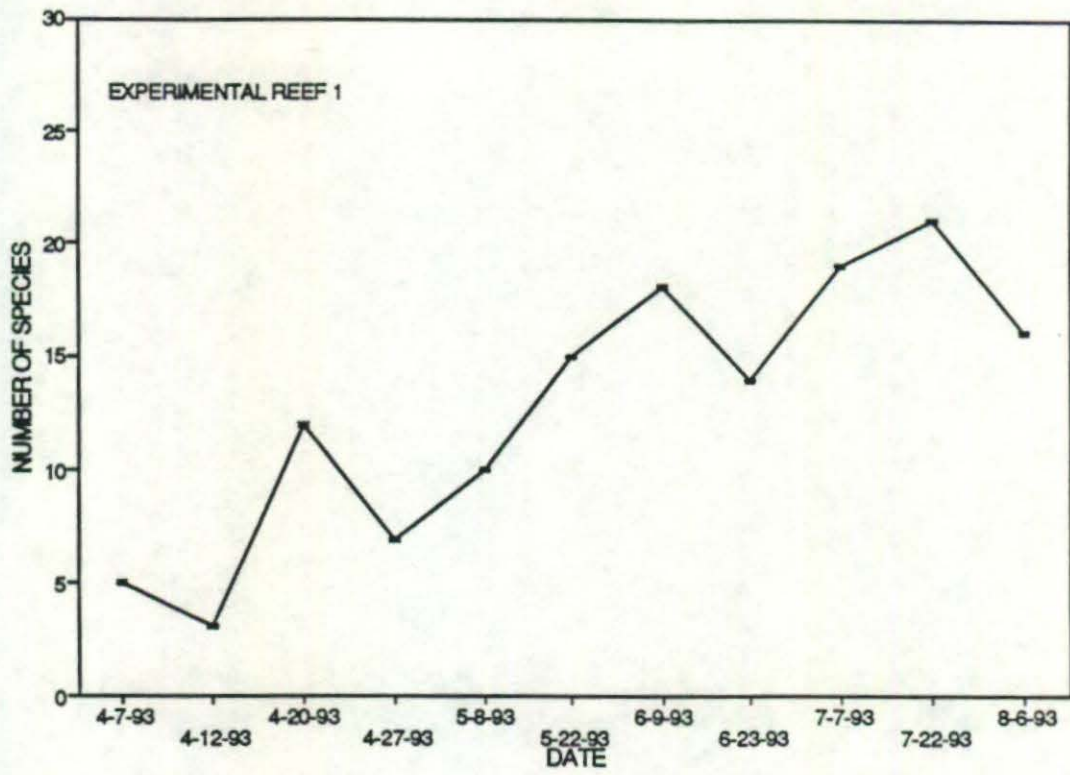


Figure 3: Continued

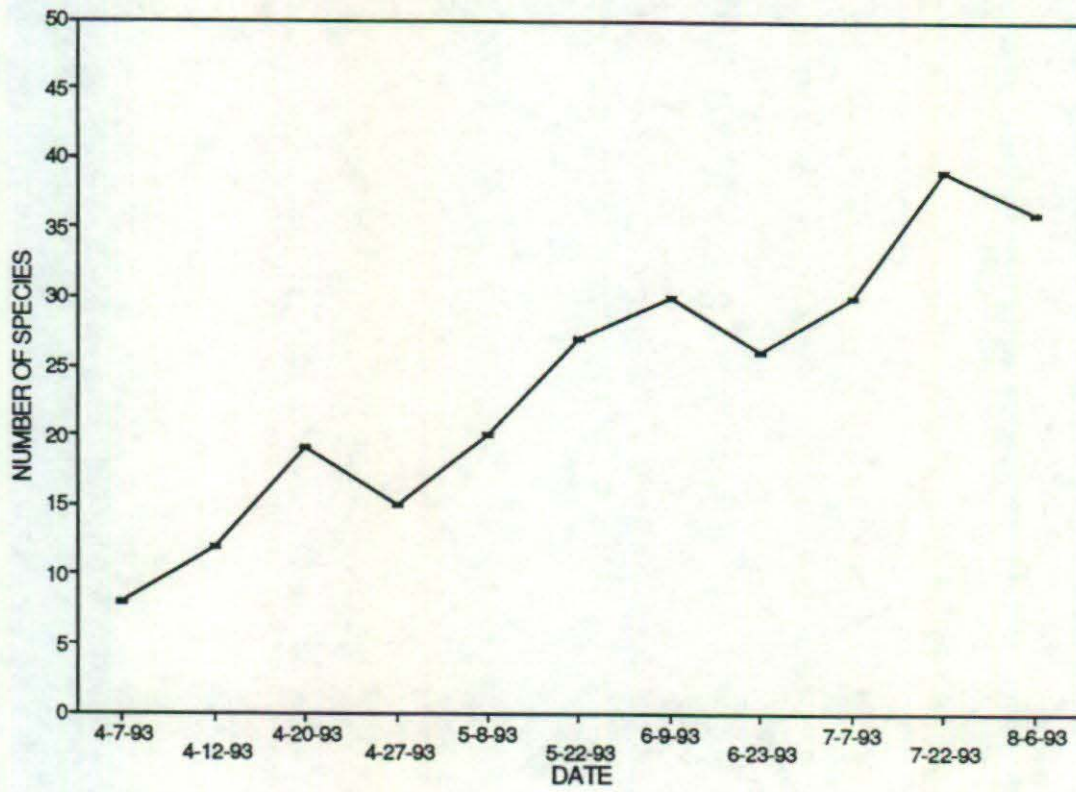


Figure 4: Total number of species (all reefs combined) found on each sample date.

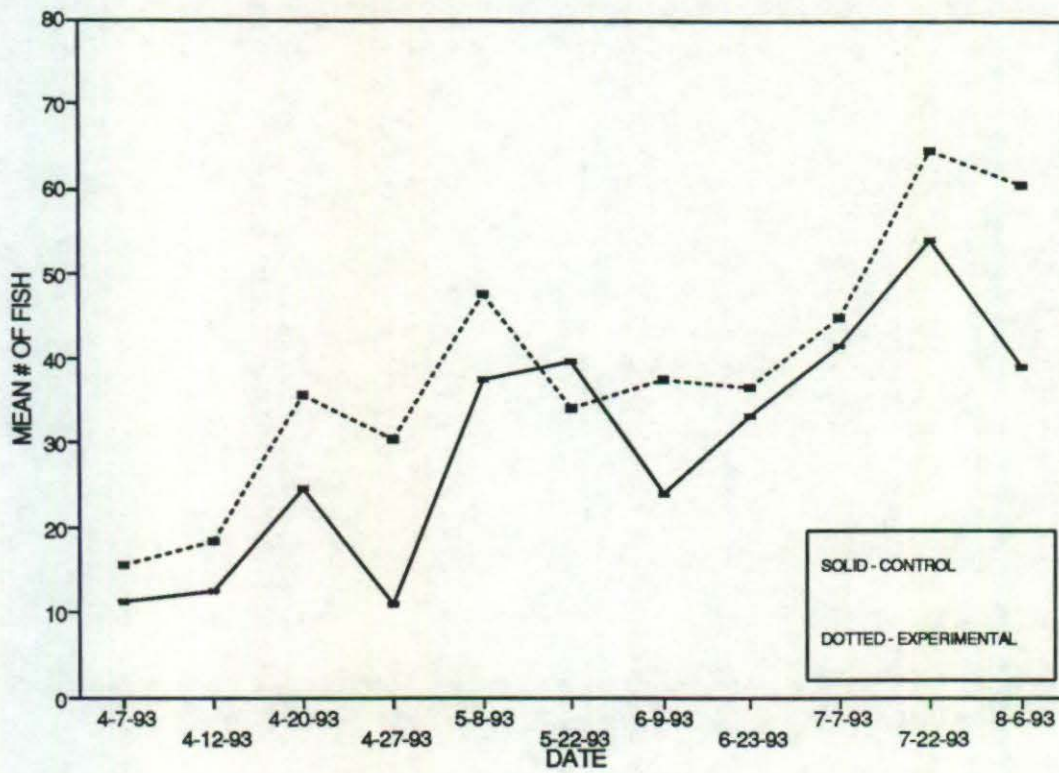


Figure 5: Mean number of fishes (all species combined) found on control and experimental reefs by sample date. Replicate reefs have been combined.

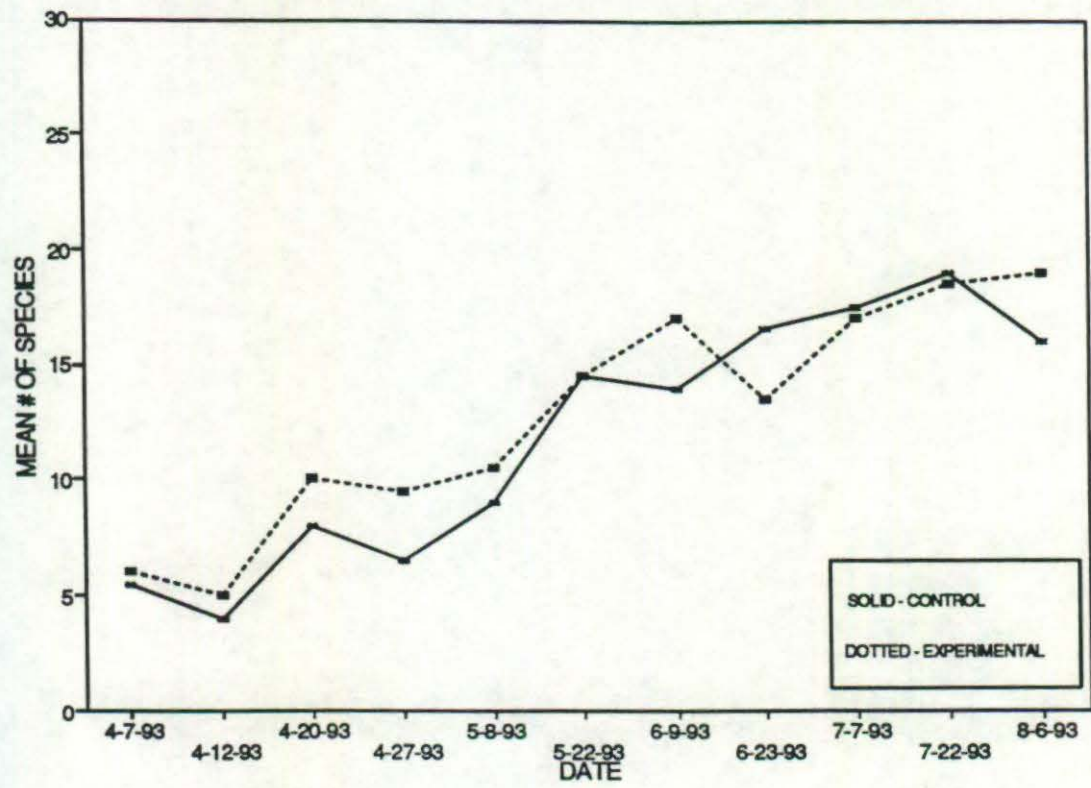


Figure 6: Mean number of species found on control and experimental reefs by date. Replicate reefs have been combined.

APPENDIX II (Second Grant Cycle, September 1993-August 1994)

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Photo 13: Photograph of a tire-concrete reef (E1) and some associated biota taken August, 1994.

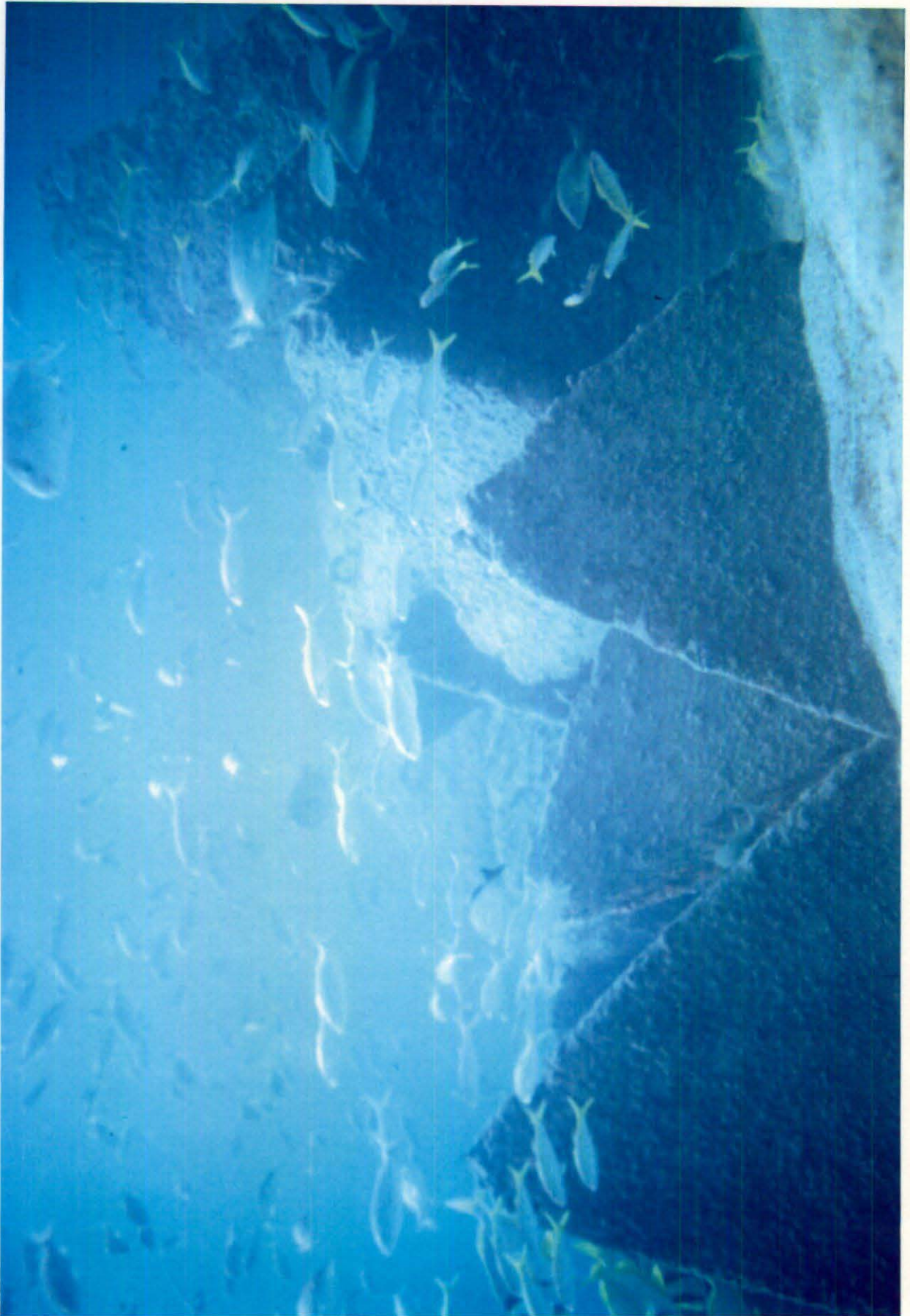


Photo 14: Photograph of a tire-concrete reef (E2) and some associated biota taken August, 1994.



Photo 15: Photograph of a gravel-concrete reef (C1) and some associated biota taken August, 1994.

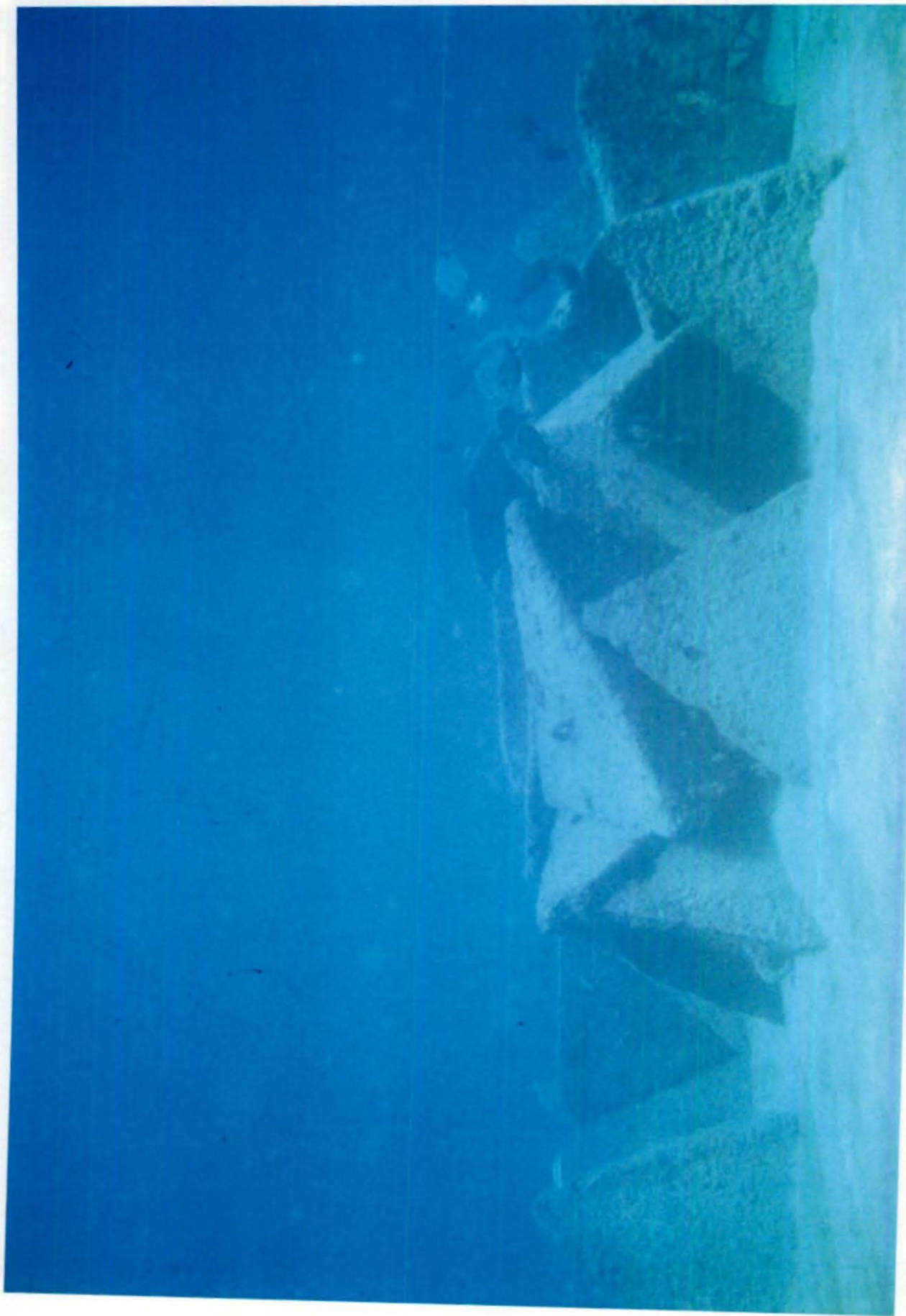


Photo 16: Photograph of a gravel-concrete reef (C2) and some associated biota taken August, 1994.

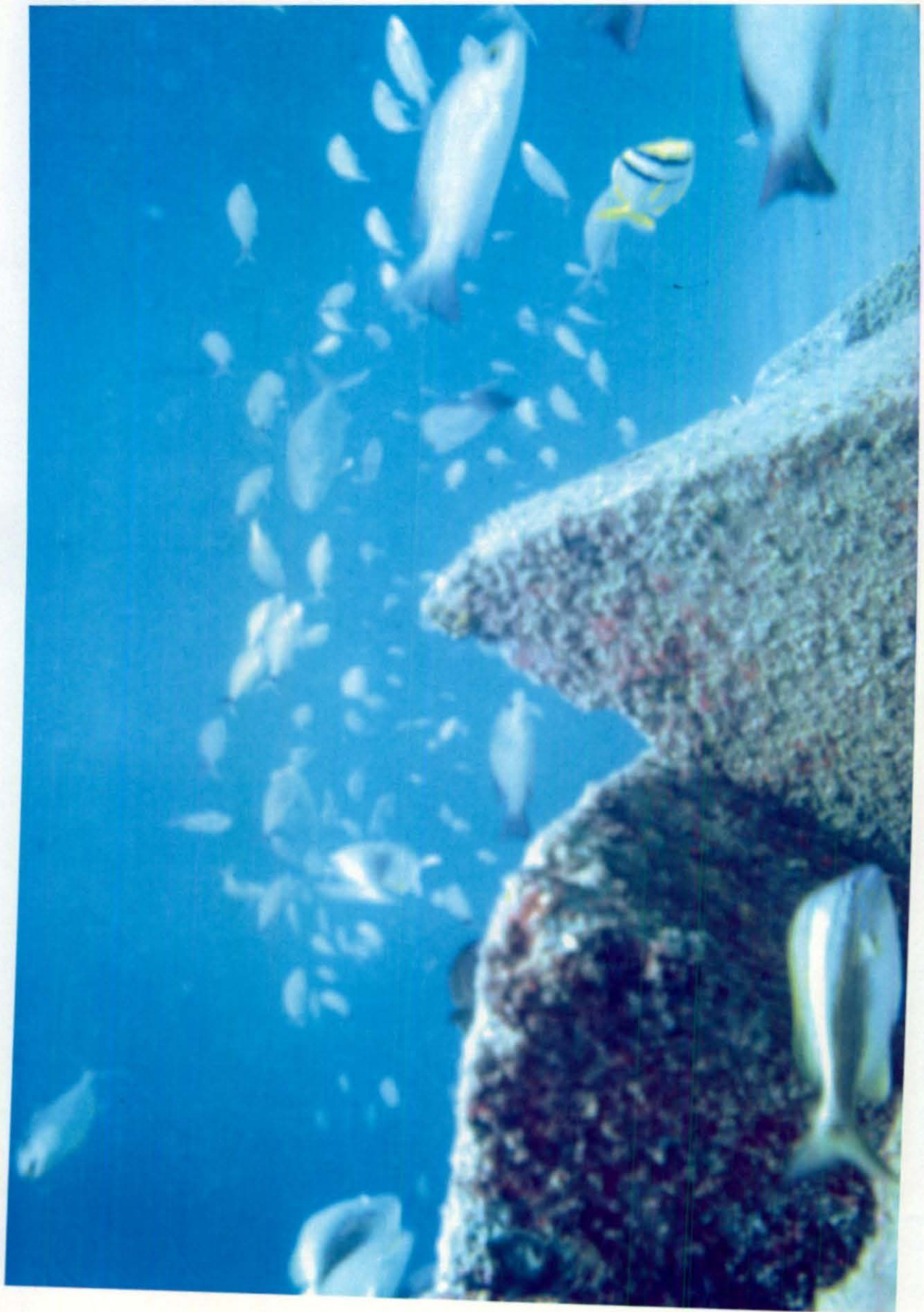


Photo 17: Photomicrographs of miniature modules made of tire-concrete. The numerals in the upper left hand corners indicate the number of days post-deployment when the miniatures were collected.

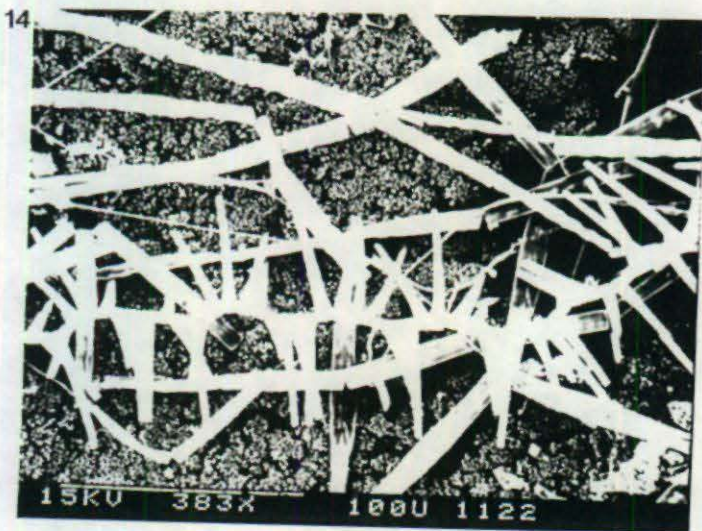
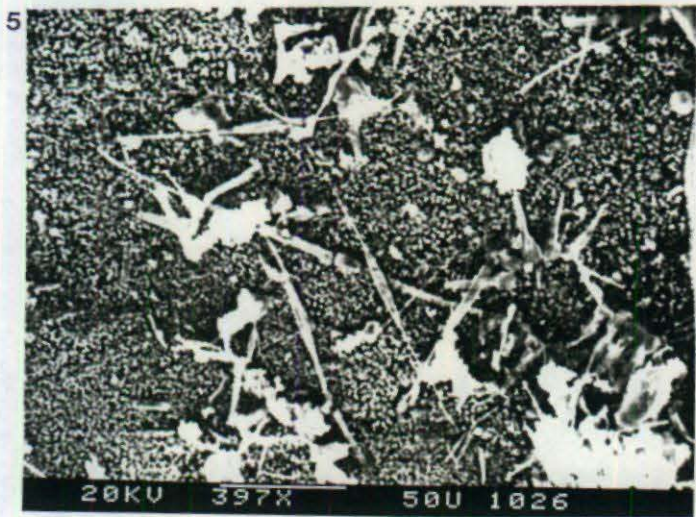
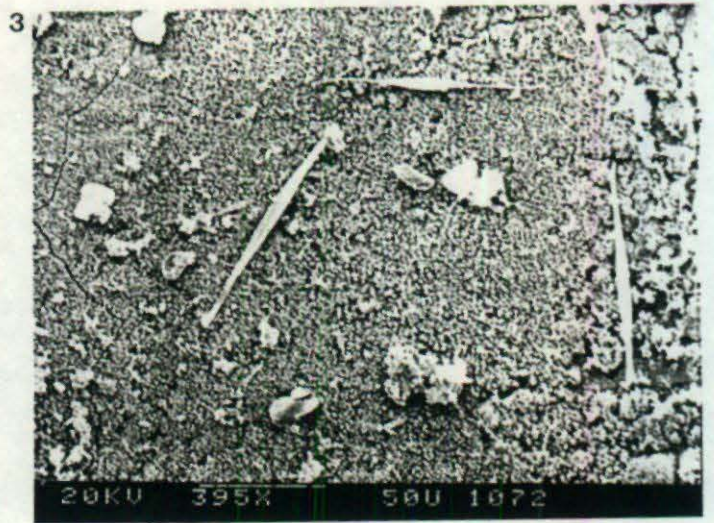
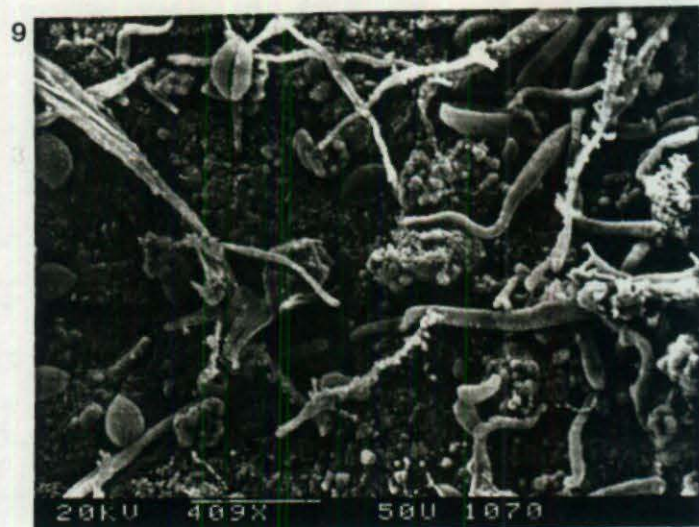
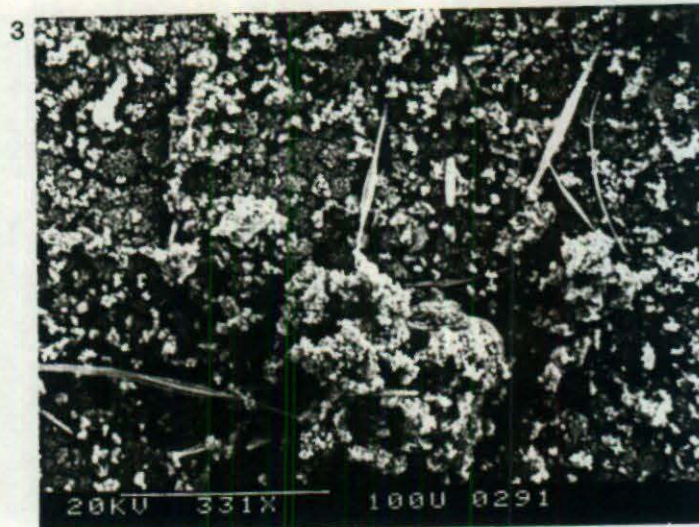
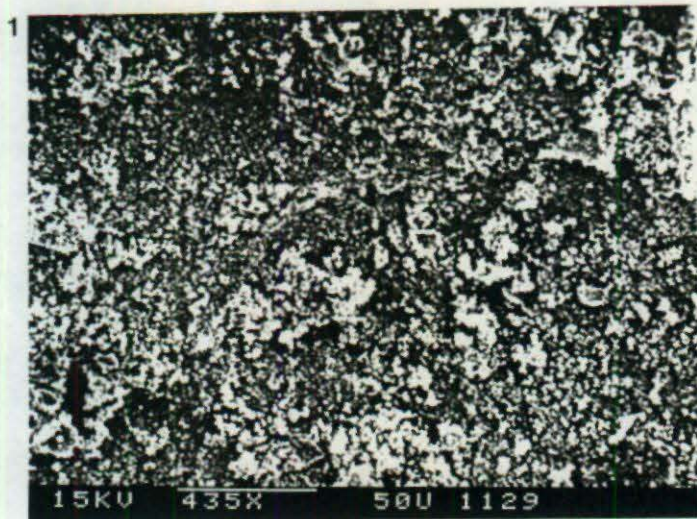


Photo 18: Photomicrographs of miniature modules made of gravel-concrete. The numerals in the upper left hand corners indicate the number of days post-deployment when the miniatures were collected.



FISHES: CONTROL REEF 1		DATE SAMPLED											
COMMON NAME	SCIENTIFIC NAME	9-10-93	10-28-93	11-19-93	12-5-93	1-30-94	2-12-94	3-18-94	4-4-94	5-10-94	6-24-94	7-17-94	8-6-94
FAMILY: STINGRAY	DASYATIDAE												
Southern stingray	<i>Dasyatis americana</i>	0	1	0	0	0	0	0	0	1	0	0	0
FAMILY: MORAY EELS	MURAENIDAE												
Green Moray	<i>Gymnothorax funebris</i>	0	0	0	0	0	0	0	0	0	0	0	0
Spotted Moray	<i>Gymnothorax moringa</i>	0	0	0	0	0	0	0	0	0	0	0	0
Purplemouth Moray	<i>Gymnothorax vicinus</i>	2	1	0	1	0	1	0	1	1	0	1	0
FAMILY: HERRINGS	CLUPEIDAE												
Clupeid	Clupeid	0	0	0	0	0	0	0	100	0	0	0	0
FAMILY: SQUIRRELFISHES	HOLOCENTRIDAE												
Blackbar soldierfish	<i>Myripristis jacobus</i>	0	0	0	0	0	0	0	1	0	0	0	0
Squirrelfish	<i>Holocentrus ascensionis</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: TRUMPETFISHES	AULOSTOMIDAE												
Trumpetfish	<i>Aulostomus maculatus</i>	0	0	0	0	0	0	0	0	0	1	0	0
FAMILY: SEA BASSES	SERRANIDAE												
Black Grouper	<i>Mycteroperca bonaci</i>	2	1	1	1	1	1	0	1	1	1	1	0
Gag	<i>Mycteroperca microlepis</i>	0	0	0	0	0	1	0	0	0	0	0	0
Sand Perch	<i>Diplectum formosum</i>	1	1	0	0	0	0	1	0	0	0	0	0
Harlequin Bass	<i>Serranus tigrinus</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: CARDINALFISHES	APOGONIDAE												
Cardinalfish	<i>Apogon sp.</i>	0	0	0	0	0	0	0	0	0	0	0	0
Flamefish	<i>Apogon maculatus</i>	0	0	3	3	1	0	1	1	3	0	1	2
Twospot Cardinalfish	<i>Apogon pseudomaculatus</i>	3	4	0	0	2	3	0	0	0	0	1	1
FAMILY: JACKS	CARANGIDAE												
Amberjack	<i>Seriola dumerili</i>	0	0	0	0	0	0	0	0	0	0	0	0
Blue Runner	<i>Caranx crysos</i>	0	0	0	0	0	0	0	0	0	0	0	0
Bar Jack	<i>Caranx ruber</i>	0	0	1	0	0	0	0	0	2	0	0	0
Yellow Jack	<i>Caranx bartholomaei</i>	1	0	0	0	0	0	0	0	0	0	0	0
FAMILY: SNAPPERS	LUTJANIDAE												
Yellowtail Snapper	<i>Ocyurus chrysurus</i>	0	1	0	0	0	0	0	0	0	1	1	0
Mahogany Snapper	<i>Lutjanus mahogani</i>	0	0	0	0	0	0	0	0	0	0	0	0
Grey Snapper	<i>Lutjanus griseus</i>	25	15	0	0	0	0	1	2	8	1	18	16
Lane Snapper	<i>Lutjanus synagris</i>	3	5	0	0	0	0	0	0	0	0	0	0
Mutton Snapper	<i>Lutjanus analis</i>	0	1	0	0	0	0	0	0	0	0	0	0

Table 13: Year 2 Fishes counted on Control Reef 1

FISHES: CONTROL REEF 1		DATE SAMPLED											
COMMON NAME	SCIENTIFIC NAME	9-10-93	10-28-93	11-19-93	12-5-93	1-30-94	2-12-94	3-18-94	4-4-94	5-10-94	6-24-94	7-17-94	8-6-94
FAMILY: MOJARRAS	GERREIDAE												
Yellowfin Mojarra	<i>Gerres cinereus</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: GRUNTS	HAEMULIDAE												
Cottonwick	<i>Haemulon melanurum</i>	0	2	0	0	0	0	0	0	0	0	0	0
White Grunt	<i>Haemulon plumieri</i>	1	1	2	3	11	2	1	1	1	1	1	2
Tomtates	<i>Haemulon aurolineatum (juv.)</i>	1	3	0	0	0	0	0	40	150	4	3	4
Margate	<i>Haemulon album</i>	0	0	0	0	0	0	0	0	0	0	0	0
French Grunt	<i>Haemulon flavolineatum</i>	0	0	0	1	0	0	0	1	1	0	1	1
Spanish Grunt	<i>Haemulon macrostomum</i>	0	0	0	0	0	0	0	0	0	0	0	0
Bluestripe Grunt	<i>Haemulon sciurus</i>	0	0	0	0	0	0	0	0	0	0	0	0
Sailors Choice	<i>Haemulon parrai</i>	0	0	0	0	0	0	0	0	0	0	0	0
Black Margate	<i>Anisotremus surinamensis</i>	0	0	0	0	0	0	0	0	0	0	0	0
Porkfish	<i>Anisotremus virginicus</i>	2	1	4	1	3	1	0	1	3	1	4	1
Pigfish	<i>Orthopristis chrysoptera</i>	0	0	0	0	0	0	0	0	2	0	0	1
FAMILY: PORGIES	SPARIDAE												
Pinfish	<i>Lagodon rhomboides</i>	0	0	0	0	0	0	0	0	0	0	0	0
Spottail Pinfish	<i>Diplodus holbrooki</i>	0	0	0	0	0	0	0	2	2	0	2	2
Saucereye Porgy	<i>Calamus calamus</i>	0	0	0	0	0	0	0	0	0	0	1	0
Grass Porgy	<i>Calamus arctifrons</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: DRUMS	SCIAENIDAE												
Highhat	<i>Equetus acuminatus</i>	1	0	0	0	0	0	0	1	2	0	0	0
FAMILY: GOATFISHES	MULLIDAE												
Spotted Goatfish	<i>Pseudupeneus maculatus</i>	1	1	0	1	0	0	0	1	1	0	0	2
Yellow Goatfish	<i>Mulloidichthys martinicus</i>	1	1	0	0	0	0	0	0	1	0	0	3
FAMILY: SEA CHUBS	KYPHOSIDAE												
Bermuda Chub	<i>Kyphosus sectatrix</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: SPADEFISHES	EPHIPPIDAE												
Spadefish	<i>Chaetodipterus faber</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: ANGELFISHES	POMACANTHIDAE												
Angelfish Juvenile	<i>Holocanthus sp. (juv.)</i>	0	0	0	0	0	0	0	0	0	0	0	0
Queen Angelfish	<i>Holocanthus ciliaris</i>	0	0	0	0	0	0	0	0	0	0	0	0
Blue Angelfish	<i>Holocanthus bermudensis</i>	0	0	0	0	0	0	0	0	0	0	0	0
French Angelfish	<i>Pomacanthus paru</i>	0	0	0	0	0	0	0	0	0	1	0	1
Grey Angelfish	<i>Pomacanthus arcuatus</i>	0	0	0	0	0	0	0	0	1	0	1	1
Angelfish Juvenile	<i>Pomacanthus sp. (juv.)</i>	0	0	0	0	0	0	0	0	0	0	0	0

Table 13: Continued

FISHES: CONTROL REEF 1		DATE SAMPLED											
COMMON NAME	SCIENTIFIC NAME	9-10-93	10-28-93	11-19-93	12-5-93	1-30-94	2-12-94	3-18-94	4-4-94	5-10-94	6-24-94	7-17-94	8-6-94
FAMILY: DAMSELFISHES	POMACENTRIDAE												
Dusky Damselfish	<i>Stegastes fuscus</i>	0	0	0	0	0	0	0	0	0	0	0	0
Threespot Damselfish	<i>Stegastes planifrons</i>	0	0	0	0	0	0	0	0	0	0	0	0
Cocoa Damselfish	<i>Stegastes variabilis</i>	0	0	0	0	0	0	0	0	0	0	0	0
Blue Chromis	<i>Chromis cyanis</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: WRASSES	LABRIDAE												
Hogfish	<i>Lachnolaimus maximus</i>	0	0	1	1	0	0	0	0	0	0	0	0
Spanish Hogfish	<i>Bodianus rufus (juv.)</i>	0	0	0	0	0	0	0	0	0	0	0	0
Clown wrasse	<i>Halichoeres maculipinna</i>	7	10	2	6	1	2	1	4	1	0	0	0
Slippery Dick	<i>Halichoeres bivittatus</i>	0	1	5	3	10	5	5	2	4	7	2	4
Yellowcheek wrasse	<i>Halichoeres cyanocephalus</i>	0	0	0	0	0	0	0	0	0	0	0	0
Puddingwife	<i>Halichoeres radiatus</i>	0	0	0	0	0	0	0	0	0	0	0	0
Bluehead Wrasse	<i>Thalassoma bifasciatum</i>	3	3	0	1	0	0	0	1	2	0	2	2
FAMILY: PARROTFISHES	SCARIDAE												
Parrotfish	SCARIDAE	0	0	0	0	0	1	0	0	0	0	0	0
Parrotfish	<i>Sparisoma sp. (juv.)</i>	0	2	2	1	0	0	0	0	0	2	1	0
Red tail Parrotfish	<i>Sparisoma chrospterum</i>	0	0	0	0	0	0	0	0	0	0	0	0
Stoplight Parrotfish	<i>Sparisoma virride</i>	0	0	0	0	0	0	0	1	1	0	1	0
Redfin Parrotfish	<i>Sparisoma rubripinne</i>	0	0	0	0	0	0	0	0	0	0	0	0
Redband Parrot	<i>Sparisoma aurofrenatum</i>	0	0	0	0	0	0	0	0	0	0	0	1
FAMILY: BARRACUDAS	SPHYAENIDAE												
Barracuda	<i>Sphyaena barracuda</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: STARGAZER	DACTYLOSCOPIIDAE												
Stargazer	<i>Dactyloscopus sp. (?)</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: CLINIDS	CLINIDAE												
Clinid	Clinidae A	0	0	0	0	0	0	0	0	0	0	0	0
Clinid	Clinidae B	0	0	0	0	0	0	0	0	0	0	0	0

Table 13: Continued

FISHES: CONTROL REEF 1													
COMMON NAME	SCIENTIFIC NAME	9-10-93	10-18-93	11-19-93	12-5-93	1-30-94	2-12-94	3-18-94	4-4-94	5-10-94	6-24-94	7-17-94	8-6-94
FAMILY: COMBTOOTH BLENNIES	BLENNIDAE												
Blenny	<i>Blennidae</i>	4	0	1	1	0	0	0	0	0	0	0	0
Redlip Blenny	<i>Ophioblennius atlanticus</i>	0	1	0	0	0	0	0	0	0	0	0	0
FAMILY: GOBIES	GOBIIDAE												
Neon Goby	<i>Gobiosoma oceanops</i>	0	0	0	0	0	0	0	0	0	0	0	0
Bridled Goby	<i>Coryphopterus glaucofraenu</i>	1	2	0	2	0	0	0	1	0	0	2	1
Masked Goby	<i>Coryphopterus personatus</i>	0	0	0	0	0	0	0	0	0	0	0	0
Goby	Gobiidae A	0	0	0	0	0	0	0	0	0	0	0	0
Goby	Gobiidae B	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: SURGEONFISHES	ACANTHURIDAE												
Ocean Surgeon	<i>Acanthurus bahianus</i>	1	10	5	10	6	6	3	4	25	20	7	50
Doctorfish	<i>Acanthurus chirurgus</i>	1	1	3	3	2	1	1	0	2	1	1	1
Blue tang	<i>Acanthurus coeruleus</i>	0	1	0	0	0	0	0	0	0	0	0	0
FAMILY: MACKERAL	SCOMBRIDAE												
Cero	<i>Scomberomorus regalis</i>	0	0	0	1	0	0	0	0	0	0	0	0
FAMILY: SCORPIONFISH	SCORPAENIDAE												
Spotted Scorpionfish	<i>Scorpaena plumieri</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: LEFTEYE FLOUNDERS	BOTHIDAE												
Gulf Flounder	<i>Paralichthys albigutta</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: LEATHERJACKETS	BALISTIDAE												
Filefish	<i>Aluterus sp.</i>	0	0	0	0	0	0	0	0	0	0	0	0
Orangespotted Filefish	<i>Cantherhines pullus</i>	0	0	0	0	0	0	0	0	0	0	0	0
Whitespotted Filefish	<i>Cantherhines macrocerus</i>	0	0	0	0	0	0	0	0	0	0	0	0
Grey Trigger	<i>Balistes capricus</i>	1	1	0	0	0	3	2	1	1	1	4	0
FAMILY: BOXFISHES	OSTRACIIDAE												
Scrawled cowfish	<i>Lactrophys quadricornis</i>	0	0	0	1	1	0	0	0	0	0	0	0
Spotted trunkfish	<i>Lactrophys trigonus</i>	0	0	1	0	0	0	0	0	0	0	0	0
Smooth trunkfish	<i>Lactrophys triquetter</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: PUFFERS	TETRAODONTIDAE												
Sharpnose Puffer	<i>Canthigaster rostrata</i>	1	0	0	0	0	0	0	1	3	3	3	0
Bandtail Puffer	<i>Sphoeroides spengleri</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: SPINY PUFFERS	DIODONTIDAE												
Porcupinefish	<i>Diodon hystrix</i>	0	0	0	0	0	0	0	0	0	0	0	0
Balloonfish	<i>Diodon holocanthus</i>	0	0	0	0	0	0	0	0	0	0	0	1
Unidentified Juveniles	UNID. JUVENILES	100	0	500	0	0	0	0	0	0	0	0	1000

Table 13: Continued

FISHES: CONTROL REEF 2		DATE SAMPLED											
COMMON NAME	FISHES	9-10-93	10-18-93	11-19-93	12-5-93	1-30-94	2-12-94	3-18-94	4-4-94	5-10-94	6-24-94	7-17-94	8-6-94
FAMILY: STINGRAY	DASYATIDAE												
Southern stingray	<i>Dasyatis americana</i>	0	0	0	0	0	0	0	0	1	0	0	0
FAMILY: MORAY EELS	MURAENIDAE												
Green Moray	<i>Gymnothorax funebris</i>	0	0	0	0	0	0	0	0	0	0	0	0
Spotted Moray	<i>Gymnothorax moringa</i>	0	0	0	0	0	0	0	0	0	0	0	0
Purplemouth Moray	<i>Gymnothorax vicinus</i>	0	0	0	0	1	1	0	0	0	0	0	1
FAMILY: HERRINGS	CLUPEIDAE												
Clupeid	Clupeid	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: SQUIRRELFISHES	HOLOCENTRIDAE												
Blackbar soldierfish	<i>Myripristis jacobus</i>	1	1	1	1	1	1	2	2	1	1	1	0
Squirrelfish	<i>Holocentrus ascensionis</i>	0	1	0	1	0	0	0	0	0	1	1	0
FAMILY: TRUMPETFISHES	AULOSTOMIDAE												
Trumpetfish	<i>Aulostomus maculatus</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: SEA BASSES	SERRANIDAE												
Black Grouper	<i>Mycteroperca bonaci</i>	0	0	0	0	0	1	0	0	1	0	1	0
Gag	<i>Mycteroperca microlepis</i>	0	0	1	0	0	0	1	0	0	1	1	0
Sand Perch	<i>Diplectrum formosum</i>	0	0	0	0	0	0	0	0	0	0	0	0
Harlequin Bass	<i>Serranus tigrinus</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: CARDINALFISHES	APOGONIDAE												
Cardinalfish	<i>Apogon sp.</i>	0	0	0	0	0	0	0	0	0	0	0	1
Flamefish	<i>Apogon maculatus</i>	0	0	0	0	0	0	1	0	2	3	2	1
Twospot Cardinalfish	<i>Apogon pseudomaculatus</i>	4	1	0	0	0	2	1	0	0	0	0	0
FAMILY: JACKS	CARANGIDAE												
Amberjack	<i>Seriola dumerili</i>	0	0	9	20	0	3	0	1	0	0	1	0
Blue Runner	<i>Caranx crysos</i>	0	0	0	0	0	0	0	0	0	0	0	0
Bar Jack	<i>Caranx ruber</i>	0	0	0	0	0	0	0	0	0	1	0	0
Yellow Jack	<i>Caranx bartholomaei</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: SNAPPERS	LUTJANIDAE												
Yellowtail Snapper	<i>Ocyurus chrysurus</i>	0	0	0	1	0	1	1	1	0	0	2	0
Mahogany Snapper	<i>Lutjanus mahogani</i>	0	0	0	0	0	0	0	0	0	0	0	0
Grey Snapper	<i>Lutjanus griseus</i>	4	11	9	2	2	9	1	1	0	15	22	22
Lane Snapper	<i>Lutjanus synagris</i>	1	10	0	0	5	0	0	0	0	0	0	0
Mutton Snapper	<i>Lutjanus analis</i>	0	0	0	0	0	0	0	0	0	0	0	0

Table 14: Year 2 fishes counted on Control Reef 2.

FISHES: CONTROL REEF 2		DATE SAMPLED											
COMMON NAME	FISHES	9-10-93	10-18-93	11-19-93	12-5-93	1-30-94	2-12-94	3-18-94	4-4-94	5-10-94	6-24-94	7-17-94	8-6-94
FAMILY: MOJARRAS	GERREIDAE												
Yellowfin Mojarra	<i>Gerres cinereus</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: GRUNTS	HAEMULIDAE												
Cottonwick	<i>Haemulon melanurum</i>	0	0	0	0	0	0	0	0	0	0	0	0
White Grunt	<i>Haemulon plumieri</i>	0	1	1	4	2	1	0	2	1	2	3	6
Tomtates	<i>Haemulon aurolineatum juveni</i>	3	50	2	4	25	20	16	20	150	20	100	100
Margate	<i>Haemulon album</i>	0	0	1	1	0	0	0	0	1	0	0	0
French Grunt	<i>Haemulon flavolineatum</i>	0	0	0	0	1	1	0	1	1	1	1	0
Spanish Grunt	<i>Haemulon macrostomum</i>	0	0	0	0	0	0	1	0	0	0	0	0
Bluestripe Grunt	<i>Haemulon sciurus</i>	0	3	5	1	2	1	0	2	0	3	2	2
Sailors Choice	<i>Haemulon parrai</i>	0	0	0	0	0	0	0	0	0	0	0	0
Black Margate	<i>Anisotremus surinamensis</i>	1	1	0	1	0	0	0	0	0	0	0	0
Porkfish	<i>Anisotremus virginicus</i>	1	2	5	7	3	2	4	4	2	4	4	2
Pigfish	<i>Orthopristis chrysoptera</i>	1	0	1	0	0	0	0	0	0	0	0	2
FAMILY: PORGIES	SPARIDAE												
Pinfish	<i>Logodon rhomboides</i>	0	0	0	0	0	0	0	0	0	0	0	0
Spottail Pinfish	<i>Diplodus holbrooki</i>	0	0	1	1	0	1	0	2	0	0	3	1
Saucereye Porgy	<i>Calamus calamus</i>	3	0	0	0	3	1	0	1	0	0	0	0
Grass Porgy	<i>Calamus artifrons</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: DRUMS	SCIAENIDAE												
Highhat	<i>Equetus acuminatus</i>	0	1	0	0	0	0	0	0	0	0	1	0
FAMILY: GOATFISHES	MULLIDAE												
Spotted Goatfish	<i>Pseudupeneus maculatus</i>	0	3	1	0	0	0	0	0	0	0	0	0
Yellow Goatfish	<i>Mulloidichthys martinicus</i>	2	1	1	0	0	0	0	0	1	0	20	0
FAMILY: SEA CHUBS	KYPHOSIDAE												
Bermuda Chub	<i>Kyphosus sectatrix</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: SPADEFISHES	EPHIPPIDAE												
Spadefish	<i>Chaetodipterus faber</i>	0	0	1	3	8	0	6	0	6	0	1	2
FAMILY: ANGELFISHES	POMACANTHIDAE												
Angelfish Juvenile	<i>Holocanthus sp. (juv.)</i>	0	0	0	0	0	0	0	0	0	0	0	0
Queen Angelfish	<i>Holocanthus ciliaris</i>	0	0	0	0	0	0	0	0	0	0	0	0
Blue Angelfish	<i>Holocanthus bermudensis</i>	0	0	0	0	0	0	0	0	0	0	0	0
French Angelfish	<i>Pomacanthus paru</i>	1	2	1	1	1	1	1	0	1	0	1	0
Grey Angelfish	<i>Pomacanthus arcuatus</i>	0	0	0	0	0	0	0	0	0	0	0	0
Angelfish Juvenile	<i>Pomacanthus sp. (juv.)</i>	0	0	0	0	0	0	0	0	0	0	0	0

Table 14: Continued

FISHES: CONTROL REEF 2		DATE SAMPLED											
COMMON NAME	FISHES	9-10-93	10-18-93	11-19-93	12-5-93	1-30-94	2-12-94	3-18-94	4-4-94	5-10-94	6-24-94	7-17-94	8-6-94
FAMILY: DAMSELFISHES	POMACENTRIDAE												
Dusky Damselfish	<i>Stegastes fuscus</i>	1	0	1	0	0	0	0	0	0	0	0	0
Threespot Damselfish	<i>Stegastes planifrons</i>	0	0	0	0	0	0	0	0	0	0	0	0
Cocoa Damselfish	<i>Stegastes variabilis</i>	0	0	0	0	0	0	0	0	0	0	0	0
Blue Chromis	<i>Chromis cyanis</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: WRASSES	LABRIDAE												
Hogfish	<i>Lachnolaimus maximus</i>	0	0	0	1	0	0	0	0	0	0	0	0
Spanish Hogfish	<i>Bodianus rufus juvenile</i>	0	0	1	0	1	2	0	1	0	0	0	0
Clown wrasse	<i>Halichoeres maculipinna</i>	10	1	5	2	1	4	0	2	4	0	1	0
Slippery Dick	<i>Halichoeres bivittatus</i>	0	5	5	4	3	2	5	4	0	1	3	0
Yellowcheek wrasse	<i>Halichoeres cyanocephalus</i>	0	0	0	0	0	0	0	0	0	0	0	0
Puddingwife	<i>Halichoeres radiatus</i>	0	0	0	0	0	0	0	0	0	0	0	0
Bluehead Wrasse	<i>Thalassoma bifasciatum</i>	0	0	0	0	0	2	0	0	0	0	0	0
FAMILY: PARROTFISHES	SCARIDAE												
Parrotfish	SCARIDAE	1	1	0	0	0	0	0	0	0	0	0	0
Parrotfish	<i>Sparisoma sp. (juv.)</i>	0	0	0	2	0	0	0	0	0	0	1	0
Red tail Parrotfish	<i>Sparisoma chrospterum</i>	0	1	0	0	0	0	0	0	0	0	0	0
Stoplight Parrotfish	<i>Sparisoma viride</i>	0	0	0	0	0	0	0	1	0	0	0	0
Redfin Parrotfish	<i>Sparisoma rubripinne</i>	0	0	0	0	0	0	0	0	0	0	0	0
Redband Parrot	<i>Sparisoma aurofrenatum</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: BARRACUDAS	SPHYAENIDAE												
Barracuda	<i>Sphyaena barracuda</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: STARGAZER	DACTYLOSCOPIIDAE												
Stargazer	<i>Dactyloscopus sp. (?)</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: CLINIDS	CLINIDAE												
Clinid	Clinidae A	0	0	0	0	0	0	0	0	0	0	0	0
Clinid	Clinidae B	0	0	0	0	0	0	0	0	0	0	0	0

Table 14: Continued

FISHES: CONTROL REEF 2		DATE SAMPLED											
COMMON NAME	FISHES	9-10-93	10-18-93	11-19-93	12-5-93	1-30-94	2-12-94	3-18-94	4-4-94	5-10-94	6-24-94	7-17-94	8-6-94
FAMILY: COMBTOOTH BLEN	BLENNIDAE												
Blenny	Blennidae	2	0	0	0	1	1	1	1	1	2	0	0
Redlip Blenny	<i>Ophioblennius atlanticus</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: GOBIES	GOBIIDAE												
Neon Goby	<i>Gobiosoma oceanops</i>	0	0	0	0	0	0	0	0	0	0	0	0
Bridled Goby	<i>Corphopterus glaucofraenum</i>	1	0	0	1	2	2	0	0	3	6	1	4
Masked Goby	<i>Coryphopterus personatus</i>	0	0	0	0	0	0	0	0	0	0	0	0
Goby	Gobiidae A	0	0	0	0	0	0	0	0	0	0	0	0
Goby	Gobiidae B	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: SURGEONFISHES	ACANTHURIDAE												
Ocean Surgeon	<i>Acanthurus bahianus</i>	1	1	1	3	0	2	5	3	3	12	7	0
Doctorfish	<i>Acanthurus chirurgus</i>	1	0	2	1	0	0	1	1	0	0	0	0
Blue tang	<i>Acanthurus coeruleus</i>	1	1	2	1	1	1	1	1	1	1	1	0
FAMILY: MACKERAL	SCOMBRIDAE												
Cero	<i>Scomberomorus regalis</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: SCORPIONFISH	SCORPAENIDAE												
Spotted Scorpionfish	<i>Scorpaena plumieri</i>	0	1	0	0	0	0	0	0	0	0	0	0
FAMILY: LEFT EYE FLOUNDE	BOTHIDAE												
Gulf Flounder	<i>Paralichthys albigutta</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: LEATHERJACKETS	BALISTIDAE												
Filefish	<i>Aluteus sp.</i>	0	0	0	0	0	0	0	0	0	0	0	0
Orangespotted Filefish	<i>Cantherhines pullus</i>	0	0	0	0	0	0	0	0	0	0	0	0
Whitespotted Filefish	<i>Cantherhines macrocerus</i>	0	0	0	0	0	0	0	0	0	0	0	0
Grey Trigger	<i>Balistes capricus</i>	2	0	1	1	1	1	2	1	1	1	1	5
FAMILY: BOXFISHES	OSTRACIIDAE												
Scrawled cowfish	<i>Lactophrys quadricornis</i>	0	0	1	0	1	1	0	0	0	0	0	0
Spotted trunkfish	<i>Lactophrys trigonus</i>	0	0	0	0	0	0	0	0	0	0	0	0
Smooth trunkfish	<i>Lactophrys triqueter</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: PUFFERS	TETRAODONTIDAE												
Sharpnose Puffer	<i>Canthigaster rostrata</i>	1	0	0	0	0	1	0	0	1	1	0	1
Bandtail Puffer	<i>Sphoeroides spengleri</i>	0	0	0	0	0	1	0	0	0	0	0	0
FAMILY: SPINY PUFFERS	DIODONTIDAE												
Porcupinefish	<i>Diodon hystrix</i>	1	0	0	0	0	0	0	0	0	0	0	0
Balloonfish	<i>Diodon holocanthus</i>	0	0	0	0	0	0	0	0	0	0	0	0
Unidentified Juveniles	UNID. JUVENILES	50	0	200	200	0	500	300	0	900	0	0	1000

Table 14: Continued

FISHES: EXPERIMENTAL 1		DATE SAMPLED											
COMMON NAME	SCIENTIFIC NAME	9-10-93	10-18-93	11-19-93	12-5-93	1-30-94	2-12-94	3-18-94	4-4-94	5-10-94	6-24-94	7-17-94	8-6-94
FAMILY: STINGRAY	DASYATIDAE												
Southern stingray	<i>Dasyatis americana</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: MORAY EELS	MURAENIDAE												
Green Moray	<i>Gymnothorax funebris</i>	0	0	0	0	0	0	0	0	0	0	0	0
Spotted Moray	<i>Gymnothorax moringa</i>	0	0	0	0	0	0	0	0	0	0	0	0
Purplemouth Moray	<i>Gymnothorax vicinus</i>	0	0	1	1	0	0	0	1	1	0	0	0
FAMILY: HERRINGS	CLUPEIDAE												
Clupeid	Clupeid	0	0	0	0	0	0	0	0	100	0	0	0
FAMILY: SQUIRRELFISHES	HOLOCENTRIDAE												
Blackbar soldierfish	<i>Myripristis jacobus</i>	0	0	0	0	0	0	0	0	0	0	0	0
Squirrelfish	<i>Holocentrus rufus</i>	0	0	0	0	0	0	0	0	1	0	1	0
FAMILY: TRUMPETFISHES	AULOSTOMIDAE												
Trumpetfish	<i>Aulostomos maculatus</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: SEA BASSES	SERRANIDAE												
Black Grouper	<i>Mycteroperca bonaci</i>	1	1	1	1	2	1	1	2	1	2	1	1
Gag	<i>Mycteroperca microlepis</i>	0	1	1	1	0	0	1	1	1	0	0	0
Sand Perch	<i>Diplectum formosum</i>	0	0	0	0	0	0	0	0	0	0	0	0
Harlequin Bass	<i>Serranus tigrinus</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: CARDINALFISHES	APOGONIDAE												
Cardinalfish	<i>Apogon sp.</i>	0	0	0	0	0	0	0	0	0	0	0	0
Flamefish	<i>Apogon maculatus</i>	0	0	0	2	0	0	0	0	1	0	0	0
Twospot Cardinalfish	<i>Apogon pseudomaculatus</i>	0	0	0	0	0	0	0	0	0	2	0	0
FAMILY: JACKS	CARANGIDAE												
Amberjack	<i>Seriola dumerili</i>	0	4	0	20	0	0	0	0	0	0	2	4
Blue Runner	<i>Caranx crysos</i>	2	0	0	0	0	0	0	0	0	0	0	0
Bar Jack	<i>Caranx ruber</i>	0	0	0	0	0	0	0	0	0	4	0	1
Yellow Jack	<i>Caranx bartholomaei</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: SNAPPERS	LUTJANIDAE												
Yellowtail Snapper	<i>Ocyurus chrysurus</i>	0	0	0	0	2	0	0	0	0	0	0	0
Mahogany Snapper	<i>Lutjanus mahogani</i>	0	0	0	0	0	0	0	0	0	0	0	1
Grey Snapper	<i>Lutjanus griseus</i>	3	10	10	0	0	0	2	1	0	3	20	30
Lane Snapper	<i>Lutjanus synagris</i>	0	5	1	0	1	0	0	0	0	0	0	0
Mutton Snapper	<i>Lutjanus analis</i>	0	0	0	0	0	0	0	0	0	0	0	0

Table 15: Year 2 fishes counted on Experimental Reef 1.

FISHES: EXPERIMENTAL 1		DATE SAMPLED											
COMMON NAME	SCIENTIFIC NAME	9-10-93	10-18-93	11-19-93	12-5-93	1-30-94	2-12-94	3-18-94	4-4-94	5-10-94	6-24-94	7-17-94	8-6-94
FAMILY: MOJARRAS	GERREIDAE												
Yellowfin Mojarra	<i>Gerres cinereus</i>	0	0	0	0	0	0	0	0	0	0	1	0
FAMILY: GRUNTS	HAEMULIDAE												
Cottonwick	<i>Haemulon melanurum</i>	0	0	0	0	0	0	0	0	0	0	0	0
White Grunt	<i>Haemulon plumieri</i>	0	3	1	0	4	2	1	2	2	7	4	20
Tomtates	<i>Haemulon aurolineatum (juv.)</i>	1	4	0	13	8	20	20	25	150	30	0	200
Margate	<i>Haemulon album</i>	0	0	0	0	0	0	0	0	0	0	0	0
French Grunt	<i>Haemulon flavolineatum</i>	0	3	0	3	8	5	5	4	11	6	7	6
Spanish Grunt	<i>Haemulon macrostomum</i>	2	0	0	0	0	0	0	0	0	0	0	0
Bluestripe Grunt	<i>Haemulon sciurus</i>	0	1	2	0	1	0	0	2	0	0	1	7
Sailors Choice	<i>Haemulon parrai</i>	0	1	0	0	0	0	0	0	0	0	0	0
Black Margate	<i>Anisotremus surinamensis</i>	0	0	0	0	0	0	0	0	0	0	0	0
Porkfish	<i>Anisotremus virginicus</i>	2	2	3	7	2	2	2	1	3	3	0	6
Pigfish	<i>Orthopristis chrysoptera</i>	2	0	1	0	0	0	0	0	0	0	0	0
FAMILY: PORGIES	SPARIDAE												
Pinfish	<i>Lagodon rhomboides</i>	0	0	0	0	0	0	0	0	0	0	0	0
Spottail Pinfish	<i>Diplodus holbrooki</i>	0	0	0	1	0	0	0	3	0	1	2	1
Saucereye Porgy	<i>Calamus calamus</i>	0	0	1	0	0	0	0	0	0	0	0	0
Grass Porgy	<i>Calamus arctifrons</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: DRUMS	SCIAENIDAE												
Highhat	<i>Equetus acuminatus</i>	1	1	0	0	0	0	0	0	0	0	0	0
FAMILY: GOATFISHES	MULLIDAE												
Spotted Goatfish	<i>Pseudupeneus maculatus</i>	0	2	1	0	0	0	0	0	1	0	1	1
Yellow Goatfish	<i>Mulloidichthys martinicus</i>	2	1	0	0	0	0	0	0	0	2	30	0
FAMILY: SEA CHUBS	KYPHOSIDAE												
Bermuda Chub	<i>Kyphosus sectatrix</i>	0	0	1	0	0	0	0	0	0	0	0	0
FAMILY: SPADEFISHES	EPHIPPIDAE												
Spadefish	<i>Chaetodipterus faber</i>	4	0	2	2	6	8	2	8	6	0	0	0
FAMILY: ANGELFISHES	POMACANTHIDAE												
Queen Angelfish	<i>Holocanthus ciliaris</i>	2	1	1	2	1	1	1	1	1	1	1	0
Blue Angelfish	<i>Holocanthus bermudensis</i>	0	0	0	0	0	0	0	0	0	0	0	0
French Angelfish	<i>Pomacanthus paru</i>	0	0	0	0	0	0	0	0	0	0	0	0
Grey Angelfish	<i>Pomacanthus arcuatus</i>	0	0	0	0	0	0	1	0	0	0	0	0
Angelfish Juvenile	<i>Pomacanthus sp. (juv.)</i>	0	0	0	0	0	0	0	0	0	0	0	0

Table 15: Continued

FISHES: EXPERIMENTAL 1		DATE SAMPLED											
COMMON NAME	SCIENTIFIC NAME	9-10-93	10-18-93	11-19-93	12-5-93	1-30-94	2-12-94	3-18-94	4-4-94	5-10-94	6-24-94	7-17-94	8-6-94
Dusky Damselfish	<i>Stegastes fuscus</i>	0	0	0	0	0	0	0	0	0	0	0	0
Threespot Damselfish	<i>Stegastes planifrons</i>	0	0	0	0	0	0	0	0	0	0	0	0
Cocoa Damselfish	<i>Stegastes variabilis</i>	0	0	0	0	0	0	0	0	0	0	0	0
Blue Chromis	<i>Chromis cyanis</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: WRASSES	LABRIDAE												
Hogfish	<i>Lachnolaimus maximus</i>	0	0	1	1	0	0	0	0	0	1	0	0
Spanish Hogfish	<i>Bodianus rufus (juv.)</i>	1	1	2	1	1	0	1	0	0	0	0	0
Clown wrasse	<i>Halichores maculipinna</i>	1	3	0	5	1	1	1	0	2	5	4	1
Slippery Dick	<i>Halichores bivittatus</i>	4	3	4	1	0	2	3	3	3	2	5	5
Yellowcheek wrasse	<i>Halichores cyanocephalus</i>	0	0	0	0	0	0	0	0	0	0	0	0
Puddingwife	<i>Halichores radiatus</i>	0	0	0	0	0	0	0	0	0	0	2	2
Bluehead Wrasse	<i>Thalassoma bifasciatum</i>	0	0	0	1	1	0	0	0	1	1	0	0
FAMILY: PARROTFISHES	SCARIDAE												
Parrotfish	SCARIDAE	0	0	0	0	0	0	0	0	0	0	0	0
Parrotfish	<i>Sparisoma sp. (juv.)</i>	0	0	0	0	0	0	0	0	0	1	1	1
Red tail Parrotfish	<i>Sparisoma chrospiterum</i>	0	1	0	0	1	0	0	0	0	0	0	0
Redfin Parrotfish	<i>Sparisoma rubripinne</i>	0	0	0	0	0	0	0	0	0	0	1	0
Stoptlight Parrotfish	<i>Sparisoma viride</i>	0	0	0	0	0	0	0	2	1	0	2	3
Redband Parrot	<i>Sparisoma aurofrenatum</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: BARRACUDAS	SPHYAENIDAE												
Barracuda	<i>Sphyaena barracuda</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: STARGAZER	DACTYLOSCOPIIDAE												
Stargazer	<i>Dactyloscopus sp. (?)</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: CLINIDS	CLINIDAE												
Clinid	Clinidae A	0	0	0	0	0	0	0	0	0	0	0	0
Clinid	Clinidae B	0	0	0	0	0	0	0	0	0	0	0	0

Table 15: Continued

FISHES: EXPERIMENTAL 1		DATE SAMPLED											
COMMON NAME	SCIENTIFIC NAME	9-10-93	10-18-93	11-19-93	12-5-93	1-30-94	2-12-94	3-18-94	4-4-94	5-10-94	6-24-94	7-17-94	8-6-94
FAMILY: COMBTOOTH BLE	BLENNIDAE												
Blenny	Blennidae	0	0	0	0	0	0	1	1	1	0	0	1
Redlip Blenny	<i>Ophioblennius atlanticus</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: GOBIES	GOBIIDAE												
Neon Goby	<i>Gobiosoma oceanops</i>	0	0	0	0	0	0	0	0	0	0	0	0
Bridled Goby	<i>Coryphopterus glaucofraenu</i>	5	0	0	2	0	3	1	2	0	0	2	1
Masked Goby	<i>Coryphopterus personatus</i>	0	0	0	0	0	0	0	0	0	0	0	0
Goby	Gobiidae A	0	0	0	0	0	0	0	0	0	0	0	0
Goby	Gobiidae B	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: SURGEONFISHES	ACANTHURIDAE												
Ocean Surgeon	<i>Acanthurus bahianus</i>	6	8	3	5	3	6	6	3	7	6	12	0
Doctorfish	<i>Acanthurus chirurgus</i>	0	1	0	2	1	1	1	2	3	1	0	0
Blue tang	<i>Acanthurus coeruleus</i>	0	0	0	1	0	0	0	0	0	0	0	1
FAMILY: MACKERAL	SCOMBRIDAE												
Cero	<i>Scomberomorus regalis</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: SCORPIONFISH	SCORPAENIDAE												
Spotted Scorpionfish	<i>Scorpaena plumieri</i>	0	0	0	0	0	0	0	0	1	0	0	0
FAMILY: LEFT EYE FLOUNDER	BOTHIDAE												
Gulf Flounder	<i>Paralichthys albigutta</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: LEATHERJACKET	BALISTIDAE												
Filefish	<i>Aluterus sp.</i>	0	0	0	0	0	0	0	0	0	0	0	0
Orangespotted Filefish	<i>Cantherhines pullus</i>	0	0	0	0	0	0	0	0	0	0	0	0
Whitespotted Filefish	<i>Cantherhines macrocerus</i>	0	0	0	0	0	0	0	0	0	0	0	0
Grey Trigger	<i>Balistes ccaprisicus</i>	2	0	1	1	1	4	2	1	1	1	0	2
FAMILY: BOXFISHES	OSTRACIIDAE												
Scrawled cowfish	<i>Lactrophrys quadricomis</i>	0	0	0	0	1	0	0	0	0	0	0	0
Spotted trunkfish	<i>Lactrophrys trigonus</i>	0	0	0	0	0	0	0	0	0	0	0	0
Smooth trunkfish	<i>Lactrophrys triqueter</i>	0	0	0	0	0	0	1	0	0	0	0	0
FAMILY: PUFFERS	TETRAODONTIDAE												
Sharpnose Puffer	<i>Canthigaster rostrata</i>	2	1	0	0	0	0	0	1	2	0	1	0
Bandtail Puffer	<i>Sphoeroides spengleri</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: SPINY PUFFERS	DIODONTIDAE												
Porcupinefish	<i>Diodon hystrix</i>	0	0	0	0	0	0	0	0	1	0	0	0
Balloonfish	<i>Diodon holocanthus</i>	0	0	0	0	0	0	0	0	0	0	0	0
Unidentified Juveniles	UNID. JUVENILES	50	0	0	0	0	0	0	0	0	0	0	1000

Table 15: Continued

FISHES: EXPERIMENTAL 2		DATE SAMPLED											
COMMON NAME	SCIENTIFIC NAME	9-10-93	10-18-93	11-19-93	12-5-93	1-30-94	2-12-94	3-18-94	4-4-94	5-10-94	6-24-94	7-17-94	8-6-94
FAMILY: STINGRAY	DASYATIDAE												
Southern stingray	<i>Dasyatis americana</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: MORAY EELS	MURAENIDAE												
Green Moray	<i>Gymnothorax funebris</i>	0	0	0	0	0	0	0	0	0	0	0	0
Spotted Moray	<i>Gymnothorax moringa</i>	0	0	0	0	0	0	0	0	0	0	0	0
Purplemouth Moray	<i>Gymnothorax vicinus</i>	0	1	0	0	1	0	1	0	1	1	0	0
FAMILY: HERRINGS	CLUPEIDAE												
Clupeid	Clupeid	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: SQUIRRELFISHES	HOLOCENTRIDAE												
Blackbar soldierfish	<i>Myripristis jacobus</i>	0	0	0	0	0	0	0	0	0	0	0	0
Squirrelfish	<i>Holocentrus rufus</i>	0	0	0	0	0	0	0	0	0	1	0	0
FAMILY: TRUMPETFISHES	AULOSTOMIDAE												
Trumpetfish	<i>Aulostomus maculatus</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: SEA BASSES	SERRANIDAE												
Black Grouper	<i>Mycteroperca bonaci</i>	0	2	0	1	1	2	1	0	0	1	1	1
Gag	<i>Mycteroperca microlepis</i>	1	1	0	0	1	1	1	0	0	0	1	0
Sand Perch	<i>Diplectrum formosum</i>	0	0	0	0	0	0	0	0	0	0	0	0
Harlequin Bass	<i>Serranus tigrinus</i>	0	0	0	0	0	0	0	0	0	0	0	1
FAMILY: CARDINALFISHES	APOGONIDAE												
Cardinalfish	<i>Apogon sp.</i>	0	0	0	0	0	0	0	0	0	0	0	2
Flamefish	<i>Apogon maculatus</i>	0	0	1	1	0	0	0	0	4	3	3	0
Twospot Cardinalfish	<i>Apogon pseudomaculatus</i>	0	3	0	1	1	3	0	4	3	0	1	1
FAMILY: JACKS	CARANGIDAE												
Amberjack	<i>Seriola dumerili</i>	0	4	0	0	0	3	0	0	0	0	0	0
Blue Runner	<i>Caranx crysos</i>	1	0	0	0	0	0	0	0	0	0	0	0
Bar Jack	<i>Caranx ruber</i>	0	0	0	0	0	0	0	0	0	2	0	1
Yellow Jack	<i>Caranx bartholomaei</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: SNAPPERS	LUTJANIDAE												
Yellowtail Snapper	<i>Ocyurus chrysurus</i>	0	5	0	0	0	3	0	2	0	1	1	5
Mahogany Snapper	<i>Lutjanus mahogani</i>	0	0	0	0	0	0	0	0	0	0	0	0
Grey Snapper	<i>Lutjanus griseus</i>	35	6	12	0	0	2	10	0	16	5	18	2
Lane Snapper	<i>Lutjanus synagris</i>	1	7	3	0	0	0	0	0	0	0	0	0
Mutton Snapper	<i>Lutjanus analis</i>	0	0	0	0	0	0	0	0	0	0	0	0

Table 16: Year 2 Fishes counted on Experimental Reef 2.

FISHES: EXPERIMENTAL 2		DATE SAMPLED											
COMMON NAME	SCIENTIFIC NAME	9-10-93	10-18-93	11-19-93	12-5-93	1-30-94	2-12-94	3-18-94	4-4-94	5-10-94	6-24-94	7-17-94	8-6-94
FAMILY: MOJARRAS	GERREIDAE												
Yellowfin Mojarra	<i>Gerres cinereus</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: GRUNTS	HAEMULIDAE												
Cottonwick	<i>Haemulon melanurum</i>	1	1	0	0	0	0	1	1	1	1	1	1
White Grunt	<i>Haemulon plumieri</i>	2	0	3	1	1	0	1	2	3	2	1	3
Tomtates	<i>Haemulon aurolineatum (j)</i>	50	30	0	4	9	15	30	50	158	100	33	100
Margate	<i>Haemulon album</i>	0	0	0	0	0	0	0	0	0	0	0	0
French Grunt	<i>Haemulon flavolineatum</i>	0	2	10	9	10	25	20	20	11	20	17	20
Spanish Grunt	<i>Haemulon macrostomum</i>	2	0	0	0	0	0	0	0	0	1	0	0
Bluestripe Grunt	<i>Haemulon sciurus</i>	0	0	3	3	1	2	0	0	0	1	5	1
Sailors Choice	<i>Haemulon parrai</i>	0	0	1	0	0	0	0	0	0	0	0	0
Black Margate	<i>Anisotremus surinamensis</i>	0	0	0	0	0	0	0	0	0	0	0	0
Porkfish	<i>Anisotremus virginicus</i>	2	1	3	1	3	3	0	1	2	0	0	1
Pigfish	<i>Orthopristis chrysoptera</i>	10	3	1	0	0	0	0	0	0	0	0	0
FAMILY: PORGIES	SPARIDAE												
Pinfish	<i>Lagodon rhomboides</i>	0	0	0	0	0	0	0	0	0	0	0	0
Spottail Pinfish	<i>Diplodus holbrooki</i>			1	0	0	0	0	0	0	0	2	0
Saucereye Porgy	<i>Calamus calamus</i>	0	0	0	0	0	2	4	0	0	0	1	0
Grass Porgy	<i>Calamus arctifrons</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: DRUMS	SCIAENIDAE												
Highhat	<i>Equetus acuminatus</i>	0	0	0	0	0	0	0	0	0	0	1	0
FAMILY: GOATFISHES	MULLIDAE												
Spotted Goatfish	<i>Pseudupeneus maculatus</i>	0	0	0	1	0	1	0	0	1	4	0	1
Yellow Goatfish	<i>Mulloidichthys martinicus</i>	1	5	0	0	0	0	1	1	1	0	17	0
FAMILY: SEA CHUBS	KYPHOSIDAE												
Bermuda Chub	<i>Kyphosus sectatrix</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: SPADEFISHES	EPHIPPIDAE												
Spadefish	<i>Chaetodipterus faber</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: ANGELFISHES	POMACANTHIDAE												
Queen Angelfish	<i>Holocanthus ciliaris</i>	0	0	0	0	0	0	0	0	0	0	0	1
Blue Angelfish	<i>Holocanthus bermudensis</i>	0	0	0	0	0	0	0	0	0	0	0	0
French Angelfish	<i>Pomacanthus paru</i>	0	0	0	0	0	0	0	0	0	0	0	0
Grey Angelfish	<i>Pomacanthus arcuatus</i>	0	0	0	0	0	0	0	0	0	0	0	0
Angelfish Juvenile	<i>Pomacanthus sp. (juv.)</i>	0	0	0	0	0	0	0	0	0	0	0	0

Table 16: Continued

FISHES: EXPERIMENTAL 2		DATE SAMPLED											
COMMON NAME	SCIENTIFIC NAME	9-10-93	10-18-93	11-19-93	12-5-93	1-30-94	2-12-94	3-18-94	4-4-94	5-10-94	6-24-94	7-17-94	8-6-94
FAMILY: DAMSELFISHES													
POMACENTRIDAE													
Dusky Damselfish	<i>Stegastes fuscus</i>	0	0	0	0	0	0	0	0	0	0	0	0
Threespot Damselfish	<i>Stegastes planifrons</i>	0	1	1	1	1	1	1	1	1	1	1	1
Cocoa Damselfish	<i>Stegastes variabilis</i>	0	0	0	0	0	0	0	0	0	0	1	1
Blue Chromis	<i>Chromis cyanis</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: WRASSES													
LABRIDAE													
Hogfish	<i>Lachnolaimus maximus</i>	0	0	0	1	0	0	0	0	0	0	0	0
Spanish Hogfish	<i>Bodianus rufus (juv.)</i>	3	2	1	2	1	1	0	0	0	0	0	0
Clown wrasse	<i>Halichores maculipinna</i>	2	4	1	2	5	4	0	5	7	8	8	9
Slippery Dick	<i>Halichores bivittatus</i>	3	0	4	5	2	0	4	2	4	6	9	6
Yellowcheek wrasse	<i>Halichores cyanocephalus</i>	0	0	0	0	0	0	0	0	0	0	0	0
Puddingwife	<i>Halichores radiatus</i>	0	0	0	0	0	0	0	0	0	0	1	1
Bluehead Wrasse	<i>Thalassoma bifasciatum</i>	0	2	0	0	1	2	0	4	4	1	0	0
FAMILY: PARROTFISHES													
SCARIDAE													
Parrotfish	SCARIDAE	0	0	0	0	0	0	0	0	0	0	0	0
Parrotfish	<i>Sparisoma sp. (juv.)</i>	0	0	0	0	0	0	0	0	0	0	0	0
Red tail Parrotfish	<i>Sparisoma chrospterum</i>	0	0	0	0	0	0	0	0	0	0	0	0
Redfin Parrot	<i>Sparisoma rubripinne</i>	0	0	0	0	0	0	0	0	0	0	1	0
Stoplight Parrotfish	<i>Sparisoma virride</i>	0	0	0	0	0	0	0	0	0	0	0	0
Redband Parrot	<i>Sparisoma aurofrenatum</i>	0	0	0	0	0	0	0	0	0	0	0	2
FAMILY: BARRACUDAS													
SPHYAENIDAE													
Barracuda	<i>Sphyaena barracuda</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: STARGAZER													
DACTYLOSCOPIIDAE													
Stargazer	<i>Dactyloscopus sp. (?)</i>	0	0	0	0	0	1	0	0	1	0	0	1
FAMILY: CLINIDS													
CLINIDAE													
Clinid	Clinidae A	0	0	0	0	0	0	0	0	0	0	0	0
Clinid	Clinidae B	0	0	0	0	0	0	0	0	0	0	0	0

Table 16: Continued

FISHES: EXPERIMENTAL 2		DATE SAMPLED											
COMMON NAME	SCIENTIFIC NAME	9-10-93	10-18-93	11-19-93	12-5-93	1-30-94	2-12-94	3-18-94	4-4-94	5-10-94	6-24-94	7-17-94	8-6-94
FAMILY: COMBTOOTH BLENNIE	BLENNIDAE												
Blenny	Blennidae	0	2	2	0	0	2	0	3	1	0	0	0
Redlip Blenny	<i>Ophioblennius atlanticus</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: GOBIES	GOBIIDAE												
Neon Goby	<i>Gobiosoma oceanops</i>	0	0	0	0	0	0	0	0	0	0	0	0
Bridled Goby	<i>Coryphopterus glaucofraenu</i>	2	3	0	0	0	3	0	1	1	0	3	4
Masked Goby	<i>Coryphopterus personatus</i>	0	0	0	0	0	0	0	0	0	0	0	3
Goby	Gobiidae A	0	0	0	0	0	0	0	0	0	0	0	0
Goby	Gobiidae B	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: SURGEONFISHES	ACANTHURIDAE												
Ocean Surgeon	<i>Acanthurus bahianus</i>	6	16	6	5	5	4	4	4	15	0	7	5
Doctorfish	<i>Acanthurus chirurgus</i>	2	0	0	0	0	3	1	2	1	0	1	0
Blue tang	<i>Acanthurus coeruleus</i>	0	1	0	0	0	0	0	0	0	0	0	0
FAMILY: MACKERAL	SCOMBRIDAE												
Cero	<i>Scomberomorus regalis</i>	0	0	0	1	0	0	0	0	0	0	0	0
FAMILY: SCORPIONFISH	SCORPAENIDAE												
Spotted Scorpionfish	<i>Scorpaena plumieri</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: LEFTEYE FLOUNDERS	BOTHIDAE												
Gulf Flounder	<i>Paralichthys albigutta</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: LEATHERJACKETS	BALISTIDAE												
Filefish	<i>Aluterus</i> sp.	0	0	0	0	0	0	0	0	0	0	0	0
Orangespotted Filefish	<i>Cantherhines pullus</i>	2	0	1	1	0	0	0	0	0	0	0	0
Whitespotted Filefish	<i>Cantherhines macrocerus</i>	0	1	0	0	0	0	0	0	0	0	0	0
Grey Trigger	<i>Balistes capriscus</i>	1	2	0	1	0	2	0	1	1	2	4	1
FAMILY: BOXFISHES	OSTRACIIDAE												
Scrawled cowfish	<i>Lactrophrys quadricornis</i>	0	0	0	0	0	1	0	0	0	0	0	0
Spotted trunkfish	<i>Lactrophrys trigonus</i>	0	0	0	0	0	0	0	0	0	0	0	0
Smooth trunkfish	<i>Lactrophrys triquetar</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: PUFFERS	TETRAODONTIDAE												
Sharpnose Puffer	<i>Canthigaster rostrata</i>	1	0	1	0	1	1	0	1	2	3	0	0
Bandtail Puffer	<i>Sphoeroides spengleri</i>	0	0	0	0	0	0	0	0	0	0	0	0
FAMILY: SPINY PUFFERS	DIODONTIDAE												
Porcupinefish	<i>Diodon hystrix</i>	0	0	0	0	0	0	0	0	0	0	0	0
Balloonfish	<i>Diodon holocanthus</i>	0	0	0	0	0	0	0	0	0	1	1	0
Unidentified Juveniles	UNID. JUVENILES	0	50	0	0	0	0	0	300	300	300	0	1000

Table 16: Continued

DATE	C1		C2		E1		E2		TOTAL	
	# FISH	# SPECIES	# FISH	# SPECIES	# FISH	# SPECIES	# FISH	# SPECIES	# FISH	# SPECIES
4-7-93	13	5	10	6	22	5	9	7	54	8
4-12-93	10	5	15	3	11	3	26	7	62	12
4-20-93	14	7	35	9	52	12	19	8	120	19
4-27-93	12	6	10	7	24	7	37	12	83	15
5-8-93	36	9	39	9	36	10	59	11	170	20
5-22-93	42	16	37	13	33	15	35	14	147	27
6-9-93	21	14	27	14	35	18	40	16	123	30
6-23-93	37	18	29	15	37	14	36	13	139	26
7-7-93	43	17	40	18	43	19	47	15	173	30
7-22-93	52	20	56	18	50	21	79	16	237	39
8-6-93	26	17	52	15	62	16	59	22	199	36
9-10-93	59	22	44	23	44	20	78	20	225	40
10-18-93	68	25	99	21	58	22	105	25	330	49
11-19-93	30	14	59	25	38	19	55	18	182	45
12-5-93	39	18	64	24	73	21	41	18	217	39
1-30-94	37	10	65	20	45	18	45	17	192	32
2-12-94	24	12	66	28	56	13	85	24	231	36
3-18-94	16	9	50	18	53	19	80	15	199	33
4-4-94	65	20	52	20	66	21	105	19	288	36
5-10-94	66	24	31	20	52	24	81	23	230	42
6-24-94	41	14	56	18	49	20	65	21	211	39
7-17-94	59	22	82	26	101	21	140	28	382	42
8-6-94	97	20	50	14	95	21	75	26	317	44
MEAN										
YEAR1	27.82	12.18	31.82	11.55	36.82	12.73	40.55	12.82	137.00	23.82
MEAN										
YEAR2	50.08	17.50	59.83	21.42	60.83	19.92	79.58	21.17	250.33	39.75
MEAN										
TOTAL	39.43	14.96	46.43	16.70	49.35	16.48	60.91	17.17	196.13	32.13

Table 17: Summary of the number of fishes and species identified on each reef and combined totals.

REEFS	DATE SAMPLED											
	9-10-93	10-18-93	11-19-93	12-5-93	1-30-94	2-12-94	3-18-94	4-4-94	5-10-94	6-24-94	7-17-94	8-6-94
CONTROL 1												
NO. SPECIES	22	25	14	18	10	12	9	20	24	14	22	20
NO. FISH	163	71	531	41	37	27	16	168	219	45	59	1097
DIVERSITY	0.682	1.1722	0.1572	1.1007	0.8229	0.9784	0.8586	0.6140	0.6103	0.8448	1.1166	0.2020
VARIANCE	0.003	0.0027	0.0005	0.0034	0.0034	0.0031	0.0055	0.0025	0.0024	0.0058	0.0038	0.0003
CONTROL 2												
NO. SPECIES	23	21	25	24	20	28	18	20	20	18	26	14
NO. FISH	94	99	259	264	65	566	350	52	1082	76	182	1150
DIVERSITY	0.862	0.8445	0.5092	0.5124	1.0072	0.2932	0.3221	1.0376	0.2649	0.9893	0.7767	0.2411
VARIANCE	0.005	0.004	0.0022	0.0002	0.0044	0.0008	0.0012	0.0053	0.0002	0.0026	0.0025	0.0002
EXP. 1												
NO. SPECIES	20	22	19	21	18	13	19	21	24	20	21	21
NO. FISH	94	58	38	73	45	56	53	66	302	79	101	1295
DIVERSITY	0.865	1.2037	1.1304	1.0709	1.1029	0.9079	1.0068	1.0243	0.6437	1.0022	1.0091	0.3676
VARIANCE	0.005	0.002	0.0039	0.0029	0.0028	0.0031	0.0050	0.0042	0.0013	0.0033	0.0024	0.0003
EXP. 2												
NO. SPECIES	20	25	18	18	17	24	15	19	23	21	28	26
NO. FISH	128	155	55	41	44	87	380	405	539	165	140	1175
DIVERSITY	0.851	1.0366	1.0794	1.1098	1.0159	1.1325	0.3937	0.4626	0.5867	0.7115	1.1059	0.3012
VARIANCE	0.003	0.0019	0.0026	0.0031	0.0034	0.0028	0.0010	0.0010	0.0007	0.0028	0.0015	0.0003

Table 18: Year 2 Shannon index of diversity for each reef and sample date.

TESTS	DATE SAMPLED											
	9-10-93	10-18-93	11-19-93	12-05-93	1-30-94	2-12-94	3-18-94	4-4-94	5-10-94	6-24-94	7-17-94	8-6-94
C1-C2												
t	-2.013	4.003	-6.774	9.805	-2.099	10.932	6.578	-4.795	6.74	-1.576	4.303	-1.731
v (DF)	88.800	166.988	80.671	43.631	99.749	43.052	23.726	104.586	263.455	84.228	142.248	2216.41
E1-E2												
t	0.157	-0.459	-14.672	0.375	1.1	-2.934	7.939	7.801	1.301	3.74	-1.55	2.772
v (DF)	88.800	125.389	47.382	96.425	88.022	133.493	74.889	100.395	607.479	201	208.492	2396.28
C1-E1												
t	-2.046	1.999	-16.563	-0.113	-4.835	1.264	-2.007	-8.244	-0.684	-2.064	1.754	-9.917
v (DF)	134.365	149.450	73.223	79.597	79.342	72.478	46.899	147.036	425.285	93.037	127.875	2348.13
C1-E2												
t	-2.182	-4.637	-7.954	-10.031	-2.345	-2.005	5.803	2.567	0.427	1.439	0.148	-4.043
v (DF)	88.000	156.127	77.152	82.966	95.162	78.002	22.094	310.1	345.93	92.554	108.469	2268.49
C2-E1												
t	-0.030	-2.501	-8.230	-10.399	-1.129	-9.867	-8.696	0.136	-9.79	-0.168	-3.327	-5.765
v (DF)	93.627	177.605	112.422	46.337	109.894	89.528	80.647	111.539	420.342	153.619	262.111	2444.14
C2-E2												
t	0.123	2.676	0.633	-0.502	-0.098	-13.941	-1.542	7.227	-10.758	3.79	-5.213	-2.554
v (DF)	93.627	147.175	80.757	102.976	108.414	143.665	713.8	73.0242	930.553	213.252	317.924	2270.02

Table 19: Year 2 Hutcheson t-test comparisons of Shannon diversity indices by sample date. Comparisons listed in left column (i.e. C1-C2 compares Control Reef 1 to Control Reef 2). Statistically significant t values are bolded.

Phylum: Sarcomastigophora

Subphylum: Sarcodina

Order: Faraminiferida

White encrusting foram

White filamentous foram

Phylum: Porifera (Sponges)

Class: Demospongiae

Family: Niphatidae

Amphimedon compressa (Erect rope sponge)

Niphates erecta (Lavender rope sponge)

Family: Stellettidae

Aaptos aaptos

Family: Aplysinidae

Aplysina sp.

Family: Darwinellidae

Ingenella notablis

Phylum: Cnidaria

Class: Hydrozoa (Hydroids)

Order: Hydroida

Suborder: Leptomedusae (Thecate hydroid)

Suborder: Anthomedusae (Athebate hydroid)

Class: Anthozoa (Hard and Soft corals)

Order: Alcyonacea

Family: Telestinae

Carijoa riisei (White telesto)

Order: Gorgonacea

Family: Gordoniidae

Pseudoptergogia acerosa

Family: Plexauridae

Eunicea succinea

Order: Scleractinia

Family: Poritidae

Porites sp.

Family: Faviidae

Montastrea sp.

Family: Mussidae

Mussa sp.

Phylum: Annelida (Segmented worms)

Class: Polychaeta

Family: Eunicidae

Family: Filogranidae

Filigrana huxleyi (Sea frost)

Family: Nereidae

Family: Sabellidae

Family: Serpulidae

Family: Syllidae

Family: Terebellidae

Family: Polynoidae

Table 20: List of invertebrates identified on Control Reef 1, July 17, 1994.

Phylum: Arthropoda
 Subphylum: Crustacea
 Class: Maxillopoda
 Subclass: Cirripedia (Barnacles)
 Family: Balinidae
 Balanus amphitrite
 Balanus trigonus
 Class: Malacostaca
 Order: Decapoda
 Family: Alpheidae (Snapping shrimp)
 Synalpheus sp.
 Red Snapping Shrimp
 Family: Rhynchocinetidae
 Rhynchocinetes rigens (Red Night Shrimp)
 Family: Palaemonida
 Family: Stenopodidea
 Stenopus hispidus (Coral Banded shrimp)
 Family: Diogenidae (Hermit crab)
 Family: Palinuridae
 Panulirus argus (Spiny lobster)
 Family: Majidae (Clinging crabs)
 Mithrax hispidus
 Mithrax sp.
 Stenorhynchus seticornis (Arrow crab)
 Order: Stomatopoda (Mantis Shrimp)
 Order: Amphipoda
 Order: Isopoda
 Order: Tanaidacea
 Order: Mysidacea
 Class: Pycnogonida (Sea spiders)

Phylum: Mollusca
 Class: Gastropoda
 Subclass: Prosobranchia
 Order: Mesogastropoda
 Family: Crepidulinae
 Crepidula aculeata (Slipper shell)
 Family: Cerithiidae
 Cerithium litteratum (Stocky cerith)
 Family: Cypraeidae
 Cypraea cervus (Atlantic Deer Cowrie)
 Subclass: Opisthobranchia
 Order: Nudibranchia
 Family: Chromodoridae
 Hypselodoris edenticulata (Florida Regal Sea Goddess)

Table 20: Continued

-
- Class: Bivalvia
Family: Arcidae
Family: Cardiidae
Papyridea semisulcata (Frisled Paper Cockle)
Family: Chamidae
Chama macerophylla (Leafy Jewel Box)
Family: Mytilidae (Mussels)
Musculus lateralis
Family: Pteriidae (Wing oysters)
Pinctada imbricata
Family: Ostreidae (Oyster)
Lopha frons
Ostrea permollis (Sponge oyster)
- Class: Polyplacophora (Chitons)
Family: Chaetopleuridae
Chaetopleura apiculata
- Phylum: Ectoprocta (Brozoans)
Class: Gymnolaemata
Order: Cheilostomata
Family: Bugulidae
Bugula sp.
Family: Cheiloporinidae
Waterspipora subovoidae
Family: Smittinidae
Parasmittina sp.
Steginoporella magnilabris
Order: Ctenostomata
Family: Alcyonidiidae
Alcyonidium sp.
Unidentified green encrusting bryozoan
Unidentified orange encrusting bryozoan
- Phylum: Echinodermata
Class: Ophiuroidea
Order: Ophiurae (Brittle stars)
Class: Echinoidea
Family: Diadematidae
Diadema antillarum (Long-Spinned Urchin)
Family: Toxopneustidae
Lytechinus variegatus (Variegated Urchin)
Class: Holothuroidea (Sea Cucumber)
-

Table 20: Continued

Phylum: Chordata
Class: Ascidiacea (Tunicates)
Order: Enterogona
Family: Ascidiidae
Ascidia nigra
Family: Clavelinidae
Clavelina sp.
Family: Didemnidae
Order: Pleurogona
Family: Molgulidae
Molgula sp.
Family: Pyuridae
Pyrura vitta
Family: Styelidae
Styela plicata
Symplegma viride
Polycarpa spongiabilis
Unidentified orange colonial ascidian
Unidentified red colonial ascidian
Unidentified grey colonial ascidian
Unidentified solitary ascidian

Table 20: Continued

Phylum: Sarcomastigophora

Subphylum: Sarcodina

Order: Foraminiferida

White encrusting foram

White filamentous foram

Phylum: Porifera (Sponges)

Class: Demospongiae

Family: Aplysinellidae

Aplysina fulva

Pseudoceratina crassa (Branching tube sponge)

Family: Niphatidae

Amphimedon compressa (Erect rope sponge)

Niphates erecta (Lavender rope sponge)

Family: Clionidae

Cliona sp.

Family: Mycalidae

Mycale sp.

Unidentified orange encrusting sponge

Unidentified grey encrusting sponge

Unidentified black encrusting sponge

Phylum: Cnidaria

Class: Hydrozoa (Hydroids)

Order: Hydroida

Suborder: Leptomedusae (Thecate hydroid)

Suborder: Anthomedusae (Athebate hydroid)

Class: Anthozoa (Hard and Soft corals)

Order: Alcyonacea

Family: Telestinae

Carijoa riisei (White telesto)

Order: Gorgonacea (Gorgonians)

Family: Plexauridae

Plexorella sp.

Family: Gorgoniidae

Pseudoptergorgia acerosa

Order: Scleractinia

Family: Poritidae

Porites sp.

Family: Mussidae

Mussa sp.

Phylum: Annelida (Segmented worms)

Class: Polychaeta

Family: Eunicidae

Family: Filogranidae

Filigrana huxleyi (Sea frost)

Family: Nereidae

Family: Sabellidae

Family: Serpulidae

Table 21: List of invertebrates identified on Control Reef 2, July 17, 1994.

Family: Syllidae
 Family: Terebellidae
 Family: Amphinomidae
 Hermodice carunculata (Bristle Worm)

Phylum: Arthropoda
 Subphylum: Crustacea
 Class: Maxillopoda
 Subclass: Cirripedia (Barnacles)
 Family: Balinidae
 Balanus amphitrite
 Balanus trigonus

 Class: Malacostaca
 Order: Decapoda
 Family: Alpheidae
 Synalpheus sp.
 Red Snapping Shrimp
 Family: Rhynchocinetidae
 Rhynchocinetes rigens (Red Night Shrimp)
 Family: Bresiliida
 Discias atlanticus
 Family: Stenopodidea
 Stenopus hispidus (Coral Banded shrimp)
 Family: Diogenidae (Hermit crab)
 Family: Palinuridae
 Panulirus argus (Spiny lobster)
 Family: Majidae
 Mithrax cinctimanus (Clinging crab)
 Mithrax sp.
 Stenorhynchus seticornis (Arrow crab)
 Family: Porcellanidae
 Petrolisthes galathirus (Porcellian Crab)

 Order: Amphipoda
 Order: Isopoda
 Order: Tanaidacea
 Order: Mysidacea

Phylum: Mollusca
 Class: Gastropoda
 Family: Cerithiidae
 Cerithium litteratum (Stocky cerith)

 Class: Bivalvia
 Family: Arcidae
 Family: Cardiidae
 Papyridea semisulcata (Frimled Paper Cockle)
 Family: Chamidae
 Chama macerophylla (Leafy Jewel Box)
 Family: Mytilidae (Mussels)
 Musculus lateralis
 Modiolus americanus (Tulip mussel)

Table 21: Continued

Family: Pteriidae (Wing oysters)
 Pinctada imbricata
 Family: Ostreidae (Oyster)
 Lopha frons
 Ostrea permollis (Sponge oyster)

Phylum: Ectoprocta (Brozoans)
 Class: Gymnolaemata
 Order: Cheilostomata
 Family: Membraniporidae
 Membranipora sp.
 Unidentified green encrusting bryozoan
 Unidentified orange encrusting bryozoan

Phylum: Echinodermata
 Class: Ophiuroidea
 Order: Ophiurae (Brittle stars)

Phylum: Chordata
 Class: Ascidiacea (Tunicates)
 Order: Enterogona
 Family: Ascidiidae
 Ascidia nigra
 Family: Didemnidae
 Order: Pleurogona
 Family: Molgulidae
 Molgula sp.
 Family: Pyuridae
 Pyrura vitta
 Family: Styelidae
 Symplegma viride
 Unidentified orange colonial ascidian
 Unidentified red colonial ascidian
 Unidentified grey colonial ascidian
 Unidentified solitary ascidian

Table 21: Continued

Phylum: Sarcomastigophora

Subphylum: Sarcodina

Order: Faraminiferida

White encrusting foram

White filamentous foram

Phylum: Porifera (Sponges)

Class: Demospongiae

Family: Agelasidae

Agelas sceptrum

Family: Aplysinidae

Aplysina fulva

Family: Niphatidae

Amphimedon compressa (Erect rope sponge)

Niphates erecta (Lavender rope sponge)

Unidentified orange encrusting sponge

Unidentified grey encrusting sponge

Unidentified black encrusting sponge

Unidentified blue sponge

Phylum: Cnidaria

Class: Hydrozoa (Hydroids)

Order: Hydroida

Suborder: Leptomedusae (Thecate hydroid)

Thyrosyphus ramosus (Algae Hydroid)

Suborder: Anthomedusae (Athebate hydroid)

Halocordyle distichal (Christmas Tree Hydroid)

Class: Anthozoa (Hard and Soft corals)

Order: Alcyonacea

Family: Telestinae

Carijoa riisei (White telesto)

Order: Gorgonaceae (Gorgonians)

Family: Plexauridae

Eunicea caliculata

Pseudoplexora sp.

Family: Gorgoniidae

Pseudopterorgia acerosa

Order: Scleractinia

Family: Poritidae

Porites sp.

Phylum: Annelida (Segmented worms)

Class: Polychaeta

Family: Amphinomidae

Hermodice carunculata (Bristle worm)

Family: Eunicidae

Family: Filigranidae

Filigrana huxleyi (Sea frost)

Table 22: List of invertebrates identified on Experimental Reef 1, July 17, 1994.

-
- Family: Nereidae
 - Family: Sabellidae (Featherduster worm)
 - Family: Serpulidae
 - Family: Syllidae
 - Family: Terebellidae
- Phylum: Arthropoda
- Subphylum: Crustacea
 - Class: Maxillopoda
 - Subclass: Cirripedia (Barnacles)
 - Family: Balinidae
 - Balanus amphitrite*
 - Balanus trigonus*
 - Class: Malacostaca
 - Order: Decapoda
 - Family: Diogenidae (Hermit crab)
 - Family: Rhynchocinetidae
 - Rhynchocinetes rigens* (Red Night Shrimp)
 - Family: Grapsidae
 - Percnon gibbesi* (Nimble spray crab)
 - Family: Majidae
 - Mithrax sp.* (Clinging crab)
 - Macrocoeloma sp.*
 - Stenorhynchus seticornis* (Arrow crab)
 - Family: Palinuridae
 - Panulirus argus* (Spiny lobster)
 - Family: Stenopodidea
 - Stenopus hispidus* (Coral Banded shrimp)
 - Family: Porcellanidae
 - Petrolisthes galathirus* (Porcelain Crab)
 - Order: Amphipoda
 - Order: Isopoda
 - Order: Tanaidacea
- Phylum: Mollusca
- Class: Gastropoda
 - Family: Cerithiidae
 - Cerithium litteratum* (Stocky cerith)
 - Family: Crepidulinae
 - Crepidula aculeata* (Spiny slipper shell)
 - Family: Cymatiidae
 - Cymantium pileare* (Atlantic Hairy Triton)
 - Class: Bivalvia
 - Family: Arcidae
 - Family: Mytilidae (Mussels)
 - Musculus lateralis*
 - Family: Pteriidae (Wing oysters)
 - Pinctada imbricata* (Atlantic Pearl Oyster)
 - Lopha Frons*
 - Family: Ostreidae (Oyster)
 - Ostrea permollis* (Sponge oyster)
-

Table 22: Continued

Family: Limidae
 Lima scraba (Flame Scallop)
 Family: Chamidae
 Chama maerophylla (Leafy Jewel Box)

Phylum: Ectoprocta (Brozoans)
 Class: Gymnolaemata
 Order: Cheilostomata
 Family: Smittinidae
 Parasmittina sp.
 Unidentified green encrusting bryozoan
 Unidentified orange encrusting bryozoan
 Order: Cyclostomata
 Family: Crisiidae
 Cisia eburnea

Phylum: Echinodermata
 Class: Ophiuroidea
 Order: Ophiurae (Brittle stars)

Phylum: Chordata
 Class: Ascidiacea (Tunicates)
 Order: Enterogona
 Family: Ascidiidae
 Ascidia nigra
 Ascidia sp.
 Family: Didemnidae
 Order: Pleurogona
 Family: Molgulidae
 Molgula sp.
 Family: Pyuridae
 Pyrura vitta
 Family: Styelidae
 Symplegma viride
 Unidentified orange colonial ascidian
 Unidentified red colonial ascidian
 Unidentified grey colonial ascidian
 Unidentified solitary ascidian

Table 22: Continued

Phylum: Sarcomastigophora

Subphylum: Sarcodina

Order: Faraminiferida

White encrusting foram

White filamentous foram

Phylum: Porifera (Sponges)

Class: Demospongiae

Family: Aplysinidae

Aplysina sp.

Family: Desmacidae

Iotrochota birotulata (Green finger sponge)

Family: Niphatidae

Amphimedon compressa (Erect rope sponge)

Niphates erecta (Lavender rope sponge)

Family: Raspailiidae

Echinodictyum pennatum

Family: Myxillidae

Tedania ignis

Family: Thorectidae

Iricinia campana

Unidentified orange encrusting sponge

Unidentified grey encrusting sponge

Unidentified black encrusting sponge

Unidentified blue sponge

Phylum: Cnidaria

Class: Hydrozoa (Hydroids)

Order: Hydroida

Suborder: Leptomedusae (Thecate hydroid)

Suborder: Anthomedusae (Athebate hydroid)

Class: Anthozoa (Hard and Soft corals)

Order: Alcyonacea

Family: Telestinae

Carijoa riisei (White Telesto)

Family: Millorporinidae

Millorporina sp. (Fire Coral)

Order: Gorgonaceae (Gorgonians)

Family: Plexauridae

Eunicea succinea

Plexorella sp.

Muriceopsis flavida

Family: Gorgoniidae

Pseudoptergogia acerosa

Order: Scleractinia

Family: Poritidae

Porities sp.

Table 23: List of invertebrates identified on Experimental Reef 2, July 17, 1994.

Phylum: Annelida (Segmented worms)

Class: Polychaeta

Family: Eunicidae

Family: Filogranidae

Filograna huxleyi (Sea frost)

Family: Nereidae

Family: Sabellidae

Family: Serpulidae

Family: Syllidae

Family: Terebellidae

Phylum: Arthropoda

Subphylum: Crustacea

Class: Maxillopoda

Subclass: Cirripedia (Barnacles)

Family: Balinidae

Balanus amphitrite

Balanus trigonus

Class: Malacostaca

Order: Decapoda

Family: Alpheidae

Alpheus sp. (Snapping shrimp)

Family: Diogenidae (Hermit crab)

Family: Majidae

Mithrax sp. (Clinging crab)

Stenorhynchus seticornis (Arrow crab)

Family: Palinuridae

Panulirus argus (Spiny lobster)

Family: Porcellanidae

Megalobrachium soriatum (Porcellain Crab)

Petrolisthes galathinus (Porcellain Crab)

Family: Grapsidae

Percnon gibbesi (Nimble Spray Crab)

Family: Stenopodidea

Stenopus hispidus (Coral Banded shrimp)

Order: Amphipoda

Order: Isopoda

Order: Mysidacea

Order: Tanaidacea

Table 23: Continued

Phylum: Mollusca

Class: Gastropoda

Family: Cerithiidae

Cerithium litteratum (Stocky cerith)

Family: Crepidulinae

Crepidula aculeata (Spiny slipper shell)

Family: Cyphomidae

Cyphoma gibbosum (Flamingo Tongue)

Family: Triviinea

Trivia pediculus (Coffee Bean Trivia)

Subclass: Opisthobranchia

Order: Nudibranchia

Class: Bivalvia

Family: Arcidae

Family: Chamidae

Chama macerophylla (Leafy Jewel Box)

Family: Cardiidae

Papyridae soleniformis (Spiny Paper Cockel)

Family: Mytilidae (Mussels)

Modiolus americanus

Family: Limnidae

Lima scabra (Flame Scallop)

Family: Pteriidae (Wing oysters)

Pinctada imbricata

Pteria colymbus (Atlantic Wing Oyster)

Family: Ostreidae (Oyster)

Ostrea permollis (Sponge oyster)

Phylum: Ectoprocta (Brozoans)

Class: Gymnolaemata

Order: Cheilostomata

Family: Microporellidae

Microporella sp.

Family: Schizoporellidae

Stylopoma sp.

Order: Cyclostomata

Family: Crisiidae

Crisia eburnea

Unidentified green encrusting bryozoan

Unidentified orange encrusting bryozoan

Table 23: Continued

Phylum: Echinodermata
Class: Ophiuroidea
Order: Ophiurae (Brittle stars)
Class: Echinoidea
Family:
Diadema antillarum (Long-Spined Urchin)

Phylum: Chordata
Class: Ascidiacea (Tunicates)
Order: Enterogona
Family: Ascidiidae
Ascidia nigra
Ascidia sp.
Family: Didemnidae
Order: Pleurogona
Family: Pyuridae
Pyrura vitta
Family: Styelidae
Symplegma viride
Unidentified orange colonial ascidian
Unidentified red colonial ascidian
Unidentified grey colonial ascidian
Unidentified solitary ascidian

Table 23: Continued

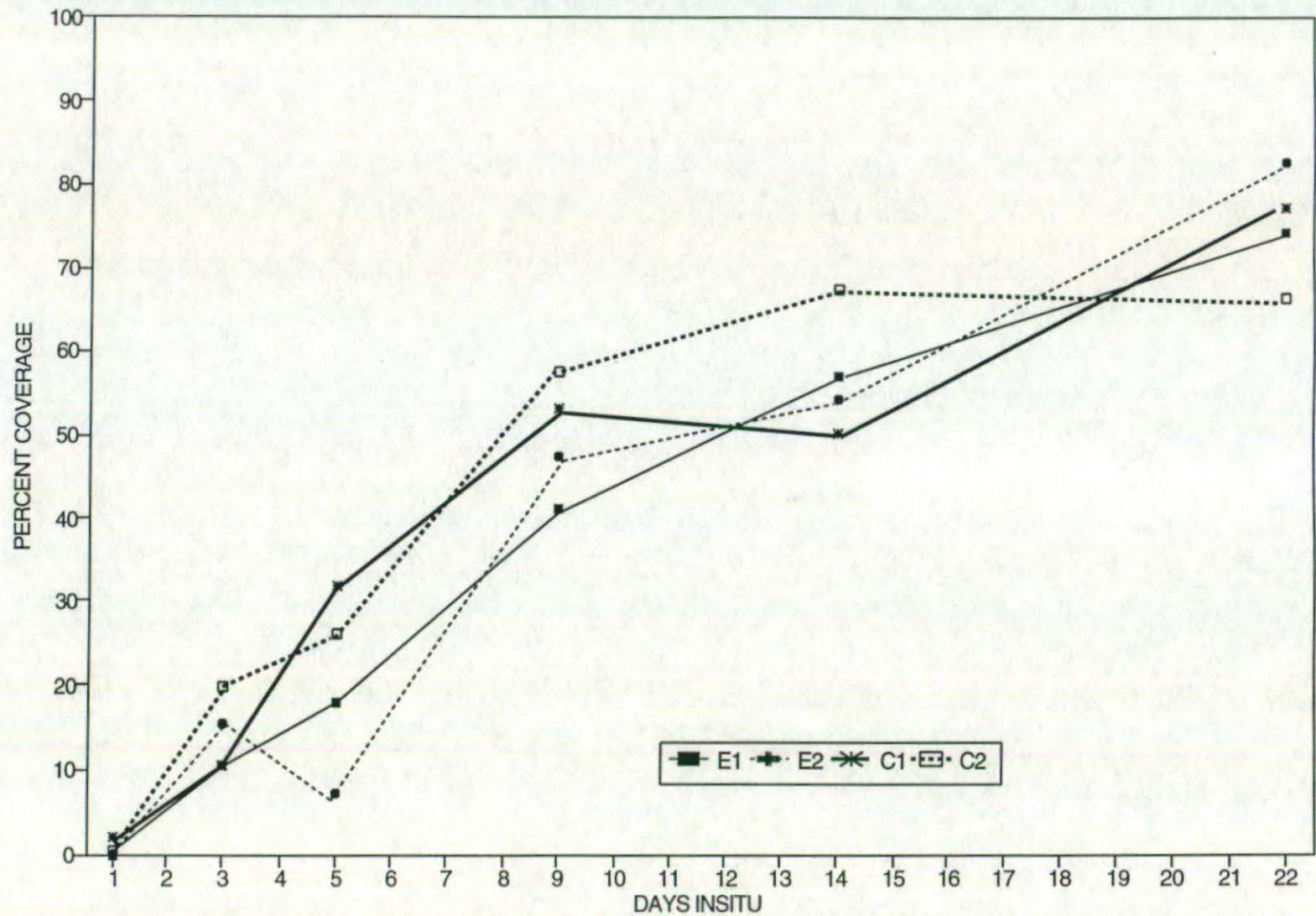


Figure 7: Mean percent organic coverage on all reefs from one day after reef deployment to 22 days after reef deployment.

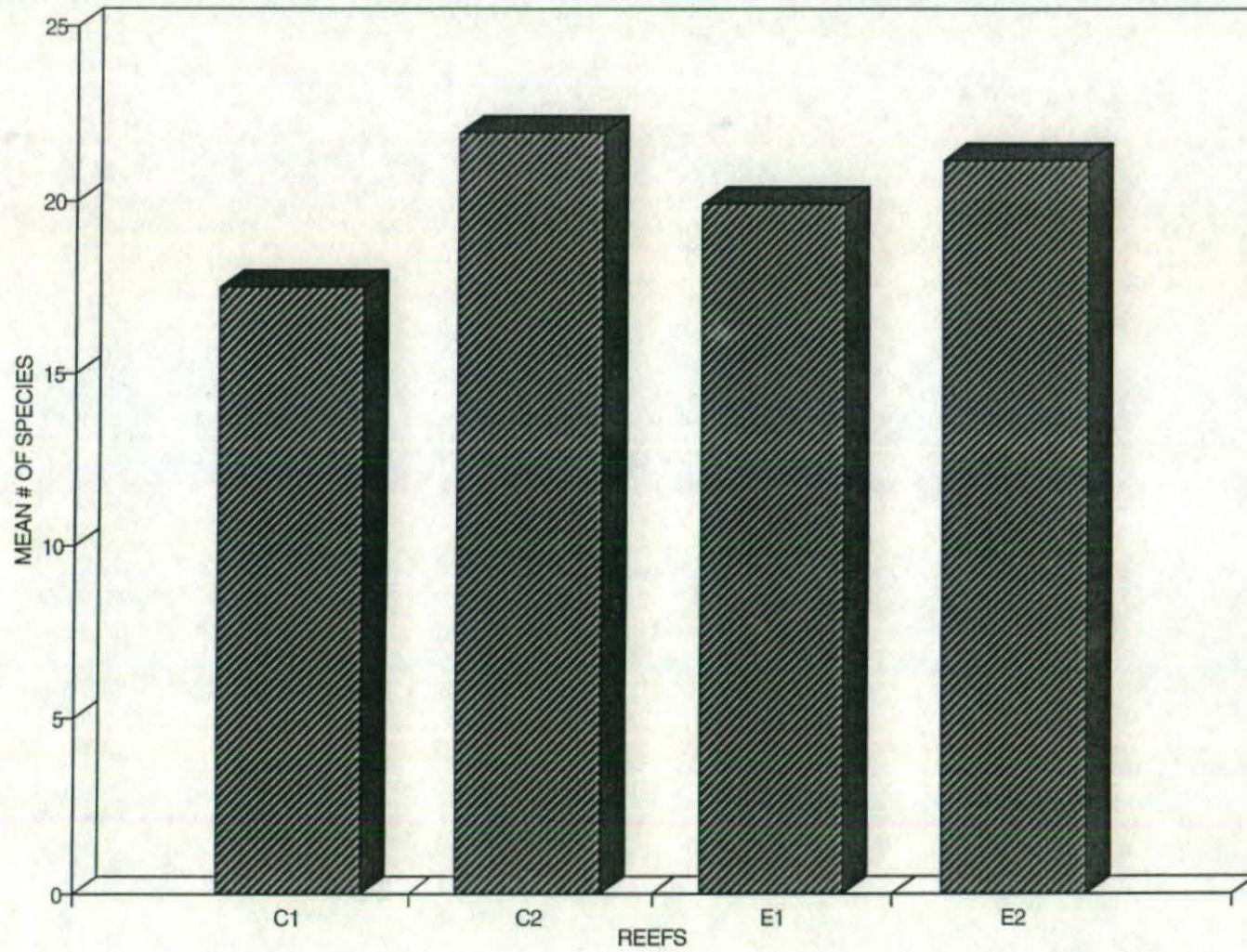


Figure 8: Mean number of species identified on each reef during the second year.

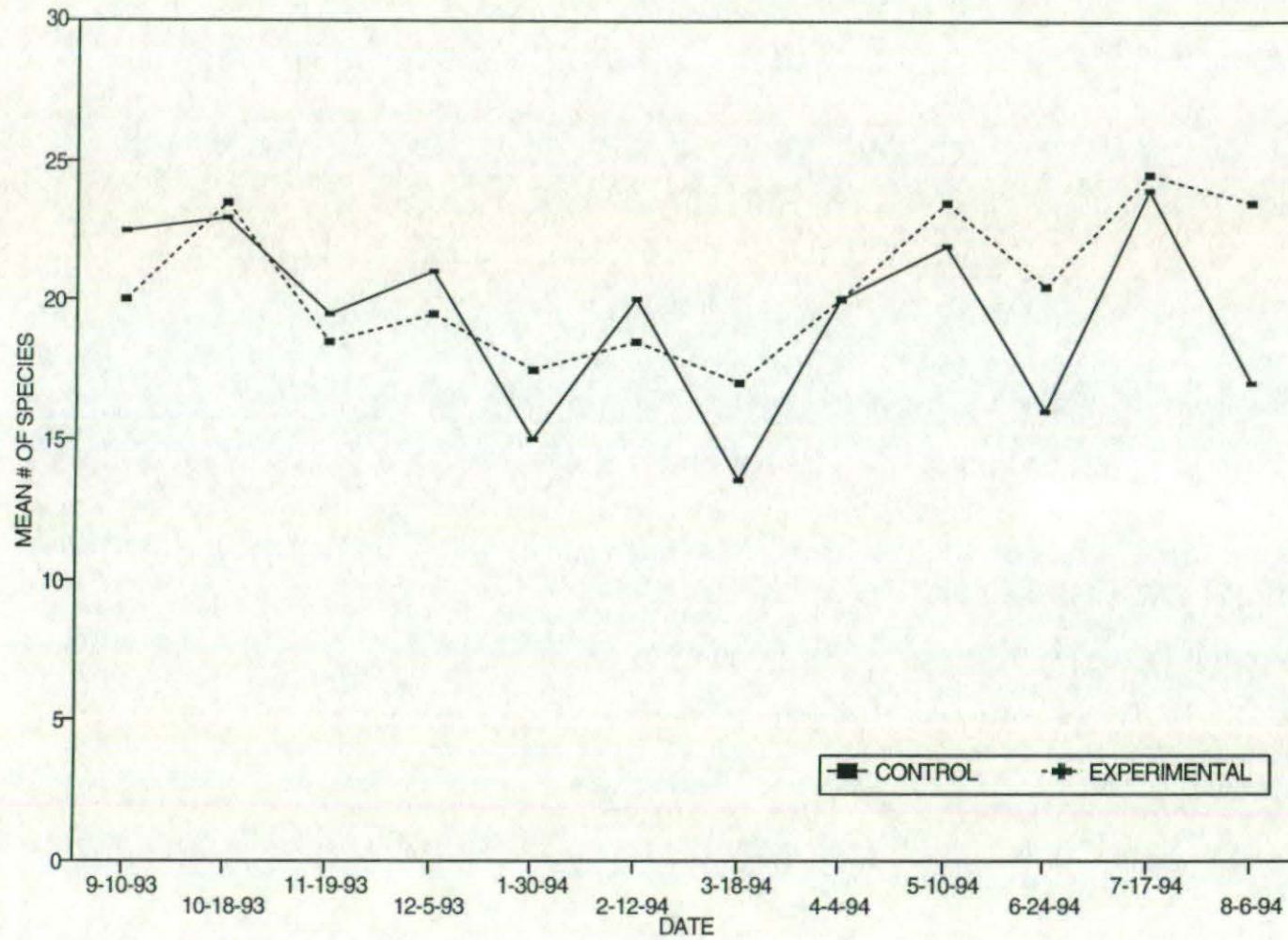


Figure 9: Mean of number of species identified on the Control reefs and Experimental reefs during the second year.

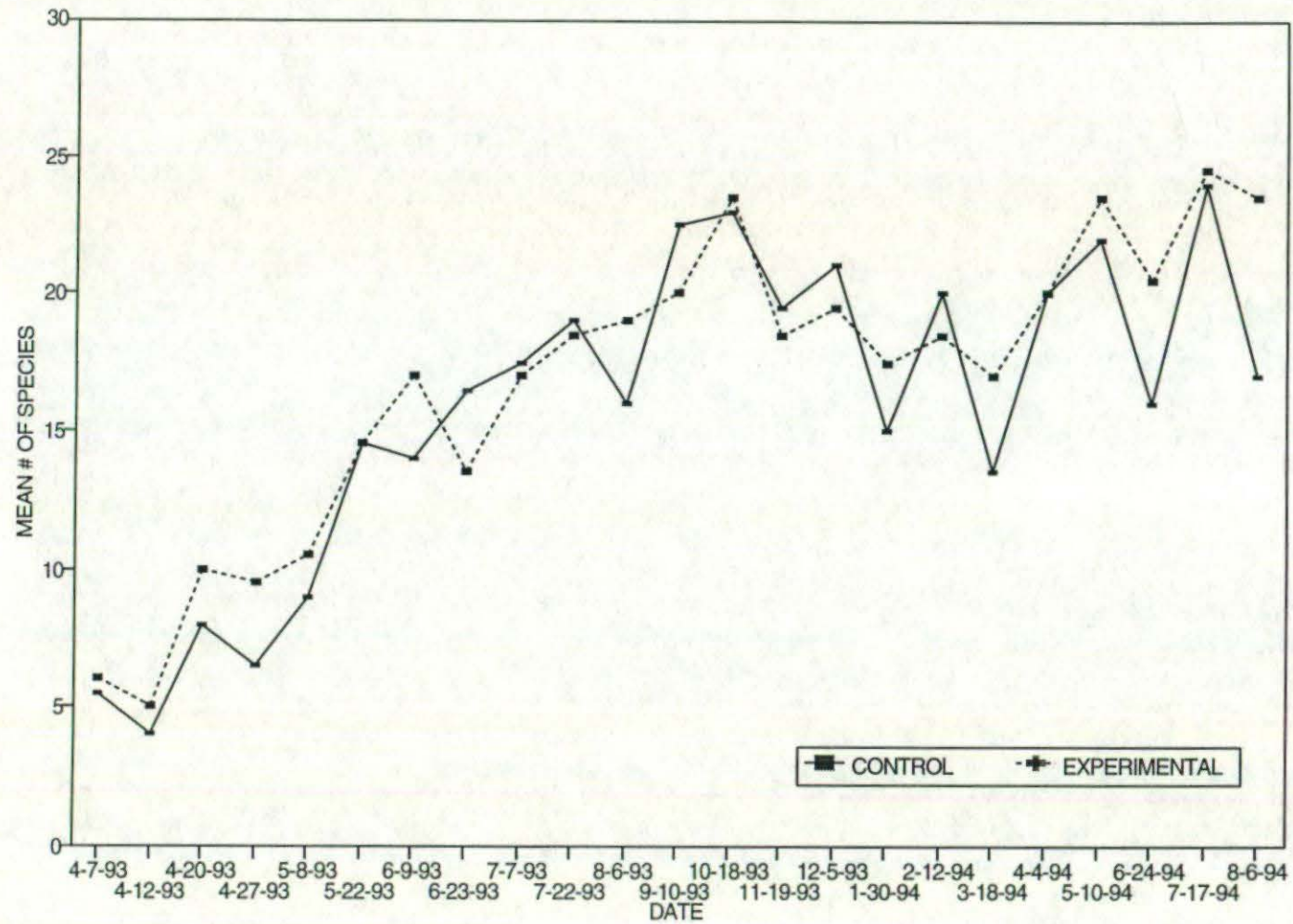


Figure 10: Mean number of species identified on the Control reefs and Experimental reefs during the first and second years.

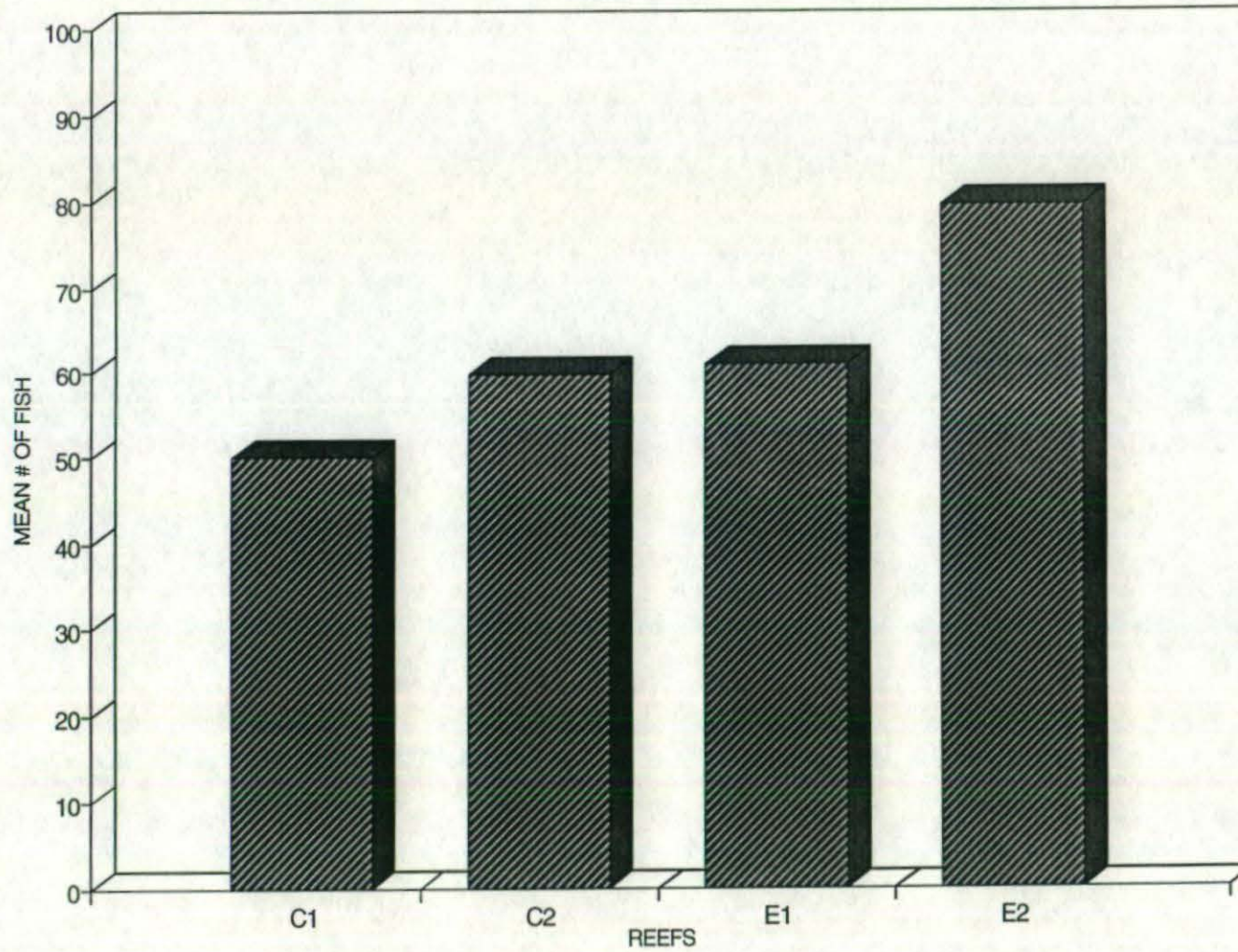


Figure 11: Mean number of fishes counted on each reef during the second year.

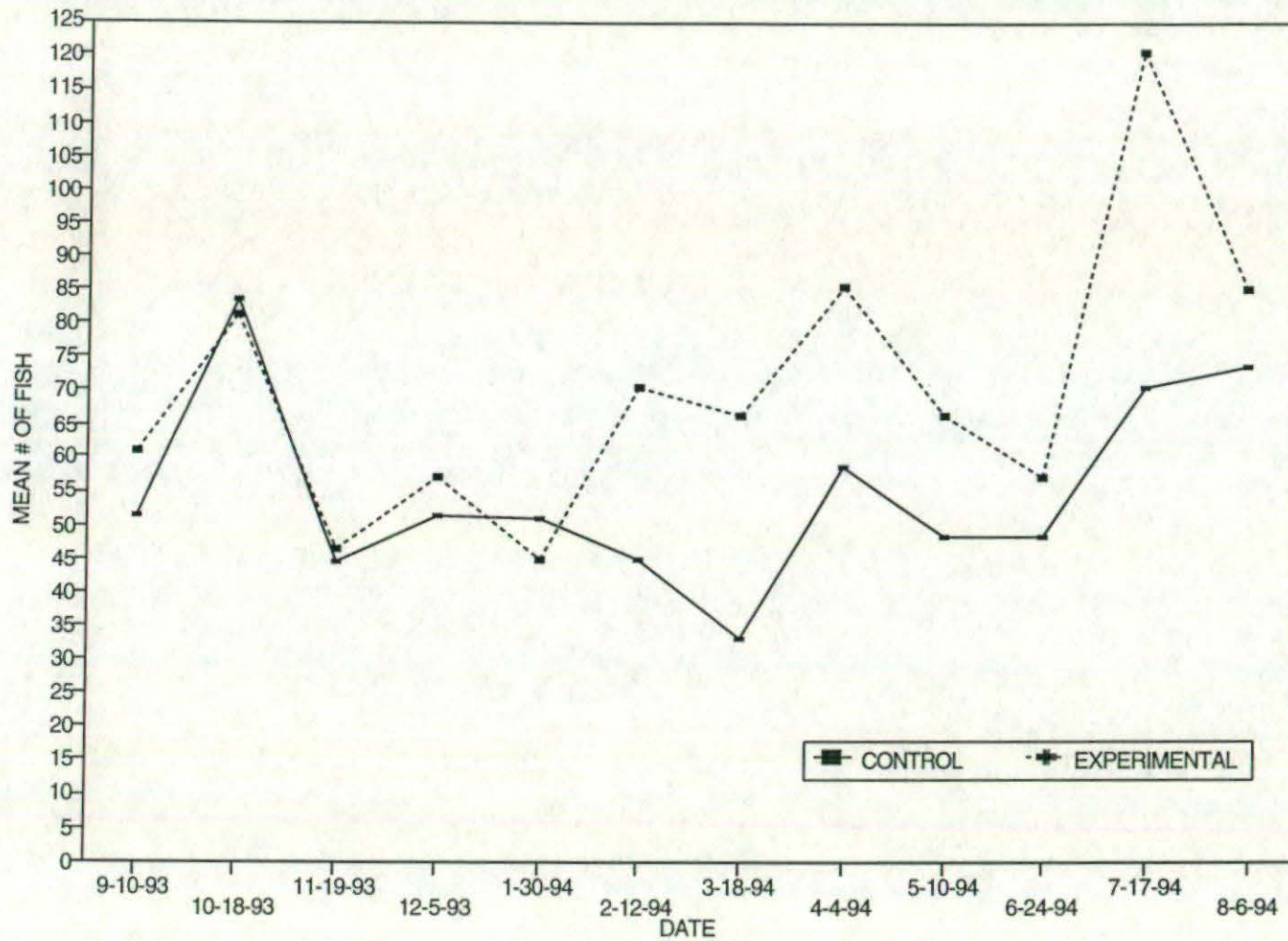


Figure 12: Mean of number of fishes counted on the Control reefs and Experimental reefs during the second year.

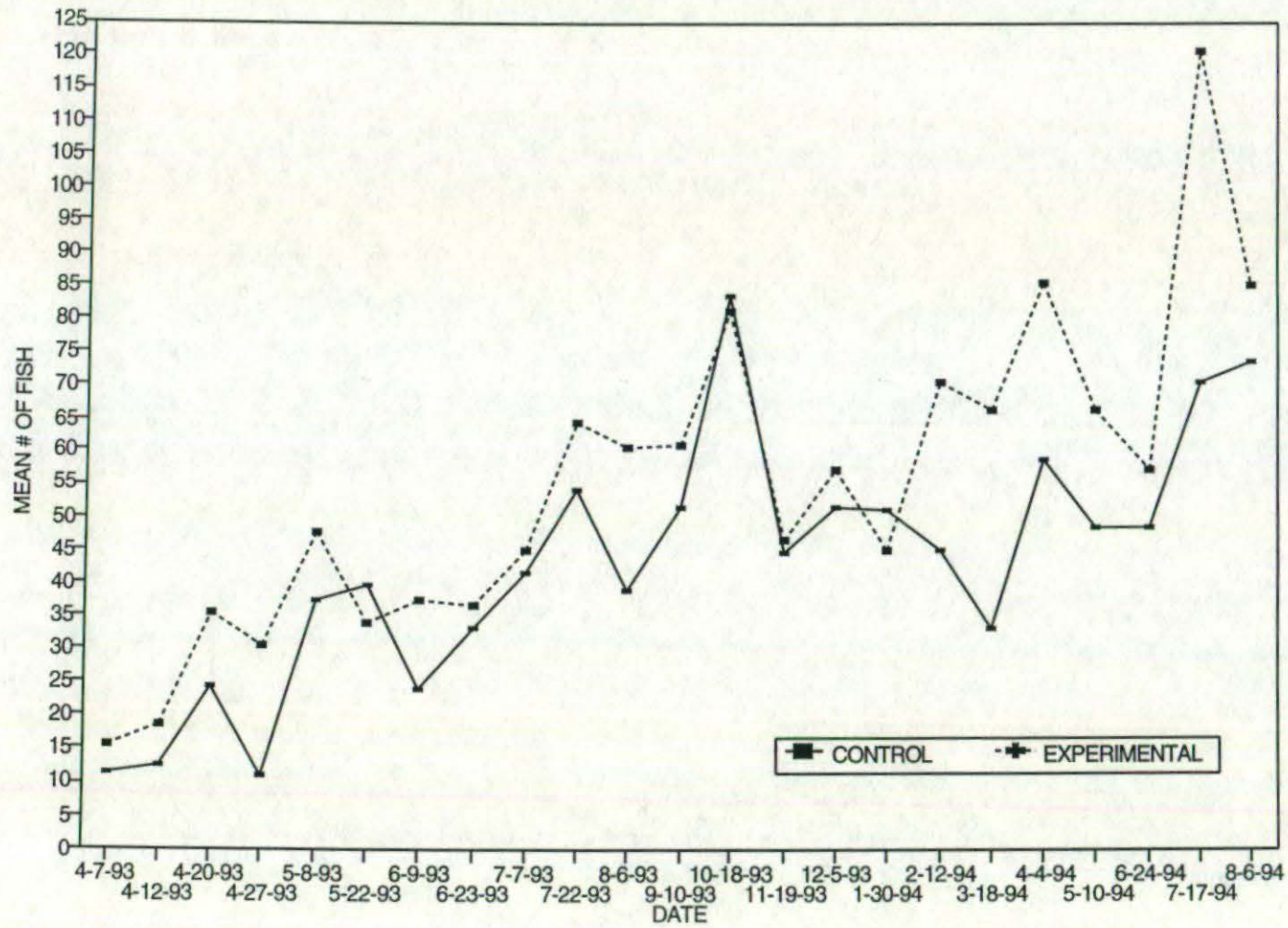


Figure 13: Mean number of fishes counted on the Control reefs and Experimental reefs during the first and second years.