ANDERSEN AIR FORCE BASE MARINE RESOURCES PRESERVE
BASELINE SURVEY OF MARINE RESOURCES

UNIVERSITY OF GUAM
MARINE LABORATORY

December 1995

Cover illustration by Robert A. Amesbury

ANDERSEN AIR FORCE BASE MARINE RESOURCES PRESERVE BASELINE SURVEY OF MARINE RESOURCES

FINAL REPORT

Steven S. Amesbury, Paul R. Chirichetti, and Jynessa Dutka-Gianelli

UNIVERSITY OF GUAM
MARINE LABORATORY

December 1995

TABLE OF CONTENTS

GENERAL INTRODUCTION 1

MARINE PLANTS by Jynessa Dutka-Gianelli 4

CORALS by Paul R. Chirichetti 12

MACRO-INVERTEBRATES by Paul R. Chirichetti 71

FISHES by Steven S. Amesbury 120

SUMMARY AND CONCLUSIONS 155

RECOMMENDATIONS 164

GENERAL INTRODUCTION

The Andersen Air Force Base Marine Resources Preserve was established in 1993 to protect marine resources within the coastal habitats adjacent to Andersen Air Force Base in northeastern Guam. The Preserve runs east from Tarague Beach around Pati Point and south to Anao Point on the east coast of Guam. Within the Preserve, harvesting marine organisms is restricted to the use of hook and line gear from the beach and small boat trolling and bottomfishing in offshore waters. Use of nets and spearguns is prohibited. It is hoped that the restrictions on harvesting within the Preserve will allow marine species there to reach reproductive size and to spawn. Because most marine animals have planktonic larvae, it is expected that reproductive activities within the Preserve will produce larvae that will settle in other reef areas on Guam and thus provide island-wide benefits.

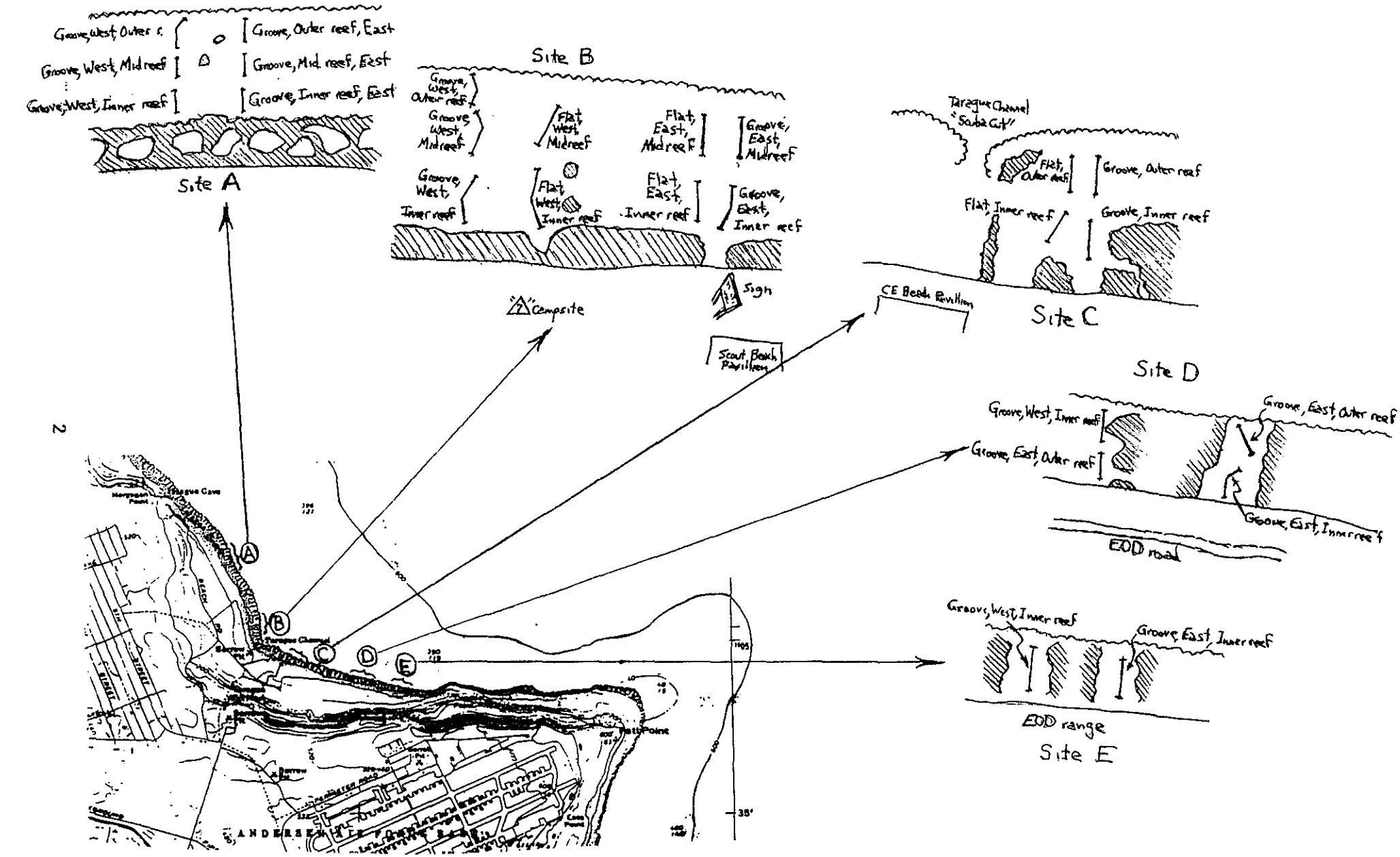
The surveys reported on here were designed to provide a baseline assessment of marine resources within habitats in the Preserve. These baseline data can be used in the future to determine whether marine communities within the Preserve have undergone any significant changes. This report presents results of surveys of marine plants, corals, conspicuous macroinvertebrates, and fishes within the Preserve.

MATERIALS AND METHODS

The Andersen Air Force Base Marine Resources Preserve includes all the coastal waters adjacent to Ansersen Air Force Base except for those included in the Tarague recreational beach area. From Tagua Point (at the site of the explosive ordnance demolition range) east to Pati Point and then south to Anao Point (Map 1), the coastline consists of cliffs with no reef fringing reef development. Between Tarague Beach and Tagua Point, a fringing reef has formed which encloses a reef flat/lagoon habitat bordered on the shoreward side by either sandy beach or consolidated reef rock. The reef flat platform is rather narrow in this area and is subjects to strong water movements, particularly when there are storms or large swell in the vicinity. There are several channels (or "cuts") through the reef margin along this reef flat platform, but the most significant one is Tarague Channel where extremely strong outward flowing currents flow during falling tides.

A notable feature of the reef flat platform in the Andersen Marine Resources Preserve is the presence of considerable emergent reef rock formed during earlier higher seawater stands. Emergent limestone "stacks" are conspicuous in the western part of the Preserve. As one proceeds easterly toward Tagua Point, the emergent reef rock comes to dominate the platform, and the only standing water occurs in occasional channels.

In order to assess the inshore marine resources in the Preserve, we established permanent 25-m long transects in various reef flat habitats (Map 1). We located some transects in deeper channel habitats where marine life was most abundant and diverse and some in shallow "flats" between channels. These latter habitats contained a much less diverse community of marine


Groove, West, Outer reef
Groove, West, Mid reef
Groove, West, Inner reef
Groove, Outer reef, East
Groove, Mid reef, East
Groove, Inner reef, East
Site A
Site B
Groove, West, Outer reef
Groove, West, Mid reef
Groove, West, Inner reef
Flat, West, Mid reef
Flat, West, Inner reef
Flat, East, Mid reef
Flat, East, Inner reef
Groove, East, Mid reef
Groove, East, Inner reef
Sign
"A" campsite
Scout Beach Pavilion
Tarague Channel "Scuba Cut"
Flat, Outer reef
Groove, Outer reef
Flat, Inner reef
Groove, Inner reef
CE Beach Pavilion
Site C
Site D
Groove, West, Inner reef
Groove, East, Outer reef
Groove, East, Outer reef
Groove, East, Inner reef
EOD road
Groove, West, Inner reef
Groove, East, Inner reef
EOD range
Site E
A
B
C
D
E
Tarague Cave
Tarague Channel
Ritidian Point
ANDERSEN AIR FORCE BASE
35'

organisms, but did contain large numbers of sea cucumbers. The transect locations were marked with rebar stakes so that they could be relocated, and the same locations were surveyed during each of the eight surveys. Surveys spanned the period from May 1993 to October 1995. The specific survey techniques used for each group of marine organisms are described in the appropriate sections of this report.

Marine Plants

Jynessa Dutka-Gianelli
Marine Laboratory
University of Guam

METHODS

Marine plant communities within the Anderson Air Force Base Marine Resources Preserve were assessed during eight surveys between June 1993 and October 1995. The Preserve was divided into sites A through E. At each site, the quantitative sampling algae surveys were performed along 25-m transects lines running perpendicular to shore.

A quadrate (25 cm x 25 cm) with 16 points was used to get data to calculate algal percent cover. The species of algae under each point of the quadrat was recorded. If there was no algae present under the points, whatever was present, e.g., sand, pavement, dead coral, live coral, sea cucumber, etc., was recorded.

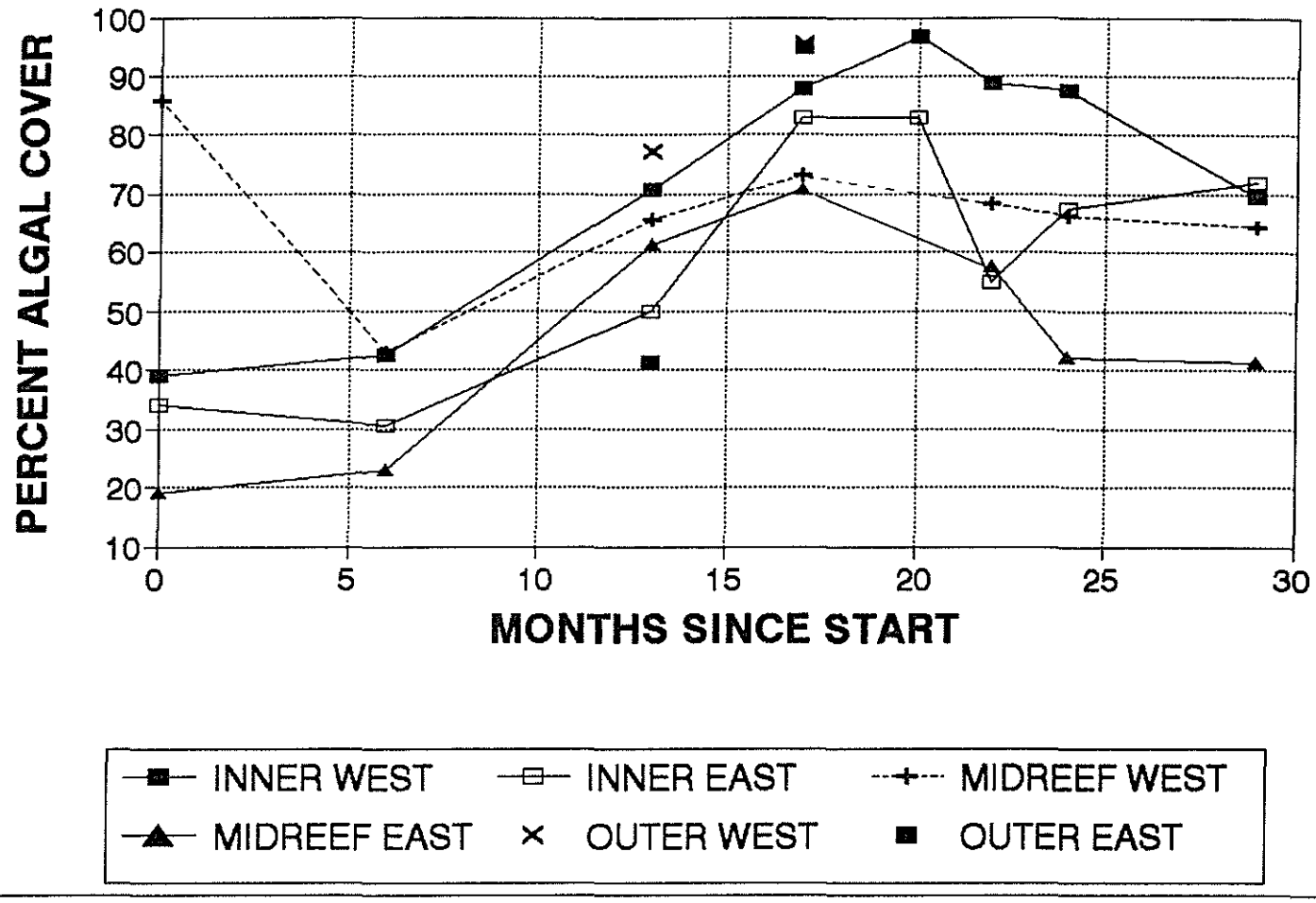
The quadrat was haphazardly tossed 6 times per transect, for total of 96 points per transect. Percent cover of each algal species was obtained by: n (number of points under which an algal species was found) divided by the total number of points of quadrat per zone, multiplied by 100. Percent cover of the non-algae categories was calculated in the same way. The algal species present in the location of the transects, but not encountered under the quadrat, were also recorded.

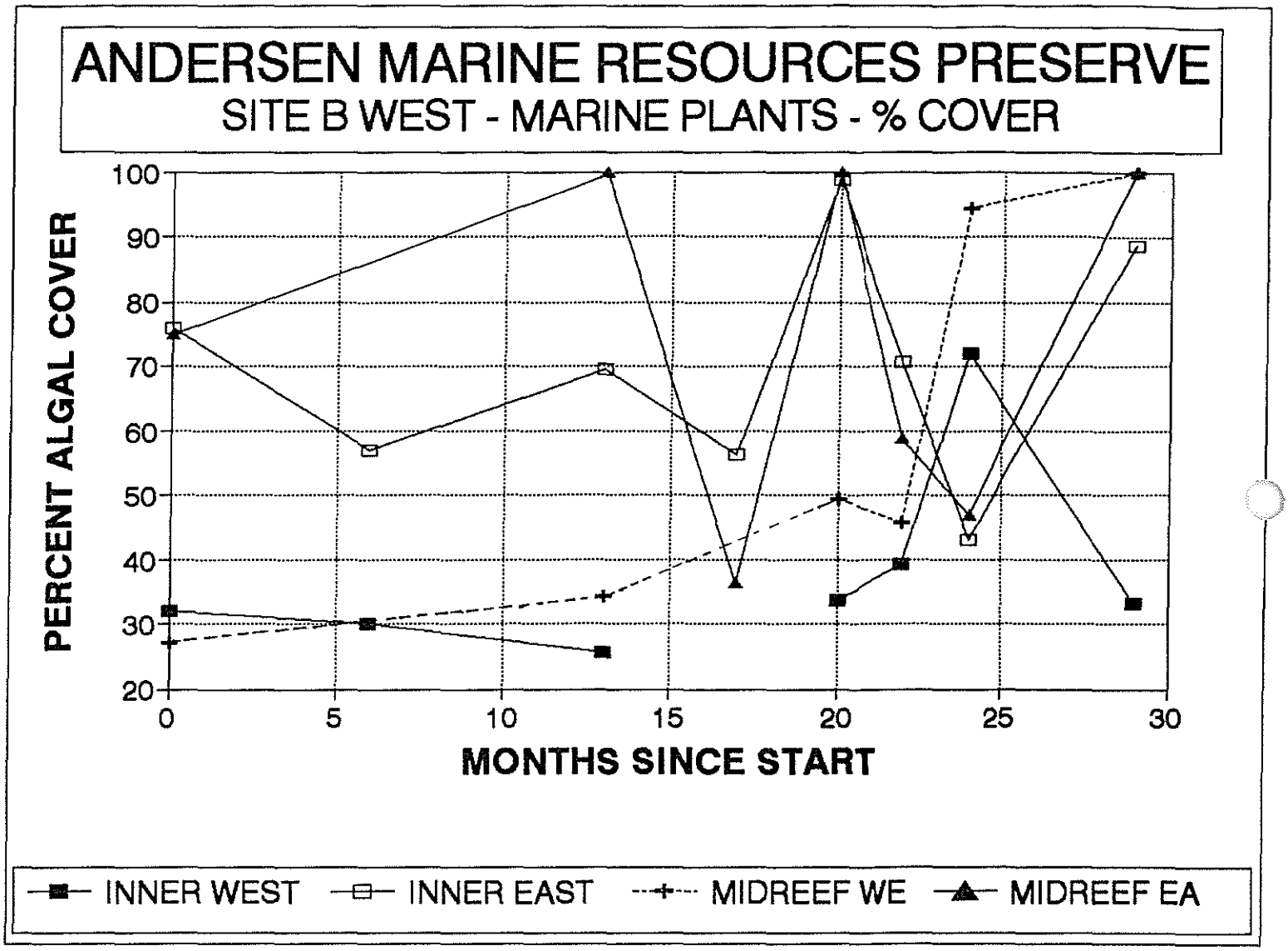
RESULTS

Overall results are presented in Figures 1 through 6 and Tables 1 and 2. Seventy-three species of marine plants were observed within the Preserve. The percent cover of marine plants (principally algae) varied considerably among the sites and throughout the study. Marine plant abundance and species composition tends to be quite variable on reefs for several reasons, most importantly seasonal variability in a number of species which corresponds with wet and dry seasons on Guam and changes in standing stock caused by strong wave action which can almost denude an area of its algae. In addition, variations in herbivore feeding can also impact the communities of seaweeds on reefs. Because marine plant communities are so variable (percent cover, for instance, ranged from almost 0 to almost 100 % on some transects), they are less suitable as indicators of environmental change than are corals or other less variable groups. Nonetheless, the data assembled her provides a baseline assessment of marine plants within the Andersen Preserve, and they may be useful for documenting major biotic changes within the Preserve.

ANDERSEN MARINE RESOURCES PRESERVE

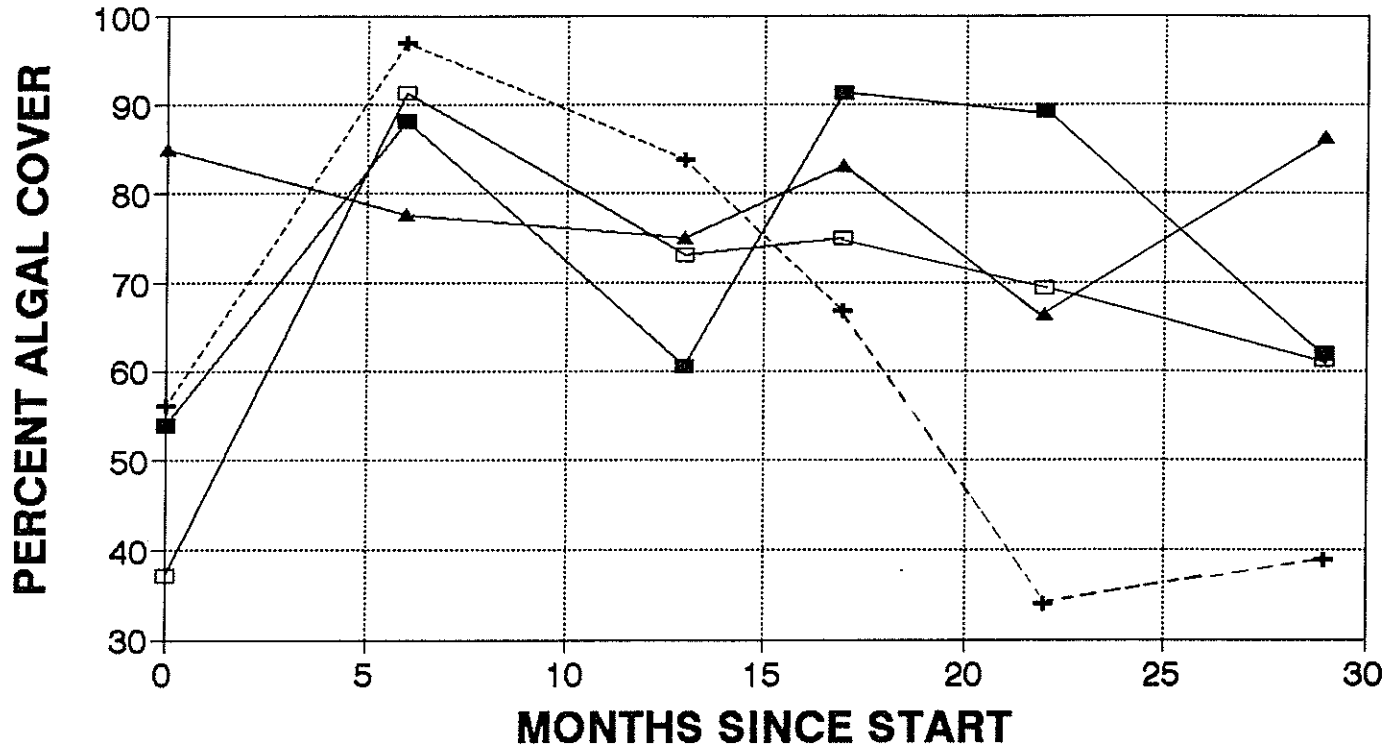
SITE A - MARINE PLANTS - PERCENT COVER




ANDERSEN MARINE RESOURCES PRESERVE
SITE B WEST - MARINE PLANTS - % COVER
PERCENT ALGAL COVER
100
90
80
70
60
50
40
30
20
0
5
10
15
20
25
30
MONTHS SINCE START
INNER WEST
INNER EAST
MIDREEF WE
MIDREEF EA

ANDERSEN MARINE RESOURCES PRESERVE

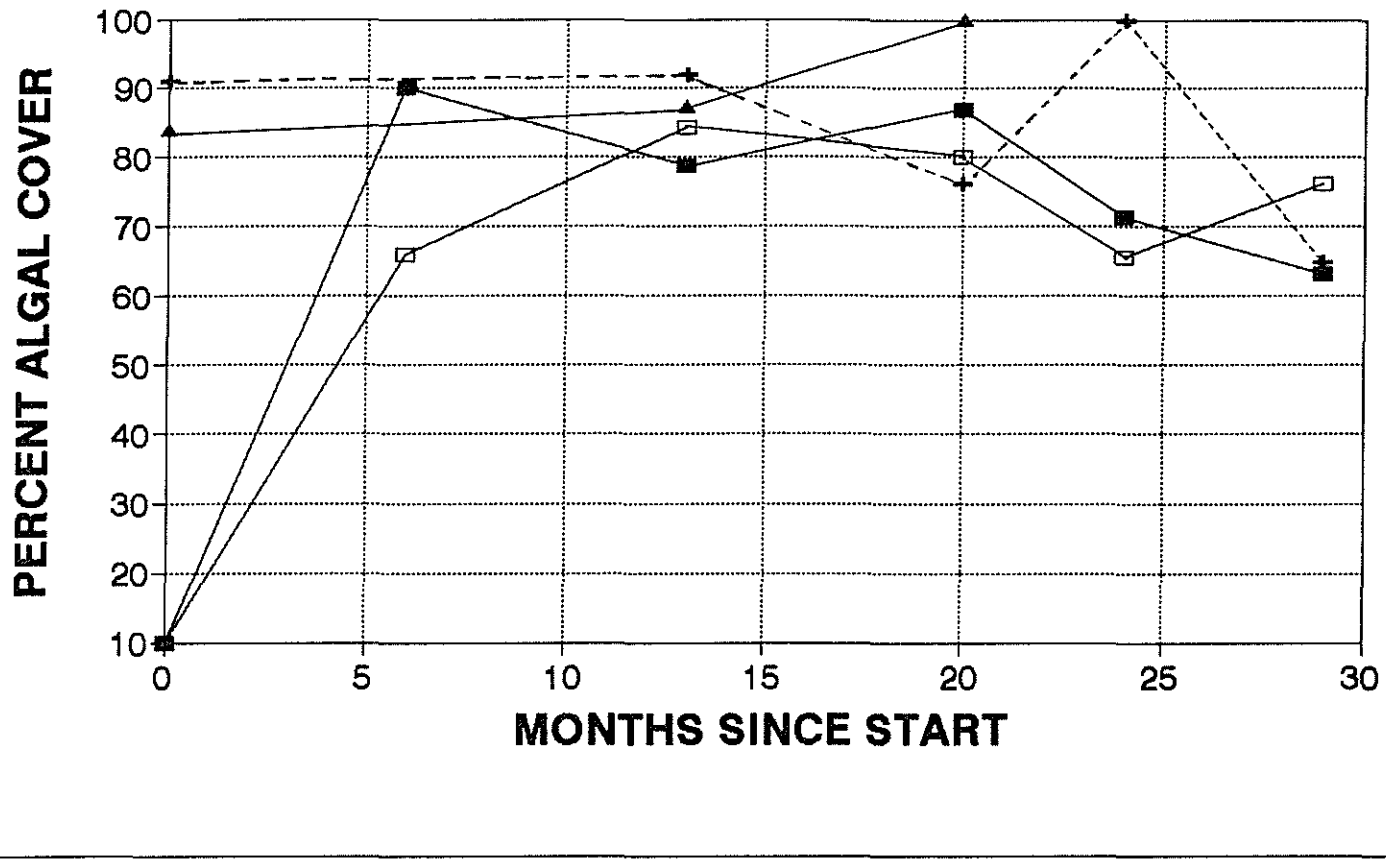
SITE C - MARINE PLANTS - % COVER



INNER WEST — INNER EAST — MIDREEF WE — MIDREEF EA

ANDERSEN MARINE RESOURCES PRESERVE

SITE D - MARINE PLANTS - % COVER



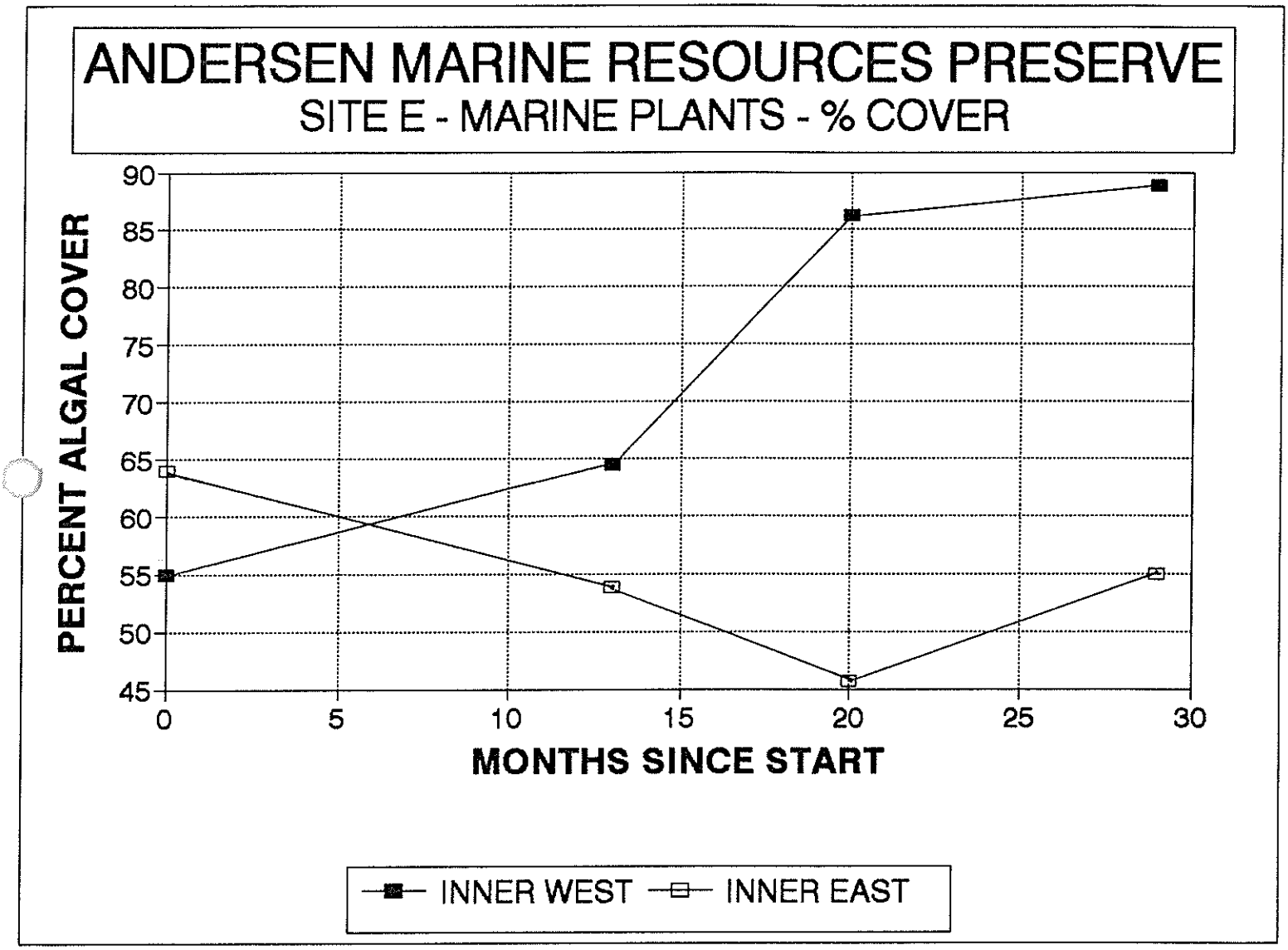

ANDERSEN MARINE RESOURCES PRESERVE
SITE E - MARINE PLANTS - % COVER
PERCENT ALGAL COVER
90
85
80
75
70
65
60
55
50
45
0
5
10
15
20
25
30
MONTHS SINCE START
INNER WEST
INNER EAST

TABLE 1. LIST OF MARINE PLANTS.
ANDERSEN MARINE PRESERVE BASELINE SURVEY

ALGAL SPP.	MAY 1993 #1	OCT93/FEB9 #2	JUNE 1994 # 3	OCT 1994 #4	JAN 1995 # 5	MAR 95 # 6	MAY 95 # 7	OCT 95 # 8
Division CYANOPHYTA								
NOSTOCACEAE								
Hormothamnion enteromorphoides			X	X	X	X*	X*	
OSCILLATORIACEAE								
Micrococleus sp.	X	X						
Schizothrix calcicola	X	X	X	X	X	X*	X	X
Schizothrix mexicana	X			X	X*		X*	X
Division CHLOROPHYTA								
ULVACEAE								
Enteromorpha clathrata	X			X*				
CAULERPACEAE								
Caulerpa brachipus		X*						
Caulerpa cupressoides		X*						
Caulerpa racemosa	X	X	X	X	X	X*		
Caulerpa serrulata	X	X		X	X	X*	X	X
Caulerpa sertularioides	X*	X*	X*	X	X*	X	X	X
Caulerpa taxifolia		X*						X
Caulerpa urvilliana		X*						
Caulerpa webbiana	X							
Caulerpa sp.		X						
CODIACEAE								
Avrainvillea obscura			X		X			X
Chlorodesmis fastigiata	X*	X*						
Chlorodesmis sp.		X		X*	X*			X
Codium arabicum	X		X	X*	X			X
Halimeda incrassata	X	X*	X	X	X	X	X	X
Halimeda macroloba		X*	X*			X		
Halimeda opuntia	X	X*	X	X	X*	X*	X	
Rhipilia sinuosa			X*	X	X	X	X	X
Tydemania sp.		X						
Udotea argentea		X*			X*			
Udotea geppii		X	X	X	X*	X	X	X
BOODLEACEAE								
Boodlea composita	X	X	X*	X*	X*		X*	X
VALONIACEAE								
Boergesenia forbesii	X	X*	X	X	X	X	X	X
Dictyosphaeria cavernosa	X		X	X	X	X	X	X
Dictyosphaeria versluysii	X	X	X*					
Dictyosphaeria sp.		X						
Valonia ventricosa		X	X	X*	X*		X	X
DASYCLADACEAE								
Acetabularia mobii	X		X	X*	X*	X	X	X
Neomeris annulata	X	X	X	X*	X*	X	X	X*
ANADYOMENACEAE								
Microdictyon sp.			X*	X*		X		X*
CLADOPHORACEAE								
Chaetomorpha crassa	X		X*	X	X	X*	X*	X
Cladophora sp.		X	X*	X*	X*	X*	X*	X

TABLE 1. CONT.

ALGAL SPP.	# 1	# 2	# 3	# 4	# 5	# 6	# 7	# 8
Division PHAEOPHYTA								
SPHACELARIACEAE								
Sphacelaria tribuloides	X							
Sphacelaria sp.			X*					
DICTYOTACEAE								
Dictyota bartayresii	X							
Dictyota divaricata	X		X*	X*	X*	X*		
Padina boryana	X	X		X*	X	X*	X*	X*
Padina boryana (var. Vaughniella)	X							
SARGASSACEAE								
Turbinaria ornata	X	X	X	X*	X*	X	X*	X
Division RHODOPHYTA								
BONNEMAISONIACEAE								
Asparagopsis taxiformis	X	X	X*					
CHAETANGIACEAE								
Actinotrichia fragilis		X*		X*	X*			X*
Galaxaura oblongata	X	X*	X*		X*	X	X*	X*
GELIDIACEAE								
Gelidiella acerosa	X		X	X	X	X	X	X
Gelidium sp.	X	X	X	X	X	X	X	X
HELMINTHOCLADIACEAE								
Liagora sp.		X						
CORALLINACEAE								
Amphiroa fragilissima	X*							
Hydrolithon reinboldii	X	X	X	X	X	X	X	X
Jania capillacea		X	X*	X	X	X*	X	X*
Jania sp.	X	X*	X*	X*	X	X*		X*
Lithophyllum moluccense	X							
Mastophora rosea	X	X	X	X*	X	X*	X*	X*
Neogoniolithon frutescens	X	X*	X	X	X	X	X	X*
Porolithon onkodes	X	X	X	X	X	X	X	X
Spongolithon sp.	X	X	X		X*	X*		
CRYPTONEMIACEAE								
Halymenia durvillaei	X*	X*	X*	X*	X*		X*	X*
PEYSSONELIACEAE								
Peyssonelia rubra	X	X	X	X	X	X	X	X
RHIZOPHYLLIDACEAE								
Portieria hornemannii	X		X*	X*	X	X	X	X*
GRACILARIACEAE								
Gelidiopsis intricata		X						
RHODYMENIACEAE								
Rhodymenia divaricata	X*							
CERAMIACEAE								
Centroceras clavulatum	X							
Centroceras sp.			X*					
Ceramium sp.	X	X	X*	X*	X	X	X	X*
Haloplegma duperreyi			X*	X*	X*		X*	X*
Leveillea jungermannioides	X		X*					X*
Polysiphonia sp.	X		X*					X*
Spyridia filamentosa	X*							
Tolypiocladia glomerulata	X							X*
RHODOMELACEAE								
Laurencia sp.		X	X*					X*
ANTHOPHYTA (seagrasses)								
Halodule uninervis					X*	X*	X*	X*
TOTAL	49	44	44	39	42	34	33	42

* = Species present in the location, but didnot fall under the quadrat

Corals

Paul R. Chirichetti
University of Guam, Marine Laboratory

Introduction

This is the eighth and final in the series of reports on general coral coverage across the main reef-flat at the Andersen Air Force Base Marine Resource Preserve. Information contained in the tables includes transect-by-transect coral density, percent coverage, and frequency as well as individual species size range, percent coverage and frequency within three zones (near-shore, mid-reef, and near-crest).

Methods

The methods used to sample the coral community during the present (September/October, 1994) survey are the same as those described in the initial report (Amesbury et al. 1994) as are the corrections in performing the calculations noted in the June 1994 survey (Amesbury et al., 1995).

Results

Near-shore zone: mean coral coverage for transects in this zone during the eighth survey ranged from 0.0% - 5.39% with a mean value for the zone at 1.16%. Mean coverage values for this zone through the eight surveys ranged between 0.76% (survey 2) and 2.39% (survey 5). The averaged values of zone means for all surveys is 1.36% (Table 1, Figure 1). The greatest coverage values on individual transects occurring consistently on transect B-3 east (range 3.82%-17.51%).

The individual coral species that contribute the most to coral coverage in the near-shore zone during this survey were *Acropora aspera*, *Porites* sp. (massive), *Goniastrea retiformis*, and *Pocillopora damicornis* and these four species were also the most important species in the near-shore zone for all surveys combined (Table 2, Figure 2). *Acropora aspera* constitutes greater than 50% of the relative coverage for all species found in this zone (Figure 2a). The total number of species found along transects in this zone during all surveys was 9.

Mid-reef zone: Estimated mean coral coverage for this zone during eight surveys ranged between 2.81%-9.79%, the mean value for this survey falling between these two values (4.19%). Replicates of B-4 east and D-4 consistently have the highest individual transect values (12.1%-29.62% and 24.17%-58.51% respectively) although transect D-4 was not sampled more than twice during the course if the survey due to hazardous water conditions that are consistently encountered at this site. (Table 3, Figure 3).

As in the near-shore zone *Acropora aspera*, *Porites* sp. (massive), *Pocillopora damicornis* and *Goniastrea retiformis* are the major contributors to overall coral coverage in this zone (Table 4, Figure 4). *Acropora aspera* has the highest relative coverage value of any species

in both zones (53% near-shore and 66% mid-reef; Figure 4a), but the relative positions of the next three corals changes. *Goniastrea retiformis* becomes more important in this zone while *Porites* sp. (massive), and *Pocillopora damicornis* maintain there positions relative to one another. *Acropora digitifera, Favia matthaii*, and *Acropora* sp. are added to the list of most important species in mid-reef zone overall. The total number of species encountered on transects in this zone during all surveys was 24.

Near-crest zone: no data was collected from transects in this zone during this survey due to hazardous water conditions along the reef crest. During the three surveys that data was able to be collected along the reef-crest mean coverage values in the zone ranged from 11.74%-15.68% with the overall zone mean value estimated at 12.88% (Table 5, Figure 5).

Corals in the near-crest zone contributing to the majority of coral coverage include *Goniastrea retiformis, Heliopora coerula, Porites* sp. (massive), *Leptoria phyrgia, Pocillopora damicornis, P. verrucosa, Porites annae, Favia stelligera, A. palifera, A. variabilis, Pocillopora setchelli, Pavona varians, Psammocora contigua, P. obtusangula, Acropora sp., Lepatstrea purpurea, Favia matthaii*, and *Montipora ehrenbergii*. (Table 6, Figure 6). The massive *G.retiformis* has the highest relative coverage value in this zone (45.7%), and the overall number of species found on the three transects in this area is 27 (Figure 6a)..

Overall mean coral coverage values increase from the near-shore zone (1.36%), through the mid-reef (4.74%) to the near-crest zone (12.88%) (Table 7). The mean coverage values for each survey in each zone is illustrated in Figure 7.

Discussion

There is a great deal of overlap in the amount of coral coverage found across all transects within zones, and also between zones across the reef flat. Near-shore transects varied between 0.0% and 17.51% (Tables A1-A8), mid-reef transects coverage values varied between 0.0% and 29.6%, excluding transect D-4 (Tables A17 - A24). Transect D-4 was only sampled twice during the eight surveys and had a high value of 58.5% (survey 1, Table A17). This transect should more properly been grouped with the near-crest transects as the latter half of this transect ends in the center of a groove cutting through the reef margin. Near-crest coral coverage values varied between 3.5% and 35.6% (Tables A33 - A35).

Pocillopora damicornis was consistently the most frequently encounter coral in the near-shore zone ranging in relative frequency from 44%-76% of all corals found during any given survey (Tables A9-A16). *P. damicornis* is a small coral, (mean colony size ranged from 27 - 111 cm sq.), but its abundance made it the third most important species (11.5% relative coverage) in the near-shore zone (Figure 2a).

This position changes slightly in the mid-reef zone where *P. damicornis* is the fourth most important coral in terms of relative coverage (4.5%, Figure 4a). With the exception of survey 5, *P. damicornis* is also the most frequently encountered (25% - 58%) coral in the mid-reef zone . The size range for *P. damicornis* is also greater in this zone, ranging from 1 - 550 cm sq.(Tables

A25 - A32).

The near-crest zone was a very difficult area to sample due to large wind-generated waves that continually break on this exposed, windward coastline. This wave action determines coral community structure favoring massive, encrusting, or branching corals with extremely compact growth forms. *G. retiformis*, *Heliopora coerula*, and *Porites* sp. make up 64% - 78% of the relative coverage in this zone (Tables A36-A38, and Figure 6a). *A. aspera* was not encountered here although the species list increases to contain 27 corals.

We have identified the species in each zone which are the most frequently encountered as well as those in each zone that contribute most to overall coral coverage. The variation shown in the changing density, frequency, and percent coverage calculations over the course of these surveys is most probably due to a combination of the highly aggregated and patchy distributions of corals that occurs naturally combined with the sampling method used. Even though the transects are "permanant" in the sense that we staked transects that were repeatedly sampled, ten exact points along each transect were not sampled every time. During each sampling the transect tape can be moved by water currents up to a foot in either direction and by sampling different points along the same general area it was thought that a much more representative picture of coral abundance and distribution would emerge.

Real variation in the size, number and area of coverage of corals over time along each individual transect will depend each corals location in relation to water depth, bottom topography, and exposure to storm waves and freshwater runoff. Corals in deeper areas of the near-shore zone such as transects B3e and B4e (containing large stands of *A. aspera*) will be buffered from extreme conditions . Transect located in shallower water or over featureless pavement, are not as protected from these conditions and may have higher variability of coral coverage over time. Long term changes in community structure may also be determined by geologic uplift, evidenced by the elevated karst deposits existing at Sites D and E.

Bibliography

Amesbury, S. S., P. R. Chirichetti, A. M. Kerr, B. Davidson, J. Dutka-Gianelli, and C. Dayton. 1993. Andersen Air Force Base Marine Resources Preserve Baseline Survey of Marine Resources. First Survey, May-August 1993. University of Guam Marine Laboratory Environmental Survey Report No. 27.

Amesbury, S.S., P.R. Chirichetti, and J. Dutka-Gianelli. 1993. Andersen Air Force Base Marine Resources Preserve Baseline Survey of Marine Resources. Third Survey, June 1994. University of Guam Marine Laboratory Environmental Survey Report No. 30.

Table 1

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Comparison of coral percent coverage by transect between surveys.
May 1993 through October 1995
Near-shore zone

Transect	Survey 1 5/93-8/93	Survey 2 11/93-2/94	Survey3 6/94	Survey 4 9/94-10/94	Survey 5 1/95	Survey 6 3/95-4/9	Survey 7 5/95	Survey 8 10/95	Transect mean	Stds	Range*
A1	0.38	1.28	1.15	0.87	0.76	0.88	0.29	0.95	0.82	0.34	0.48-1.16
A4	0.00	0.02	0.09	0.03	0.13	0.07	0.12	0.34	0.10	0.11	0-0.21
B1 west	0.003	no data	0.00	0.00	0.00	0.005	0.00	0.001	0.001	0.002	0-0.003
B4 west	0.14	no data	1.20	0.36	1.05	1.99	2.30	2.88	1.17	1.01	0.16-2.18
B1 east	0.01	0.00	0.00	0.00	0.00	0.18	0.00	0.00	0.02	0.06	0-0.08
B3 east	9.27	5.91	9.29	3.82	17.51	0.78	9.16	5.39	7.64	5.00	2.64-12.64
C1	no data	0.00	0.00	0.001	no data	0.01	0.01	0.02	0.01	0.01	0-0.02
C3	0.002	0.11	0.22	0.39	no data	0.09	0.91	0.08	0.26	0.31	0-0.57
D1	1.59	0.05	0.05	no data	0.71	no data	0.06	0.35	0.47	0.61	0-1.08
D3	1.75	0.31	2.07	no data	0.93	no data	1.25	0.47	1.13	0.70	0.43-1.83
E1	1.78	0.00	1.14	no data	1.25	no data	no data	1.79	1.19	0.73	0.46-1.92
E2	0.22	1.06	1.93	no data	0.37	no data	no data	0.77	0.87	0.68	0.19-1.55
Zone mean	1.06	0.76	1.71	1.85	2.39	0.81	1.17	1.16	1.36	0.57	0.79-1.93

Range is defined as one standard deviation from the mean value in either direction.

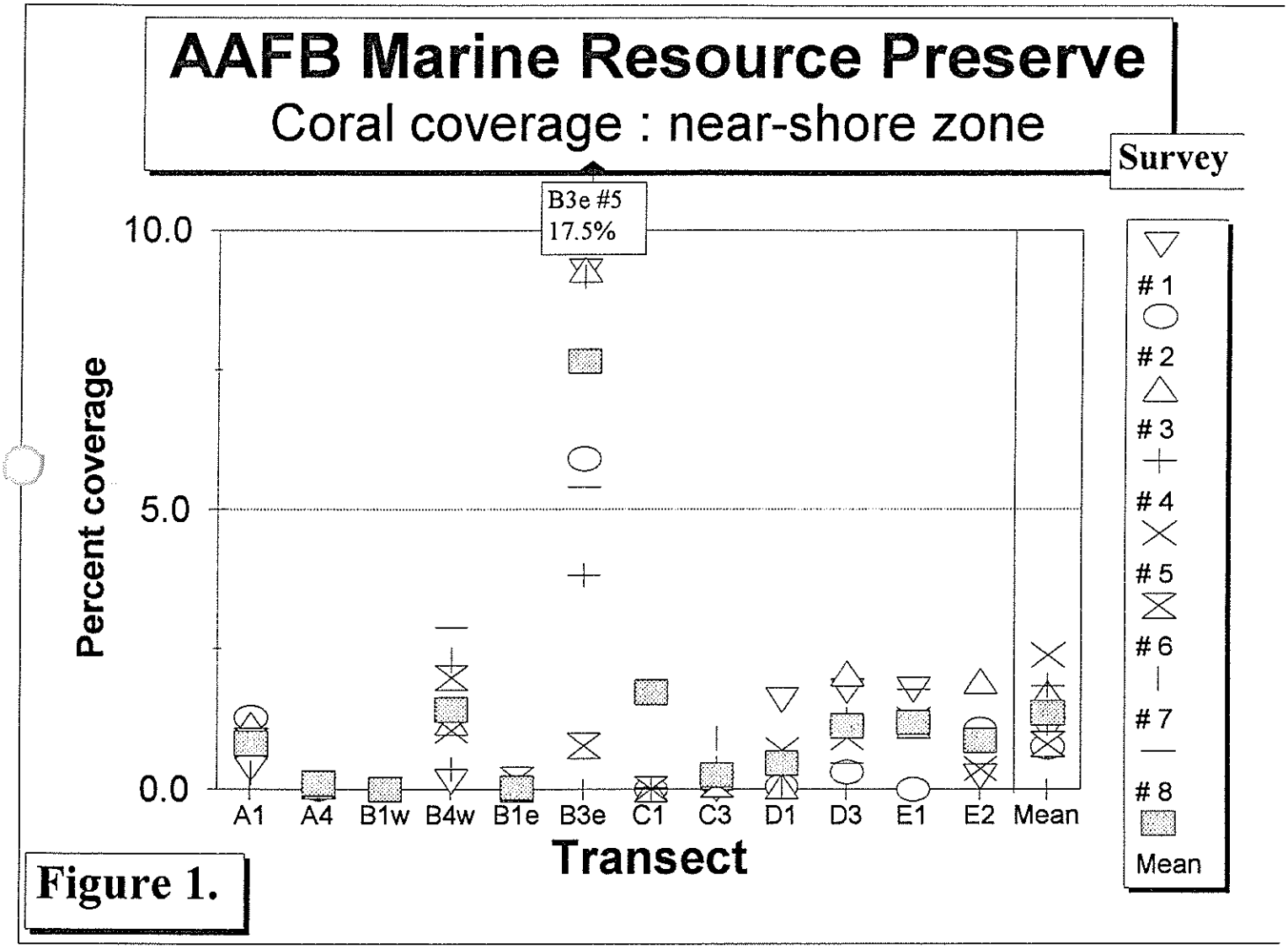

AAFB Marine Resource Preserve
Coral coverage : near-shore zone
Survey
B3e #5
17.5%
10.0
5.0
0.0
Percent coverage
A1
A4
B1w
B4w
B1e
B3e
C1
C3
D1
D3
E1
E2
Mean
Transect
1
2
3
4
5
6
7
8
Mean

Figure 1.

Table 2.

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Contribution of most important coral species (*) to percent coverage within zones between surveys.
All survey comparison: May 1993-October 1995.
Near-shore zone.

Species	Survey # 1	# 2 (**)	# 3	# 4 (**)	# 5 (**)	# 6 (**)	# 7 (**)	# 8	Mean
Acropora aspera	**0.34**	**0.22**	**0.74**	**1.59**	**1.35**	**0.62**	**0.76**	**0.18**	**0.72**
Porites sp.	**0.41**	**0.37**	**0.34**	0.10	**0.59**	0.05	**0.20**	**0.56**	**0.33**
Pocillopora damicornis	**0.07**	**0.12**	**0.18**	**0.15**	**0.16**	**0.15**	**0.17**	**0.24**	**0.16**
Goniastrea retiformis	**0.23**	0.05	**0.45**	0	**0.23**	0	0.03	**0.18**	**0.15**
Acropora formosa	0.02	0	0	0	0.05	0	0	0	0.01
Leptastrea purpurea	0.0004	0.002	0	0.002	0.001	0	0.0004	0.001	0.001
Heliopora coerula	0	0	0	0	0.01	0	0.01	0	0.002
Acropora digitifera	0	0	0	0	0.002	0	0	0	0.0003
Favia sp.	0	0	0	0	0	0	0	0.00004	0.000005
Percent coverage most important species	1.04	0.71	1.71	1.74	2.33	0.76	1.14	1.16	1.32
Percent coverage other species	0.02	0.05	0.002	0.11	0.06	0.05	0.03	0.001	0.04
Total percent coverage for survey	1.06	0.76	1.71	1.85	2.39	0.81	1.17	1.16	1.36

Most important species defined as those species combining to contribute 95%or greater relative percent coverage during each individual survey. Most important species in bold.

***Not all transects surveyed**

AAFB Marine Resource Preserve

Greatest coral cover : near-shore zone

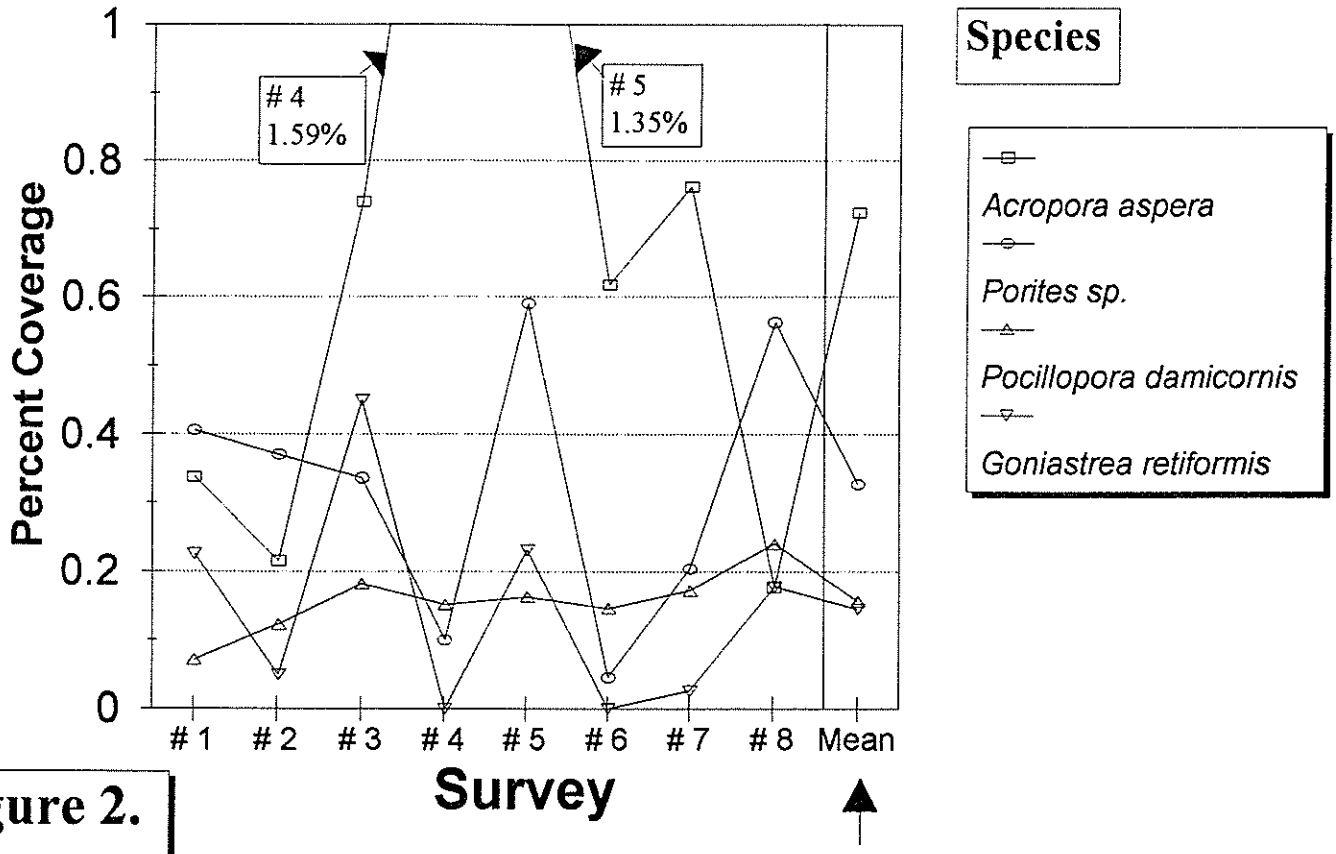


Figure 2.

Relative abundance of corals in sample

Most important species:near-shore zone

Range of mean coral coverage values for all surveys = 0.81%-2.39%.Grand mean, all surveys combined : 1.36%

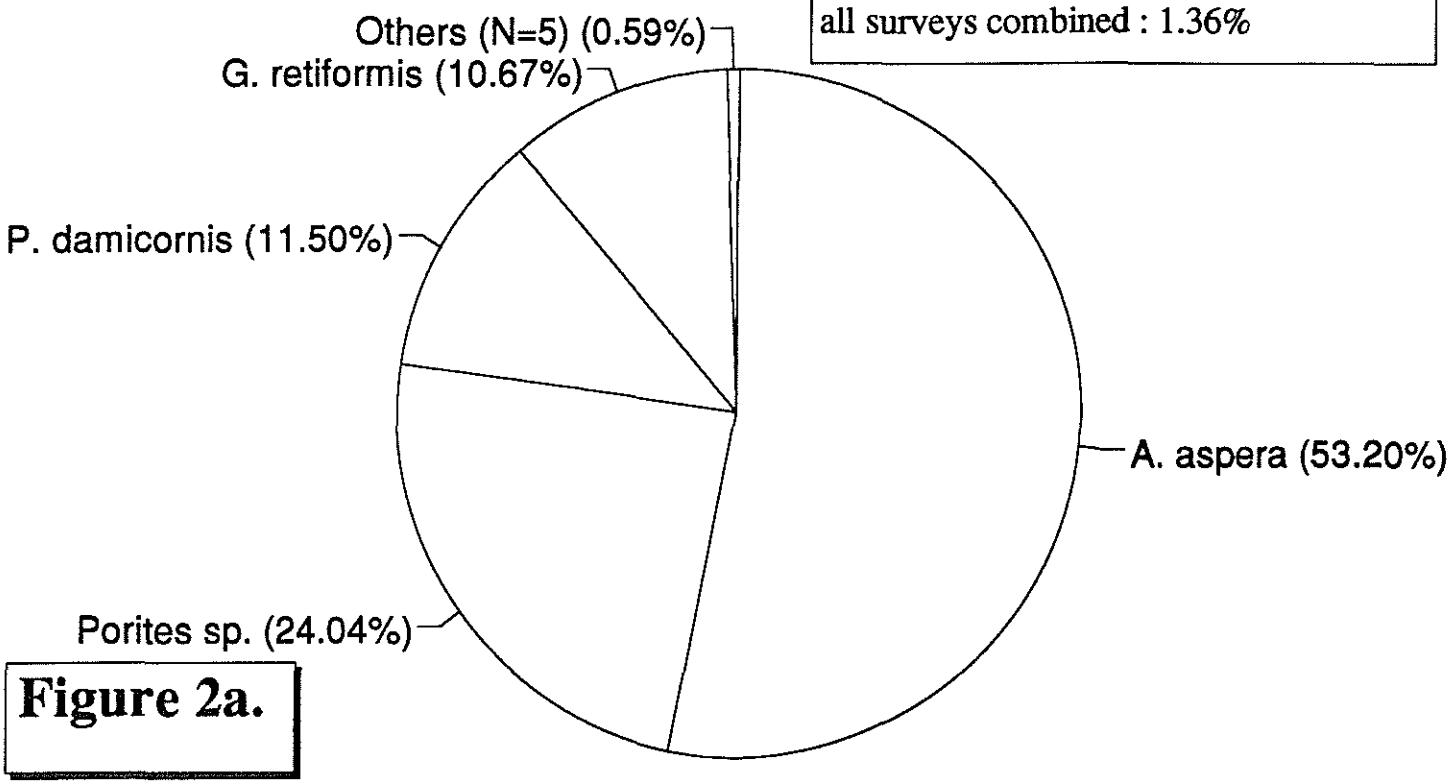


Figure 2a.

Table 3.

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Comparison of coral percent coverage by transect between surveys.
May 1993 through October 1995
Mid-reef zone

Transect	Survey 1 5/93-8/93	Survey 2 11/93-2/94	Survey3 6/94	Survey 4 9/94-10/9	Survey 5 1/95	Survey 6 3/95-4/95	Survey 7 5/95	Survey 8 5/95	Transect mean	Stds	Range*
A2	4.61	1.51	2.03	1.24	no data	7.08	1.34	1.71	2.79	2.22	0.57-6.01
A5	0.25	0.15	0.34	0.43	no data	0.32	0.80	0.78	0.44	0.26	0.18-0.7
B2 west	0.003	no data	0.00	0.00	0.003	0.00	0.00	0.00	0.001	0.002	0-0.003
B5 west	0.84	no data	0.46	1.64	1.41	0.77	0.98	1.13	1.03	0.40	0.63-1.43
B2 east	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0-0.03
B4 east	17.82	14.36	12.10	18.98	16.95	29.62	26.84	27.18	20.48	6.53	13.95-27.01
C2	0.07	0.02	0.002	0.01	no data	0.05	0.08	0.04	0.04	0.03	0.01-0.07
C4	no data	0.01	0.00	0.21	no data	0.40	0.26	1.59	0.41	0.57	0-0.98
D2	5.97	2.11	10.34	no data	6.72	no data	no data	5.26	6.08	2.96	3.12-6.08
D4	58.51	no data	24.17	no data	no data	no data	no data	no data	41.34	24.28	17.06-65.62
Zone mean	6.28	3.54	3.45	2.75	4.23	4.50	3.49	8.37	4.58	1.86	2.71-4.57

Range is defined as one standard deviation from the mean value in either direction.

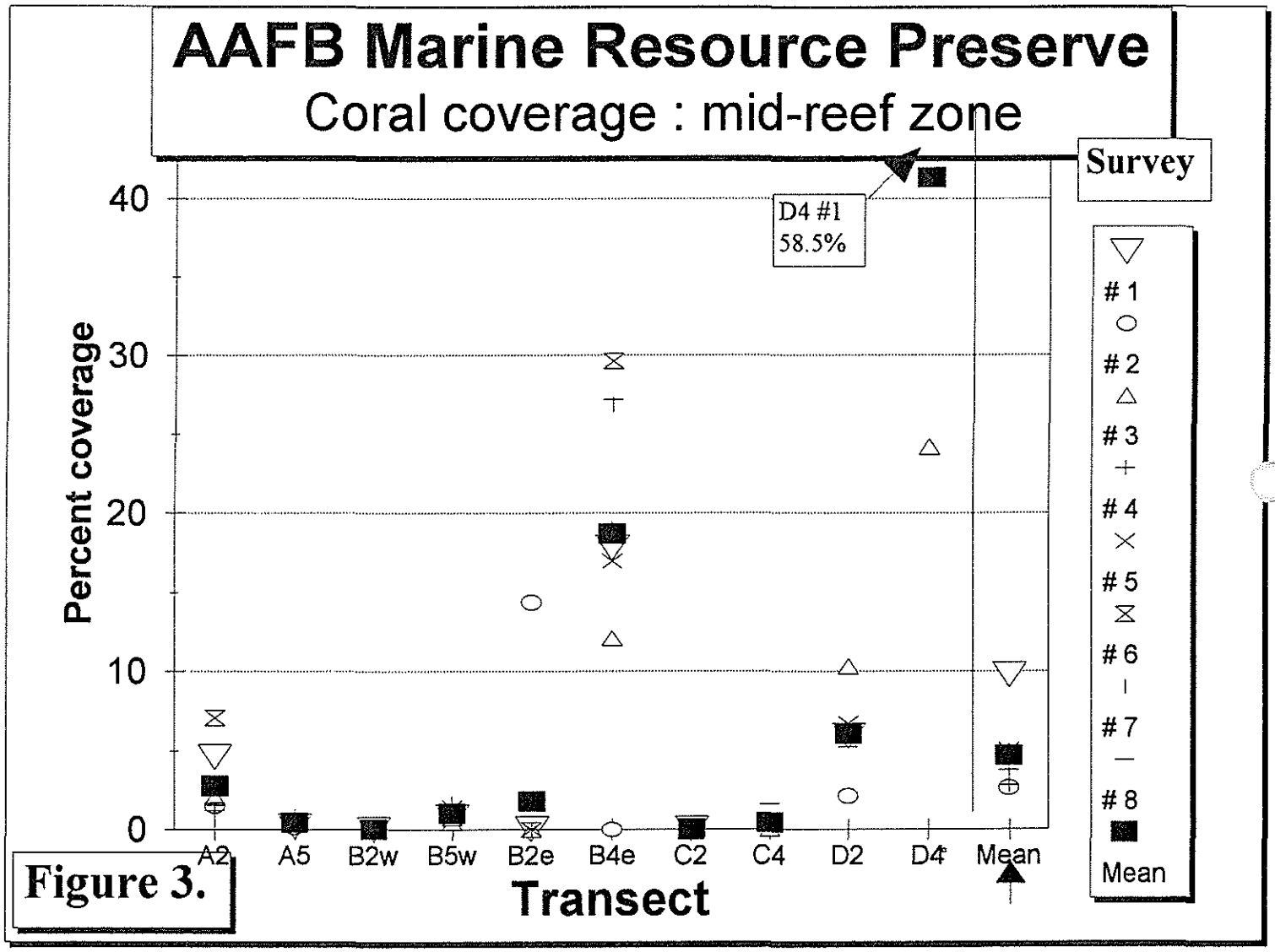

AAFB Marine Resource Preserve
Coral coverage : mid-reef zone
Survey
D4 #1
58.5%
Percent coverage
40
30
20
10
0
A2
A5
B2w
B5w
B2e
B4e
C2
C4
D2
D4
Mean
Transect
1
2
3
4
5
6
7
8
Mean

Figure 3.

Table 4.

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Contribution of most important coral species(*) to percent coverage within zones between surveys.
All survey comparison: May 1993-October 1995.
Mid-reef zone.

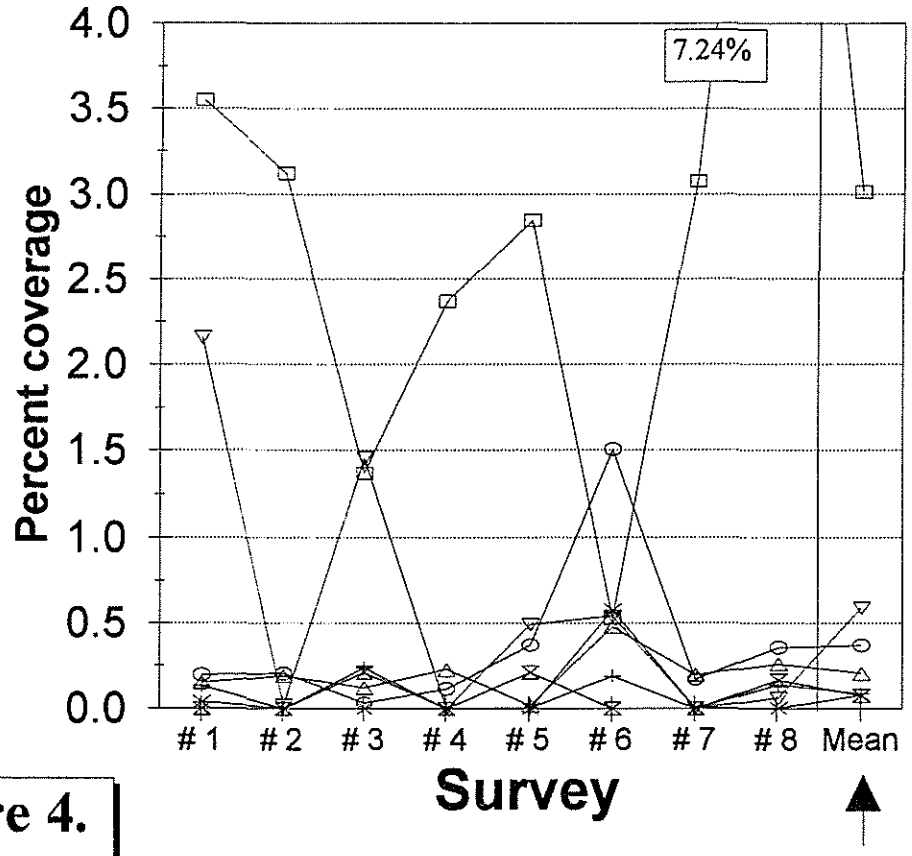
Species	Survey # 1 (**)	# 2 (**)	# 3	# 4 (**)	# 5 (**)	# 6 (**)	# 7 (**)	# 8 (**)	Mean
Acropora aspera	**3.55**	**3.12**	**1.37**	**2.37**	**2.85**	**0.53**	**3.07**	**7.24**	**3.01**
Goniastrea retiformis	**2.16**	0.02	**1.46**	0	**0.49**	**0.54**	0	0.06	**0.59**
Porites sp.	**0.19**	**0.20**	0.03	**0.11**	**0.37**	**1.51**	**0.17**	**0.36**	**0.37**
Pocillopora damicornis	**0.15**	**0.19**	**0.12**	**0.23**	0.02	**0.48**	**0.19**	**0.26**	**0.21**
Favia matthaii	0.13	0	**0.23**	0	0.002	0.19	0.001	0.14	**0.09**
Acropora sp.	0.04	0	0	0	0	**0.58**	0.003	0.003	**0.08**
Acropora digitifera	0	0	**0.21**	0	**0.21**	0	0	**0.17**	**0.07**
Heliopora coerula	0.01	0	0.01	0.003	0	**0.24**	0.04	0.07	0.05
Leptastrea purpurea	0.001	0.002	0	0.003	0.01	**0.26**	0.01	0.01	0.04
Favites abidita	0	0	0.003	0	**0.23**	0	0	0	0.03
Porites (encrusting)	0.002	0	0	0	0	**0.22**	0.01	0	0.03
Acropora valida	0.02	0	0	0	0.03	0	0	0.02	0.01
Favia sp.	0.00	0	0	0	0	0	0	0.05	0.01
Favites russelli	0.02	0	0	0	0	0	0	0	0.002
Acropora variabilis	0	0	0.01	0	0	0	0	0	0.0011
Platygyra pini	0	0	0	0	0	0	0	0.01	0.0008
Psammocora contigua	0	0	0.001	0.004	0	0	0	0	0.0007
Montipora sp.	0	0	0.002	0.0005	0	0	0	0.003	0.0007
Pachyseris speciosa	0.004	0	0	0	0	0	0	0	0.0005
Favia favus	0	0	0	0	0.003	0	0	0	0.0004
Favia pallida	0	0.002	0	0	0	0	0	0	0.0003
Porites superfusa	0	0	0	0	0	0	0	0	0.0002
Porites annae	0	0	0.002	0	0	0	0	0	0.0002
Psammocora sp.	0	0	0	0.001	0	0	0	0	0.0001
Percent coverage most important species	6.05	3.52	3.19	2.71	3.92	4.31	3.44	7.99	4.39
Percent coverage other species	0.23	0.02	0.26	0.04	0.31	0.24	0.05	0.38	0.19
Total percent coverage for survey	6.28	3.54	3.45	2.75	4.23	4.55	3.49	8.37	4.58

Most important species defined as contributing greater than 95% relative percent coverage during survey.
Most important species in bold.

*** Some transects not done during survey.***

AAFB Marine Resource Preserve

Greatest coral cover : mid-reef zone



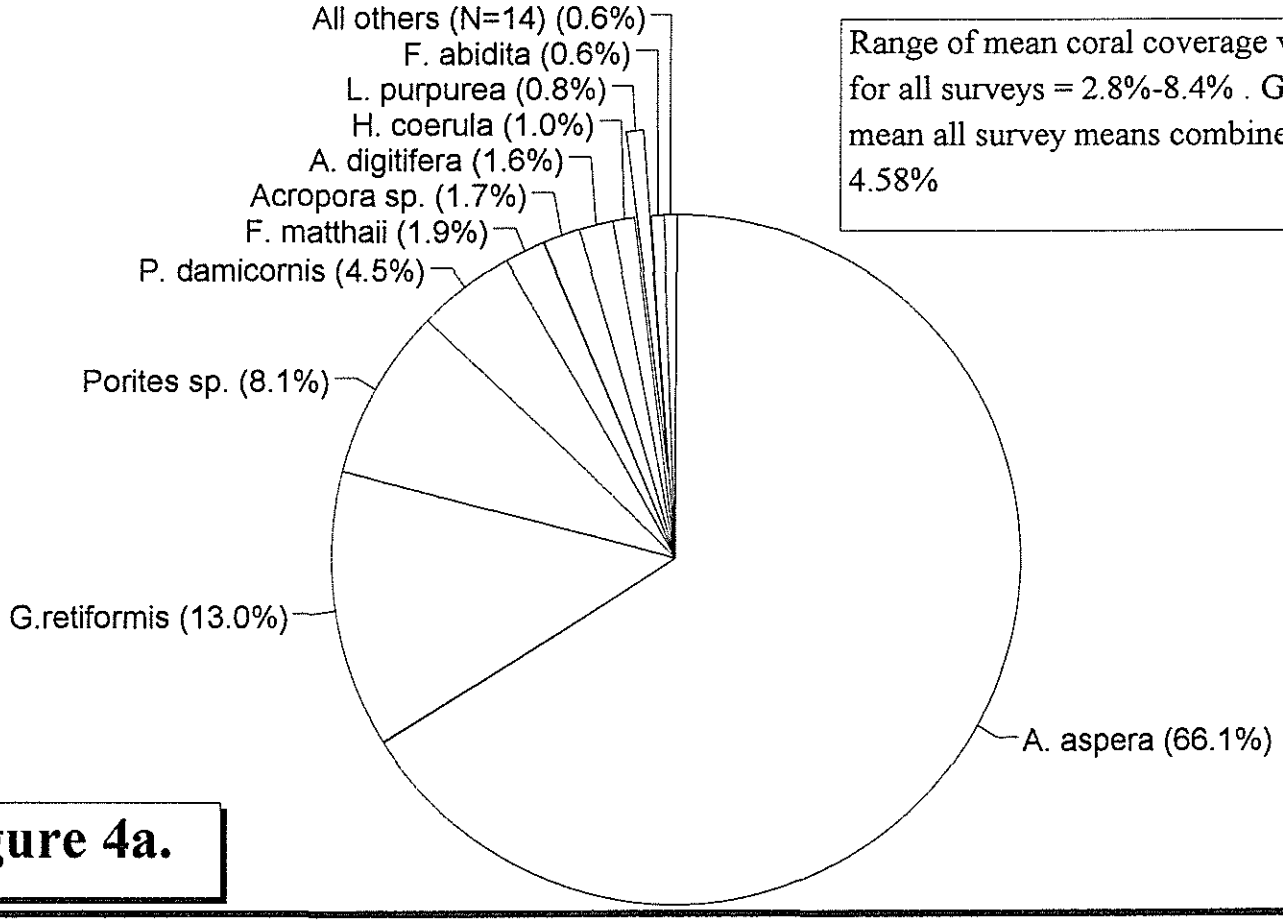
Species

- *A. aspera*
- *G.retiformis*
- *Porites sp.*
- *P. damicornis*
- *F. matthaii*
- *Acropora sp.*
- *A. digitifera*

Figure 4.

Mean relative coral coverage

Mid-reef zone : most important corals



Range of mean coral coverage values for all surveys = 2.8%-8.4% . Grand mean all survey means combined : 4.58%

Figure 4a.

Table 5.

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Comparison of coral percent coverage by transect between surveys.
May 1993 through October 1995
Near-crest zone

Transect	Survey 1 5/93-8/9	Survey 2 11/93-2/94	Survey3 6/94	Survey 4 9/94-10/9	Survey 5 1/95	Survey 6 3/95-4/9	Survey 5/95	Survey 8 10/95	Transect mean	Stds	Range*
A3	7.18	no data	11.77	5.35	no data	no data	no data	no data	8.10	3.31	4.79-11.41
A5	25.27	no data	27.41	35.76	no data	no data	no data	no data	29.48	5.54	23.94-35.02
B3 west	9.36	no data	3.53	no data	no data	no data	no data	no data	6.45	4.13	2.32-10.58
Zone mean	11.74	no data	11.23	15.68	no data	no data	no data	no data	12.88	2.43	10.45-15.31

AAFB Marine Resource Preserve

Coral coverage : near-crest zone

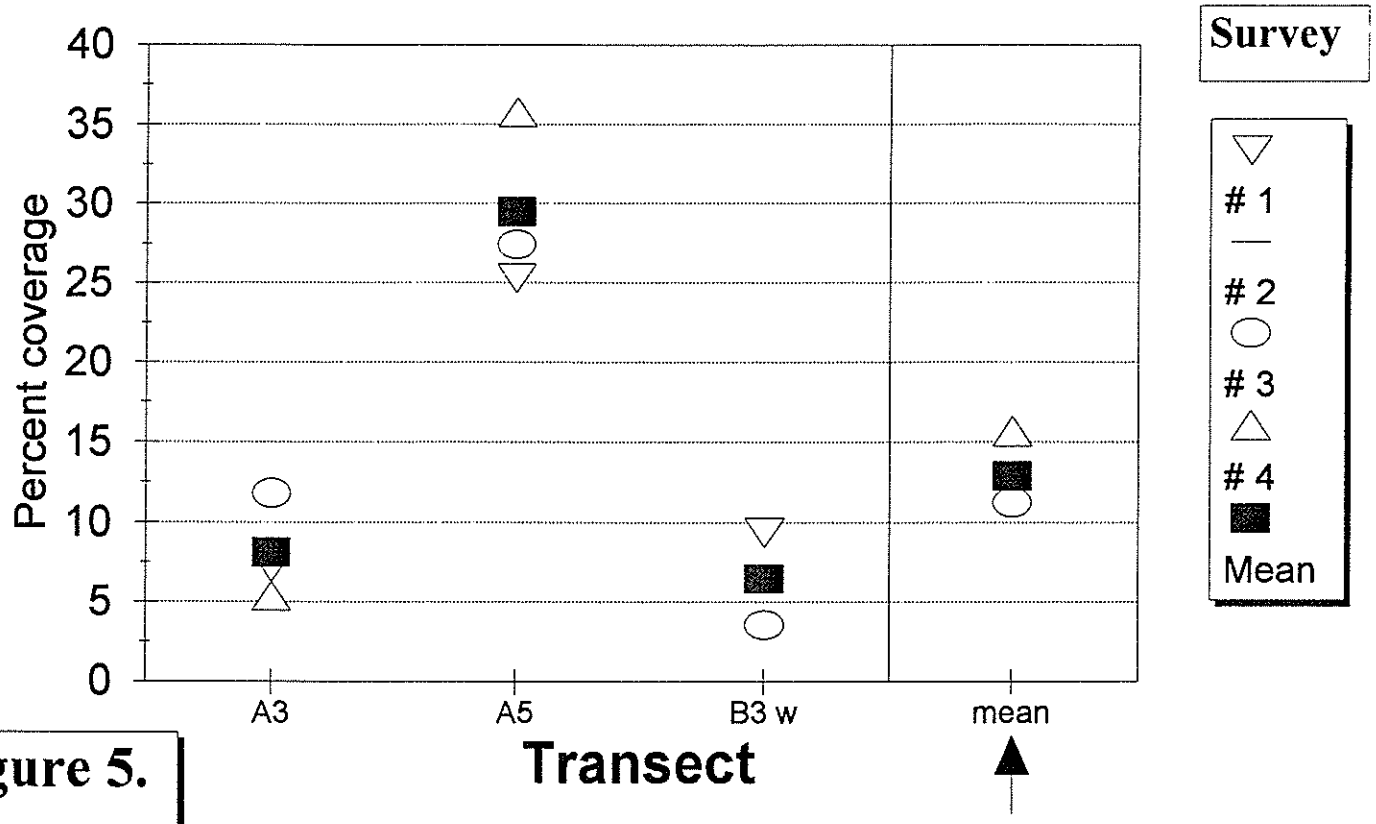


Figure 5.

Table 6.

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Contribution of most important coral species (*) to percent coverage within zone between surveys.
All survey comparison: May 1993-October 1995.
Near-crest zone

Species	Survey # 1	# 2	# 3	# 4	# 5	# 6	# 7	# 8	Mean
		no data		(**)	no data	no data	no data	no data	
Goniastrea retiformis	**4.49**		**6.20**	**6.95**					**5.88**
Heliopora coerula	**0.37**		**1.44**	**3.92**					**1.91**
Porites sp.	**0.95**		**1.05**	**1.38**					**1.13**
Leptoria phyrgia	**2.14**		0						**1.07**
Pocillopora damicornis	**0.45**		**0.72**	**1.21**					**0.79**
Pocillopora verrucosa	**0.40**		**0.39**						**0.40**
Porites annae	**0.51**		0.07						**0.29**
Favia stelligera	**0.47**		0.05						**0.26**
Acropora palifera	**0.32**		**0.25**	0.19					**0.25**
Acropora variabilis	0		**0.49**						**0.25**
Pocillopora setchelli	0.01		0	**0.70**					**0.24**
Pavona varians	**0.43**		0						**0.22**
Psammocora contigua	0		0.07	**0.57**					**0.21**
Psammocora obtusangula	**0.31**		0						**0.15**
Acropora sp.	0.11		0	**0.34**					**0.15**
Leptastrea purpurea	0.09		0.16						0.13
Favia matthaii	**0.12**		**0.19**	0.02					**0.11**
Montipora ehrenbergii	**0.20**		0						**0.10**
Acropora sp. 3	0.14		0	0.14					0.09
Acropora nasuta	0		0.08	0.11					0.06
Acropora valida	0.11		0						0.06
Porites lichen	0.10		0						0.05
Montipora sp.	0.04		0.02	0.07					0.04
Acropora surculosa	0.08		0						0.04
Porites superfusa	0.05		0						0.02
Cyphastrea chalcidicum	0		0.04	0.02					0.02
Pocillopora meandrina	0		0	0.05					0.02
Percent coverage most important species	11.28		10.93	15.29					12.23
Percent coverage other species	0.46		0.30	0.39					0.65
Total percent coverage for survey	11.74		11.23	15.67					12.88

Most important species defined as those species combining to contribute greater than 95% relative percent coverage during each individual survey. Most important species in bold.

****Not all transects surveyed***

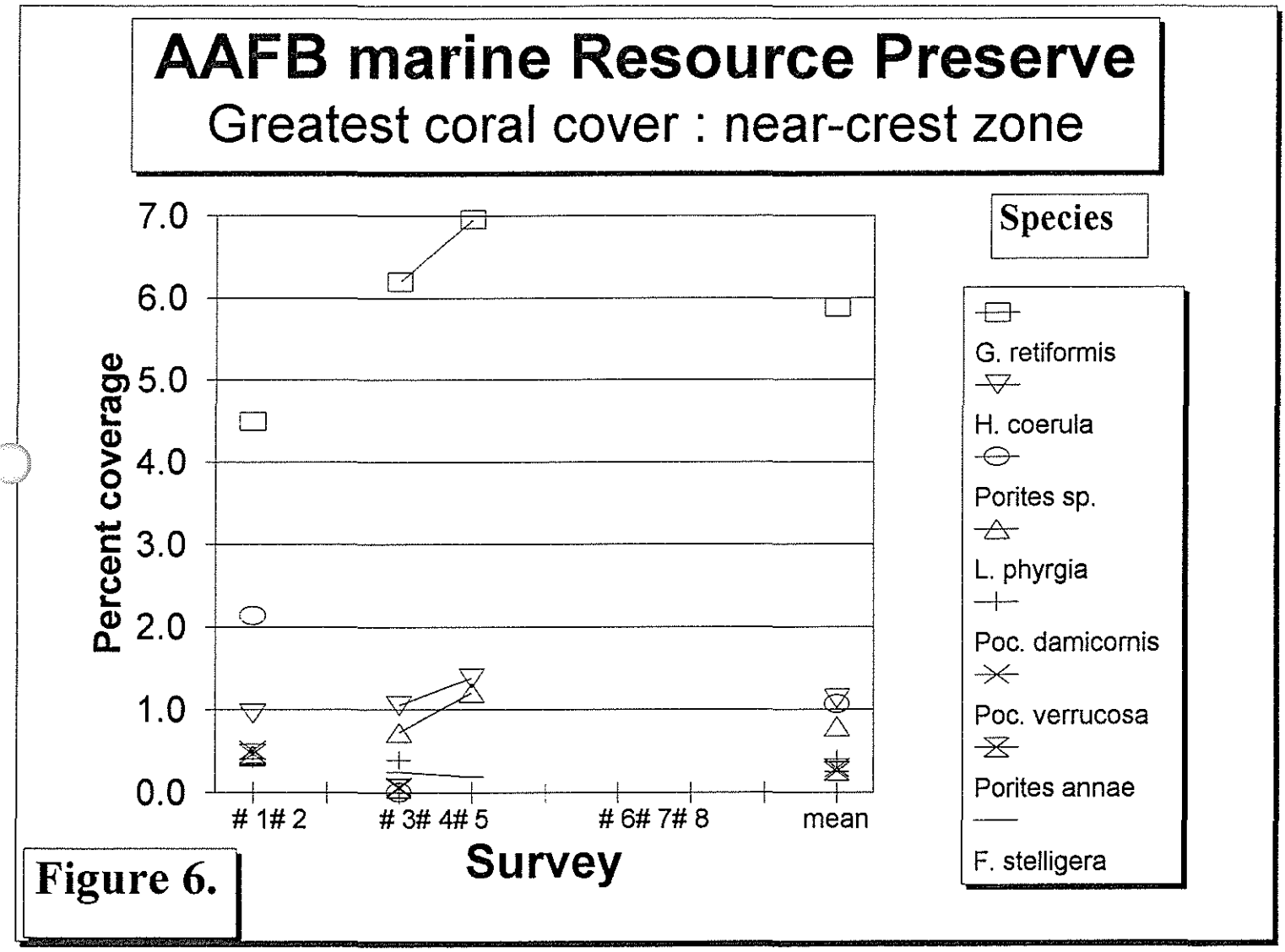

AAFB marine Resource Preserve
Greatest coral cover : near-crest zone
Percent coverage
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
1# 2
3# 4# 5
6# 7# 8
mean
Survey
Species
G. retiformis
H. coerula
Porites sp.
L. phyrgia
Poc. damicornis
Poc. verrucosa
Porites annae
F. stelligera

Figure 6.

Relative abundance of corals in sample

Most important species:near-crest zone

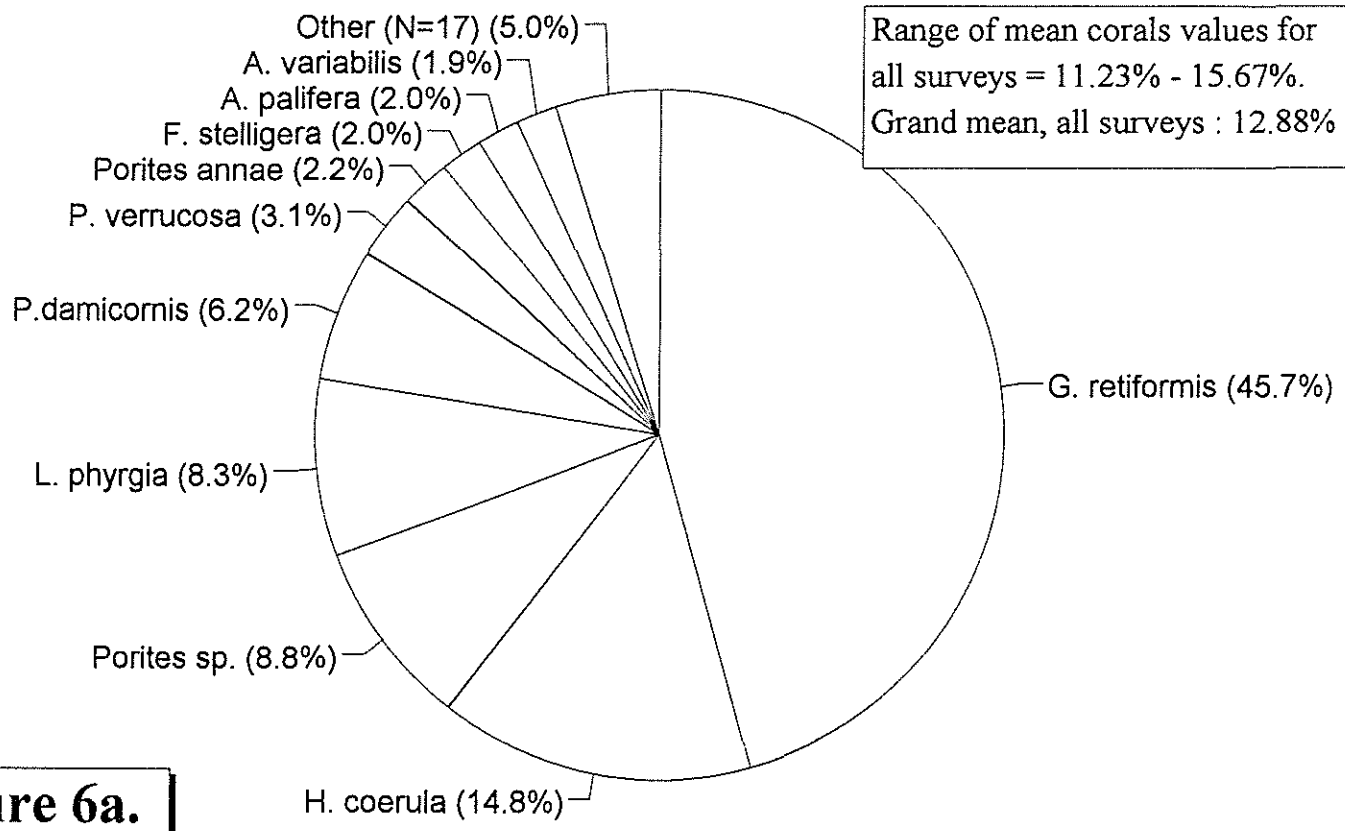


Figure 6a.

Table 7.

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Comparison of coral percent coverage by zone between surveys.
May 1993 through October 1995
Near-shore, mid-reef and near-crest zone grand means

	Survey 1 5/93-8/93	Survey 2 11/93-2/94	Survey3 6/94	Survey 4 9/94-10/94	Survey 5 1/95	Survey 6 3/95-4/95	Survey 7 5/95	Survey 8 5/95	Mean	Stds	Range*
Near-shore	1.06	0.76	1.71	1.85	2.39	0.81	1.17	1.16	1.36	0.57	0.79-1.93
Mid-reef	6.28	3.54	3.45	2.75	4.23	4.50	3.49	8.37	4.58	1.86	2.71-6.54
Near-crest	11.74	no data	11.23	15.68	no data	no data	no data	no data	12.88	2.44	10.44-15.32

Range is defined as one standard deviation from the mean value in either direction.

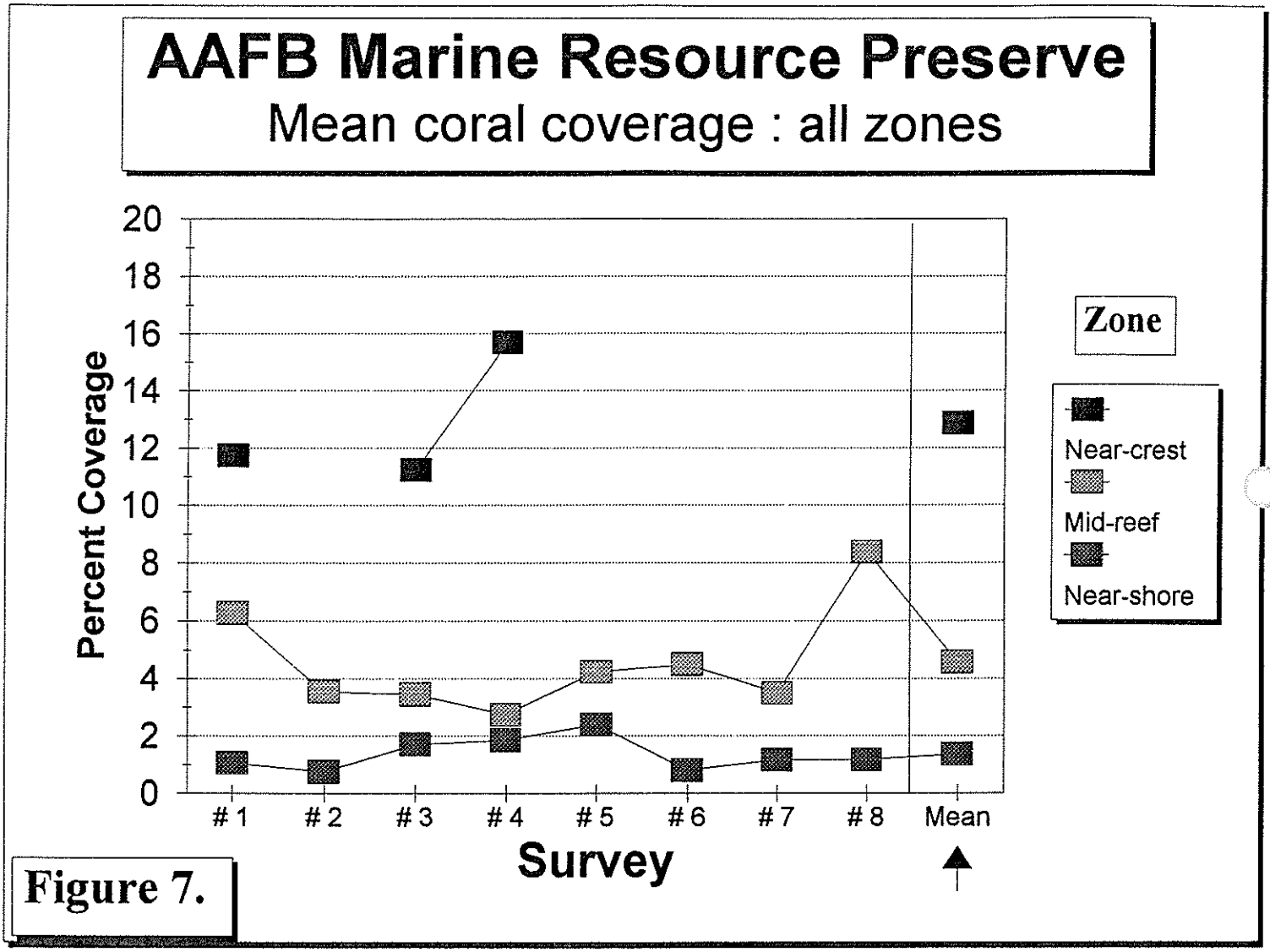

AAFB Marine Resource Preserve
Mean coral coverage : all zones
Percent Coverage
20
18
16
14
12
10
8
6
4
2
0
#1
#2
#3
#4
#5
#6
#7
#8
Mean
Survey
Zone
Near-crest
Mid-reef
Near-shore

Figure 7.

Table A-1.

Survey #1

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Comparison of coral density and percent coverage by zone between transects.
Near-shore zone
May 6,11,18; August 11,12, 1993.

Site	Date	N	Mean dist. (cm)	Mean area (cm sq.)	nk-no	no/nk	Correction factor	Density	Percent Coverage	Fre-quency
A1	11 Aug., 93	20	44.60	22.03	20	0.50	0.33930	1.71	0.38	0.50
A4	11 Aug., 93	0	0.00	0.00	0	0.00	0.00000	0.00	0.00	0.00
B1 west	18 May, 93	1	98.00	28.27	1	0.98	0.01139	0.01	0.00	0.03
B4 west	18 May, 93	6	62.83	63.09	6	0.85	0.08899	0.23	0.14	0.15
B1 east	5 May, 93	1	54.00	15.71	1	0.98	0.01139	0.04	0.01	0.03
B3 east	5 May, 93	19	35.68	347.97	19	0.53	0.33930	2.66	9.27	0.48
C1	11 May, 93	1	8.00	678.58	1	0.98	0.01139	1.78	12.08	0.03
C3	11 May, 93	1	57.00	7.07	1	0.98	0.01139	0.04	0.00	0.03
D1	11 May, 93	2	28.00	435.11	2	0.95	0.02873	0.37	1.59	0.05
D3	11 May, 93	6	46.17	419.64	6	0.85	0.08899	0.42	1.75	0.15
E1	6 May, 93	13	64.38	366.36	13	0.68	0.20162	0.49	1.78	0.33
E2	6 May, 93	2	91.50	654.24	2	0.95	0.02873	0.03	0.22	0.05
Zone mean			48.85	283.16		0.85	0.08899	0.37	1.06	0.15
Total		72			72					

Table A-2.

Survey # 2.

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Comparison of coral density and percent coverage by zone between transects.
Near-shore zone
Oct. 29; Nov. 11, 1993; Feb. 2,4, 1994.

Site	Date	N	Mean dist. (cm)	Mean area (cm sq.)	nk-no	no/nk	Correction factor	Density	Percent Coverage	Fre-quency
A1	29 Oct., 93	9	37.67	135.52	9	0.78	0.13367	0.94	1.28	0.23
A4	29 Oct., 93	2	47.50	12.37	2	0.95	0.02873	0.13	0.02	0.05
B1 west	no data									
B4 west	no data									
B1 east	5 Nov., 93	0	0.00	0.00	0	1.00	0.00000	0.00	0.00	0.00
B3 east	5 Nov., 93	14	42.86	486.22	14	0.65	0.22308	1.21	5.91	0.35
C1	2 Feb., 94	0	0.00	0.00	0	1.00	0.00000	0.00	0.00	0.00
C3	2 Feb., 94	1	81.00	650.31	1	0.98	0.01139	0.02	0.11	0.03
D1	4 Feb., 94	4	34.25	9.82	4	0.90	0.05837	0.50	0.05	0.10
D3	4 Feb., 94	1	85.00	1947.79	1	0.98	0.01139	0.02	0.31	0.03
E1	11 Nov., 93	0	0.00	0.00	0	1.00	0.00000	0.00	0.00	0.00
E2	11 Nov., 93	14	67.64	218.40	14	0.65	0.22308	0.49	1.06	0.35
Zone mean			50.76	305.48		0.89	0.06441	0.25	0.76	0.11
Total		45			45					

Table A-3.

Survey # 3

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Comparison of coral density and percent coverage by zone between transects.
Near-shore zone
June 7,9,10,and 14, 1994

Site	Date	N	Mean dist. (cm)	Mean area (cm sq.)	nk-no	no/nk	Correction factor	Density	Percent Coverage	Fre-quency
A1	7 June, 94	22	41.05	50.66	22	0.45	0.38200	2.27	1.15	0.55
A3	7 June, 94	8	37.38	10.11	8	0.80	0.12068	0.86	0.09	0.20
B1 west	10 June, 94	0	0.00	0.00	0	0.00	0.00000	0.00	0.00	0.00
B4 west	10 June, 94	23	57.74	100.00	23	0.43	0.39974	1.20	1.20	0.58
B1 east	9 June, 94	0	0.00	0	0	0.00	0.00000	0.00	0.00	0.00
B3 east	9 June, 94	16	60.19	1294.63	16	0.60	0.26006	0.72	9.29	0.40
C1	10 June, 94	0	0.00	0.00	0	0.00	0.00000	0.00	0.00	0.00
C3	10 June, 94	2	72.50	399.68	2	0.95	0.02873	0.05	0.22	0.05
D1	14 June, 94	1	55.00	127.23	1	0.98	0.01139	0.04	0.05	0.03
D3	14 June, 94	9	51.78	406.66	9	0.78	0.13670	0.51	2.07	0.23
E1	14 June, 94	3	95.33	2567.73	3	0.93	0.04047	0.04	1.14	0.08
E2	14 June, 94	12	73.92	563.06	12	0.70	0.18761	0.34	1.93	0.30
Zone mean			55.44	435.98		0.80	0.12068	0.39	1.71	0.20
Total		96			96					

Table A-4.

Survey # 4

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Comparison of coral density and percent coverage by zone between transects.
Near-shore zone
September , October 14, 1994

Site	Date	N	Mean dist. (cm)	Mean area (cm sq.)	nk-no	no/nk	Correction factor	Density	Percent Coverage	Fre-quency
A1	Sept., 94	23	40.43	35.58	23	0.43	0.39974	2.44	0.87	0.33
A4	Sept., 94	2	63.00	34.95	2	0.95	0.02873	0.07	0.03	0.05
B1 west	14 Oct., 94	0	100.00	0.00	0	1.00	0.00000	0.00	0.00	0.00
B4 west	14 Oct., 94	26	34.85	19.45	26	0.65	0.22308	1.84	0.36	0.65
B1 east	14 Oct., 94	0	100.00	0.00	0	1.00	0.00000	0.00	0.00	0.00
B3 east	14 Oct., 94	28	53.89	591.69	28	0.70	0.18761	0.65	3.82	0.70
C1	Oct., 94	1	82.00	7.07	1	0.98	0.01139	0.02	0.00	0.03
C3	Oct., 94	2	63.00	534.86	2	0.95	0.02873	0.07	0.39	0.05
D1	no data									
D3	no data									
E1	no data									
E2	no data									
Zone mean			44.87	232.17		0.74	0.16023	0.80	1.85	0.26
Total		82			82					

Table A-5.

Survey # 5

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Comparison of coral density and percent coverage by zone between transects.
Near-shore zone
January 11, 12, 13, 1995

Site	Date	N	Mean dist. (cm)	Mean area (cm sq.)	nk-no	no/nk	Correction factor	Density	Percent Coverage	Fre-quency
A1	11 Jan., 95	18	41.22	43.37	18	0.55	0.29874	1.76	0.76	0.45
A4	11 Jan., 95	6	54.00	42.28	6	0.85	0.08899	0.31	0.13	0.15
B1 west	12 Jan., 95	0	0.00	0.00	40	0.00	0.00000	0.00	0.00	0.00
B4 west	12 Jan., 95	25	46.32	50.33	25	0.38	0.44594	2.08	1.05	0.63
B1 east	12 Jan., 95	1	54.00	7.07	1	0.98	0.01139	0.00	0.00	0.03
B3 east	12 Jan., 95	29	55.86	997.24	29	0.28	0.54791	1.76	17.51	0.73
C1	no data									
C3	no data									
D1	13 Jan., 95	1	60.00	2238.38	1	0.98	0.01139	0.03	0.71	0.03
D3	13 Jan., 95	7	44.14	177.61	7	0.83	0.10153	0.52	0.93	0.18
E1	13 Jan., 95	11	59.55	264.96	11	0.73	0.16699	0.47	1.25	0.28
E2	13 Jan., 95	2	92.00	1082.28	2	0.95	0.02873	0.03	0.37	0.05
Zone mean			51.06	405.83		0.75	0.15351	0.59	2.39	0.25
Total		100			100					

Table A-6.

Survey # 6

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Comparison of coral density and percent coverage by zone between transects.
Near-shore zone
March 28, 30; April 3, 1995

Site	Date	N	Mean dist. (cm)	Mean area (cm sq.)	nk-no	no/nk	Correction factor	Density	Percent Coverage	Fre-quency
A1	28 Mar., 95	19	47.21	62.05	19	0.53	0.31473	1.41	0.88	0.48
A4	28 Mar., 95	7	72.57	34.22	7	0.83	0.10153	0.19	0.07	0.18
B1 west	30 Mar., 95	1	14.00	0.79	1	0.98	0.01139	0.58	0.00	0.03
B4 west	30 Mar., 95	30	38.40	50.50	30	0.25	0.58159	3.94	1.99	0.75
B1 east	30 Mar., 95	1	69.00	742.20	1	0.98	0.01139	0.02	0.18	0.03
B3 east	3 April, 95	35	49.31	270.72	35	0.13	0.07050	0.29	0.78	0.88
C1	3 April, 95	2	61.50	12.57	2	0.95	0.02873	0.08	0.01	0.05
C3	3 April, 95	1	99.00	785.40	1	0.98	0.01139	0.01	0.09	0.03
D1	no data									
D3	no data									
E1	no data									
E2	no data									
Zone mean			47.79	145.44		0.79	0.12715	0.56	0.81	0.30
Total		96			96					

Table A-7.

Survey # 7

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Comparison of coral density and percent coverage by zone between transects.
Near-shore zone
May 10, 11, 12, 18, and 19, 1995.

Site	Date	N	Mean dist. (cm)	Mean area (cm sq.)	nk-no	no/nk	Correction factor	Density	Percent Coverage	Fre-quency
A1	10 May, 95	18	55.72	75.53	18	0.55	0.12068	0.39	0.29	0.45
A4	10 May, 95	10	65.10	32.20	10	0.75	0.15351	0.36	0.12	0.25
B1 west	11 May, 95	0	0.00	0.00	0	1.00	0.00000	0.00	0.00	0.00
B4 west	11 May, 95	32	48.00	82.49	32	0.20	0.64182	2.79	2.30	0.80
B1 east	12 May, 95	0	0.00	0.00	0	1.00	0.00000	0.00	0.00	0.00
B3 east	12 May, 95	24	50.13	538.95	24	0.40	0.42712	1.70	9.16	0.60
C1	18 May, 95	2	61.00	16.49	2	0.95	0.02873	0.08	0.01	0.05
C3	18 May, 95	2	39.00	479.49	2	0.95	0.02873	0.19	0.91	0.05
D1	19 May, 95	1	56.00	176.71	1	0.98	0.01139	0.04	0.06	0.03
D3	19 May, 95	11	66.00	327.08	11	0.73	0.16699	0.38	1.25	0.28
E1	no data									
E2	no data									
Zone mean			53.75	220.23		0.75	0.15351	0.53	1.17	0.25
Total		100			100					

Table A-8.

Survey # 8

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Comparison of coral density and percent coverage by zone between transects.
Near-shore zone
October 11, 16, 18, and 20, 1995

Site	Date	N	Mean dist. (cm)	Mean area (cm sq.)	nk-no	no/nk	Correction factor	Density	Percent Coverage	Fre-quency
A1	11 Oct., 95	15	49.27	97.28	15	0.63	0.23768	0.98	0.95	0.38
A4	11 Oct., 95	4	30.25	53.80	4	0.90	0.05837	0.64	0.34	0.10
B1 west	16 Oct., 95	1	72.00	4.71	1	0.98	0.01139	0.02	0.00	0.03
B4 west	16 Oct., 95	25	35.24	80.14	25	0.38	0.44594	3.59	2.88	0.63
B1 east	16 Oct., 95	0	0.00	0.00	0	1.00	0.00000	0.00	0.00	0.00
B3 east	16 Oct., 95	30	53.63	266.72	30	0.25	0.58159	2.02	5.39	0.75
C1	18 Oct., 95	1	55.00	63.62	1	0.98	0.01139	0.04	0.02	0.03
C3	18 Oct., 95	1	99.00	706.86	1	0.98	0.01139	0.01	0.08	0.03
D1	20 Oct., 95	1	99.00	2968.80	1	0.98	0.01139	0.01	0.35	0.03
D3	20 Oct., 95	8	59.50	136.76	8	0.80	0.12068	0.34	0.47	0.20
E1	20 Oct., 95	10	56.00	365.45	10	0.75	0.15351	0.49	1.79	0.25
E2	20 Oct., 95	2	74.50	1492.26	2	0.95	0.02873	0.05	0.77	0.05
Zone Mean			49.60	236.29		0.80	0.12068	0.49	1.16	0.20
Total		98			98					

Table A-9.

Survey # 1

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Species composition from all transects within zone. Data on number, size, percent coverage and frequency.
Near-shore zone
May 6,11,18; August 11,12, 1993.

Species	N	Mean dist. (cm)	Mean area (cm sq.)	Size range (cm sq.)	Relative percent coverage	Sample area percent coverage	Relative frequency	Sample area frequency
Porites sp.	**12**	54.50	**651.49**	**12-3738**	**38.35**	**0.41**	**16.67**	**0.03**
Acropora aspera	**15**	35.73	**432.54**	**6-5301**	**31.83**	**0.34**	**20.83**	**0.03**
Goniastrea retiformis	**5**	72.80	**867.55**	**13-2670**	**21.28**	**0.23**	**6.94**	**0.01**
Pocillopora damicornis	**36**	49.06	**38.33**	**1-452**	**6.77**	**0.07**	**50.00**	**0.08**
Acropora formosa	2	57.00	177.50	154-201	1.74	0.02	2.78	0.004
Leptastrea purpurea	2	41.50	4.32	2-7	0.04	0.0004	2.78	0.004
Zone mean		48.85	283.16			1.06		0.15
Total	72				100.00		100.00	

Table A-10.

Survey # 2.

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Species composition from all transects within zone. Data on number, size, percent coverage and frequency.
Near-shore zone
Oct. 29; Nov. 11, 1993; Feb. 2,4, 1994.

Species	N	Mean dist. (cm)	Mean area (cm sq.)	Size range (cm sq.)	Relative percent coverage	Sample area percent coverage	Relative fre-quency	Sample area fre-quency
Porites sp.	**10**	65.80	**669.79**	**6-2827**	**48.72**	**0.37**	**22.22**	**0.03**
Acropora aspera	**10**	37.00	**389.71**	**3-1484**	**28.35**	**0.22**	**22.22**	**0.03**
Pocillpora damicornis	**20**	51.00	**111.07**	**1-424**	**16.16**	**0.12**	**44.44**	**0.05**
Goniastrea retiformis	1	99.00	890.64		6.48	0.05	2.22	0.003
Leptastrea purpurea	4	34.25	9.82	7-13	0.29	0.002	8.89	0.01
Zone mean		50.76	305.48			0.76		0.11
Total	45				100.00		100.00	

Table A-11.

Survey # 3.

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Species composition from all transects within zone. Data on number, size, percent coverage and frequency.
Near-shore zone
June 7,9,10,and 14, 1994

Species	N	Mean dist. (cm)	Mean area (cm sq.)	Size range (cm sq.)	Relative percent coverage	Sample area percent coverage	Relative fre-quency	Sample area fre-quency
Acropora aspera	**12**	70.17	**1518.44**	**22-13823**	**43.54**	**0.74**	**12.50**	**0.03**
Goniastrea retiformis	**4**	91.50	**2735.74**	**1145-3731**	**26.15**	**0.45**	**4.17**	**0.01**
Porites sp. (massive)	**10**	68.30	**823.49**	**3-3499**	**19.68**	**0.34**	**10.42**	**0.02**
Pocillopora damicornis	**70**	49.01	**63.64**	**1-573**	**10.64**	**0.18**	**72.92**	**0.15**
Zone mean		55.44	435.98			1.71		0.20
Total	96				100.00		100.00	

Table A-12.

Survey # 4.

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Species composition from all transects within zone. Data on number, size, percent coverage and frequency.
Near-shore zone
September, October 1994

Species	N	Mean dist. (cm)	Mean area (cm sq.)	Size range (cm sq.)	Relative percent coverage	Sample area percent coverage	Relative frequency	Sample area frequency
Acropora aspera	**19**	56.42	**862.70**	**16-11960**	**86.10**	**1.59**	**23.17**	**0.06**
Pocillopora damicornis	**58**	40.22	**26.95**	**1-154**	**8.21**	**0.15**	**70.73**	**0.18**
Porites sp. (massive)	2	47.00	533.28	6-1060	5.60	0.10	2.43	0.01
Leptastrea purpurea	3	60.00	5.76	1-9	0.09	0.002	3.65	0.01
Zone mean		44.87	232.17			1.85		0.26
Total	82				100.00		99.98	

Table A-13.

Survey # 5

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Species composition from all transects within zone. Data on number, size, percent coverage and frequency.
Near-shore zone
Jan 11,12,13, 1995

Species	N	Mean dist. (cm)	Mean area (cm sq.)	Size range (cm sq.)	Relative percent coverage	Sample area percent coverage	Relative fre-quency	Sample area fre-quency
Acropora aspera	**16**	56.88	**1428.05**	**3-19620**	**56.30**	**1.35**	**16.00**	**0.04**
Porites sp. (massive)	**9**	48.00	**1114.04**	**7-5961**	**24.71**	**0.59**	**9.00**	**0.02**
Goniastrea retiformis	**3**	89.00	**1309.78**	**962-1885**	**9.68**	**0.23**	**3.00**	**0.01**
Pocillopora damicornis	**66**	47.85	**42.06**	**1-450**	**6.84**	**0.16**	**66.00**	**0.17**
Acropora formosa	2	57.00	400.55	94-707	1.97	0.05	2.00	0.01
Heliopora coerula	1	97.00	117.81		0.29	0.01	1.00	0.00
Acropora digitifera	1	86.00	38.48		0.09	0.00	1.00	0.00
Leptastrea purpurea	2	21.00	9.42	3-16	0.05	0.001	2.00	0.01
Zone mean		51.06	405.83			2.39		0.25
Total	100				99.94		100.00	

Table A-14.

Survey # 6.

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Species composition from all transects within zone. Data on number, size, percent coverage and frequency.
Near-shore zone
March 28,30; April 3, 1995

Species	N	Mean dist. (cm)	Mean area (cm sq.)	Size range (cm sq.)	Relative percent coverage	Sample area percent coverage	Relative frequency	Sample area frequency
Acropora aspera	**22**	51.45	**484.59**	**13-7069**	**76.36**	**0.62**	**22.91**	**0.07**
Pocillopora damicornis	**73**	45.99	**34.46**	**1-239**	**18.02**	**0.15**	**76.04**	**0.23**
Porites sp. (massive)	1	99.00	785.40		5.63	0.05	1.05	0.003
Zone mean		47.79	145.44			0.81		0.30
Total	96				100.00		100.00	

Table A-15.

Survey # 7.

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Species composition from all transects within zone. Data on number, size, percent coverage and frequency.
Near-shore zone
May 10, 11, 12, 18, and 19, 1995.

Species	N	Mean dist. (cm)	Mean area (cm sq.)	Size range (cm sq.)	Relative percent coverage	Sample area percent coverage	Relative fre-quency	Sample area fre-quency
Acropora aspera	**19**	53.84	**754.77**	**8-7634**	**65.12**	**0.76**	**19.00**	**0.05**
Porites sp. (massive)	**7**	71.71	**547.31**	**16-2651**	**17.40**	**0.20**	**7.00**	**0.02**
Pocillopora damicornis	**71**	51.59	**45.64**	**1-226**	**14.71**	**0.17**	**71.00**	**0.18**
Goniastrea retiformis	1	73.00	490.87		2.23	0.03	1.00	0.00
Heliopora coerula	1	84.00	112.31		0.51	0.01	1.00	0.00
Leptastrea purpurea	1	30.00	7.07		0.03	0.00	1.00	0.00
Zone Mean		53.75	220.23			1.17		0.25
Total	100				100.00		100.00	

Table A-16.

Survey # 8.

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Species composition from all transects within zone. Data on number, size, percent coverage and frequency.
Near-shore zone.
October 11, 16, 18, and 20, 1995

Species	N	Mean dist. (cm)	Mean area (cm sq.)	Size range (cm sq.)	Relative percent coverage	Sample area percent coverage	Relative frequency	Sample area frequency
Porites sp. (massive)	**8**	66.50	**1404.09**	**28-5576**	**48.51**	**0.56**	**8.16**	**0.02**
Pocillopora damicornis	**66**	46.26	**72.85**	**1-661**	**20.76**	**0.24**	**67.35**	**0.14**
Goniastrea retiformis	**3**	78.67	**1185.69**	**573-2199**	**15.36**	**0.18**	**3.06**	**0.01**
Acropora aspera	**17**	53.59	**208.22**	**13-1414**	**15.29**	**0.18**	**17.35**	**0.04**
Leptastrea purpurea	3	22.33	6.02	5-7	0.08	0.001	3.06	0.01
Favia sp.	1	62.00	0.79		0.003	0.00004	1.02	0.002
Zone mean		49.60	236.29			1.16		0.20
Total	98				100.00		100.00	

Table A-17.

Survey #1

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Comparison of coral density and percent coverage by zone between transects.
Mid-reef zone
May 6,11,18; August 11,12, 1993.

Site	Date	N	Mean dist. (cm)	Mean area (cm sq.)	nk-no	no/nk	Correction factor	Density	Percent coverage	Fre-quency
A2	11 Aug., 93	23	59.30	405.64	23	0.43	0.39974	1.14	4.61	0.58
A5	11 Aug., 93	13	69.69	59.51	13	0.68	0.20162	0.42	0.25	0.33
B2 west	18 May, 93	1	98.00	28.27	1	0.98	0.01139	0.01	0.00	0.03
B5 west	18 May, 93	12	73.00	239.74	12	0.70	0.18761	0.35	0.84	0.30
B2 east	5 May, 93	2	50.00	54.98	2	0.95	0.02873	0.11	0.06	0.05
B4 east	5 May, 93	14	74.71	4458.25	14	0.65	0.22308	0.40	17.82	0.35
C2	11 May, 93	4	50.50	30.04	4	0.90	0.05837	0.23	0.07	0.10
C4	no data									
D2	11 May, 93	9	29.67	392.77	9	0.78	0.13367	1.52	5.97	0.23
D4	11 May, 93	22	30.50	1424.89	22	0.45	0.38200	4.11	58.51	0.55
Zone mean			55.30	1105.37		0.72	0.17381	0.57	6.28	0.28
Total		100			100					

Table A-18.

Survey # 2.

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Mid-reef zone
Comparison of coral density and percent coverage by zone between transects.
Oct. 29; Nov. 11, 1993; Feb. 2,4, 1994.

Site	Date	N	Mean dist. (cm)	Mean area (cm sq.)	nk-no	no/nk	Correction factor	Density	Percent coverage	Fre-quency
A2	29 Oct., 93	13	55.77	232.18	13	0.68	0.20162	0.65	1.51	0.33
A5	29 Oct., 93	8	63.00	47.91	8	0.80	0.12068	0.30	0.15	0.20
B2 west	no data									
B5 west	no data									
B2 east	5 Nov., 93	0	0.00	0.00	0	1.00	0.00000	0.00	0.00	0.00
B4 east	5 Nov., 93	12	78.92	4765.99	12	0.70	0.18761	0.30	14.36	0.30
C2	2 Feb., 94	3	41.33	9.16	3	0.93	0.04047	0.24	0.02	0.08
C4	2 Feb., 94	5	72.00	158.00	5	0.88	0.07050	0.14	0.22	0.11
D2	4 Feb., 94	6	49.50	580.41	6	0.85	0.08899	0.36	2.11	0.15
D4	no data									
Zone mean			62.91	1380.78		0.83	0.10153	0.26	3.54	0.17
Total		47			47					

Table A-19.

Survey #3

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Comparison of coral density and percent coverage by zone between transects.
Mid-reef zone
June 7,9,10,and 14, 1994

Site	Date	N	Mean dist. (cm)	Mean area (cm sq.)	nk-no	no/nk	Correction factor	Density	Percent coverage	Fre-quency
A2	7 June, 94	28	53.57	110.77	28	0.30	0.52633	1.83	2.03	0.07
A5	7 June, 94	16	68.38	61.26	16	0.60	0.26006	0.56	0.34	0.04
B2 west	10 June, 94	0	0.00	0.00	0	0.00	0.00000	0.00	0.00	0.00
B5 west	10 June, 94	14	58.07	69.45	14	0.65	0.22308	0.66	0.46	0.04
B2 east	9 June, 94	0	0.00	0.00	0	0.00	0.00000	0.00	0.00	0.00
B4 east	9 June, 94	23	73.22	1623.28	23	0.43	0.39974	0.75	12.10	0.06
C2	10 June, 94	1	65.00	7.07	1	0.98	0.01139	0.03	0.00	0.00
C4	10 June, 94	0	0.00	0.00	0	0.00	0.00000	0.00	0.00	0.00
D2	14 June, 94	14	47.14	1029.82	14	0.65	0.22308	1.00	10.34	0.04
D4	14 June, 94	25	51.80	1454.24	25	0.38	0.44594	1.66	24.17	0.06
Zone mean			58.52	770.00		0.75	0.15351	0.45	3.45	0.30
Total		121			121					

Table A-20.

Survey #4

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Comparison of coral density and percent coverage by zone between transects.
Mid-reef zone
September, October, 1994

Site	Date	N	Mean dist. (cm)	Mean area (cm sq.)	nk-no	no/nk	Correction factor	Density	Percent coverage	Fre-quency
A2	Sept., 94	30	59.70	75.76	30	0.25	0.58159	1.63	1.24	0.75
A5	Sept., 94	13	57.15	70.20	13	0.68	0.20162	0.62	0.43	0.33
B2 west	Oct., 94	0	0.00	0.00	0	1.00	0.00000	0.00	0.00	0.00
B5 west	Oct., 94	14	54.00	214.97	14	0.65	0.22308	0.77	1.64	0.35
B2 east	Oct., 94	0	0.00	0.00	0	1.00	0.00000	0.00	0.00	0.00
B4 east	Oct., 94	21	61.81	2036.61	21	0.48	0.35611	0.93	18.98	0.53
C2	Oct., 94	6	66.50	5.63	6	0.85	0.08899	0.20	0.01	0.15
C4	Oct., 94	15	59.80	31.63	15	0.63	0.23768	0.66	0.21	0.38
D2	no data									
D4	no data									
Zone mean			59.43	499.72		0.69	0.19458	0.55	2.75	0.31
Total		99			99					

Table A-21.

Survey # 5.

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Comparison of coral density and percent coverage by zone between transects.
Mid-reef zone
January 11,12,13, 1995

Site	Date	N	Mean dist. (cm)	Mean area (cm sq.)	nk-no	no/nk	Correction factor	Density	Percent coverage	Fre-quency
A2	no data									
A5	no data									
B2 west	12 Jan., 95	1	32.00	3.14	1	0.98	0.01139	0.11	0.003	0.03
B5 west	12 Jan., 95	18	55.61	146.09	18	0.55	0.29874	0.97	1.41	0.45
B2 east	12 Jan., 95	0	0.00	0.00	0	0.00	0.00000	0.00	0.00	0.00
B4 east	12 Jan., 95	25	49.24	921.74	25	0.38	0.44594	1.84	16.95	0.63
C2	no data									
C4	no data									
D2	13 Jan., 95	15	44.80	567.21	15	0.63	0.23768	1.18	6.72	0.38
D4	no data									
Zone mean			49.76	579.40		0.71	0.18068	0.73	4.23	0.30
Total		59			59					

Table A-22.

Survey # 6.

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Comparison of coral density and percent coverage by zone between transects.
Mid-reef zone
March 28, 30; April 3, 1995

Site	Date	N	Mean dist. (cm)	Mean area (cm sq.)	nk-no	no/nk	Correction factor	Density	Percent coverage	Fre-quency
A2	28 Mar., 95	26	42.62	270.81	26	0.35	0.47507	2.62	7.08	0.65
A5	28 Mar., 95	14	65.00	60.87	14	0.65	0.22308	0.53	0.32	0.35
B2 west	30 Mar., 95	0	0.00	0.00	0	0.00	0.00000	0.00	0.00	0.00
B5 west	30 Mar., 95	13	50.46	97.09	13	0.68	0.20162	0.79	0.77	0.33
B2 east	30 Mar., 95	0	0.00	0.00	0	0.00	0.00000	0.00	0.00	0.00
B4 east	3 April, 95	21	55.62	2573.15	21	0.48	0.35611	1.15	29.62	0.53
C2	3 April, 95	13	60.69	9.16	13	0.68	0.20162	0.55	0.05	0.33
C4	3 April, 95	17	49.29	35.53	17	0.58	0.27532	1.13	0.40	0.43
D2	no data									
D4	no data									
Zone mean			52.59	614.56		0.68	0.20162	0.73	4.49	0.33
Total		104			104					

Table A-23.

Survey #7

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Comparison of coral density and percent coverage by zone between transects.
Mid-reef zone
10, 11, 12, and 18 May, 1995

Site	Date	N	Mean dist. (cm)	Mean area (cm sq.)	nk-no	no/nk	Correction factor	Density	Percent coverage	Fre-quency
A2	10 May, 95	25	52.12	81.78	25	0.38	0.44594	1.64	1.34	0.08
A5	10 May, 95	16	58.06	103.92	16	0.60	0.26006	0.77	0.80	0.05
B2 west	11 May, 95	0	0.00	0.00	0	1.00	0.00000	0.00	0.00	0.00
B5 west	11 May, 95	16	51.13	98.13	16	0.60	0.26006	0.99	0.98	0.05
B2 east	12 May, 95	0	0.00	0.00	0	1.00	0.00000	0.00	0.00	0.00
B4 east	12 May, 95	23	53.43	1916.81	23	0.43	0.39974	1.40	26.84	0.07
C2	18 May, 95	12	50.58	10.73	12	0.70	0.18761	0.73	0.08	0.04
C4	18 May, 95	19	56.47	26.50	19	0.53	0.31473	0.99	0.26	0.06
D2	no data									
D4	no data									
Zone mean			53.68	450.41		0.65	0.22308	0.77	3.49	0.35
Total		111			111					

Table A-24.

Survey #8

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Comparison of coral density and percent coverage by zone between transects.
Mid-reef zone.
October 11, 16, 18, and 20, 1995

Site	Date	N	Mean dist. (cm)	Mean area (cm sq.)	nk-no	no/nk	Correction factor	Density	Percent coverage	Frequency
A2	11 Oct., 95	19	49.11	130.87	19	0.53	0.31473	1.31	1.71	0.48
A5	11 Oct., 95	17	58.24	96.14	17	0.58	0.27532	0.81	0.78	0.43
B2 west	16 Oct., 95	0	0.00	0.00	0	1.00	0.00000	0.00	0.00	0.00
B5 west	16 Oct., 95	17	53.59	117.58	17	0.58	0.27532	0.96	1.13	0.43
B2 east	16 Oct., 95	0	0.00	0.00	0	1.00	0.00000	0.00	0.00	0.00
B4 east	16 Oct., 95	22	74.77	3978.22	22	0.45	0.38200	0.68	27.18	0.55
C2	18 Oct., 95	7	64.29	14.59	7	0.83	0.10153	0.25	0.04	0.18
C4	18 Oct., 95	23	43.91	76.59	23	0.43	0.39974	2.07	1.59	0.58
D2	20 Oct., 95	16	41.94	355.93	16	0.60	0.26006	1.48	5.26	0.40
D4	no data									
Zone mean			54.63	836.36		0.55	0.29874	1.00	8.37	0.34
Total		121			121					

Table A-25.

Survey # 1.

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Species composition from all transects within zone. Data on number, size, percent coverage and frequency.
Mid-reef zone
May 6,11,18; August 11,12, 1993.

Species	N	Mean distance (cm)	Mean area (cm sq.)	Size range (cm sq.)	Relative percent coverage	Sample area percent coverage	Relative frequency	Sample area frequency
Acropora aspera	**14**	72.36	**4461.34**	**3-47124**	**56.50**	**3.55**	**14.00**	**0.04**
Goniastrea retiformis	**20**	33.40	**1899.72**	**7-7210**	**34.37**	**2.16**	**20.00**	**0.06**
Porites sp.	**13**	51.15	**263.41**	**20-746**	**3.10**	**0.19**	**13.00**	**0.04**
Pocillopora damicornis	**37**	66.24	**71.77**	**1-254**	**2.40**	**0.15**	**37.00**	**0.10**
Favia matthaii	5	37.20	466.53	13-1268	2.11	0.13	5.00	0.01
Acropora sp.	1	16.00	706.86		0.64	0.04	1.00	0.00
Acropora valida	3	45.67	112.57	28-177	0.31	0.02	3.00	0.01
Favite russelli	1	37.00	283.53		0.26	0.02	1.00	0.00
Heliopora coerulea	2	31.50	119.38	82-157	0.22	0.01	2.00	0.01
Pachyseris speciosa	1	92.00	63.62		0.06	0.00	1.00	0.00
Porites superfusa	2	79.50	14.14	13-16	0.03	0.00	2.00	0.01
Leptastrea purpurea	1	43.00	12.57		0.01	0.00	1.00	0.00
Zone mean		55.30	1105.37			6.28		0.28
Total	100				100.00		100.00	

Table A-26.

Survey # 2.

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Species composition from all transects within zone. Data on number, size, percent coverage and frequency.
Mid-reef zone.
Oct. 29; Nov. 11, 1993; Feb. 2,4, 1994.

Species	N	Mean distance (cm)	Mean area (cm sq.)	Size range (cm sq.)	Relative percent coverage	Sample area percent coverage	Relative frequency	Sample area frequency
Acropora aspera	**11**	76.55	**5203.26**	**102-12596**	**88.20**	**3.12**	**23.40**	**0.04**
Porites sp.	**6**	52.33	**622.69**	**3-2651**	**5.76**	**0.20**	**12.77**	**0.02**
Pocillopora damicornis	**25**	58.96	**141.59**	**3-550**	**5.45**	**0.19**	**53.19**	**0.09**
Goniastrea retiformis	1	60.00	318.09		0.49	0.02	2.13	0.004
Favia pallida	1	90.00	39.27		0.06	0.002	2.13	0.004
Leptastrea purpurea	3	59.00	9.16	3-13	0.04	0.001	6.38	0.01
Zone mean		62.91	1380.78			3.54		0.17
Total	47				100.00		100.00	

Table A-27.

Survey # 3.

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Species composition from all transects within zone. Data on number, size, percent coverage and frequency.
Mid-reef zone
June 7,9,10,and 14, 1994

Species	N	Mean distance (cm)	Mean area (cm sq.)	Size range (cm sq.)	Relative percent coverage	Sample area percent coverage	Relative frequency	Sample area frequency
Goniastrea retiformis	**21**	52.90	**1882.11**	**64-8718**	**42.42**	**1.46**	**17.36**	**0.05**
Acropora aspera	**19**	69.84	**1940.30**	**9-25133**	**39.57**	**1.37**	**15.70**	**0.05**
Favia matthaii	**8**	55.63	**789.42**	**20-2847**	**6.78**	**0.23**	**6.61**	**0.02**
Acropora digitifera	**7**	53.00	**821.08**	**79-2121**	**6.17**	**0.21**	**5.79**	**0.02**
Pocillopora damicornis	**47**	64.32	**67.36**	**1-347**	**3.40**	**0.12**	**38.84**	**0.12**
Porites sp. (massive)	4	57.75	207.74	77-491	0.89	0.03	3.31	0.01
Hellopora coerula	3	33.00	94.77	28-212	0.31	0.01	2.48	0.01
Acropora variabilis	1	8.00	235.62		0.25	0.01	0.83	0.003
Favites abdita	1	62.00	70.69		0.08	0.003	0.83	0.003
Montipora sp.	8	31.25	6.19	2-9	0.05	0.002	6.61	0.02
Porites annae	1	80.00	42.41		0.05	0.002	0.83	0.003
Psammocora contigua	1	74.00	37.70		0.04	0.001	0.83	0.003
Zone mean		58.52	770.00			3.45		0.30
Total	121				100.00		100.00	

Table A-28.

Survey # 4.

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Species composition from all transects within zone. Data on number, size, percent coverage and frequency.
Mid-reef zone
September, October, 1994

Species	N	Mean distance (cm)	Mean area (cm sq.)	Size range (cm sq.)	Relative percent coverage	Sample area percent coverage	Relative frequency	Sample area frequency
Acropora aspera	**15**	65.13	**2844.97**	**1-21205**	**86.26**	**2.37**	**15.15**	**0.05**
Pocillopora damicornis	**57**	59.49	**72.16**	**3-1766**	**8.31**	**0.23**	**57.58**	**0.18**
Porites sp. (massive)	**8**	64.88	**256.14**	**5-962**	**4.14**	**0.11**	**8.08**	**0.03**
Hellopora coerula	4	50.25	123.50	57-254	1.00	0.03	4.04	0.01
Psammocora contigua	1	54.00	75.40		0.15	0.00	1.01	0.00
Leptastrea purpurea	9	53.78	5.06	2-12	0.09	0.00	9.09	0.03
Psammocora sp.	1	48.00	11.78		0.02	0.00	1.01	0.00
Montipora sp.	4	52.50	2.16	1-3	0.02	0.00	4.04	0.01
Zone mean		59.43	499.72			2.75		0.31
Total	99				100.00		100.00	

Table A-29.

Survey # 5.

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Species composition from all transects within zone. Data on number, size, percent coverage and frequency.
Mid-reef zone
January 11, 12, 13, 1995

Species	N	Mean distance (cm)	Mean area (cm sq.)	Size range (cm sq.)	Relative percent coverage	Sample area percent coverage	Relative frequency	Sample area frequency
Acropora aspera	**21**	48.76	**1095.18**	**15-17671**	**67.28**	**2.85**	**35.59**	**0.11**
Goniastrea retiformis	**2**	73.00	**1987.06**	**204-3770**	**11.63**	**0.49**	**3.39**	**0.01**
Porites sp. (massive)	**6**	46.17	**498.99**	**101-1272**	**8.76**	**0.37**	**10.17**	**0.03**
Favites abdita	**2**	39.50	**936.19**	**616-1257**	**5.48**	**0.23**	**3.39**	**0.01**
Acropora digitifera	**4**	57.50	**427.26**	**79-707**	**5.00**	**0.21**	**6.78**	**0.02**
Acropora valida	1	17.00	267.04		0.78	0.03	1.69	0.01
Pocillopora damicornis	15	59.93	10.73	1-64	0.47	0.02	25.42	0.08
Favia matthaii	3	26.67	45.03	28-82	0.40	0.02	5.08	0.02
Leptastrea purpurea	4	38.50	11.20	0.1-24	0.13	0.01	6.78	0.02
Favia favus	1	30.00	28.27		0.08	0.00	1.69	0.01
Zone mean		49.76	579.40			4.23		0.30
Total	59				100.00		99.98	

Table A-30.

Survey # 6.

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Species composition from all transects within zone. Data on number, size, percent coverage and frequency.
Mid-reef zone
March 28,30; April 3, 1995

Species	N	Mean distance (cm)	Mean area (cm sq.)	Size range (cm sq.)	Relative percent coverage	Sample area percent coverage	Relative frequency	Sample area frequency
Porites sp. (massive)	**6**	59.00	**363.64**	**85-707**	**33.57**	**1.51**	**5.77**	**0.02**
Acropora sp.	**6**	75.17	**109.43**	**1-11**	**12.87**	**0.58**	**5.77**	**0.02**
Goniastrea retiformis	**1**	99.00	**77.89**		**12.06**	**0.54**	**0.96**	**0.003**
Acropora aspera	**20**	59.55	**126.71**	**6-45239**	**11.81**	**0.53**	**19.23**	**0.06**
Pocillopora damicornis	**52**	51.77	**131.68**	**2-200**	**10.67**	**0.48**	**50.00**	**0.16**
Leptastrea purpurea	11	39.82	93.20	2-16	5.81	0.26	10.58	0.03
Heliopora coerula	4	43.25	79.85	102-471	5.40	0.24	3.85	0.01
Porites (encrusting)	3	12.67	248.45	3-16	4.92	0.22	2.88	0.01
Favia matthaii	1	33.00	81.16		4.19	0.19	0.96	0.003
Zone mean		52.59	614.56			4.55		0.33
Total	104				101.30		100.00	

Table A-31.

Survey #7

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Species composition from all transects within zone: density, percent coverage and frequency
Mid-reef zone
10, 11, 12, 18, and 19 May, 1995

Species	N	Mean distance (cm)	Mean area (cm sq.)	Size range (cm sq.)	Relative percent coverage	Sample area percent coverage	Relative frequency	Sample area frequency
Acropora aspera	**18**	57.17	**2446.51**	**3-31416**	**88.08**	**3.07**	**16.22**	**0.06**
Pocillopora damicornis	**58**	55.34	**48.06**	**1-357**	**5.58**	**0.19**	**52.25**	**0.18**
Porites sp. (massive)	**8**	59.00	**305.62**	**35-785**	**4.89**	**0.17**	**7.21**	**0.03**
Heliopora coerula	2	25.00	251.33	79-424	1.01	0.04	1.80	0.01
Porites (encrusting)	7	43.71	13.13	1-57	0.18	0.01	6.31	0.02
Leptastrea purpurea	11	42.73	6.85	1-20	0.15	0.01	9.91	0.03
Acropora sp.	6	58.50	7.46	2-14	0.09	0.00	5.41	0.02
Favia matthaii	1	71.00	11.78		0.02	0.00	0.90	0.00
Zone mean		53.68	450.41			3.49		0.35
Total	111				100.00		100.00	

Table A-32.

Survey # 8.

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Species composition from all transects within zone. Data on number, size, percent coverage and frequency.
Mid-reef zone.
October 11, 16, 18, and 20, 1995

Species	N	Mean distance (cm)	Mean area (cm sq.)	Size range (cm sq.)	Relative percent coverage	Sample area percent coverage	Relative frequency	Sample area frequency
Acropora aspera	**19**	73.00	**4604.12**	**13-23562**	**86.44**	**7.24**	**15.70**	**0.05**
Porites sp. (massive)	**13**	52.69	**333.85**	**1-1378**	**4.29**	**0.36**	**10.74**	**0.04**
Pocillopora damicornis	**57**	52.75	**55.34**	**2-440**	**3.12**	**0.26**	**47.11**	**0.16**
Acropora digitifera	**4**	49.75	**503.24**	**64-912**	**1.99**	**0.17**	**3.31**	**0.01**
Favia matthaii	2	53.50	825.06	742-948	1.63	0.14	1.65	0.01
Heliopora coerula	4	35.25	203.81	79-471	0.81	0.07	3.31	0.01
Goniastrea retiformis	3	37.67	251.07	212-315	0.74	0.06	2.48	0.01
Favia sp.	3	53.67	183.52	28-412	0.54	0.05	2.48	0.01
Acropora valida	2	41.00	107.60	38-167	0.21	0.02	1.65	0.01
Platygyra pini	1	62.00	78.54		0.08	0.01	0.83	0.003
Leptastrea purpurea	10	49.00	7.46	1-16	0.07	0.01	8.26	0.03
Acropora sp.	1	80.00	38.48		0.04	0.00	0.83	0.00
Montipora sp.	2	48.00	18.85	13-25	0.04	0.00	1.65	0.01
Zone mean		54.63	836.36			8.37		0.34
Total	121				100.00		100.00	

Table A-33.

Survey # 1.

Andersen Air Force Base Marine Preserve Baseline Survey
Comparison of coral density and percent coverage by zone between transects.
Near-crest zone
May 6,11,18; August 11,12, 1993.

Site	Date	N	Mean dist. (cm)	Mean area (cm sq.)	nk-no	no/nk	Correction factor	Density	Percent Coverage	Fre-quency
A3	11 Aug., 93	34	49.79	251.35	34	0.15	0.70845	2.86	7.18	0.28
A6	11 Aug., 93	40	40.20	408.31	40	1.00	1.00000	6.19	25.27	0.33
B3w	18 May, 93	21	39.95	419.64	21	0.48	0.35611	2.23	9.36	0.18
Zone mean			43.58	354.64		0.21	0.62931	3.31	11.75	0.79
Total		95			95					

Table A-34.

Survey # 3.

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Comparison of coral density and percent coverage by zone between transects.
Near-crest zone
7and 10 June, 94

Site	Date	N	Mean dist. (cm)	Mean area (cm sq.)	nk-no	no/nk	Correction factor	Density	Percent Coverage	Fre-quency
A3	7 June, 94	37	53.81	416.71	37	0.08	0.81771	2.82	11.77	0.93
A5	7 June, 94	40	36.80	371.22	40	0.00	1.00000	7.38	27.41	1.00
B3 w	10 June, 94	15	67.40	674.6	15	0.63	0.23768	0.52	3.53	0.38
Zone mean			48.63	438.98		0.23	0.60502	2.56	11.23	0.77
Total		92			92					

Table A-35.

Survey # 4.

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Comparison of coral density and percent coverage by zone between transects.
Near-crest zone
Sept 30, 1994

Site	Date	N	Mean dist. (cm)	Mean area (cm sq.)	nk-no	no/nk	Correction factor	Density	Percent Coverage	Fre-quency
A3	Sept. 30, 94	35	50.54	185.15	35	0.13	0.73741	2.89	5.35	0.88
A5	Sept. 30, 94	39	33.95	449.81	39	0.03	0.91630	7.95	35.76	0.98
B3 w	no data									
Zone mean			41.13	324.30		0.08	0.81771	4.83	15.68	0.93
Total		74			74					

Table A-36.

Survey # 1.

Andersen Air Force Base Marine Preserve Baseline Survey
Comparison of coral density and percent coverage by zone between transects.
Mid-reef zone
May 6,11,18; August 11,12, 1993.

Species	N	Mean distance (cm)	Mean area (cm sq.)	Size range (cm sq.)	Relative percent coverage	Sample area percent coverage	Relative percent frequency	Sample area frequency
Goniastrea retiformis	**18**	33.78	**715.06**	**13-4241**	**38.20**	**4.49**	**18.95**	**0.15**
Leptoria phyrgia	**2**	22.50	**3065.41**	**2121-4010**	**18.20**	**2.14**	**2.11**	**0.02**
Porites sp.	**3**	74.00	**911.13**	**87-1940**	**8.11**	**0.95**	**3.16**	**0.03**
Porites annae	**2**	67.00	**728.85**	**201-1257**	**4.33**	**0.51**	**2.11**	**0.02**
Favia stelligera	**1**	28.00	**1335.18**		**3.96**	**0.47**	**1.05**	**0.01**
Pocillopora damicornis	**21**	43.86	**61.67**	**2-183**	**3.84**	**0.45**	**22.11**	**0.18**
Pavona varians	**2**	89.50	**618.89**	**531-707**	**3.67**	**0.43**	**2.11**	**0.02**
Pocillopora verrucosa	**16**	45.88	**72.60**	**13-255**	**3.45**	**0.40**	**16.84**	**0.13**
Hellopora coerula	**2**	42.00	**531.71**	**491-573**	**3.16**	**0.37**	**2.11**	**0.02**
Acropora palifera	**1**	81.00	**911.85**		**2.71**	**0.32**	**1.05**	**0.01**
Psammocora obtusangula	**6**	22.67	**147.92**	**7-573**	**2.63**	**0.31**	**6.32**	**0.05**
Montipora ehrenbergii	**1**	54.00	**572.55**		**1.70**	**0.20**	**1.05**	**0.01**
Favia matthaii	**2**	46.00	**176.32**	**38-314**	**1.05**	**0.12**	**2.11**	**0.02**
Acropora valida	2	42.50	159.83	95-225	0.95	0.11	2.11	0.02
Acropora sp.	1	99.00	314.16		0.93	0.11	1.05	0.01
Porites lichen	1	9.00	283.53		0.84	0.10	1.05	0.01
Leptastrea purpurea	2	38.00	133.52	13-255	0.79	0.09	2.11	0.02
Acropora surculosa	1	45.00	226.98		0.67	0.08	1.05	0.01
Porites superfusa	7	44.43	18.63	5-63	0.39	0.05	7.37	0.06
Montipora sp.	3	54.00	35.60	13-79	0.32	0.04	3.16	0.03
Pocillopora setchelli	1	35.00	31.42		0.09	0.01	1.05	0.01
Zone mean		43.58	354.64			11.74		0.79
Total	95				100.00		100.00	

Table A-37.

Survey # 3.

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Species composition from all transects within zone. Data on number, size, percent coverage and frequency.
Near crest zone
June 7,9,10,and 14, 1994

Species	N	Mean distance (cm)	Mean area (cm sq.)	Size range (cm sq.)	Relative percent coverage	Sample area percent coverage	Relative percent frequency	Sample area frequency
Goniastrea retiformis	**14**	66.21	**1592.39**	**12-7540**	**55.20**	**6.20**	**15.22**	**0.12**
Heliopora coerula	**2**	27.50	**2584.35**	**16-5153**	**12.80**	**1.44**	**2.17**	**0.02**
Porites sp. (massive)	**6**	65.50	**631.20**	**13-2042**	**9.38**	**1.05**	**6.52**	**0.05**
Pocillopora damicornis	**20**	46.25	**129.98**	**7-806**	**6.44**	**0.72**	**21.74**	**0.17**
Acropora variabilis	**8**	47.63	**222.17**	**20-573**	**4.40**	**0.49**	**8.70**	**0.07**
Pocillopora verrucosa	**17**	38.06	**82.74**	**12-236**	**3.48**	**0.39**	**18.48**	**0.14**
Acropora palifera	**2**	34.00	**456.32**	**64-849**	**2.26**	**0.25**	**2.17**	**0.02**
Favia matthaii	**3**	52.00	**224.89**	**20-605**	**1.67**	**0.19**	**3.26**	**0.03**
Leptastrea purpurea	2	51.00	283.14	154-412	1.40	0.16	2.17	0.02
Acropora nasuta	1	99.00	293.74		0.73	0.08	1.09	0.01
Psammocora contigua	5	38.00	52.46	3-181	0.65	0.07	5.43	0.04
Porites annae	1	72.00	251.33		0.62	0.07	1.09	0.01
Favia stelligera	1	81.00	176.71		0.44	0.05	1.09	0.01
Cyphastrea chalcidicum	2	22.00	75.79	64-88	0.38	0.04	2.17	0.02
Montipora sp.	8	41.75	7.95	3-14	0.16	0.02	8.70	0.07
Zone mean		48.63	438.98			11.23		0.77
Total	92				100.00		100.00	

Table A-38.

Survey # 4.

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Species composition from all transects within zone: density, percent coverage and frequency.
Near crest zone
September 30, 1994

Species	N	Mean distance (cm)	Mean area (cm sq.)	Size range (cm sq.)	Relative percent coverage	Sample area percent coverage	Relative percent frequency	Sample area frequency
Goniastrea retiformis	**6**	53.33	**1725.52**	**113-3927**	**44.34**	**6.95**	**8.33**	**0.08**
Hellopora coerula	**4**	29.00	**1460.25**	**9-5027**	**25.02**	**3.92**	**5.56**	**0.05**
Porites sp. (massive)	**2**	63.00	**1030.83**	**177-1885**	**8.83**	**1.38**	**2.78**	**0.03**
Pocillopora damicornis	**20**	41.40	**89.89**	**3-194**	**7.70**	**1.21**	**27.78**	**0.25**
Pocillopora setchelli	**17**	37.88	**61.08**	**7-173**	**4.45**	**0.70**	**23.61**	**0.21**
Psammocora contigua	**5**	24.80	169.49	**3-412**	**3.63**	**0.57**	**6.94**	**0.06**
Acropora sp.	**4**	35.50	128.22	**1-382**	**2.20**	**0.34**	**5.56**	**0.05**
Acropora palifera	1	85.00	282.74		1.21	0.19	1.39	0.01
Acropora sp. 3	2	19.00	107.60	52-163	0.92	0.14	2.78	0.03
Acropora nasuta	1	56.00	162.58		0.70	0.11	1.39	0.01
Montipora sp.	7	34.71	14.14	3-39	0.42	0.07	9.72	0.09
Pocillopora meandrina	1	99.00	75.40		0.32	0.05	1.39	0.01
Favia matthaii	1	70.00	31.42		0.13	0.02	1.39	0.01
Cyphastrea chalcidicum	1	70.00	31.42		0.13	0.02	1.39	0.01
Zone mean		41.13	324.30			15.68		0.90
Total	72				100.00		100.00	

Macro-invertebrates

Paul R. Chirichetti
University of Guam Marine Laboratory

Introduction

This was the eighth and final survey in the series. Data from survey #8 will not be described by itself, instead it will be incorporated into tables and figures comparing diversity and density means for invertebrates over all eight surveys.

Methods

The materials and methods were originally desribed in the first survey in this series (Environmental Survey Report #27). To make reference to this description simpler I will repeat it here. Twenty-five meter line transects were permanently marked between the near-shore and the reef crest from approximately 300 yards east of Tarague beach to the reef flat in front of the Explosive Ordnance Disposal area at Tagua point. Six separate sites were picked and recorded as A, B-west, B-east, C, D, and E. Site A was the nearest to Tarague beach and Site E was nearest to Tagua point. Each site had at least two transects laid out perpendicularly to the beach and roughly parallel to one another. The reef flat narrows from Tarague beach to Tagua point. Where the reef flat is widest (Site A) 3 pairs of transects were laid out, one pair in the near-shore, one pair in the mid-reef, and one pair near the near-crest areas. At site E, the reef flat narrows so much that only one pair of transects could be staked before reaching the reef crest. Transects were marked by pounding short sections of re-bar into the substrata.

Density and diversity (in the form of numbers of different species per transect) of invertebrates greater than 3 cm were recorded from a one meter wide corridor on either side of each 25 meter transect. In areas where the sea cucumber *Holothuria atra* was common (greater than 10 / 1 m sq) it was necessary to save time in the field by restricting the count to one half of the transect and quadrupling the results to estimate numbers per 100 meters square .

Results

Near-shore zone:

As few as two and as many as 12 species of invertebrates were found during the course of all the surveys with overall mean values around 4-6 different species per transect (Table 1). Wider fluctuations in species numbers on transects between surveys were seen between Sites A and C. Sites D and E had lower variability over time (Figure 1). The overall mean number of species for all transects combined in this zone averaged 5.3 (Table 4).

Conspicuous macro-invertebrates tend to become less abundant as the reef flat narrows from west to east, averaging 648 per meter square at Site A1 and 36 per meter square at site E2 (Table 5, Figure 5). The echinoderm *Holothuria atra*, makes up greater than 90% of all

invertebrates counted on transects on Site A1, A4, B1e, C1, and C3 (Table 11). Low density transects (overall mean values between 2.3-51.5 *H. atra* per100 meters square)were B1w, B4w, B3e, and D1, D3, E1 and E2 (Table 9, Figures 9a). High density transects A1, A1, B1e, C1, and C1 had mean values ranging from 101.0-481.8 *H. atra* per 100 meters square (Table 9 and Figure 9b).

Mid-reef zone:

As few as two and as many as 11 species of invertebrates were found during the course of all the surveys with overall mean values ranged between 4 and 9 species per transect (Table 2). Species diversity is slighty higher than the near-shore zone, and also has a wider range of variability between transects (Figure 2). The overall mean number of species for all transects combined in this zone averaged 6.0 (Table 4, Figure 4).

Invertebrate abundance decreases somewhat in the mid-reef zone but follows the same general pattern of variation seen in the near-shore transects at each site. Site A invertebrates are very abundant, Sites B-west and B-east have few (except B2e which has higher densities), site C has abundant invertebrates while site D has few (Table 6, Figure 6).

The echinoderm *Holothuria atra*, makes up greater than 90% of all invertebrates counted on transects A2, A5, B2e, and C2 (86.8% on C4) (Table 12). Low density transects (between 5-35 *H. atra* per100 meters square)B2w, B5w, B4e, and D2 (no data collected from D4) had mean density values ranging between 2.3-18.2 per 100 meters square (Table 10, Figures 10a). High density transects A2, A5, B2e, C2, and C4 had mean values ranging from 172.0-570.0 *H. atra* per 100 meters square (Table 10 and Figure 10b).

Near-crest zone:

Reliable data for this zone was only available for one survey (4th), but mean numbers of species were higher here than in the other zones (Table 3, Figure 3). The overall mean number of species for all transects combined in this zone averaged 9.0 (Table 4, Figure 4).

Macro-invertebrate density is low in this area ranging between 19 and 38 per meter square (Table 7, Figure 7).

Discussion

It should be remembered that this survey was limited to daylight observations of conspicuous (greater than 3 cm and non-cryptic) macro-invertebrates. Many invertebrates hide during the day to avoid visual predators, so conclusions drawn about the relative adundance and diversity of these animals should bear this in mind. Diversity seems to increase from the near-shore to the near-crest zone, with the mean values for both the near-shore and the near-crest zone varying around five to six species per transect, while the near-crest zone averaged nine different species per transect.

Densities generally decrease from shore seaward across the reef flat and from Site A eastward to Site E (Table 8, Figure 8). The sea cucumber *Holothuria atra* is the most important invertebrate on the reef-flat in terms of abundance. Nine of the 12 transects in the near-shore zone have *H. atra* densities exceeding 50% of all invertebrates recorded, and five of the 12 transects in the near-shore zone have *H. atra* densities greater than 90% (A1, A4, B1e, C1, and C3) (Table 9, Figures 9a, 9b). Seven of the 10 transects in the mid-reef zone have *H. atra* densities greater than 50% of all invertebrates recorded, and four of 10 have densities of *H. atra* exceeding 90% (A2, A5, B2e, C2) (Table 10, Figure 10a, 10b).

The mean number of each individual species of invertebrate found during all surveys for each transect along with estimates of density per 100 meters square and percentage contribution of Holothuria atra to density is given in Tables 11 (near-shore) and 12 (mid-reef). Tables of data showing the type and abundance of each species for individual transects over the course of all eight surveys are compiled in the appendix. Tables A-1 through A-12 cover the near-shore zone tables A-13 through A-22 cover the mid-reef zone, and A-23 the near-crest zone.

Bibliography

Amesbury, S. S., Chirichetti, P. R., Kerr, A. M., Davidson, B., Dutka-Gianelli, J., and Dayton, C. 1993. Andersen Air Force Base Marine Resource Preserve Baseline Survey of Marine Resources. First Survey, May-August 1993. University of Guam Marine Laboratory Environmental Survey Report No. 27. October 12, 1993.

Table 1.

Survey 8

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Conspicuous macroinvertebrate species diversity : number of different species per transect.
Near-shore zone: All survey comparison.

	Survey										
Transect	!st 5/93	2nd 2/94	3rd 6/94	4th 9/94	5th 1/95	6th 3/95	7th 5/95	8th 10/95	Mean	Stds	Range*
A1	2	3	no data	4	5	5	9	5	4.7	2.2	2.5-6.9
A4	5	8	no data	3	4	7	5	3	5.0	1.9	3.1-6.9
B1w	4	2	no data	3	9	6	12	6	6.0	3.5	2.5-8.5
B4w	6	6	no data	no data	3	5	8	7	5.8	1.7	4.1-7.5
B1e	no data	3	no data	3	5	9	4	6	5.0	2.3	2.7-7.3
B3e	no data	5	no data	4	2	6	11	8	6.0	3.2	2.8-9.2
C1	2	3	no data	3	no data	2	5	8	3.8	2.3	1.5-6.1
C3	5	3	no data	2	no data	5	4	11	5.0	3.2	1.8-8.2
D1	4	7	no data	no data	6	no data	5	6	5.6	1.1	4.5-6.7
D3	7	5	no data	no data	5	no data	8	4	5.8	1.6	4.2-7.4
E1	5	8	no data	no data	3	no data	no data	6	5.5	2.1	3.4-7.6
E2	5	7	no data	no data	6	no data	no data	4	5.5	1.3	4.2-6.8

Range defined as plus or minus one standard deviation from the mean.

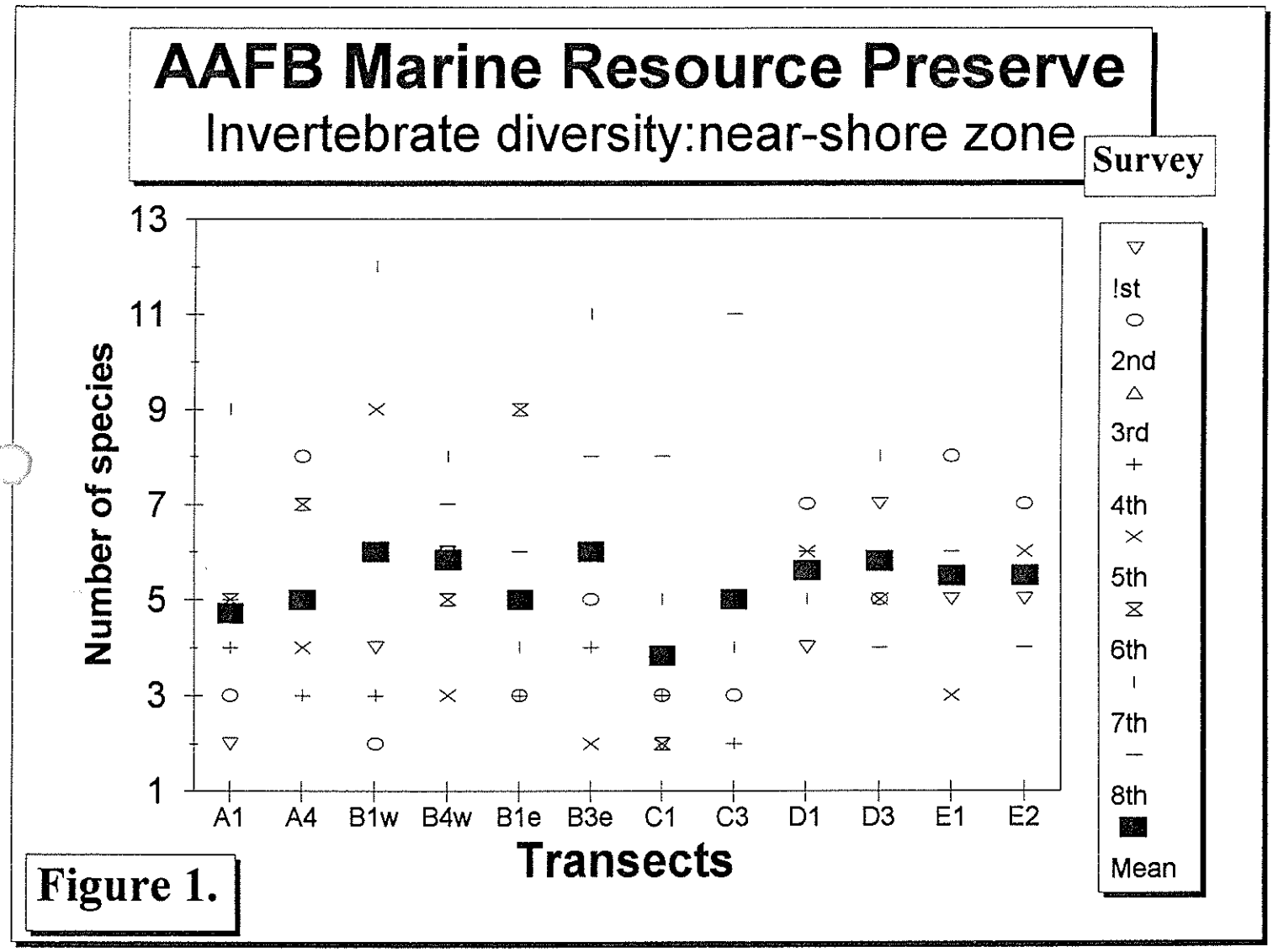

AAFB Marine Resource Preserve
Invertebrate diversity:near-shore zone
Survey
13
11
9
7
5
3
1
Number of species
A1
A4
B1w
B4w
B1e
B3e
C1
C3
D1
D3
E1
E2
Transects
!st
2nd
3rd
4th
5th
6th
7th
8th
Mean

Figure 1.

Table 2.

Survey 8

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Conspicuous macroinvertebrate species diversity : number of different species per transect.
Mid-reef zone: All survey comparison.

	Survey										
Transect	!st 5/93	2nd 2/94	3rd 6/94	4th 9/94	5th 1/95	6th 3/95	7th 5/95	8th 10/95	Mean	Stds	Range*
A2	6	4	no data	7	no data	9	8	7	6.8	1.7	5.1-8.5
A5	5	3	no data	5	no data	5	5	4	4.5	0.8	3.7-5.3
B2w	3	2	no data	3	4	5	7	4	4.0	1.6	2.4-5.6
B5w	2	5	no data	3	8	7	7	8	5.7	2.4	3.3-8.1
B2e	no data	2	no data	5	3	8	2	6	3.7	2.4	1.3-6.1
B4e	no data	5	no data	no data	6	4	8	4	5.4	1.7	3.7-7.1
C2	3	2	no data	9	no data	4	9	8	5.8	3.2	2.6-9.0
C4	2	5	no data	no data	no data	8	11	8	6.8	3.4	3.4-10.2
D2	no data	8	no data	no data	9	no data	7	11	8.8	1.7	7-10.5
D4	no data	8	no data	no data	no data	no data	no data	no data	8.0		

Range defined as plus or minus one standard deviation from the mean.

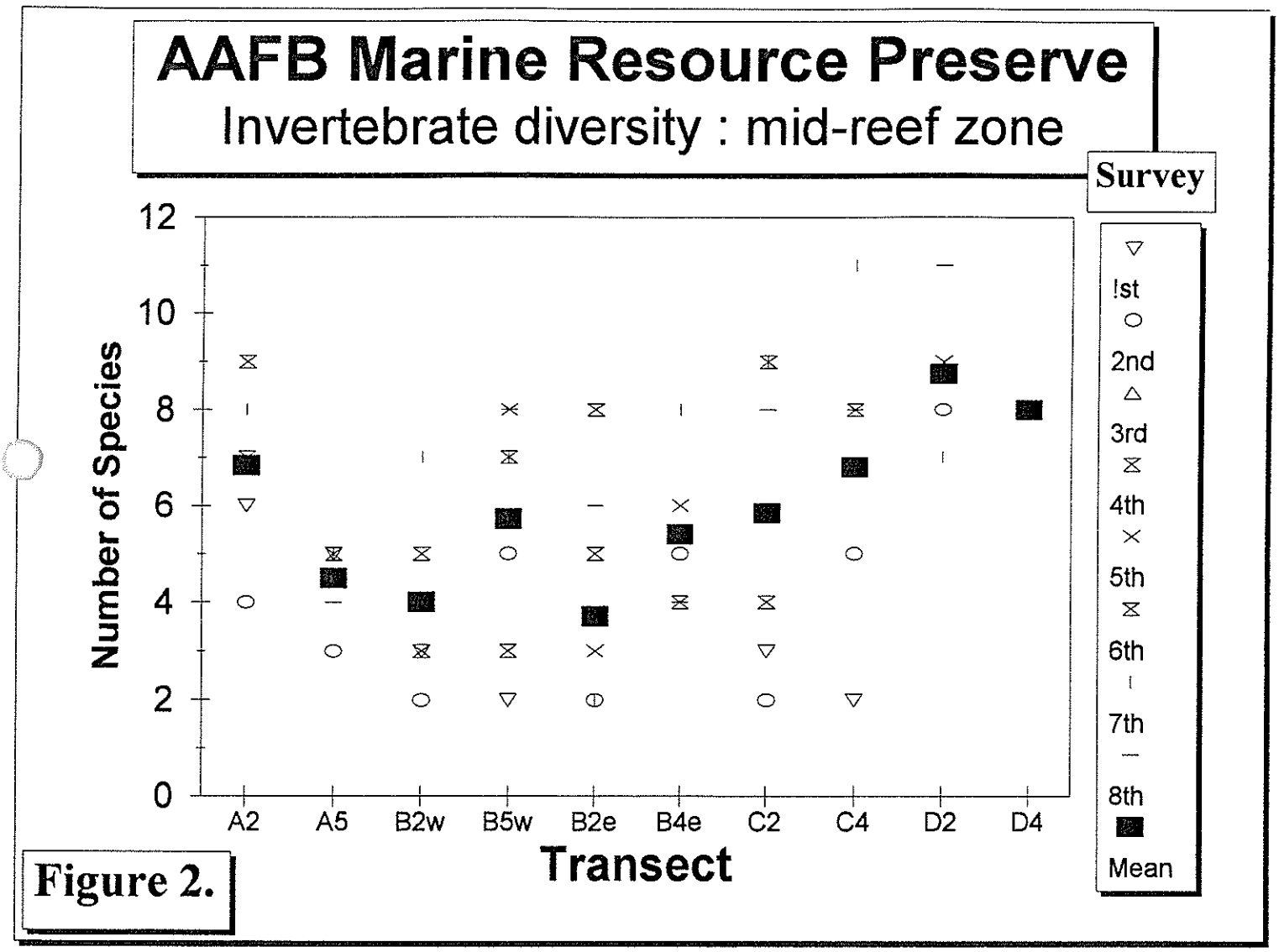

AAFB Marine Resource Preserve
Invertebrate diversity : mid-reef zone
Survey
!st
2nd
3rd
4th
5th
6th
7th
8th
Mean
Number of Species
0
2
4
6
8
10
12
A2
A5
B2w
B5w
B2e
B4e
C2
C4
D2
D4
Transect

Figure 2.

Table 3.

Survey 8

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Conspicuous macroinvertebrate species diversity :number of different species per transect.
Near-crest zone: All survey comparison.

Survey

Transect	1st 5/93	2nd 2/94	3rd 6/94	4th 9/94	5th 1/95	6th 3/95	7th 5/95	8th 10/95	Mean	Stds	Range*
A3	5	no data	no data	11	no data	no data	no data	no data	8	4.24	3.8-12.2
A6	5	no data	no data	9	no data	no data	no data	no data	7	2.83	4.2-9.8
B3 w	12	no data	no data	no data	no data	no data	no data	no data	12		

Range defined as plus or minus one standard deviation from the mean.

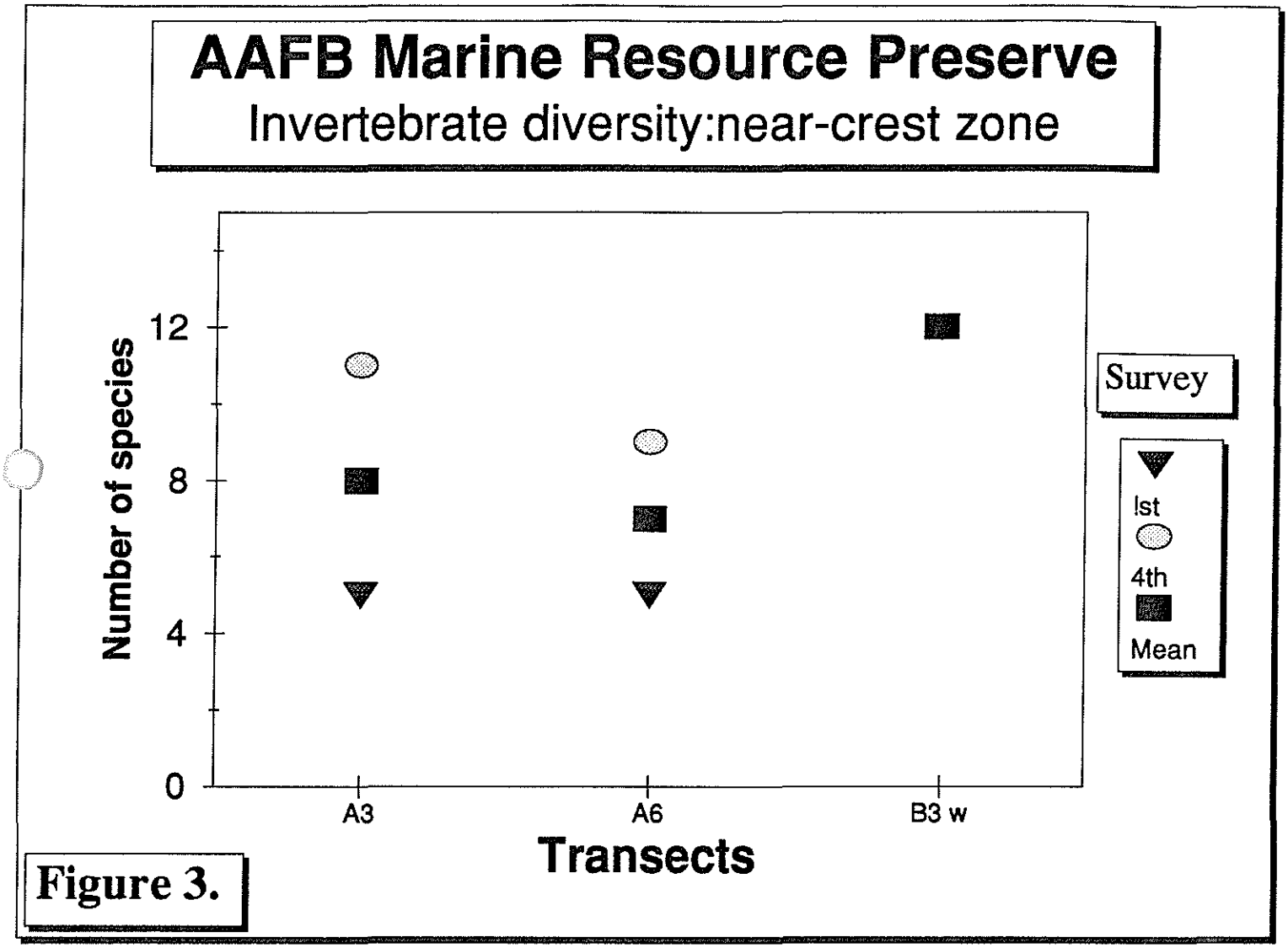

AAFB Marine Resource Preserve
Invertebrate diversity:near-crest zone
Number of species
0
4
8
12
A3
A6
B3 w
Transects
Survey
1st
4th
Mean

Figure 3.

Table 4.

Survey 8

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Conspicuous macroinvertebrate species diversity:number of different species/ transe
All zones: All survey comparison.

Zone					
Near-shore		Mid-reef		Near-crest	
Transect	Mean	Transec	Mean	Transect	Mean
A1	4.7	A2	6.8	A3	8.0
A4	5.0	A5	4.5	A6	7.0
B1 w	6.0	B2 w	4.0	B3 w	12.0
B4 w	5.8	B5 w	5.7		
B1 e	5.0	B2 e	3.7		
B3 e	6.0	B4 e	5.4		
C1	3.8	C2	5.8		
C3	5.0	C4	6.8		
D1	5.6	D2	8.8		
D3	5.8	D4	8.0		
E1	5.5				
E2	5.5				
Mean	5.3		6.0		9.0

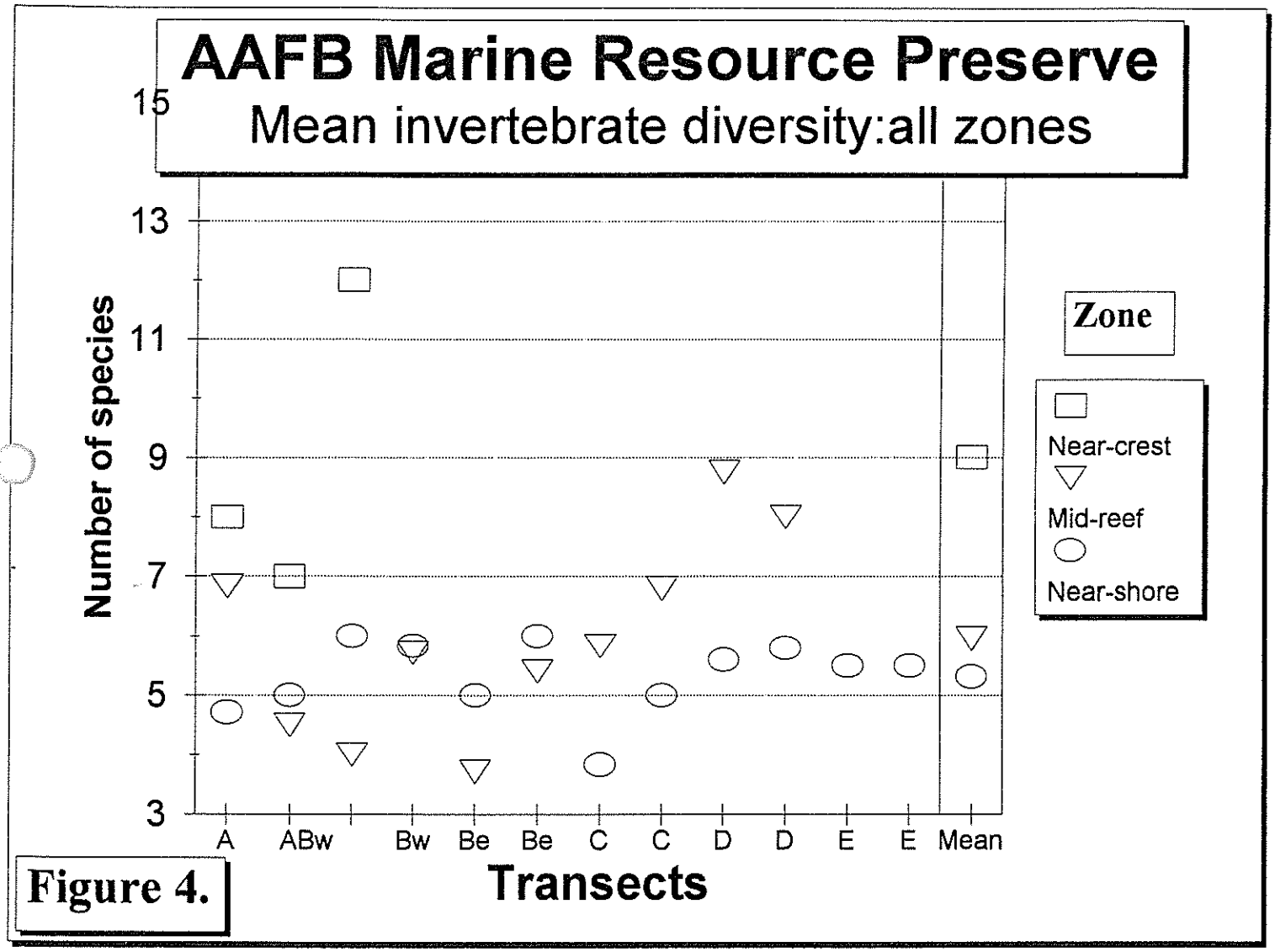

AAFB Marine Resource Preserve
Mean invertebrate diversity:all zones
Number of species
15
13
11
9
7
5
3
A
ABw
Bw
Be
Be
C
C
D
D
E
E
Mean
Transects
Zone
Near-crest
Mid-reef
Near-shore

Figure 4.

Table 5.

Survey 8

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Conspicuous macroinvertebrate species density per 100 meters square.
Near-shore zone : all transects, all surveys.

	Transects											
Survey	A1	A4	B1w	B4w	B1e	B3e	C1	C3	D1	D3	E1	E2
# 1	930	722	130	120	247	130	389	290	65	99	31	37
# 2	389	340	no data	no data	114	74	390	250	49	25	28	19
# 3	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
# 4	336	384	8	no data	278	212	18	6	no data	no data	no data	no data
# 5	592	702	116	64	166	122	no data	no data	54	34	26	64
# 6	822	962	168	66	238	136	804	538	no data	no data	no data	no data
# 7	770	1222	218	88	244	144	918	640	54	84	no data	no data
# 8	696	632	176	62	290	84	1814	662	86	68	48	24
Mean	648	709	136	80	225	129	722	398	62	62	33	36

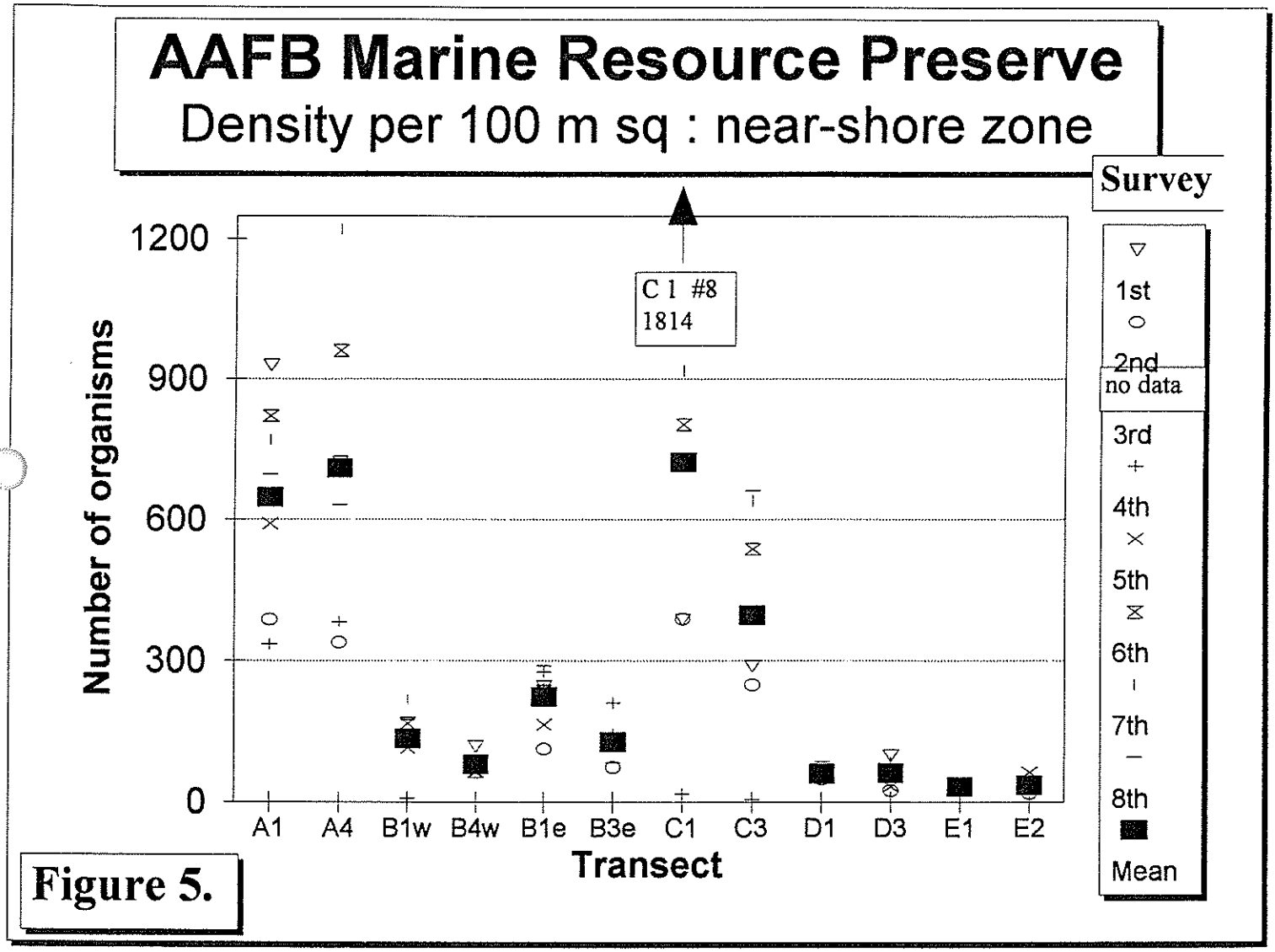

AAFB Marine Resource Preserve
Density per 100 m sq : near-shore zone
Survey
1st
2nd
no data
3rd
4th
5th
6th
7th
8th
Mean
C 1 #8
1814
1200
900
600
300
0
Number of organisms
A1
A4
B1w
B4w
B1e
B3e
C1
C3
D1
D3
E1
E2
Transect

Figure 5.

Table 6.

Survey 8

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Conspicuous macroinvertebrate species density per 100 meters square
Mid-reef zone : all transects, all surveys

	Transects									
Survey	A2	A5	B2w	B5w	B2e	B4e	C2	C4	D2	D4
# 1	300	744	31	25	63	28	150	825	70	32
# 2	225	344	no data	no data	19	112	338	944	no data	no data
# 3	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
# 4	352	272	12	no data	388	6	40	no data	no data	no data
# 5	no data	no data	27	21	177	40	no data	no data	25	no data
# 6	560	466	66	76	374	70	1190	538	no data	no data
# 7	598	748	66	96	492	90	1210	462	24	no data
# 8	594	304	74	32	456	36	1304	262	108	no data
Mean	438	480	46	50	281	55	705	606	57	32

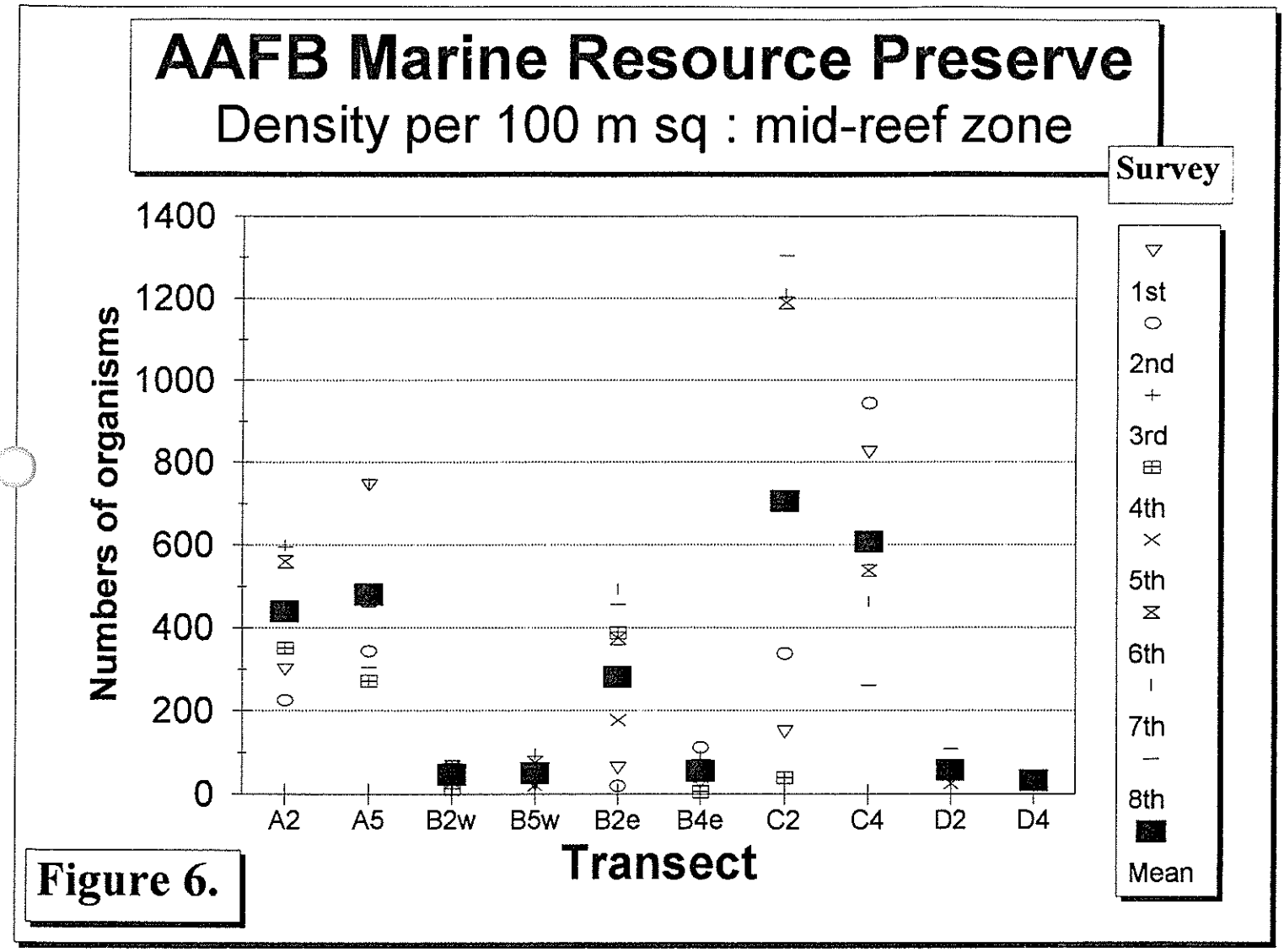

AAFB Marine Resource Preserve
Density per 100 m sq : mid-reef zone
Survey
1st
2nd
3rd
4th
5th
6th
7th
8th
Mean
Numbers of organisms
1400
1200
1000
800
600
400
200
0
A2
A5
B2w
B5w
B2e
B4e
C2
C4
D2
D4
Transect

Figure 6.

Table 7.

Survey 8

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Conspicuous macroinvertebrate species density per 100 meters square.
Near-crest zone : all transects, all surveys.

	Transects		
Survey	A3	A6	B3w
# 1	19	38	31
# 2	no data	no data	no data
# 3	no data	no data	no data
# 4	31	22	no data
# 5	no data	no data	no data
# 6	no data	no data	no data
# 7	no data	no data	no data
# 8	no data	no data	no data
Mean	25	30	31

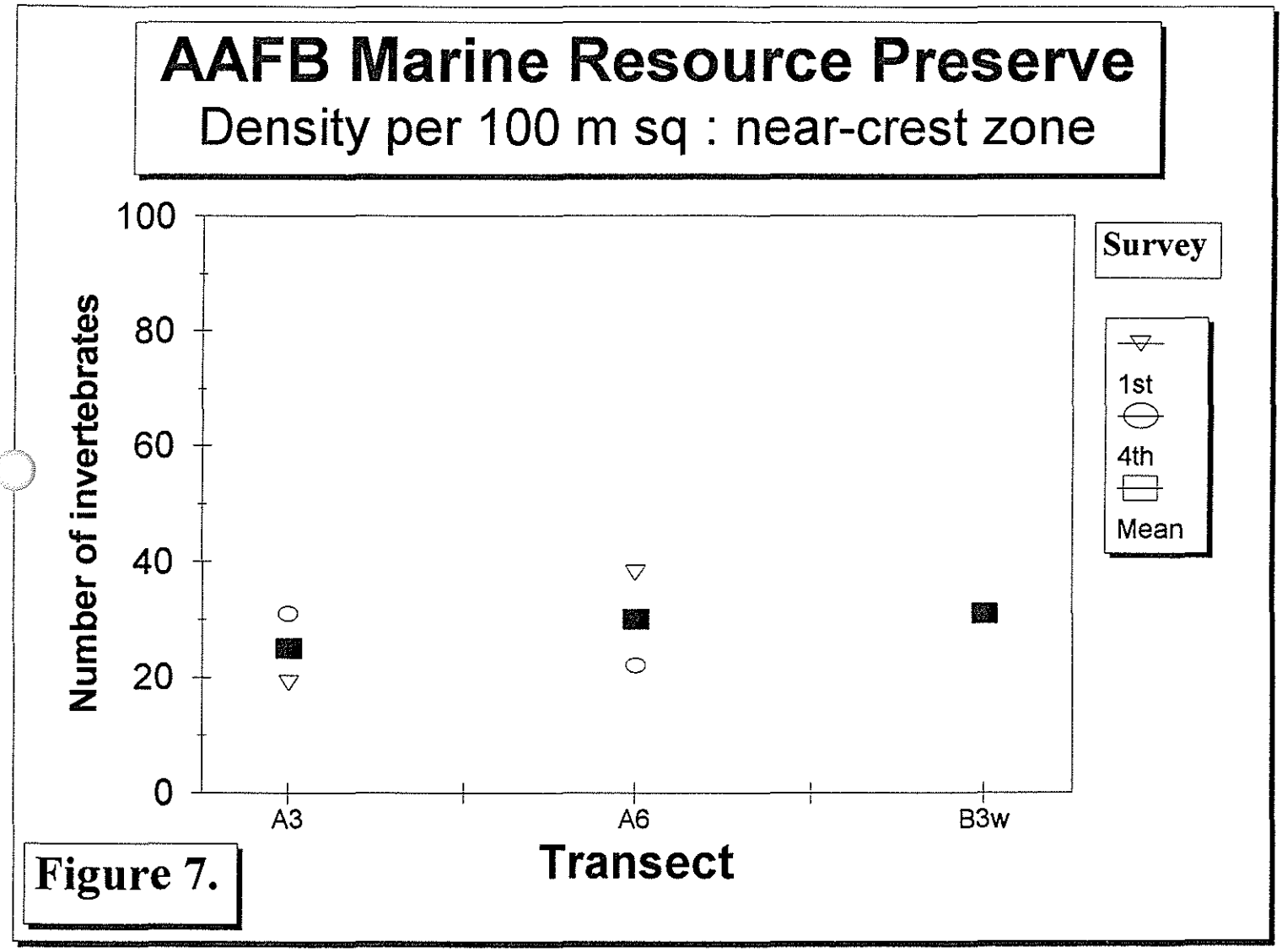

AAFB Marine Resource Preserve
Density per 100 m sq : near-crest zone
Number of invertebrates
100
80
60
40
20
0
A3
A6
B3w
Transect
Survey
1st
4th
Mean

Figure 7.

Table 8.

Survey 8

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Conspicuous macroinvertebrate species density : mean number of individuals estimated per 100 meters sq
All zone comparison of overall means for all surveys combined.

Transect	Near-shore	Mid-reef	Near-crest
A	648	438	25
A	709	480	30
Bw	136	46	31
Bw	80	50	
Be	225	281	
Be	129	55	
C	722	705	
C	398	606	
D	62	57	
D	62	32	
E	33		
E	36		

AAFB Marine Resource Preserve

Mean invert density : all zones

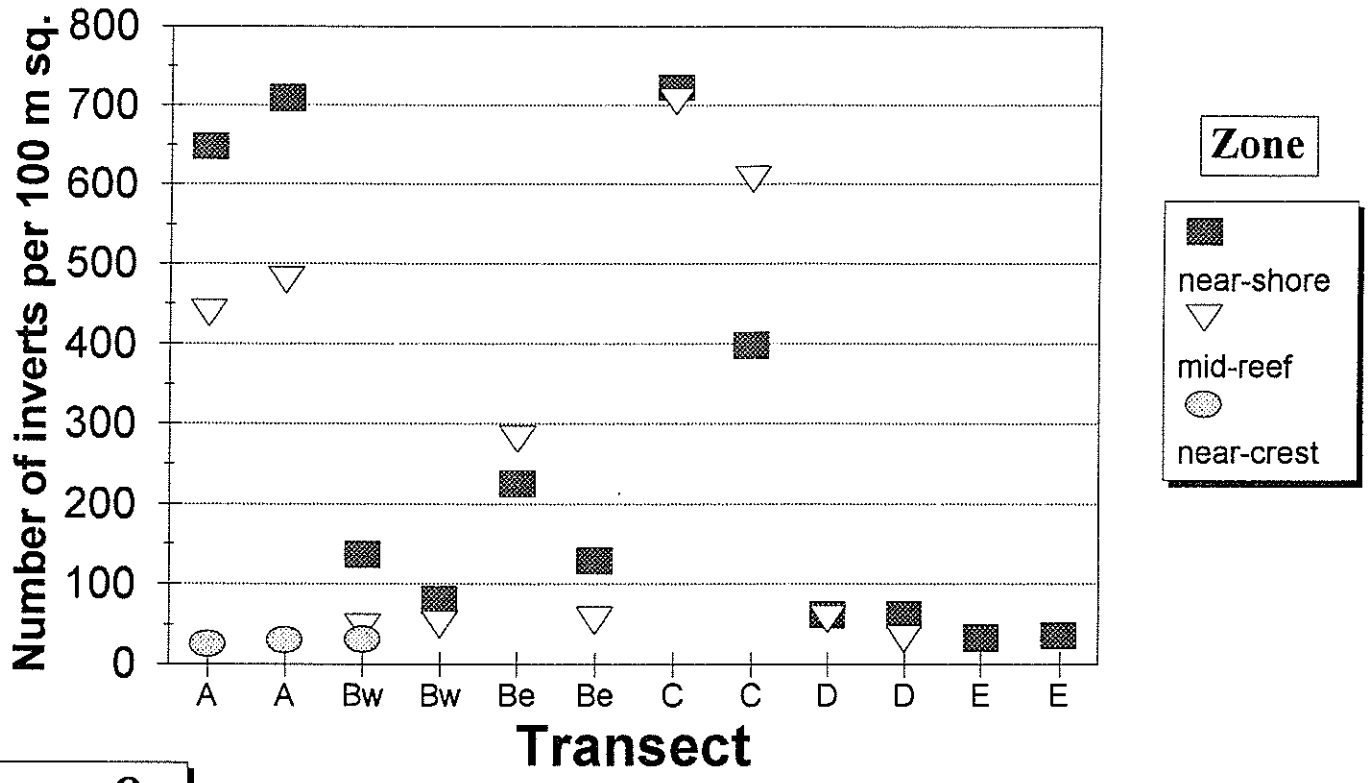


Figure 8.

Table 9

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Near-shore transects, May 1993 - October 1995, all survey comparison
Holothuria atra Changes in mean densities per 100 m sq. over time.

Transect	Survey 1st	Survey 2nd	Survey 3rd	Survey 4th	Survey 5th	Survey 6th	Survey 7th	Survey 8th	Mean	Stds
A1	nd	193	nd	165	292	405	376	344	295.8	98.4
A4	nd	161	nd	189	340	464	602	312	344.7	167.0
B1 w	nd	nd	nd	nd	40	63	67	68	47.6	29.0
B4 w	nd	nd	nd	nd	30	16	25	22	23.3	5.9
B1 e	nd	52	nd	134	76	102	116	126	101.0	31.5
B3 e	nd	22	nd	84	60	59	58	26	51.5	23.4
C1	nd	192	nd	nd	nd	401	450	884	481.8	290.6
C3	nd	116	nd	nd	nd	262	314	308	250.0	92.3
D1	nd	0	nd	nd	1	nd	2	6	2.3	2.6
D3	nd	1	nd	nd	2	nd	10	0	3.3	4.6
E1	nd	6	nd	nd	10	nd	nd	5	7.0	2.6
E2	nd	4	nd	nd	26	nd	nd	4	11.3	12.7

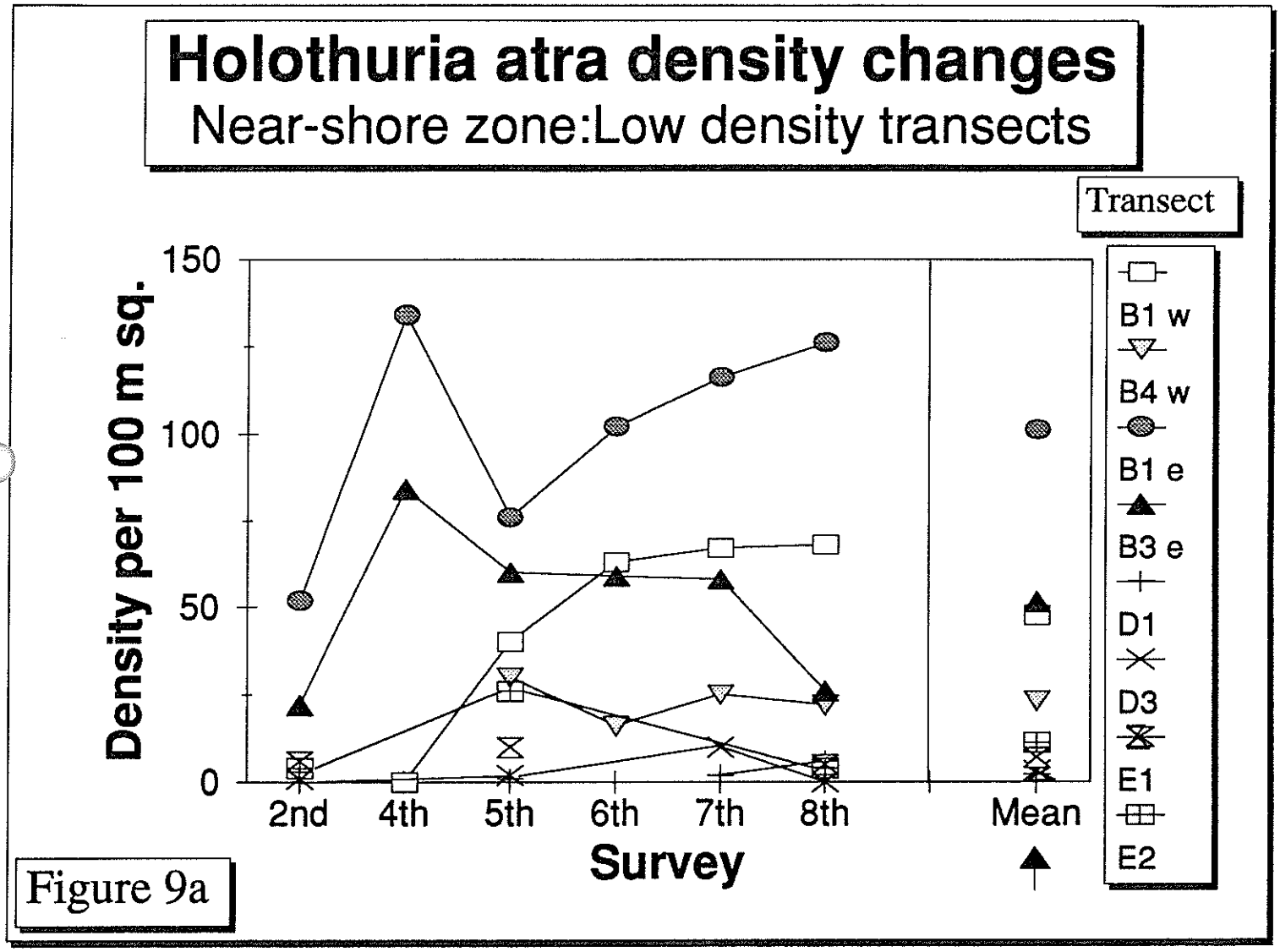

Holothuria atra density changes
Near-shore zone:Low density transects
Transect
Density per 100 m sq.
150
100
50
0
2nd
4th
5th
6th
7th
8th
Mean
Survey
B1 w
B4 w
B1 e
B3 e
D1
D3
E1
E2

Figure 9a

Holothuria atra density changes

Near-shore zone:high density transects

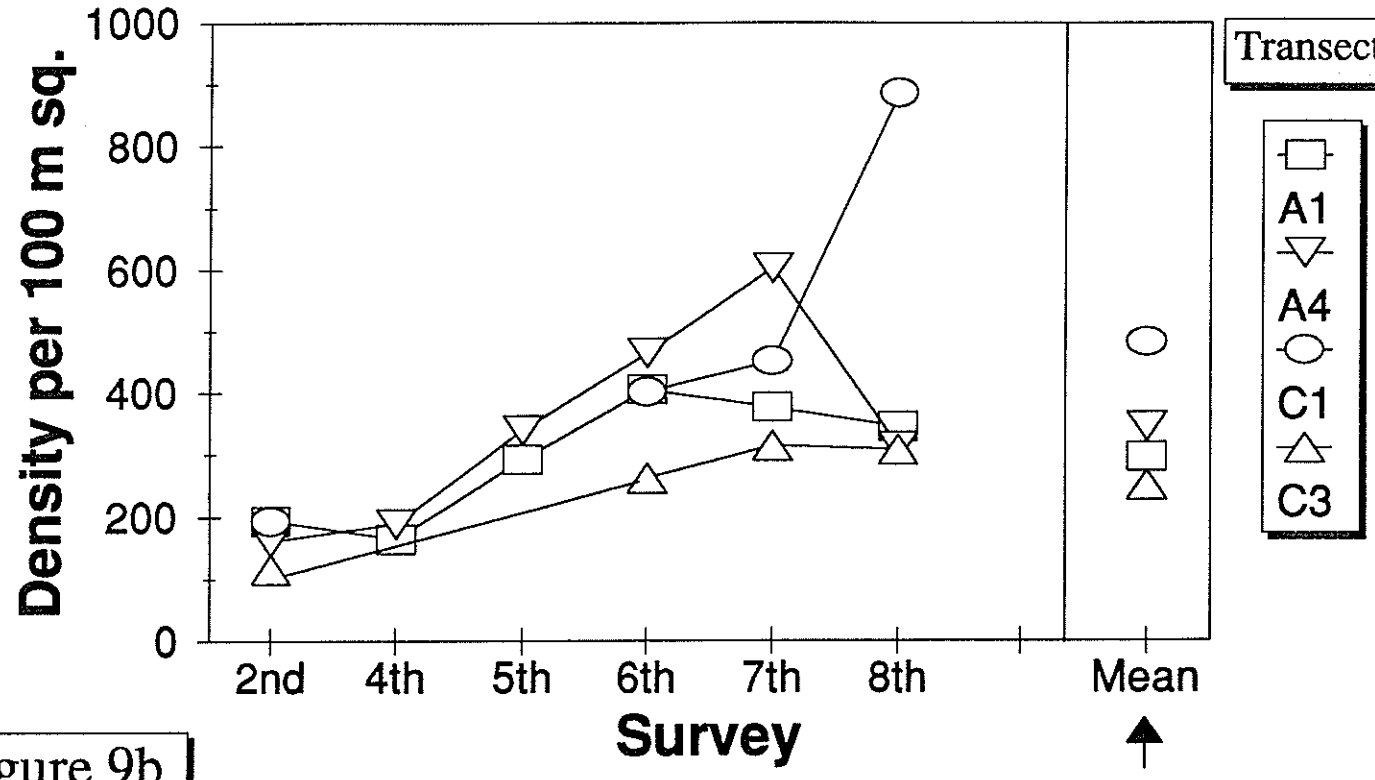


Figure 9b

Table 10

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Mid-reef transects, May 1993 - October 1995, all survey comparison
Holothuria atra Changes in mean densities per 100 m sq. over time.

Transect	Survey 1st	Survey 2nd	Survey 3rd	Survey 4th	Survey 5th	Survey 6th	Survey 7th	Survey 8th	Mean	Stds
A2	nd	99	nd	167	nd	265	282	280	218.6	82.0
A5	nd	60	nd	130	nd	224	368	148	186.0	117.3
B2w	nd	nd	nd	nd	20	23	14	34	18.2	12.5
B5w	nd	nd	nd	nd	16	24	12	5	14.3	7.9
B2e	nd	45	nd	192	170	178	245	214	174.0	68.8
B4e	nd	5	nd	nd	30	26	21	8	18.0	11.0
C2	nd	462	nd	nd	nd	592	586	640	570.0	75.9
C4	nd	160	nd	nd	nd	234	200	94	172.0	60.2
D2	nd	nd	nd	nd	1	nd	2	4	2.3	1.5
D4	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd

Holothuria atra density changes

Mid-reef zone : Low density transects

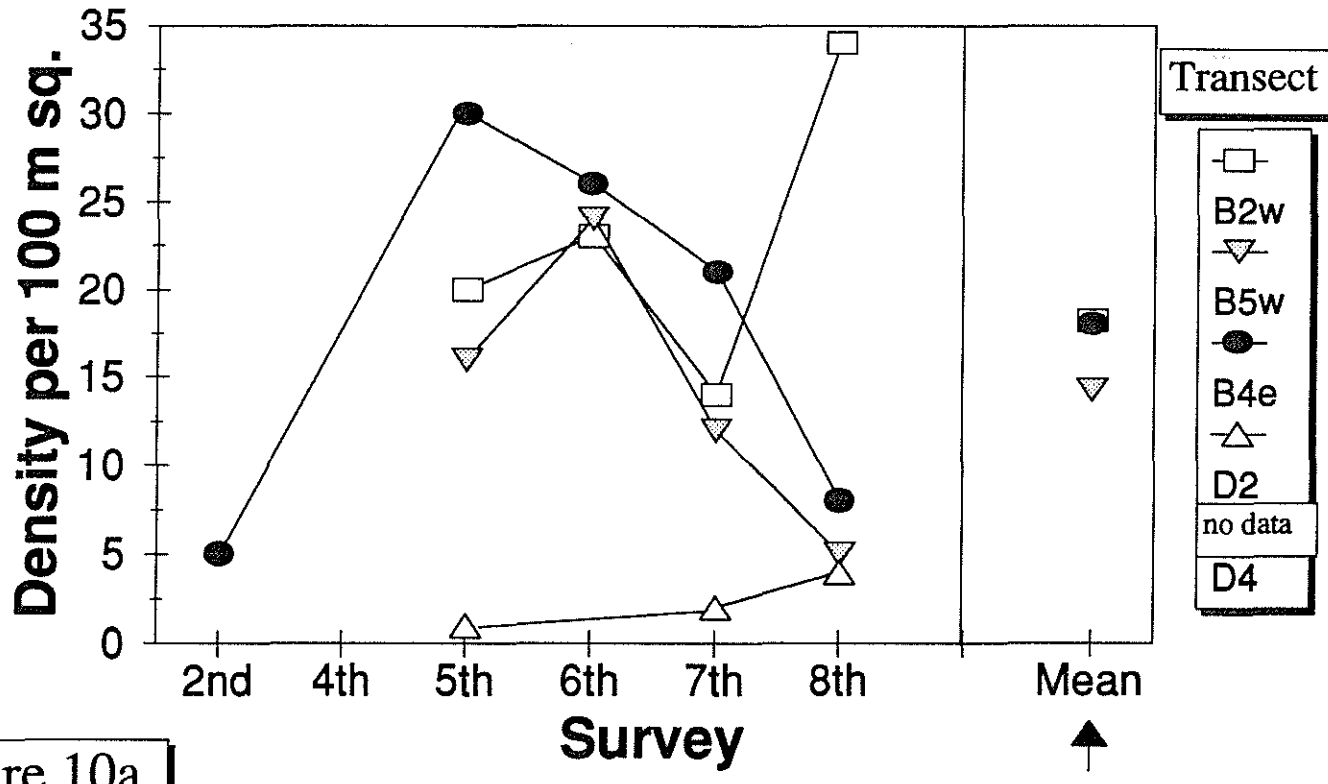


Figure 10a

Holothuria atra density changes

Mid-reef zone : High density transects

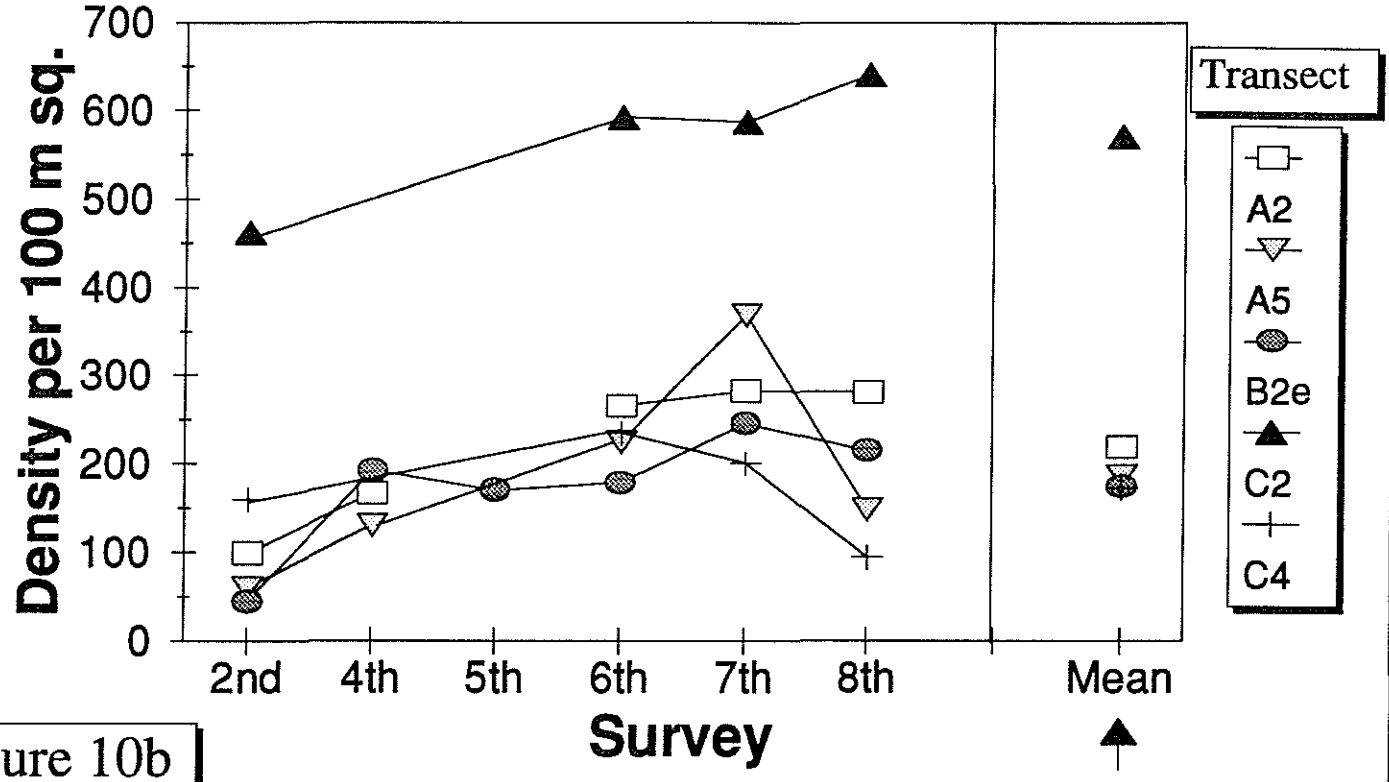


Figure 10b

Table 11

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Conspicuous macroinvertebrates
Near-shore transects, May 1993 - October 1995
Mean values for numbers of each species found within 50 m belt transects from all surveys combined

Species	A1 Mean N = 6	A4 Mean N = 6	B1 w Mean N = 5	B4 w Mean N = 4	B1 e Mean N = 6	B3 e Mean N = 6	C1 Mean N = 4	C3 Mean N = 4	D1 Mean N = 4	D3 Mean N = 4	E1 Mean N = 3	E2 Mean N = 3
Crustaecea												
Aectodes												0.3
Dardanus					0.2							
Echinodermata												
Actinopyga echinites	0.5	3.5	1.0	0.8	0.2	0.2			0.3			
Bohadschia argus	0.2	0.2	1.8	1.3	1.3	0.7		1.0				
Diadema sp.												1.3
Echinotrhix diadema											0.3	
Euapta godoffryi										0.3		
Holothuria atra	295.8	344.7	47.6	23.3	101.0	51.5	481.8	250.0	2.3	3.3	7.0	11.3
H. cinerascens									0.3			0.3
H. hilla			0.2									
H. leucospilota		0.2		0.8		4.7	0.3	0.8	18.5	6.5	0.7	
H. pervicax									0.3			
Linckia multifora	0.2									0.3		
Ophiuroid										0.5		
Stichopus chloronotus	0.8	1.8	0.4	1.0	1.5	1.2	1.8	2.8				
Synapta maculata		0.3	0.4	5.0		0.8						
Cnidaria												
Herteractis sp.				2.0		0.7		0.3	0.3	8.5		
Mollusca												
Cerithium nodulosum			0.2									
Chichoreus sp.							0.3					
Conus cattus	0.2		1.0			0.2			1.0	0.3		
C. ebraeus	0.3	1.5	6.4	0.3	2.5	0.5	2.5	1.0	1.3	0.5	2.7	1.0
C. flavidus	0.5	0.5	2.8		0.8	0.3		0.5		0.8	0.7	0.7
C. leopardus/pulicarius									0.3			
Conus sp.	0.3		0.8		1.0	0.2		0.3		0.5		
C. sponsalis							2.5	0.3	2.8	0.5	3.3	1.3
Cypraea moneta	0.2		0.8	0.5	1.0	0.8	0.3					
Dendropoma sp.						1.5		0.8			0.3	
Drupa (purple)	0.3											
Mitre stitica			0.2			0.2	0.3					
Morula sp.								0.3			0.3	
Nudibranch	0.2											
Octopus												0.3
Thais tuberosa	0.3		2.0	0.3	0.5	0.3	0.3	0.8		1.5		
Tridacna maxima								0.3				
Vasum turbinellus	0.5	0.3	3.0		0.5	0.2	0.5	1.8	2.8	1.8		0.3
Density per 100msq	600.7	706.0	137.2	70.0	221.0	127.7	980.5	521.0	59.5	50.0	30.7	33.3
Percentage H. atra	98.5	97.6	69.4	66.4	91.4	80.7	98.3	96.0	7.6	13.0	45.7	68.0

Table 12

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Conspicuous macroinvertebrates
Mid-reef transects, May 1993 - October 1995
Mean values for numbers of each species found within 50 m belt transects from all surveys combined

Species	A2	A5	B2w	B5w	B2e	B4e	C2	C4	D2	D4
	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	no data
	N = 5	N = 5	N = 5	N = 4	N = 6	N = 5	N = 4	N = 4	N = 3	
Crustaecea										
Dardanus sp.						0.2		0.3		
Echinodermata										
Actinopyga echinites	2.8	1.6	0.4	1.3	0.3	0.2	0.5	0.3	0.3	
A. mauritiana	0.2								0.3	
Bohadschia argus			0.2	0.3	0.2	1.6	0.3			
Diadema sp.	1.0								0.3	
Echinometra matthaii			0.4	0.3						
Echinotrhix diadema	0.8			0.3						
Holothuria atra	218.6	186.0	18.2	14.3	174.0	18.0	570.0	172.0	2.3	
H. cinerascens									4.7	
H. leucospilota				0.3			0.3	0.3		
H. nobilis						0.2				
Stichopus chloronotus	4.6	2.6	1.2	1.0	1.3	0.4	1.5	2.5		
Synapta maculata						6.6				
Cnidaria										
Herteractis sp.	0.6					0.2		15.8	2.0	
Mollusca										
Bursa sp.									0.3	
Cerithium nodulosum							1.5	2.5		
Chichoreus sp.					0.2				0.7	
Conus cattus						0.2		0.3	4.5	
C. flavidus	0.4		2.6	1.5	0.3		0.5	0.5		
C. ebraeus	0.2	0.2	0.4	1.3	1.3	0.2	1.0			
C. leopardus/pulicarius					0.2					
C. lividus			0.2		0.2			0.3	1.7	
C. sponsalis							0.3	0.3	3.3	
Conus sp.	1.0		1.4		1.0	0.2	0.8	1.0		
Cypraea moneta	0.4	0.6	0.4	0.5	0.2	0.2	0.5			
C. annulata				0.3				1.0		
Dendropoma sp.	0.0			8.5						
Drupa sp. (purple)			0.2	0.3			0.3			
Mitre stitica		0.2			0.2				0.3	
Morula sp.										
Nudibranch				0.3						
Thais tuberosa	0.2	0.6	1.4	0.5	0.3	0.4	1.0			
Tridacna maxima	1.0	0.2						0.3	0.3	
Trochus niloticus	0.0			0.3				1.0		
Trochus sp.								0.3	0.3	
Vasum turbinellus	0.2	0.2	0.2		0.3		0.8		10.0	
Estimated per 100 m sq	464.0	384.4	54.4	61.5	360.0	57.6	1158.0	396.5	60.7	
Percentage H. atra	94.2	96.8	66.9	46.3	96.7	62.5	98.4	86.8	7.7	

Table A-1

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Conspicuous macroinvertebrates
Near-shore transects, May 1993 - October 1995, all survey comparison

Species	A1 1st nd	A1 2nd	A1 3rd nd	A1 4th	A1 5th	A1 6th	A1 7th	A1 8th		A1 Mean	A1 Stds
Crustaecea											
Aectodes											
Dardanus											
Echinodermata											
Actinopyga echinites					1	1		1		0.5	0.5
Bohadschia argus							1			0.2	0.4
Diadema sp.											
Echinotrhix diadema											
Euapta godoffryi											
Holothuria atra		193		165	292	405	376	344		295.8	98.4
H. cinerascens											
H. hilla											
H. leucospilota											
H. pervicax											
Linckia multifora					1					0.2	0.4
Ophiuroid											
Stichopus chloronotus				1		2	2			0.8	1.0
Synapta maculata											
Cnidaria											
Herteractis sp.											
Mollusca											
Cerithium nodulosum											
Chichoreus sp.											
Conus cattus							1			0.2	0.4
C. ebraeus					1	1				0.3	0.5
C. flavidus		1					1	1		0.5	0.5
C. leopardus/pulicarius											
Conus sp.							1	1		0.3	0.5
C. sponsalis											
Cypraea moneta							1			0.2	0.4
Dendropoma sp.											
Drupa (purple)				1			1			0.3	0.5
Mitre stitica											
Morula sp.											
Nudibranch							1			0.2	0.4
Octopus											
Thais tuberosa						2				0.3	0.8
Tridacna maxima											
Vasum ceramicum				1	1			1		0.5	0.5
Density per 100 m sq.		388		336	592	822	770	696		600.7	201.0
Percentage H. atra		99.5		98.2	98.6	98.5	97.7	98.9		98.5	

*nd = no data

Table A-2

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Conspicuous macroinvertebrates
Near-shore transects, May 1993 - October 1995, all survey comparison

Species	A4 1st nd	A4 2nd	A4 3rd nd	A4 4th	A4 5th	A4 6th	A4 7th	A4 8th	A4 Mean	A4 Stds
Crustaecea										
Aectodes										
Dardanus										
Echinodermata										
Actinopyga echinites		3			2	9	5	2	3.5	3.1
Bohadschia argus						1			0.2	0.4
Diadema sp.										
Echinotrhix diadema										
Euapta godoffryi										
Holothuria atra		161		189	340	464	602	312	344.7	167.0
H. cinerascens										
H. hilla										
H. leucospilota		1							0.2	0.4
H. pervicax										
Linckia multifora										
Ophiuroid										
Stichopus chloronotus		1		1	3	3	1	2	1.8	1.0
Synapta maculata		1				1			0.3	0.5
Cnidaria										
Herteractis sp.										
Mollusca										
Cerithium nodulosum										
Chichoreus sp.										
Conus cattus										
C. ebraeus					6	2	1		1.5	2.3
C. flavidus						1	2		0.5	0.8
Conus leopardus/pulicarius										
Conus sp.										
C. sponsalis										
Cypraea moneta										
Dendropoma sp.										
Drupa (purple)										
Mitre stitica										
Morula sp.										
Nudibranch										
Octopus										
Thais tuberosa										
Tridacna maxima										
Vasum turbinellus				2					0.3	0.8
Density per 100 m sq.		334		384	702	962	1222	632	706.0	340.4
Percentage H. atra		96.4		98.4	96.9	96.5	98.5	98.7	97.6	

*nd = no data

Table A-3

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Conspicuous macroinvertebrates
Near-shore transects, May 1993 - October 1995, all survey comparison

Species	B1 w 1st nd	B1 w 2nd nd	B1 w 3rd nd	B1 w 4th	B1 w 5th	B1 w 6th	B1 w 7th	B1 w 8th		B1 w Mean	B1 w Stds
Crustaecea											
Aectodes											
Dardanus											
Echinodermata											
Actinopyga echinites					4		1			1.0	1.7
Bohadschia argus				2	2	2	3			1.8	1.1
Diadema sp.											
Echinotrhix diadema											
Euapta godoffryi											
Holothuria atra					40	63	67	68		47.6	29.0
H. cinerascens											
H. hilla				1						0.2	0.4
H. leucospilota											
H. pervicax											
Linckia multifora											
Ophiuroid											
Stichopus chloronotus				1			1			0.4	0.5
Synapta maculata							1	1		0.4	0.5
Cnidaria											
Herteractis sp.											
Mollusca											
Cerithium nodulosum							1			0.2	0.4
Chichoreus sp.											
Conus cattus						2	2	1		1.0	1.0
C. ebraeus					6	10	12	4		6.4	4.8
C. flavidus					1	5	7	1		2.8	3.0
Conus leopardus/pulicarius											
Conus sp.							4			0.8	1.8
C. sponsalis											
Cypraea moneta					1		3			0.8	1.3
Dendropoma sp.											
Drupa (purple)											
Mitre stitica					1					0.2	0.4
Morula sp.											
Nudibranch											
Octopus											
Thais tuberosa					1	2	7			2.0	2.9
Tridacna maxima											
Vasum turbinellus					2			13		3.0	5.7
Density per 100 m sq.				8	116	168	218	176		137.2	80.8
Percentage H. atra				0.0	69.0	75.0	61.5	77.3		69.4	

*nd = no data

Table A-4

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Conspicuous macroinvertebrates
Near-shore transects, May 1993 - October 1995, all survey comparison

Species	B4 w 1st nd	B4 w 2nd nd	B4 w 3rd nd	B4 w 4th nd	B4 w 5th	B4 w 6th	B4 w 7th	B4 w 8th		B4 w Mean	B4 w Stds
Crustaecea											
Aectodes											
Dardanus											
Echinodermata											
Actinopyga echinites					1		2			0.8	1.0
Bohadschia argus						3	1	1		1.3	1.3
Diadema sp.											
Echinotrhix diadema											
Euapta godoffryi											
Holothuria atra					30	16	25	22		23.3	5.9
H. cinerascens											
H. hilla											
H. leucospilota							2	1		0.8	1.0
H. pervicax											
Linckia multifora											
Ophiuroid											
Stichopus chloronotus						3		1		1.0	1.4
Synapta maculata						9	10	1		5.0	5.2
Cnidaria											
Herteractis sp.						2	2	4		2.0	1.6
Mollusca											
Cerithium nodulosum											
Chichoreus sp.											
Conus cattus											
C. ebraeus					1					0.3	0.5
C. flavidus											
C. leopardus/pulicarius											
Conus sp.											
C. sponsalis											
Cypraea moneta							1	1		0.5	0.6
Dendropoma sp.											
Drupa (purple)											
Mitre stitica											
Morula sp.											
Nudibranch											
Octopus											
Thais tuberosa							1			0.3	0.5
Tridacna maxima											
Vasum turbinellus											
Density per 100 m sq.					64	66	88	62		70.0	12.1
Percentage H. atra					93.8	48.5	56.8	71.0		66.4	

*nd = no data

Table A-5

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Conspicuous macroinvertebrates
Near-shore transects, May 1993 - October 1995, all survey comparison

Species	B1 e 1st nd	B1 e 2nd	B1 e 3rd nd	B1 e 4th	B1 e 5th	B1 e 6th	B1 e 7th	B1 e 8th		B1 e Mean	B1 e Stds
Crustaecea											
Aectodes											
Dardanus						1				0.2	0.4
Echinodermata											
Actinopyga echinites						1				0.2	0.4
Bohadschia argus		1			2	1	2	2		1.3	0.8
Diadema sp.											
Echinotrhix diadema											
Euapta godoffryi											
Holothuria atra		52		134	76	102	116	126		101.0	31.5
H. cinerascens											
H. hilla											
H. leucospilota											
H. pervicax											
Linckia multifora											
Ophiuroid											
Stichopus chloronotus		1			1	3	3	1		1.5	1.2
Synapta maculata											
Cnidaria											
Herteractis sp.											
Mollusca											
Cerithium nodulosum											
Chichoreus sp.											
Conus cattus											
C. ebraeus					3	3	1	8		2.5	3.0
C. flavidus				1		4				0.8	1.6
C. leopardus/pulicarius											
Conus sp.								6		1.0	2.4
C. sponsalis											
Cypraea moneta				3	1	2				1.0	1.3
Dendropoma sp.											
Drupa (purple)											
Mitre stitica											
Morula sp.											
Nudibranch											
Octopus											
Thais tuberosa				1		2				0.5	0.8
Tridacna maxima											
Vasum turbinellus		1						2		0.5	0.8
Density per 100 m sq.		110		278	166	238	244	290		221.0	69.5
Percentage H. atra		94.5		96.4	91.6	85.7	95.1	86.9		91.4	

*nd = no data

Table A-6

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Conspicuous macroinvertebrates
Near-shore transects, May 1993 - October 1995, all survey comparison

Species	B3 e 1st nd	B3 e 2nd	B3 e 3rd nd	B3 e 4th	B3 e 5th	B3 e 6th	B3 e 7th	B3 e 8th		B3 e Mean	B3 e Stds
Crustaecea											
Aectodes											
Dardanus											
Echinodermata											
Actinopyga echinites					1					0.2	0.4
Bohadschia argus		2		1		1				0.7	0.8
Diadema sp.											
Echinotrhix diadema											
Euapta godoffryi											
Holothuria atra		22		84	60	59	58	26		51.5	23.4
H. cinerascens											
H. hilla											
H. leucospilota		6		18			3	1		4.7	6.9
H. pervicax											
Linckia multifora											
Ophiuroid											
Stichopus chloronotus		2				2	1	2		1.2	1.0
Synapta maculata		2					2	1		0.8	1.0
Cnidaria											
Herteractis sp.						2	1	1		0.7	0.8
Mollusca											
Cerithium nodulosum											
Chichoreus sp.											
Conus cattus							1			0.2	0.4
C. ebraeus						3				0.5	1.2
C. flavidus						1	1			0.3	0.5
C. leopardus/pulicarius											
Conus sp.							1			0.2	0.4
C. sponsalis											
Cypraea moneta				3			1	1		0.8	1.2
Dendropoma sp.								9		1.5	3.7
Drupa (purple)											
Mitre stitica							1			0.2	0.4
Morula sp.											
Nudibranch											
Octopus											
Thais tuberosa							2			0.3	0.8
Tridacna maxima											
Vasum turbinellus								1		0.2	0.4
Density per 100 m sq.		68		212	122	136	144	84		127.7	50.9
Percentage H. atra		64.7		79.2	98.4	86.8	80.6	61.9		80.7	

*nd = no data

Table A-7

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Conspicuous macroinvertebrates
Near-shore transects, May 1993 - October 1995, all survey comparison

Species	C1 1st nd	C1 2nd	C1 3rd nd	C1 4th nd	C1 5th nd	C1 6th	C1 7th	C1 8th	C1 Mean	C1 Stds
Crustaecea										
Aectodes										
Dardanus										
Echinodermata										
Actinopyga echinites										
Bohadschia argus										
Diadema sp.										
Echinotrhix diadema										
Euapta godoffryi										
Holothuria atra		192				401	450	884	481.8	290.6
H. cinerascens										
H. hilla										
H. leucospilota								1	0.3	0.5
H. pervicax										
Linckia multifora										
Ophiuroid										
Stichopus chloronotus						1	4	2	1.8	1.7
Synapta maculata										
Cnidaria										
Herteractis sp.										
Mollusca										
Cerithium nodulosum										
Chichoreus sp.							1		0.3	0.5
Conus cattus										
C. ebraeus		1					3	6	2.5	2.6
C. flavidus										
C. leopardus/pulicarius										
Conus sp.										
C. sponsalis								10	2.5	5.0
Cypraea moneta								1	0.3	0.5
Dendropoma sp.										
Drupa (purple)										
Mitre stitica								1	0.3	0.5
Morula sp.										
Nudibranch										
Octopus										
Thais tuberosa							1		0.3	0.5
Tridacna maxima										
Vasum turbinellus								2	0.5	1.0
Density per 100 m sq.		386				804	918	1814	980.5	600.9
Percentage H. atra		99.5				99.8	98.0	97.5	98.3	

*nd = no data

Table A-8

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Conspicuous macroinvertebrates
Near-shore transects, May 1993 - October 1995, all survey comparison

Species	C3 1st nd	C3 2nd	C3 3rd nd	C3 4th nd	C3 5th nd	C3 6th	C3 7th	C3 8th	C3 Mean	C3 Stds
Crustaecea										
Aectodes										
Dardanus										
Echinodermata										
Actinopyga echinites										
Bohadschia argus		2				1	1		1.0	0.8
Diadema sp.										
Echinotrhix diadema										
Euapta godoffryi										
Holothuria atra		116				262	314	308	250.0	92.3
H. cinerascens										
H. hilla										
H. leucospilota		2						1	0.8	1.0
H. pervicax										
Linckia multifora										
Ophiuroid										
Stichopus chloronotus		1				2	4	4	2.8	1.5
Synapta maculata										
Cnidaria										
Herteractis sp.								1	0.3	0.5
Mollusca										
Cerithium nodulosum										
Chichoreus sp.										
Conus cattus										
C. ebraeus		1						3	1.0	1.4
C. flavidus						2			0.5	1.0
C. leopardus/pulicarius										
Conus sp.								1	0.3	0.5
C. sponsalis								1	0.3	0.5
Cypraea moneta										
Dendropoma sp.								3	0.8	1.5
Drupa (purple)										
Mitre stitica										
Morula sp.								1	0.3	0.5
Nudibranch										
Octopus										
Thais tuberosa						2	1		0.8	1.0
Tridacna maxima								1	0.3	0.5
Vasum turbinellus								7	1.8	3.5
Density per 100 m sq.		244				538	640	662	521.0	192.4
Percentage H. atra		95.1				97.4	98.1	93.1	96.0	

*nd = no data

Table A-9

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Conspicuous macroinvertebrates
Near-shore transects, May 1993 - October 1995, all survey comparison

Species	D1 1st nd	D1 2nd	D1 3rd nd	D1 4th nd	D1 5th	D1 6th nd	D1 7th	D1 8th		D1 Mean	D1 Stds
Crustaecea											
Aectodes											
Dardanus											
Echinodermata											
Actinopyga echinites							1			0.3	0.5
Bohadschia argus											
Diadema sp.											
Echinotrhix diadema											
Euapta godoffryi											
Holothuria atra					1		2	6		2.3	2.6
H. cinerascens		1								0.3	0.5
H. hilla											
H. leucospilota		19			21		21	13		18.5	3.8
H. pervicax		1								0.3	0.5
Linckia multifora											
Ophiuroid											
Stichopus chloronotus											
Synapta maculata											
Cnidaria											
Herteractis sp.					1					0.3	0.5
Mollusca											
Cerithium nodulosum											
Chichoreus sp.											
Conus cattus					1		1	2		1.0	0.8
C. ebraeus		1			2		2			1.3	1.0
C. flavidus											
C. leopardus/pulicarius								1		0.3	0.5
Conus sp.											
C. sponsalis								11		2.8	5.5
Cypraea moneta											
Dendropoma sp.											
Drupa (purple)											
Mitre stitica											
Morula sp.											
Nudibranch											
Octopus											
Thais tuberosa											
Tridacna maxima											
Vasum turbinellus					1			10		2.8	4.9
Density per 100 m sq.		44			54		54	86		59.5	18.3
Percentage H. atra		0.0			3.7		7.4	14.0		7.6	

*nd = no data

Table A-10

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Conspicuous macroinvertebrates
Near-shore transects, May 1993 - October 1995, all survey comparison

Species	D3 1st nd	D3 2nd	D3 3rd nd	D3 4th nd	D3 5th	D3 6th nd	D3 7th	D3 8th		D3 Mean	D3 Stds
Crustaecea											
Aectodes											
Dardanus											
Echinodermata											
Actinopyga echinites											
Bohadschia argus											
Diadema sp.											
Echinotrhix diadema											
Euapta godoffryi		1								0.3	0.5
Holothuria atra		1			2		10			3.3	4.6
H. cinerascens											
H. hilla											
H. leucospilota		2			7		5	12		6.5	4.2
H. pervicax											
Linckia multifora					1					0.3	0.5
Ophiuroid		2								0.5	1.0
Stichopus chloronotus											
Synapta maculata											
Cnidaria											
Herteractis sp.					6		15	13		8.5	6.9
Mollusca											
Cerithium nodulosum											
Chichoreus sp.											
Conus cattus							1			0.3	0.5
C. ebraeus		1					1			0.5	0.6
C. flavidus					1		2			0.8	1.0
C. leopardus/pulicarius											
Conus sp.							2			0.5	1.0
C. sponsalis								2		0.5	1.0
Cypraea moneta											
Dendropoma sp.											
Drupa (purple)											
Mitre stitica											
Morula sp.											
Nudibranch											
Octopus											
Thais tuberosa							6			1.5	3.0
Tridacna maxima											
Vasum turbinellus								7		1.8	3.5
Density per 100 m sq.		14			34		84	68		50.0	31.8
Percentage H. atra		14.3			11.8		23.8	0.0		13.0	

*nd = no data

Table A-11

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Conspicuous macroinvertebrates
Near-shore transects, May 1993 - October 1995, all survey comparison

Species	E1 1st nd	E1 2nd	E1 3rd nd	E1 4th nd	E1 5th	E1 6th nd	E1 7th nd	E1 8th	E1 Mean	E1 Stds
Crustaecea										
Aectodes										
Dardanus										
Echinodermata										
Actinopyga echinites										
Bohadschia argus										
Diadema sp.										
Echinotrhix diadema		1							0.3	0.6
Euapta godoffryi										
Holothuria atra		6			10			5	7.0	2.6
H. cinerascens										
H. hilla										
H. leucospilota		1						1	0.7	0.6
H. pervicax										
Linckia multifora										
Ophiuroid										
Stichopus chloronotus										
Synapta maculata										
Cnidaria										
Herteractis sp.										
Mollusca										
Cerithium nodulosum										
Chichoreus sp.										
Conus cattus										
C. ebraeus					2			6	2.7	3.1
C. flavidus		1			1				0.7	0.6
C. leopardus/pulicarius										
Conus sp.										
C. sponsalis								10	3.3	5.8
Cypraea moneta										
Dendropoma sp.								1	0.3	0.6
Drupa (purple)										
Mitre stitica										
Morula sp.								1	0.3	0.6
Nudibranch										
Octopus										
Thais tuberosa										
Tridacna maxima										
Vasum turbinellus										
Density per 100 m sq.		18			26			48	30.7	15.5
Percentage H. atra		66.7			76.9			20.8	45.7	

*nd = no data

Table A-12

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Conspicuous macroinvertebrates
Near-shore transects, May 1993 - October 1995, all survey comparison

Species	E2 1st nd	E2 2nd	E2 3rd nd	E2 4th nd	E2 5th	E2 6th nd	E2 7th nd	E2 8th	E2 Mean	E2 Stds
Crustaecea										
Aectodes		1							0.3	0.6
Dardanus										
Echinodermata										
Actinopyga echinites										
Bohadschia argus										
Diadema sp.					2			2	1.3	1.2
Echinotrhix diadema										
Euapta godoffryi										
Holothuria atra		4			26			4	11.3	12.7
H. cinerascens					1				0.3	0.6
H. hilla										
H. leucospilota										
H. pervicax										
Linckia multifora										
Ophiuroid										
Stichopus chloronotus										
Synapta maculata										
Cnidaria										
Herteractis sp.										
Mollusca										
Cerithium nodulosum										
Chichoreus sp.										
Conus cattus										
C. ebraeus					1			2	1.0	1.0
C. flavidus					2				0.7	1.2
C. leopardus/pulicarius										
Conus sp.										
C. sponsalis								4	1.3	2.3
Cypraea moneta										
Dendropoma sp.										
Drupa (purple)										
Mitre stitica										
Morula sp.										
Nudibranch										
Octopus					1				0.3	0.6
Thais tuberosa										
Tridacna maxima										
Vasum turbinellus		1							0.3	0.6
Density per 100 m sq.		12			64			24	33.3	27.2
Percentage H. atra		66.7			81.3			33.3	68.0	

*nd = no data

Table A-13

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Conspicuous macroinvertebrate density per 50 meter square belt transect
Mid-reef transects, all survey comparison

Species	A2 1st nd	A2 2nd	A2 3rd nd	A2 4th	A2 5th nd	A2 6th	A2 7th	A2 8th	A2 Mean	A2 Stds
Crustaecea										
Dardanus sp.										
Echinodermata										
Actinopyga echinites		4		2		2	1	5	2.8	1.6
A. mauritiana								1	0.2	0.4
Bohadschia argus										
Diadema sp.						1	1	3	1.0	1.2
Echinometra matthaii										
Echinotrhix diadema		2		2					0.8	1.1
Holothuria atra		99		167		265	282	280	218.6	82.0
H. cinerascens										
H. leucospilota										
H. nobilis										
Stichopus chloronotus		1		2		5	10	5	4.6	3.5
Synapta maculata										
Cnidaria										
Herteractis sp.		1		1		1			0.6	0.5
Mollusca										
Bursa sp.										
Cerithium nodulosum										
Chichoreus sp.										
Conus cattus										
C. flavidus							1	1	0.4	0.5
C. ebraeus						1			0.2	0.4
C. leopardus/pulicarius										
C. lividus										
C. sponsalis										
Conus sp.						3	2		1.0	1.4
Cypraea moneta		1				1			0.4	0.5
C. annulata										
Dendropoma sp.									0.0	0.0
Drupa sp. (purple)										
Mitre stitica										
Morula sp.										
Nudibranch										
Thais tuberosa							1		0.2	0.4
Tridacna maxima				1		1	1	2	1.0	0.7
Trochus niloticus									0.0	0.0
Trochus sp.										
Vasum turbinellus				1					0.2	0.4
Estimated per 100 m sq		216		352		560	598	594	464.0	171.8
Percentage H. atra		91.7		94.9		94.6	94.3	94.3	94.2	

* nd = no data

Table A-14

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Conspicuous macroinvertebrate density per 50 meter square belt transect
Mid-reef transects, all survey comparison

Species	A5 1st nd	A5 2nd	A5 3rd nd	A5 4th	A5 5th nd	A5 6th	A5 7th	A5 8th	A5 Mean	A5 Stds
Crustaecea										
Dardanus sp.										
Echinodermata										
Actinopyga echinites		2		2		2	1	1	1.6	0.5
A. mauritiana										
Bohadschia argus										
Diadema sp.										
Echinometra matthaii										
Echinotrhix diadema										
Holothuria atra		60		130		224	368	148	186.0	117.3
H. cinerascens										
H. leucospilota										
H. nobilis										
Stichopus chloronotus		3		2		3	3	2	2.6	0.5
Synapta maculata										
Cnidaria										
Herteractis sp.										
Mollusca										
Bursa sp.										
Cerithium nodulosum										
Chichoreus sp.										
Conus cattus										
C. flavidus										
C. ebraeus							1		0.2	0.4
C. leopardus/pulicarius										
C. lividus										
C. sponsalis										
Conus sp.										
Cypraea moneta						2	1		0.6	0.9
C. annulata										
Dendropoma sp.										
Drupa sp. (purple)										
Mitre stitica				1					0.2	0.4
Morula sp.										
Nudibranch										
Thais tuberosa						2		1	0.6	0.9
Tridacna maxima		1							0.2	0.4
Trochus niloticus										
Trochus sp.										
Vasum turbinellus				1					0.2	0.4
Estimated per 100 m sq		132		272		466	748	304	384.4	235.4
Percentage H. atra		90.9		95.6		96.1	98.4	97.4	96.8	

* nd = no data

Table A-15

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Conspicuous macroinvertebrate density per 50 meter square belt transect
Mid-reef transects, all survey comparison

Species	B2w 1st nd	B2w 2nd nd	B2w 3rd nd	B2w 4th	B2w 5th	B2w 6th	B2w 7th	B2w 8th	B2w Mean	B2w Stds
Crustaecea										
Dardanus sp.										
Echinodermata										
Actinopyga echinites					2				0.4	0.9
A. mauritiana										
Bohadschia argus				1					0.2	0.4
Diadema sp.										
Echinometra matthaii				1				1	0.4	0.5
Echinotrhix diadema										
Holothuria atra					20	23	14	34	18.2	12.5
H. cinerascens										
H. leucospilota										
H. nobilis										
Stichopus chloronotus						2	4		1.2	1.8
Synapta maculata										
Cnidaria										
Herteractis sp.										
Mollusca										
Bursa sp.										
Cerithium nodulosum										
Chichoreus sp.										
Conus cattus										
C. flavidus				2		5	6		2.6	2.8
C. ebraeus						1	1		0.4	0.5
C. leopardus/pulicarius										
C. lividus								1	0.2	0.4
C. sponsalis										
Conus sp.					5		2		1.4	2.2
Cypraea moneta							2		0.4	0.9
C. annulata										
Dendropoma sp.										
Drupa sp. (purple)								1	0.2	0.4
Mitre stitica										
Morula sp.										
Nudibranch										
Thais tuberosa				1		2	4		1.4	1.7
Tridacna maxima										
Trochus niloticus										
Trochus sp.										
Vasum turbinellus				1					0.2	0.4
Estimated per 100 m sq				12	54	66	66	74	54.4	24.8
Percentage H. atra				0.0	74.1	69.7	42.4	91.9	66.9	

* nd = no data

Table A-16

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Conspicuous macroinvertebrate density per 50 meter square belt transect
Mid-reef transects, all survey comparison

Species	B5w 1st nd	B5w 2nd nd	B5w 3rd nd	B5w 4th nd	B5w 5th	B5w 6th	B5w 7th	B5w 8th		B5w Mean	B5w Stds
Crustaecea											
Dardanus sp.											
Echinodermata											
Actinopyga echinites					1	3	1			1.3	1.3
A. mauritiana											
Bohadschia argus							1			0.3	0.5
Diadema sp.											
Echinometra matthaii								1		0.3	0.5
Echinotrhix diadema								1		0.3	0.5
Holothuria atra					16	24	12	5		14.3	7.9
H. cinerascens											
H. leucospilota								1		0.3	0.5
H. nobilis											
Stichopus chloronotus					1			3		1.0	1.4
Synapta maculata											
Cnidaria											
Herteractis sp.											
Mollusca											
Bursa sp.											
Cerithium nodulosum											
Chichoreus sp.											
Conus cattus											
C. flavidus						4	1	1		1.5	1.7
C. ebraeus						3	2			1.3	1.5
C. leopardus/pulicarius											
C. lividus											
C. sponsalis											
Conus sp.											
Cypraea moneta					1	1				0.5	0.6
C. annulata					1					0.3	0.5
Dendropoma sp.						1	30	3		8.5	14.4
Drupa sp. (purple)							1			0.3	0.5
Mitre stitica											
Morula sp.											
Nudibranch								1		0.3	0.5
Thais tuberosa						2				0.5	1.0
Tridacna maxima											
Trochus niloticus					1					0.3	0.5
Trochus sp.											
Vasum turbinellus											
Estimated per 100 m sq					42	76	96	32		61.5	29.7
Percentage H. atra					76.2	63.2	25.0	31.3		46.3	

* nd = no data

Table A-17

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Conspicuous macroinvertebrate density per 50 meter square belt transect
Mid-reef transects, all survey comparison

Species	B2e 1st	B2e 2nd	B2e 3rd	B2e 4th	B2e 5th	B2e 6th	B2e 7th	B2e 8th		B2e Mean	B2e Stds
	nd		nd								
Crustaecea											
Dardanus sp.											
Echinodermata											
Actinopyga echinites						1		1		0.3	0.5
A. mauritiana											
Bohadschia argus					1					0.2	0.4
Diadema sp.											
Echinometra matthaii											
Echinotrhix diadema											
Holothuria atra		45		192	170	178	245	214		174.0	68.8
H. cinerascens											
H. leucospilota											
H. nobilis											
Stichopus chloronotus				1		1	1	5		1.3	1.9
Synapta maculata											
Cnidaria											
Herteractis sp.											
Mollusca											
Bursa sp.											
Cerithium nodulosum											
Chichoreus sp.						1				0.2	0.4
Conus cattus											
C. flavidus		1			1					0.3	0.5
C. ebraeus					5	3				1.3	2.2
C. leopardus/pulicarius				1						0.2	0.4
C. lividus								1		0.2	0.4
C. sponsalis											
Conus sp.								6		1.0	2.4
Cypraea moneta						1				0.2	0.4
C. annulata											
Dendropoma sp.											
Drupa sp. (purple)											
Mitre stitica						1				0.2	0.4
Morula sp.											
Nudibranch											
Thais tuberosa						1		1		0.3	0.5
Tridacna maxima											
Trochus niloticus											
Trochus sp.											
Vasum turbinellus		2								0.3	0.8
Transect total		96		388	354	374	492	456		360.0	69.8
Percentage H. atra		93.8		99.0	96.0	95.2	99.6	93.9		96.7	

* nd = no data

Table A-18

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Conspicuous macroinvertebrate density per 50 meter square belt transect
Mid-reef transects, all survey comparison

Species	B4e 1st	B4e 2nd	B4e 3rd	B4e 4th	B4e 5th	B4e 6th	B4e 7th	B4e 8th		B4e Mean	B4e Stds
	nd		nd	nd							
Crustaecea											
Dardanus sp.						1				0.2	0.4
Echinodermata											
Actinopyga echinites					1					0.2	0.4
A. mauritiana							1				
Bohadschia argus					2	2	2	2		1.6	0.9
Diadema sp.											
Echinometra matthaii											
Echinotrhix diadema											
Holothuria atra		5			30	26	21	8		18.0	11.0
H. cinerascens											
H. leucospilota											
H. nobilis					1					0.2	0.4
Stichopus chloronotus					1			1		0.4	0.5
Synapta maculata		1			3	6	16	7		6.6	5.8
Cnidaria											
Herteractis sp.					1					0.2	0.4
Mollusca											
Bursa sp.											
Cerithium nodulosum											
Chichoreus sp.											
Conus cattus							1			0.2	0.4
C. flavidus											
C. ebraeus							1			0.2	0.4
C. leopardus/pulicarius											
C. lividus											
C. sponsalis											
Conus sp.					1					0.2	0.4
Cypraea moneta							1			0.2	0.4
C. annulata											
Dendropoma sp.											
Drupa sp. (purple)											
Mitre stitica											
Morula sp.											
Nudibranch											
Thais tuberosa							2			0.4	0.9
Tridacna maxima											
Trochus niloticus											
Trochus sp.											
Vasum turbinellus											
Estimated per 100 m sq		12			80	70	90	36		57.6	32.6
Percentage H. atra		83.3			75.0	74.3	46.7	44.4		62.5	

* nd = no data

Table A-19

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Conspicuous macroinvertebrate density per 50 meter square belt transect
Mid-reef transects, all survey comparison

Species	C2 1st nd	C2 2nd	C2 3rd nd	C2 4th nd	C2 5th nd	C2 6th	C2 7th	C2 8th	C2 Mean	C2 Stds
Crustaecea										
Dardanus sp.										
Echinodermata										
Actinopyga echinites						1	1		0.5	0.6
A. mauritiana										
Bohadschia argus		1							0.3	0.5
Diadema sp.										
Echinometra matthaii										
Echinotrhix diadema										
Holothuria atra		462				592	586	640	570.0	75.9
H. cinerascens										
H. leucospilota								1	0.3	0.5
H. nobilis										
Stichopus chloronotus							5	1	1.5	2.4
Synapta maculata										
Cnidaria										
Herteractis sp.										
Mollusca										
Bursa sp.										
Cerithium nodulosum		1				1	4		1.5	1.7
Chichoreus sp.										
Conus cattus										
C. flavidus							1	1	0.5	0.6
C. ebraeus								4	1.0	2.0
C. leopardus/pulicarius										
C. lividus										
C. sponsalis								1	0.3	0.5
Conus sp.						1	2		0.8	1.0
Cypraea moneta							1	1	0.5	0.6
C. annulata										
Dendropoma sp.										
Drupa sp. (purple)							1		0.3	0.5
Mitre stitica										
Morula sp.										
Nudibranch										
Thais tuberosa							4		1.0	2.0
Tridacna maxima										
Trochus niloticus										
Trochus sp.										
Vasum turbinellus								3	0.8	1.5
Estimated per 100 m sq		928				1190	1210	1304	1158.0	161.2
Percentage H. atra		99.6				99.5	96.9	98.2	98.4	

* nd = no data

Table A-20

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Conspicuous macroinvertebrate density per 50 meter square belt transect
Mid-reef transects, all survey comparison

Species	C4 1st nd	C4 2nd	C4 3rd nd	C4 4th nd	C4 5th nd	C4 6th	C4 7th	C4 8th	C4 Mean	C4 Stds
Crustaecea										
Dardanus sp.						1			0.3	0.5
Echinodermata										
Actinopyga echinites							1		0.3	0.5
A. mauritiana										
Bohadschia argus										
Diadema sp.										
Echinometra matthaii										
Echinotrhix diadema										
Holothuria atra		160				234	200	94	172.0	60.2
H. cinerascens										
H. leucospilota							1		0.3	0.5
H. nobilis										
Stichopus chloronotus						1	7	2	2.5	3.1
Synapta maculata										
Cnidaria										
Herteractis sp.		2				21	10	30	15.8	12.3
Mollusca										
Bursa sp.										
Cerithium nodulosum						7	2	1	2.5	3.1
Chichoreus sp.										
Conus cattus							1		0.3	0.5
C. flavidus							2		0.5	1.0
C. ebraeus										
C. leopardus/pulicarius										
C. lividus								1	0.3	0.5
C. sponsalis								1	0.3	0.5
Conus sp.						1	3		1.0	1.4
Cypraea moneta										
C. annulata							3	1	1.0	1.4
Dendropoma sp.										
Drupa sp. (purple)										
Mitre stitica										
Morula sp.										
Nudibranch										
Thais tuberosa										
Tridacna maxima								1	0.3	0.5
Trochus niloticus						3	1		1.0	1.4
Trochus sp.						1			0.3	0.5
Vasum turbinellus										
Estimated per 100 m sq		324				538	462	262	396.5	126.0
Percentage H. atra		98.8				87.0	86.6	71.8	86.8	

* nd = no data

Table A-21

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Conspicuous macroinvertebrate density per 50 meter square belt transect
Mid-reef transects, all survey comparison

Species	D2 1st nd	D2 2nd nd	D2 3rd nd	D2 4th nd	D2 5th	D2 6th nd	D2 7th	D2 8th		D2 Mean	D2 Stds
Crustaecea											
Dardanus sp.											
Echinodermata											
Actinopyga echinites								1		0.3	0.6
A. mauritiana					1					0.3	0.6
Bohadschia argus											
Diadema sp.								1		0.3	0.6
Echinometra matthaii											
Echinotrhix diadema											
Holothuria atra					1		2	4		2.3	1.5
H. cinerascens					8		2	4		4.7	3.1
H. leucospilota											
H. nobilis											
Stichopus chloronotus											
Synapta maculata											
Cnidaria											
Herteractis sp.					2			4		2.0	2.0
Mollusca											
Bursa sp.								1		0.3	0.6
Cerithium nodulosum											
Chichoreus sp.							1	1		0.7	0.6
Conus cattus					6		3			4.5	2.1
C. flavidus											
C. ebraeus											
C. leopardus/pulicarius											
C. lividus								5		1.7	2.9
C. sponsalis							3	7		3.3	3.5
Conus sp.											
Cypraea moneta											
C. annulata											
Dendropoma sp.											
Drupa sp. (purple)											
Mitre stitica								1		0.3	0.6
Morula sp.											
Nudibranch											
Thais tuberosa											
Tridacna maxima					1					0.3	0.6
Trochus niloticus											
Trochus sp.							1			0.3	0.6
Vasum turbinellus					5			25		10.0	13.2
Estimated per 100 m sq					50		24	108		60.7	43.0
Percentage H. atra					4.0		16.7	7.4		7.7	

* nd = no data

Table A-22

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Conspicuous macroinvertebrate density per 50 meter square belt transect
Mid-reef transects, all survey comparison

Species	D4 1st nd	D4 2nd nd	D4 3rd nd	D4 4th nd	D4 5th nd	D4 6th nd	D4 7th nd	D4 8th nd
No data available								

Table A-23

Andersen Air Force Base Marine Resource Preserve Baseline Survey
Conspicuous macroinvertebrates
Near-crest transects, September 1994

Species	A3	A6	B3 west
	9/30/94	9/30/94	9/30/94
			no data
Crustaecea			
Aectodes			
Dardanus	2	1	
Echinodermata			
Actinopyga echinites	1		
A. mauritiana	6	7	
Bohadschia argus			
Diadema sp.			
Echinometra matthaii		1	
Echinotrhix diadema	1	2	
Euapta godoffryi			
Holothuria atra	1	4	
H. cinerascens			
H. hilla			
H. leucospilota			
H. pervicax			
Linckia multifora			
Ophiuroid			
Stichopus chloronotus	12	4	
Synapta maculata			
Cnidaria			
Herteractis sp.			
Palythoa sp.	2		
Mollusca			
Cerithium nodulosum	1		
Chichoreus sp.			
Conus cattus			
C. ebraeus		1	
C. flavidus			
C. leopardus/pulicarius			
Conus sp.	3	1	
C. sponsalis			
Cypraea moneta			
Dendropoma sp.			
Drupa (purple)	1		
Mitre stitica			
Morula sp.			
Nudibranch			
Octopus			
Thais tuberosa			
Tridacna maxima			
Trochus niloticus			
Vasum turbinellus	1	1	
Number of species	11	9	no data
Density per 100 m sq.	62	44	no data

FISHES

Steven S. Amesbury
Marine Laboratory
University of Guam

METHODS

Fishes were surveyed visually along each of the transects during the eight survey periods. Fishes within 1 m of the transect line were enumerated by species. The area covered in each transect survey was 50 m^2 (25 m X 2 m). As the transect locations were marked with rebar stakes, the same locations were surveyed during each of the eight surveys.

RESULTS

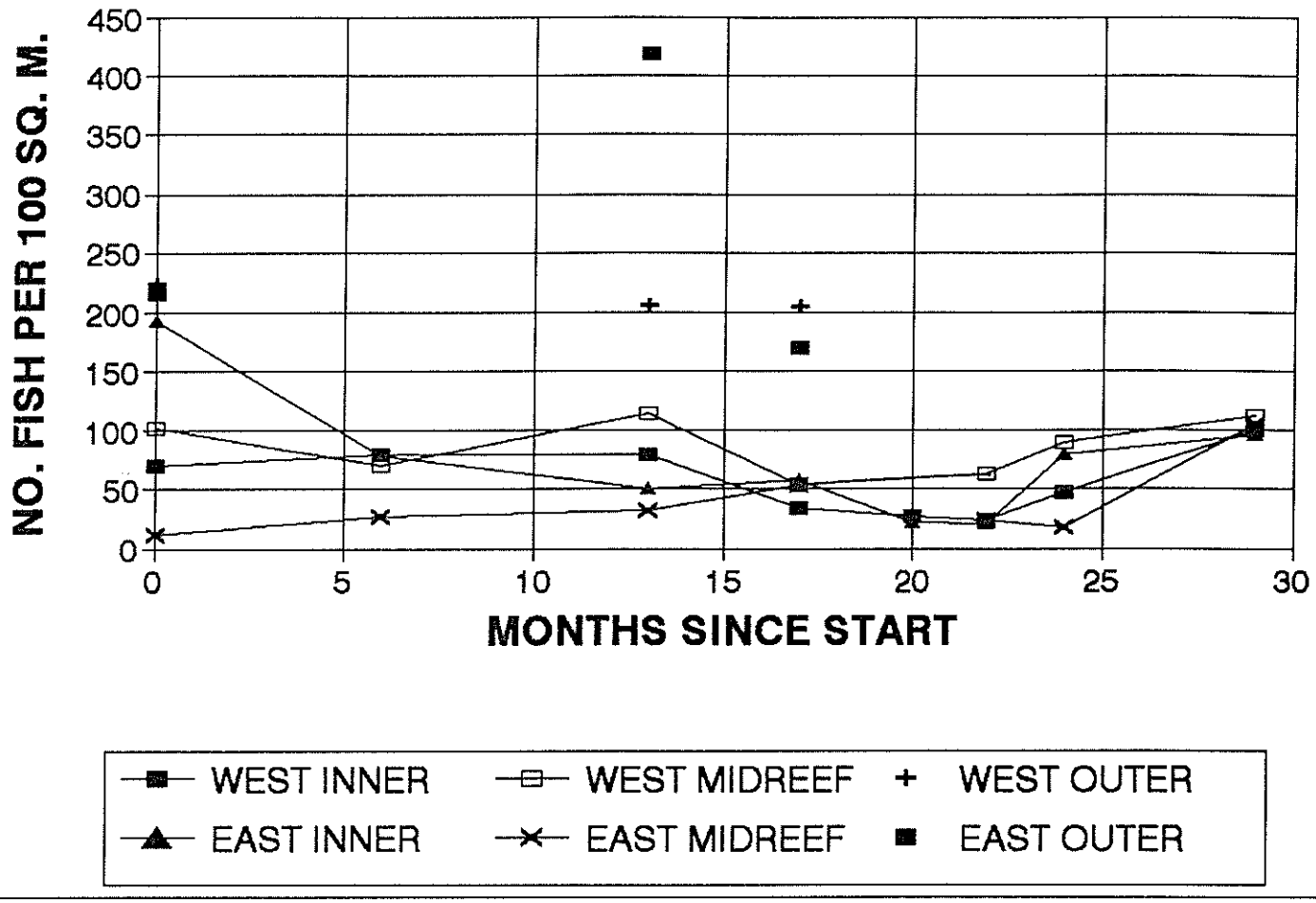
The survey results are presented for each survey site (A, B, C, D, and E) in Tables 1 through 5. Figures 1 through 10 present the overall results of fish abundance and species diversity graphically. There is a tendency for transects closer to the reef margin to be richer in species and more densely populated with fishes than the transects closer to the beach. Transects located in "grooves" were considerably richer in fishes than transects located in adjacent "flats."

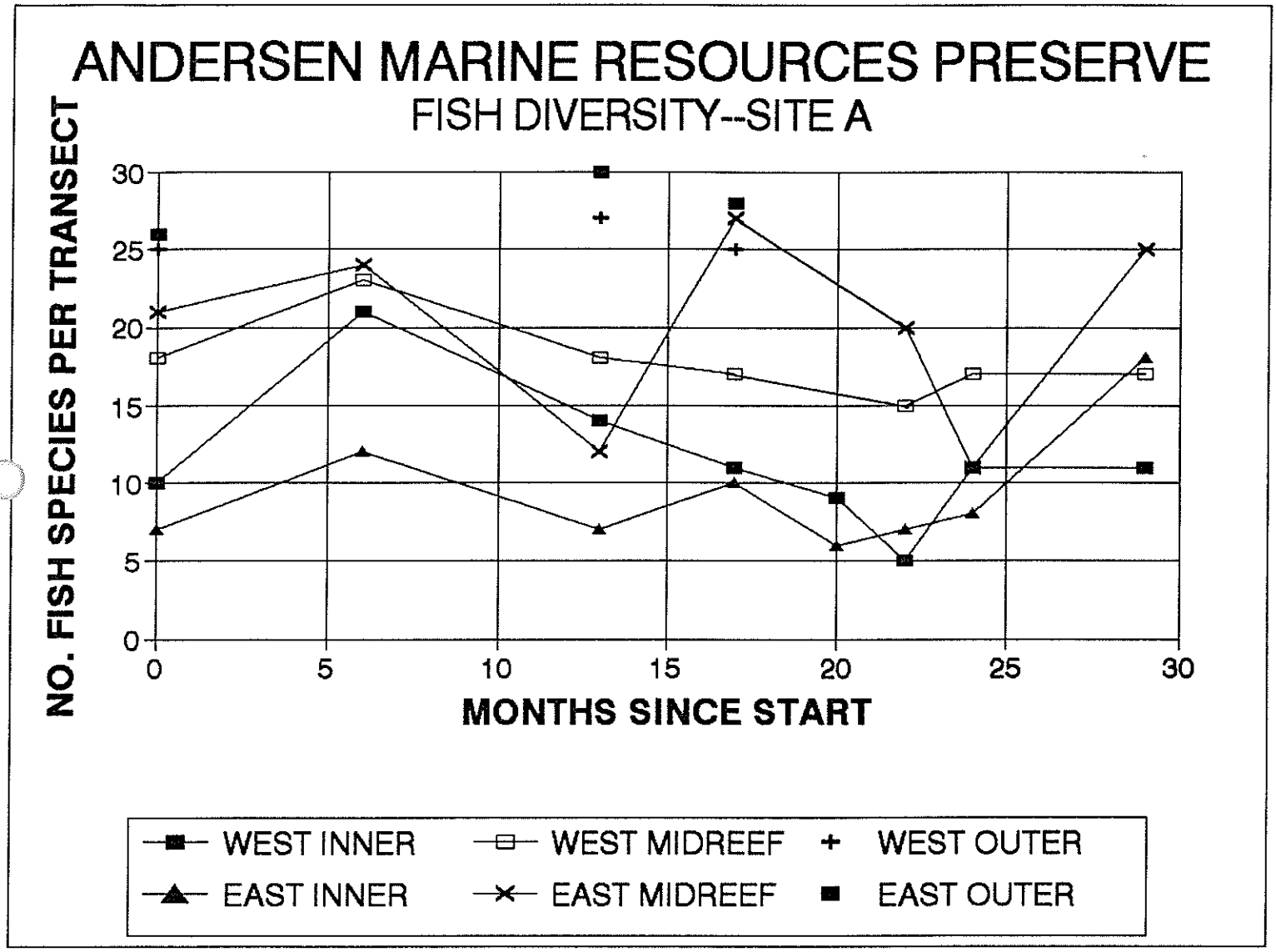
There were variations in the number of fish and the number of species observed on the same transects at different times during the 29-month survey period. These variations show similar patterns in transects located at the same site, but the variation does not appear to be closely related to seasons of the year.

Although there are variations from survey to survey, there is enough consistency in the results to provide a useful baseline data set on fish communities within the preserve. Should significant changes in fish abundance or species composition occur in the future, resurveying the transects should reveal these changes.

ANDERSEN MARINE RESOURCES PRESERVE

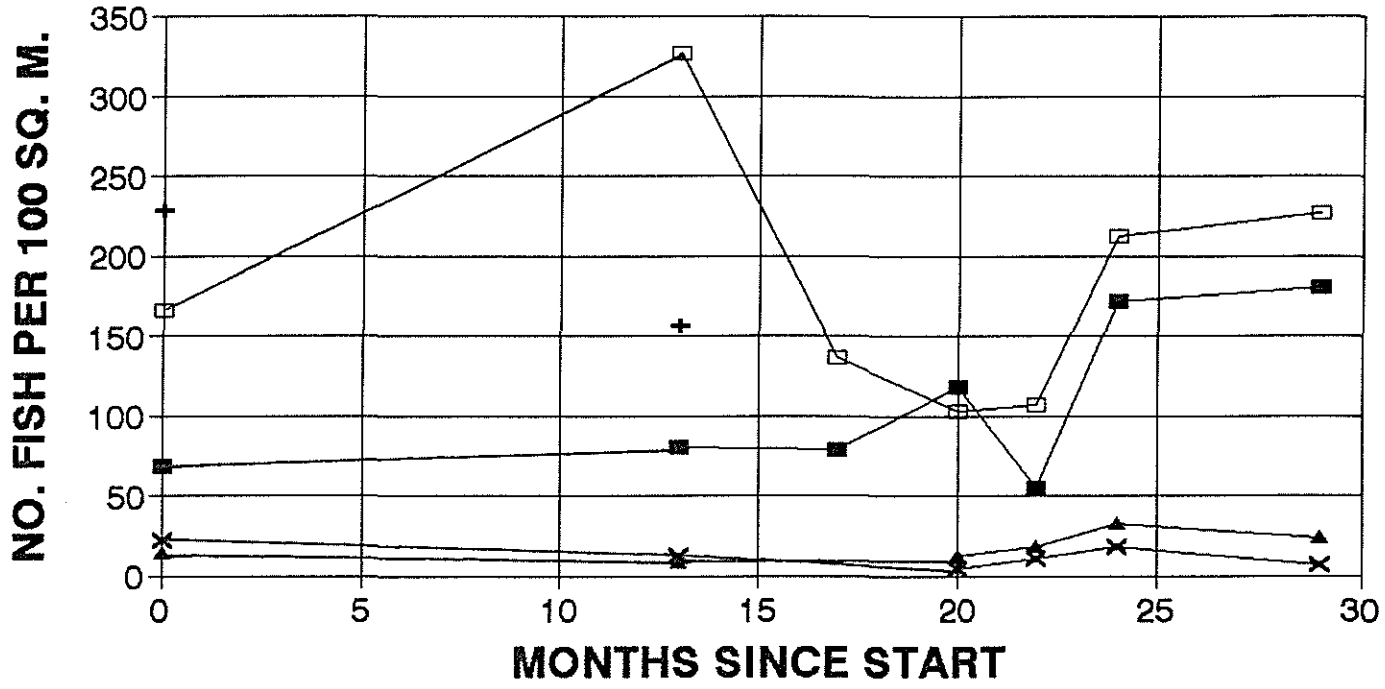
FISH ABUNDANCE--SITE A




ANDERSEN MARINE RESOURCES PRESERVE
FISH DIVERSITY--SITE A
NO. FISH SPECIES PER TRANSECT
30
25
20
15
10
5
0
0
5
10
15
20
25
30
MONTHS SINCE START
WEST INNER
WEST MIDREEF
WEST OUTER
EAST INNER
EAST MIDREEF
EAST OUTER

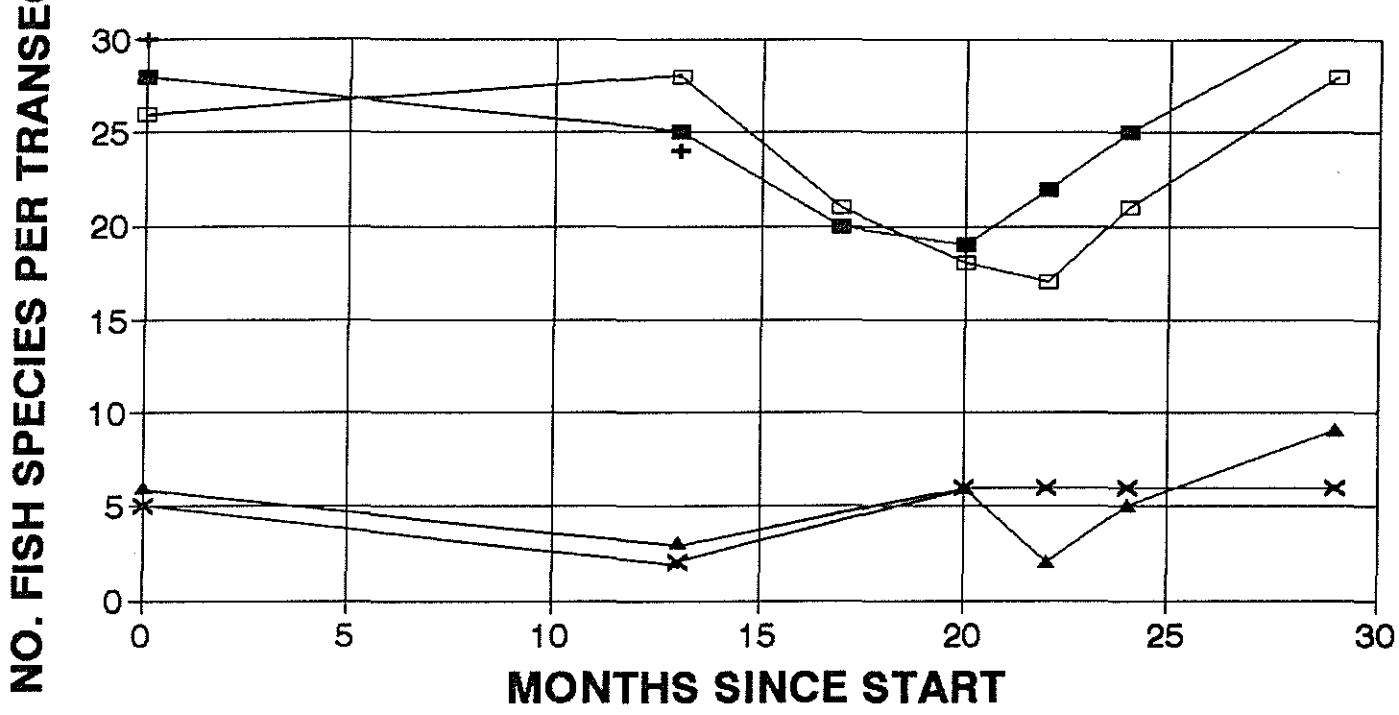
ANDERSEN MARINE RESOURCES PRESERVE

FISH ABUNDANCE--SITE B WEST



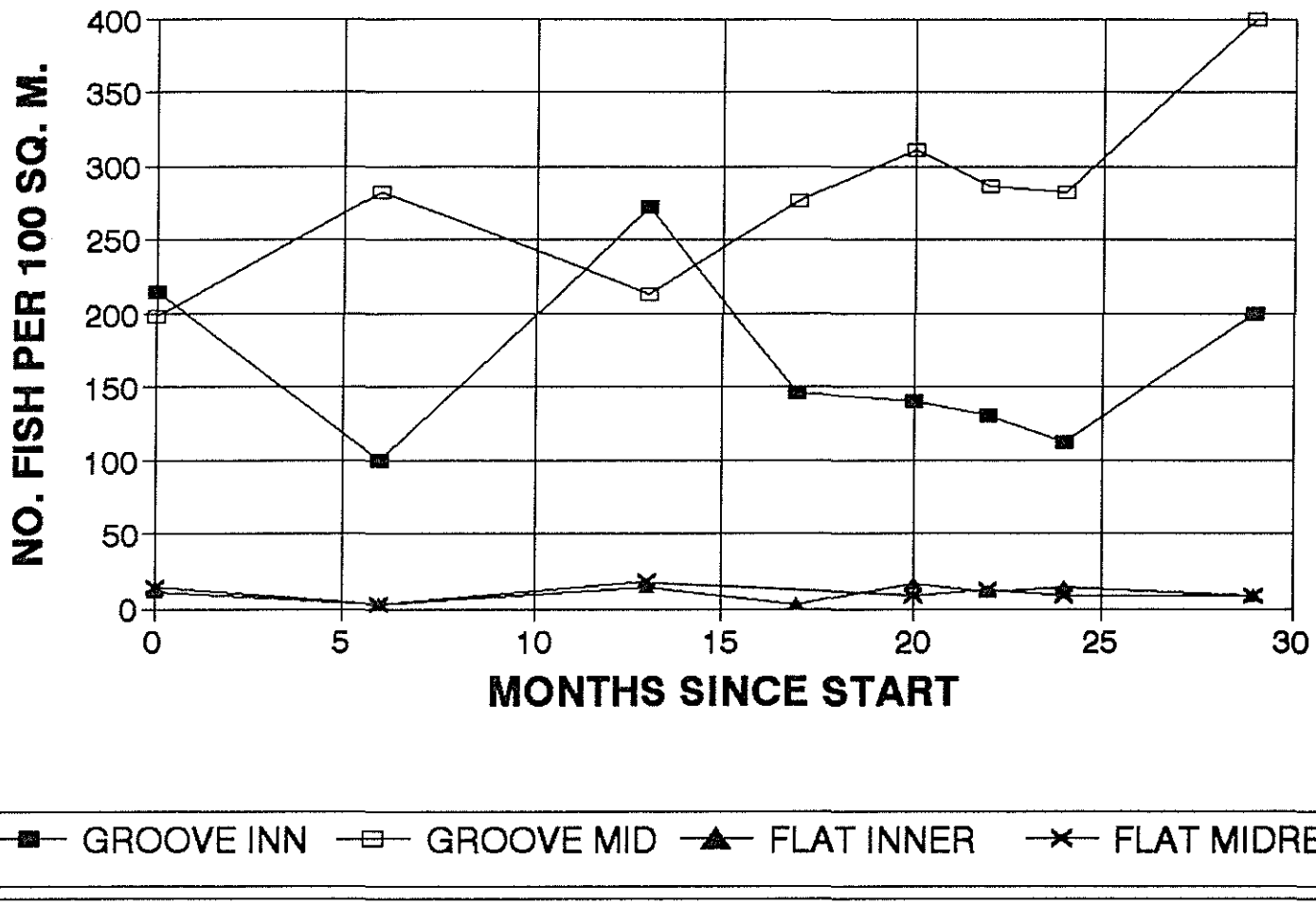
ANDERSEN MARINE RESOURCES PRESERVE

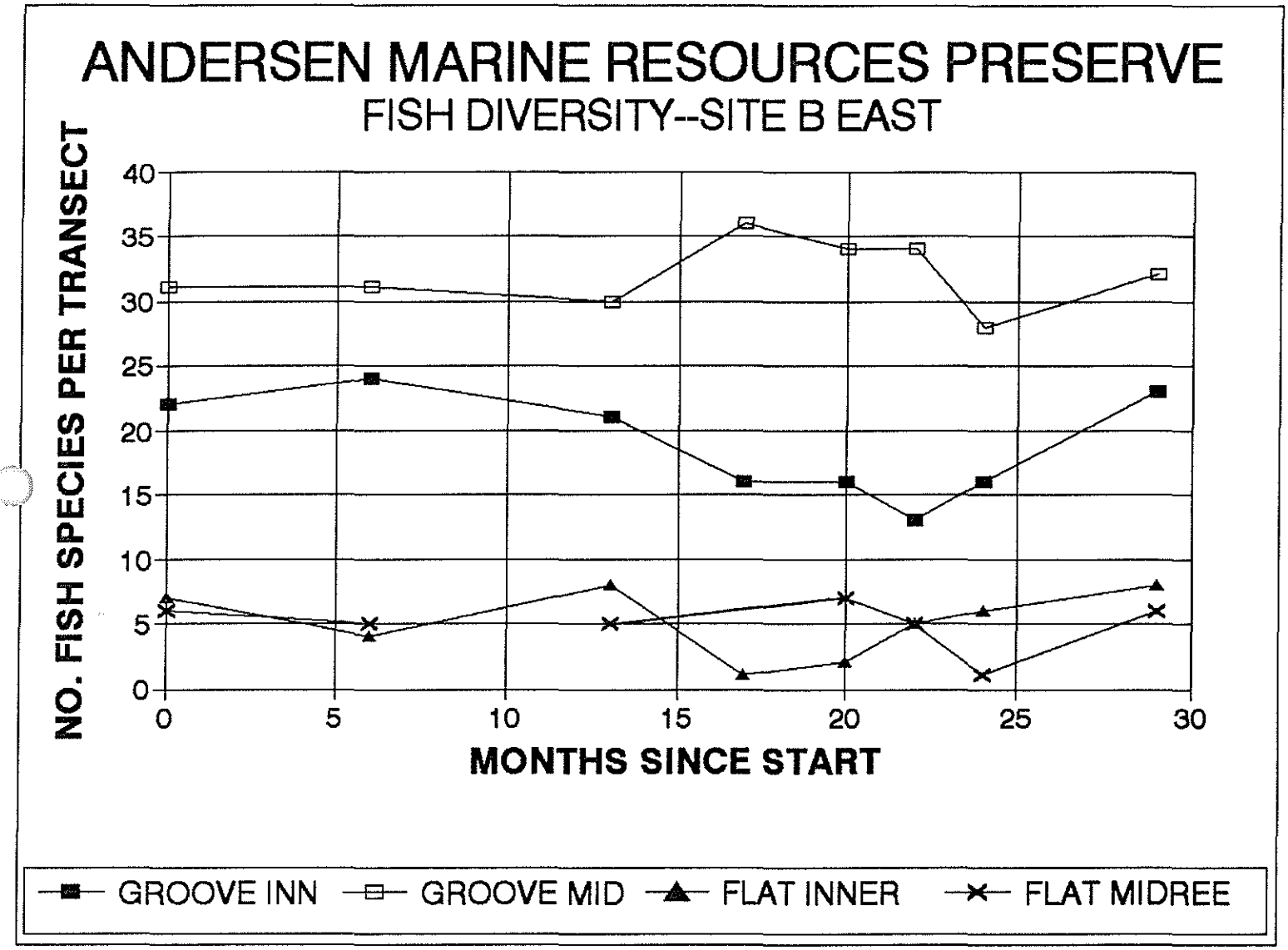
FISH DIVERSITY--SITE B WEST

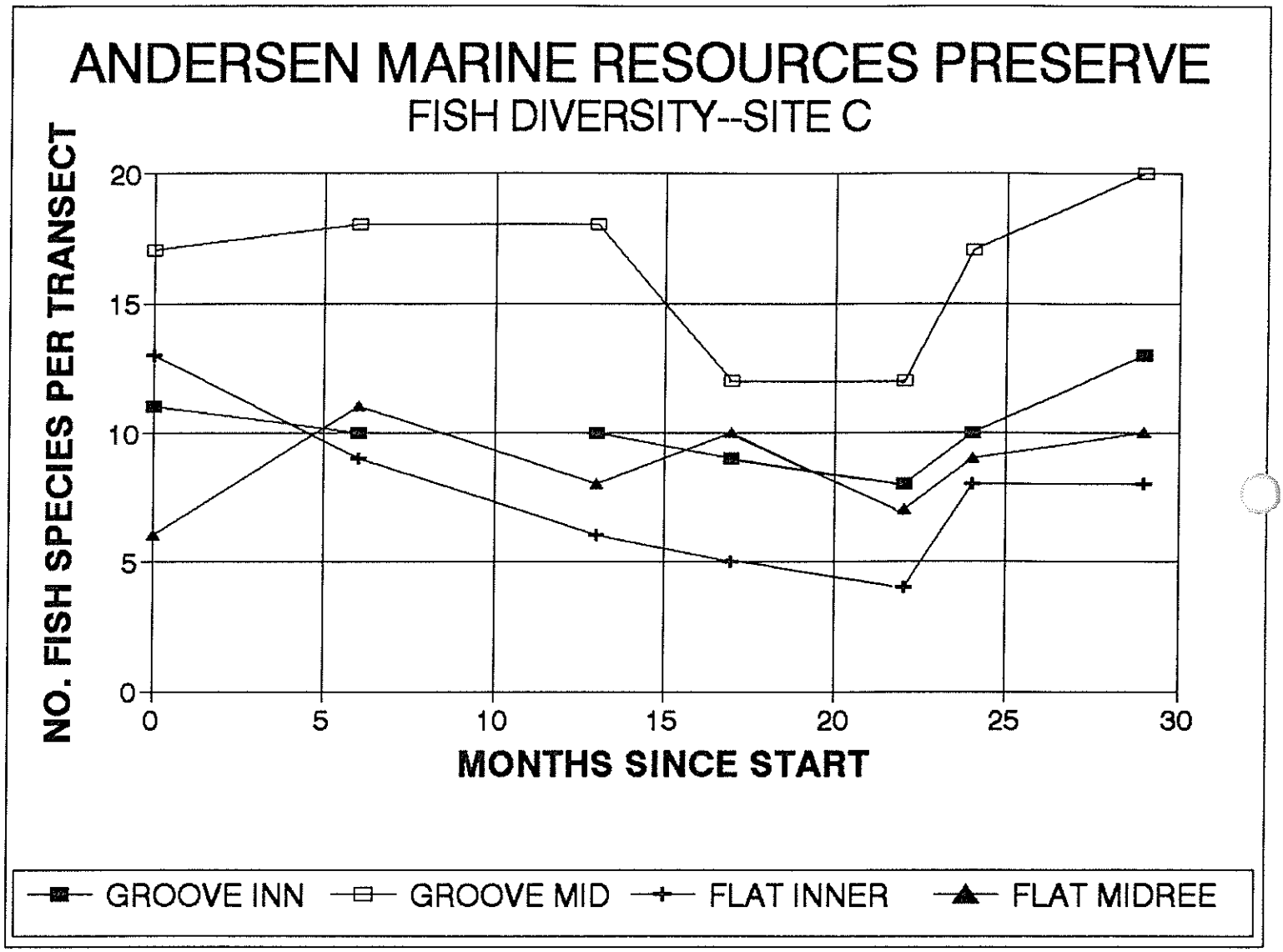


ANDERSEN MARINE RESOURCES PRESERVE

FISH ABUNDANCE--SITE B EAST

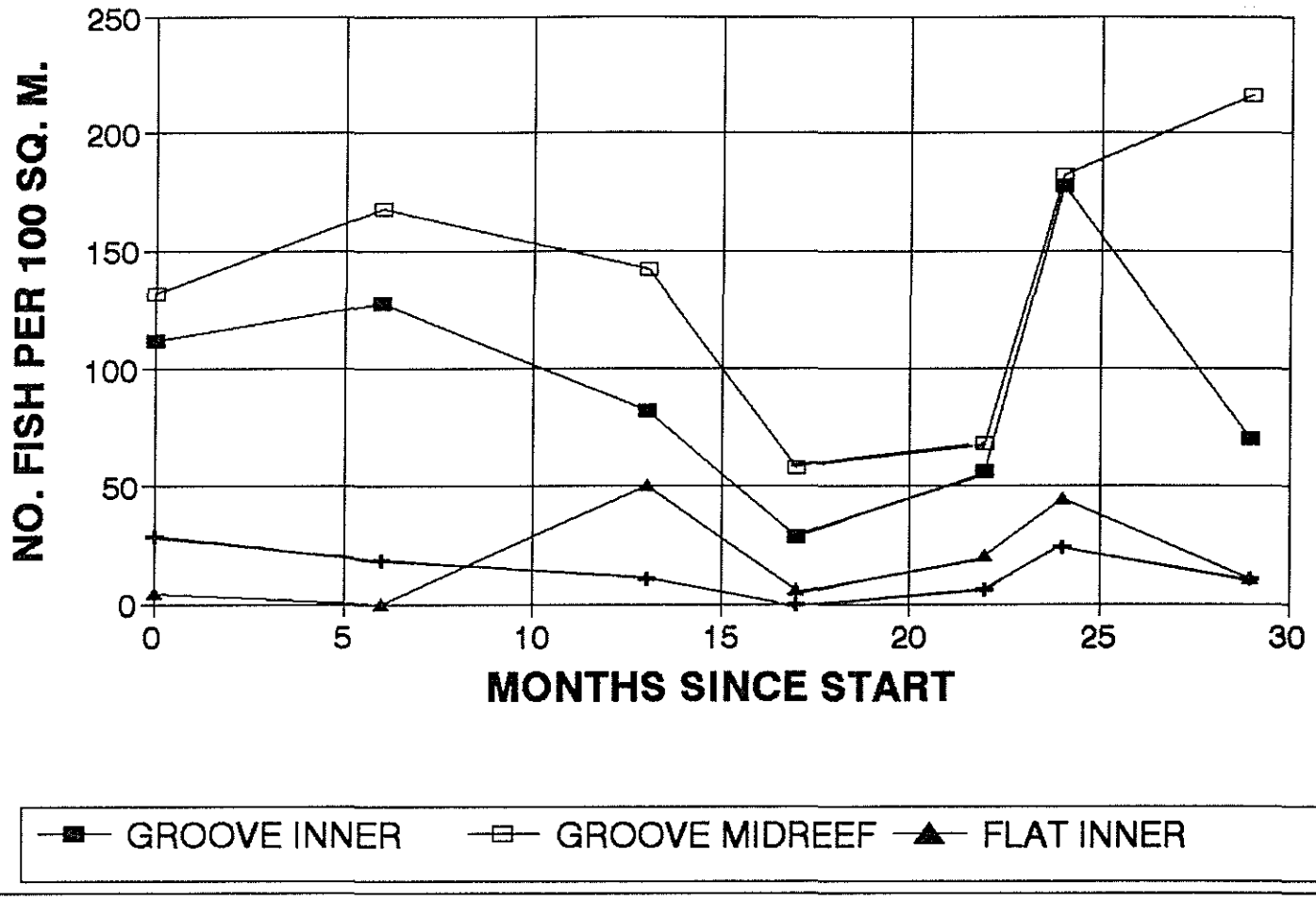



ANDERSEN MARINE RESOURCES PRESERVE
FISH DIVERSITY--SITE B EAST
NO. FISH SPECIES PER TRANSECT
40
35
30
25
20
15
10
5
0
0
5
10
15
20
25
30
MONTHS SINCE START
GROOVE INN
GROOVE MID
FLAT INNER
FLAT MIDREE


ANDERSEN MARINE RESOURCES PRESERVE
FISH DIVERSITY--SITE C
NO. FISH SPECIES PER TRANSECT
0
5
10
15
20
0
5
10
15
20
25
30
MONTHS SINCE START
GROOVE INN
GROOVE MID
FLAT INNER
FLAT MIDREE

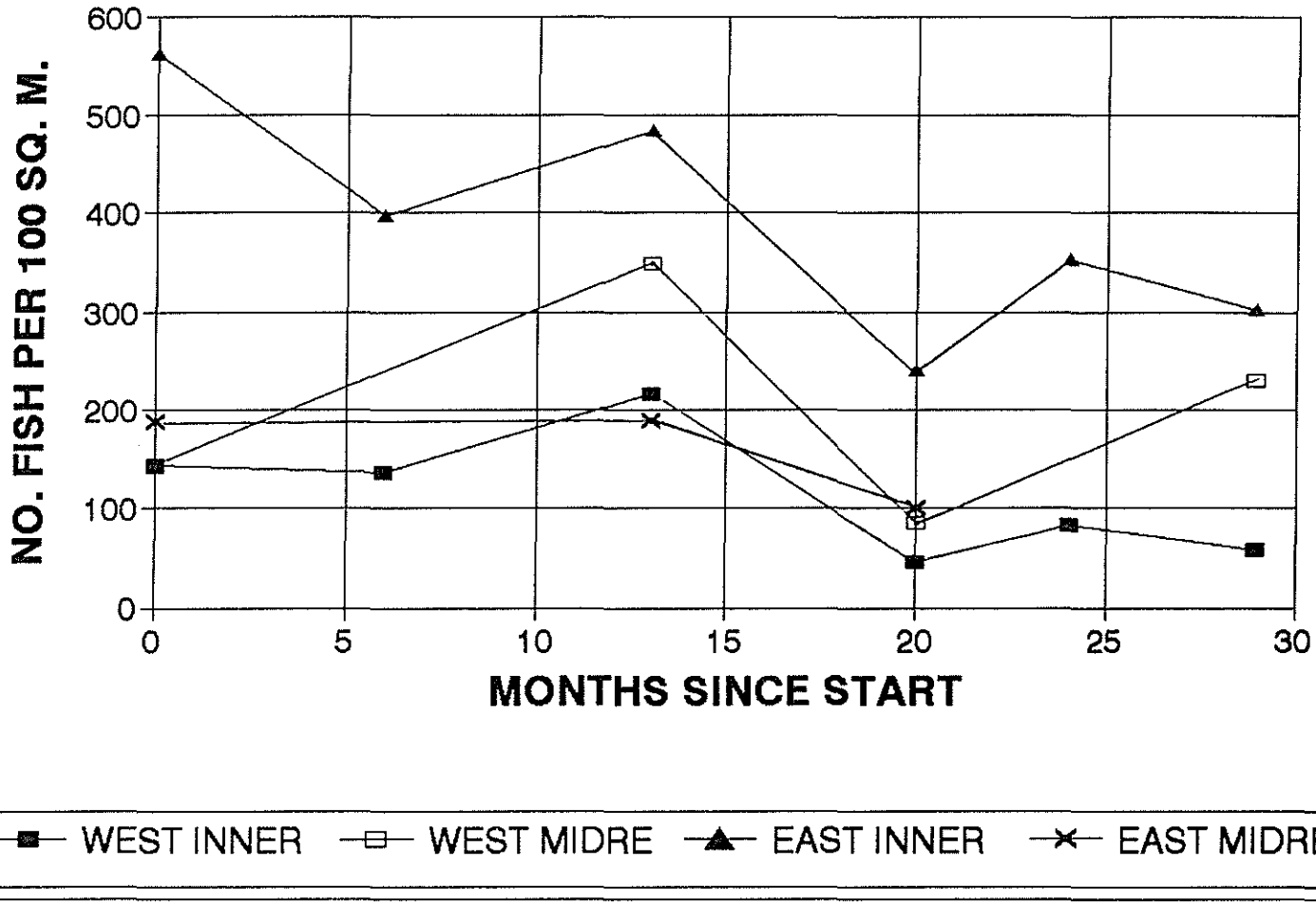
ANDERSEN MARINE RESOURCES PRESERVE

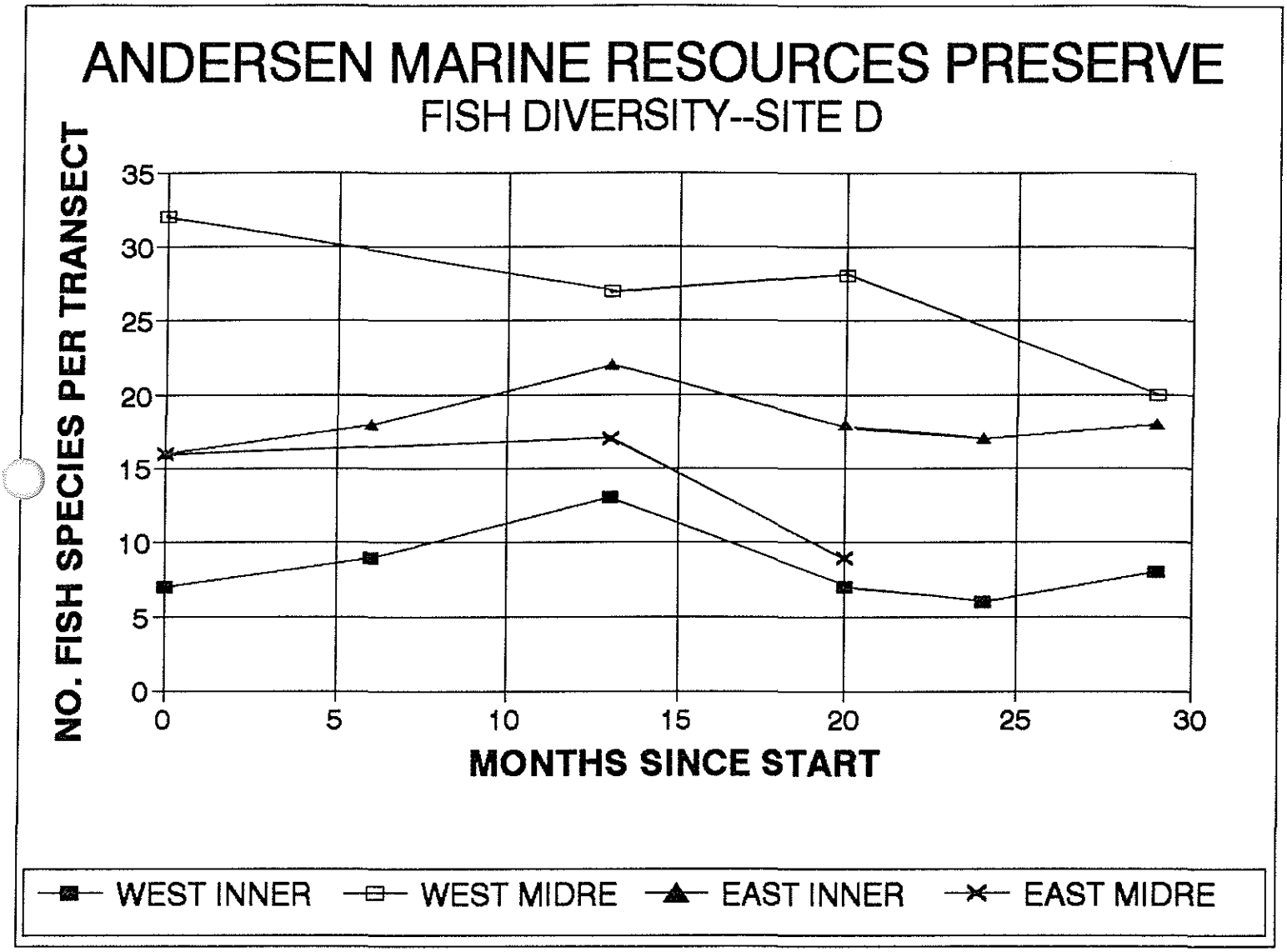
FISH ABUNDANCE--SITE C

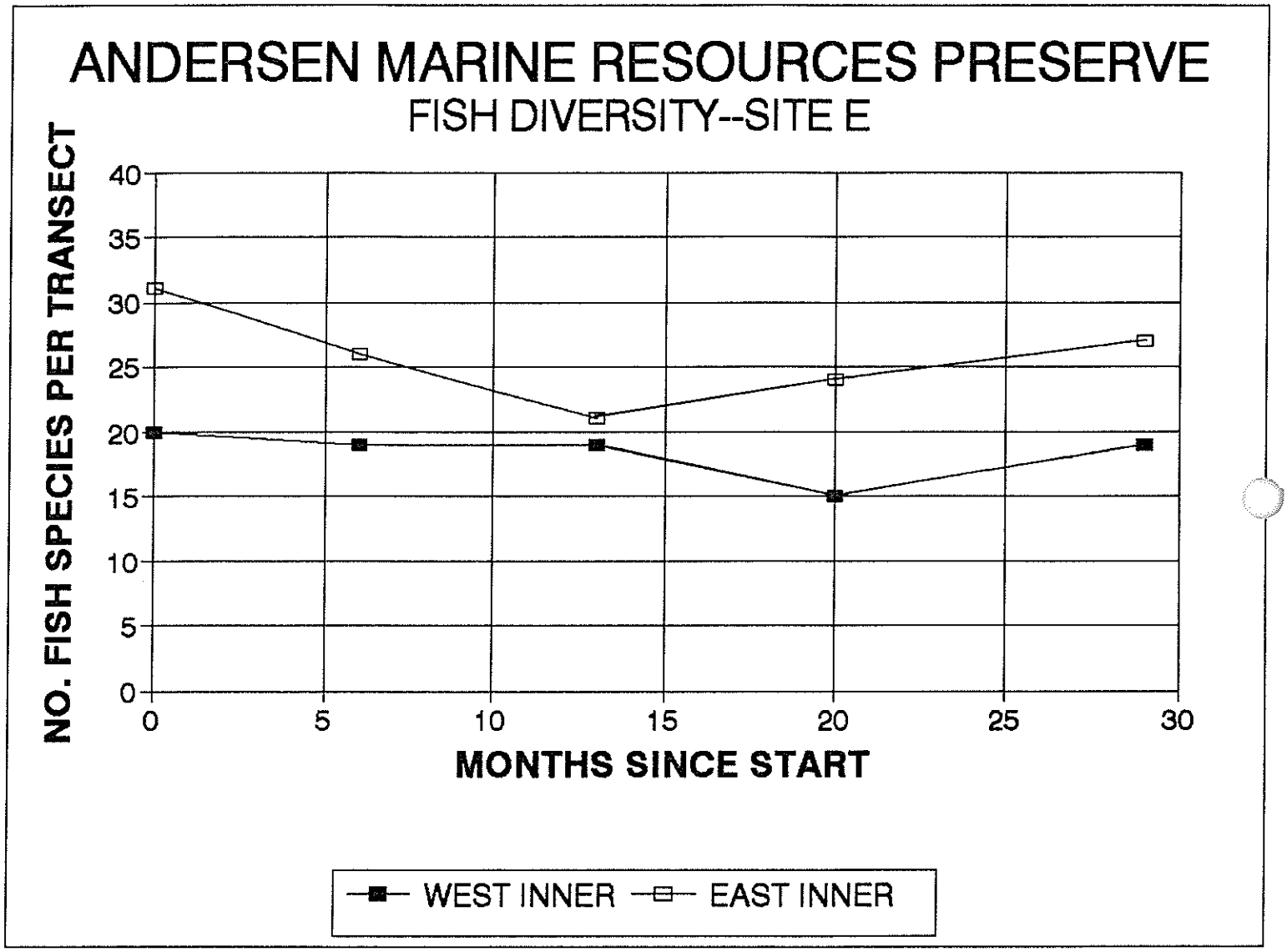


ANDERSEN MARINE RESOURCES PRESERVE

FISH ABUNDANCE--SITE D

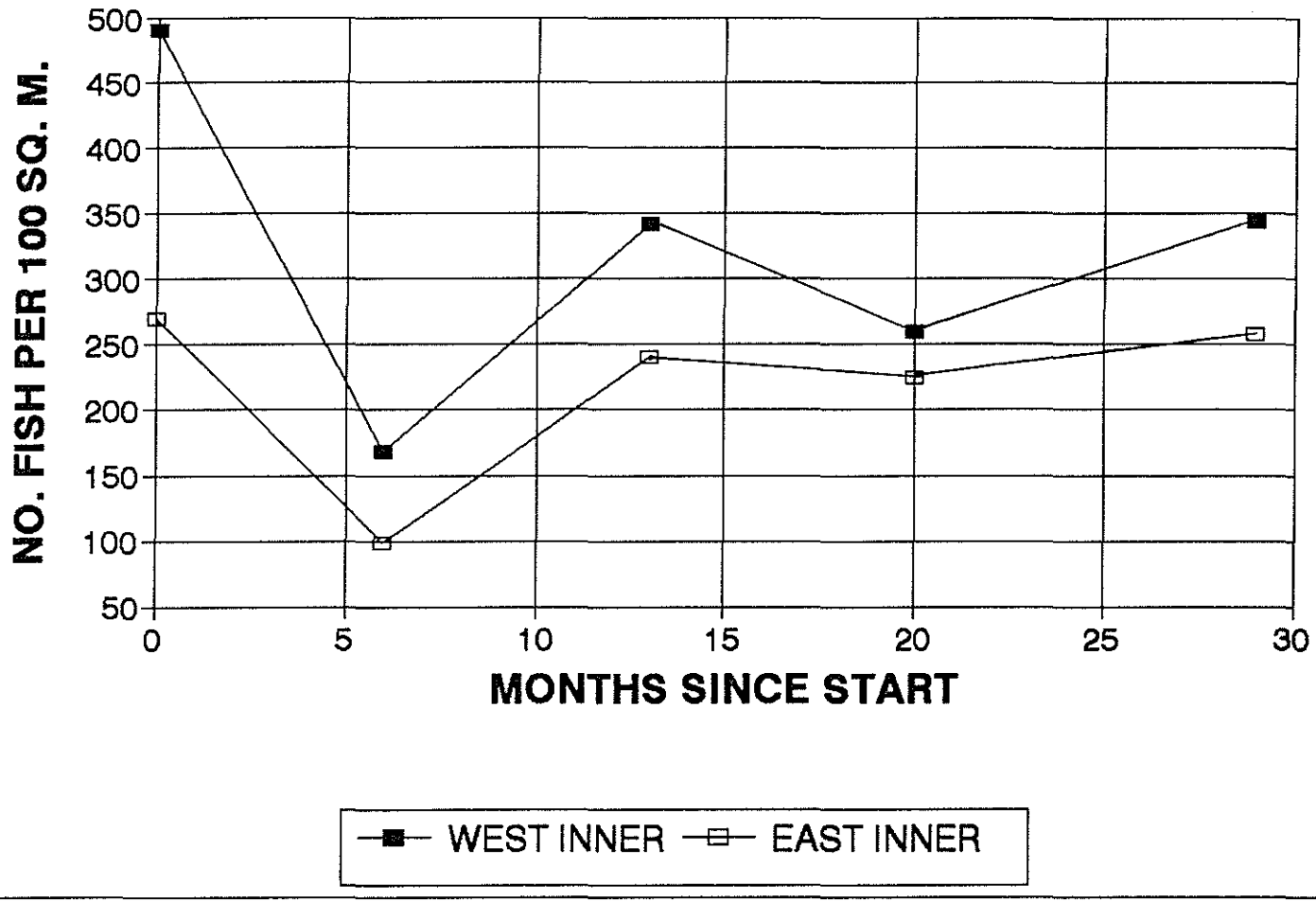



ANDERSEN MARINE RESOURCES PRESERVE
FISH DIVERSITY--SITE D
NO. FISH SPECIES PER TRANSECT
35
30
25
20
15
10
5
0
0
5
10
15
20
25
30
MONTHS SINCE START
WEST INNER
WEST MIDRE
EAST INNER
EAST MIDRE


ANDERSEN MARINE RESOURCES PRESERVE
FISH DIVERSITY--SITE E
NO. FISH SPECIES PER TRANSECT
40
35
30
25
20
15
10
5
0
0
5
10
15
20
25
30
MONTHS SINCE START
WEST INNER
EAST INNER

ANDERSEN MARINE RESOURCES PRESERVE

FISH ABUNDANCE--SITE E



ANDERSEN SURVEY
SITE A
SURVEY 1 - 6
TRAN LENGTH = 25 M

		EAST TRANSECTS																	
		INNER ONE	INNER TWO	INNER THRE	INNER FOUR	INNER FIVE	INNER SIX	INNER SEVE	INNER EIGHT	MIDRE ONE	MIDRE TWO	MIDRE THRE	MIDRE FOUR	MIDRE SIX	MIDRE SEVE	MIDRE EIGHT	OUTE ONE	OUTE TWO	OUTE THRE	OUTE FOUR
ACANTHURIDAE	Acanthurus guttatus																		obs	
ACANTHURIDAE	Acanthurus lineatus									obs	1	obs	obs	obs		obs	obs		3	1
ACANTHURIDAE	Acanthurus nigricans																obs			
ACANTHURIDAE	Acanthurus nigrofuscus									obs	obs	2	obs	obs	obs		14		2	2
ACANTHURIDAE	Acanthurus nigroris												1	obs		4	obs		1	3
ACANTHURIDAE	Acanthurus triostegus	obs	2	4		obs	obs	2	obs	obs	1	obs	3	obs	obs	obs	obs		1	
ACANTHURIDAE	Acanthurus xanthopterus												obs							3
ACANTHURIDAE	Acanthurus juv																			
ACANTHURIDAE	Ctenochaetus striatus																		1	
ACANTHURIDAE	Naso lituratus									obs	obs					obs	obs			
ACANTHURIDAE	Naso unicornis									obs	obs									
APOGONIDAE	Apogon novemfasciatus																		1	
BALISTIDAE	Rhinecanthus aculeatus	obs	obs			obs								obs						
BALISTIDAE	Rhinecanthus rectangulus										obs		obs	obs		obs				
BLENNIIDAE	Salarias fasciatus									obs	obs	obs				obs				
BLENNIIDAE	unidentified			obs																
BOTHIDAE	Bothus sp.													obs						
CARANGIDAE	Caranx melampygus																			obs
CARCHARHINIDAE	Carcharhinus melanopterus																			
CHAETODONTIDA	Chaetodon auriga	obs	obs										obs			obs	2		1	obs
CHAETODONTIDA	Chaetodon citrinellus									obs	obs	1	obs	obs	1	obs	1		obs	obs
CHAETODONTIDA	Chaetodon lunula														obs					obs
CHAETODONTIDA	Chaetodon melannotus									obs										
CHAETODONTIDA	Chaetodon ornatissimus									obs							obs		obs	
CHAETODONTIDA	Chaetodon quadrimaculatus																obs		obs	
CHAETODONTIDA	Chaetodon reticulatus									obs									obs	
CHAETODONTIDA	Chaetodon ulietensis																			
CHAETODONTIDA	Chaetodon unimaculatus										obs									
CIRRHITIDAE	Cirrhites pinnulatus																			
HOLOCENTRIDAE	Neoniphon sammara																1			
HOLOCENTRIDAE	Sargocentron tiere																			
FISTULARIIDAE	Fistularia commersonii		obs																	
KUHLIIDAE	Kuhlia mugil																			
LABRIDAE	Anampses caeruleopunctatus										obs								obs	
LABRIDAE	Chellinus chlorourus																			
LABRIDAE	Chellinus trilobatus								obs		obs		1			1	obs			obs
LABRIDAE	Coris ayguia																			obs
LABRIDAE	Coris gaimard																			obs
LABRIDAE	Gomphosus varius										obs		obs	obs		obs	obs		obs	
LABRIDAE	Hallchoeres hortulanus									obs	obs		obs			obs	obs		5	obs
LABRIDAE	Hallchoeres margaritaceus								1	obs	obs	obs	2	2	2	7	5		30	24
LABRIDAE	Hallchoeres marginatus															obs			3	
LABRIDAE	Hallchoeres trimaculatus	15	10	5	3	4	6	10	2	4	2	3	2	6	4	15			2	
LABRIDAE	Hemigymnus melapterus									obs						obs				
LABRIDAE	Labroides dimidiatus												obs			obs				

ANDERSEN SURVEY
SITE A
SURVEY 1 - 6
TRAN LENGTH = 25 M

		EAST TRANSECTS																		
		INNER ONE	INNER TWO	INNER THRE	INNER FOUR	INNER FIVE	INNER SIX	INNER SEVE	INNER EIGHT	MIDRE ONE	MIDRE TWO	MIDRE THRE	MIDRE FOUR	MIDRE SIX	MIDRE SEVE	MIDRE EIGHT	OUTE ONE	OUTE TWO	OUTE THRE	OUTE FOUR
LABRIDAE	Macropharyngodon meleagris										obs			obs			obs			
LABRIDAE	Novaculichthys taeniourus				obs		1	obs	obs											1
LABRIDAE	Stethojulis bandanensis	12	obs	1	5		obs	3	5	obs	1	3	2	obs	obs	3	6		9	2
LABRIDAE	Thalassoma hardwicki										obs		obs	obs						
LABRIDAE	Thalassoma lutescens																			
LABRIDAE	Thalassoma quinquevittata									obs	obs		obs		obs	obs	2		3	obs
LABRIDAE	juvenile		4	3	5				3		2		2		1				1	1
LETHRINIDAE	Lethrinus harak												obs							
LUTJANIDAE	Lutjanus fulvus																obs			
LUTJANIDAE	Lutjanus monostigmus																			
MUGILIDAE	Valamugil engeli																		obs	
MULLIDAE	Mulloides flavolineatus								obs											
MULLIDAE	Mulloides vanicolensis																			obs
MULLIDAE	Parupeneus bifasciatus								obs				obs							obs
MULLIDAE	Parupeneus cyclostomus																			obs
MULLIDAE	Parupeneus multifasciatus												obs							
NEMIPTERIDAE	Scolopsis lineatus		obs		obs				obs											
OSTRACIIDAE	Ostracion meleagris																obs			
PEMPHERIDAE	Pempheris oualensis																			
PINGUIPEDIDAE	Parapercis sp.																			obs
POMACENTRIDAE	Abudefduf septemfasciatus			obs															obs	
POMACENTRIDAE	Abudefduf sordidus																			
POMACENTRIDAE	Abudefduf vaigiensis															obs				
POMACENTRIDAE	Amphiprion melanopus																			
POMACENTRIDAE	Chrysiptera biocellata	obs	obs		3	1			7											
POMACENTRIDAE	Chrysiptera glauca	68	16	12	9	5	1	14	23	2	4	2	4	obs		7	2			
POMACENTRIDAE	Chrysiptera leucopoma								2	obs	obs	3	6	3	1	2	49		115	38
POMACENTRIDAE	Plectroglyphidodon dickii																2		obs	obs
POMACENTRIDAE	Plectroglyphidodon imparipennis																			
POMACENTRIDAE	Plectroglyphidodon leucozona																			1
POMACENTRIDAE	Stegastes albifasciatus		2			obs	obs	1	2	obs	2	2	1	1	obs	5	19		16	8
POMACENTRIDAE	Stegastes fasciolatus																2		4	1
POMACENTRIDAE	Stegastes nigricans																			
POMACENTRIDAE	juvenile				3		5		4											
SCARIDAE	Calotomus carolinus															obs				
SCARIDAE	Scarus forsteni																			
SCARIDAE	Scarus frontalis												obs	obs		5				
SCARIDAE	Scarus sordidus																			
SCARIDAE	juveniles		5		obs					obs			3	obs			1			obs
SERRANIDAE	Epinephelus merra									obs										
SIGANIDAE	Siganus argenteus																		9	
SIGANIDAE	Siganus spinus											obs							2	
TETRAODONTIDAE	Canthigaster solandri								obs											
ZANCLIDAE	Zanclus cornutus				1						obs		obs	obs		obs			obs	obs
NO. FISH PER 100 SQ.M.		192	76	50	56	22	26	60	98	12	26	32	54	24	16	104	216		416	170
NO. FISH SPECIES		7	12	7	10	6	7	6	16	21	24	12	27	20	11	25	26		30	26

ANDERSEN SURVEY
SITE A
SURVEY 1 - 6
TRAN LENGTH = 25 M

		WEST TRANSECTS																	
		INNER ONE	INNER TWO	INNER THRE	INNER FOUR	INNER FIVE	INNER SIX	INNER SEVE	INNER EIGHT	MIDDL ONE	MIDDL TWO	MIDDL THRE	MIDRE FOUR	MIDRE SIX	MIDRE SEVE	MIDRE EIGHT	OUTE ONE	OUTE TWO	OUTE THRE	OUTE FOUR
ACANTHURIDAE	Acanthurus guttatus																obs		4	obs
ACANTHURIDAE	Acanthurus lineatus										obs	obs	obs	obs			1		obs	2
ACANTHURIDAE	Acanthurus nigricans														obs		obs		1	obs
ACANTHURIDAE	Acanthurus nigrofuscus		obs	obs						obs	obs	obs	obs	2	1	2			2	4
ACANTHURIDAE	Acanthurus nigroris											obs	obs		obs	obs	obs		4	obs
ACANTHURIDAE	Acanthurus triostegus	obs	obs	1	obs	1		obs		1	obs		obs	obs		obs	1		2	3
ACANTHURIDAE	Acanthurus xanthopterus																			
ACANTHURIDAE	Acanthurus juv			obs															2	
ACANTHURIDAE	Ctenochaetus striatus																12		obs	
ACANTHURIDAE	Naso lituratus										obs	obs							obs	
ACANTHURIDAE	Naso unicornis																			
APOGONIDAE	Apogon novemfasciatus																			
BALISTIDAE	Rhinecanthus aculeatus		obs											obs						
BALISTIDAE	Rhinecanthus rectangulus										obs			obs						
BLENNIIDAE	Salarias fasciatus										obs									
BLENNIIDAE	unidentified									obs										
BOTHIDAE	Bothus sp.																			
CARANGIDAE	Caranx melampygus																		obs	
CARCHARHINIDAE	Carcharhinus melanopterus																			obs
CHAETODONTIDA	Chaetodon auriga		1																	
CHAETODONTIDA	Chaetodon citrinellus	obs	obs		obs		1	obs		2	1	2	obs		obs	obs				1
CHAETODONTIDA	Chaetodon lunula	obs	obs														4			
CHAETODONTIDA	Chaetodon melannotus																			
CHAETODONTIDA	Chaetodon ornatissimus																			
CHAETODONTIDA	Chaetodon quadrimaculatus																			
CHAETODONTIDA	Chaetodon reticulatus										obs		obs						obs	
CHAETODONTIDA	Chaetodon ulietensis																obs			
CHAETODONTIDA	Chaetodon unimaculatus																			
CIRRHITIDAE	Cirrhitus pinnulatus																obs			
HOLOCENTRIDAE	Neoniphon sammara																obs			obs
HOLOCENTRIDAE	Sargocentron tiere						obs													
FISTULARIIDAE	Fistularia commersonii		obs					1												
KUHLIIDAE	Kuhlia mugil																		obs	
LABRIDAE	Anampses caeruleopunctatus																			
LABRIDAE	Cheilinus chlorourus								obs											
LABRIDAE	Cheilinus trilobatus		1								obs	1		obs						
LABRIDAE	Coris aygula	obs																		
LABRIDAE	Coris gaimard																			
LABRIDAE	Gomphosus varius									obs	obs		obs	obs						
LABRIDAE	Halichoeres hortulanus									2	1				obs		1		obs	1
LABRIDAE	Halichoeres margaritaceus	1	2	2	obs	obs	obs	obs	1	5	3	3	3	16	11	9	11		14	13
LABRIDAE	Halichoeres marginatus									1		1	obs	obs			2		1	obs
LABRIDAE	Halichoeres trimaculatus	4	12	8	4	2	2	5	7	3	2	4	2	2	1	5	obs			
LABRIDAE	Hemigymnus melapterus									obs						obs				
LABRIDAE	Labroides dimidiatus															obs	obs		obs	1

ANDERSEN SURVEY
SITE A
SURVEY 1 - 8
TRAN LENGTH = 25 M

		WEST TRANSECTS																		
		INNER ONE	INNER TWO	INNER THRE	INNER FOUR	INNER FIVE	INNER SIX	INNER SEVE	INNER EIGHT	MIDDL ONE	MIDDL TWO	MIDDL THRE	MIDRE FOUR	MIDRE SIX	MIDRE SEVE	MIDRE EIGHT	OUTE ONE	OUTE TWO	OUTE THRE	OUTE FOUR
LABRIDAE	Macropharyngodon meleagris										obs									
LABRIDAE	Novaculichthys taeniourus						1								1					
LABRIDAE	Stethojulis bandanensis	3	4	5	obs	3	6	obs	10	1	1	6	4	2	6	10	2		4	3
LABRIDAE	Thalassoma hardwicki	obs	obs	obs					obs		obs	1		obs	obs	4				
LABRIDAE	Thalassoma lutescens									obs										
LABRIDAE	Thalassoma quinquevittata		obs	obs						obs	6	1		obs	obs		2		4	1
LABRIDAE	juvenile		obs	4					3		1	1	6		7	3				1
LETHRINIDAE	Lethrinus harak												obs							
LUTJANIDAE	Lutjanus fulvus																			
LUTJANIDAE	Lutjanus monostigmus																			obs
MUGILIDAE	Valamugil engeli																			
MULLIDAE	Mulloides flavolineatus							obs	obs											
MULLIDAE	Mulloides vanicolensis																			
MULLIDAE	Parupeneus bifasciatus																1		obs	
MULLIDAE	Parupeneus cyclostomus																		obs	
MULLIDAE	Parupeneus multifasciatus								obs											
NEMIPTERIDAE	Scolopsis lineatus																			
OSTRACIIDAE	Ostracion meleagris																			
PEMPHERIDAE	Pempheris oualensis																obs			obs
PINGUIPEDIDAE	Parapercis sp.															obs				
POMACENTRIDAE	Abudefduf septemfasciatus	obs	obs	obs	obs															
POMACENTRIDAE	Abudefduf sordidus					obs														
POMACENTRIDAE	Abudefduf vaigiensis							obs		4	obs									
POMACENTRIDAE	Amphiprion melanopus															1				
POMACENTRIDAE	Chrysiptera biocellata				obs															
POMACENTRIDAE	Chrysiptera glauca	27	19	16	12	6	2	17	29	12	7	2	1	obs	1	7				
POMACENTRIDAE	Chrysiptera leucopoma		obs	2	obs	1				6	3	17	7	3	12	11	64		52	56
POMACENTRIDAE	Plectroglyphidodon dickii																			1
POMACENTRIDAE	Plectroglyphidodon imparipennis																1			
POMACENTRIDAE	Plectroglyphidodon leucozona																3			6
POMACENTRIDAE	Stegastes albifasciatus			obs			obs	obs	obs	9	4	6	4	6	5	4	3		6	2
POMACENTRIDAE	Stegastes fasciolatus																4		1	3
POMACENTRIDAE	Stegastes nigricans		1																	
POMACENTRIDAE	juvenile				1															
SCARIDAE	Calotomus carolinus																			
SCARIDAE	Scarus forsteni																		obs	
SCARIDAE	Scarus frontalis		obs			obs										obs	obs		6	4
SCARIDAE	Scarus sordidus																		obs	
SCARIDAE	juveniles		obs							5	4		obs	obs	obs					
SERRANIDAE	Epinephelus merra													obs	obs					
SIGANIDAE	Siganus argenteus											11								
SIGANIDAE	Siganus spinus											1								
TETRAODONTIDAE	Canthigaster solandri		obs	obs																
ZANCLIDAE	Zanclus cornutus				obs	obs		obs	obs										obs	obs
NO. FISH PER 100 SQ.M.		70	80	80	54	26	26	46	100	102	70	114	54	62	90	112	224		206	204
NO. FISH SPECIES		10	21	14	11	9	6	11	11	16	23	16	17	16	17	17	25		27	25

ANDERSEN SURVEY 8
SITE B EAST
TRAN LENGTH = 25 M

		GROOVE															
		INNER ONE	INNER TWO	INNER THRE	INNER FOUR	INNER FIVE	INNER SIX	INNER SEVE	INNER EIGHT	MIDRE ONE	MIDRE TWO	MIDRE THRE	MIDRE FOUR	MIDRE FIVE	MIDRE SIX	MIDRE SEVE	MIDRE EIGHT
ACANTHURIDAE	Acanthurus lineatus										obs			obs	obs		
ACANTHURIDAE	Acanthurus nigricans											1					
ACANTHURIDAE	Acanthurus nigrofuscus				obs			obs				obs	2	1	5	obs	obs
ACANTHURIDAE	Acanthurus nigroris														1		
ACANTHURIDAE	Acanthurus triostegus	8	1	6	obs		2	obs	obs	obs	obs		obs	obs		obs	
ACANTHURIDAE	Ctenochaetus striatus									3							
ACANTHURIDAE	Naso unicornis																
ACANTHURIDAE	Naso juvenile																
ACANTHURIDAE	Zebrasoma flavescens							obs	1	obs	obs	1	obs	1	2		1
ACANTHURIDAE	Zebrasoma veliferum													obs	obs		
ACANTHURIDAE	juvenile		1	obs													
APOGONIDAE	Apogon novemfasciatus			2	obs				1					1		obs	
BALISTIDAE	Rhinecanthus aculeatus		obs							obs	obs						
BELONIDAE	unidentified								obs								
BLENNIIDAE	Salarias fasciatus				1												
CARANGIDAE	Caranx melampygus																
CHAETODONTIDA	Chaetodon auriga	obs	obs	1	1	obs		obs	2	16	18	obs	13	5		1	5
CHAETODONTIDA	Chaetodon citrinellus	obs	obs	1				2	obs	obs		obs	2	2	obs		1
CHAETODONTIDA	Chaetodon ephippium		obs			1		obs			1				1		1
CHAETODONTIDA	Chaetodon lunula									obs	obs		2	obs			
CHAETODONTIDA	Chaetodon ornatissimus		obs							1							
CHAETODONTIDA	Chaetodon reticulatus											1					obs
CHAETODONTIDA	Chaetodon trifascialis	1	1	2	1	2	3	obs	obs	obs	4	2	12	10	11		5
CHAETODONTIDA	Chaetodon trifasciatus			obs								obs	2	obs	obs		obs
FISTULARIIDAE	Fistularia commersonii								obs				obs				
GERRIIDAE	Gerres argyreus												obs				
GOBIIDAE	unidentified							1								obs	
GRAMMISTIDAE	Grammistes sexlineatus	obs															
HOLOCENTRIDAE	Myripristis kuntee									1		1	2	4			5
HOLOCENTRIDAE	Neoniphon sammara									2		obs	obs	2	4		
HOLOCENTRIDAE	Sargocentron diadema	1		1						1		1	2		1		1
HOLOCENTRIDAE	Sargocentron spiniferum																2
HOLOCENTRIDAE	Sargocentron tiere														1		
LABRIDAE	Cheilinus chlorourus							obs									
LABRIDAE	Cheilinus trilobatus		obs									1				obs	
LABRIDAE	Cheilinus sp.												1				
LABRIDAE	Coris aygula															2	
LABRIDAE	Epibulus insidiator		obs							1	1						1
LABRIDAE	Gomphosus varius								obs		obs	2		obs			obs
LABRIDAE	Hallchoeres hortulanus						1							1	1	2	
LABRIDAE	Hallchoeres margaritaceus																
LABRIDAE	Hallchoeres marginatus														obs	2	
LABRIDAE	Hallchoeres trimaculatus	8	12	29	25	12	16	15	2	5	4	6	5	10	10	33	3
LABRIDAE	Hemigymnus melapterus			1		2		obs		obs	2	obs	2	obs	obs	3	obs

ANDERSEN SURVEY 6
SITE B EAST
TRAN LENGTH = 25 M

		GROOVE															
		INNER ONE	INNER TWO	INNER THREE	INNER FOUR	INNER FIVE	INNER SIX	INNER SEVEN	INNER EIGHT	MIDRE ONE	MIDRE TWO	MIDRE THREE	MIDRE FOUR	MIDRE FIVE	MIDRE SIX	MIDRE SEVEN	MIDRE EIGHT
LABRIDAE	Labroides dimidiatus									obs		1	2	2	2		obs
LABRIDAE	Stethojulis bandanensis	1	2	5	3	1	2	7	obs	2		2	4	3	1	3	1
LABRIDAE	Thalassoma hardwicki	obs	obs		obs			obs	1		1	2	1	obs	obs		
LABRIDAE	juvenile	3	2	10	5		1		5	obs	2		2				1
LETHRINIDAE	Gnathodentex aurolineatus									obs							
LUTJANIDAE	Lutjanus fulvus									obs	obs						
MUGILIDAE	Liza vaigiensis														obs		
MULLIDAE	Mulloides flavolineatus								obs				1		obs		5
MULLIDAE	Mulloides vanicolensis																18
MULLIDAE	Parupeneus barberinus	obs															
MULLIDAE	Parupeneus bifasciatus																3
MULLIDAE	Parupeneus multifasciatus																
MURAENIDAE	Sideria picta	obs						obs									
NEMIPTERIDAE	Scolopsis lineatus							obs		obs	2		3	obs		obs	
OSTRACIIDAE	Ostracion cubicus										1						
PINGUIPEDIDAE	Parapercis sp.												obs				
POMACANTHIDAE	Pomacanthus imperator										obs						
POMACENTRIDAE	Abudefduf septemfasciatus						obs	obs	obs	obs	obs	obs	obs	obs	obs	obs	
POMACENTRIDAE	Abudefduf sexfasciatus		1														
POMACENTRIDAE	Abudefduf sordidus													obs			
POMACENTRIDAE	Abudefduf vaigiensis	obs															
POMACENTRIDAE	Amphiprion chrysopterus																
POMACENTRIDAE	Amphiprion melanopus							1		obs			obs		obs		1
POMACENTRIDAE	Chrysiptera biocellata	obs	4	1	7	2	1	3	4		3	2	3		1	7	3
POMACENTRIDAE	Chrysiptera glauca	42	15	35	5	1	6	18	6	1	obs			obs		25	3
POMACENTRIDAE	Chrysiptera leucopoma	1		1	1	1	2		2	obs		1		1	obs		
POMACENTRIDAE	Dascyllus aruanus	16	3	7	15	18	15	5	55	45	75	56	51	76	60	3	109
POMACENTRIDAE	Plectroglyphidodon dickii								obs			1	1	5	7		4
POMACENTRIDAE	Plectroglyphidodon imparipennis	1															
POMACENTRIDAE	Pomacentrus vaiuli										1			1	1		
POMACENTRIDAE	Stegastes albifasciatus	22	5	6	7	19	12	28	16	10	2	5	4	7	10	22	11
POMACENTRIDAE	Stegastes lividus		obs			1		obs			13		6	7	5		
POMACENTRIDAE	Stegastes nigricans	obs				3		obs		4	obs	7	obs	10	3		obs
POMACENTRIDAE	juvenile	2	1	19	3	5	4	4	5		1	2					2
SCARIDAE	Scarus frontalis		obs					obs			obs		12				4
SCARIDAE	Scarus sordidus							obs									
SCARIDAE	juvenile	1	1	1						7	10	9		4	1	1	5
SERRANIDAE	Epinephelus merra									obs			obs				
SIGANIDAE	Siganus argenteus											obs					
SIGANIDAE	Siganus spinus			6													
SYNGNATHIDAE	Corythoichthys intestinalis											obs		obs	obs		
SYNODONTIDAE	unidentified																
TETRAODONTIDAE	Arothron nigropunctatus			obs						obs			obs				
TETRAODONTIDAE	Canthigaster bennetti					1											
TETRAODONTIDAE	Canthigaster solandri		1			1		2			obs	2	2	2		2	
ZANCLIDAE	Zanclus cornutus							obs	obs		obs		obs		obs	obs	5
NO. FISH PER 100 SQ. M.		214	100	272	148	140	130	172	200	198	282	212	278	310	296	212	400
NO. FISH SPECIES		22	24	21	16	16	13	28	23	31	31	30	35	34	34	21	32

ANDERSEN SURVEY 8
SITE B EAST
TRAN LENGTH = 25 M

		FLAT														
		INNER ONE	INNER TWO	INNER THRE	INNER FOUR	INNER FIVE	INNER SIX	INNER SEVE	INNER EIGHT	MIDRE ONE	MIDRE TWO	MIDRE THRE	MIDRE FIVE	MIDRE SIX	MIDRE SEVE	MIDRE EIGHT
ACANTHURIDAE	Acanthurus lineatus															
ACANTHURIDAE	Acanthurus nigricans															
ACANTHURIDAE	Acanthurus nigrofuscus															
ACANTHURIDAE	Acanthurus nigroris															
ACANTHURIDAE	Acanthurus triostegus	1		obs				obs		obs	obs	2	obs			obs
ACANTHURIDAE	Ctenochaetus striatus															
ACANTHURIDAE	Naso unicornis															
ACANTHURIDAE	Naso juvenile															
ACANTHURIDAE	Zebrasoma flavescens															
ACANTHURIDAE	Zebrasoma veliferum															
ACANTHURIDAE	juvenile															
APOGONIDAE	Apogon novemfasciatus															
BALISTIDAE	Rhinecanthus aculeatus	obs					obs				obs		obs	obs		obs
BELONIDAE	unidentified															
BLENNIIDAE	Salarias fasciatus													obs		
CARANGIDAE	Caranx melampygus															
CHAETODONTIDA	Chaetodon auriga															
CHAETODONTIDA	Chaetodon citrinellus															
CHAETODONTIDA	Chaetodon ephippium															
CHAETODONTIDA	Chaetodon lunula															
CHAETODONTIDA	Chaetodon ornatissimus															
CHAETODONTIDA	Chaetodon reticulatus															
CHAETODONTIDA	Chaetodon trifascialis															
CHAETODONTIDA	Chaetodon trifasciatus															
FISTULARIIDAE	Fistularia commersonii															
GERRIIDAE	Gerres argyreus						obs									
GOBIIDAE	unidentified															
GRAMMISTIDAE	Grammistes sexlineatus															
HOLOCENTRIDAE	Myripristis kuntee															
HOLOCENTRIDAE	Neoniphon sammara															
HOLOCENTRIDAE	Sargocentron diadema															
HOLOCENTRIDAE	Sargocentron spiniferum															
HOLOCENTRIDAE	Sargocentron tiere															
LABRIDAE	Cheilinus chlorourus															
LABRIDAE	Cheilinus trilobatus															
LABRIDAE	Cheilinus sp.															
LABRIDAE	Coris aygula															
LABRIDAE	Epibulus insidiator															
LABRIDAE	Gomphosus varius															
LABRIDAE	Halichoeres hortulanus															
LABRIDAE	Halichoeres margaritaceus												2			
LABRIDAE	Halichoeres marginatus															
LABRIDAE	Halichoeres trimaculatus	obs	obs	obs	1	5	2	2	1	obs	1	2	obs	3	obs	2
LABRIDAE	Hemigymnus melapterus															

ANDERSEN SURVEY 8
SITE B EAST
TRAN LENGTH = 25 M

		FLAT															
		INNER ONE	INNER TWO	INNER THREE	INNER FOUR	INNER FIVE	INNER SIX	INNER SEVEN	INNER EIGHT	MIDRE ONE	MIDRE TWO	MIDRE THREE	MIDRE FIVE	MIDRE SIX	MIDRE SEVEN	MIDRE EIGHT
LABRIDAE	Labroides dimidiatus															
LABRIDAE	Stethojulis bandanensis		obs	obs				2	1							obs
LABRIDAE	Thalassoma hardwickii															
LABRIDAE	juvenile	obs					obs			1					1	
LETHRINIDAE	Gnathodentex aurolineatus															
LUTJANIDAE	Lutjanus fulvus															
MUGILIDAE	Liza vaigiensis															
MULLIDAE	Mulloides flavolineatus															
MULLIDAE	Mulloides vanicolensis															
MULLIDAE	Parupeneus barberinus															
MULLIDAE	Parupeneus bifasciatus															
MULLIDAE	Parupeneus multifasciatus								obs							
MURAENIDAE	Sideria picta	obs														
NEMIPTERIDAE	Scolopsis lineatus															
OSTRACIIDAE	Ostracion cubicus															
PINGUIPEDIDAE	Parapercis sp.															
POMACANTHIDAE	Pomacanthus imperator															
POMACENTRIDAE	Abudefduf septemfasciatus			obs				obs	obs			obs				
POMACENTRIDAE	Abudefduf sexfasciatus															
POMACENTRIDAE	Abudefduf sordidus															
POMACENTRIDAE	Abudefduf vaigiensis															
POMACENTRIDAE	Amphiprion chrysopterus															
POMACENTRIDAE	Amphiprion melanopus															
POMACENTRIDAE	Chrysiptera biocellata			1							obs					obs
POMACENTRIDAE	Chrysiptera glauca	3	1	6		3	3	12	obs	6	obs	4	1	3	6	2
POMACENTRIDAE	Chrysiptera leucopoma			obs					obs	obs		1	obs	obs		
POMACENTRIDAE	Dascyllus aruanus			obs					obs							
POMACENTRIDAE	Plectroglyphidodon dickii															
POMACENTRIDAE	Plectroglyphidodon imparipennis															
POMACENTRIDAE	Pomacentrus vaiuli															
POMACENTRIDAE	Stegastes albifasciatus															
POMACENTRIDAE	Stegastes lividus															
POMACENTRIDAE	Stegastes nigricans															
POMACENTRIDAE	juvenile	1	obs						2	obs			1		1	
SCARIDAE	Scarus frontalis															
SCARIDAE	Scarus sordidus															
SCARIDAE	juvenile															
SERRANIDAE	Epinephelus merra															
SIGANIDAE	Siganus argenteus															
SIGANIDAE	Siganus spinus															
SYNGNATHIDAE	Corythoichthys intestinalis															
SYNODONTIDAE	unidentified														obs	
TETRAODONTIDAE	Arothron nigropunctatus															
TETRAODONTIDAE	Canthigaster bennetti															
TETRAODONTIDAE	Canthigaster solandri															
ZANCLIDAE	Zanclus cornutus															
NO. FISH PER 100 SQ. M.		10	2	14	2	16	10	32	8	14	2	16	8	12	16	8
NO. FISH SPECIES		7	4	8	1	2	5	5	8	6	5	5	7	5	5	6

ANDERSEN SURVEY 8

SITE B WEST

TRAN LENGTH = 25M

SITE B -- WEST

		GROOVE INNER ONE	GROOVE INNER THREE	GROOVE INNER FOUR	GROOVE INNER FIVE	GROOVE INNER SIX	GROOVE INNER SEVEN	GROOVE INNER EIGHT	GROOVE MIDREEF ONE	GROOVE MIDREEF THREE	GROOVE MIDREEF FOUR	GROOVE MIDREEF FIVE	GROOVE MIDREEF SIX	GROOVE MIDREEF SEVEN	GROOVE MIDREEF EIGHT	GROOVE OUTER ONE	GROOVE OUTER THREE
ACANTHURIDAE	Acanthurus guttatus																obs
ACANTHURIDAE	Acanthurus lineatus											obs				1	obs
ACANTHURIDAE	Acanthurus nigrofuscus		obs	1	obs	1	obs	obs	obs		7	3	5	obs	3	1	
ACANTHURIDAE	Acanthurus nigroris																obs
ACANTHURIDAE	Acanthurus triostegus	obs		2	2	1	obs	1	4	2		4		obs	obs	3	2
ACANTHURIDAE	Acanthurus xanthopterus										1				2		
ACANTHURIDAE	Acanthurus juvenile									17							
ACANTHURIDAE	Naso lituratus																obs
ACANTHURIDAE	Zebrasoma flavescens				obs	obs	obs	obs							obs		
ACANTHURIDAE	Zebrasoma veliferum					obs											
APOGONIDAE	Apogon novemfasciatus							obs	obs	2	obs		3	obs	7		
BALISTIDAE	Rhinecanthus aculeatus			obs							obs		obs		obs		
BALISTIDAE	Rhinecanthus rectangulus															obs	
BLENNIIDAE	Salarias fasciatus	obs		obs						1	obs					1	
BLENNIIDAE	unidentified														obs	1	
CHAETODONTIDA	Chaetodon auriga	obs	obs	obs	obs	obs	obs	obs		obs	obs			1	obs	2	
CHAETODONTIDA	Chaetodon citrinellus	obs	obs	obs	1	1	2	obs	4	obs	1		obs		obs	2	obs
CHAETODONTIDA	Chaetodon ephippium	obs		obs		obs	obs	obs									
CHAETODONTIDA	Chaetodon lunula		obs					obs		obs							obs
CHAETODONTIDA	Chaetodon quadrimaculatus											1					
CHAETODONTIDA	Chaetodon reticulatus	obs															
CHAETODONTIDA	Chaetodon trifasciatis		obs		obs		obs										
CHAETODONTIDA	Chaetodon trifasciatus		obs														
DIODONTIDAE	Diodon hystrix								1								
GOBIIDAE	unidentified		1				1	1		obs				obs			
HOLOCENTRIDAE	Myripristis kuntee	obs			obs	obs			obs			obs	obs			obs	obs
HOLOCENTRIDAE	Neoniphon sammara	obs	obs					obs									
HOLOCENTRIDAE	Sargocentron diadema															obs	
HOLOCENTRIDAE	Sargocentron spiniferum															obs	
LABRIDAE	Cheilinus chlorurus						obs	1									
LABRIDAE	Cheilinus trilobatus					obs				obs				obs			
LABRIDAE	Coris aygula													2		obs	
LABRIDAE	Epibulus insidiator	obs											obs				
LABRIDAE	Gomphosus varius	1							obs	1	obs					obs	
LABRIDAE	Halichoeres hortulanus	obs										obs		2		1	obs
LABRIDAE	Halichoeres margaritaceus																2
LABRIDAE	Halichoeres marginatus	obs				obs			2	1	3	1		2	obs		2
LABRIDAE	Halichoeres trimaculatus	5	6	7	9	9	15	2	15	49	19	7	19	33	19	8	obs
LABRIDAE	Hemigymnus melapterus	obs	obs			1	obs	obs	obs	obs		obs		3	obs		
LABRIDAE	Labroides dimidiatus		obs			obs			obs	3						1	obs
LABRIDAE	Stethojulis bandanensis	obs	3	1	11	1	7	4	8	20	2	4	7	3	7	7	11
LABRIDAE	Thalassoma hardwicki	1	1		obs		obs	1	obs	obs	obs				1		
LABRIDAE	Thalassoma purpureum															obs	
LABRIDAE	Thalassoma quinquevittata															obs	
LABRIDAE	juvenile	5	obs	1				9	9	7	4		1		8	6	2

ANDERSEN SURVEY 8

SITE B WEST

TRAN LENGTH = 25M

SITE B – WEST

		GROOVE INNER ONE	GROOVE INNER THREE	GROOVE INNER FOUR	GROOVE INNER FIVE	GROOVE INNER SIX	GROOVE INNER SEVEN	GROOVE INNER EIGHT	GROOVE MIDREEF ONE	GROOVE MIDREEF THREE	GROOVE MIDREEF FOUR	GROOVE MIDREEF FIVE	GROOVE MIDREEF SIX	GROOVE MIDREEF SEVEN	GROOVE MIDREEF EIGHT	GROOVE OUTER ONE	GROOVE OUTER THREE
LUTJANIDAE	Lutjanus monostigmus																obs
LUTJANIDAE	Lutjanus fulvus		obs	obs													obs
MUGILIDAE	Liza vaigiensis														obs		
MULLIDAE	Mulloidas flavolineatus		obs					obs									
MULLIDAE	Parupeneus bifasciatus	obs						obs	1	1					1	2	
MURAENIDAE	Gymnothorax javanicus																obs
MURAENIDAE	Sideria picta						obs		obs	obs							1
NEMIPTERIDAE	Scolopsis lineatus		obs	obs	obs	obs	obs	1			obs	1		obs	1	obs	
POMACANTHIDAE	Pomacanthus imperator							obs									
POMACENTRIDAE	Abudefduf septemfasciatus	obs	1	obs		obs	obs		1	1				obs		obs	
POMACENTRIDAE	Abudefduf sordidus						1			1							
POMACENTRIDAE	Amphiprion melanopus							obs									
POMACENTRIDAE	Chrysiptera biocellata		obs	7	7	6	3	obs	obs		1	4	3	7	3		
POMACENTRIDAE	Chrysiptera glauca	5	4	obs	obs	2	16	7	18	17	13	6	3	25	17	30	23
POMACENTRIDAE	Chrysiptera leucopoma	1							1	2		3			1	13	24
POMACENTRIDAE	Dascyllus aruanus	8	6	6	4	5	5	14	4	1	3	1	2	3			
POMACENTRIDAE	Plectroglyphidodon imparipennis															1	
POMACENTRIDAE	Plectroglyphidodon leucozona																obs
POMACENTRIDAE	Pomacentrus valuli														obs		
POMACENTRIDAE	Stegastes albifasciatus	7	14	9	24	12	28	37	11	3	8	14	6	22	22	25	6
POMACENTRIDAE	Stegastes lividus	obs	obs		obs		obs	obs									
POMACENTRIDAE	Stegastes nigricans	obs		obs	obs	obs	obs					obs			obs	2	
POMACENTRIDAE	Juvenile	obs	4	5	1	1	4	10	1	20	2		1		8	3	4
SCARIDAE	Scarus frontalis						obs	obs							4		
SCARIDAE	Scarus sordidus						obs				4						
SCARIDAE	Juvenile	obs	obs	obs	obs			obs	2	11			2	1	6	4	1
SIGANIDAE	Siganus spinus	obs															
SYNGNATHIDAE	Corythoichthys intestinalis								obs		obs						
SYNODONTIDAE	unidentified												obs				
TETRAODONTIDA	Canthigaster solandri						2	2	1	3		obs	1	2	3		
ZANCLIDAE	Zanclus cornutus						obs	obs						obs			
NO. FISH PER 100 SQ. M.		68	60	78	116	84	172	180	166	326	136	102	106	212	225	228	156
NO. FISH SPECIES		28	25	20	19	22	28	31	26	28	21	16	17	21	26	30	25

ANDERSEN SURVEY 8
SITE B WEST
TRAN LENGTH = 25M

		FLAT INNER ONE	FLAT INNER THREE	FLAT INNER FIVE	FLAT INNER SIX	FLAT INNER SEVEN	FLAT INNER EIGHT	FLAT MIDREEF ONE	FLAT MIDREEF THREE	FLAT MIDREEF FIVE	FLAT MIDREEF SIX	FLAT MIDREEF SEVEN	FLAT MIDREEF EIGHT
ACANTHURIDAE	Acanthurus guttatus												
ACANTHURIDAE	Acanthurus lineatus												
ACANTHURIDAE	Acanthurus nigrofuscus												
ACANTHURIDAE	Acanthurus nigroris												
ACANTHURIDAE	Acanthurus triostegus	obs	obs	obs		obs	obs		obs		obs		obs
ACANTHURIDAE	Acanthurus xanthopterus												obs
ACANTHURIDAE	Acanthurus juvenile												
ACANTHURIDAE	Naso lituratus												
ACANTHURIDAE	Zebrasoma flavescens												
ACANTHURIDAE	Zebrasoma veliferum												
APOGONIDAE	Apogon novemfasciatus												
BALISTIDAE	Rhinecanthus aculeatus			obs			1			obs			obs
BALISTIDAE	Rhinecanthus rectangulus									obs			
BLENNIIDAE	Salarias fasciatus												
BLENNIIDAE	unidentified	obs											
CHAETODONTIDA	Chaetodon auriga												
CHAETODONTIDA	Chaetodon citrinellus												
CHAETODONTIDA	Chaetodon ephippium												
CHAETODONTIDA	Chaetodon lunula												
CHAETODONTIDA	Chaetodon quadrimaculatus												
CHAETODONTIDA	Chaetodon reticulatus												
CHAETODONTIDA	Chaetodon trifascialis												
CHAETODONTIDA	Chaetodon trifasciatus												
DIODONTIDAE	Diodon hystrix												
GOBIIDAE	unidentified												
HOLOCENTRIDAE	Myripristis kuntee												
HOLOCENTRIDAE	Neoniphon sammara												
HOLOCENTRIDAE	Sargocentron diadema												
HOLOCENTRIDAE	Sargocentron spiniferum												
LABRIDAE	Cheilinus chlorurus												
LABRIDAE	Cheilinus trilobatus												
LABRIDAE	Coris aygula												
LABRIDAE	Epibulus insidiator												
LABRIDAE	Gomphosus varius												
LABRIDAE	Halichoeres hortulanus												
LABRIDAE	Halichoeres margaritaceus												
LABRIDAE	Halichoeres marginatus												
LABRIDAE	Halichoeres trimaculatus	obs		3	4	2	obs	obs		obs	4	obs	
LABRIDAE	Hemigymnus melapterus												
LABRIDAE	Labroides dimidiatus												
LABRIDAE	Stethojulis bandanensis					2				obs	obs		
LABRIDAE	Thalassoma hardwicki												
LABRIDAE	Thalassoma purpureum												
LABRIDAE	Thalassoma quinquevittata												
LABRIDAE	juvenile	obs		1				1				1	

ANDERSEN SURVEY 8
SITE B WEST
TRAN LENGTH = 25M

		FLAT INNER ONE	FLAT INNER THREE	FLAT INNER FIVE	FLAT INNER SIX	FLAT INNER SEVEN	FLAT INNER EIGHT	FLAT MIDREEF ONE	FLAT MIDREEF THREE	FLAT MIDREEF FIVE	FLAT MIDREEF SIX	FLAT MIDREEF SEVEN	FLAT MIDREEF EIGHT
LUTJANIDAE	Lutjanus monostigmus												
LUTJANIDAE	Lutjanus fulvus												
MUGILIDAE	Liza vaigiensis												
MULLIDAE	Mulloides flavolineatus						10						
MULLIDAE	Parupeneus bifasciatus												
MURAENIDAE	Gymnothorax javanicus												
MURAENIDAE	Sideria picta												
NEMIPTERIDAE	Scolopsis lineatus						obs						
POMACANTHIDAE	Pomacanthus imperator												
POMACENTRIDAE	Abudefduf septemfasciatus			obs		obs	obs	1			obs		obs
POMACENTRIDAE	Abudefduf sordidus	obs					obs						obs
POMACENTRIDAE	Amphiprion melanopus												
POMACENTRIDAE	Chrysiptera biocellata												
POMACENTRIDAE	Chrysiptera glauca	7	3	2	5	12	1	8	6	2	obs	6	3
POMACENTRIDAE	Chrysiptera leucopoma							1					
POMACENTRIDAE	Dascyllus aruanus												
POMACENTRIDAE	Plectroglyphidodon imparipennis												
POMACENTRIDAE	Plectroglyphidodon leucozona												
POMACENTRIDAE	Pomacentrus valuli												
POMACENTRIDAE	Stegastes albifasciatus												
POMACENTRIDAE	Stegastes lividus												
POMACENTRIDAE	Stegastes nigricans												
POMACENTRIDAE	juvenile		1							obs	1	1	
SCARIDAE	Scarus frontalis												
SCARIDAE	Scarus sordidus												
SCARIDAE	juvenile												
SIGANIDAE	Siganus spinus												
SYNGNATHIDAE	Corythoichthys intestinalis												
SYNODONTIDAE	unidentified											obs	
TETRAODONTIDA	Canthigaster solandri						obs						
ZANCLIDAE	Zanclus cornutus												
NO. FISH PER 100 SQ. M.		14	8	12	18	32	24	22	12	4	10	16	6
NO. FISH SPECIES		6	3	6	2	5	9	5	2	6	6	5	6

ANDERSEN SURVEY 8
SITE C
TRAN LENGTH = 25M

		SITE C													
		GROOVE													
		INNER ONE	INNER TWO	INNER THREE	INNER FOUR	INNER SIX	INNER SEVEN	INNER EIGHT	MIDREEF ONE	MIDREEF TWO	MIDREEF THREE	MIDREEF FOUR	MIDREEF SIX	MIDREEF SEVEN	MIDREEF EIGHT
ACANTHURIDAE	Acanthurus lineatus														
ACANTHURIDAE	Acanthurus nigrofuscus									1					
ACANTHURIDAE	Acanthurus triostegus	3	1	obs	obs		2	obs	13	2	2	obs	obs	obs	obs
ACANTHURIDAE	Ctenochaetus striatus														
ACANTHURIDAE	Naso unicornis								obs						
ACANTHURIDAE	Naso juvenile									obs					
ACANTHURIDAE	Zebrasoma flavescens														
ACANTHURIDAE	juvenile										obs				
APOGONIDAE	Apogon novemfasciatus														
ATHERINIDAE	unidentified							obs							
BALISTIDAE	Rhinecanthus aculeatus														
BLENNIIDAE	Salarias fasciatus									obs		obs			
CARANGIDAE	Carenx melampygus													obs	
CHAETODONTIDA	Chaetodon auriga							obs			2				obs
CHAETODONTIDA	Chaetodon citrinellus				obs				1	1	obs		obs		
CHAETODONTIDA	Chaetodon ephippium										obs				
CHAETODONTIDA	Chaetodon lunula	obs													
CHAETODONTIDA	Chaetodon ornatissimus														
CHAETODONTIDA	Chaetodon reticulatus								1						
CHAETODONTIDA	Chaetodon trifasciatis														
FISTULARIIDAE	Fistularia commersonii	obs												2	obs
GOBIIDAE	Valenciennea strigata														
GOBIIDAE	unidentified						obs								
GRAMMISTIDAE	Grammistes sexlineatus														
HEMIRHAMPHIDA	unidentified														
HOLOCENTRIDAE	Myripristis kuntee														
HOLOCENTRIDAE	Neoniphon sammara														
HOLOCENTRIDAE	Sargocentron diadema														
LABRIDAE	Cheilinus trilobatus														
LABRIDAE	Epibulus insidiator														
LABRIDAE	Gomphosus varius														
LABRIDAE	Hallchoeres hortulanus														
LABRIDAE	Hallchoeres margaritaceus			obs					obs	obs			obs	4	obs
LABRIDAE	Hallchoeres marginatus									1	1	1			
LABRIDAE	Hallchoeres trimaculatus	4	7	3	obs	obs	3	1	5	7		obs	obs	1	3
LABRIDAE	Hemigymnus melapterus								obs	2	obs				
LABRIDAE	Labroides dimidiatus														
LABRIDAE	Novaculichthys taeniourus														
LABRIDAE	Stethojulis bandanensis	1	5	2	obs				2	1	obs	obs	obs	obs	obs
LABRIDAE	Thalassoma hardwicki	obs							obs	2	3				
LABRIDAE	juvenile	4	1	2			obs		4	8	5	obs			
LETHRINIDAE	Gnathodentex aurolineatus														
LETHRINIDAE	Lethrinus harak											obs		obs	obs
LUTJANIDAE	Lutjanus fulvus														

ANDERSEN SURVEY 8
SITE C
TRAN LENGTH = 25M

		SITE C													
		GROOVE													
		INNER ONE	INNER TWO	INNER THREE	INNER FOUR	INNER SIX	INNER SEVEN	INNER EIGHT	MIDREEF ONE	MIDREEF TWO	MIDREEF THREE	MIDREEF FOUR	MIDREEF SIX	MIDREEF SEVEN	MIDREEF EIGHT
MUGILIDAE	Liza vaigiensis														
MULLIDAE	Mulloides flavolineatus														1
MULLIDAE	Parupeneus barberinus														
MULLIDAE	Parupeneus bifasciatus														
MULLIDAE	Parupeneus multifasciatus														obs
MURAENIDAE	Siderla picta														
NEMIPTERIDAE	Scolopsis lineatus														
OSTRACIDAE	Ostracion cubicus														
PINGUIPEDIDAE	Parapercis sp.							obs				obs			
POMACANTHIDAE	Pomacanthus imperator														
POMACENTRIDAE	Abudefduf septemfasciatus					obs					obs				
POMACENTRIDAE	Abudefduf sexfasciatus														
POMACENTRIDAE	Abudefduf sordidus							obs							
POMACENTRIDAE	Abudefduf vaigiensis														
POMACENTRIDAE	Amphiprion chrysopterus														
POMACENTRIDAE	Amphiprion melanopus								obs	2	2				
POMACENTRIDAE	Chrysiptera biocellata		2						obs	1					
POMACENTRIDAE	Chrysiptera glauca	42	39	16	obs	1	6	5	30	40	17		4	6	1
POMACENTRIDAE	Chrysiptera leucopoma		2	2		2	obs		obs		1	2	6	9	
POMACENTRIDAE	Dascyllus aruanus														
POMACENTRIDAE	Plectroglyphidodon imparipennis														
POMACENTRIDAE	Pomacentrus valuli														
POMACENTRIDAE	Stegastes albifasciatus		4	15					9	10	20				
POMACENTRIDAE	Stegastes lividus														
POMACENTRIDAE	Stegastes nigricans														
POMACENTRIDAE	juvenile		1	1			1								
SCARIDAE	Scarus frontalis														
SCARIDAE	juvenile								1	5	6				
SERRANIDAE	Epinephelus merra														
SIGANIDAE	Siganus spinus	obs									12				
TETRAODONTIDA	Arothron nigropunctatus														
TETRAODONTIDA	Canthigaster bennetti	obs													
TETRAODONTIDA	Canthigaster solandri	2	2	obs			obs	1	obs	1	obs				
ZANCLIDAE	Zanclus cornutus											obs			
NO. FISH PER 100 SQ. M.		112	126	62	0	6	24	10	132	168	142	6	20	44	10
NO. FISH SPECIES		11	10	10	5	4	6	6	17	16	16	10	7	9	10

ANDERSEN SURVEY 8
SITE C
TRAN LENGTH = 25M

FLAT

		INNER ONE	INNER TWO	INNER THREE	INNER FOUR	INNER SIX	INNER SEVEN	INNER EIGHT	MIDREEF ONE	MIDREEF TWO	MIDREEF THREE	MIDREEF FOUR	MIDREEF SIX	MIDREEF SEVEN	MIDREEF EIGHT
ACANTHURIDAE	Acanthurus lineatus														
ACANTHURIDAE	Acanthurus nigrofuscus									obs				obs	
ACANTHURIDAE	Acanthurus triostegus	5	obs		obs	obs	1			obs		1	1	5	obs
ACANTHURIDAE	Ctenochaetus striatus														
ACANTHURIDAE	Naso unicornis														
ACANTHURIDAE	Naso juvenile														
ACANTHURIDAE	Zebrasoma flavescens														obs
ACANTHURIDAE	juvenile														
APOGONIDAE	Apogon novemfasciatus	obs													
ATHERINIDAE	unidentified														
BALISTIDAE	Rhinecanthus aculeatus			obs			1	obs	obs						
BLENNIIDAE	Salarias fasciatus														1
CARANGIDAE	Caranx melampygus	obs						obs							
CHAETODONTIDA	Chaetodon auriga				obs			1						obs	obs
CHAETODONTIDA	Chaetodon citrinellus	obs	obs							obs	1		obs		obs
CHAETODONTIDA	Chaetodon ephippium														
CHAETODONTIDA	Chaetodon lunula	obs		obs											
CHAETODONTIDA	Chaetodon ornatissimus														
CHAETODONTIDA	Chaetodon reticulatus														
CHAETODONTIDA	Chaetodon trifascialis														
FISTULARIIDAE	Fistularia commersonii	1						1							
GOBIIDAE	Valenciennea strigata														obs
GOBIIDAE	unidentified														
GRAMMISTIDAE	Grammistes sexlineatus	obs													
HEMIRHAMPHIDA	unidentified											obs			
HOLOCENTRIDAE	Myripristis kuntee														
HOLOCENTRIDAE	Neoniphon sammara														
HOLOCENTRIDAE	Sargocentron diadema														
LABRIDAE	Cheilinus trilobatus														
LABRIDAE	Epibulus insidiator														
LABRIDAE	Gomphosus varius												obs	1	obs
LABRIDAE	Halichoeres hortulanus														1
LABRIDAE	Halichoeres margaritaceus		1					obs	obs	obs	9	obs	obs	obs	2
LABRIDAE	Halichoeres marginatus														
LABRIDAE	Halichoeres trimaculatus	obs	3	obs	obs	10	15	1	obs	obs	5			11	2
LABRIDAE	Hemigymnus melapterus											1	1		obs
LABRIDAE	Labroides dimidiatus														
LABRIDAE	Novaculichthys taeniourus													obs	
LABRIDAE	Stethojulis bandanensis	obs	obs	obs	obs	4	1	3		obs	1	obs	6	9	1
LABRIDAE	Thalassoma hardwicki				obs			1				obs		1	2
LABRIDAE	juvenile	obs	1		obs	1				obs		3	1		
LETHRINIDAE	Gnathodentex aurolineatus														
LETHRINIDAE	Lethrinus harak												obs		
LUTJANIDAE	Lutjanus fulvus														

ANDERSEN SURVEY 8
SITE C
TRAN LENGTH = 25M

		FLAT													
		INNER ONE	INNER TWO	INNER THREE	INNER FOUR	INNER SIX	INNER SEVEN	INNER EIGHT	MIDREEF ONE	MIDREEF TWO	MIDREEF THREE	MIDREEF FOUR	MIDREEF SIX	MIDREEF SEVEN	MIDREEF EIGHT
MUGILIDAE	Liza valigienis													obs	
MULLIDAE	Mulloides flavolineatus														obs
MULLIDAE	Parupeneus barberinus														
MULLIDAE	Parupeneus bifasciatus						obs							obs	
MULLIDAE	Parupeneus multifasciatus														
MURAENIDAE	Sideria picta						obs								
NEMIPTERIDAE	Scolopsis lineatus														
OSTRACIDAE	Ostracion cubicus														
PINGUIPEDIDAE	Parapercis sp.														
POMACANTHIDAE	Pomacanthus imperator														
POMACENTRIDAE	Abudefduf septemfasciatus														
POMACENTRIDAE	Abudefduf sexfasciatus														
POMACENTRIDAE	Abudefduf sordidus														
POMACENTRIDAE	Abudefduf valigienis														
POMACENTRIDAE	Amphiprion chrysopterus	obs													
POMACENTRIDAE	Amphiprion melanopus							1				2	1	4	4
POMACENTRIDAE	Chrysiptera biocellata				2			1			obs			obs	
POMACENTRIDAE	Chrysiptera glauca	8	4	4	5	9	65	11	2	obs	4	8	6	34	53
POMACENTRIDAE	Chrysiptera leucopoma					2	1		obs	obs	5		3	3	
POMACENTRIDAE	Dascyllus aruanus														
POMACENTRIDAE	Plectroglyphidodon imparipennis								obs						
POMACENTRIDAE	Pomacentrus valuli													1	
POMACENTRIDAE	Stegastes albifasciatus				7	7	7	12				14	15	22	15
POMACENTRIDAE	Stegastes lividus														
POMACENTRIDAE	Stegastes nigricans														
POMACENTRIDAE	juvenile		obs	1						obs					
SCARIDAE	Scarus frontalis														obs
SCARIDAE	juvenile											obs			25
SERRANIDAE	Epinephelus merra														
SIGANIDAE	Siganus spinus										obs				
TETRAODONTIDA	Arothron nigropunctatus														
TETRAODONTIDA	Canthigaster bennetti														
TETRAODONTIDA	Canthigaster solandri	obs	obs			obs	obs	3		obs		obs			2
ZANCLIDAE	Zanclus cornutus														
NO. FISH PER 100 SQ. M.		26	18	10	28	66	178	70	4	0	50	58	68	182	216
NO. FISH SPECIES		13	9	6	9	8	10	13	6	11	8	12	12	17	20

ANDERSEN SURVEY 8
SITE D
TRAN LENGTH = 25 M

		WEST									
		INNER ONE	INNER TWO	INNER THREE	INNER FIVE	INNER SEVEN	INNER EIGHT	MIDREEF ONE	MIDREEF THREE	MIDREEF FIVE	MIDREEF EIGHT
ACANTHURIDAE	Acanthurus guttatus							obs	10	3	
ACANTHURIDAE	Acanthurus lineatus							1	obs	1	obs
ACANTHURIDAE	Acanthurus nigroris			obs	obs			1	10		8
ACANTHURIDAE	Acanthurus nigrofuscus								4		4
ACANTHURIDAE	Acanthurus triostegus	6	2	3	4	2	1	7	8	4	2
ACANTHURIDAE	Acanthurus juvenile										
ACANTHURIDAE	Naso lituratus							obs		obs	
APOGONIDAE	Apogon novemfasciatus										
BALISTIDAE	Rhinecanthus aculeatus							obs		obs	
BALISTIDAE	Rhinecanthus rectangulus			1				obs			
BLENNIIDAE	Salarias fasciatus										
BLENNIIDAE	unidentified										
BOTHIDAE	Bothus sp.									obs	
CARANGIDAE	Caranx melampygus					OBS					
CHAETODONTIDA	Chaetodon auriga							obs		obs	1
CHAETODONTIDA	Chaetodon citrinellus			2				obs			2
CHAETODONTIDA	Chaetodon ephippium							obs			
CHAETODONTIDA	Chaetodon lunula									obs	
CHAETODONTIDA	Chaetodon quadrimaculatus										
CHAETODONTIDA	Heniochus monoceros										
CIRRHITIDAE	Cirrhitus pinnulatus							obs			
FISTULARIIDAE	Fistularia commersonii	obs									
GERREIDAE	Gerres argyreus										
GRAMMISTIDAE	Grammistes sexlineatus										
HOLOCENTRIDAE	Myripristis kuntee								obs		
HOLOCENTRIDAE	Neoniphon sammara							1	4	obs	1
HOLOCENTRIDAE	Sargocentron tiere										
KUHLIIDAE	Kuhlia mugil								obs		
KYPHOSIDAE	Kyphosus cinerascens								obs		
LABRIDAE	Anampses caeruleopunctatus									obs	
LABRIDAE	Coris aygula									obs	
LABRIDAE	Coris gaimard										
LABRIDAE	Gomphosus varius										
LABRIDAE	Halichoeres hortulanus							1	2	obs	
LABRIDAE	Halichoeres margaritaceus	1	3	3		2	1	10	2	2	3
LABRIDAE	Halichoeres marginatus							obs	obs	obs	
LABRIDAE	Halichoeres trimaculatus	4	1	7	4	6	4			4	
LABRIDAE	Labroides dimidiatus							1	obs	obs	obs
LABRIDAE	Novaculichthys taeniourus			obs							
LABRIDAE	Stethojulis bandanensis	obs	4	24			8	5	2	1	obs
LABRIDAE	Thalassoma hardwicki										
LABRIDAE	Thalassoma lutescens										
LABRIDAE	Thalassoma purpureum							obs			
LABRIDAE	Thalassoma quinquevittatum								obs		13
LABRIDAE	juvenile	2	5	1	obs		3		obs	3	

ANDERSEN SURVEY 8
SITE D
TRAN LENGTH = 25 M

		WEST									
		INNER ONE	INNER TWO	INNER THREE	INNER FIVE	INNER SEVEN	INNER EIGHT	MIDREEF ONE	MIDREEF THREE	MIDREEF FIVE	MIDREEF EIGHT
LUTJANIDAE	Lutjanus fulvus									1	
LUTJANIDAE	Lutjanus monostigmus										
MUGILIDAE	Liza vaigiensis										
MUGILIDAE	Valamugil engeli										
MULLIDAE	Mulloides flavolineatus										
MULLIDAE	Parupeneus bifasciatus							2	2	1	5
NEMIPTERIDAE	Scolopsis lineatus							2	obs	obs	2
MURAENIDAE	Sideria picta										
PINGUIPEDIDAE	Parapercis sp.			1				obs			
POLYNEMIDAE	Polydactylus sexfilis										
POMACANTHIDAE	Pomacanthus imperator					1					
POMACENTRIDAE	Abudefduf septemfasciatus		obs	obs	obs		1	obs		obs	obs
POMACENTRIDAE	Abudefduf sordidus										
POMACENTRIDAE	Amphiprion melanopus							2	8	obs	4
POMACENTRIDAE	Chrysiptera glauca	59	51	55	15	30	10	20	60	7	55
POMACENTRIDAE	Chrysiptera leucopoma		1	11	obs		1	8	40	9	10
POMACENTRIDAE	Dascyllus aruanus										
POMACENTRIDAE	Dascyllus trimaculatus							obs	2		2
POMACENTRIDAE	Plectroglyphidodon dickii							obs	obs	obs	
POMACENTRIDAE	Plectroglyphidodon imparipennis							1	obs		
POMACENTRIDAE	Plectroglyphidodon leucozona							3	8	3	
POMACENTRIDAE	Stegastes albifasciatus		1					1	4	4	2
POMACENTRIDAE	Stegastes fasciolatus							4	8		
POMACENTRIDAE	Stegastes nigricans										
POMACENTRIDAE	juvenile										
SCARIDAE	Scarus frontalis										1
SCARIDAE	juvenile										
SIGANIDAE	Siganus spinus										
TETRAODONTIDAE	Canthigaster amboinensis							1			
TETRAODONTIDAE	Canthigaster solandri										
ZANCLIDAE	Zanclus cornutus										
NO. FISH PER 100 SQ. M.		144	136	216	46	82	58	142	348	86	230
NO. FISH SPECIES		7	9	13	7	6	8	32	27	28	20

ANDERSEN SURVEY 8
SITE D
TRAN LENGTH = 25 M

		SITE D								
		EAST								
		INNER ONE	INNER TWO	INNER THREE	INNER FIVE	INNER SEVEN	INNER EIGHT	MIDREEF ONE	MIDREEF THREE	MIDREEF FIVE
ACANTHURIDAE	Acanthurus guttatus							obs	obs	
ACANTHURIDAE	Acanthurus lineatus				obs		obs		obs	
ACANTHURIDAE	Acanthurus nigroris		2	obs	obs	obs	obs	12	10	8
ACANTHURIDAE	Acanthurus nigrofuscus			obs	obs					
ACANTHURIDAE	Acanthurus triostegus	9	2	7	3	4	2	4	1	4
ACANTHURIDAE	Acanthurus juvenile									
ACANTHURIDAE	Naso lituratus									
APOGONIDAE	Apogon novemfasciatus							obs		
BALISTIDAE	Rhinecanthus aculeatus									
BALISTIDAE	Rhinecanthus rectangulus									
BLENNIIDAE	Salarias fasciatus									
BLENNIIDAE	unidentified	obs						1		
BOTHIDAE	Bothus sp.									
CARANGIDAE	Caranx melampygus									
CHAETODONTIDA	Chaetodon auriga					obs				
CHAETODONTIDA	Chaetodon citrinellus	1	2	2	obs	obs				
CHAETODONTIDA	Chaetodon ephippium									
CHAETODONTIDA	Chaetodon lunula		obs	2		obs	obs			
CHAETODONTIDA	Chaetodon quadrimaculatus									
CHAETODONTIDA	Heniochus monoceros									
CIRRHITIDAE	Cirrhitus pinnulatus									
FISTULARIIDAE	Fistularia commersonii									
GERREIDAE	Gerres argyreus			1					obs	
GRAMMISTIDAE	Grammistes sexlineatus									
HOLOCENTRIDAE	Myripristis kuntee									
HOLOCENTRIDAE	Neoniphon sammara									
HOLOCENTRIDAE	Sargocentron tiere									
KUHLIIDAE	Kuhlia mugil									
KYPHOSIDAE	Kyphosus cinerascens			obs			1			
LABRIDAE	Anampses caeruleopunctatus									
LABRIDAE	Coris aygula	obs								
LABRIDAE	Coris gaimard									
LABRIDAE	Gomphosus varius	obs								
LABRIDAE	Hallchoeres hortulanus	obs		1	obs					
LABRIDAE	Hallchoeres margaritaceus	2	9	10	obs	9		5	12	8
LABRIDAE	Hallchoeres marginatus		1		obs		1			2
LABRIDAE	Hallchoeres trimaculatus	6	8	21	7	22	14			
LABRIDAE	Labroides dimidiatus	obs		1						
LABRIDAE	Novaculichthys taeniourus									
LABRIDAE	Stethojulis bandanensis	23	7	14	obs	8	7	8	9	
LABRIDAE	Thalassoma hardwickii						1			
LABRIDAE	Thalassoma lutescens									
LABRIDAE	Thalassoma purpureum									
LABRIDAE	Thalassoma quinquevittatum							obs	1	
LABRIDAE	juvenile	13	9	1	1		5	18		

ANDERSEN SURVEY 8
SITE D
TRAN LENGTH = 25 M

		SITE D								
			EAST							
		INNER ONE	INNER TWO	INNER THREE	INNER FIVE	INNER SEVEN	INNER EIGHT	MIDREEF ONE	MIDREEF THREE	MIDREEF FIVE
LUTJANIDAE	Lutjanus fulvus									
LUTJANIDAE	Lutjanus monostigmus									
MUGILIDAE	Liza vaigiensis			obs					10	
MUGILIDAE	Valamugil engeli									
MULLIDAE	Mulloides flavolineatus									
MULLIDAE	Parupeneus bifasciatus		1			obs				
NEMIPTERIDAE	Scolopsis lineatus	obs	obs			obs	obs			
MURAENIDAE	Siderla picta			obs						
PINGUIPEDIDAE	Parapercis sp.			1						
POLYNEMIDAE	Polydactylus sexfilis								obs	
POMACANTHIDAE	Pomacanthus imperator									
POMACENTRIDAE	Abudefduf septemfasciatus		obs	1	obs	obs	obs			1
POMACENTRIDAE	Abudefduf sordidus		obs			obs			obs	
POMACENTRIDAE	Amphiprion melanopus		1		obs	obs	6	5	2	8
POMACENTRIDAE	Chrysiptera glauca	212	144	169	102	127	106	7	10	5
POMACENTRIDAE	Chrysiptera leucopoma	obs	1	1	obs	obs	2	17	27	4
POMACENTRIDAE	Dascyllus aruanus						1			
POMACENTRIDAE	Dascyllus trimaculatus									
POMACENTRIDAE	Plectroglyphidodon dickii									
POMACENTRIDAE	Plectroglyphidodon imparipe	obs								
POMACENTRIDAE	Plectroglyphidodon leucozona		obs				obs	13	10	10
POMACENTRIDAE	Stegastes albifasciatus	14	12	8	6	9	5	2	1	
POMACENTRIDAE	Stegastes fasciolatus				obs	obs		2		
POMACENTRIDAE	Stegastes nigricans									
POMACENTRIDAE	juvenile									
SCARIDAE	Scarus frontalis									
SCARIDAE	juvenile			obs	1				2	
SIGANIDAE	Siganus spinus			2						
TETRAODONTIDA	Canthigaster amboinensis							obs		
TETRAODONTIDA	Canthigaster solandri									
ZANCLIDAE	Zanclus cornutus									
NO. FISH PER 100 SQ. M.		560	398	484	240	358	302	188	190	100
NO. FISH SPECIES		16	18	22	18	17	18	16	17	9

ANDERSEN SURVEY 8
SITE E
TRAN LENGTH = 25 M

		SITE E									
		WEST					EAST				
		INNER ONE	INNER TWO	INNER THREE	INNER FIVE	INNER EIGHT	INNER ONE	INNER TWO	INNER THREE	INNER FIVE	INNER EIGHT
ACANTHURIDAE	Acanthurus guttatus		obs	1							
ACANTHURIDAE	Acanthurus lineatus	obs			obs		obs	obs		obs	obs
ACANTHURIDAE	Acanthurus nigroris	obs	obs	obs		obs		1	7	4	1
ACANTHURIDAE	Acanthurus nigrofuscus						obs			2	
ACANTHURIDAE	Acanthurus triostegus	20	17	4	3	11	8	11	7	14	6
ACANTHURIDAE	Acanthurus juvenile								obs		
ACANTHURIDAE	Naso lituratus										
APOGONIDAE	Apogon novemfasciatus	obs	obs								
BALISTIDAE	Rhinecanthus aculeatus										
BALISTIDAE	Rhinecanthus rectangulus		obs	1					obs		
BLENNIIDAE	Salarias fasciatus						obs				
BLENNIIDAE	unidentified						4				
BOTHIDAE	Bothus sp.										
CARANGIDAE	Caranx melampygus		obs								
CHAETODONTIDA	Chaetodon auriga			obs	obs		1	1	3	obs	1
CHAETODONTIDA	Chaetodon citrinellus	3	1	1		obs	3		3	2	obs
CHAETODONTIDA	Chaetodon ephippium										
CHAETODONTIDA	Chaetodon lunula	1	1	1			obs	1	7	2	5
CHAETODONTIDA	Chaetodon quadrimaculatus	obs									
CHAETODONTIDA	Heniochus monoceros									obs	
CIRRHITIDAE	Cirrhitus pinnulatus										
FISTULARIIDAE	Fistularia commersonii						obs				
GERREIDAE	Gerres argyreus										obs
GRAMMISTIDAE	Grammistes sexlineatus	obs					obs				
HOLOCENTRIDAE	Myripristis kuntee						obs				
HOLOCENTRIDAE	Neoniphon sammara						obs				
HOLOCENTRIDAE	Sargocentron tiere						obs				
KUHLIIDAE	Kuhlia mugil										
KYPHOSIDAE	Kyphosus cinerascens										
LABRIDAE	Anampses caeruleopunctatus										
LABRIDAE	Coris aygula					2		obs			1
LABRIDAE	Coris gaimard						1				
LABRIDAE	Gomphosus varius										
LABRIDAE	Halichoeres hortulanus						1	obs		obs	obs
LABRIDAE	Halichoeres margaritaceus	obs	3	20	10	3	3	obs	4	3	1
LABRIDAE	Halichoeres marginatus			3	4	3	1	1		obs	1
LABRIDAE	Halichoeres trimaculatus	1	1	14	3	23	2	4	6	4	19
LABRIDAE	Labroides dimidiatus										
LABRIDAE	Novaculichthys taeniourus						1		1		
LABRIDAE	Stethojulis bandanensis		2	17	obs	10	7	2	5	5	25
LABRIDAE	Thalassoma hardwickii		obs		1	1	obs	1			
LABRIDAE	Thalassoma lutescens							1			
LABRIDAE	Thalassoma purpureum										
LABRIDAE	Thalassoma quinquevittatum										
LABRIDAE	juvenile	17			6	3	6		1		1

ANDERSEN SURVEY 8

SITE E

TRAN LENGTH = 25 M

		SITE E									
		WEST					EAST				
		INNER ONE	INNER TWO	INNER THREE	INNER FIVE	INNER EIGHT	INNER ONE	INNER TWO	INNER THREE	INNER FIVE	INNER EIGHT
LUTJANIDAE	Lutjanus fulvus		1							obs	
LUTJANIDAE	Lutjanus monostigmus									obs	obs
MUGILIDAE	Liza vaigiensis									4	
MUGILIDAE	Valamugil engeli							obs			
MULLIDAE	Mulloides flavolineatus				obs					obs	
MULLIDAE	Parupeneus bifasciatus	obs				obs	obs	1			2
NEMIPTERIDAE	Scolopsis lineatus			4		1	obs	1	obs	obs	1
MURAENIDAE	Sideria picta										
PINGUIPEDIDAE	Parapercis sp.										1
POLYNEMIDAE	Polydactylus sexfilis										
POMACANTHIDAE	Pomacanthus imperator				1			obs			1
POMACENTRIDAE	Abudefduf septemfasciatus			obs			obs	2	15	10	1
POMACENTRIDAE	Abudefduf sordidus	obs						obs	obs		obs
POMACENTRIDAE	Amphiprion melanopus										
POMACENTRIDAE	Chrysiptera glauca	139	46	64	78	86	72	13	46	62	48
POMACENTRIDAE	Chrysiptera leucopoma	22	8	36	15	13	4	2	4	obs	5
POMACENTRIDAE	Dascyllus aruanus										
POMACENTRIDAE	Dascyllus trimaculatus										
POMACENTRIDAE	Plectroglyphidodon dickii										
POMACENTRIDAE	Plectroglyphidodon imparipennl	obs									
POMACENTRIDAE	Plectroglyphidodon leucozona	19	obs	3	6	13	obs		obs		
POMACENTRIDAE	Stegastes albifasciatus	1	1	2	3	3	2	1	3	obs	
POMACENTRIDAE	Stegastes fasciolatus									obs	
POMACENTRIDAE	Stegastes nigricans	2					obs				
POMACENTRIDAE	juvenile		1								1
SCARIDAE	Scarus frontalis							4			
SCARIDAE	juvenile	20				obs	19		obs		6
SIGANIDAE	Siganus spinus			obs				obs	8		
TETRAODONTIDAE	Canthigaster amboinensis			obs		obs		1			
TETRAODONTIDAE	Canthigaster solandri		2			obs		1			2
ZANCLIDAE	Zanclus cornutus									obs	obs
NO. FISH PER 100 SQ. M.		490	168	342	260	344	270	98	240	224	258
NO. FISH SPECIES		20	19	19	15	19	31	26	21	24	27

SUMMARY AND CONCLUSIONS

This final report presents the survey results of eight biological surveys carried out in the Andersen Air Force Base Marine Resources Preserve between June 1993 and October 1995 by personnel from the University of Guam Marine Laboratory. The marine communities within the Preserve are rich in species of marine plants, corals, conspicuous macroinvertebrates, and fishes. The survey results illustrate the normal range of variation in species composition and abundance in these marine communities over a 28-month period. This data set provides a baseline assessment of these marine communities against which future changes can be measured. In terms of the total amount of data assembled, this survey is perhaps the most comprehensive quantitative marine biological assessment thus far carried out on Guam. The survey project had three purposes, each of which will be summarized and evaluated below.

The three purposes of the survey were as follows:

1) To provide an inventory of the marine organisms present within the Andersen Air Force Base Marine Resources Preserve,

2) To serve as a baseline assessment of the abundance and diversity of marine communities within the preserve so that follow-up surveys could be performed to determine whether significant ecological changes have occurred over time, and

3) To provide information on the marine communities within the preserve for the development of interpretive programs for the public.

Inventory of Marine Organisms

At each of the eight field surveys carried out during the project, quantitative surveys were made of marine plants, reef corals, conspicuous macroinvertebrates (primarily echinoderms, mollusks, and crustaceans), and fishes. These are the biological groups which typically dominate in coral reef communities, and they were the dominant organisms within the Marine Resources Preserve.

Table 1 lists the 73 species of marine plants observed in the Preserve. This is one-third of the total number of marine plant species (220) recorded from Guam, and is nearly half again as many as have been recorded from Tumon Bay (55) (Amesbury et al., 1993). Clearly the Marine Resources Preserve is rich in marine plant species.

Thirty-nine species of corals are recorded from the Preserve (Table 2). This is only 13% of the approximately 300 species of corals recorded from Guam. However, there no doubt are more species within the Preserve which did not happen to be included within the point-quarter surveys; this survey technique is designed primarily as a method for determining coral density

rather than species diversity. Surveys in Tumon Bay (Amesbury et al., 1993) indicated the presence of 81 species of coral on that reef.

Some 35 species of macroinvertebrates were recorded within the Preserve (Table 3). This is a rather modest number, but the majority of shallow-water marine invertebrates are cryptic or nocturnal, and so we have undoubtedly missed many species during our surveys. Only 25 macroinvertebrate species were observed during surveys in Tumon Bay (Amesbury et al., 1993).

Fish were extremely diverse within the Preserve, and we recorded some 221 species in 40 families (Table 4). This is approximately 25% of the total recorded fish fauna from Guam and undoubtedly underestimates the diversity of some cryptic groups.

Baseline Assessment of Marine Communities within the Preserve

In order to serve as a useful baseline assessment against which future survey results can be compared, the variability within the marine community needs to be considered. Sources of variability include both natural variability in the abundance of different species but also variability which results from the survey methodology used. Variability for each of the four major groups is discussed here.

Plants

Marine plant abundance can fluctuate in response to a number of environmental variables including seasonal variations in sunlight intensity, concentrations of dissolved nutrients (which can be influenced by seasonal rainfall patterns), grazing by herbivorous fishes and invertebrates, water turbulence (which, during very rough conditions, can tear seaweeds loose from their attachments to the reef and carry them away), and tidal exposure (particularly during the summer when extremely low midday tides can kill shallow attached plants.

During the time period during which these surveys were carried out (May 1993 - October 1995), variations in all these factors occurred and influenced variations in marine plant abundance.

During the spring of 1994, there was a strong island-wide run of rabbitfish (Siganidae). The young of these fish recruit to the reef seasonally, and when the run of young rabbitfish is heavy, they can significantly affect the standing stock of edible attached algae.

Freshwater intrusion on the reef areas under study is primarily from the groundwater leaking out of the subsurface water lens at sea level. There are many areas within the Preserve where freshwater emerges, and with the freshwater come dissolved nutrients which may stimulate marine plant growth. There are variations in the concentrations of nutrient materials in Guam's groundwater and variations in the rate at which groundwater intrudes into the inshore surface marine waters. Some variability in marine plant standing stock can be attributed to these nutrient variations, but this source of variability is much less than that which occurs in southern Guam where impermeable volcanic rocks resist the formation of an underground freshwater lens, and

TABLE 3. INVERTEBRATES OBSERVED IN THE ANDERSEN MARINE RESOURCES PRESERVE

CNIDARIA (JELLYFISH & RELATIVES)
Heteractis sp.
MOLLUSCA (SNAILS & RELATIVES)
Cerithium nodulosum
Chichoreus sp.
Conus cattus
C. ebraeus
C. flavida
C. leopardus/pulicarius
C. sponsalis
Conus sp.
Cypraea moneta
Dendropoma sp.
Drupa (purple)
Mitre stitica
Morula sp.
Nudibranch
Octopus
Thais tuberosa
Tridacna maxima
Vasum turbinellus

CRUSTACEA (CRABS & RELATIVES)
Aectodes sp.
Dardanus sp.
ECHINODERMS (SEA CUCUMBERS & RELATIVES)
Actinopyga echinites
Bohadschia argus
Diadema sp.
Echinothrix diadema
Euapta godffroyi
Holothuria atra
H. cinerascens
H. hilla
H. leucospilota
H. pervicax
Linckia multifora
Ophiuroid
Stichopus chloronotus
Synapta maculata

TABLE 2. CORALS OBSERVED IN THE ANDERSEN MARINE RESOURCES PRESERVE

POCILLOPORIDAE
Pocillopora damicornis
Pocillopora meandrina
Pocillopora setchelli
Pocillopora verrucosa
ACROPORIDAE
Acropora aspera
Acropora digitifera
Acropora formosa
Acropora nasuta
Acropora palifera
Acropora surculosa
Acropora valida
Acropora variabilis
Acropora sp.
Acropora sp. 3
Montipora ehrenbergii
Montipora sp.
PORITIDAE
Porites annae
Porites lichen
Porites superfusa
Porites (encrusting)
Porites sp.

SIDERASTREIDAE
Psammocora contigua
Psammocora obtusangula
Psammocora sp.
AGARICIIDAE
Pachyseris speciosa
Pavona varians
FAVIIDAE
Favia favus
Favia matthaii
Favia pallida
Favia stelligera
Favia sp.
Favites abdita
Favites russelli
Goniastrea retiformis
Leptastrea purpurea
Leptoria phrygia
Platygyra pini
Cyphastrea chalcidium
HELIOPORIDAE
Heliopora coerula

TABLE 1. MARINE PLANTS OBSERVED IN THE ANDERSEN MARINE RESOURCES PRESERVE

CYANOPHYTA (BLUE-GREEN ALGAE)
Hormothamnion enteromorphoides
Microcoleus sp.
Schizothrix calcicola
S. mexicana
CHLOROPHYTA (GREEN ALGAE)
Enteromorpha clathrata
Caulerpa brachipus
C. cupressoides
C. racemosa
C. serrulata
C. sertularioides
C. taxifolia
C. urviliana
C. webbiana
Caulerpa sp.
Avrainvillea obscura
Chlorodesmis fastigiata
Chlorodesmis sp.
Codium arabicum
Halimeda incrassata
H. macroloba
H. opuntia
Rhipilia sinuosa
Tydemania sp.
Udotea argentea
U. geppii
Boodlea composita
Boergesenia forbesii
Dictyosphaeria cavernosa
D. verslunsii
Dictyosphaeria sp.
Valonia ventricosa
Acetabularia moebii
Neomeris annulata
Microdictyon sp.
Chaetomorpha crassa
Cladophora sp.

PHAEOPHYTA (BROWN ALGAE)
Sphacelaria tribuloides
Sphacelaria sp.
Dictyota bartayresii
D. divaricata
Padina boryana
P. borynan (var. vaughaniella)
Turbinaria ornata
RHODOPHYTA (RED ALGAE)
Asperigopsis taxiformis
Actinotrichia fragilis
Galaxaura oblongata
Gelidiella acerosa
Gelidium sp.
Liagora sp.
Amphiroa fragilissima
Hydrolithon reinboldii
Jania capillacea
Jania sp.
Lithophyllum moluccense
Mastophora rosea
Neogoniolithon frutescens
Porolithon onkodes
Sporolithon sp.
Halymenia durvillaei
Peyssonelia rubra
Portieria hornemanni
Gelidiopsis intricata
Rhodymenia divaricata
Centroceras clavulatum
Centroceras sp.
Ceramium sp.
Haloplegma duperreyi
Leveillea jungermannoides
Polysiphonia sp.
Spyridia filamentosa
Tolypiocladia glomerulata
Laurencia sp.
ANTHOPHYTA (SEAGRASSES)
Halodule uninervis

TABLE 4. FISH OBSERVED IN THE ANDERSEN MARINE RESOURCES PRESERVE

ACANTHURIDAE	Acanthurus guttatus
ACANTHURIDAE	Acanthurus lineatus
ACANTHURIDAE	Acanthurus nigricans
ACANTHURIDAE	Acanthurus nigricauda
ACANTHURIDAE	Acanthurus nigrofuscus
ACANTHURIDAE	Acanthurus nigroris
ACANTHURIDAE	Acanthurus olivaceus
ACANTHURIDAE	Acanthurus pyroferus
ACANTHURIDAE	Acanthurus triostegus
ACANTHURIDAE	Acanthurus xanthopterus
ACANTHURIDAE	Acanthurus juvenile
ACANTHURIDAE	Ctenochaetus binotatus
ACANTHURIDAE	Ctenochaetus striatus
ACANTHURIDAE	Naso brevirostris
ACANTHURIDAE	Naso lituratus
ACANTHURIDAE	Naso tuberosus
ACANTHURIDAE	Naso unicornis
ACANTHURIDAE	Naso juvenile
ACANTHURIDAE	Paracanthurus hepatus
ACANTHURIDAE	Zebrasoma flavescens
ACANTHURIDAE	Zebrasoma veliferum
ACANTHURIDAE	juvenile
APOGONIDAE	Apogon novemfasciatus
BALISTIDAE	Balistapus undulatus
BALISTIDAE	Balistoides conspicillum
BALISTIDAE	Balistoides viridescens
BALISTIDAE	Melichthys niger
BALISTIDAE	Melichthys vidua
BALISTIDAE	Odonus niger
BALISTIDAE	Pseudobalistes flavimarginatus
BALISTIDAE	Rhinecanthus aculeatus
BALISTIDAE	Rhinecanthus rectangulus
BALISTIDAE	Sufflamen bursa
BALISTIDAE	Sufflamen chrysoptera
BLENNIIDAE	Cirripectes variolosus
BLENNIIDAE	Ecsenius bicolor
BLENNIIDAE	Plagiotremus tapeinosoma
BLENNIIDAE	Salarias fasciatus
BLENNIIDAE	unidentified
BOTHIDAE	Bothus sp.
CAESIONIDAE	Caesio caerulaureus
CAESIONIDAE	Pterocaesio tile
CARANGIDAE	Caranx melampygus
CARANGIDAE	Caranx sexfasciatus
CARANGIDAE	Decapterus maruadsi
CARCHARHINIDAE	Carcharhinus melanopterus
CARCHARHINIDAE	Triaenodon obesus
CHAETODONTIDAE	Chaetodon auriga
CHAETODONTIDAE	Chaetodon citrinellus
CHAETODONTIDAE	Chaetodon ephippium
CHAETODONTIDAE	Chaetodon kleini
CHAETODONTIDAE	Chaetodon lunula
CHAETODONTIDAE	Chaetodon melannotus
CHAETODONTIDAE	Chaetodon mertensii
CHAETODONTIDAE	Chaetodon ornatissimus
CHAETODONTIDAE	Chaetodon punctatofasciatus
CHAETODONTIDAE	Chaetodon quadrimaculatus
CHAETODONTIDAE	Chaetodon reticulatus
CHAETODONTIDAE	Chaetodon trifascialis
CHAETODONTIDAE	Chaetodon trifasciatus
CHAETODONTIDAE	Chaetodon ulietensis
CHAETODONTIDAE	Chaetodon unimaculatus
CHAETODONTIDAE	Chaetodon vagabundus
CHAETODONTIDAE	Forcipiger flavissimus
CHAETODONTIDAE	Hemitaurichthys polylepis
CHAETODONTIDAE	Heniochus chrysostomus
CHAETODONTIDAE	Heniochus monoceros
CIRRHITIDAE	Cirrhitichthys falco
CIRRHITIDAE	Cirrhitus pinnulatus
CIRRHITIDAE	Neocirrhites armatus
CIRRHITIDAE	Paracirrhites arcatus
CIRRHITIDAE	Paracirrhites forsteri
CIRRHITIDAE	Paracirrhites hemistictus
DIODONTIDAE	Diodon hystrix
FISTULARIIDAE	Fistularia commersonii
GERREIDAE	Gerres argyreus
GOBIIDAE	Valenciennea strigata
GOBIIDAE	unidentified
GRAMMISTIDAE	Grammistes sexlineatus
HOLOCENTRIDAE	Myripristis kuntee
HOLOCENTRIDAE	Neoniphon sammara
HOLOCENTRIDAE	Sargocentron caudimaculatus
HOLOCENTRIDAE	Sargocentron diadema
HOLOCENTRIDAE	Sargocentron spiniferum
HOLOCENTRIDAE	Sargocentron tiere
KUHLIIDAE	Kuhlia mugil
KYPHOSIDAE	Kyphosus cinerascens
LABRIDAE	Anampses caeruleopunctatus
LABRIDAE	Anampses twisti
LABRIDAE	Bodianus axillaris
LABRIDAE	Cheilinus chlorourus
LABRIDAE	Cheilinus trilobatus
LABRIDAE	Cheilinus undulatus
LABRIDAE	Cheilinus unifasciatus
LABRIDAE	Cheilio inermis
LABRIDAE	Cirrhilabrus sp.1
LABRIDAE	Cirrhilabrus sp.2
LABRIDAE	Coris aygula
LABRIDAE	Coris gaimard
LABRIDAE	Epibulus insidiator
LABRIDAE	Gomphosus varius
LABRIDAE	Halichoeres hortulanus
LABRIDAE	Halichoeres margaritaceus
LABRIDAE	Halichoeres marginatus
LABRIDAE	Halichoeres trimaculatus
LABRIDAE	Hemigymnus fasciatus
LABRIDAE	Hemigymnus melapterus
LABRIDAE	Hologymnosus doliatus
LABRIDAE	Labroides bicolor
LABRIDAE	Labroides dimidiatus
LABRIDAE	Labropsis xanthonotus
LABRIDAE	Macropharyngodon meleagris
LABRIDAE	Novaculichthys taeniourus
LABRIDAE	Stethojulis bandanensis
LABRIDAE	Thalassoma amblycephalum
LABRIDAE	Thalassoma hardwicki
LABRIDAE	Thalassoma lutescens
LABRIDAE	Thalassoma purpureum
LABRIDAE	Thalassoma quinquevittatum
LABRIDAE	Thalassoma trilobatum
LABRIDAE	juvenile
LETHRINIDAE	Gnathodentex aurolineatus
LETHRINIDAE	Lethrinus harak
LETHRINIDAE	Lethrinus ramak
LETHRINIDAE	Lethrinus rubrioperculatus
LETHRINIDAE	Monotaxis grandoculis
LUTJANIDAE	Aphareus furca
LUTJANIDAE	Aprion virescens
LUTJANIDAE	Lutjanus bohar
LUTJANIDAE	Lutjanus fulvus
LUTJANIDAE	Lutjanus gibbus
LUTJANIDAE	Lutjanus monostigmus
LUTJANIDAE	Macolor niger
MALACANTHIDAE	Malacanthus brevirostris
MALACANTHIDAE	Malacanthus latovittatus
MICRODESMIDAE	Nemateleotris magnifica
MICRODESMIDAE	Ptereleotris evides
MICRODESMIDAE	Ptereleotris heteroptera
MICRODESMIDAE	Ptereleotris zebra
MOBULIDAE	Manta alfredi
MONACANTHIDAE	Cantherhines dumerilli
MONACANTHIDAE	Cantherhines pardalis
MONACANTHIDAE	Paraluteres prionurus
MUGILIDAE	Liza vaigiensis
MUGILIDAE	Valamugil engeli
MULLIDAE	Mulloides flavolineatus
MULLIDAE	Mulloides vanicolensis
MULLIDAE	Parupeneus barberinus
MULLIDAE	Parupeneus bifasciatus
MULLIDAE	Parupeneus cyclostomus
MULLIDAE	Parupeneus multifasciatus
MULLIDAE	Parupeneus pleurostigma
MURAENIDAE	Gymnothorax javanicus
MURAENIDAE	Sideria picta
NEMIPTERIDAE	Scolopsis lineatus
OSTRACIIDAE	Ostracion cubicus
OSTRACIIDAE	Ostracion meleagris
PEMPHERIDAE	Pempheris oualensis
PINGUIPEDIDAE	Parapercis clathrata
POLYNEMIDAE	Polydactylus sexfilis
POMACANTHIDAE	Apolemichthys trimaculatus
POMACANTHIDAE	Centropyge bispinosus
POMACANTHIDAE	Centropyge flavissimus
POMACANTHIDAE	Centropyge heraldi
POMACANTHIDAE	Centropyge shepardi
POMACANTHIDAE	Pomacanthus imperator
POMACANTHIDAE	Pygoplites diacanthus
POMACENTRIDAE	Abudefduf septemfasciatus
POMACENTRIDAE	Abudefduf sexfasciatus
POMACENTRIDAE	Abudefduf sordidus
POMACENTRIDAE	Abudefduf vaigiensis
POMACENTRIDAE	Amphiprion chrysopterus
POMACENTRIDAE	Amphiprion melanopus
POMACENTRIDAE	Chromis acares
POMACENTRIDAE	Chromis agilis
POMACENTRIDAE	Chromis margaritifer
POMACENTRIDAE	Chromis xanthura
POMACENTRIDAE	Chrysiptera biocellata
POMACENTRIDAE	Chrysiptera glauca
POMACENTRIDAE	Chrysiptera leucopoma
POMACENTRIDAE	Dascyllus aruanus
POMACENTRIDAE	Dascyllus reticulatus
POMACENTRIDAE	Dascyllus trimaculatus
POMACENTRIDAE	Plectroglyphidodon dickii
POMACENTRIDAE	Plectroglyphidodon imparipennis
POMACENTRIDAE	Plectroglyphidodon johnstonianus
POMACENTRIDAE	Plectroglyphidodon lacrymatus
POMACENTRIDAE	Plectroglyphidodon leucozona
POMACENTRIDAE	Plectroglyphidodon phoenixensis
POMACENTRIDAE	Pomacentrus vaiuli
POMACENTRIDAE	Pomachromis guamensis
POMACENTRIDAE	Stegastes albifasciatus
POMACENTRIDAE	Stegastes fasciolatus
POMACENTRIDAE	Stegastes lividus
POMACENTRIDAE	Stegastes nigricans
POMACENTRIDAE	juvenile
SCARIDAE	Calotomus carolinus
SCARIDAE	Hipposcarus longiceps
SCARIDAE	Scarus forsteni
SCARIDAE	Scarus frontalis
SCARIDAE	Scarus globiceps
SCARIDAE	Scarus oviceps
SCARIDAE	Scarus psittacus
SCARIDAE	Scarus rubroviolaceus
SCARIDAE	Scarus schlegeli
SCARIDAE	Scarus sordidus
SCARIDAE	juvenile
SERRANIDAE	Cephalopholis argus
SERRANIDAE	Cephalopholis urodeta
SERRANIDAE	Epinephelus fasciatus
SERRANIDAE	Epinephelus merra
SERRANIDAE	Pseudanthias pascalus
SIGANIDAE	Siganus argenteus
SIGANIDAE	Siganus spinus
SYNGNATHIDAE	Corythoichthys intestinalis
TETRAODONTIDAE	Arothron nigropunctatus
TETRAODONTIDAE	Arothron stellatus
TETRAODONTIDAE	Canthigaster amboinensis
TETRAODONTIDAE	Canthigaster bennetti
TETRAODONTIDAE	Canthigaster solandri
ZANCLIDAE	Zanclus cornutus

freshwaters flow directly from the land into coastal waters. In these situations, the variability in freshwater flow is much greater and is coupled directly to rainfall patterns, and the concentrations of dissolved nutrient in the freshwaters is much more variable and dependent upon patterns of soil erosion.

During the period of the surveys we noted significant variation in water turbulence; during some survey times, the water was so rough that it was hazardous to enter. However, there were no major tropical storms or typhoons impinging upon Guam during the survey period, so the effect of this factor on plant variability was probably less that would be the case during years when Guam experienced major storms.

Seasonal changes in sunlight intensity and in tidal exposure during the survey period were typical of other years as they are controlled by astronomical patterns rather than regional weather and local biological events.

In addition to natural variation in the occurrence of marine plants in the study area, there is also variability produced by the survey methodology. We attempted to minimize this source of variability by establishing permanent, marked transects so that we would be surveying the same locations during each of our eight surveys. For the plant surveys, a 25 cm X 25 cm square quadrat was placed at specific locations along the transect line, and the plants under each of 25 internal points were listed. Even with this degree of reproducibility, there is inevitably some variability introduced: variations in water motion can cause the transect line to lie in slightly different positions on each survey, and thus the quadrat frame will not lie at exactly the same location. This will result in differences in the algae recorded from subsequent surveys.

Corals

Reef corals are subject to much less environmentally induced variability than are marine plants. The principal cause of coral variability (over a short period of time such as the time of these surveys) is due to fragmentation caused by strong water turbulence. This process can reduce the mean size of coral colonies and can redistribute coral species on the reef. Longer-term changes can be the result of predators, such as the crown-of-thorns starfish, diseases (e.g. "red band disease" and "white band disease"), undermining of coral colonies by boring sponges, bivalves, endolithic algae, and worms, and bleaching, a phenomenon associated with increased water temperature. Corals on shallow reef flats can also be killed during El Niño events when seal levels in the western Pacific drop and shallow-water corals can be emergent throughout several tide cycles.

During the survey period covered here there were no severe storms or El Niño events, and so the variability of coral cover due to these factors was not seen. Neither were there evidences of crown-of-thorns damage, coral diseases, or significant boring damage.

Since corals do not move, it would seem that there should be little variability in coral

cover or species composition induced by survey methodology. However, even though the same marked transect locations were surveyed during each of the eight surveys, there was notable variation in the results from survey to survey. This variability arises because the point selected for the center of the point-quarter measurements varies somewhat from survey to survey, because the tape measure does not lie in exactly the same position every time it is set out. We tried to reduce this variation by selecting as the center of the point-quarter measure points which lay directly below increments on the measuring tape (rather than using a haphazard toss of a geological hammer as is the standard method). Despite this modification, variability in subsequent coral surveys occurred.

Invertebrates

Many of the macroinvertebrates species are either nocturnal (especially the mollusks) or cryptic (both mollusks and crustaceans), and thus among these groups there is considerable variability because observing one of these animals is a happenstance event, unlikely to be replicated in subsequent surveys. However, the dominant invertebrates in the survey area were sea cucumbers (holothurians), and these are, for the most part, slow-moving, exposed animals. Strong water turbulence is the environmental factor most likely to influence sea cucumbers which can be rolled off the reef into deeper water or onto the beach by strong storm surge. As there were no especially large storms affecting the waters around Guam during the period of these surveys, variability in sea cucumbers was at a minimum.

The method of surveying macroinvertebrates is to count those individuals within a meter of the entire transect line. There is some variation due to slightly different placement of the line from survey to survey (because water currents may stretch it to one side or the other), but this surveying technique is probably the most repeatable of all the techniques used.

Fishes

The natural variability of fishes on the reef depends to a large extent upon the behavioral ecology of the species. Large, roving carnivores such as jacks (Carangidae) tend to be highly variable in their occurrence on any particular transect, while territorial species, such as many of the damselfishes (Pomacentridae) and butterflyfishes (Chaetodontidae), will be consistently present. Some species, most notably the rabbitfishes (Siganidae), have significant seasonal variation in their abundance because they exhibit strong seasonal patterns of larval recruitment. Other species, such as surgeonfishes (Acanthuridae), groupers (Serranidae), goatfishes (Mullidae), and many others, may gather in large aggregations prior to spawning; this is usually associated with phases of the moon and thus produces lunar variations in abundance. Strong storm surge can cause fish to take refuge in protected areas and thus affect their occurrence in shallow-water habitats, and fishes can be killed during El Niño events when water trapped on the reef flat is not renewed by tidal fluctuations and becomes hot and deoxygenated.

The method used for surveying fishes, counting those within a meter of either side of the

transect line, is reasonably reliable, although variations in the position of the line will affect the counts. In addition to that, many fish react to the presence of the surveyor, either fleeing or, in some cases, following the individual around.

Development of Interpretive Programs

Part of this project consisted of shooting video footage of habitats and organisms within the Marine Resources Preserve and producing text and illustrative photographs for an informational brochure. These materials can provide the basis for an educational program describing the objectives of the Marine Resources Preserve and the resource species within its boundaries. This program would be particularly appropriate for groups, such as the Boy Scout, Girl Scouts, 4-H, diving groups, and others who may use the visitor facilities near the Preserve.

References Cited

Amesbury, S. S., R. T. Tsuda, R. H. Randall, A. M. Kerr, and B. D. Smith. 1993. Biological communities in Tumon Bay, 1977-1991. University of Guam Marine Laboratory, Tech. Rept. No. 99. 111 p.

RECOMMENDATIONS

Monitoring Surveys

The information obtained during the eight resource surveys described in this report provides a basis for future monitoring of the biological communities in the Preserve to determine how these communities change over time. Such long-term monitoring would be quite valuable for two reasons:

1) There have been few detailed long-term studies of coral reef communities carried out in this region, and any information on long-term changes in reef communities would be a useful contribution to the overall understanding of coral reef dynamics.

2) Monitoring of biological communities within the Preserve is essential to detect whether these communities are being impacted by human activities or natural events so that appropriate ameliorative action could be taken.

The following monitoring plan is recommended for the Marine Resources Preserve:

1) Monitoring surveys should be carried out every 2 years or in the event that some major impact or conspicuous change occurs, such as a ship grounding, major typhoon damage, crown-of-thorns starfish outbreak, hazardous waste spill, conspicuous algal bloom, etc.

2) The monitoring surveys should be carried out during the summer months when water conditions are calm within the Preserve. This will reduce much of the variation caused when the transect line is moved around by water surge and will also eliminate seasonal variations. This will make the monitoring surveys more reliable detectors of true biological changes.

3) The same sites and transect locations as the baseline survey should be resurveyed during the monitoring surveys. Four surveys per transect should be carried out to provide adequate replicates for statistical comparisons.

4) The same surveying methods for marine plants, macroinvertebrates, and fishes as were used in the baseline surveys should be used in the monitoring surveys. They should be sufficiently reliable if variability due to seasonality and to variations in water turbulence are controlled.

5) For corals, we suggest that both the point-quarter method used in the baseline surveys and the line-intercept method be used during the first monitoring survey. The method which provides the most repeatable results should then be used in subsequent monitoring surveys.

Fish Catch Survey

In addition to the above, we recommended that data be gathered on the fish caught by pole-and-line fishermen fishing from the beach. Permits could be required for this type of fishing, and a record of the catch be required of all permit recipients. Data gathered should include the the total length and identification of all fishes caught. Identification posters and measuring boards could be set up at various locations within the Preserve. Analysis of these catch data would be very informative in assessing the condition of the reef.

Current Studies

A final data gathering effort that should be undertaken is a study of ocean currents in the vicinity of the Preserve to determine the probable fate of pelagic eggs and larvae of marine species which spawn within the Preserve. This could best be done with drift bottles or cards. Such a study is essential to determine whether the Preserve actually contributed to the repopulation of other reefs on Guam.