FINAL REPORT

AN ENVIRONMENTAL ASSESSMENT OF THE KEY LARGO NATIONAL MARINE SANCTUARY

by

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Introduction

The Florida Keys form a crescentric chain of limestone islands extending from near Miami to Key West a distance of about 240 km. Between the line of the Keys and the Florida Current lies an extensive shallow platform bearing scattered coral reefs, the whole known as the Florida reef tract. The reef tract has an average width of about 6.5 km.

The Florida reef tract supports a wide range of water oriented activities: boating, water skiing, sportfishing, spearfishing, scuba diving and sightseeing. Prior to 1960 the area was being despoiled by treasure hunters, commercial coral, shell and tropical fish collectors and spearfishermen (Voss, 1960). Construction work on the Keys converted natural shoreline into developed marinas and boat channels were cut through the seagrass meadows.

In 1957 Voss proposed that an extensive area of the Hawk Channel, bank, and coral reefs seaward of Key Largo should be preserved from these depredations and in 1960 the Pennekamp Coral Reef State Park was formed by the State of Florida and the Federal Government (Voss, 1960; Griswold, 1965). The park waters extended in the south from near Rodriguez Key to the north end of Key Largo and seaward to the 18 m isobath. In 1975 under the Marine Protection, Research and Sanctuary Act of 1972, the Federal area was extended to the 91 m isobath. The Federal preserve now known as the Key Largo Coral Reef Marine Sanctuary is approximately 32.2 km long and 8.05 km wide (Jameson, 1981) (Figure 1a).

To assist in the management and protection of the Sanctuary and Park fauna and flora, various studies were supported or encouraged to determine the state of the health of the coral reefs and their associates. Among these studies are Antonius (1974) on the health of the outer and middle reefs, Dustan et al. (1975), Dustan (1977a) on coral reef mortality, Hudson (1981) on coral growth rates and Jameson (1981) on the deep-water environment beyond the 18 m isobath. A series

FIGURE 1a. Map showing the main portion of the Florida reef tract extending from Fowey Rocks off Miami 241 km southwest to Key West, and the position of the study area on the tract.

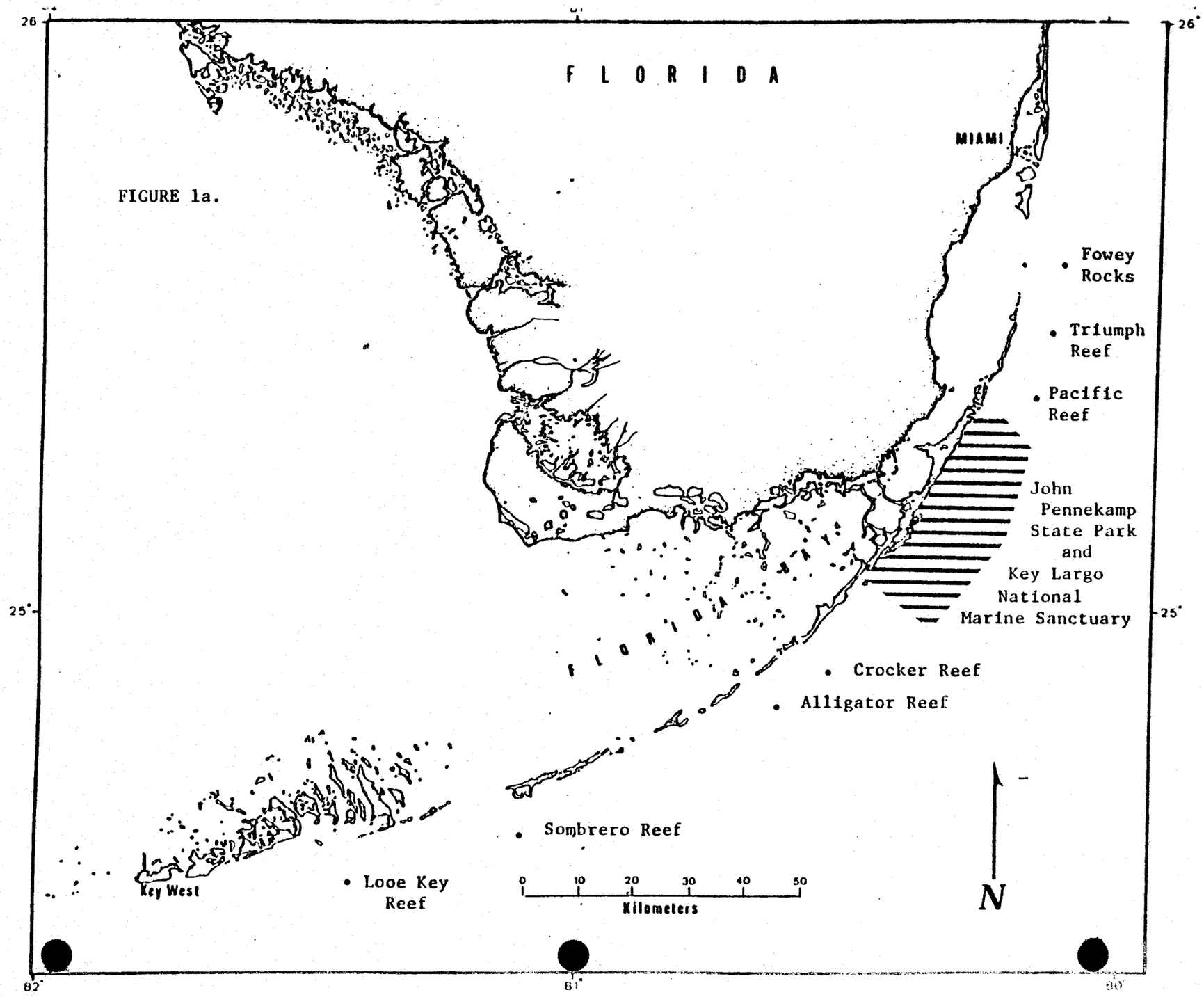

FLORIDA
MIAMI
Fowey Rocks
Triumph Reef
Pacific Reef
John Pennekamp State Park and Key Largo National Marine Sanctuary
Crocker Reef
Alligator Reef
Sombrero Reef
Looe Key Reef
Key West
0 10 20 30 40 50
Kilometers
N
26°
25°
82°
81°
80°

FIGURE 1a.

of habitat maps of the area were published by Marszalek (1982).

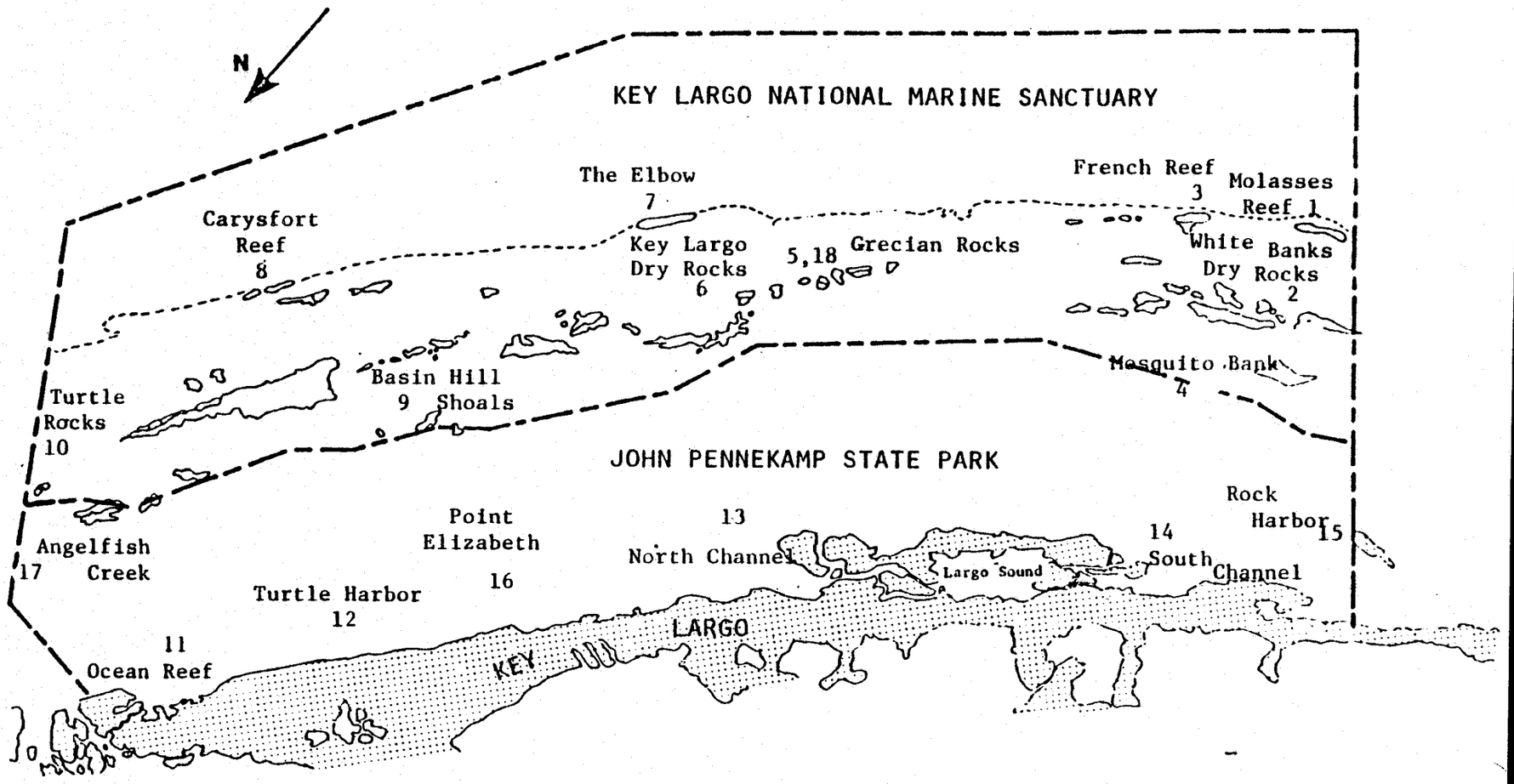
The present study was requested by the Office of Coastal Zone Management to assess the environmental resources of the Sanctuary shoreward of the 18 m isobath and to provide a base-line study of the fauna and flora for use in management, planning and future studies. Ten reef sites within the Sanctuary and seven shallow grass and hard bottom sites within the Park were chosen for study (Figure 1b). A brief survey of earlier studies in the Florida reef tract may aid in placing the present report in perspective.

The Florida reefs have been described by several writers. L. Agassiz surveyed them in 1851 (L. Agassiz, 1852, 1880) and discussed their origins. Pourtales (1871) described and illustrated many of the corals. A. Agassiz (1883) published a report on the corals of the Dry Tortugas and presented a detailed map. With the founding of the Tortugas Marine Laboratory of the Carnegie Institute, the first studies of the biology of corals were initiated by Vaughan who presented data on the water temperatures of the Florida reef tract (1918). A general survey of the shallow inshore waters with emphasis on the ecology was made by Stephenson and Stephenson (1950). Voss et al. (1969) published a detailed literature and data survey, and map of the newly created Biscayne National Monument, immediately north of the Sanctuary. Hoffmeister (1974) discussed the reef tract and stated that the Florida coral reefs have their finest development to seaward of Key Largo where they are protected by the land mass from the sediment rich waters of Florida Bay. He divided the Florida reefs into two types, (1) outer reefs on the seaward edge of the platform and (2) patch reefs or clusters of irregular coral masses located behind the outer reefs.

Hudson (1981) included Molasses Reef, French Reef, The Elbow, Carysfort Reef, Grecian Rocks and Key Largo Dry Rocks in the "offshore reefs" although strictly speaking the latter two lie within an indentation in the reef line. The

FIGURE 1b. Map showing John Pennekamp State Park and Key Largo National Marine Sanctuary. The number and name for each of the 17 study sites are given at the respective locations.

FIGURE 1b.


N
KEY LARGO NATIONAL MARINE SANCTUARY
The Elbow
7
French Reef
3
Molasses
Reef 1
Carysfort
Reef
8
Key Largo
Dry Rocks
6
5,18
Grecian Rocks
White Banks
Dry Rocks
2
Mesquito Bank
4
Basin Hill
9 Shoals
Turtle
Rocks
10
JOHN PENNEKAMP STATE PARK
Rock
Harbor
15
Point
Elizabeth
16
13
North Channel
14
South
Channel
Largo Sound
Angelfish
17 Creek
Turtle Harbor
12
11
Ocean Reef
KEY
LARGO

remaining reefs of the Sanctuary, White Bank Dry Rocks, Mosquito Bank, Basin Hill Shoals, Turtle Rocks and the numerous small reefs unnamed on National Ocean Survey Chart 11462 are patch reefs. Hudson (loc. cit.) stated that the "midshore reefs" of Basin Hill Shoals and White Bank Dry Rocks have greater water clarity than the extreme inshore reefs due to influxes of clear oceanic water from the Straits (Jones, 1963). Jones's study of Margot Fish Shoal is the only published source of water conditions in the northern part of the reef tract.

The geology and sedimentology of the reef tract have been discussed by Ginsburg (1956), Hoffmeister and Multer (1968), Hoffmeister (1974), Shinn (1963); Shinn et al. (1982) and Marszalek (1982).

The present reefs are growing on Holocene fossil reefs dating from about 15,000 years ago, and which also form the offshore hard bottom. The inshore hard bottom bordering the Keys is Key Largo Limestone of Pleistocene origin upon which the later fossilized coral rock and sediments lie. Ginsburg (1956) gave the composition of the reef tract sediments as fine grained carbonates and fragments of Halimeda, coralline algae, corals, foraminifera and mollusk shells. The sediments of the outer platform area tend to be coarse while those of the lower fore reef and inshore form carbonate muds (Marszalek, 1982). The carbonate production of the coral Diploria labyrinthiformis was studied by Ghiold and Enos (1982). Shinn (1980) reported on the geologic history of Grecian Rocks, the only detailed study of a coral reef within the Sanctuary.

Studies of the biology of Florida reef corals have been primarily concerned with growth. Vaughan (1915) published results of work at the Dry Tortugas. He gave the growth rate of Montastrea annularis as 6-7 mm annually. He considered that this was the controlling growth of the reefs as this species formed the basis of the Florida reefs. Hoffmeister and Multer (1964) conducted growth rate studies at Carysfort Reef and found that M. annularis grow at a rate of 10.7 mm per year.

Hudson (1981) found that this species grew at different rates according to location, 6.3 mm per year on the outer reefs, 8.2 mm per year on the inner reefs and 11.2 mm per year on the midshore reefs. He also found that the growth rate was lowest during the years of uncontrolled dredging and filling along the keys but that it increased when dredging was banned. In contrast with the slow outward growth of Monatastrea annularis, Shinn (1966) found that Acropora cervicornis grew terminally at the rate of 100 mm per year.

The problem of coral reef deterioration or damage due to devastating storms and human impact has been reported by numerous investigators (Voss, 1973; Shinn, 1975; Dustan, 1977a, 1977b; Davis, 1977; Tilmant et al., 1981; Antonius, 1982; Raymond, 1982). Coral disease has been reviewed by Antonius (1981a, 1981b). Studies to assess damage, death and disease have been made by Antonius (1974), Antonius et al. (1978), Dustan et al. (1975), Davis (1977, 1982) and Tilmant et al. (1981). Hudson et al. (1976) have used coral slabbing and sclerochronology for interpreting coral growth versus environmental perturbations.

Studies of the assemblages of organisms of the reef tract are diverse. Among the most useful are Stephenson and Stephenson (1950), Voss and Voss (1955), Ebbs (1966), Kier and Grant (1965) and Voss et al. (1969). The last named has an extensive bibliography dealing with works on the Florida reef tract up to 1969. References to works on fishes will be found in the extensive list given by Bannerot and Schmale in the separate report on the fish census.

The present report deals with the coral reefs and the assemblages of fauna and flora found in the reef tract with the exception of fish. The latter are dealt with by Schmale and Bannerot. Their report is appended as a separate study.

Acknowledgements

This study was funded by the Office of Coastal Zone Management, NOAA, under contract NA-79-SAC-00813. Lt. Stephen Jameson assisted in the early stages of the planning. Mr. James Stephenson, Department of Natural Resources, Tallahassee, provided collecting permits for State waters. The Superintendent of the Pennekamp Coral Reef State Park and his staff provided gear storage space at the Park headquarters and assisted the work in many ways. The staff of the Park concession was helpful in too many ways to enumerate.

Dr. Dennis Taylor, RSMAS, planned the field work and methods of analysis but left the university before field work began. Dr. Jon Staiger assisted in the early phases of the field studies. Ronald Toll was in charge of logistics during the first year, followed by Lynne Fieber. Divers on the study included the following: Fred Baddour, Scott Bannerot, Thomas Burns, Peter Bushnell, Meri Cummings, Ian Davis, Jeffrey Erickson, Charles Evans, Lynne Fieber, David Gordon, Mark Gottfried, Charlene Grall, Diane Ledder, Valery Lee, Susan Markley, John Martin, Mark Poli, Robert Riggio, Alice Russel, Edward Rutherford, Michael Schmale, Alan Schneyer, Susan Sogard, Douglas Wilson and Janet Zurschneider. The RSMAS Dive Officer, Stewart McCormick, supervised the deep dives at Molasses Reef. Dr. James Bohnsack supervised the poison stations at Grecian Rocks.

Specimen sorting was supervised by Ronald Toll who also made many of the identifications. The following persons identified or checked identifications of specimens in the laboratory: Dr. F.M. Bayer, USNM, alcyonarians and corals; Dr. James Bohnsack, CIMAS, poison station fishes; Rafael Lemaitre, crabs and shrimp; Dr. Lowell Thomas, ophiuroids; Dr. C.R. Robins, fishes; Dr. Gilbert Voss, ophiuroids and algae; Robert Work, sponges and worms. Catalogue photographs were mainly taken by John Park. Lynne Gilliss and Susan Candela assisted with data compilation.

Grateful thanks are extended to all these persons without whose help this study could not have been carried out.

METHODOLOGY

Field methodology

Seventeen sites were designated to be studied qualitatively and quantitatively within the Sanctuary and Park (Figure 1b). The odd numbered sites were to be worked the first year (1980) and the even numbered sites the second year (1981). One site was to be censused twice for which Grecian Rocks was chosen. Cryptic species of fish and invertebrates were to be collected by use of rotenone at selected coral sites, and reef health and anchor damage were to be assessed. A full fish census based on the Jones and Thompson (1978) method was to be made at all sites.

Field studies were delayed until late spring in 1980 due to stormy weather and turbid waters with low visibility. Work on the odd numbered sites continued through the summer until fall weather prohibited further activities. The even numbered sites were worked during the summer and fall of 1981.

At each site three parallel transects not less than 400 m long were run perpendicular to the reef or shore, each 300 m apart. The transect lines were made of braided nylon and were marked at every 5 m with red tape. Each line was equipped with anchors and buoys. On the outer reefs the transects started in 18 m depth and ran across the reef crest to the back reef in the turtle grass. In patch reefs the transects ran from sand or grass bottom across the reef to sand or grass bottom on the other side.

The first transect at each site was located in relation to a permanent structure on or near the site such as a lighthouse, navigational marker, pipe or stake, and was laid down on a compass course later converted to true course. The second and third transects were made 300 m apart on the same course.

Observations, data collecting and sampling were done by two teams of divers. The first team consisted of the photographer and an assistant who carried a 1 m^2

quadrat frame made of PVC pipe. This was laid down on the transect line at each 5 m with the meter marker in the center of the frame and the quadrat was photographed. The assistant noted on the clipboard the meter marker number and depth, the latter read from calibrated diver's depth gauge.

About 10 m behind the photographic team was the fauna and flora team consisting of an identifier and a bagger. At each marker the identifier wrote down on the clipboard the name of the animal or plant beneath the marker and the marker number. If the organism was unknown, it was collected and bagged with a label containing the number of the site, transect and meter marker. Identification aids carried aboard the boat were Greenberg's (1979,1980) diver's fish and coral identification cards, Smith's (1948) coral hand book, Taylor's (1972) algal manual and Voss's (1980) invertebrate and algal guide.

Bags were collected at intervals by a person in the attending boat where camera transfer and film changes were also done.

Quantitative sampling in the various zones at each site was done by the fauna and flora team. Two 1 m^2 PVC pipe quadrat frames were linked together and one set of frames was laid down on each side of the transect line providing four 1 m^2 frames. Within each frame all of the species were identified and each specimen counted. Where possible all 4 m^2 quadrat sampling was done on the transect at points where the line crossed over the appropriate zone. In sand areas, the sand was removed to a depth of 10 cm, screened through a set of geologist's sieves and all specimens 1 cm long or longer were retained for identification and counting. Further explanations of methodology are given in Appendix A.

All specimens were preserved in the field in 10% seawater formalin. In the laboratory they were sorted out and where appropriate changed to 70% ethanol or in the case of algae to buffered 5% seawater formalin. As identifications were received the names were entered in the appropriate site file for transect and meter

marker. Voucher specimens were catalogued into the research collections of RSMAS.

Individually selected specimens were photographed and the photographs filed for later compilation of the photographic catalogue to be deposited with NOAA.

Some discrepancies between entries in the transect list and the catalogue specimens were inevitable. Often a quickly moving animal under the marker could not be caught and was entered simply as crab, shrimp, brittlestar or other general term. The meter marker was approximately 2 cm broad and offered no problem with the average specimen. When the marker rested upon a small piece of rubble covered with sessile organisms, the piece of rubble was collected and all of the species attached to it were listed. The first species listed was arbitrarily selected as the one species under the marker for analysis purposes.

While the contract called for identification to species of all algae, this was often not possible because of the condition of the specimen such as time in preservative, maturity of the plant, lack of seasonal fruiting bodies, or insufficient material. This primarily was a concern in small red and blue-green algae and corallines.

Identification of worms, both polychaetes and sipunculids, often proved difficult and many could only be taken to family. Many of the worms were fragmented or so contracted in preservation that critical characters were obscured. Some worms need relaxing and the use of special preservative techniques not possible in general field work and require the attention of a specialist. Further discussions on survey problems are given in Appendix A.

Coral Health. Two methods of recording coral health were used. The first was by observation of the amount of white area on each coral under the marker as done by Antonius (1974). Observations at each 5 meter marker afforded too few data points and this method was dropped. At each 5 m a photograph was taken of a

1 m^2 area. These photographs provided many more corals on each transect and careful scrutiny by hand lens and screen projection permitted observation of white areas and estimates of percentage of cover. This method was adopted for analysis. Antonius used an "all or nothing" method in which if a coral had 50% or more of its surface bare of tissue and uneroded it was considered to be "dead"; a coral with less than 50% white area was considered to be "live". While this method was used for comparisons with Antonius' 1974 findings, the number of corals with less than 50% white areas as well as the number with no white spots were recorded.

Sea grass health. Sea grass health estimates are subjective at best. In this report only turtle grass, Thalassia, is considered. Health of turtle grass is indicated by the general condition of the grass blades: length, width, color, erectness of blades, and amount of aufwuchs or sessile growth on the blades, especially filamentous algae. As some of these characters may change seasonally, care must be taken in their use. However, as the grass areas were surveyed in summer and fall, comparisons between sites should be of value. In this report mature turtle grass beds are those in which only turtle grass was present. Where manatee grass was mixed or occurred in large patches, it was considered that the area was possibly under stress or recovery from turtle grass loss. Areas were considered "lush" when the turtle grass completely covered the bottom and the blades were long and broad.

Anchor and boat damage. No general survey of the reefs was made, thus observations on boat and anchor damage depended upon the observations made by the divers in both the transect and fish census studies. Few indications of damage were seen such as broken coral or gashes made by keels or propeller blades.

Fish census. The fish census was conducted separately from the transect and quadrat work in order to have less disturbance of the fish populations. The methodology required was the space, time technique of Jones and Thompson (1978).

Because it does not take bottom type into consideration, the data could not be incorporated into zone descriptions. The full methodology is described in the separate fish census report by Bannerot and Schmale.

Poison stations. A 2.1 m radius cast net with a stretched mesh of 1.5 mm was lowered over the area to be sampled, except at station 4. The net was not used at that station to avoid excessive damage to the corals. Approximately .5 l of pure liquid rotenone (without synergistic agents) was applied to the sample area. Attempts were made to collect all specimens that appeared to be affected by the poison. Four SCUBA divers were used for specimen collecting.

Transect profiles. The base lines of the pictorial profiles were drawn from the diver depth gauge data. The organisms illustrated were taken directly from the 35 mm color transparencies shot at each 5 meter along the transect line. A key to the symbols used is given in Figure 2.

Metric conversions. Depth readings from diver gauges and lead line were recorded directly in feet. When converted to meters they were rounded to one decimal place as the use of two decimal places infers a precision greater than the field measurement, a common error seen in conversion figures.

Statistical analyses. Species diversity was estimated as H' in the Shannon Weaver equation

$$H' = -\sum p_i \log_e p_i \quad \text{where } p_i \approx \frac{n_i}{N}$$

n_i is the number of individuals of the ith species, N is the total number of individuals in the community.

Description of the Study Area

The section of the Florida reef tract surveyed in this report is shown in Figure 1a. It includes the waters of the Pennekamp Coral Reef State Park and the Key Largo Coral Reef Marine Sanctuary. The present study covered only sites within the 18 m isobath indicated in the figure by a dotted line. Table 1, modified from Bannerot and Schmale (this volume), lists the sites by name and number, habitat and type and amount of use. The data on distances, depths and locations are taken from National Ocean Survey Chart 11462.

About two thirds of the combined Sanctuary and Park lies within the 18 m isobath. The area seaward to the 91 m isobath has been studied by Sanctuary personnel (Jameson, 1981). Within the 18 m isobath water depths of 4.5 to 7 m predominate with numerous hard bottom and coral outcrops several of which are awash at extreme low tide: Molasses Hump, White Bank Dry Rocks, and Key Largo Dry Rocks.

The bottom within the area is very diversified as shown by the habitat map prepared by Marszalek (1982) from aerial surveys. As much as 75 percent of the bottom may be classified as turtle grass cover which maintains a distinctive faunal and floral community. The second major bottom type is calcareous sands and sediments comprising perhaps another ten percent of the bottom. The remaining 15 percent of the bottom is formed of hard bottom.

A dominant feature of the Sanctuary is the shoal, sedimentary bank formation known as White Bank which extends from just inshore of Molasses Reef northeastward terminating at Turtle Rocks near the northeastern extremity of the Sanctuary. It is discussed briefly by Shinn (1980). Many patch reefs are located on White Bank.

Growing on the offshore fossil reef rock are the living coral reefs of the Sanctuary. Marszalek's maps do not distinguish the living coral reefs and their area

TABLE 1. (Modified from Bannerot and Schmale) List of study sites by number and name with habitat type and approximate extent and type of usage by visitors. Habitat definitions are (1) offshore reef (OR) - a major aggregation of scleractinian corals occurring on a contour approximately 6 km offshore defined by the outermost lighthouses on the Florida reef tract; (2) patch reef (PR) - an aggregation or group of various sized aggregations of scleractinian corals usually at least 2 km inshore of the outer reef line; (3) turtle grass (TG) - an area dominated by turtle grass, Thalassia testudinum, bottom; (4) hardbottom (H) - bedrock areas featuring numerous octocorals, various sponges, and encrusting and small head scleractinian corals. The term "diving" includes non-consuming recreational SCUBA and snorkeling, the only consumptive usuage being the taking of lobsters in season. "Fishing" refers only to hook and line fishing, most of which is recreational (spearfishing and fish traps are illegal in both conservation areas). Boat traffic is only considered for turtle grass or hardground sites less than 4.9 m depth where bottom disturbance from wakes and prop turbulence is most noticeable. The extent of the various activities are strictly subjective impressions obtained by one of the authors during 6 years of diving experience in the area and by both authors during the course of the study (no quantitative data such as boat counts were obtained on a regular basis). H = heavy usage, M = moderate usage, L = light usage, O = very little or no usage.

Site No.	Name	Habitat	Approx. Extent and Type of Usage		
			Diving	Fishing	Boat Traffic
	Molasses Reef	OR	H	H	---
	White Bank Dry Rocks	PR	M	L	---
	French Reef	OR	H	H	---
	Mosquito Bank	PR	L	M to L	---
	Grecian Rocks	OR	H	H	---
	Key Largo Dry Rocks	OR	H	H	---
	The Elbow	OR	H to M	H	---
	Carysfort Reef	OR	M	M to L	---
	Basin Hill Shoals	PR	L	L	---
10	Turtle Rocks	PR	L	L	---
11	Ocean Reef	TG	O	O	---
12	Turtle Harbor	TG	O	O	L
13	North Channel	TG/H	O	O	M
14	South Channel	TG/H	O	O	H
15	Rock Harbor	TG	O	O	H to M
16	Point Elizabeth	TG/H	O	O	L
17	Angelfish Creek	PR	L	L	---

but within the 18 m isobath approximately 5 percent of the bottom may be characterized as living coral reefs, the main subject of this study. When it is considered that the best developed coral reefs of the Florida reef tract are found seaward of Key Largo (Hoffmeister, 1974) and that the Florida reefs are the only shallow water coral reefs in the continental waters of the United States, the importance of the Sanctuary to their protection and preservation becomes clear.

The classification of the Sanctuary reefs is somewhat confused. Hoffmeister (1974), following local usage, divided the reefs into "(1) outer reefs, which form at the seaward edge of the platform, (2) patch reefs, which are found behind the outer reefs in the back reef zone". He gave Key Largo Dry Rocks and Carysfort Reef as examples of the first and Mosquito Bank as an example of the second. Hudson (1981) divided the reefs into inshore reefs such as Basin Hill Shoals and Mosquito Bank, midshore reefs, those lying on White Bank, and offshore reefs, those lying seaward of White Bank. Bannerot and Schmale (this volume) use offshore reefs for Carysfort, the Elbow, French and Molasses reefs, intermediate reefs for White Bank Dry Rocks, Grecian Rocks and Key Largo Dry Rocks and inshore patch reefs for Basin Hill Shoals, Mosquito Bank, Turtle Rocks and Angelfish Creek. Nonetheless, it is often convenient to speak of the reefs in reference to their location within the Santuary as outer, middle and inner reefs.

In the present study Hoffmeister (loc. cit.) is followed. Carysfort Reef, Key Largo Dry Rocks, Grecian Rocks, the Elbow, French Reef and Molasses Reef are considered as outer reefs. Angelfish Creek, Turtle Rocks, Basin Hill Shoals, Mosquito Bank and White Bank Dry Rocks are patch reefs.

Outer Reefs

On the basis of their geologic history, the outer reefs are often termed bank reefs (Shinn, 1963) while in their functional aspect they are termed barrier reefs (Ginsburg, 1956). As Ginsburg stated, while they are barrier reefs, they are of

little individual extent, have wide, nonreef areas between them and are only somewhat more consolidated within the Sanctuary and northward to Fowey Light.

From northeast to southwest the outer reefs are Carysfort, The Elbow, Key Largo Dry Rocks, Grecian Rocks, French Reef and Molasses Reef. With the exception of Key Largo Dry Rocks, all of the reefs are located on the edge of the bank about 8-9 km from shore and are bordered seaward by the Florida Current. The fore-reef slope is rather steep and the 18 m isobath is located within only a few hundred meters of the reef crest.

Below the 18 m isobath the bottom drops off in terraces of calcareous sands, deep coral reefs, coral rubble, deep hard bottom and finally to the outer platform of calcareous sand extending outward to the edge of the canyon of the Straits of Florida. The deep coral reef lies between about 30 to 40 m depth. This reef is composed predominantly of Monastrea and alcyonarians. This area has been surveyed and reported upon by Jameson (1981) working from a submersible.

Carysfort Reef is perhaps the best developed of the outer reefs and is more characteristically Caribbean in its zonation. The fore reef is terraced, there is a crustose coralline agal ridge, an Acropora crest and well developed back reef (Jones and Thompson, 1978), but it lacks developed spurs and grooves. According to Bannerot and Schmale (this volume) there is an extensive Acropora cervicornis thicket at approximately 14 m. The reef is marked by Carysfort Lighthouse.

The Elbow lies on a separate small shoal surrounded except seaward by waters not less than 8 m deep and is several kilometers from the nearest part of White Bank. It has an extensive back reef rubble area, a limited Acropora crest and well-developed spurs and grooves with large Montastrea heads.

French Reef has been described by Jones and Thomson (1978). The spur and groove system is composed mainly of Montastrea annularis rather than Acropora palmata and the spurs are often interlaced with cavernous passages.

Molasses Reef has been described by Jones and Thompson (1978) and Shinn (1963). It has an extensive back reef rubble area, a few live Acropora colonies but an extensive old Acropora spur and groove system with Montastrea on the reef slope. The offshore deep reef was not surveyed by Jameson (1981). The fore reef slope levels off onto a sand terrace at about 14 m.

Key Largo Dry Rocks and Grecian Rocks set back from the edge of the bank by over 1 km, located in a long break in the outer reefs between the Elbow and Dixie Shoal. The bottom seaward of the reef slope is only about 7 - 8 m deep composed of calcareous sand.

Grecian Rocks has been well described by Shinn (1963, 1980). It is over 700 m long and 200 m wide. Although located behind the outer reef line it exhibits well defined spurs and grooves, a terraced reef slope, an Acropora crest, reef flat and rubble back reef (Shinn, 1980).

Key Largo Dry Rocks is situated only a little over 1 km to the northeastward. It rises abruptly from the bottom with large fields of Acropora palmata and A. cervicornis and has a large back reef rubble area.

None of the outer reefs are much more than 1 km long and .5 km wide with even a lesser extent of living coral.

Patch Reefs

The named patch reefs within the Sanctuary are Turtle Rocks, Basin Hill Shoals, Mosquito Bank and White Bank Dry Rocks. The patch reef called Angelfish Creek in this study is not named on the chart.

All of the patch reefs consist of patches of corals and coral associates surrounded by turtle grass and rise from depths of only 3 to 4.5 m. Basin Hill Shoals consists of a series of coral patches extending for a distance of some 4 km. It is the largest series of patch reefs in the Sanctuary. There is no distinct zonation on the patch reefs although some of the larger coral patches have

extensive rubble areas, especially in the central portion of the patch.

White Bank Dry Rocks, although located further offshore, is similar to the other patch reefs although somewhat more consolidated. It shares none of the outer reef features despite its more seaward position.

Turtle Grass and Hard Bottom

Six of the sites were inshore of the Sanctuary on sea grass meadows or low hard bottom bars. The locations of the sites were chosen to represent areas of heavy to moderate or nearly no boat use. Sites at Ocean Reef, Turtle Harbor and Rock Harbor were on turtle grass meadows. Sites at Point Elizabeth, North Channel and South Channel were mixed turtle grass and hard bottom.

The hard bottom at these inshore sites was formed of low, flat rock bars of Key Largo Limestone. Where this limestone is exposed, it supports a fauna of sponges, alcyonarians, and corals as well as rock dwelling algae.

Four of the inshore sites have considerable boat traffic. In increasing order they are (1) Ocean Reef located off the Ocean Reef Club and its marina, (2) North Channel with considerable yacht and commercial traffic out of Largo Sound and Garden Cove Marina, (3) Rock Harbor with boat traffic out of the several marinas in the area and (4) South Channel which bears the traffic from Pennekamp Park Marina and Largo Sound.

The sites at Point Elizabeth and Turtle Harbor were chosen as representing areas with very little boat traffic and which could therefore be used for comparison with areas of heavy use.

RESULTS

Site 1. Molasses Reef

Molasses Reef lies on the outer edge of the reef line approximately 5.5 nautical miles off Key Largo. It is composed largely of coral rubble of which the highest point, "Molasses Hump," is exposed on low spring tides. The reef crest has extensive growths of alcyonarians but few live corals. It appears similar to conditions 50 years ago.

Three transects were made across the reef, all about 600 m long on headings of 308° true (Fig. 3). The reference point for the transects is the iron pipe just back of the reef and northeast of the light. Transect 1 ended at the pipe. Transect 2 was parallel to Transect 1 and 300 m west. Transect 3 was 300 m to the east.

Transect 1 (Fig. 4.1) was about 625 m long and extended from 16 m depth shoreward to the pipe on the reef flat. The first 60 m was hard bottom with rubble and a thin layer of white sediments. The fauna was primarily low scattered colonies of alcyonarians, sea feathers and sea whips, and occasional small colonies of finger corals, Porites, and star corals, Montastrea. At about 225 m the reef face rose upward to about 5 m depth over a distance of about 50-75 m. This area was covered with small clumps of elkhorn coral, Acropora palmata, sea feathers, and numerous sea fans, Gorgonia ventalina. At about 280 m the reef contour dipped a few meters and then rose to the reef flat at a depth of about 3-4 m. From about 300 to 450 m the bottom was formed of large rubble with silty sand. This rise was covered with sea fans and occasional large bushy sea feathers but in the last 50 m the sea fans and sea feathers were small and poorly developed. The remaining 150 m of the transect was over sea grass beds. A few large vase sponges were seen in the area.

Transect 2 (Fig. 4.2) began in 17.5 m depth and was about 525 m long. The bottom for the first 200 m was mainly hard with much rubble and occasional small sand patches. This area was very similar to that in Transect 1 but sponges,

alcyonarians and small coral colonies were much more numerous. Vase sponges were conspicuous, scattered sea fans occurred below their usual 7 to 9 m depth, and stinging corals were found in patches. There were occasional small colonies of finger corals, Porites, and brain corals, Meandrina and one colony of Stylaster roseus was seen. At 200 m the contour dipped about 3 m and the bottom was clean sand followed by numerous small rubble until the reef crest was reached at about 250 m. The crest of the reef consisted of hard bottom and rubble with numerous sea fans, feathers and clumps of a bushy red alga. At about 310 m the bottom was covered with small rubble in which were small sea feathers and sea fans. At about 360 m the bottom flattened out in about 8 m depth and was formed of densely packed stag horn coral, Acropora cervicornis rubble with scattered dwarfed alcyonarians. As there is now very little live staghorn coral on Molasses Reef, this rubble may have come from a more luxuriant growth in earlier times.

Transect 3 (Fig. 4.3) began in 16.5 m depth and for the first 75 m was over a rather smooth rubble bottom with a thin veneer of silt. It supported a sparse growth of sponges, alcyonarians and algae. At about 75 m the bottom changed abruptly to a clean grayish white fine sand with only a few scattered small sea whips and an occasional small Porites. This continued to about 200 m where a little small rubble appeared, patches of red alga Galaxaura and small balls of a green filamentous alga. The bottom trended upward with slightly increasing surface growth until at 425 m at a depth of about 7 m a ridge of scattered, poorly developed elkhorn coral, Acropora palmata occurred for about 50 m. From 475 m shoreward the bottom continued to shoal with rubble and sand and scattered small sea fans, sea feathers and sea whips.

In general the seaward side of Molasses covered by the transects can be characterized as a fore reef slope rising from 17 to about 7 m composed of hard

bottom on which are found green and red algae, scattered alcyonarians and vase sponges. A band of elkhorn coral, Acropora palmata and sea fans is found on the reef face at about 7-8 m depth and across the top of the reef. Although not encountered on the transects, the reef crest also had numbers of the common star coral, Montastrea annularis, and other stony corals. Shoreward of this crest is a broad reef flat formed of large rubble and numerous sea fans. Sea grasses grow close to the reef on the shoreward side.

At this site three additional transects were made in 1981 (see Appendix A, site 18) extending from about 18 m depth downward and offshore to a depth of about 30 m. Comparing the profiles with those of Jameson (1981) at French, the Elbow and Carysfort reefs, the area covered was along the upper reef slope shown as a blank area on Jameson's pictorial profiles.

The three Molasses Reef profiles are very similar. Each transect was 60 m long up the slope face. Thus the horizontal distance was somewhat shorter. Within this distance the slope rose approximately 12 m.

The slope is formed of hard bottom, sand and mixed large and small rubble, with many open clear spaces. Growing on the slope were large, scattered colonies of Montastrea and other head forming corals, some small patches of Acropora cervicornis, sponges of which the most prominent were large Xestospongia muta and Agelas sp., numerous large sea feathers and fans, and patches of green, brown and red algae.

It is probable that at the base of this slope at about 30 m depth the bottom flattened out in a sand terrace before turning downward again in the deep reef zone.

Site 2. White Bank Dry Rocks

White Bank Dry Rocks consists of a cluster of patch reefs and slightly elevated areas of hard bottom surrounded by an extensive area of turtle grass meadow. It lies well back from the outer reef margin but because of its low profile hardly warrants being termed a true lagoon patch reef.

Because of its highly irregular formations and clustering, transects across White Banks do not show profiles that parallel each other as on a single reef entity. Three 400 transects (Fig. 5) were run shoreward from the outer edge of the bank on headings of about 298° true.

Transect 1 was the northeasternmost (Fig. 6.1). It started at a depth of 9.5 m and for the first 165 m shoaled to about 8 m depth. The first 165 m was rather smooth and consisted of turtle grass beds. In some areas these were dense. In others the plants were sparse with areas of silty sand. Small amounts of manatee grass are present as well as scattered plants of the calcareous alga Halimeda incrassata and the shaving brush alga Penicillus capitatus. There were few sponges. From 165 m to 253 m the bottom shoaled to a depth of about 3 m. From the turtle grass area to the top of the rise the bottom was formed of cemented rubble, loose rubble, and sand. This section was dominated by various alcyonarians, mainly sea feathers, Pseudopterogorgia, sea whips such as Muriceopsis, and corals, Siderastrea. At the top of the reef in 3-4 m the gorgonian zone was reached. This is characterized by numerous colonies of sea fans, Gorgonia ventalina, patches of staghorn coral, Acropora cervicornis, stinging coral, Millepora, and the brown alga Stypopodium zonale.

At about 335 m the depth increased slightly and the bottom was again covered with turtle grass for about 40 m. The transect ended in about 25 m on hard bottom formed of rock, small rubble, small colonies of the starlet coral, Siderastrea, sponges and sea whips.

Transect 2 (Fig. 6.2) began in 5.4 m depth on the offshore edge of a well developed patch reef that rose to a depth of about 3 m across the top. The first 25 m was composed of patches of staghorn coral of Acropora cervicornis, sea whips, and sea fans. This continued for 125 m with occasional large heads of common star coral, Montastrea annularis, finger corals, Porites, and starlet coral, Siderastrea siderea, stinging corals, sea feathers and sponges.

At about 125 m and for the next 35 m the transect crossed a patch of large common star coral, Montastrea annularis forming a patch reef. Beyond this point the transect crossed over a thick turtle grass bed with manatee grass, the calcareous alga Halimeda, sea biscuits and occasional mollusks. At about 350 m another patch of low hard bottom and rubble occurred with low colonies of staghorn coral, Acropora cervicornis, Pseudopterogorgia, Gorgonia and corky sea fingers, Briareum asbestinum. The transect ended in turtle grass near the 400 m marker.

Transect 3, the southwestern transect, started in 8.5 m on a small area of hard bottom in the midst of a turtle grass bed (Fig. 6.3). It contained a few sponges and small sea whips. The meadow extended for about 145 m where the bottom rose to a depth of 3 m which was maintained for the remainder of the transect. The top of the reef was composed of large, extensive patches of staghorn coral, Acropora cervicornis, sea whips, and occasional large heads of the common star coral, Montastrea annularis and starlet coral, Siderastrea siderea. At about 175 m sea fans became conspicuous as usual at this depth and exposure. The bottom was rocky, hard, with cemented and loose coral rubble and scattered sand patches.

The reef ended at about 375 m in the usual turtle and manatee grass meadow.

Site 3. French Reef

French Reef lies 5.7 nautical miles directly offshore of the south entrance to Largo Sound. It is on the edge of the drop-off into the Straits of Florida and is bathed by the edge of the Florida Current. Despite its offshore position, French Reef has little live coral growth and, like Molasses, is primarily formed of coral rubble on an old coral reef base.

Three transects, one of over 700 m, were run at this site (Fig. 7). The base line transect, Transect 1, was run on a heading of 308° true and at 49 m passed immediately by the piling or stake on the reef flat shown on the chart. Transect 2 was run parallel to Transect 1, 300 m to the southwest, while Transect 3 was 300 m to the northeast. It is difficult to relate the three transects. 1 and 2 have similar profiles for about the first 250 m. The profile for 3 is very different and one could consider that the offshore end of 3 might be compared with the area at about 100 m on the other two. The difference is probably due to the small size of French Reef.

Transect 1 (Fig. 8.1) began in 18.5 m depth on a hard bottom with star corals, Montastrea, sponges, small alcyonarians, and algae. This broken, partially rubble bottom with sea feathers, sea whips, tube sponges and corallines slowly shoaled to 14 m depth on a ridge 75 m from the start. Here the bottom dropped sharply away for about 3 m and then shoaled again to 7 m depth on a rather narrow ridge. The bottom from the first ridge to the second was sediment-covered flat rock with scattered sponges, stinging coral and small sea whips and sea fans. A few scattered heads of starlet corals, Siderastrea, and finger corals, Porites were seen. A few small patches of staghorn coral, Acropora cervicornis were noted. Loggerhead sponges were common. The bottom up the slope was smooth rock with some rubble, most overlaid with white calcareous sand.

At 180 m the crest of the second ridge rose to within 7 m of the surface. It

was covered by large sea fans, Gorgonia ventalina, and patches of elkhorn coral, Acropora palmata, and large heads of common brain coral, Diploria strigosa. The ridge dropped away by 4 m to a white sand bottom with scattered patches of Agaricia, Porites and stinging coral, and some rubble with bushy red algae.

At about 215 m another irregular ridge occurred that was covered with sea feathers and small coral heads. It was topped at 250 m by another area of elkhorn coral, Acropora palmata. This area was followed by a wide expanse of calcareous sands that shoaled slowly to rubble bottom with alcyonarians and occasional sponges, followed by other areas of sand. The crest of the reef was reached at about 425 m and for the next 100 m was rubble, scattered sea feathers and numerous sea fans. About 50 m beyond the stake the bottom changed to small rubble, few scattered and stunted sea whips and small patches of algae. Most of the rubble in this area was formed of old sections of elkhorn coral, A. palmata.

Transect 2 (Fig. 8.2) began in 16.8 m depth on hard bottom overlaid by calcareous sand and old coral rubble. The first 60 m was covered by heads of Montastrea annularis, tube sponges and sea feathers. At about 60 m the bottom fell away to open sand and rubble. The bottom then shoaled slowly to about 7 m depth at 175 m distance. The bottom changed to rubble with patches of red and green algae, a few small coral heads, occasional sponges and small whips. At about 175 m the second ridge was formed of rubble with some sea feathers and patches of algae, especially long streamers of Gulf weed, Sargassum. The bottom then changed to small rubble, dipped downward 4 m depth and then rose again. The raised area at about 215 m was the reef crest and from 235 to 300 m it was covered with sea feathers, sea whips and sea fans on a flat rubble bottom. At about 300 m the alcyonarians thinned out, the bottom was flat with small coral heads with occasional small stunted sea whips and patches of red and green algae.

Transect 3 (Fig. 8.3) began in 15 m depth on hard bottom. The first 85 m

was flat, covered with rubble, scattered coral heads of starlet corals, Siderastrea, sea feathers and Gulf weed, Sargassum. At about 60-65 m the bottom changed to large rocky areas with large coral heads and large bushy sea whips. This continued to the base and up the walls of the rise at 85 m. On top of the rise for the next 500 m the bottom was nearly flat, shoaling slowly from 12 to 4 m depth. Throughout this area the bottom was hard rock overlaid by calcareous sediments and small rubble. A few small patches of staghorn coral, Acropora cervicornis, occurred at about 100-125 m. Beyond this the only corals were of little heads of Favia, Porites and Siderastrea, a few small scattered sea feathers and sea whips, sea fans and scattered sponges.

At 625 m the bottom rose again to between 1-3 m depth and for the first 50 m numbers of sea fans, Gorgonia ventalina, were noted. Beyond this the bottom became filled with fine small rubble and slowly tapered off into sea grasses.

The three transects each started at about 18 m depth on hard bottom with Montastrea, sponges, alcyonarians and algae. As the bottom to seaward shelves downward the hard bottom gives way to a terrace covered with calcareous sand. At about 28 m the Deep Coral Reef begins and extends downward to about 45 m where the lithothamnion cobble zone occurs. Jameson (1981) stated that the deep reef is continuous with the shallow reef but neither his pictorial profile nor depths agree and show the two reefs separated by a broad area of bare sand. The reef face contour is much more irregular than is indicated in Jameson's Figure 13.

Site 4. Mosquito Bank

Mosquito Bank is located directly offshore of the town of Key Largo in the middle of the bank southeast of the south entrance to Largo Sound. It is marked by a lighted beacon "35." On the east is a 6 m deep, white sand channel separating White Bank from the shallow inshore bank covered by sea grass.

Three 400 m transects were run on a heading of about 303° true across the bank and 300 m apart. Transect 1 was the northeastern, Transect 2 the middle and Transect 3 the southwestern one (Fig. 9).

Transect 1 (Fig. 10.1) started in 3.7 m depth in sea grass. At about 75 m the bottom shoaled to 1.8 m depth on a hard bottom ridge or bar occupied by scattered starlet coral, Siderastrea, finger coral, Porites, stinging coral, sea feathers, sea whips and sponges. At 110 m the bottom dropped off to 3.7 m depth in beds of turtle grass and manatee grass. These continued to the end of the transect. The fauna and flora were typical of sea grass habitats.

Transect 2 (Fig. 10.2) started in 2.7 m depth on a ridge of hard bottom among rubble, sea feathers and sea whips. At 25 m the bottom deepened to around 4 m in sea grass for 175 or so meters. At 235 m another low hard bottom bar was crossed. It was covered by starlet coral, Siderastrea, brain coral, Colpophyllia, and sea feathers and sea fans. At about 270 m the bottom was again covered by sea grass and remained so to the end of the transect.

Transect 3 (Fig. 10.3) also began on a bar in 3.4 m depth. The first 5 m was over sand and rubble with sea feathers and whips. From 6 m to 210 m the bottom was covered by sea grasses and their associated fauna. At 210 m another bar was crossed. This had starlet coral, Siderastrea, star coral, Dichocoenia and finger coral, Porites, stinging coral, sea feathers and sea whips, various sponges and red and green algae. At 250 m the transect crossed over sea grass meadows and continued so to its end.

Unfortunately, part of the film on both transects 2 and 3 were exposed and photos are unavailable for the inshore parts of both transects.

Site 5. Grecian Rocks

Grecian Rocks is a small cluster of patch reef located somewhat inshore of the outer reef line. It is bordered by grass meadows on the shoreward side but to seaward the bottom drops off onto clear silty sand or calcareous mud. A privately maintained buoy WOR "E" is anchored just inside of the reef.

Three 400 m transects were run on a heading of 308° true, 200 m apart and parallel to each other (Fig. 11). Transect 1, the middle one, was run on a line with the buoy and the microwave tower. Transect 2 was southwest; Transect 3 was northeast of Transect 1.

Transect 1 (Fig. 12.1) began in 10 m depth on smooth clean silty sand with occasional small bits of rubble and little mats of algae. With little change in depth this bottom continued for the first 125 m. Large rubble then began to appear along with scattered, straggly sea whips and small coral heads. The bottom shoaled and at a depth of about 4 m sea fans appeared along with colonies of stinging coral. At about 175 m coral heads were common but at 180 m these gave way to large masses of elkhorn coral, Acropora palmata, at a depth of about 1 m. A. palmata was distributed in large clumps or sparsely for the next 120 m with occasional breaks of sand or rubble, finally rising to within .5 m depth of the surface. At about 310 m the corals ended in scattered turtle grass, first in rubble and then in deep sandy mud.

Transect 2 (Fig. 12.2) began in 9.5 m depth on a clear sand bottom with only small patches of matted algae and occasional green algae. At about 100 m the bottom changed with a few scattered alcyonarians on large rubble. At 125 m the bottom shoaled and at 6 m depth the first sea fans appeared along with patches of stinging coral. Only a few scattered Acropora palmata and Porites with sea feathers and sea whips occurred until about 235 m at a depth of 1.1 m when large areas of Acropora palmata appeared and continued to about 325 m where the corals

ended abruptly, the bottom dropped off to about 2.5 m depth and the transect ended over sea grass beds with several patches of nearly pure stands of Syringodium. Almost no Acropora cervicornis was seen on this transect.

Transect 3 (Fig. 12.3) began in 10.5 m depth on a small patch of hard bottom and rubble with a few coral heads and sea whips. The bottom then levelled off at about 11.5 m depth and except for some scattered turtle grass at about 100 m continued on smooth sandy silt to about 175 m where the bottom rose in a series of steps. At 180 m a considerable patch of Acropora cervicornis appeared along with a few sea fans, a small patch of A. palmata and some coral heads. This was followed by a few meters of open sand after which the bottom again shoaled. At about 6 m depth numerous sea fans appeared along with scattered stinging coral. At 265 m and a depth of 4 m a large patch of A. palmata formed the second crest. The bottom then fell away to sand and then shoaled onto the reef crest proper at about 3 m depth. For the next 50 m the reef was covered by a dense stand of Acropora cervicornis with a few large Montastrea heads. The last 50 m of the transect was over sea grass beds.

The zonation shown on the profiles (Figure 12) correspond roughly to that shown by Shinn (1980, Fig. 2) of Grecian Rocks: an offshore rubble zone, a low terraced Millepora and Montastrea zone, a second terrace for the Acropora zone, the reef flat and back reef. Shinn showed a strong spur and groove system on the seaward reef face not shown in the present profiles. Otherwise the two studies show similar features including the rich Acropora stand in the reef flat.

Site 6. Key Largo Dry Rocks

Largo Dry Rocks has one of the most extensive coral growths within the Sanctuary and Park area. While many forces were acting upon it during the period from the 1940's to its integration into the Park, the reef has withstood them well: hurricanes, coral collectors, reef fish collectors, observation tower builders, and many others.

The north central area is formed of jumble of old reef and large coral rubble honey combed with passages and open spaces. Some of the old rock bares out at low tide, formerly marked by a stake. South of this is a broad expanse of elkhorn coral, Acropora palmata, and staghorn coral, A. cervicornis, probably the best in the Park. Offshore the reef is bounded by clear sand bottom at a depth of about 11 m. Inshore the sea grass beds extend shoreward in an almost unbroken expanse.

Three 400 m transects were run across the reef on a heading of about 278-298° true (Fig. 11). Transect 1 was run past the Dry Rocks buoy "D." Transect 2 was 300 m to the northeastward and Transect 3 was 300 m to the southwestward of Transect 1.

Transect 1 (Fig. 13.1) began in 10.7 m depth on deep, clear, silty sand or coral mud which extended for about 60 m. The bottom contained some rubble and small patches of algae. The bottom rose to within 4 m of the surface and on its top were a few sea fans and sea whips. At 75 m the bottom fell away to white sand at 7.6 m depth but immediately started to rise, with large brain coral heads, Colpophyllia natans, sea whips and rubble. At 110 m Acropora palmata began to appear and covered the bottom as it shoaled to 1.5 m depth at 130 m. The reef was nearly flat for the next 125 m, the entire top covered with Acropora palmata with large patches of A. cervicornis. Occasional rubble with sea feathers, sea fans and sea whips, was interspersed. The tops of the coral formed a flat expanse that lay just a few centimeters from the surface, controlled apparently by sea level at low

spring tides. At 265 m the inner edge of the reef dropped off abruptly to sea grasses that extended to the end of the transect.

Transect 2 (Fig. 13.2) began in 10.4 m depth on a sandy turtle grass area that extended for 250 m, varying from sand patches to dense sea grass. At 250 m the bottom shoaled to about 6.5 m depth and a small area about 100 m wide had a moderate to lush growth of Acropora cervicornis interspersed with sea whips and an occasional sea fan. A small rubble area led into sea grass which extended to the end of the transect.

Transect 3 (Fig. 13.3) began in 9.1 m depth on the seaward slope of a small rise. The bottom was covered with large rubble and silt with small clumps of green algae. The bottom rose and levelled off at 6.1 m depth where some large patches of A. cervicornis occurred for about 35 m. These ended in the middle of the rise on sand bottom. The bottom then fell away at 60 m distance to a depth of 9 m for only a short distance and then rose to level off at 7.6 m depth on sandy, silty bottom. This region extended for 200 m on bare sand with only occasional scattered patches of turtle grass and small clumps of algal mats. At about 310 m the bottom again rose slightly to 6.1 m depth where another 30 m patch of Acropora cervicornis and a few sea fans were found on the seaward slope. At 350 m the bottom changed to sea grasses which extended to the end of the transect.

Site 7. The Elbow

The reef known as the Elbow is located directly offshore of Garden Cove on the outer edge of the reef line. It is unusual in that it lies apart from the shallow bank and is surrounded to the north, west and south by waters at least 10 m deep and to the eastward by an abrupt drop-off to over 30 m. It is mainly composed of old coral rubble piled atop the old reef base on which some corals have become established. There is an old wreck on the reef now indicated by parts of the hull, boilers and engine.

Three transects (Fig. 14) were run across the reef. Transect 1 was made on a heading of 278° true and passed alongside of the light, crossing over the wreck at approximately 430 m from the start. Transect 2 was parallel to Transect 1 but 300 m to the southwest. Transect 3 was 300 m to the northeast.

Transect 1 (Fig. 15.1) began in 18.3 m depth on hard bottom with a thin covering of white sediments. The flora consisted mostly of green algae such as Dictyota, Dilophus, Enteromorpha, and filamentous greens, brown algae, Pocockiella, various red algae and corallines. Alcyonarians such as sea feathers and sea whips were mostly low but some grew to .7 to 1 m high. Sponges, mostly vase and tube sponges, were scattered. There were a few small patches of staghorn coral as well as scattered heads of Siderastrea, Porites, and others. Hard bottom extended for about 250 m where a series of ridges bore colonies of large bushy alcyonarians. Shoreward of the ridges the bottom dropped to about 10 m depth and was sandy with a little rubble and an occasional sea whip. At 425 m the transect crossed over the timbers of the wreck lying on a small ridge. At approximately 480 m the reef crest was reached with a small area of elkhorn coral in 3.7 m depth. Shoreward of the Acropora the bottom dropped to about 5.5 to 6.0 m depth and was covered by rubble of which the inner part was made up of rod-like rubble formed by dead Acropora cervicornis. The transect ended in sea grass beds.

Transect 2 began in 16.5 m depth on hard bottom (Fig. 15.2). This shoaled steadily with only minor small ridges for about 350 m. The hard bottom was very rich, covered with algae, sponges, alcyonarians, corals, and other sessile life, but with no Acropora except for a small patch of A. cervicornis near the start. At about 325 m in 6 m depth the sea fan zone began and extended to the end of the transect at 550 m. Despite its extent, there was no Acropora on the reef top and very little stinging coral. The transect ended just short of the sea grass beds.

Transect 3 (Fig. 15.3) began in 13.7 m depth on hard bottom with rubble and sediments. This transect missed the reef top and ran for 400 m in a series of low ridges and sand areas. The bottom was sparsely covered with algae and occasional small alcyonarians, sponges and few little coral heads.

The deep reef survey (Jameson, 1981, Fig. 14) depicted a sand/soft (horny?) coral zone lying between the shallow reef and the deep reef. This is undoubtedly a continuation of the sand covered hard bottom described above. This zone characteristically is found between ridges on the fore reef slope but is not indicated in the somewhat diagrammatic figure given by Jameson. Seaward, the deep reef extends down to about 40 m where it gives way to corraline algae and leafy algae. Jameson remarked that at both French Reef and the Elbow "the deep reef extends to 39.6 meters (130 feet) but the majority of the reef formation is found at depths less than 36.6 meters (120 feet)." While this is true at the Elbow, the 36.6 m contour is found approximately in the middle of the deep reef zone at French Reef.

Site 8. Carysfort Reef

Carysfort Reef is located on the outer edge of the bank at the edge of the drop off into the Straits and is swept by the oceanic waters of the Florida Current. It is marked by Carysfort Light, formerly with a keeper and assistants but now untended. The reef proper is less than 600 m long although the shallow rocky bank on which it is located is about three quarters of a nautical mile in length.

Transect 1 was 785 m long, it was run on a heading of 293° true on Carysfort Light which it passed at about the 665 m mark. Transect 2 was 300 m to the northeast while Transect 3, only 200 m long, was 300 m to the southwest (Fig. 16).

Transect 1 (Fig. 17.1) started on hard, silt covered bottom in 16.8 m depth. The bottom shoaled slowly to about 8.5 m depth at 235 m across a rock ridge and then fell away to 16.8 m depth before again ascending. From the start to approximately 300 m the bottom was rocky with small rubble covered by a thin layer of white silt. Viewed from above in the camera shots the bottom had a mottled or "salt and pepper" appearance but from the bottom it had growths of red and green algae and small sea whips that gave it a "shaggy" look. The fauna and flora were composed mostly of green algae such as Halimeda, Dictyota and Dilophus as well as filamentous greens and occasional reds. Sponges, alcyonarians such as sea whips, and corals were scattered about among the algae.

At about 300 m the bottom became a narrow trough and was typically covered by bare white silty sand. At about 365 m the bottom rose toward the reef crest. The bottom was hard with small to large coral rubble, and with alcyonarians, mostly sea whips but some sea feathers, sponges, stinging coral, a few coral heads and scattered small patches of Acropora cervicornis. At about 460 m the first sea fans, Gorgonia ventalina, were seen and at 480 m the transect crossed a small patch of Acropora palmata. From there to 560 m was a rich sea fan zone which gave way for about 40 m to extensive beds of stinging coral. At

approximately 600 m and at a depth of 2.1 m an extensive area of Acropora palmata, 80 m wide, broke to the surface opposite the Light. Immediately inshore the back reef of rubble and sand blended into the sea grass meadows.

Transect 2 (Fig. 17.2) began in 17.1 m depth on hard bottom covered by a thin layer of silt and some rubble, the area corresponding to the first part of Transect 1. The bottom slope and coverage were similar to Transect 1 except that the dip shoreward of the first ridge was longer and flatter with an expanse of bare sand nearly 150 m across. At 400 m the bottom began to shoal and was characterized by a conspicuous sea feather and sea whip zone followed at 475 m in 6 m depth by the sea fan zone that continued to 560 m. Here a small stand of elkhorn coral was followed by a rather broad area covered predominantly by stinging coral. The transect ended in small rubble thinly coated by white sediments with occasional small individual sea fans and sea whips. This was followed by sea grass meadows.

These two transects were very similar and clearly show the basic zonations of the outer reef tracts: (1) a deep hard bottom zone shoaling into (2) a rubble, sea feather and sea whip zone, giving way (3) to the sea fan zone usually starting at 6-7 m depth and extending across the reef top interrupted (4) on some reefs by a broad Acropora zone. This zone ended (5) in the back reef area formed of coral rubble and small sea whips and sea fans, terminating (6) in the thin sediment sea grass beds.

Transect 3 was only about 200 m long (Fig. 17.3). It started at a depth of 21.9 m on sandy bottom that must lay back of an offshore ridge. The bottom shoaled rapidly and steeply on a hard bottom zone to 5 m depth where the sea fan zone began. This zone continued across the shoal reef top and down the inshore side to the end of the transect. The reef crest contained large beds of stinging coral with only limited areas of elkhorn coral. This transect ran across the southwest end of the reef where the profile showed that it dropped off into the deeper water separating Carysfort Reef from the main bank of the Hawk Channel.

Bannerot and Schmale (this volume) report an extensive thicket of Acropora cervicornis at approximately 14 m depth off of Carysfort Reef, within the purview of this report. Jameson (1981) also reported that the deep reef off South Carysfort, in about 26 - 34 m depth was "also unique in that the common shallow reef staghorn coral, Acropora cervicornis, is present." However, it is not shown in his Figure 15. The deep reef off Carysfort is not as wide as at the other reefs, the slope is less but there is a stronger terracing of the "Lithothamnion cobble zone."

Site 9. Basin Hill Shoals

Basin Hill Shoals is an area of small patch reefs and shallow hard bottom bars located slightly south of a line between Point Elizabeth and Carysfort Reef. It is approximately halfway from shore to the edge of the outer reef. It is surrounded by turtle grass meadows at depths from about 3 to 5 m.

Three 400 m transects (Fig. 18) were run on headings of 288° true across the patch reef area. Transect 1 was started at 4.3 m depth and ran shoreward, ending at day marker BH19. Transect 2 was run on the same heading and parallel to Transect 1, 300 m to the southwest. Transect 3 was parallel to 1 and the same distance to the northeast.

Transect 1 (Fig. 19.1) passed over turtle grass for the first 90 m. The grass was lush, with long, broad blades. There were scattered sand mounds. Some Syringodium was present. At about 90 m the transect passed over a small patch reef composed of the common star coral, Montastraea annularis, the starlet coral, Siderastrea siderea, sponges and sea whips on rubble partly covered by silt. The reef was about 25 m across followed by about 25 m of turtle grass. At about 135 m another small patch reef about 15 m wide was crossed over. This consisted of large coral heads with small alcyonarians. Another 70 m of turtle grass ended with another patch reef about 20 m wide consisting of Montastrea and alcyonarians. This was followed by an expanse of turtle grass about 25 m across and a fourth patch reef. The latter was 25 m wide and composed of large heads of Montastrea with alcyonarians and sponges on silt covered hard bottom. From this point on the bottom was almost entirely covered by turtle grass except for patches of alcyonarians at 275 and 300 m. The grass beds extended to day marker BH19 at the end of the transect.

Transect 2 (Fig. 19.2) began at a depth of 6.0 m on silty mud with a sparse growth of Thalassia and numerous sand mounds. Moving shoreward, the turtle grass

increased in spread and density, with longer and wider blades. Sand mounds averaged 3-6/m^2. No macroorganisms were found except for a few scattered loggerhead sponges, Spheciospongia vesparia, a few isolated alcyonarians, worms and the tiger lucina, Codakia. In some areas there were a few Syringodium patches; this grass was scattered among the turtle grass.

At about 330 m the transect crossed a narrow hard bottom bar covered by bare sand, about 20 m wide. A few large heads of the common brain coral, Diploria strigosa, bushy alcyonarians and sponges were seen. The inner edge of the bar had small colonies of either Porites or Siderastrea all in apparent good health.

Transect 3 began in 5.2 m in turtle grass beds (Fig. 19.3). These extended shoreward for about 250 m, often mixed with manatee grass, Syringodium, which occasionally grew in thick patches or predominated over the turtle grass. At 250 m a patch reef occurred, formed mainly of Montastrea annularis, sea feathers, sea whips, and sponges. This patch was about 20 m wide. Turtle grass and manatee grass were common and their beds extended from the inner edge of the reef to the end of the transect, accompanied by few scattered sponges and the usual grass meadow calcareous algae.

Bannerot and Schmale (this volume) report an extensive thicket of Acropora cervicornis at approximately 14 m depth off of Carysfort Reef, within the purview of this report. Jameson (1981) also reported that the deep reef off South Carysfort, in about 26 - 34 m depth was "also unique in that the common shallow reef staghorn coral, Acropora cervicornis, is present." However, it is not shown in his Figure 15. The deep reef off Carysfort is not as wide as at the other reefs, the slope is less but there is a stronger terracing of the "Lithothamnion cobble zone."

Site 10. Turtle Rocks

Turtle Rocks is located offshore of the Ocean Reef Club on a point of shoals forming the eastern side of Turtle Rocks Anchorage. It is surrounded on all sides except the south by depths of 10 m or more. It is unprotected from the east and the waters of the Florida Current.

Three 400 m transects (Fig. 20) were run parallel to each other and 300 m apart. Transect 1 was run on a heading of 238° true almost due east of marker "6." Transect 2 and 3 were progressively farther north.

While this area is called Turtle Rocks, it does not contain true patch reefs and the National Ocean Survey chart 11462 shows no coral patches at this location.

Transect 1 began in 3.0 m depth (Fig. 21.1) on hard bottom covered with white calcareous sands or silt. This bar covered about 55 m. Corals consisted only of a few small colonies of Porites. The other fauna consisted of stinging corals, the alcyonarians Pseudopterogorgia americana and Plexaurella mammosa, a few low sea whips, the sponge Iotrochota birotulata and various corallines. The main part of the transect was over sea grass beds, much of which was sparse and somewhat muddy. At 300 m a little hard bottom was encountered with a few low sea whips. The last 40-50 m was sandy with sparse grasses and an occasional vase sponge.

Transect 2 began in 6-8 m depth (Fig. 21.2). The bottom gradually shoaled until at 65 m it levelled out at about 4.6 m depth for the rest of the transect. For the first 25-30 m the bottom was rocky overlain with a thin layer of calcareous sand in which were a few scattered alcyonarians, mainly sea whips. The rest of the transect was over sea grasses growing thickly or thinned out in sand patches. A few small colonies of Porites, scattered sponges and the usual grass associates made up the grass beds formed of turtle and manatee grasses.

Transect 3 (Fig. 21.3) began in 3.0 m depth on hard bottom and shoaled in

25 m to a depth of 1.8 m which was continued for 125 m across a shoal hard bottom bar. The bar was rock overlain by a thin layer of calcareous sand and silt. Growth on the bar consisted of alcyonarians, scattered patches of Acropora palmata and A. cervicornis, Porites, Siderastrea and Montastrea growing on flat rock and coral rubble. The rest of the transect was over beds of turtle and manatee grasses with their associated algae and invertebrates.

While the transects were not very productive in quantity and diversity, both the grass and coral quadrats were very rich.

Site 11. Ocean Reef

This site lies just offshore of the Ocean Reef Club at the north end of Key Largo. Three 400 m transects (Fig. 22) were made at a nearly constant depth of 4 m. Transect 1 was run on a heading of 288° true and ended 500 m from navigation marker "2," bearing 288° true. Transect 2 was parallel to Transect 1 and 300 m to the northeast. Transect 3 was 300 m to the southwest of Transect 1.

The entire area (Fig. 23) was covered by an almost pure stand of Thalassia within which no Syringodium was seen. This seems to indicate that this was a mature, unstressed Thalassia meadow. The grass blades were long and wide and appeared healthy. The entire area was closely peppered with sand mounds often averaging 3-4/m^2.

Algae were not plentiful and were nearly restricted to Halimeda monile, H. tuna and H. incrassata, shaving brush alga, Penicillus capitatus and Rhipocephalus phoenix. Few sponges were seen. Those present were the green sponge Haliclona viridis, chicken-liver sponge, Chondrilla nucula and an unidentified demospongiid. One sea whip, Plexaura lamourouxi, represented the coelenterates.

Seven species of mollusks were noted. Of these, the tiger lucina, Codakia orbicularis must be considered common. Other invertebrates were a single starfish and some ascidians.

Site 12. Turtle Harbor

Three transects (Fig. 24) each 400 m long were made north or shoreward of Turtle Harbor Anchorage in from 4.5-6.6 m depth. The transect profiles were nearly flat. Transect 1 was started about 100 m inshore of navigation marker "27" on a range with Carysfort Light and was run on a heading of 318° true. Transect 2 was parallel to Transect 1 and 300 m southwest; Transect 3 was also parallel and 300 m to the northeast.

The Turtle Harbor site consisted of a lush turtle grass meadow (Fig. 25). The blades were long, wide, and appeared healthy. There was very little admixture of other species of plants, these being mainly Penicillus, Halimeda, Udotea and Avrainvillea, all nearly obscured by the grass blades. Very little Syringodium was present.

One large loggerhead sponge, Spheciospongia vesparia, was recorded near the beginning of Transect 3.

A few tube worms were attached to the grass blades and one medusa worm, Loimia was recorded. There were very few sand mounds in the area except near the inshore end of Transect 3.

Transect 3 was somewhat more open because of the sand mounds and most of the algae noted were found on this transect as well as the mollusks, Codakia orbicularis, Laevicardium laevigatum and Linga pensylvanica.

A single holothurian, Actinopyga agassizi, and two sea urchins, Lytechinus variegatus, accounted for all of the echinoderms seen.

Site 13. North Channel

This site (Fig. 26) lies off Garden Cove, the northern entrance to Largo Sound. Three transects were run, each 400 m long. Transect 1 began at the base of marker "32" and was run shoreward toward the wreck on a bearing of 278° true. Transect 2 was run parallel to Transect 1, 300 meters to the southwest and Transect 3 a similar distance to the northeast. The depths varied from about 4.6 m at the offshore end to little more than 1.5 m depth as the transects passed over a rocky bar (Fig. 27). The bar is covered with a thin layer of white silty sand too thin to permit the growth of turtle grass but offering firm attachment for a wide assortment of inshore hard bottom algae and invertebrates.

The turtle grass beds offshore had the usual grass bed associates such as the algae Halimeda incrassata, H. monile, mermaid's wine glass, Acetabularia crenulata, mermaid's fan, Udotea flabellum, Avrainvillea nigricans, shaving brush, Penicillus, Rhipocephalus, and others. Sponges were represented by Aplysina cauliformis, green sponge, Haliclona viridis, Ircinia felix, chicken liver sponge, Chondrilla nucula and several others. Grass bed corals were represented by the rose coral, Manicina areolata, small finger coral, Porites divaricata and clubbed finger coral, P. porites. Sand mounds were present.

As the transects proceded shoreward the turtle grass thinned out and the bottom changed to an underlying hard rock covered over by a thin layer of silt and sand not deep enough for turtle grass rhizomes to develop. Wherever the rock or small stones were uncovered, various green algae such as Penicillus, Acetabularia, Dasycladus, Rhipocephalus, Anadyomene, Udotea, Caulerpa, Halimeda and others, and various reds such as Gracilaria, Laurencia, and Colpomenia partially covered the bottom. At this site only, the filamentous green alga Enteromorpha was common, noted throughout the hard bottom area. This alga is often considered as an indicator of various types of pollution or environmental stress.

Most notable of the algae was the brown Gulf weed, Sargassum pteropleuron, that grows profusely on top of the rock bar. In 1948 this sargassum grew so densely here and at South Channel that at low tide it formed a golden band along the sea surface and motor boats had difficulty getting through it because it fouled their propellers (Voss, 1948).

Sponges noted were two species of Ircinia, Aplysina cauliformis, several species of Spongia and Niphates digitatus. Vase sponges and loggerheads were seen in the photographic survey.

Only small inshore species of corals were present, Siderastrea siderea, Porites furcata and the stinging coral Millepora alcicornis but alcyonarians were numerous: Pseudoplexaura flagellosa, Pseudopterogorgia acerosa, and the sea whip Pterogorgia anceps.

Few mollusks were seen among which were Glycimeris, Chione and Arca.

Several species of polychaetes were found. Both amphinomids and sabellids were among the rocks. The golden tube worm, Cistenides gouldi, the star feather worm, Pomatostegus stellata and a Marphysa were identified.

A few ophiuroids were seen and Ophionereis squamata was collected. The common sea biscuit Clypeaster rosaceus occurred frequently.

Regrettably, the survey was not notified of the new development of Port Bougainville then being constructed inshore of the site. Park officials have stated that the proposed channel for the marina is west of the marker between it and the wreck in deep mud and turtle grass meadows. Transect 2 lies closest to this area. If Port Bougainville becomes active, transects should be made over the proposed traffic area to monitor changes to the turtle grass. The present survey should show changes if boat traffic follows the marked channel now in use.

Site 14. South Channel

Three 400 meter transects (Fig. 28) were made off the South Channel to Largo Sound. Transect 1 started at navigation marker "2" and ran shoreward on a heading of 328° true. Transects 2 and 3 were spaced 300 meters apart proceeding northeastward from and parallel to Transect 1. The general depth was 4 meters (Fig. 29). This area is used by boats coming out of Rock Harbor and Largo Sound as well as marinas along the shore. It offers deeper water for boats entering and leaving Largo Sound than is found at North Channel leading out of Garden Cove.

Near marker "2" the bottom was generally covered with turtle grass, fairly lush seaward of the marker but shorter leaved and more scattered as the sand layer above the underlying rock became thinner. The grasses were interspersed with Halimeda, various sponges, and with occasional mollusks, Codakia and Astraea.

At around 50 to 100 m the Thalassia beds gave way to the flora and fauna associated with hard bottom overlaid by a thin superficial layer of sediments. This hard bottom rock bar is a part of the same bottom encountered at North Channel but is deeper.

The bottom from this point shoreward for over 300 m showed little variation in life. The bottom was nearly covered with patches of low, matted, filamentous algae, both greens and reds. Throughout the area the bottom was peppered with small upright plants of Penicillus, Dasycladus, Batophora, Rhipocephalus and Halimeda and the fanlike Udotea, and Avrainvillea. Because of their upright growth pattern they frequently resembled miniature forests. Among these algae were single plants or patches of larger red algae, the prickly appearing Acanthophora and the knobby Laurencia. The latter sometimes breaks loose from its holdfast and forms floating mats on the bottom.

Sponges were not numerous. They consisted mainly of Ircinia campana and I. strobilina, Haliclona viridis and its associate the white sponge, Geodia gibberosa,

Aplysina cauliformis, Niphates, the little blue heavenly sponge, Dysidea etheria and occasional large loggerheads, Spheciospongia vesparia.

The corals encountered were all small. The starlet corals, Siderastrea radians and S. siderea were perhaps the most common along with small heads of the star coral, Favia fragum and pillars of the lobed star coral, Solenaster hyades. One of the most characteristic components of the bar was the alcyonarians. The large sea feathers were very scattered but the angular sea whip Pterogorgia anceps and certain others were prominent.

More mollusks were found here than in the other inshore locations. Nine species were listed in the quadrats of which the commonest was Arca zebra with Astrea tecta next. In the grass beds Codakia orbicularis was noted along with the turtle grass denizen Modulus modulus.

The variegated urchin, Lytechinus variegatus was moderately common and two ophiurans, Ophioderma rubicundum and the little striped Ophiothrix oerstedi were found in rocky crevices.

This site is subject to medium to heavy boating activity but this may not be responsible for the apparently poor health of the region as indicated by the condition of the turtle grass and the appearance of the hard bottom. The amount of filamentous algae present may have been a reflection of the long, warm summer. Certain algae bloom in late summer in this region and large areas of Largo Sound often used to be draped with filamentous algae near the end of the summer (Voss, personal observations). The present area should be monitored to determine if the condition noted is a long term or a seasonal change.

Site 15. Rock Harbor

Three 400 meter transects (Fig. 30) were run offshore of Rock Harbor immediately east of Rodriguez Key run on a heading of 278° true. The depth was nearly constant at between 2.7-4 m (Fig. 31). The bottom was silty sand covered by a growth of Thalassia with a small mixture of Syringodium. The bottom was thickly spotted with sand mounds about 15 cm in diameter probably made by a callianassid shrimp. The mounds showed in nearly every picture from the photographic survey.

Small plants of Halimeda incrassata were scattered throughout the transects with an occasional H. opuntia triloba and H. monile. Other green algae were Penicillus capitatus, P. dumetosus, P. lamourouxi, P. pyriformis, Acetabularia crenulata, Udotea flabellum, Rhipocephalus phoenix, Avrainvillea nigricans, Dictyosphaeria cavernosa, D. vanbosseae and the red alga Gracilaria sp.

Few sponges were seen and no large loggerheads. The chicken liver sponge Chondrilla nucula was sparse. Haliclona compressa, H. viridis, Ircinia strobilina, and I. felix were found on the transects as well as Aplysina cauliformis and a species of Tethya. Lissodendoryx sigmata was seen only once.

The corals were all characteristic of turtle grass beds. They included Porites divaricata, P. furcata and the tube coral, Cladocora arbuscula. One Manicina areolata, the rose coral, was noted in the quadrats.

While this area should have been suitable for the occurrence of bivalve mollusks, none were noted. Gastropods were present such as Astraea tecta, A. phoebia, Tegula fasciata and Calliostoma jujubinum.

Echinoderms were represented by the sea urchin Lytechinus variegatus, an ophiuroid, Ophioderma brevispinum, and a sea cucumber Astichopus multifidus. A tunicate, Didemnum candidum, was noted.

Because of the silty water, visibility was greatly reduced and therefore the photographic survey was poor.

Site 16. Point Elizabeth

Three 400 transects were run just offshore of Point Elizabeth (Fig. 32) in about 4 m depth. The bottom was deep silty mud/sand covered by a rather lush growth of Thalassia (Fig. 33). The bottom was pockmarked with sand mounds about 15 cm in diameter made by a callianassid shrimp of which none were seen or captured. These mounds averaged 2-3 in each square meter as can be seen in the survey pictures.

Scattered throughout the area were small plants of Halimeda of which H. opuntia triloba was most common followed by H. tuna and H. incrassata. Penicillus capitatus was also common.

Because of the deep silt substrate few sponges occurred; those present were mainly species of Haliclona and Callyspongia fallax. Surprisingly, no Chondrilla nucula, the chicken liver sponge, were noted. Worms were Eunice unifrons, terebellids and sabellids.

By far the most numerous large invertebrate was the bivalve mollusk Codakia orbicularis which was noted numerous times on all three transects. It was accompanied by four other bivalves, the common Chione cancellata, Diplodonta punctata, Linga pensylvanica, and Anadara notabilis. The gastropods Strombus raninus, Calliostoma jujubinum, Astraea phoebia and Modulus modulus, as well as a single octopod, Octopus joubini, were also seen.

Several unidentified holothurians and a single Lytechinus variegatus were listed.

More species of large organisms than those mentioned above may have been present but did not show in the photographs because of the poor visibility in the silt ladened and murky water.

Site 17. Angelfish Creek

The Angelfish Creek site (Fig. 34) is located offshore of Angelfish Creek between navigation marker "2" and the entrance to the creek. It is in a sea grass area and little variation was found over the area surveyed.

Three 400 m transects were run at the site. Transect 1 started at navigation marker "2" and was run inshore on a heading of about 278° true toward marker "PA" at the creek entrance. Transect 2 was run northeast of marker "2"; transect 3 was southwest.

Transect 1 varied in depth from 3 to 7 m. Transects 2 and 3 were on level bottom and maintained a depth of 6 m throughout.

All of the transects (Fig. 35) ran over lush sea grass meadows with no hard bottom except for the last 10 m of transect 1 which ended in a hard bottom area inhabited by sea feathers, sea whips, and some Siderastrea.

The grass appeared very healthy. There were considerable areas in which Syringodium formed a large percentage of the cover but Thalassia dominated most of the bottom.

The last 100 m of transect 2 does not show in the pictorial profiles as the film for this area was accidentally exposed.



Acropora palmata



Acropora cervicornis



Siderastrea spp.
Montastrea spp.



Diploria spp.



Millepora spp.



Sea whips



Sea feathers



Sea fans



Loggerhead sponge



Vase sponge



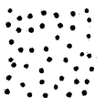
Sponge



Large rubble & silt



Small rubble & silt



Sand or silt



Algal patches



Hard bottom



A. cervicornis rubble



Sea grass



Sand mounds



Wreckage



Crevasses

Figure 3

Location of Transects

Site 1. Molasses Reef

(National Ocean Survey Chart 11462)

White Bank
Dry Rocks
Molasses Reef
Channel
hrd S
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T3
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Figure 4

Pictorial Transect Profiles

Site 1. Molasses Reef

(Profiles at left from deep-dive site)

Molasses Reef

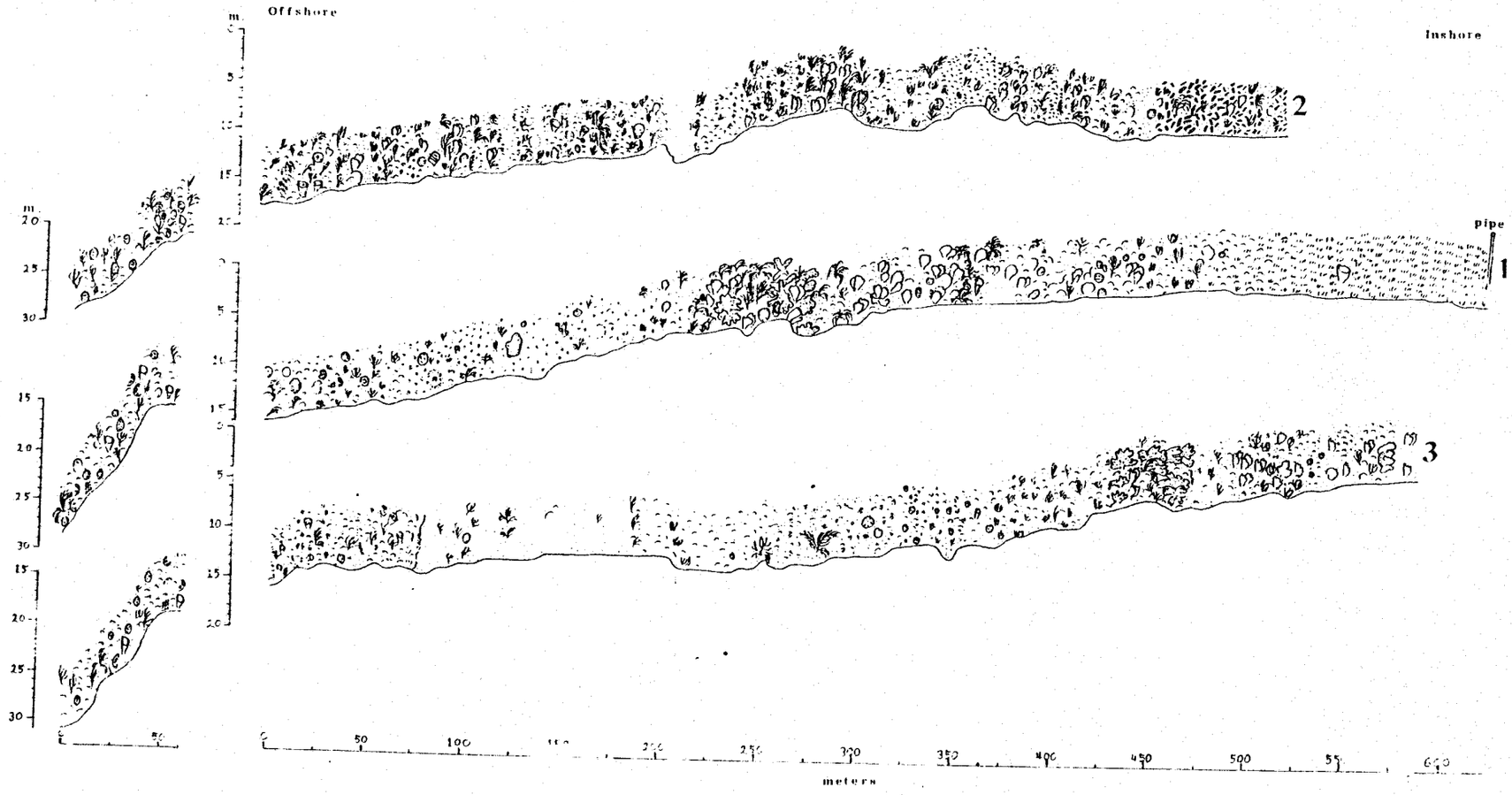


Figure 5

Location of Transects

Site 2. White Bank Dry Rocks

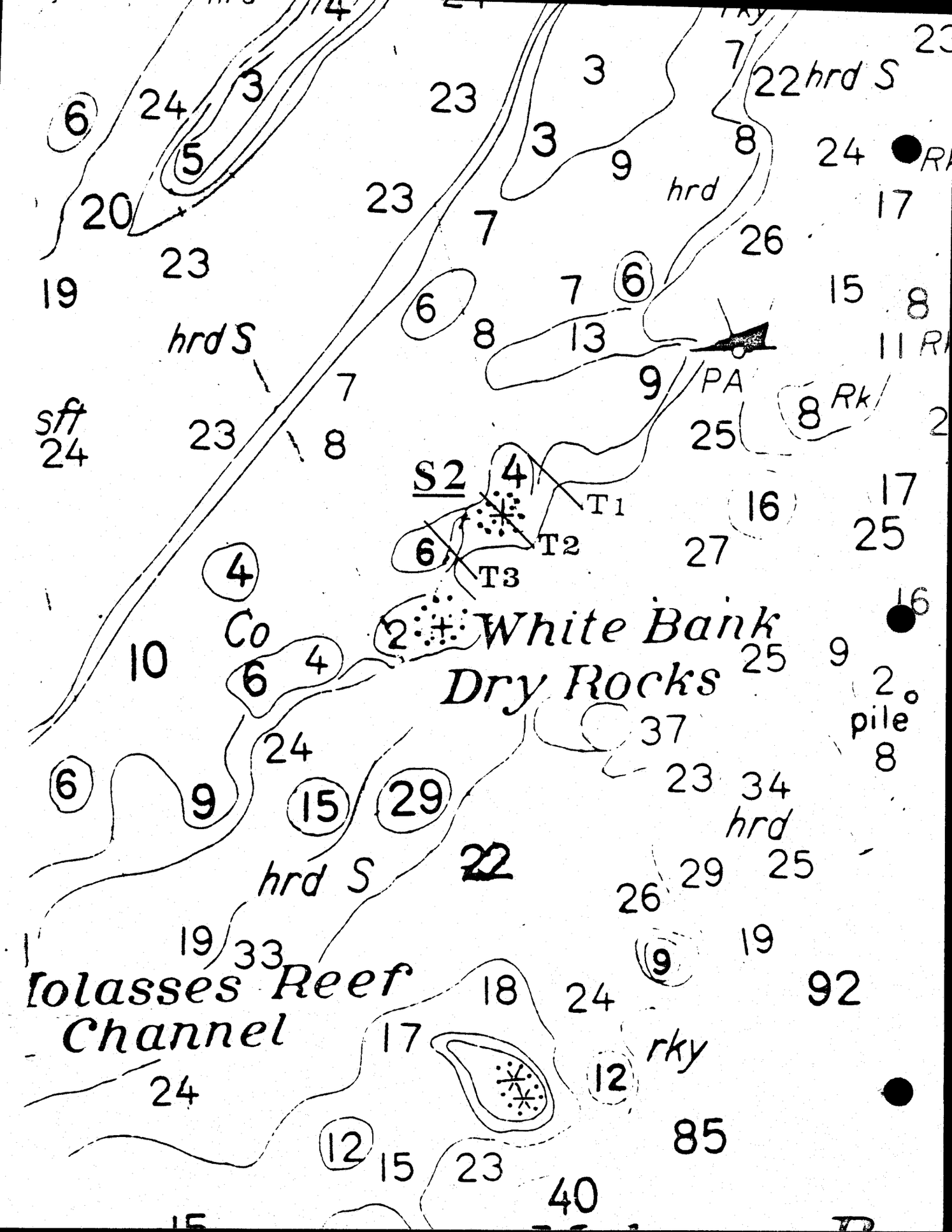

S2
T1
T2
T3
White Bank
Dry Rocks
Co
PA
Rk
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hrd S
rky
pile
Molasses Reef
Channel

Figure 6

Pictorial Transect Profiles

Site 2. White Bank Dry Rocks

White Bank Dry Rocks

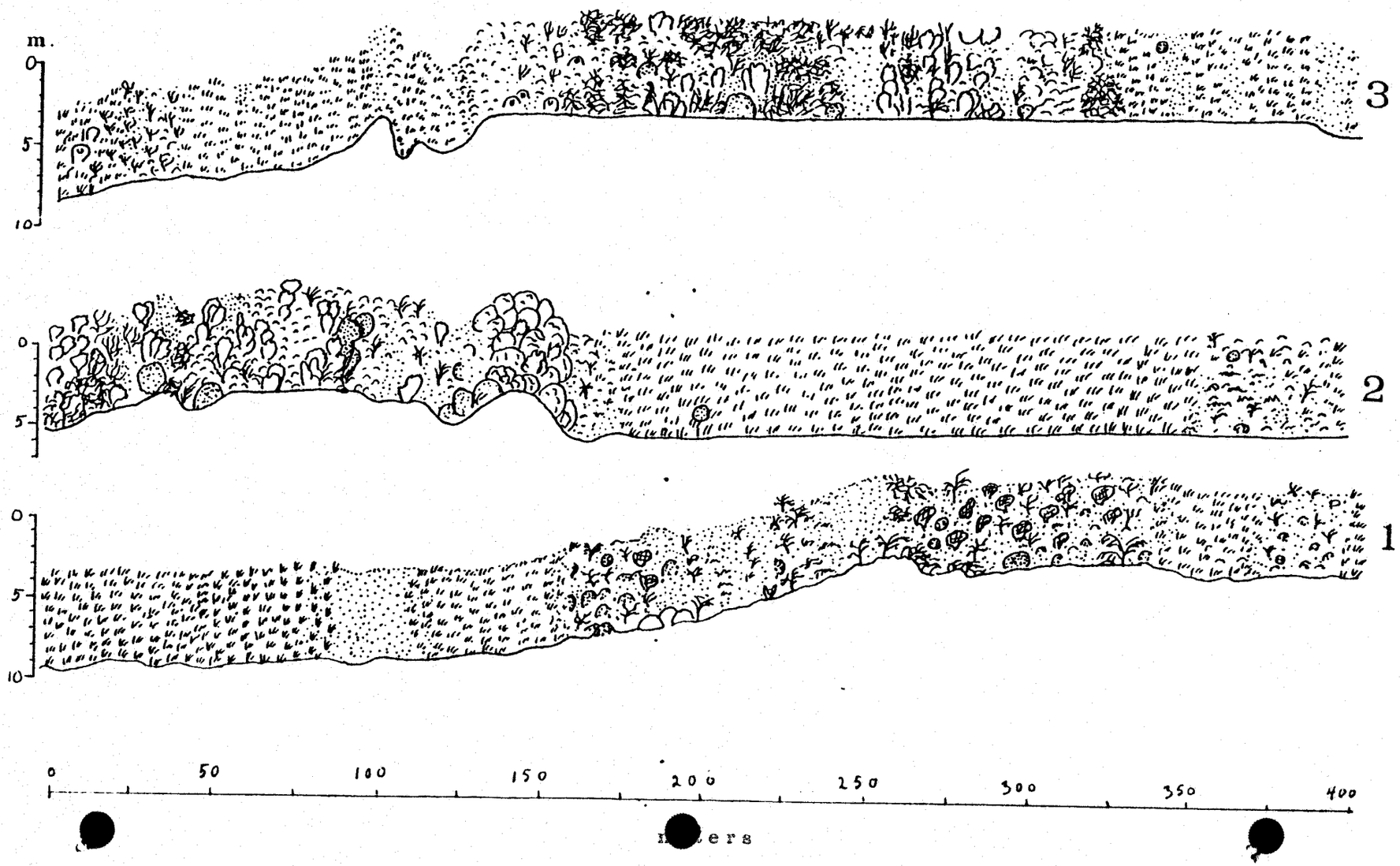


Figure 7

Location of Transects

Site 3. French Reef

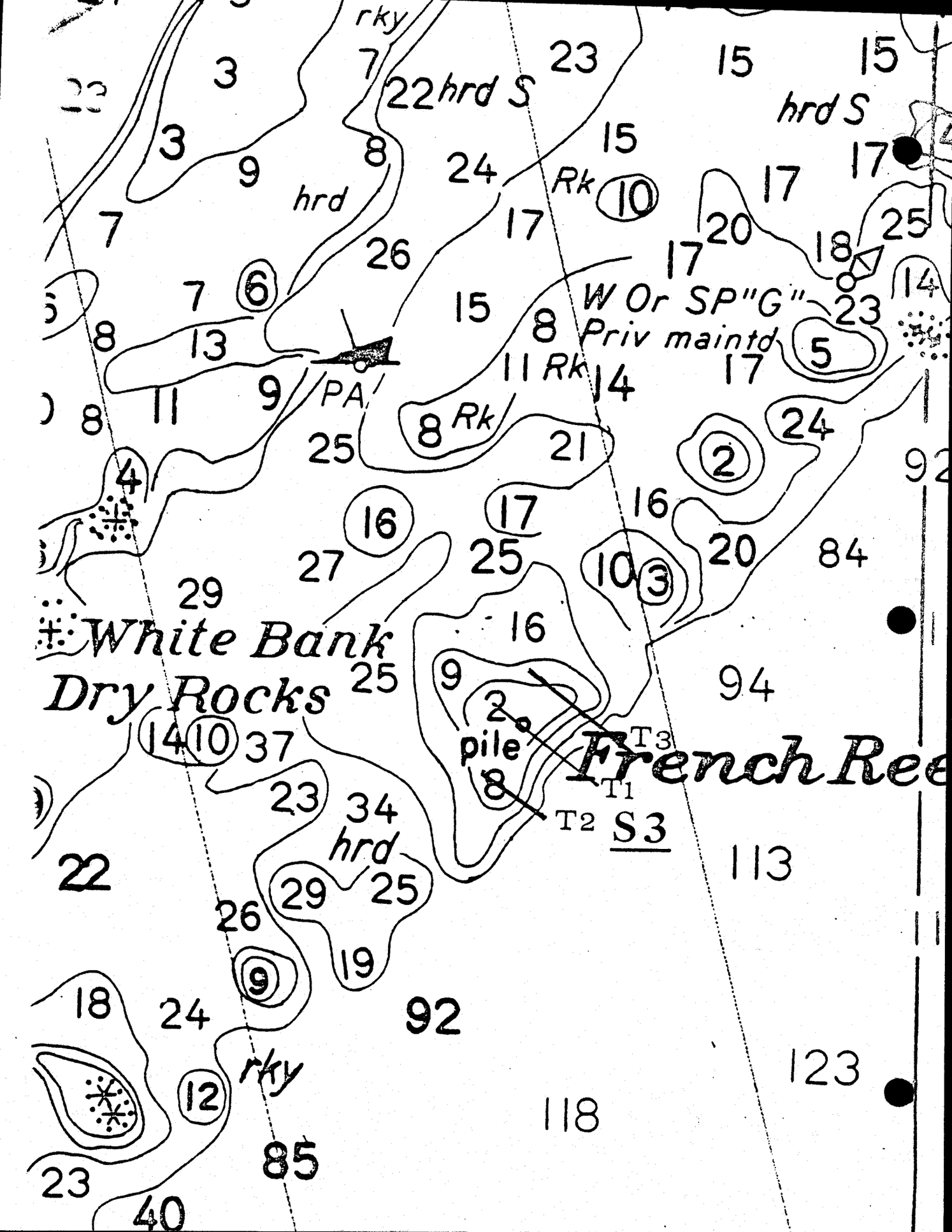

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Figure 8

Pictorial Transect Profiles

Site 3. French Reef

French Reef



Figure 9

Location of Transects

Site 4. Mosquito Bank

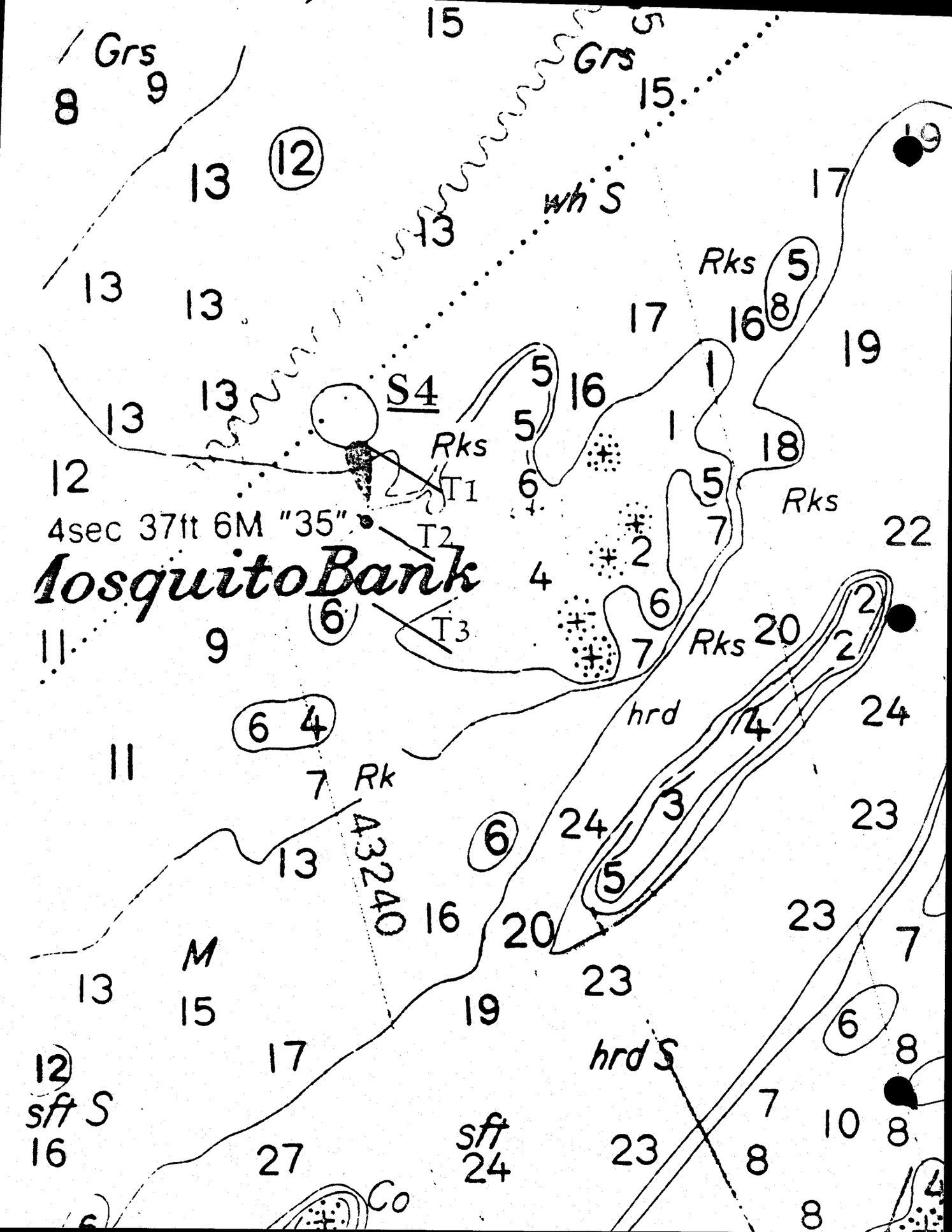

Grs
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Figure 10

Pictorial Transect Profiles

Site 4. Mosquito Bank

Mosquito Bank

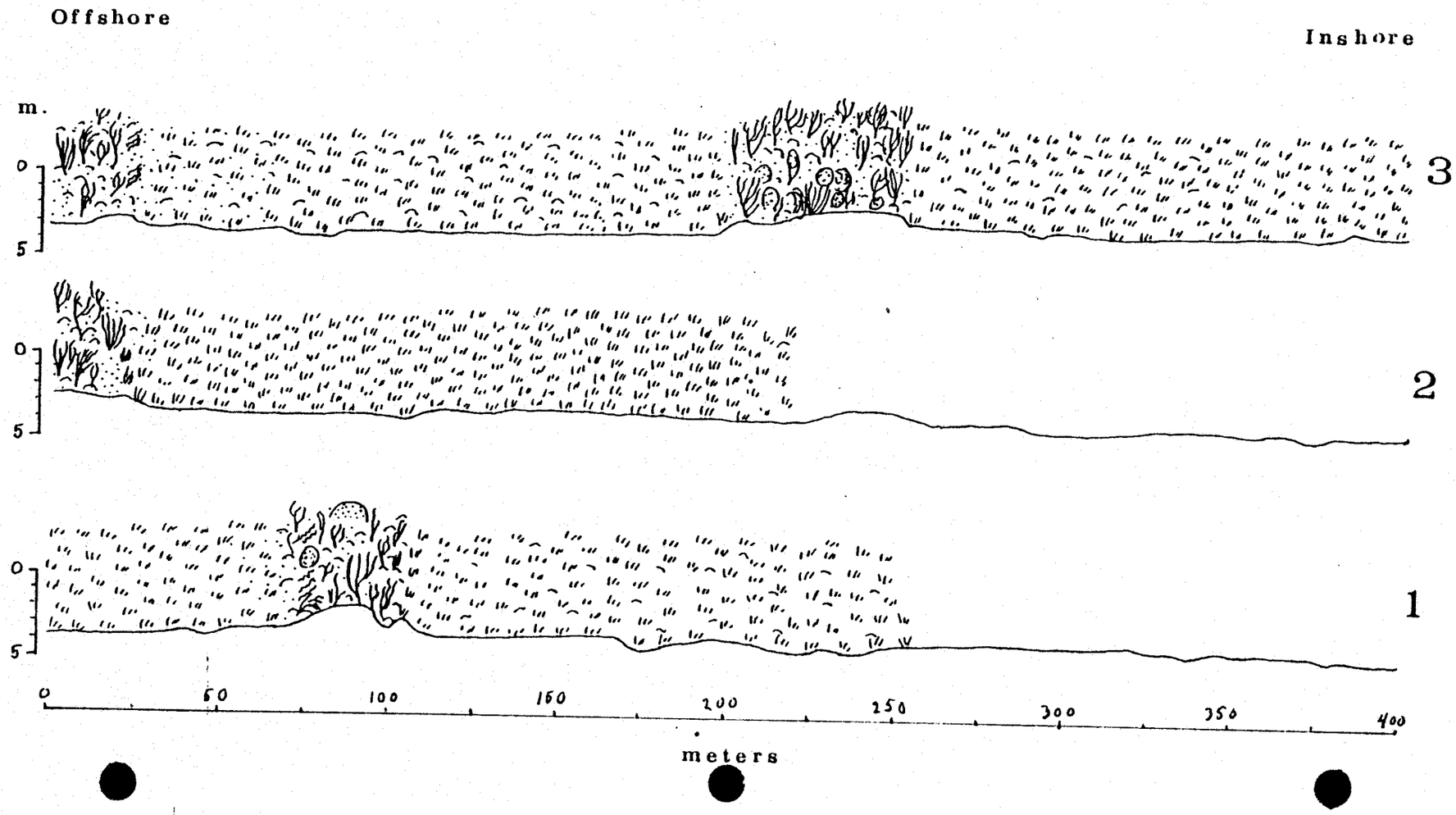


Figure 11

Location of Transects

Site 5 - 6. Grecian Rocks and Key Largo Dry Rocks

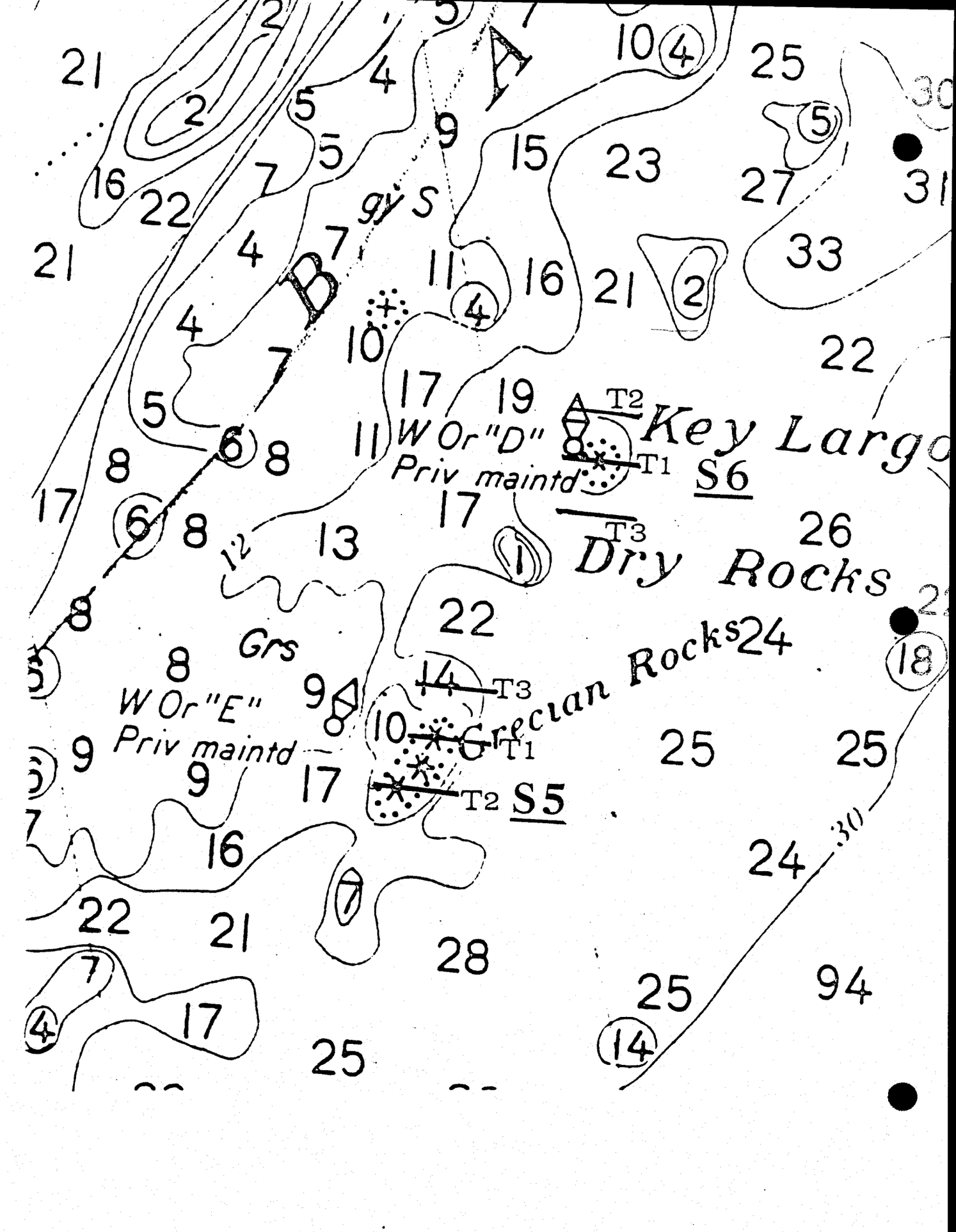

A
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S6
T3
Key Largo
Dry Rocks
Grecian Rocks
W Or "E"
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T3
T1
T2
S5
30

Figure 12

Pictorial Transect Profiles

Site 5. Grecian Rocks

Grecian Rocks

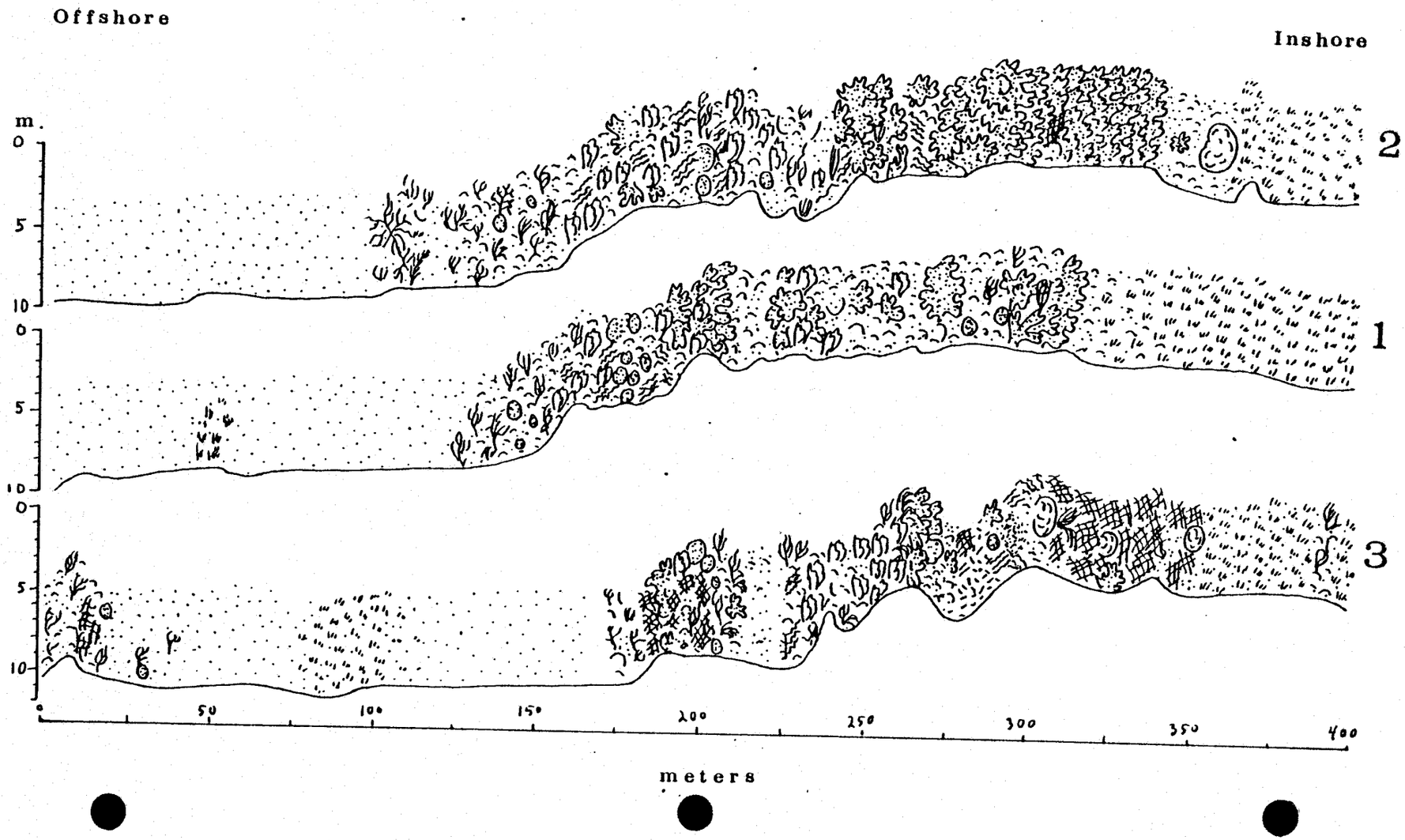


Figure 13

Pictorial Transect Profiles

Site 6. Key Largo Dry Rocks

Key Largo Dry Rocks

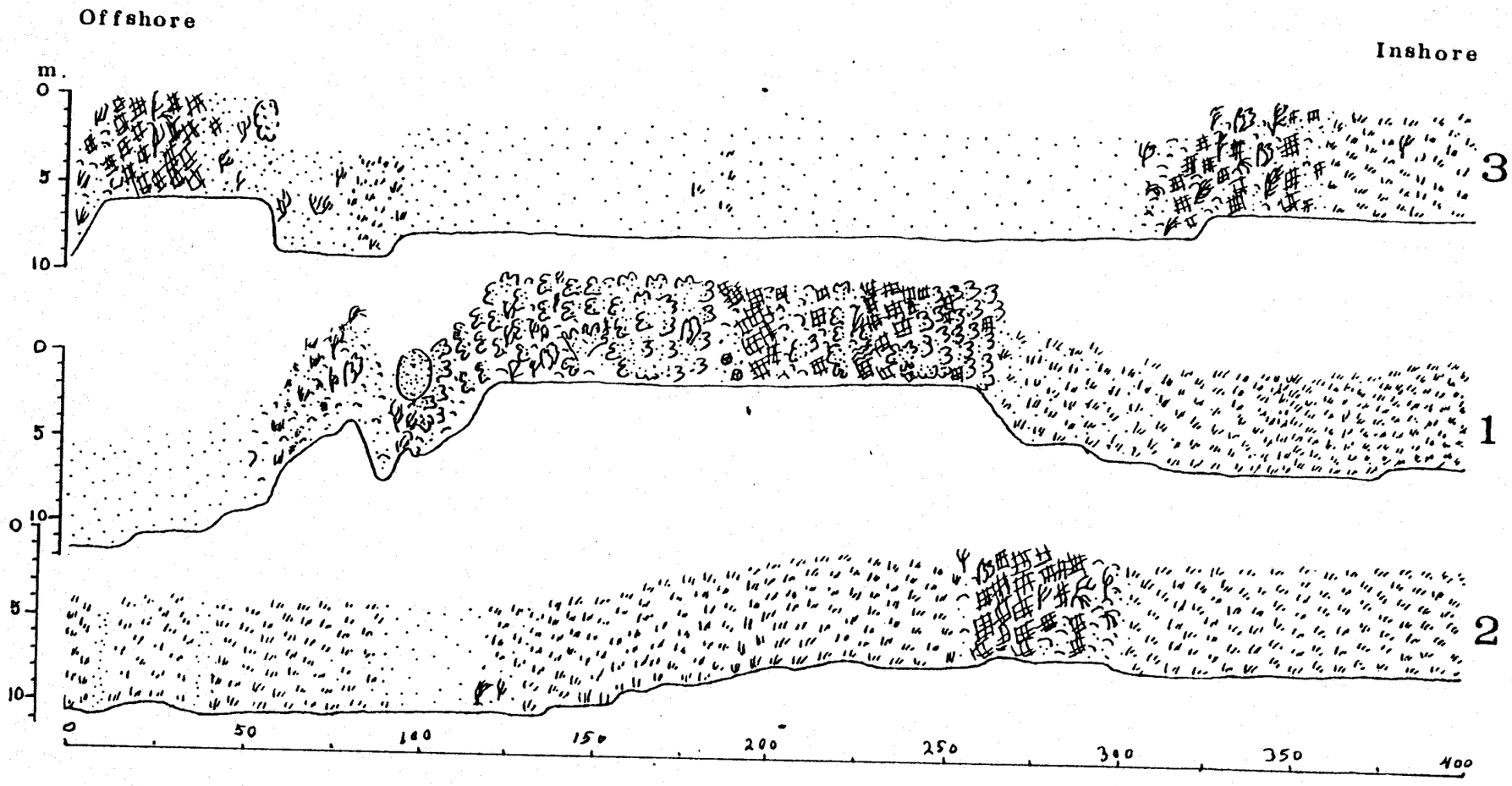


Figure 14

Location of Transects

Site 7. The Elbow

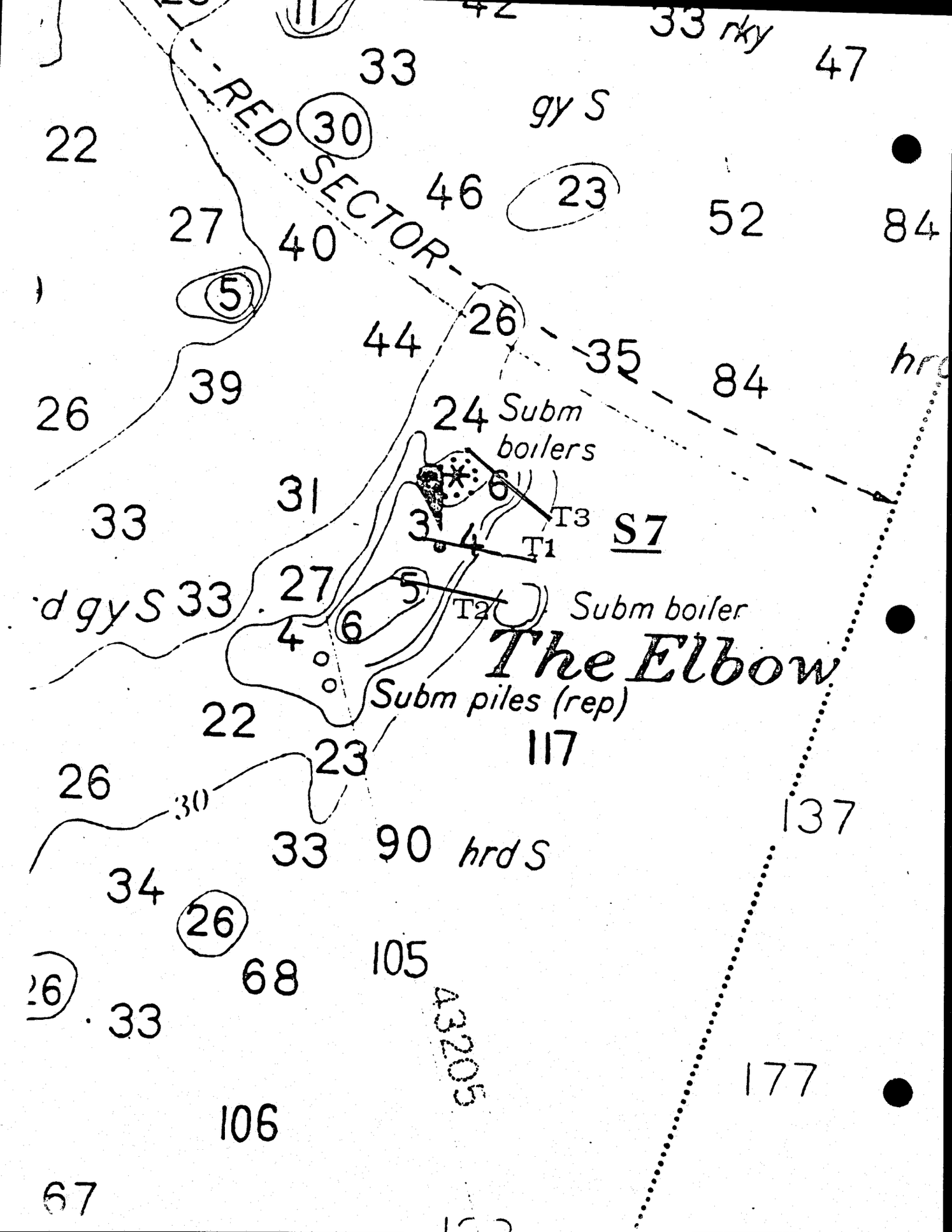

RED SECTOR
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26
24 Subm
boilers
31
6
T3
33
3
4
T1
S7
d gy S 33
27
5
T2
Subm boiler
4
6
The Elbow
Subm piles (rep)
22
23
117
26
30
137
33
90
hrd S
34
26
105
68
26
33
A3205
177
106
67

Figure 15

Pictorial Transect Profiles

Site 7. The Elbow

The Elbow

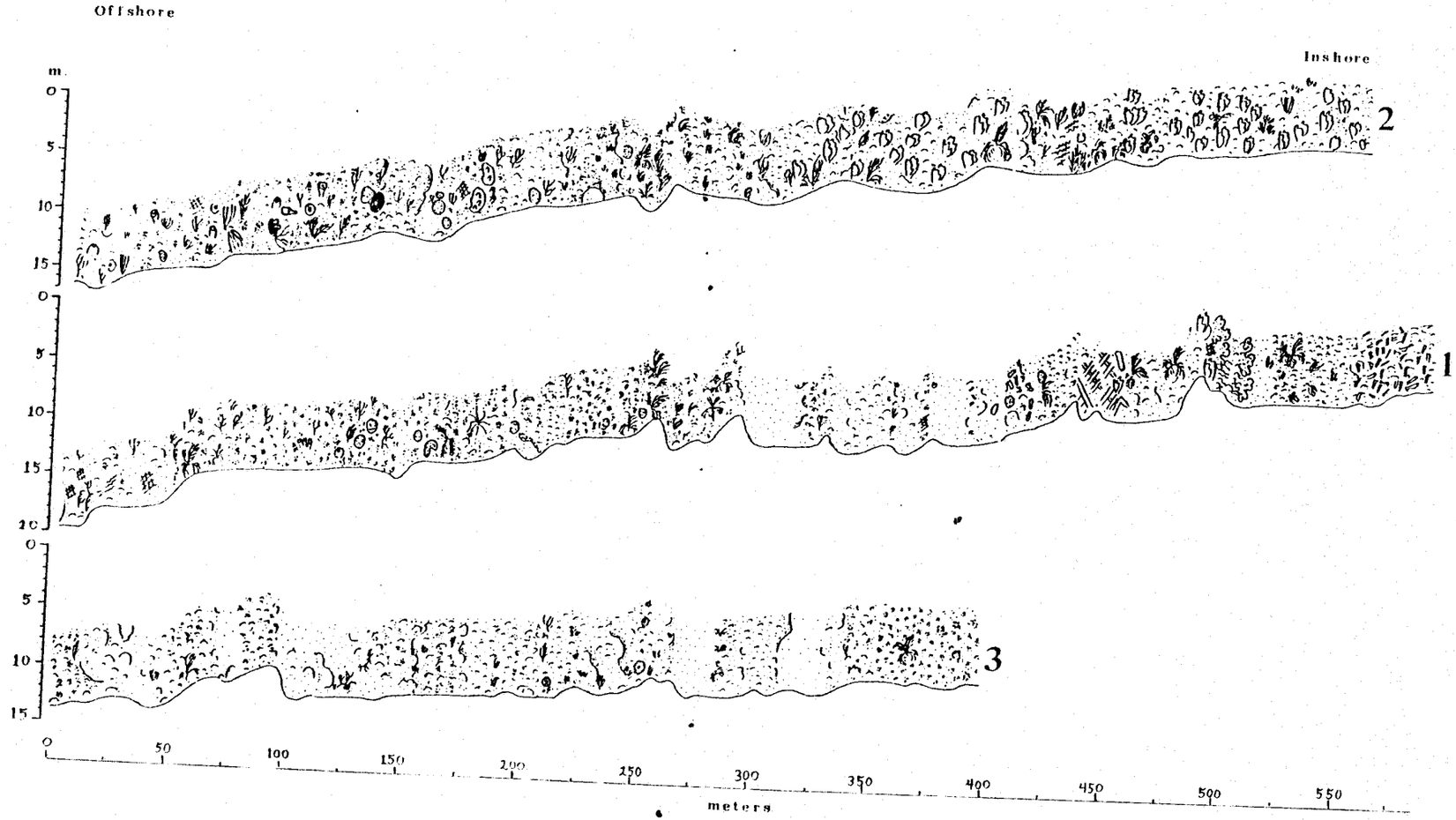

Offshore
Inshore
m.
0
5
10
15
2
0
5
10
15
20
1
0
5
10
15
3
0
50
100
150
200
250
300
350
400
450
500
550
meters

Figure 17

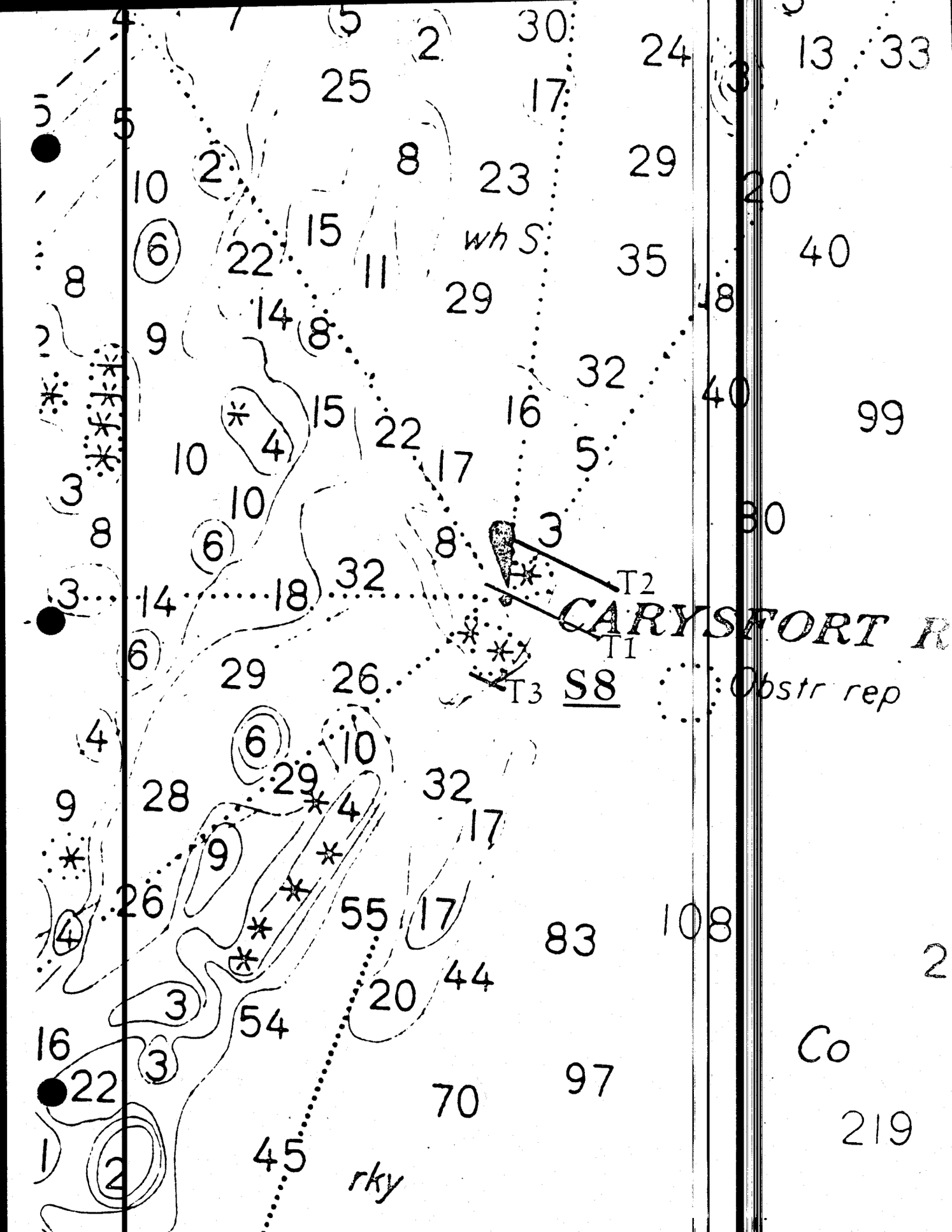
Pictorial Transect Profiles

Site 8. Carysfort Reef

Figure 16

Location of Transects

Site 8. Carysfort Reef


CARYSFORT R
T1
T2
T3
S8
Obstr rep
wh S
rky
Co

Carysfort Reef

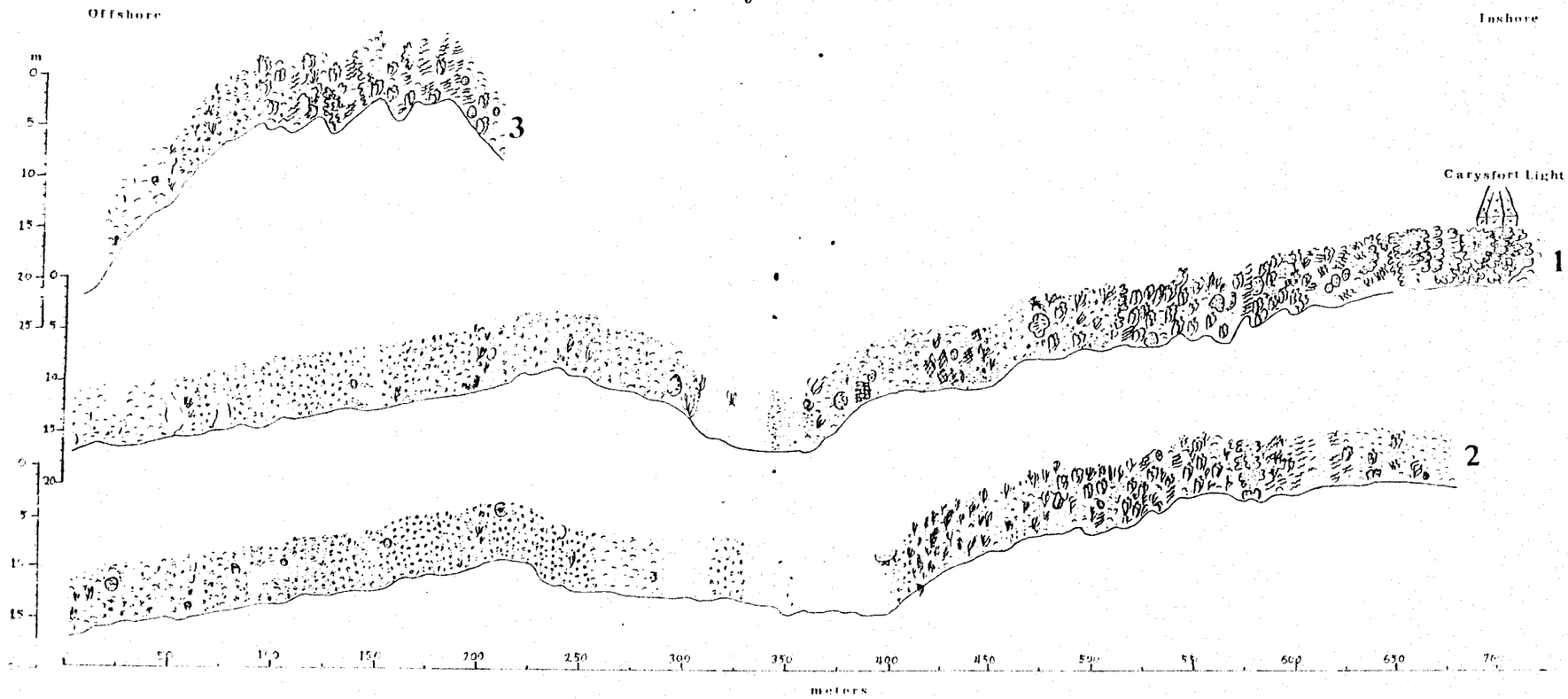


Figure 18

Location of Transects

Site 9. Basin Hill Shoals

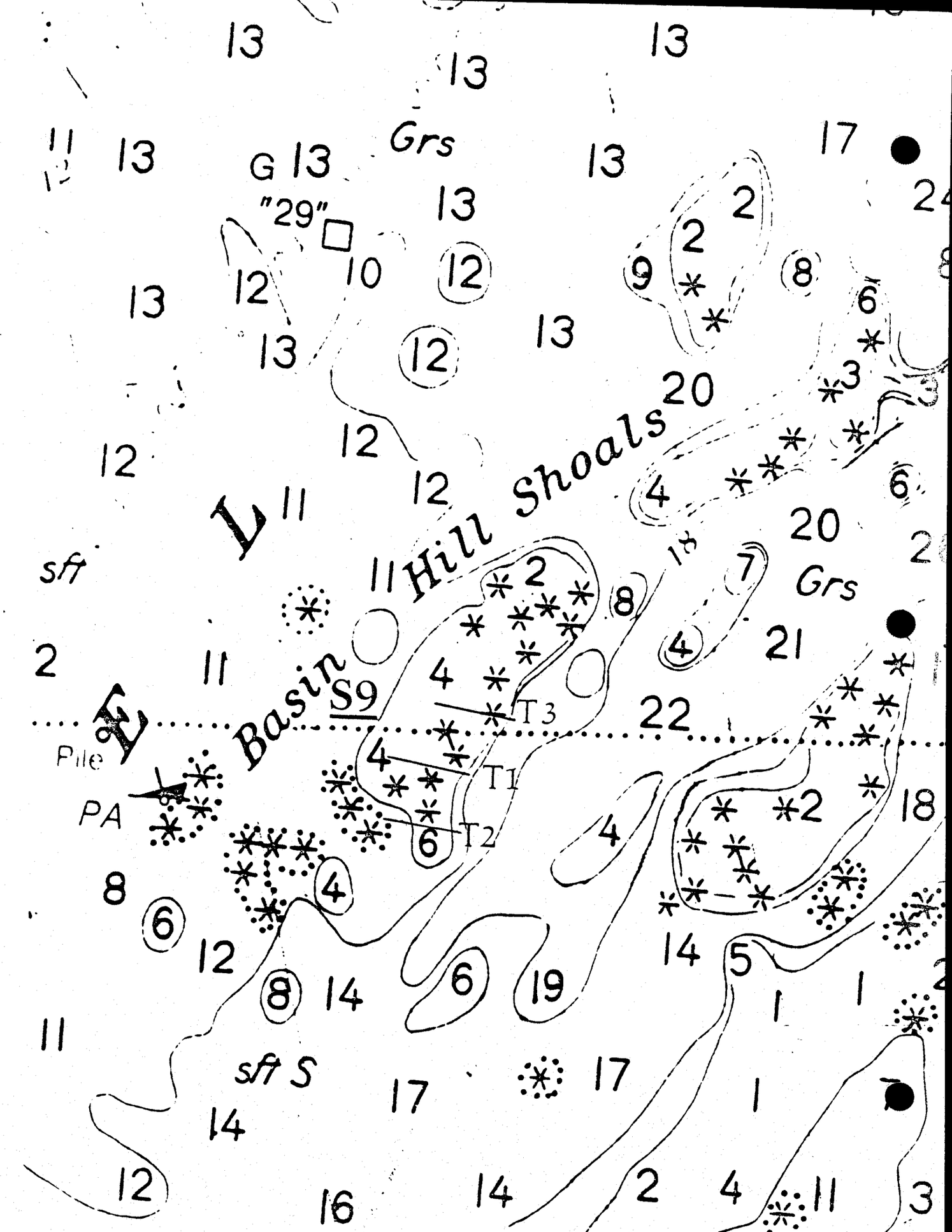

Hill Shoals
Basin
Grs
sft
sft S
PA
Pile
S9
T1
T2
T3
"29"
G
13
12
11
10
9
8
7
6
5
4
3
2
1
20
21
22
19
18
17
16
14

Figure 19

Pictorial Transect Profiles

Site 9. Basin Hill Shoals

Basin Hill Shoals

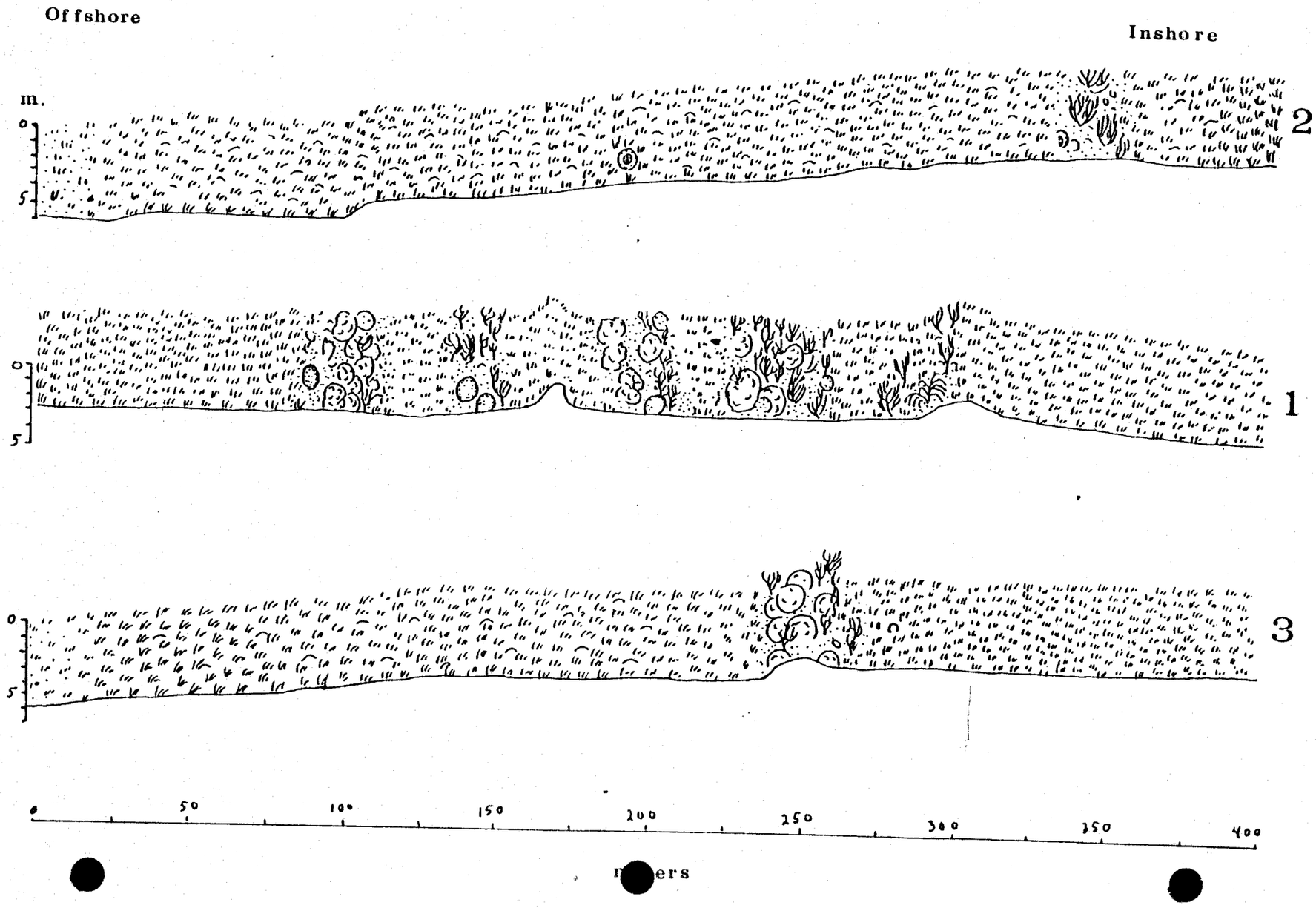


Figure 20

Location of Transects

Site 10. Turtle Rocks

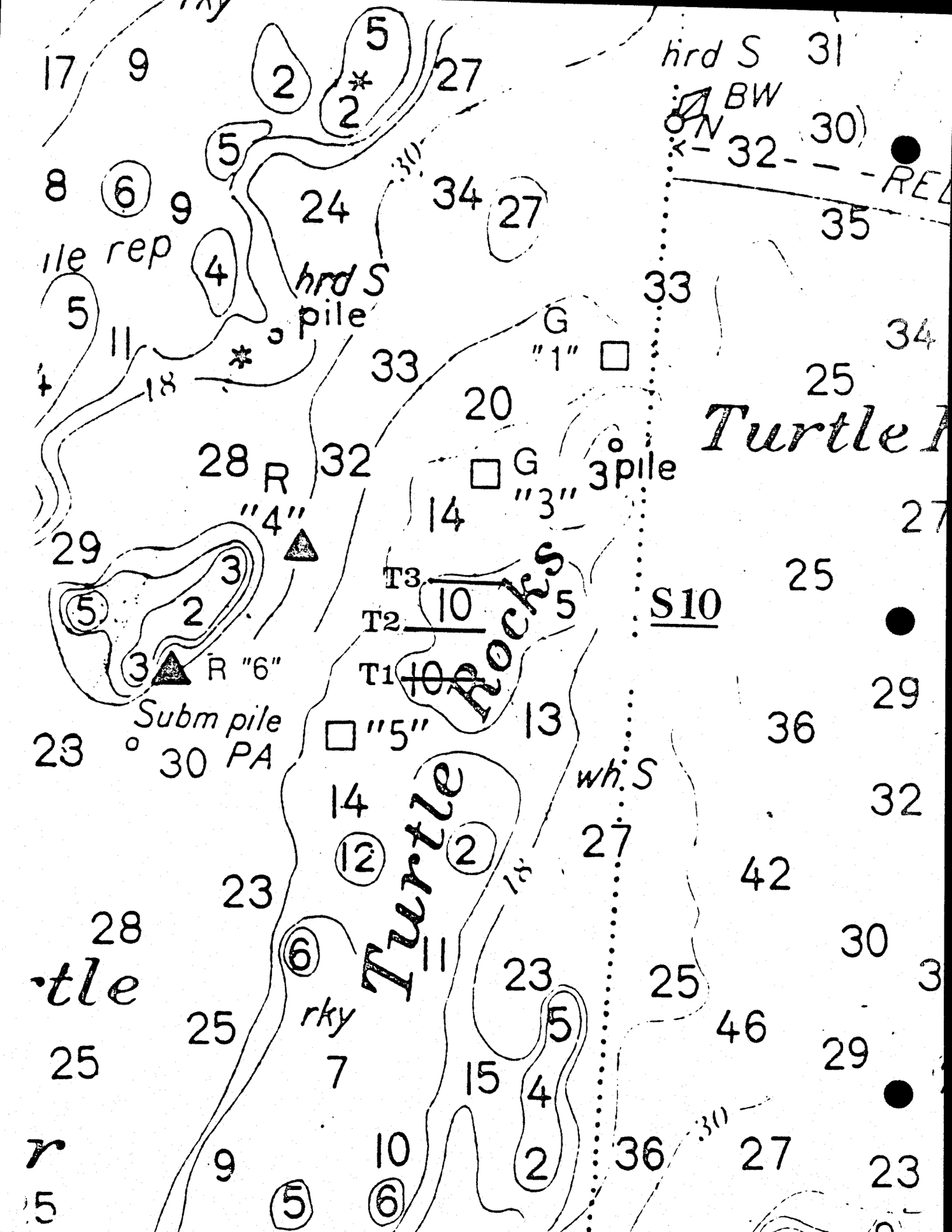

rky
17
9
2
5
2
27
hrd S
31
BW
N
30
32
REL
35
8
6
9
24
34
27
30
ile rep
4
hrd S
pile
33
5
11
18
G
"1"
34
33
25
20
Turtle R
28
R
32
G
3
pile
"4"
"3"
14
27
29
3
25
T3
10
5
S10
5
2
T2
T1
10
R "6"
Turtle Rocks
29
Subm pile
PA
"5"
13
36
23
30
wh S
14
32
12
2
27
1s
42
23
28
30
6
11
23
25
3
tle
rky
25
5
46
25
7
15
4
29
r
10
36
27
23
9
2
5
6
5

Figure 21

Pictorial Transect Profiles

Site 10. Turtle Rocks

Turtle Rocks

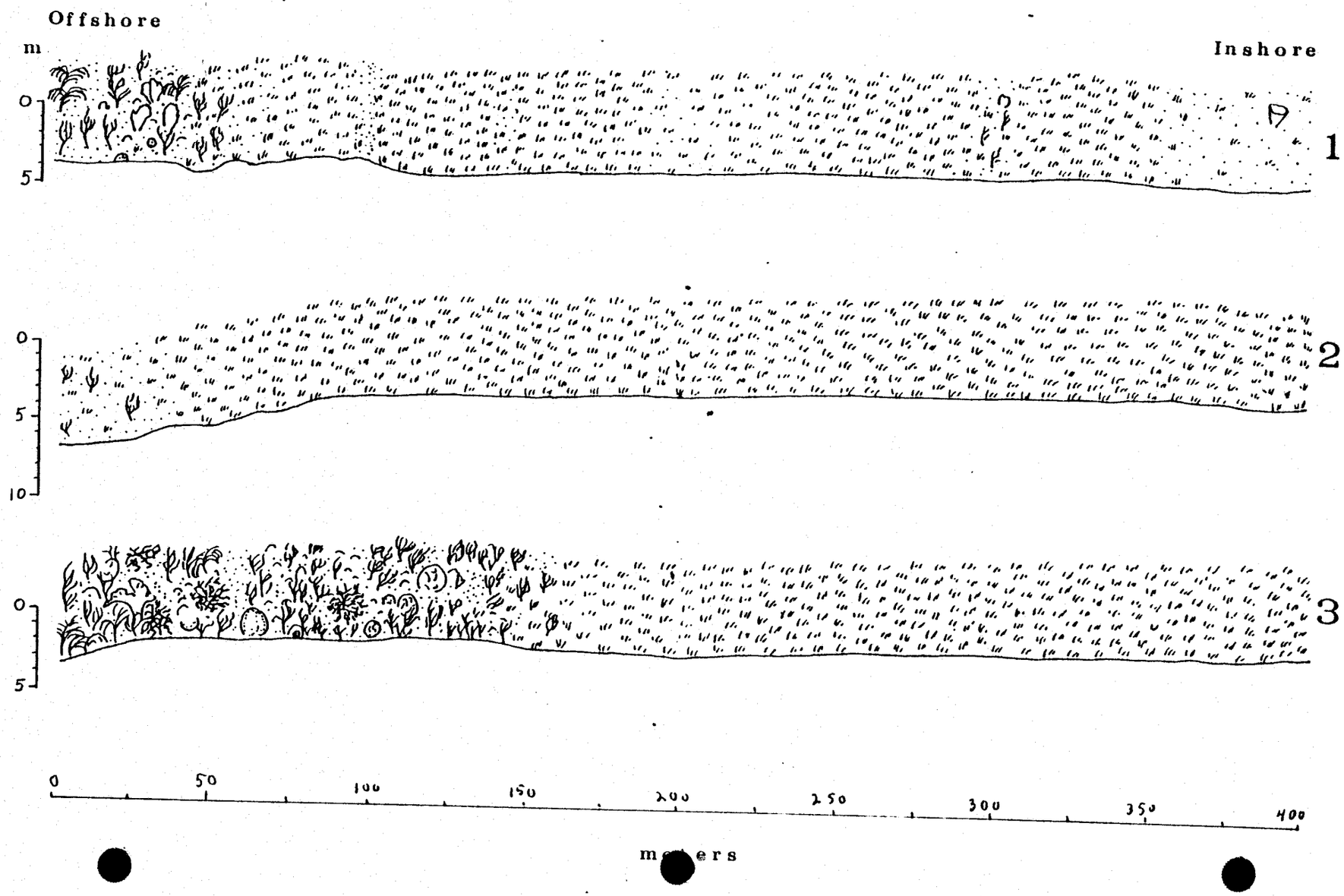


Figure 22

Location of Transects

Site 11. Ocean Reef

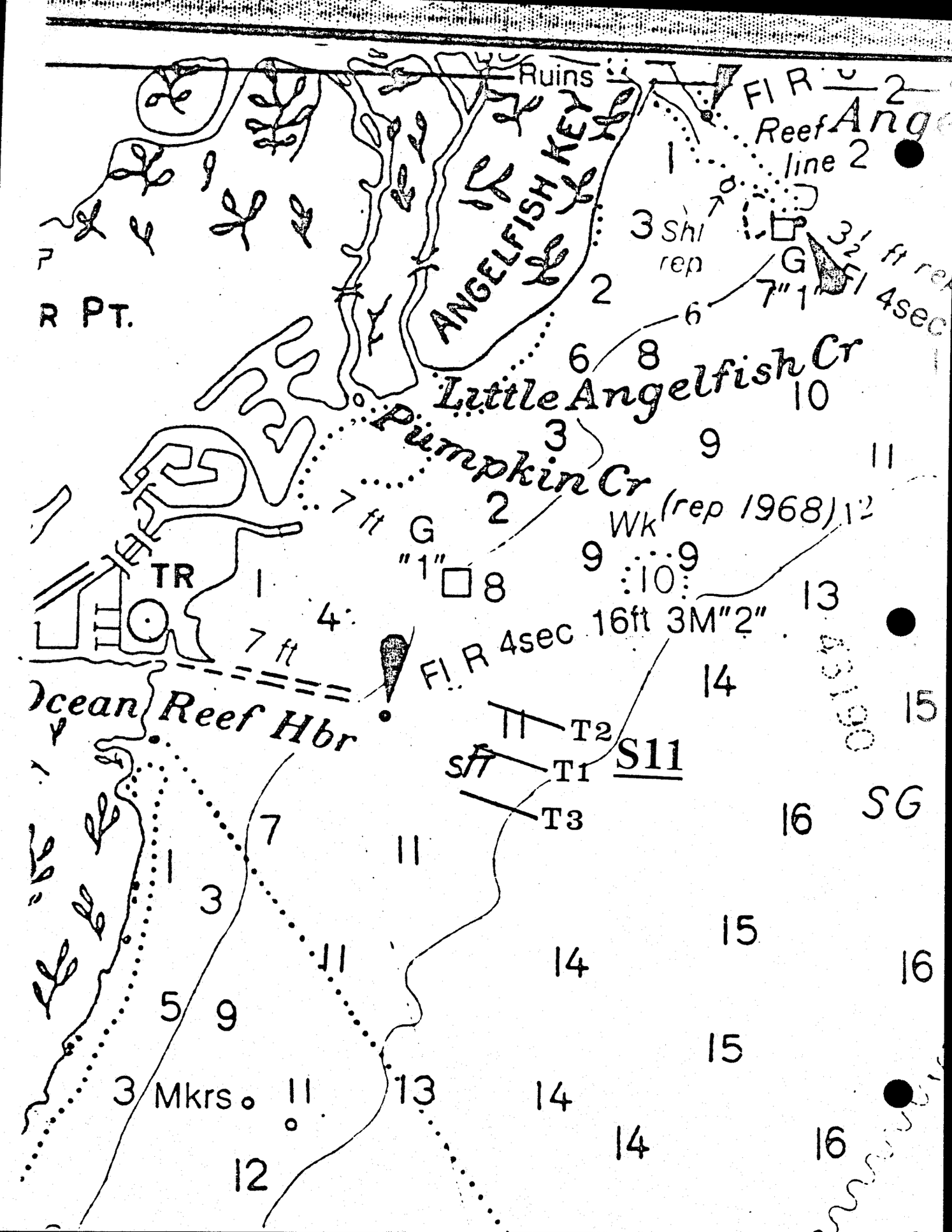

Ruins
Fl R 2
Reef
line 2
ANGELFISH KEY
3 Shl
rep
G
7" 1
Fl 4sec
R PT.
6
8
Little Angelfish Cr
10
Pumpkin Cr
3
9
11
2
7 ft
G
"1"
8
Wk (rep 1968) 12
TR
1
9
9
10
13
4
7 ft
Fl R 4sec 16ft 3M "2"
14
15
Ocean Reef Hbr
T2
S11
sft
T1
T3
16
SG
7
11
1
3
15
11
14
16
5
9
15
3 Mkrs
11
13
14
14
16
12

Figure 23

Pictorial Transect Profiles

Site 11. Ocean Reef

Ocean Reef

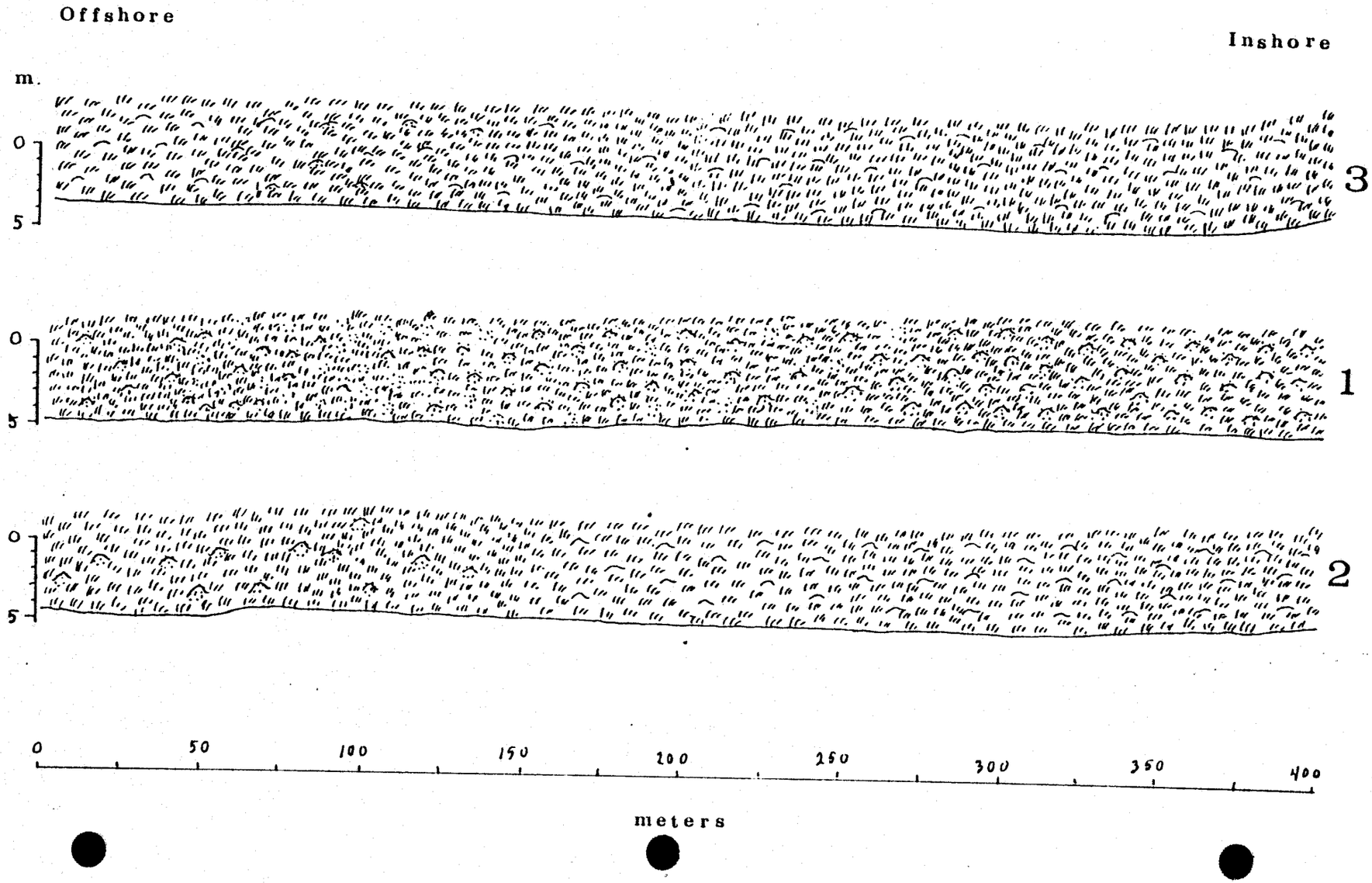

Offshore
Inshore
m.
0
5
3
0
5
1
0
5
2
0
50
100
150
200
250
300
350
400
meters

Figure 24

Location of Transects

Site 12. Turtle Harbor

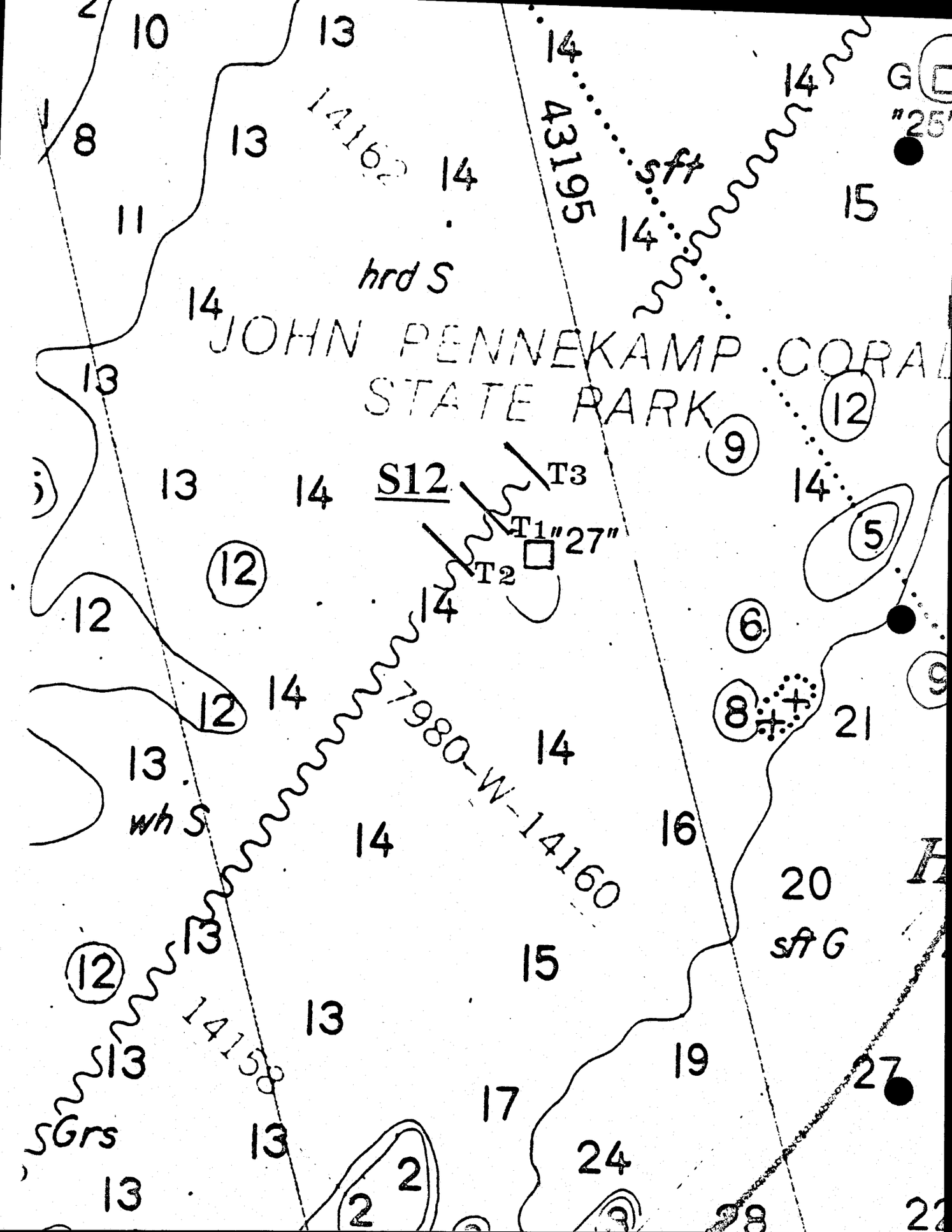

JOHN PENNEKAMP CORAL
STATE PARK
S12
T1
T2
T3
"27"
14160
43195
1980-W-14160
14158
hrd S
wh S
sft
sft G
Grs

Figure 25

Pictorial Transect Profiles

Site 12. Turtle Harbor

Turtle Harbor

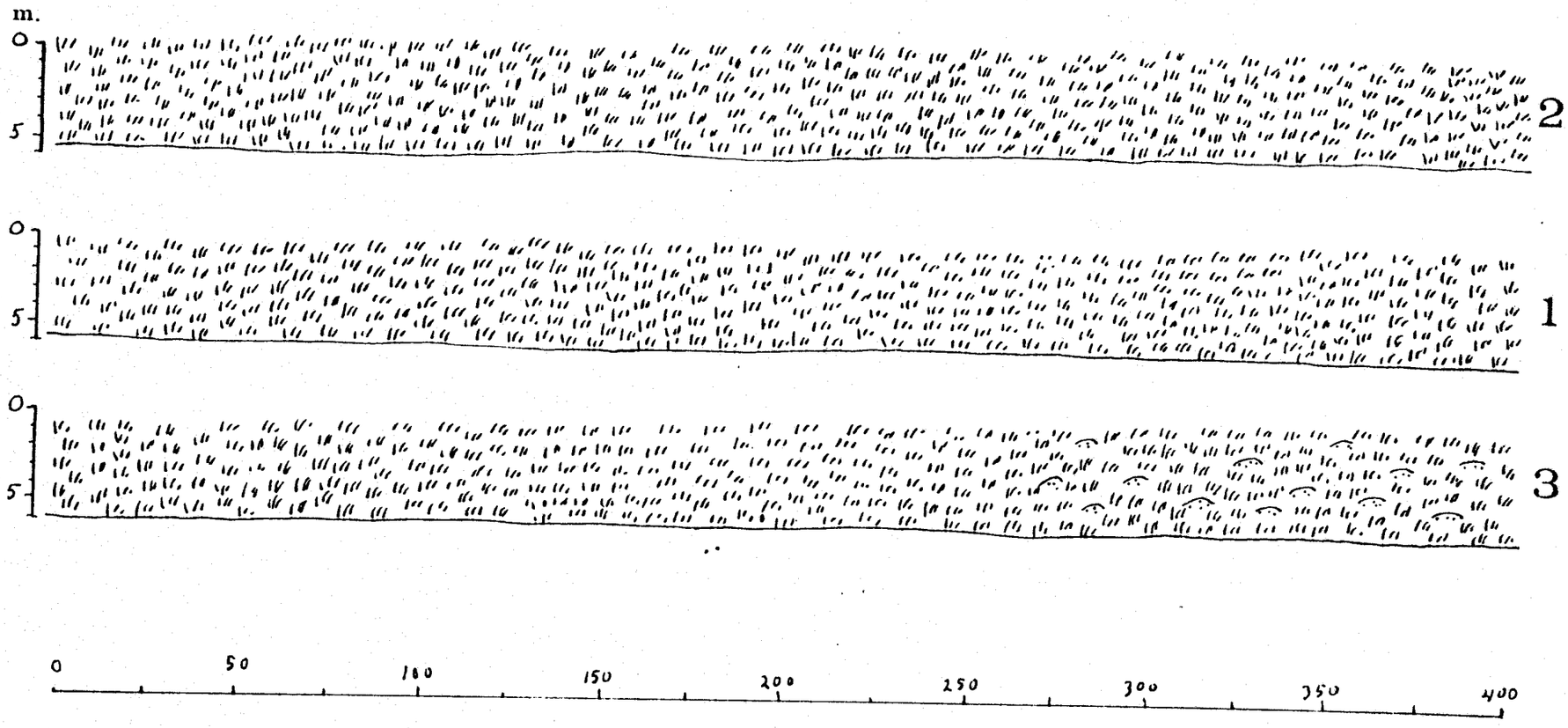


Figure 26

Location of Transects

Site 13. North Channel

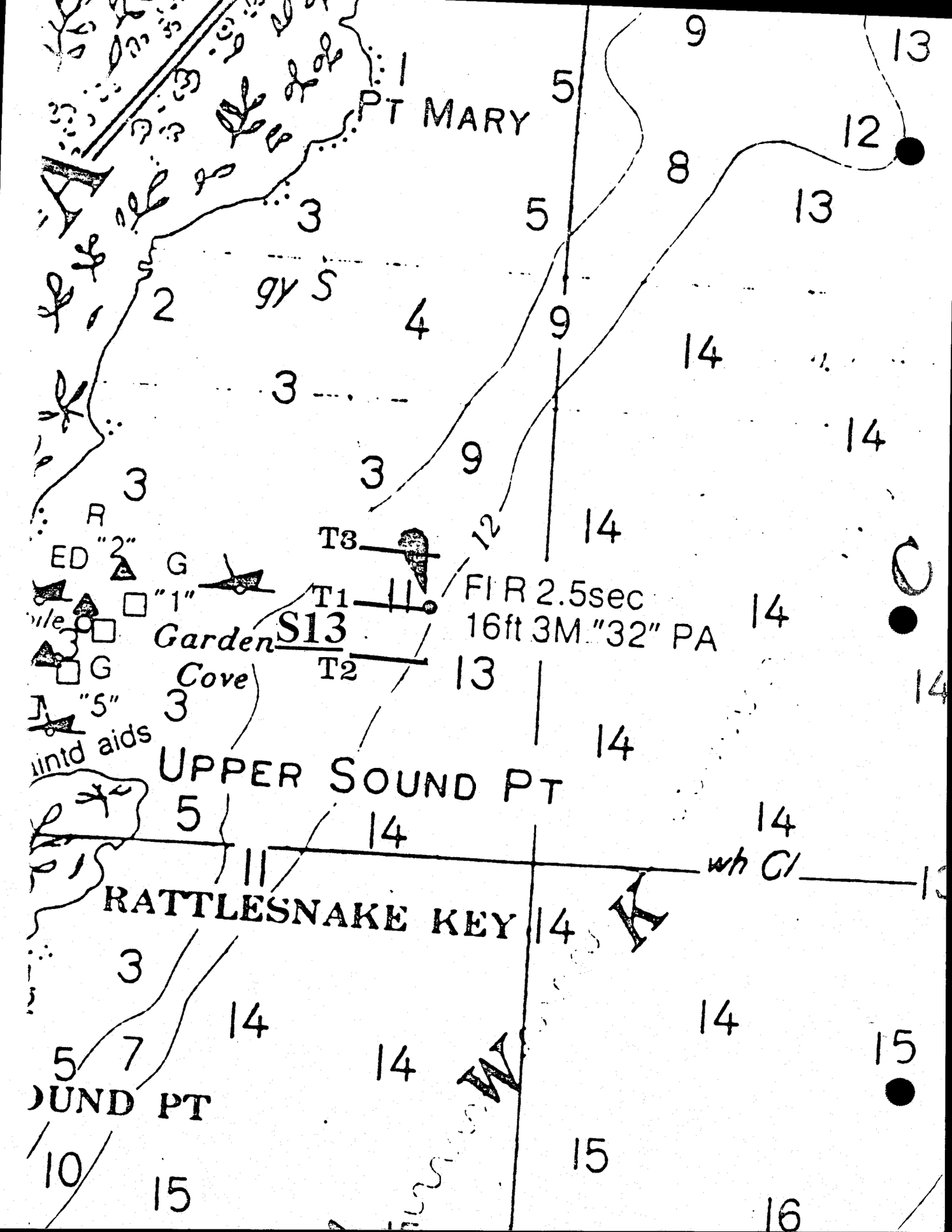

PT MARY
UPPER SOUND PT
RATTLESNAKE KEY
Garden Cove
S13
T1
T2
T3
Fl R 2.5sec
16ft 3M "32" PA
"1"
"2"
"5"
R
G
ED
intd aids
wh Cl
UND PT

Figure 27

Pictorial Transect Profiles

Site 13. North Channel

North Channel

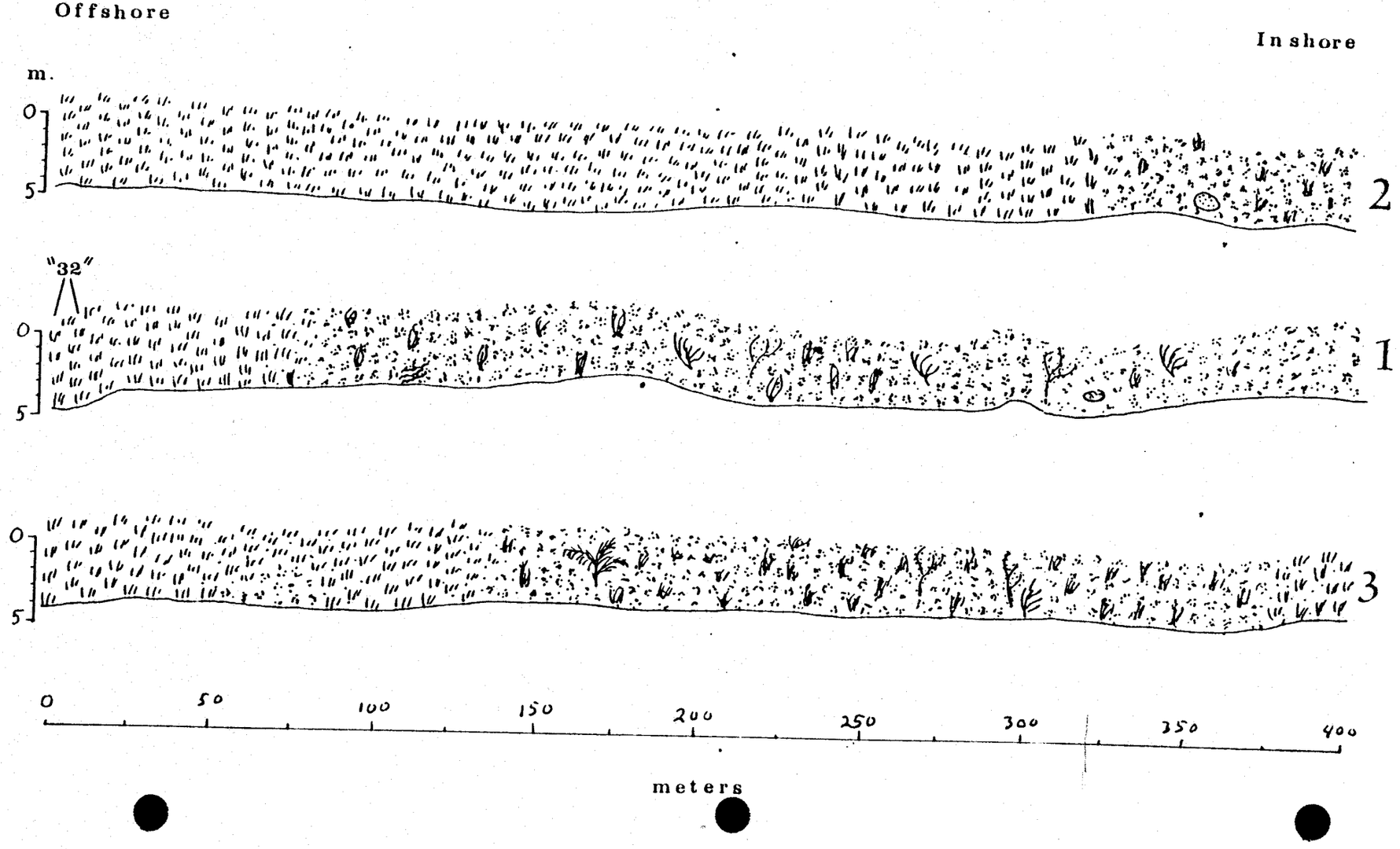


Figure 28

Location of Transects

Site 14. South Channel

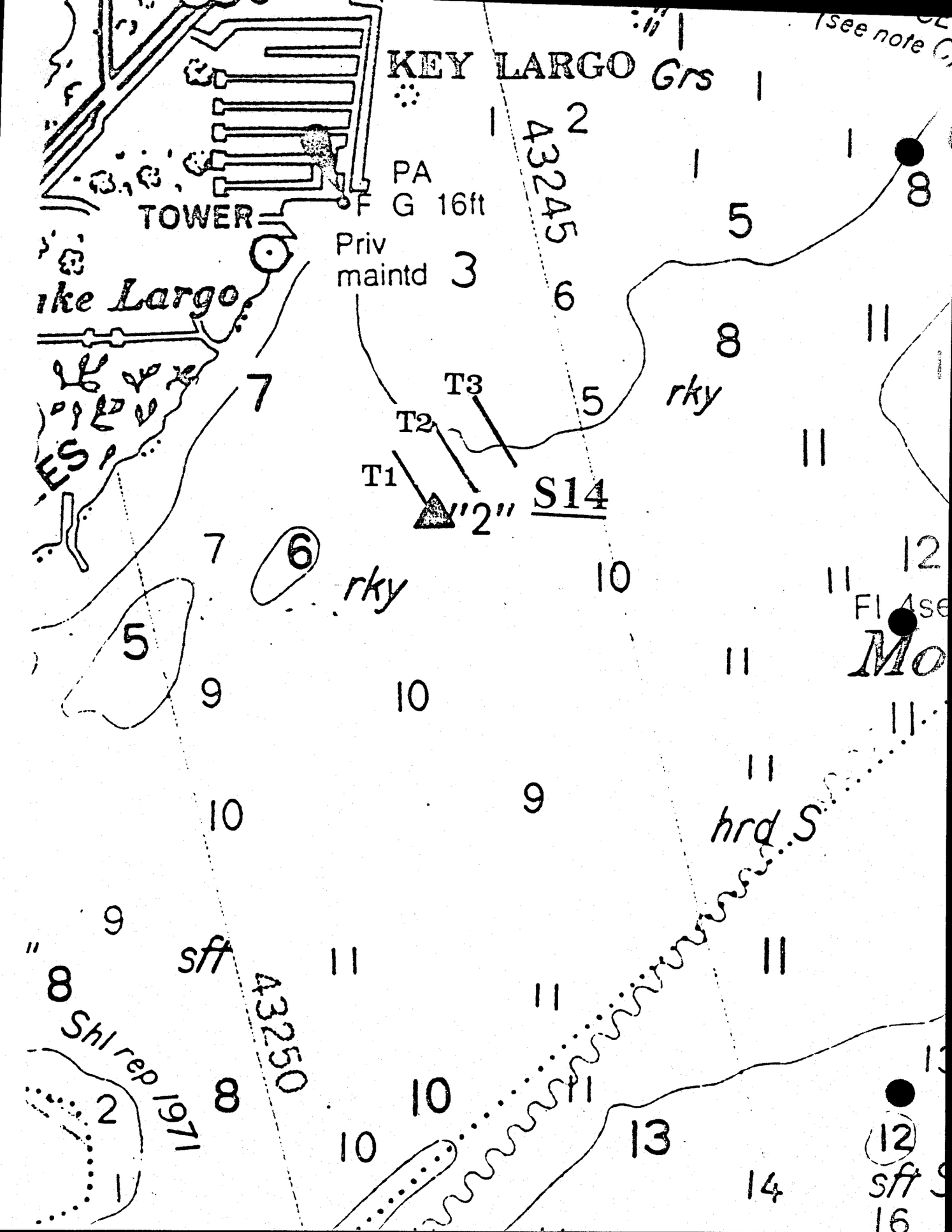

KEY LARGO
PA
F G 16ft
TOWER
Priv
maintd
T1
T2
T3
S14
rky
rky
hrd S
sft
sft
Shl rep 1971
43245
43250
Fl Ase

Figure 29

Pictorial Transect Profiles

Site 14. South Channel

South Channel

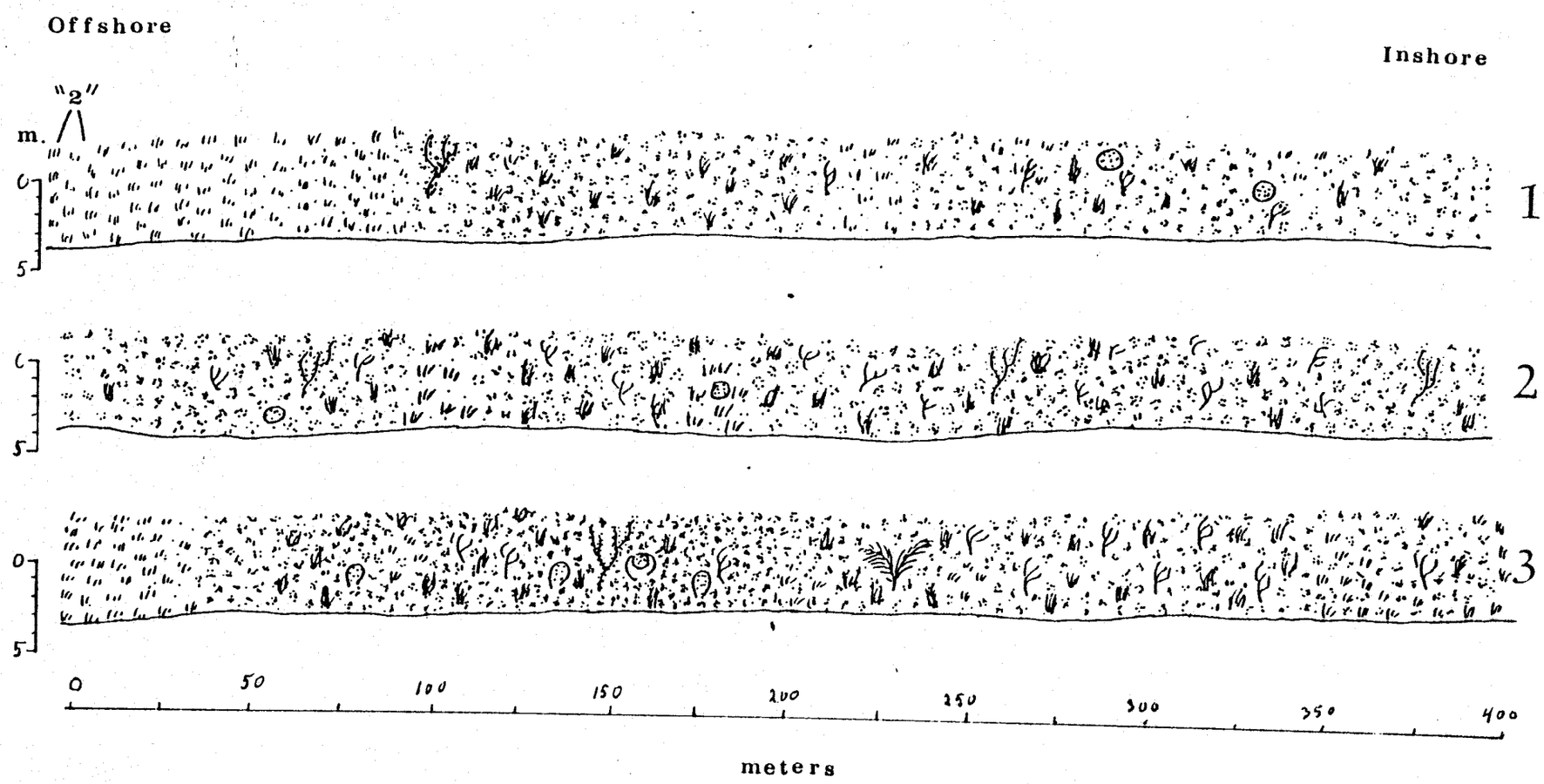


Figure 30

Location of Transects

Site 15. Rock Harbor

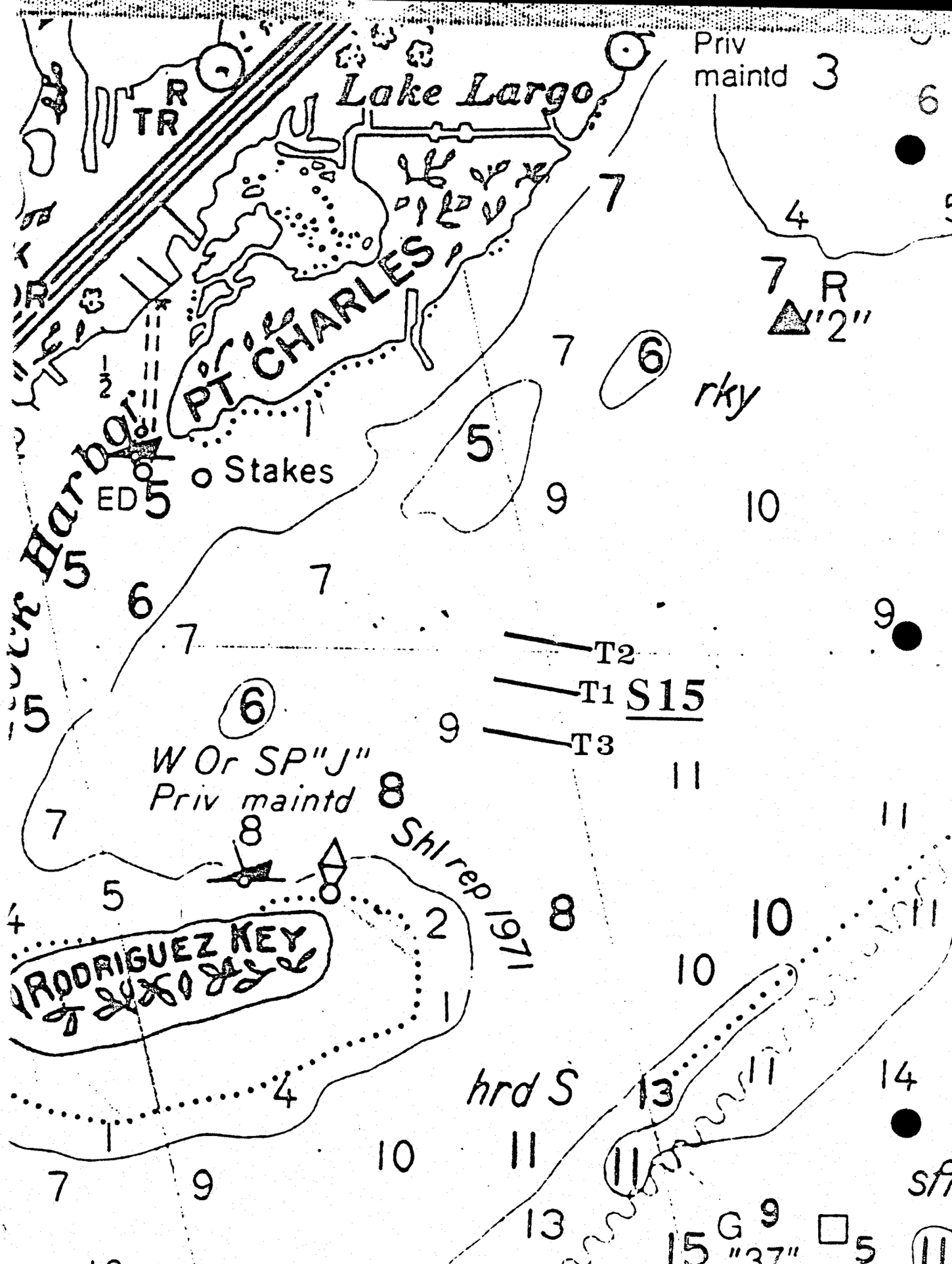

Lake Largo
PT CHARLES
Harbor
Stakes
ED
Priv maintd
rky
T2
T1
T3
S15
W Or SP "J"
Priv maintd
Shl rep 1971
RODRIGUEZ KEY
hrd S
"2"
"37"

Figure 31

Pictorial Transect Profiles

Site 15. Rock Harbor

Rock Harbor

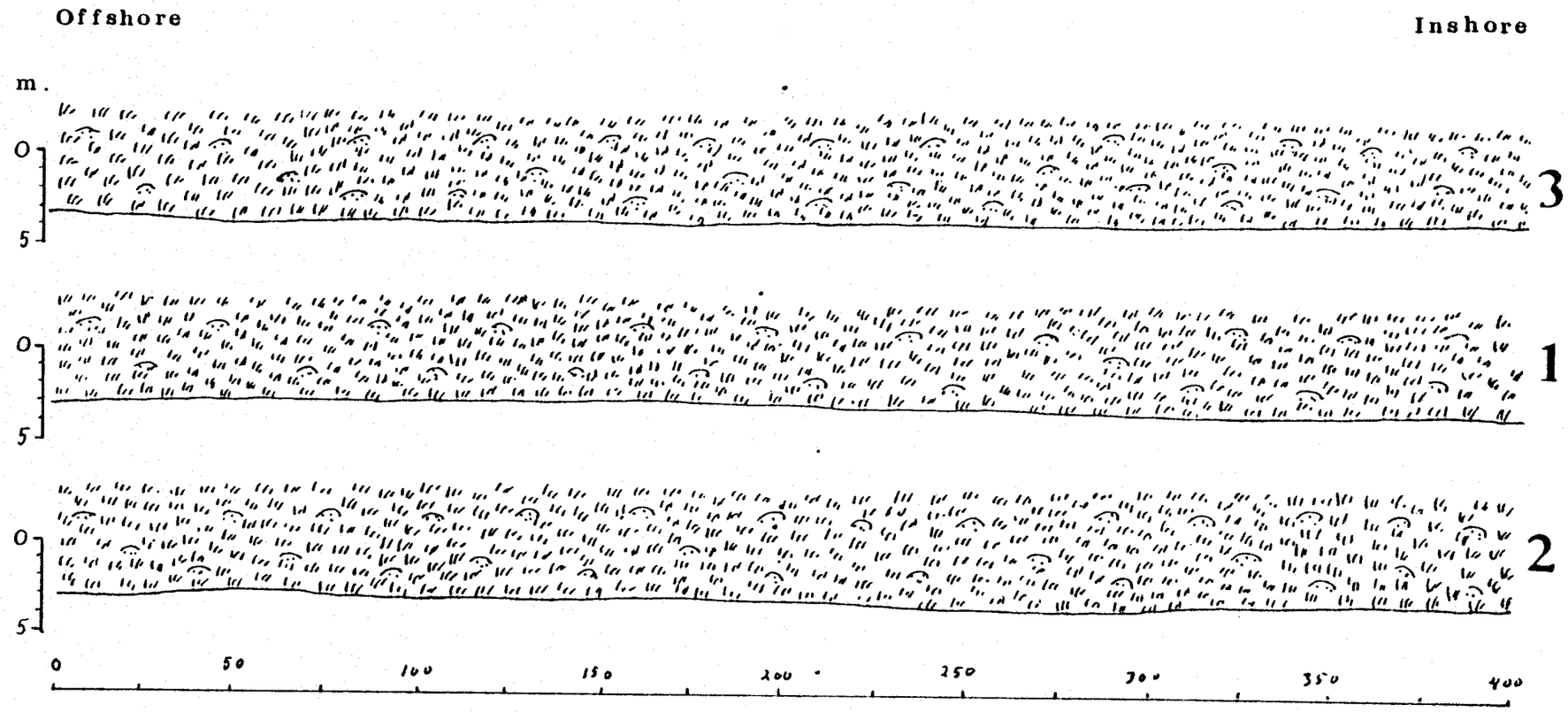

Offshore
Inshore
m.
0
5
3
0
5
1
0
5
2
0
50
100
150
200
250
300
350
400
meters

Figure 32

Location of Transects

Site 16. Point Elizabeth

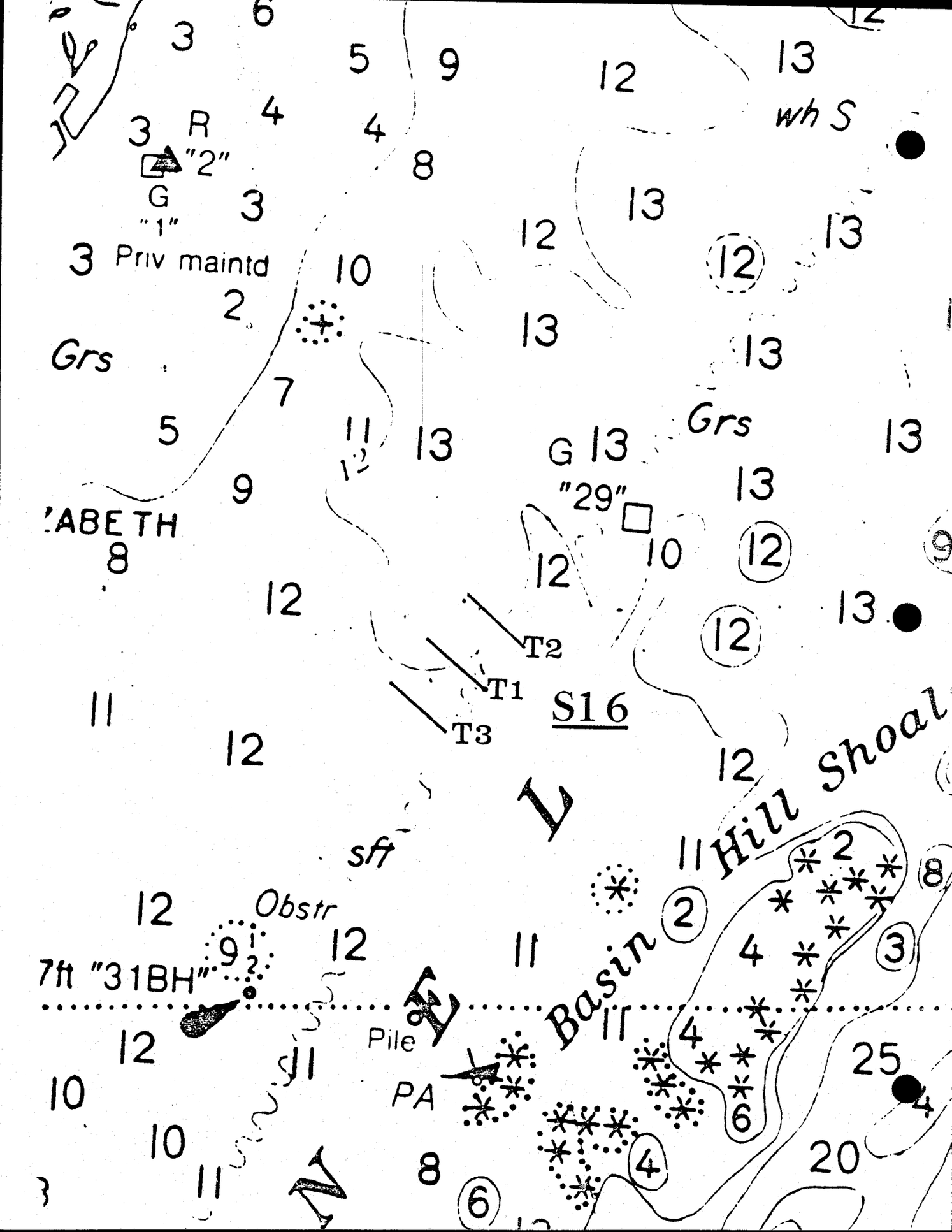

R
"2"
G
"1"
Priv maintd
Grs
G
"29"
Grs
T2
T1
T3
S16
Hill Shoal
sft
Obstr
7ft "31BH"
Pile
PA
Basin
wh S
25
20

Figure 33

Pictorial Transect Profiles

Site 16. Point Elizabeth

Point Elizabeth

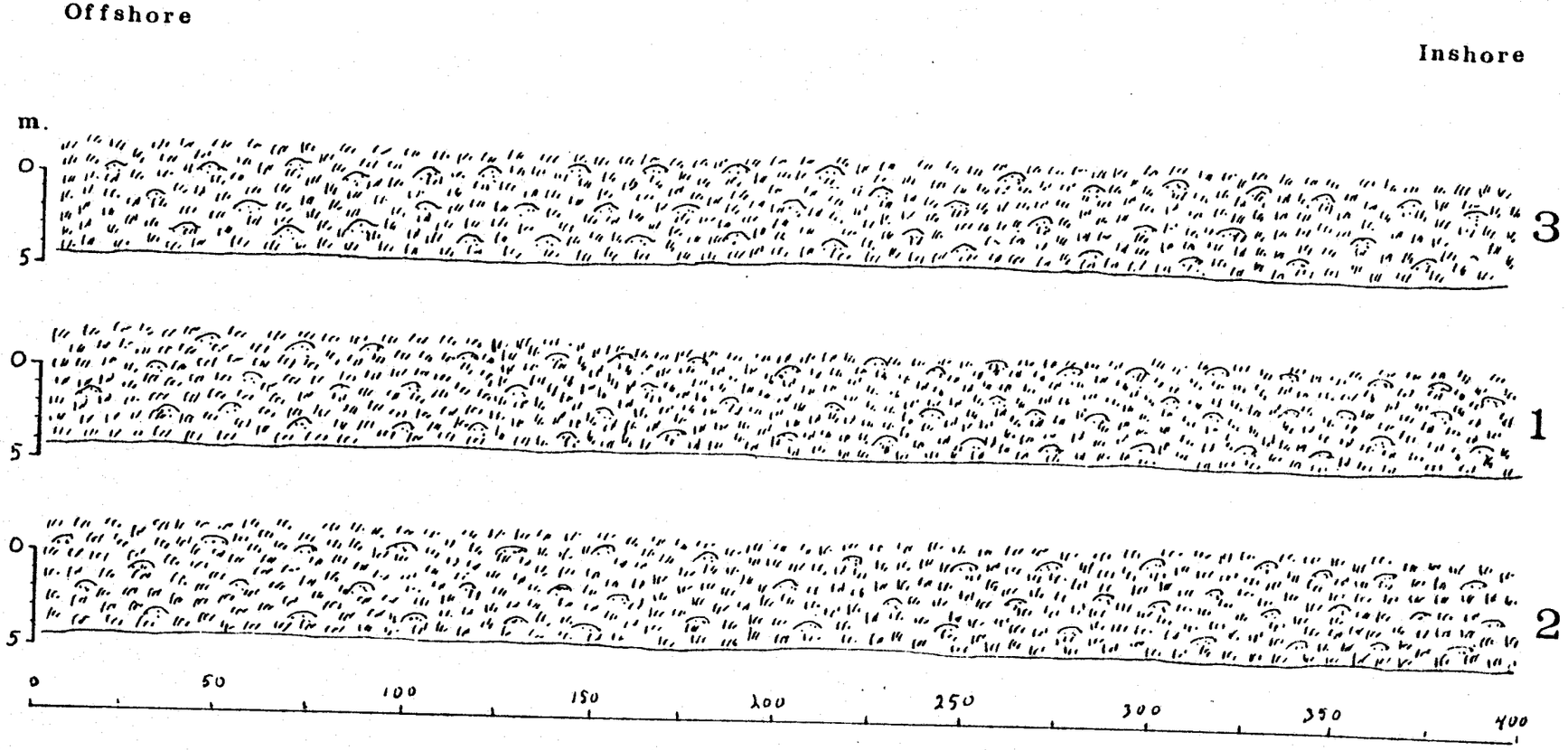


Figure 34

Location of Transects

Site 17. Angelfish Creek

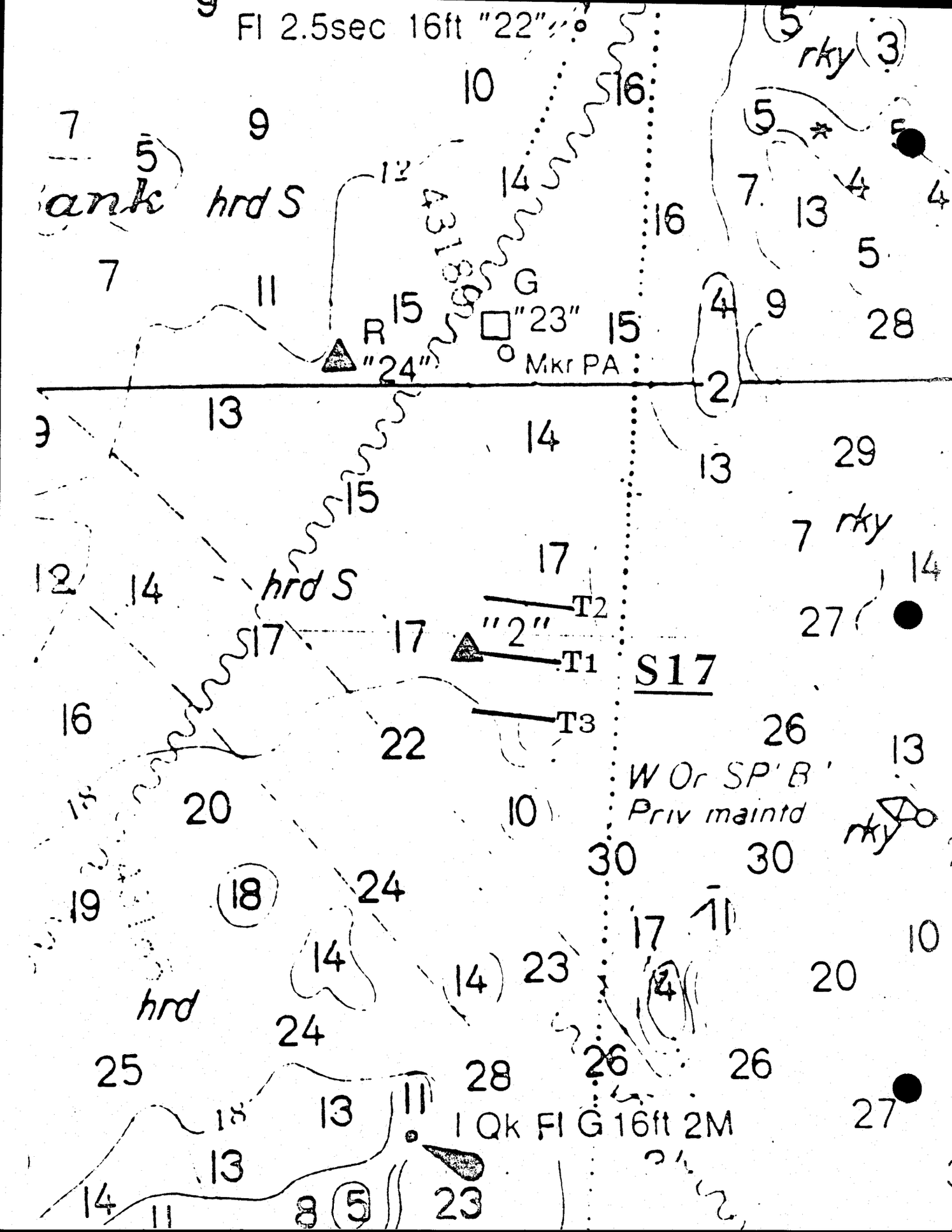
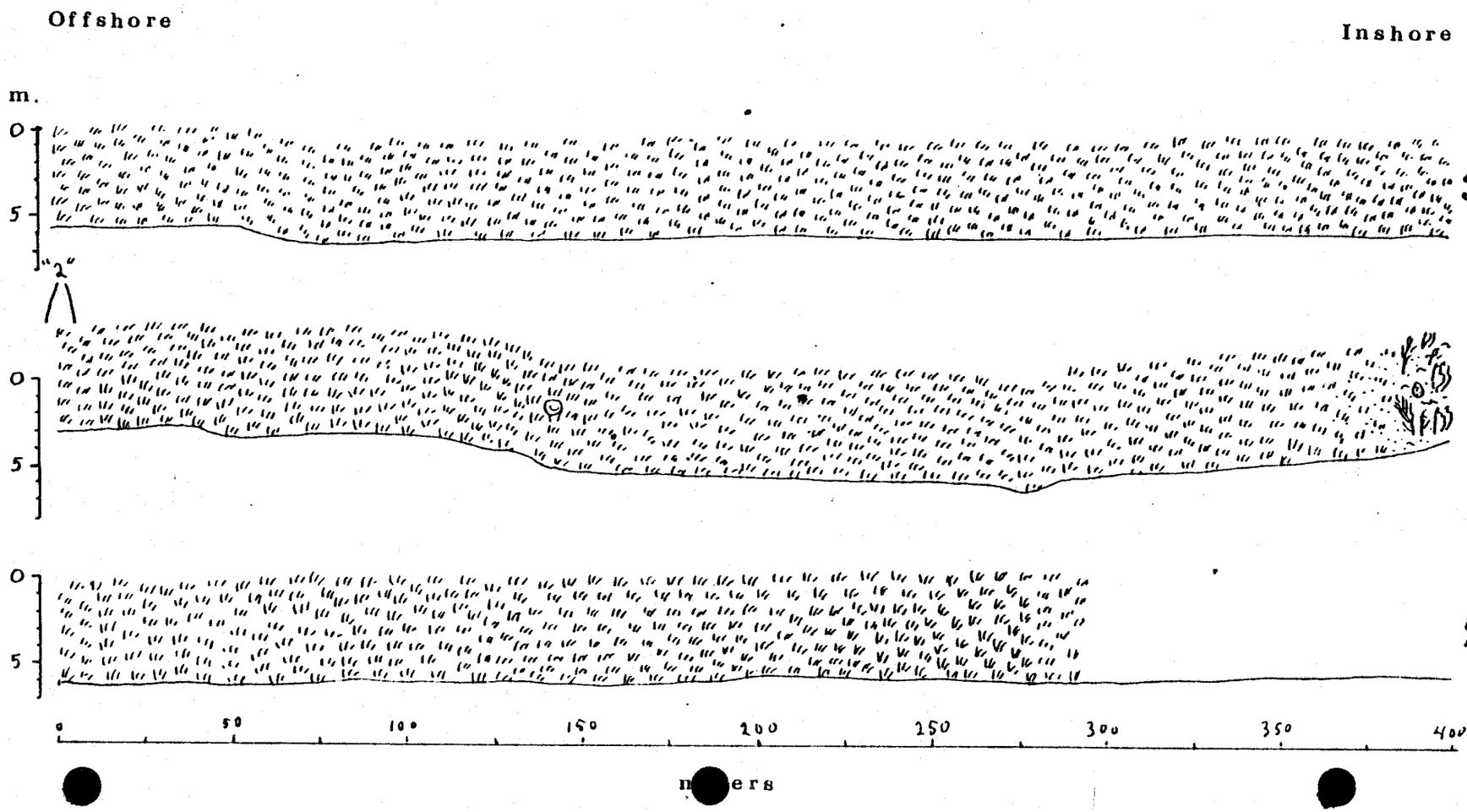

Fl 2.5sec 16ft "22"
rky
ank
hrd S
R
"24"
G
"23"
Mkr PA
hrd S
T2
"2"
T1
T3
S17
W Or SP 'B'
Priv maintd
rky
hrd
1 Qk Fl G 16ft 2M

Figure 35

Pictorial Transect Profiles

Site 17. Angelfish Creek

Angelfish Creek



DISCUSSION

Reef Structure and Zonation

In this and the following sections the terms Outer Reefs and Patch Reefs are used as defined in the section Description of the Study Area.

Outer Reefs

The structure and zonation of the outer reefs conform to a general pattern that varies in some features from reef to reef. All of the reefs are built upward from a Holocene fossil reef that underlies much of the edge of the reef tract platform. Where the fossil reef projects above the carbonate sediments, living corals became established and grew upward. The present live corals are growing upon a base of old dead corals and coral rubble.

Spurs and grooves are found on the upper fore reef slope of most of the outer reefs with the notable exception of Carysfort Reef (Jones and Thompson, 1978). Shinn has investigated spur and groove formation in the Keys (Shinn, 1963; Shinn et al., 1983). According to him, the spurs are formed of old fossil Acropora palmata or reef rubble on which living coral is now growing. The spurs in the upper part of the reef bear A. palmata or Millepora while lower on the slope the spurs are formed of Montastrea. The area between the spurs is filled with loose shifting sand preventing the growth of corals in the grooves. Shinn considered that spurs and grooves in living coral reefs are constructional, not erosional, in origin.

A constant feature of all of the outer reefs is the presence of terracing. This begins offshore with a broad, flat sand terrace that may be several nautical miles wide, extending from the foot of the reef slope to the edge of the drop off into the Straits of Florida canyon. Its upper limit lies at about 70 m depth. Here a strong slope leads upward to the second terrace composed (Jameson, 1981) of lithothamnion cobble. From the cobble zone the reef slope again rises at a depth of 35 to 45 m as the Deep Coral Reef. This reef, rising to about 25 m depth forms a ridge behind which lies another sand terrace that extends upward to within the

depths covered by the present study. Unfortunately, Jameson's profiles (1981, figs. 13-15) are very diagrammatic and no definite locations for the profiles are given other than "The Elbow," "French Reef," and "South Carysfort Reef", so that direct comparisons with the profiles of the shallow reefs are difficult.

Shoreward of the Deep Coral Reef is another broad terrace of calcareous sands extending to near the base of the upper reef slope or face. This sand terrace rises to a depth of about 15-18 m depth. Above this a nearly constant feature is a series of small terraces or ridges and valleys lying parallel to the reef axis. The seaward slopes and the tops of the ridges are formed of hard bottom and low, cemented or partially cemented rubble. These slopes and ridges have an average elevation of about 2.5 to 4 m. The surface is covered with coral, mainly Montastrea, sponges, alcyonarians, and other characteristic hard bottom life. Behind and shoreward of these ridges lie valleys of nearly bare calcareous, shifting sands. The valleys may have a width of only 10 - 15 m to as much as a hundred meters. At Molasses Reef the ridges and valleys are low and narrow but they are high and wide at French Reef.

After about three or four of the alternating ridges and valleys, the reef crest is reached at about 7 - 8 m depth. The lower part is often marked by large Montastrea but these are displaced above by Acropora palmata and Gorgonia ventalina. Behind the crest is the reef flat. The reef ends in the back reef with coral rubble blending into the sea grass meadows.

Zones, as can be seen from the above description, are often difficult to delimit. At Grecian Rocks Shinn (1980) showed 5 zones proceeding from seaward toward the Hawk Channel: (1) Rubble Zone, (2) Millepora/Montastrea Zone, (3) Acropora Zone, (4) Reef Flat, and (5) Back Reef.

At Key Largo Dry Rocks, however, in one area the zones are (1) Rubble Zone, (2) Millepora Zone, (3) Acropora Zone, (4) Reef Flat, while in another section it is

(1) Rubble, (2) Acropora with no reef flat in the customary sense of large coral rubble, alcyonarians, a few corals and sponges.

If the zones are followed from the outer platform in 80 - 90 m shoreward, they might be listed as (1) Sand Zone, (2) Lithothamnion cobble Zone, (3) Deep coral Reef, (4) Sand Zone, (5) Ridge and Valley Zone, (6) Rubble Zone, (7) Millepora/Montastrea Zone, (8) Acropora Zone, (9) Reef Flat, and (10) Back Reef.

Apparently the basal Holocene reef formation dictates much of the zonation in the upper 18 m of the reef while the terrace ridges and the Deep Coral Reef are old shorelines of the Pleistocene period.

With the many bottom differences described above, it is difficult to give a single zonational pattern that will fit all of the outer reefs of the Sanctuary or even all sections of a single reef. Reef structure reflects the diversity and defies attempts to depict order in them.

Patch Reefs

Patch reefs in the Sanctuary are numerous and range from only a few meters in diameter to a few nearly 100 m across. They may be single reefs growing on rock outcrops surrounded by turtle grass or a series of reefs such as at Mosquito Bank.

Regardless of their size and position, the patch reefs show a greater general similarity than was found in the outer reefs. Small patch reefs are usually formed of clusters of primarily Montastrea annularis rising abruptly from the surrounding sea grass meadows. The base of the reef is surrounded by a narrow band or "halo" of bare sand. If the patch reef has coral rubble in the center, alcyonarians, primarily sea feathers and sea fans, will be growing on it. Some small patch reefs have almost no coral rubble. In large patch reefs the large Montastrea and other head-forming corals grow mainly around the perimeter of the patch and the center of the reef will be formed of scattered Montastrea, patches of Acropora palmata

and A. cervicornis with masses of sea fans, sea feathers and sea whips. In very large patch reefs the center of the reef might be termed a reef flat. Due to their location on the banks, patch reefs show little difference in coral growth or zonation from inshore to offshore or vice versa unless one side or the other borders on a channel with deeper water which alters and increases coral growth.

Zonation in patch reefs, where it occurs, typically would be (1) Montastrea/coral zone, (2) Rubble Zone, (3) Montastrea/coral Zone. In some patch reefs only a coral zone is evident.

Patch reefs, being built up by large boulder type corals growing one atop the other, often have a honey comb to cavernous interior. At Abaco in the Bahamas Storr (1964) found that the entire center of many patch reefs were hollow and that by prizing away some of the coral heads he could swim or crawl into the central cavern and, in some cases even stand upright inside the reef. While such extremes of solution of the central part of patch reefs have not been found in the Florida reefs, the honey combing and solution is sufficient for the reef to form a living tenement house for swarms of fish which are not seen outside of the reef. Poisoning of small patch reefs at Margot Fish Shoal north of the Sanctuary revealed this large population of fishes supported inside the reef (Voss and Bayer, 1968).

Sanctuary and Park Habitats

In the preceding section the zones across the outer reefs and patch reefs were described: rubble, Millepora, Millepora/Montastrea, Acropora, reef flat and back reef. In describing the general habitats within the confines of the Sanctuary and Park covered by this study, five large habitats may be seen: coral-sea fan, rubble, hard bottom, sand and sea grass meadows. Inshore of the study area another might be listed as a coral/coralline habitat. This is found along much of the intertidal and shallow waters bordering the seaward side of the keys and is composed of low growths of Porites furcata, and a mixture of coralline algae such as Jania, Amphiroa and Goniolithon along with various species of the calcareous alga Halimeda. It is not discussed further here but is worth future study.

The five habitats are distinct and easily recognized wherever they occur. In various areas, however, their borders may be ill-defined. For example, the rhizomes and blades of turtle grass may invade the edges of the reef flat rubble, there may be patches of sand scattered within both sea grass and rubble, and small patches of corals and sea fans may be found within the rubble. Nonetheless, the habitats remain distinct with these minor exceptions.

In most of the habitats one or more species are dominant. The sea grass habitat is formed primarily of the turtle grass, Thalassia testudinum, and manatee grass, Syringodium filiforme. Characteristic organisms grow attached to their blades and the whole warrants being called the turtle grass community as Thorson (1957) has done for the level sea-bottom communities. Following the Thorson system, the coral-sea fan habitat could similarly, because of its dominance, be termed the coral-sea fan community. No such general community designations coincide with the hard bottom, rubble and sand habitats where a number of different communities may be found in each habitat.

It had been the intention, in this survey, to document, if possible, a number of

the communities in the study area. It was soon realized, however, that transect surveys, even if species were documented at one meter intervals, would not yield community data except for large organisms, i.e. alcyonarian community, coral community and grass community. For community designation, numerous repetitive quantitative sampling stations are required to establish the relationships between the species both by numbers and biological connections. Recurrent Groups Analysis as applied by Bayer et al. (1972) for Panamanian waters could not be validly applied from the present data.

In the habitat accounts that follow, the descriptions are based mainly upon data from the present study with supplementary information drawn from other published and unpublished sources. Unpublished sources are from data sheets and field notes kept by Voss from over 35 years of field studies within the Sanctuary and adjacent waters.

Coral-Sea Fan Habitat

Three types of coral reefs are found within the boundaries of the Sanctuary: (1) deep coral reefs, not included in this study, (2) outer (barrier) reefs: Molasses, French, the Elbow, Grecian Rocks, Key Largo Dry Rocks and Carysfort Reef and (3) patch reefs: Mosquito Bank, Basin Hill Shoals, White Bank Dry Rocks and Angelfish. With the exception of the deep coral reefs, all of the others lie in comparatively shallow water with major coral growth on the reefs occurring from approximately 10 m to the surface. The live coral area probably occupies no more than about 5 per cent of the total area of the Sanctuary and Park.

The live coral community is not a rich aggregation. When quadrats are made directly in pure stands of living coral few invertebrates and algae are found. The live coral quadrats in this study were made in mixed bottom of live coral and rubble so that both coral associated organisms as well as some rubble fauna and flora are included.

The coral-sea fan zone and habitat is typical of the shallow coral reefs of the Florida Keys and the Caribbean. It comprises most of the reef crest and extends into the reef flat on the outer reefs. It may comprise the entire reef in patch reefs.

Outer Reefs

On the outer reefs from about 9 to 7 m depth the elkhorn coral, Acropora palmata, the staghorn coral, A. cervicornis and the sea fan Gorgonia ventalina first appear together as the large dominant species. The staghorn coral is often absent on the reef face but has a wider depth range than the elkhorn coral, being recorded from the deep coral reef (Jameson, 1981). On the reef crest all three are usually present. Besides these three large, conspicuous species, the abundance of others is unnoticeable to the casual observer. In the smooth, cemented rock of the reef crest, heavily shadowed by these three species, a few other organisms occur. Lettuce coral, Agaricia agaricia, may be found growing at the base of Acropora palmata or under ledges or in crevices. It is particularly abundant at Carysfort Reef (Voss, 1949). The hard bottom under the corals is scoured by wave surges. Large, wave battered old conchs, Strombus gigas and S. samba, and the vase shell, Vasum muricatum, often occur between the coral bases. The long spined black sea urchin, Diadema antillarum, is present, sometimes on the open bottom in calm weather but more often partially protected by crevices and overhanging coral.

The corals are "hosts" to a number of organisms. Several polychaete worms such as the star featherworm Pomatostegus stellatus and the horned featherworm Spirobranchus giganteus form calcareous tubes on or in living coral, especially head corals. Another polychaete, the green bristle worm Hermodice carunculata and the bearded worm Amphinome jamaicensis are found under dead coral slabs during the day but at night feed on the living coral polyps. Several small crabs form galls on the two species of Acropora. The coral snail, Coralliophila abbreviata feeds on the

polyps of Acropora and is particularly common on A. palmata from which over 114 specimens were collected from elkhorn coral in one patch on Carysfort Reef (Voss, 1948). Parrotfishes feed upon the coral polyps and their teeth marks are often seen on corals that have been grazed.

Sea fans are host to very small delicate gastropods Simnia spp. which often escape notice because of their camouflage coloration. Both sea fans and sea feathers also may have another gastropod which feeds on them, the brightly colored flamingo tongue, Cyphoma, of which there are several species on the outer reef. During calm weather they may be found anywhere on the alcyonarian but during heavy wave action they descend to the base of the host. The grass shrimp, Tozeuma carolinensis, green colored when on grass, lives on the purple sea plume Pseudopterogorgia acerosa; it is deep purple and not often seen unless the sea plume is brushed against (Voss, 1957).

Most of the free living invertebrate life of the coral-sea fan habitat is found during the day beneath old dead coral slabs. When these are turned over, the under surface may be coated with coralline algae or Homotrema rubrum and attached mollusk egg cases, sponges and tunicates, an occasional cowrie, Cypraea spp.; various small crabs, snakeskinned brittle stars, Ophioderma spp. and the comet star Linckia guildingi may be found below. A common gastropod is the miniature triton-trumpet, Pisania pusio. Many other species of invertebrates are known from the habitat.

Some of the most spectacular animals are the reef fishes many of which are illustrated in full color by Randall (1968). The fish census by Bannerot and Schmale (this volume) lists the fishes of the outer reefs but does not designate the habitats. While certain fish species such as the French Angel, the blue parrotfish, Queen parrotfish, the Reef butterfly fish, Rock Beauty and Queen trigger fish may be conspicuous by their bright colors, the ten most common fish in order on the outer

reefs are the surgeonfish Acanthurus bahianus, the blue head Thalassoma bifasciatus, the French grunt, Haemulon flavolineatum, the yellowtail snapper, Ocyurus chrysurus, damselfish Pomacentrus partitus, yellowhead wrasse Halichoerus garnoti, redband parrotfish Sparisoma aurofrenatus, the sergeant major Abudefduf saxatilis, and the blue tang Acanthurus coeruleus. All of them are found in the coral-sea fan habitat but wander about over the whole reef.

Patch Reef

In the patch reef coral-sea fan habitat shifts of the organisms occur primarily associated with the different types of corals and the association of the corals with the reef matrix. In the outer reefs the rubble habitat lies either below the coral habitat or behind it on the reef flat; patch reef corals grow around and on top of the rubble matrix. The major corals of the patch reefs are Montastrea annularis and cavernosa, Porites spp., Diploria clivosa, Eusmilia spp., and others to a lesser degree. Most of the corals are of the head or boulder type. The massive specimens on the outer perimeter of a patch reef may rise several meters from the surrounding bottom. The top of the reef may be large rubble with growths of sea fans and sea feathers or may be corals growing on top of the rubble with alcyonarians growing between them.

Few invertebrates other than coelenterates are visible on a patch reef in the coral-sea fan habitat. These few are mainly muricid gastropods, polychaete featherworms, especially Pomatostegus and Spirobranchus which may be very common, the sea fan and sea feather associates listed in the outer reefs and the boring bivalve mollusk Lithophaga spp.

In the patch reefs much of the life of the reef lives within the reef (Voss and Bayer, 1968) in contrast to on top or outside as in the outer reefs, thus a much more complex assemblage of organisms occurs. During this study it was not possible to collect and itemize the fauna of the patch reefs inhabiting the inside

structure because it would have required extensive poisoning which was not permitted because of potential adverse public reaction. Poisoning would have produced species and numbers of caridean shrimps, fishes (both day and night feeders), many mollusks including cephalopods, and other animals that respire by means of gills. The lack of poisoning is regrettable because the only patch reef in the Florida Keys ever adequately sampled by poisoning was done at Margot Fish Shoal in 1962 (Voss and Bayer, 1968). No futher data for comparison are available.

The ten most common species of fish in the patch reefs, taken by Bannerot and Schmale are, in order: White Grunt Haemulon plumieri, stoplight parrotfish Sparisoma viride, yellow tail snapper Ocyurus chrysurus, bluehead Thalassoma bifasciatus, yellow damselfish Pomacentrus planifrons, blue tang Acanthurus coeruleus, French grunt Haemulon flavolineatum, redband parrotfish Sparisoma aurofrenatum, cocoa damselfish Pomacentrus variabilis, and the bicolor damselfish Pomacentrus partitus. Six of the ten species are also among the commonest fish of the outer reefs.

In order to compare the species diversity of the outer and patch reefs on a simple number-of-species-present basis, Table 2 was compiled from the live coral 4 m^2 quadrats. It is interesting to note that of the 140 species associated with the live coral habitat, 34 or 24 percent are from the outer reefs, 43 or 31 percent are from the patch reefs while 63 or 45 percent are common to both. Grecian Rocks with by far the smallest number of associates had only 19 species of which 2 were shared with the outer reefs and two with the patch reefs. The low number of species at Grecian Rocks is probably another reflection of the poor health of that reef, possibly due to over use and the effects of the coral kill reported by Shinn in 1978.

Table 2. Number of species recorded from live coral quadrats. Shared species are common to both outer and patch reefs. Outer reef species are from outer reef quadrats only. Patch reef species are from patch reef quadrats only. Figures in parens represent total number of species in each of the categories.

Category	Outer Reefs *						Patch Reefs **				
	1	3	5	6	7	8	2	4	9	10	17
Number of species (140)											
Number of species by station	37	31	19	37	37	41	28	54	32	48	55
Shared species (63)	25	19	19	26	31	31	25	30	26	37	41
Percent shared species	68%	61%	100%	70%	84%	76%	89%	56%	81%	77%	75%
Outer reef species (34)	12	12	--	11	6	10	--	--	--	--	--
Percent outer reef species	32%	39%	0	30%	16%	24%	0	0	0	0	0
Patch reef species (43)	--	--	--	--	--	--	3	24	6	11	14
Percent patch reef species	0	0	0	0	0	0	11%	44%	19%	23%	25%

* Outer reefs - 1. Molasses; 3. French; 5. Grecian Rocks; 6. Key Largo Dry Rocks; 7. Elbow; 8. Carysfort.

** Patch Reefs - 2. White Bank Dry Rocks; 4. Mosquito Bank; 9. Basin Hill Shoals; 10. Turtle Rocks; 17. Angelfish Creek.

Rubble Habitat

The rubble habitat around the reefs varies in size and extent with each individual reef. It also varies with bottom contour and substrate composition. Rubble expanses are found from the fore reef downward to beyond the scope of the survey. The nature of the rubble varies with depth and position. In the deeper waters of the fore reef the rubble is half buried or imbedded in calcareous sands and silts and in this condition, often lying on top of the rock bottom, should be included in the hard bottom zone. The rubble and hard bottom area excluding the living corals occupies about 10 per cent of the total area of the Sanctuary and Park.

Rubble bottom is considered to be the larger rubble forming much of the top of such reefs as Molasses and French, and the reef flat to near its termination in sand or grass. The rubble area on top of the reef is one of the richest in numbers of species in the whole reef system if the rubble is large, loose, and not buried in sand. Much of this rubble is formed of loose slabs of live Acropora palmata recently broken off of mature colonies, dead slabs covered over with algal mats and old coral rock, all lying on top of smaller older rubble. These form large but protected areas for a multitude of animals both free living and sessile. Many of the fragments of rubble are cemented together by coralline algae such as lithothamnids, calcareous deposits, algal mats and alcyonarian spicules. Near the back reef the rubble becomes smaller, formed either of old branches of Acropora palmata or the rodlike branches of A. cervicornis, and is buried in the sediments.

At Molasses, French, and the north end of Key Largo Dry Rocks, the rubble zone is extensively developed. At Key Largo Dry Rocks it appears that the reef may be largely hollow under the rubble cap as is the case in many high elevation patch reefs (Storr, 1964). This condition affords a great deal of living space within the reef proper, aside from just the surface fauna and flora and that coating the underside of the rocks. Rubble bottom was only found at seven sites: French, Molasses, Carysfort, the Elbow,

Key Largo Dry Rocks, Grecian Rocks and White Bank Dry Rocks.

The plotless line transect method gives little indication of the rich rubble life and the survey does not represent it. To find and describe the fauna associated with the rubble, the old coral slabs and rock must be turned over, revealing both the attached life on the underside of the slabs and the free, crawling animals that instantly try to escape into the rubble beneath. To assess this fauna in its entirety is very difficult and was not done in this study. The life described below is taken from previous studies and compilations by Voss.

Viewed from above, the rubble shows little indication of active life. The surface of the rock is covered by several types of low encrusting coralline algae, mainly lithothamnids, splotches of the red foram Homotrema rubrum and the circular discs of Melobesia, largely obscured by a low thick coating of various algae, principally Bostrychia, Dictyota, Padina, Pocockiella, Stypopodium and Turbinaria. A number of sponges are prominent but species vary greatly from reef to reef probably in response to unknown ecological factors. Perhaps the most prominent animals are the coelenterates, especially the sea fans Gorgonia ventalina and the sea whips and feathers, particularly species of Pseudopterogorgia, Plexaura, Eunicea, and Muriceopsis. These are not confined to rubble but may be found on almost any hard bottom. The corals of this zone are generally small, consisting of Diploria, Favia, Porites, Siderastrea, Dichocoenia, Acropora cervicornis, and others. Species of Millepora are common.

The main life is found beneath the rocks and old coral slabs: encrusting sponges, solitary and encrusting tunicates, egg capsules of many diverse forms of invertebrates, and various small, gliding forms of mollusks. In crevices are the red and yellow tentacles of the file shells, Lima, and beneath the edge of the rocks the pale orange or red keyhole limpets Diodora, the blotched and warty Pleurobranchus, and everywhere the long sharp spines of the long-spined black sea urchin Diadema antillarum, and its

less dangerous cousin the slate-pencil urchin Eucidaris tribuloides. Occasionally on turning a slab the sticky, wormlike sea cucumber Euapta lappa drifts upward in the surge, streaming its sticky white exudate.

Crustaceans are everywhere. Dromia erythropus the sponge crab crawls about holding a fitted sponge on its carapace by means of its specially modified posterior legs. Portunid, xanthid, grapsoid and majid crabs abound, the most characteristic of the outer reef rubble being the beautiful coral crab, Carpilius corallinus, the deeply sculptured or hairy xanthids Actaea acantha, Glyptoxanthus erosus, Leptodius floridanus, Heteractaea ceratopus, the flattened, swift moving Plagusia depressa and Percnon gibbesi and the spider crabs Mithrax spinosissimus and M. sculptus. There are numerous others, many of which are very difficult to collect.

One of the commonest animals in the rubble zone but not encountered by the survey is the orange to dark purple comet star, Linckia guildingi. It is often broken up by the surge and a perfect one is rarely seen. It is typically found with only one arm intact with the buds of the other four growing out from its base. Very similar but seldom broken is the orangish Ophidiaster guildingi. Common brittlestars are the slimy brittlestars Ophiocoma echinata and O. wendti and various species of the snake-skinned brittlestars Ophioderma spp..

Small solitary tunicates are common attached to the underside of the rocks, especially Polycarpa obtecta and Pyura vittata, the latter with its bright red siphonal openings.

But its is the mollusks that are so characteristic. They are too numerous to mention all of them but in the Sanctuary a few species are noteworthy, especially Pisania pusio, Leucozonia cingulifera, Conus regius (possibly poisonous), Mitra floridana, Cypraea spurca and cervus, Trivia quadripunctata, Tegula fasciata and Lima scabra.

The following list of the rubble region is taken only from the site surveys.

Table 3. List of the species inhabiting the rubble zone (combined sites 1-17) recorded from the 4 m^2 quadrats.

ALGAE

Amphiroa sp.
Anadyomene stellata
Batophora oerstedi
Dasycladus vermicularis
Dictyota cervicornis
Dilophus alternans
Galaxaura cylindrica
Goniolithon sp.
Halimeda incrassata
H. opuntia
H. tuna
Lithothamnion sp.
Neomeris annulata
Padina sanctaecrucis
Stypopodium zonale
Valonia ventricosa
Laurencia sp.

PORIFERA

Aplysina cauliformis
Callyspongia fallax
C. vaginalis
Chondrilla nuclea
Cliona sp.
Dysidea etherea
Haliclona compressa
Homaxinella rudis
Pseudopterogorgia kallos
P. rigida
Ircinia campana
I. felix
I. strobilina
Iotrochota birotula
Leucosella floridana
Merriamium tortugaensis
Microcionid
Mycale sp.
Siphonodictyon siphonum
Spongia cerebriformis
Niphates erecta
Thalysias juniperus
Tricheurypon viridea

COELENTERATA

Horny corals
Bartholomea sp.
Eunicea tourneforti
Gorgonia ventilina
Millepora alcicornis
M. complanata
Muriceopsis flavida

Palythoa mammilosa
Plexaura flexuosa
P. homomalla
Pseudopterogorgia acerosa
P. americana
P. bipinnata
Stony Corals
Agaricia agaricites
Acropora cervicornis
Diploria labyrinthiformis
D. clivosa
Favia fragum
Dichocoenia stokesi
Meandrina meandrites
Porites astreoides
P. porites
Siderastrea siderea
S. radians

WORMS

Eunice kinbergi
E. mutilata
E. longicirrata
Glycera sp.
Pomatostegus sp.
Sabellid

MOLLUSKS

Ischonochiton erythronotus
Stenoplax floridana
Cerithium eburneum
C. guinacum
C. litteratum
C. algicola
Gorio sp.
Polinices lactea
Thais deltoides
Vasum muricatum
Barbatia candida
B. dominguensis
Anadara notabilis
Periglyphus listeri
Lithophaga sp.

CRUSTACEA

Calcinus tibicens
Mantis shrimp
Mithrax forceps
Paguristes wassi
Xantha denticulata

ECHINODERMATA

Disdema antillarum
Eucidaris triculoides
Echinometra viridis
Ophiocoma echinata
O. pumila
Ophiothrix oerstedi

Ophiozona impressa

TUNICATA

Styela sp.

Ascidia nigra

Didemnum candidum

Hard Bottom Habitat

The hard bottom habitat in the Sanctuary and Park is widely distributed. There are two forms that seem similar but are in fact different. The first type is the offshore hard bottom formed on the fossilized Holocene reefs and associated rubble usually covered by a thin veneer of calcareous sediments ranging from fine silts to coarse sands. This type of hard bottom is found in the fore reef and probably forms a nearly continuous band along the outer line of the reefs. The second type of hard bottom is exposed Pleistocene limestone in the near shore areas. This limestone outcrops along the shore of the keys, in the passes between the keys, and often a considerable area swept by tidal currents in the mouth of each pass. It is particularly noticeable as the rocky bar extending across the entrances to North and South Channels into Largo Sound.

Offshore hard bottom. This habitat is found primarily in the fore reef zone. It is an area swept by clear, clean ocean water, and is probably relatively little affected by changes in salinity, temperature or pollutants from inshore. In this study each reef transect began on hard bottom at about 18 m depth. The rock substrate was covered by a thin layer of coarse calcareous sand with rock outcrops. Viewed from above the bottom appeared speckled or spotted. Viewed from the bottom, however, it has a shaggy, almost unkept garden appearance. The growth is mainly various species of both green and brown algae such as Halimeda, Dictyota, Dilophus and Sargassum. Various sponges including the large vase sponge, a great variety of sea feathers and whips, scattered coral heads and associated animal life occur. This is interspersed with low ledges and considerable expanses of almost barren calcareous sands. Coralline algae such as Amphiroa, Lithothamnion, and Goniolithon coat the bare rocky surfaces. The characteristic sponge is Agelas schmidti. Common corals are Montastrea annularis, Favia fragum, Diploria labyrinthiformis, Dichocoenia stokesi, Siderastrea siderea and others. It is much

richer in coelenterates than the inshore hard bottom.

Inshore hard bottom. The inshore hard bottom habitat has a much lower profile than its offshore counterpart and is rather smooth but filled with holes and erosion cavities. As it lies in rather shallow water, this habitat is subject to many environmental changes such as varying salinities and temperatures and increased sedimentation but it is relatively free from wave and surge disturbances. The water is often turbid. The bottom has a very rich algal flora consisting primarily of calcareous greens such as Batophora, Halimeda, Acetabularia and Udotea with some browns such as Sargassum. The common sponges are Aplysina cauliformis, Chondrilla nucula and Ircinia strobilina.

The inshore hard bottom is impoverished as compared with the offshore hard bottom (Table 4). There is only about one half as many coelenterates including only about one third of the corals and one third of the alcyonarians. The corals are Favia fragum, the finger coral Porites furcata, two Siderastrea, Stephanocoenia michelini and Solenaster hyades.

There are over twice the number of sponges on the outer hard bottom as compared with the inner hard bottom bars. Other groups are about evenly distributed between the two areas.

The common fish of this habitat are not separated from those of the sea grass habitat and are given in that section.

Table 4. Number of species obtained from 4 m^2 quadrats from hard bottom habitats from the outer reef area and inshore hardbottom bars.

Phylum	Outer Reef Hard Bottom	Inshore Hard Bottom
Protozoa	1	0
Algae	16	22
Porifera	15	7
Coelenterata	36	15
Worms	5	3
Mollusca	3	8
Crustacea	6	3
Echinodermata	5	4
Total	87	62

Sand Habitat

The second largest area of bottom in the Sanctuary and Park, accounting for about 10 percent of the bottom coverage, is formed of sediments of fine calcareous silts or calcareous sands, the latter often coarse. The sands are easily moved by wave action and may be smooth or rippled. The bottom is usually bare but occasional thin patches of grass, coral boulders, or other hard objects may have organisms growing on them, including small corals and alcyonarians. Over most of the sand bottom the surface is bare. Some large animals live on the surface or burrow just beneath it.

Although none were captured or seen during the survey three large, spectacular animals inhabit this region. Oreaster reticulatus, the cushion star, was formerly often seen lying on the open sand, searching for small bivalve mollusks. The large numbers formerly seen have been collected out for the curio trade. The spectacular giant helmet shell, Cassis madagascarensis spinella, occurs spottily in sand patches where it hunts down and eats the long spined sea biscuit, Plagiobrissus grandis, which burrows as much as .3 m beneath the surface of the loose sand. Both of these animals formerly occurred in sand patches between the reefs and could be very common locally. More than 100 individuals of this species of Cassis have been taken in one single sand patch, the largest weighing up to 9-13 kilos (Voss, 1949). The largest of these is now in the collections of the Museum of Comparative Zoology at Harvard. None were found or seen during the survey. Plagiobrissus grandis may attain a length of over 25 cm and is the largest sea biscuit in Florida waters. Several starfish, Astropecten duplicatus, A. articulatus and Luidia senegalensis burrow beneath the surface of these sandy areas. Only Astropecten duplicatus was taken in the survey.

The major animals of the sand community in the Sanctuary were polychaete worms, often plentiful in sand, and mollusks. The number of species and

individuals would have been greatly increased if a smaller mesh sieve had been used; it would also have greatly increased the amount of time for identifications even to families. The animals were collected by removing the top 10 cm of sand from each of the four 1 m^2 quadrats and sieving it.

The sand community is composed of animals that live in or on the sand and are not associated with rubble, old bivalve shells, emergent hard substrate and grass patches. Those listed below in the first group are sand restricted. The second group contains species noted in the sand quadrats but where obviously there was a thin layer of sand over rock substrate that permitted attachment of sessile forms. The sand community, so called here, does not seem to reflect the Level Sea Bottom Communities of Thorson (1957). More extensive, careful grab sampling and fine sieving might show that some of these standard communities are present as were described from Biscayne Bay by McNulty et al. (1962). Certainly a Cassis/Plagiobrissus community is present in some areas but apparently the reef sand areas have too low an organic composition to afford a home for complex, stable, self maintaining communities, especially those containing infaunal brittlestars.

The sands of this habitat have been studied by Ginsburg (1956) who showed that they are composed of carbonates. The larger particles are formed of fragments of calcareous algae, Halimeda, coralline algae, foraminifera, corals and mollusks shells. Non-calcareous structures such as sponge and horny coral spicules are often included.

In addition to the coarser sands, fine silty sediments are common especially in nearshore areas. The fine, mudlike fraction is composed largely of carbonate particles precipitated from the calcium carbonate-supersaturated water when seeded by bottom particles in suspension during stormy weather. This results in the "milky" waters during and after storms (Smith, 1940). Supersaturation occurs when

the waters are warm and have a high CO_2 load. This condition is commoner in shallow water near shore where the fine silty bottom is more frequently encountered. Few silicate or quartz sands are present as most quartz sands are of Carolinian origin swept southward by the inshore counter current, reaching their southern limit just south of Miami; only small amounts of quartz sand occurs in the keys, mainly at Big Pine Key. Renaud-Debyser (1955) in work at Bimini, Bahamas, reported that the interstitial fauna of calcium carbonate sands is much richer than in silicate sands.

The sandy bottom areas are probably maintained through continual build up, shifting loose sands discouraging sea grass growth, and destruction of pioneering sea grass by strong wave surges during winter storms and occasional hurricanes. Sand areas between coral patches or rubble and sea grass beds are caused by herbivorous reef-dwelling fish such as parrotfish and other organisms foraging near the reef.

Table 5. Sand habitat animals. Group 1 consists of true sand dwelling organisms. Group 2 consists of organisms attached to hard objects in the sand habitat. All data from 4 m^2 sand quadrats.

Group 1

POLYCHAETA

- Eunice sp.
- Nepthys sp.
- Glycera sp.
- Ophelidae
- Capitellidae
- Flabelligeridae
- Hesionidae
- Terebellidae
- Sabellidae
- Lumbrinereidae
- Goniadidae
- Cirratulidae
- Nereidae
- Onuphidae
- Siqualionidae

SIPUNCULIDEA

- Phascolion sp.

MOLLUSCA

- Terebra hastata
- Olivella nivea
- Calliostoma jujubinum
- Dentalium calamus
- Tellina listeri
- Mycale angulosa

CRUSTACEA

- Cycloes bairdi

ECHINODERMATA

- Astropecten duplicatus
- Meoma ventricosa
- Mellita sexiesperforata

Group 2

ALGAE

- Halimeda tuna
- Goniolithon sp.
- Laurencia sp.
- Dasycladus vermicularis
- Acetabularis crenulata
- Penicillus capitatus
- Caulerpa prolifera
- Bostrychia montagnei

PORIFERA

- Aplysina cauliformis
- Ircinia strobilina

COELENTERATA

- Millepora alcicornis
- Plexaura homomalla

Eunicea tourneforti

Siderastrea siderea

Favia fragum

Agaricia agaricites

Porites astreoides

MOLLUSCA

Crepidula aculeata

Chama macrophylla

Arca imbricata

ECHINODERMATA

Lytechinus variegatus

Turtle Grass Habitat

Over 75 percent of the bottom within the Sanctuary and Park is covered by sea grass meadows (see Marszalek maps). These begin at the intertidal zone at the shore and extend seaward to the back reef zone of the outer reefs, approaching to within a few meters of the living reef. The sea grasses are limited only by the depth of the sediments in the back reef and the decrease of illumination due to turbidity in the deeper waters of the Hawk Channel in depths of about 10-12 m.

The dominant plant is a phanerogam or true flowering plant unrelated to the marine algae, the turtle grass Thalassia testudinum Koenig and Sims. It produces long flat leaves about 4-8 mm wide growing upward from rhizomes or runners that also send roots down into the substrate. The richness of the turtle grass (number of leaf blades/m^2 and their length) is determined by a number of factors including the depth of the substrate which permits full development of the rhizome system. Scattered tufts of short blades are typical of turtle grass in shallow sediments over rock bottom. This may be seen in the back reef area where sediments are thin. Where there are depressions in the rock bottom and sediments are deep, the turtle grass is often lush and dense. In mature turtle grass, the flat blade surfaces may increase attachment surface for sessile organisms by as much as ten fold.

In the Sanctuary and Park area the manatee grass, Syringodium filiforme Kutzing (=Cymodocea filiforme) is often found mixed in with turtle grass and occasionally in pure stands. Manatee grass may be easily recognized as the leaves are round, tapered and long. Viewed among the turtle grass, manatee grass may have a yellowish appearance. Manatee grass has not been shown to be of major importance in the marine habitat because its slender leaves permit little surface for attachment, weak sediment entrapment and poorly developed root and rhyzome systems.

When all new blades of turtle grass grow out after a hurricane has stripped

the plants, the leaves are bright green because they are clean and have no aufwuchs. Very shortly, however, the blades become covered with the whitish calcareous sediments, attached foraminifera, hydroids, diatoms, colonial tunicates, sponges, a large number of species of epiphytic algae, and many species of mollusks. As a result the leaves appear grayish. If the aufwuchs becomes too great the plants may suffer from lack of sunlight, have a wilted appearance, and sluff off their leaves. This condition often occurs during the warmest periods of the year, when the grass beds may have a "sick" appearance. The leaves may also be killed off in shallow water during a severe cold spell. Thus, leaf kill may occur at both extremes during late summer and late winter (Phillips, 1960). Turtle grass in Largo Sound has been killed back in summer by heavy blooms of filamentous red algae that covered over the turtle grass like the webs of tent caterpillers (Voss, pers. observ.). This condition may last for several months and it may take weeks for the grass to recover its normal condition as the waters cool.

Although reproduction is both vegetative and sexual, the 3-petalled flowers are seldom seen in the Keys except offshore in rich back reef areas. They have been found over many years around Long Reef and Molasses (Voss, pers. observ.).

The turtle grass community is one of the richest known in the marine world. It is filled with both macro- and micro-organisms. As many as 29,130 individuals/m^2 of 6 species of micro-mollusks have been recorded in Biscayne Bay (Moore, 1963) and Humm (1964) has listed 113 species of epiphytic algae in the Biscayne Bay area. A number of Shannon-Weaver species diversity indices have been calculated for the grass community. In shallow waters off Key Biscayne indices of 4.57 and 4.52 were recorded by State biologists while studies made by RSMAS personnel yielded an index of 5.45, perhaps the highest ever recorded for this habitat (Toll, unpublished). These indices were obtained from analyses based upon grab samples sieved through a 1 mm^2 mesh.

Much of the turtle grass community is composed of organisms smaller than 1 cm, the size limit of this study. The larger organisms (greater than 1 cm) are still very numerous but it is difficult to list species that are solely restricted to the grass community. Many species, however, are typically found in turtle grass and are considered part of the community. The plants and animals in Table 6 are commonly found in turtle grass but may also be found in one or more of the other Sanctuary habitats. Missing from the list are two species that formerly were very commonly found in turtle grass, the pink conch, Strombus gigas, and the hawksbill turtle. In the 1930's conchs were so numerous that in some areas over a hundred mature conchs could be captured in no more than a 10 by 10 m area (Voss, pers. observ.). In the survey the transect line passed over only one specimen. Likewise, one or more hawksbills would be seen on each visit to the reefs, feeding in the turtle grass beds. None were seen in the survey.

The geographical distribution of turtle grass in Florida and the factors involved in limiting its depth have been discussed by Moore (1936) and hurricane effects on the grass meadows have been reported by Thomas et al. (1961). Phillips (1960) discussed the ecology of turtle grass and the effects of temperature extremes.

The importance of turtle grass beds as nursery grounds for many important commercial and sports species of fish and invertebrates was first brought to attention by Tabb et al. (1962). While the blades of grass offer little nourishment or nutrient themselves, the proliferating leaf blades greatly increase the amount of attachment surface for small sessile plants and animals that in turn afford food for young fish, crawfish and other animals in their early life histories.

Other important functions served by Thalassia is bottom stabilization by means of the dense network of roots and rhyzomes, and sediment entrapment by the long leaves. Because of its many beneficial attributes turtle grass is protected

by both local and State laws.

Few animals feed directly on turtle grass but Randall (1965) has discussed various herbivores. The most important grazers are several species of parrot fishes (Randall, 1965) and Diadema antillarum (Randall et al., 1964). The latter are sometimes very numerous and the last authors reported counts of 1.2 urchins per square meter in the turtle grass off Lower Matecumbe, south of the present study areas.

Randall has shown by field experiments (Randall et al., 1965) that the primary cause of the sand halos between the reefs and the grass beds is directly caused by several species of parrot fishes and surgeon fishes. The general fauna and flora of the turtle grass meadows is rather uniform throughout the keys. In areas of deep sediments there is little variation in the grass assemblages. However, in the intertidal and very shallow waters along the shores of the keys the turtle grass becomes intermixed with low, extensive colonies of Porites furcata and numerous corallines, especially Goniolithon, Jania, and Amphiroa. This zone, often tens of meters wide, gradually thins out and gives way to the fully developed grass beds.

The importance of turtle grass in the Sanctuary and Park cannot be over emphasized. It serves as a nursery ground for many of the animal species of the area, filters sediments from the water thus aiding in water clarity for the corals and stabilizes the bottom sediments. It provides the largest single habitat within the study area and much of its nutrients.

Numerous species of fish are found swimming about over the grass areas. In the fish census no distinction was made between grass and the intermixed inshore hard bottom. As the great preponderance of bottom is grass, the fishes of this mixed area are listed here. The ten most commonly encountered species ranked in order of their occurrence are: white grunt Haemulon plumieri, bridled goby

Coryphopterus glaucofrenum, sand perch Diplectrum formosum, banner goby Microgobius microlepis, redtail parrotfish Sparisoma chrysopterum, tiger goby Gobiosoma macrodon, rockcut goby Gobiosoma grosvenori, high hat Equetus acuminatus, gray angelfish Pomacanthus arcuatus and the cocoa damselfish Pomacentrus variabilis.

Table 6. List of the species inhabiting the sea grass habitat (combined sites) recorded for the 4 m^2 quadrats.

ALGAE

Green Algae

- *Acetabularia crenulata*
- *Anadyomene stellata*
- *Avrainville nigricans*
- *Batophora oerstedi*
- *Caulerpa cupressoides*
- *Dasycladus vermicularis*
- *Dictyosphaeria cavernosa*
- *D. vanbosseae*
- *Enteromorpha* sp.
- *Halimeda globosa*
- *H. incrassata*
- *H. lacrimosa*
- *H. monile*
- *H. opuntia*
- *H. o. minor*
- *H. o. triloba*
- *Penicillus capitatus*
- *P. dumetosus*
- *P. lamourouxi*
- *Phipocephalus phoenix*
- *Udotea flabellum*
- *Ulva lactuca*
- *Valonia ventricosa*

Brown Algae

- *Dictyota cervicornis*
- *Dilophus alterans*
- *Solenastrea hyades*

Red Algae

- *Acanthophora* sp.
- *Colpomenia sinuosa*
- *Laurencia* sp.

GRASSES

- *Thalassia testudinum*
- *Syringodium filiforme*
- *Diplanthera wrightii*

PORIFERA

- *Aplysina cauliformis*
- *Chondrilla nucula*
- *Cliona deletrix*
- *Dysidea etheria*
- *Geodia gibberosa*
- *Haliclona compressa*
- *H. viridis*
- *Ircina campana*
- *Lissodendrix stigmata*
- *Spheciospongia vesparia*
- *Verongia longissima*

COELENTERATA

Briareum asbestinum

Porites divaricata

P. furcata

P. porites

Siderastrea siderea

Modiolus modiolus

M. m. squamosus

Pecten antillarum

Pinctada radiata

WORMS

Cistenides gouldi

C. regalis

Hermodice carunculata

Eunice frons

Loimia sp.

Marphysa sp.

Sabella melanostigma

MOLLUSCA

Gastropoda

Astraea tecta americana

A. phoebia

Calliostoma jujubinum

Haminoea sp.

Modulus modulus

Tegula fasciata

Pelecypoda (Bivalvia)

Americardia media

Anadara notabilis

Arca zebra

Chione cancellata

C. paphia

Codakia orbicularis

Glycimeris pectinata

Laevicardium laevigatum

Linga pensylvanica

Octopoda

Octopus joubini

CRUSTACEA

Dardanus venosus

Paguristes puncticeps

Pitho anisodon

ECHINODERMATA

Ophioderma brevispinum

O. rubricundum

Ophionereis squamosa

Ophiothrix lineata

O. oerstedi

Clypeaster rosaceus

Lytechinus variegatus

Actinopyga agassizi

Astichopus multifidis

TUNICATA

Didemnum candidum

D. savigni

Microcosmus jelleri

Styela sp.

Cryptic Fauna

Several recent papers have dealt with the cryptic faunas of Florida, the Bahamian, and Caribbean reefs. Uebelacku (1977) studied the cryptic fauna of the coral reef sponge Gelliodes digitalis in the Bahamas. Bonem (1977) investigated the fauna of coral reef cavities in sites near Miami while Caffey and Florida (1977) studied the cryptic bryozoans of coral cavities at Andros and Eleuthera and Logan (1977) the bryozoans at Grand Cayman. Earlier Voss and Bayer (1968) had investigated the fish and invertebate fauna of patch reefs at Margot Fish Shoal in the Biscayne National Park. There are many other accounts of cryptic fauna studies including the classic report by Pearse (1932) of the organisms inhabiting the canals in the loggerhead sponge, Spheciospongia vesparia. No full study of the cryptic fauna of the Florida reef tract has been undertaken because of the magnitude of the task.

Cryptic fauna, as can be seen from the literature cited, includes both animals that live within other animals such as burrowing or boring organisms in coral skeletons, sponges and sea grass rhyzomes and those that live hidden in crevices, crannies, under rocks or in cavities and caverns.

No investigations were undertaken in this study of the burrowing and boring fauna of the corals, sponges and other hosts. Corals may be the host of gall forming crabs, tube dwelling polychaete worms and others. Gall crabs are seen most frequently in the two species of Acropora while the tube dwelling polychaetes such as Pomatostegus stellatus and Spirobranchus giganteus are common in the massive corals such as Montastrea and Porites.

Acorn worms or sipunculids prefer to burrow or bore into dead coral rock. The boring bivalves Lithophaga nigra and L. antillarum also live in coral rock.

Sponges are hosts to myriads of small shrimp of the genus Alpheus and Synalpheus. Pearse (1932) at Loggerhead Key, the Dry Tortugas, found 16,000

Synalpheus snapping shrimp in a single large loggerhead sponge and 13,500 in another somewhat smaller one. Sponges of the genus Ircinia in the Keys often are hosts to large eunicid polychaetes such as Eunice spongicola that forms a thin papery lining to its burrow.

The cryptic life beneath rocks and in cavities and caverns may be both seeking shelter and occupying a niche with reduced illumination thus permitting some deeper dwelling animals to live in shallower depths (Bonem, 1977). The undersides of rocks and the roofs of caves are often covered by encrusting corallines, bryozoans and even some deep water corals.

The major cryptic species of the Sanctuary are the crustaceans and fishes that occupy the open spaces in the reef. During the day these may be mainly night time feeders while at night day time feeders take their place. Studies at Margot Fish Shoal (Voss and Bayer, 1968), using rotenone to bring the cryptic organisms out of the patch reef matrix, revealed a much greater reef population than could be seen by diving operations.

In order to assess the major cryptic species of the Santuary it was originally planned to poison several small patch reefs as had been done previously at Margot Fish Shoal where no adverse effects on the living corals was observed either immediately thereafter or in later years. Because of the possibility of adverse impact on the user public, the poison operations were reduced to only four stations at Grecian Rocks: a coral ledge with numerous small caves, rubble bottom with sand and solid carbonate substrate, an isolated coral head and a living coral patch. Each area was about 10 m^2 in size.

Twenty-three species of invertebrates (Table 7) were obtained of which only 3 or 13 percent had been recorded from the transects and quadrats. The 87 percent remaining consisted of 2 polychaete worms, 1 mollusk and 18 crustaceans of which 14 were caridean shrimp belonging to 6 genera. All but one species were

epresented by single individuals at each station.

The fish were far more numerous (Table 8). Thirty-five species were taken. Of these only 8 species or 23 percent were not also recorded by Bannerot and Schmale. However, 129 individual specimens were collected, graphically demonstrating the amount of refuge offered by the cavities within the coral reef matrix.

While poisoning is an effective method for obtaining shrimp and fish, it does not provide information on the large number of polychaete worms living in borings or burrows in the reef. These must be obtained by collecting and breaking up large coral heads and carefully extracting the animals living within. Ebbs (1966) thus studied the cryptic species of polychaetes at Margot Fish Shoal where he obtained 10 species of which Hermenia verruculosa and Eunice schemacephala were at that time known only from the Florida back reef areas. The most common species was Eunice schemacephala, the Atlantic palolo, which is also coral destructive, actually boring into the coral heads.

Table 7. List of cryptic invertebrates collected from poison stations at Grecian Rocks.

Species	Number of Individuals stations 1	2	3	4
Polychaeta				
Notopygos crinita	-	1	-	-
Eurythoe complantata	-	-	1	-
Hermodice carunculata	-	-	1	-
Mollusca				
Tridachia crispata	-	-	-	1
Octopus briareus	1	-	-	-
Crustacea				
Alpheus amblyonyx	1	1	1	-
A. cristulifrons	1	-	-	-
A. formosus	1	1	-	1
A. normani	-	1	-	-
A. ridleyi	1	1	-	-
A. sp. A	1	-	-	-
A. sp. B	-	1	-	-
Brachycarpus biunguiculatus	1	1	-	-
Hippolyte nicholsoni	-	1	-	-
Lysamata intermedia	-	1	1	-
Mithrax sp.	1	-	-	-
Paguristes cadenati	-	1	1	1

Table 7. (continued)

Species	Number of individuals stations 1	2	3	4
P. sp. A	1	-	-	-
Petrolisthes galathinus	6	1	-	1
Synalpheus fritzmuelleri	1	-	-	-
S. minos	1	-	-	-
S. townsendi	1	-	-	-
Thor manningi	1	1	-	-

Table 8. List of fishes collected from poison stations at Grecian Rocks.

Species	Number of Individuals Station				Total Individuals
Acanthuridae (surgeonfishes)					6
Acanthurus bahianus	-	3	-	-	3
Acanthurus coeruleus	-	-	1	2	3
Apogonidae (cardinalfishes)					11
Apogon bionatus	2	-	-	-	2
Apogon maculatus	2	1	-	1	4
Phaeoptyx pigmentaria	5	-	-	-	5
Aulostomidae (trumpetfishes)					1
Aulostomus maculatus	-	-	-	1	1
Balistidae (filefishes)					1
Cantherhines pullus	-	-	1	-	1
Bythitidae (viviparous brotulas)					5
Ogilbia cayorum	1	3	1	-	5
Clinidae (clinids)					56
Acanthemblemaria chaplini	7	7	8	2	24
Enneanectes jordani	6	4	-	2	12
Labrisomus bucciferus	1	2	-	1	4
Malacoctenus triangulatus	1	-	7	-	8
Paraclinus marmoratus	-	1	2	1	4
Starksia ocellata	2	1	-	-	3
Stathmonotus hemphilli	1	-	-	-	1
Dactyloscopidae (sand stargazers)					8
Gillellus rubrocinctus	2	2	1	3	8
Gobiidae (gobies)					4
Coryphopterus dicrus	-	1	1	-	2
Gnatholepis thompsoni	-	1	-	-	1
Gobiosoma oceanops	-	-	1	-	1
Grammistidae (soapfishes)					1
Rypticus saponaceus	1	-	-	-	1
Lutjanidae (snappers)					1
Ocyurus chrysurus	-	-	1	-	1
Muraenidae (morays)					1
Gymnothorax moringa	-	-	1	-	1
Ophichthidae (snake eels)					1
Myrichthys oculatus	-	1	-	-	1

Table 8 (continued)

Species	Number of Individuals Station 1	2	3	4	Total Individuals
Pempheridae (sweepers)					2
Pempheris schomburgki	2	-	-	-	2
Pomacentridae (damselfishes)					10
Pomacentrus diencaeus	1	1	-	-	2
Pomacentrus partitus	-	2	1	-	3
Pomacentrus planifrons	-	-	1	1	2
Pomacentrus variabilis	1	1	-	-	2
Microspathodon chrysurus	-	-	1	-	1
Priacanthidae (bigeyes)					1
Priacanthus cruentatus	1	-	-	-	1
Scaridae (parrotfishes)					16
Scarus croicensis	-	1	-	-	1
Sparisoma viride	1	1	12	1	15
Serranidae (sea basses)					2
Serranus tigrinus	-	-	2	-	2
Sygnathidae (pipefishes)					1
Corythoichthys albirostris	-	-	-	1	1
Tetraodontidae (puffers)					1
Canthigaster rostrata	-	-	1	-	1

Total Individuals	129
Total Species	36
Total Genera	30
Total Families	19

Coral Health

Coral health is of interest to Sanctuary and Park scientists and managers because the fate of the coral reefs and their faunal and floral assemblages depends on the health of the corals. The state of health of corals is difficult to determine and no reliable methods of assessment are known. A health indicator now commonly used is the presence or absence of white spotting on a coral colony. White spotting is the presence of small to large areas of white, freshly bared, coral skeleton. These areas stand put distinctly from the healthy creamy-brown coral tissue. The presence or absence of white spots can be easily noted and estimates can be made of the percent of white areas versus natural living surface.

When white spotting was first interpreted as a sign of possible coral deterioration, it was used as a general term. White spotting may be caused simply by the loss of symbiotic zooxanthellae in which case the living tissue is still present. As used in most studies, it refers to the loss of the tissue itself, baring the skeleton which bleaches white. The term is here used in this sense.

White spotting may occur from a variety of causes: tissue eaten by coral predators such as certain bristle worms, mollusks and fishes; physical damage by boats and anchors; diver and swimmer contact; heavy siltation; storm damage; pollution; infection by bacteria and viruses; destruction by algal invaders, and others. In few cases has it been possible to isolate or pinpoint the causative agents. White spotting, its occurrence and possible causes has been reviewed and discussed by several writers (Antonius, 1981a, 1981b; Dustan, 1977; Voss, 1973).

Because white spotting and coral death occur from both natural and man-made causes, it is widespread and to some degree nearly universal. It is only when the incidence of white areas becaomes higher than usual that it is noticeable and an alarm is raised. It is seldom possible to determine whether the occurrence is from natural or man-made causes. Recent outbreaks of extensive coral reef

damage from infections of the cyanophyte Oscillatoria submembranacea (Antonius, 1981b) have raised the question whether corals living under stress conditions, such as pollution, may be more susceptible to the disease. Antonius (1977) has suggested that Shut-down-reaction (SDR) or the sloughing off of the entire living surface under stress, may be a more important factor. That very serious destruction may occur is vividly shown by the near total death of the coral reefs in the Gulf of Chiriqui, Panama, in a documented period of little more than four months (Glynn, personal communication). No cause has been discovered although pollution from pesticides and heavy metals is suspected.

Two cases of major coral death have been recorded in the Florida reef tract. The first occurred at Hen and Chickens Reef in the winter of 1969-70 (Voss, 1973) when apparently cold water killed off approximately 90 percent of the corals (Hudson et al. 1976). Antonius (1977) suggested that SDR caused the massive kill while the corals were under stress. Likewise, Grecian Rocks suffered a heavy coral kill in 1978, after Antonius (1974) had presented data on the health of that reef. Shinn (letter) reported that this was probably caused by warm water during a particularly warm period in the summer.

While natural catastrophies such as those at Hen and Chickens and Grecian Rocks cannot be guarded against, coral loss through man's activities can be controlled and prevented provided means are found for assessing coral health and the causes of deterioration can be detected. One of the methods of assessing coral health is the determination of the amount and extent of dead versus living coral.

In 1973 Antonius described a method of analysis using transect lines. Each coral under the line was recorded at one meter intervals. If over 50 percent of the coral was dead, the coral was listed as dead. If less than 50 percent was dead, it was listed as living. A coral with 100 percent dead surface but which could still be identified to species by its skeletal structure was listed as dead. When

identification from the skeleton was impossible, it was listed as rock.

In the present survey, corals were recorded at every five meters. The number of coral point samples was low and the incidence of dead surfaces was negligible. The photographic survey, however, in which at least 1 m^2 was photographed at each five meters, permited the observation of a large number of corals and an assessment of the percentage of dead surfaces. In Table 9 four items are listed: (1) the total number of corals seen, (2) the number of corals with no dead areas, (3) the number of corals containing dead areas, and (4) the number of corals with 50 percent or greater dead surfaces. To facilitate comparisons with Antonius' (1974) figures, the numbers and percentages of living versus dead corals are given in Table 10 following the format given by Antonius.

The results of the coral health assessment are interesting. The reefs following the outer line of the banks: Molasses, French, the Elbow and Carysfort have a percent dead coral range and mean of 1-3.1-6; the the middle reefs represented by White Bank Dry Rocks, Grecian Rocks and Key Largo Dry Rocks show 12-18-22, while the inner reefs represented by Mosquito Bank, Basin Hill Shoals and Turtle Rocks have a range of 3-5.7-8.

Only five of these reefs were studied by Antonius in 1974. In Table 9 the number of corals recorded and the percentage of dead corals in the present study are given first, followed by Antonius' figures in parentheses.

Table 9. Comparison of number of corals and percent dead corals from present survey (1980-81) and that of Antonius (1974). Data from Antonius are enclosed in parentheses.

Reef	Number of Corals		Percent dead corals	
Molasses Reef	182	(160)	1%	(6.9%)
The Elbow	62	(197)	6%	(7.1%)
Carysfort Reef	116	(193)	1%	(7.3%)
Grecian Rocks 1980	120	(271)	31%	(14%)
Grecian Rocks 1981	121		22%	
Largo Dry Rocks	186	(289)	12%	(8%)

It is doubtful that the differences shown are significant as the transects are not identical and the conditions of the corals could vary according to the nature of the reef at the transect line. The number of corals sampled does not appear to have signficance. The major difference occurs at Grecian Rocks where in 1974 Antonius calculated 14 percent dead corals while in 1980 there were 31 percent dead colonies. This reflects the kill recorded by Shinn (letter) and others in 1978, four years after the survey by Antonius and two years prior to the present survey.

In this study Grecian Rocks was surveyed in both 1980 and 1981. While the transects did not cover exactly the same corals in the two surveys, 120 corals were recorded in 1980 and 121 in 1981. The 1980 survey showed 31 percent dead corals versus 22 percent dead in 1981. It is tantalizing to consider that the difference of 9 percent less dead corals in 1981 indicates a recovery. It is probable, however, that the difference is a reflection of different transect line position rather than improvement in reef health.

It is possible that the higher percentage of dead corals at Key Largo Dry Rocks, Grecian Rocks and White Bank Dry Rocks is partly due to the greater use of these reefs by visitors on private boats, commercial dive boats and Park tour boats. This is partially supported by the fact that even in 1974 when Antonius surveyed Grecian Rocks, the percentage of dead corals was 14, higher than any of the other reefs in this area.

Unfortunately, Tilmant et al. (unpublished report) did not evaluate coral health in Biscayne National Park just to the north of the Sanctuary, thus no comparisons can be made in that area. On the other hand at Looe Key, Antonius (1978) found 25 percent dead corals on the reef flat, 10 percent on the fore reef and 22 percent on the deep reef. Looe Key, like Grecian Rocks and Key Largo Dry Rocks, is very popular with fishermen and divers. It may well be that the high percentage of dead coral at these reefs is due to overuse more than to natural

factors, indicating the possible deterioration of the reefs in general if visitor impact increases with the planned increased development predicted for the Florida Keys.

Table 10. Percentages of live versus dead corals based on combined transect data at 10 sites in the Key Largo Coral Reef Marine Sanctuary. Criteria for dead and living corals are as given by Antonius (1974). Data from transect photographs.

Site 1. Molasses Reef			
Total	182	sample points	100%
Live corals	180	"	98%
Dead corals	2	"	1%
Site 2. White Bank Dry Rocks			
Total	159	sample points	100%
Live corals	127	"	79%
Dead corals	32	"	20%
Site 3. French Reef			
Total	99	sample points	100%
Live corals	94	"	94%
Dead corals	5	"	6%
Site 4. Mosquito Bank			
Total	25	sample points	100%
Live corals	23	"	92%
Dead corals	2	"	8%
Site 5. Grecian Rocks (1980)			
Total	120	sample points	100%
Live corals	83	"	69%
Dead corals	37	"	31%
Site 5. Grecian Rocks (1981)			
Total	121	sample points	100%
Live corals	94	"	78%
Dead corals	27	"	22%

Table 10. continued

Site 6. Key Largo Dry Rocks

Total	186	sample points	100%
Live corals	164	"	88%
Dead corals	22	"	12%

Site 7. The Elbow

Total	62	sample points	100%
Live corals	58	"	93%
Dead corals	4	"	6%

Site 8. Carysfort Reef

Total	116	sample points	100%
Live corals	115	"	99%
Dead corals	1	"	0.8%

Site 9. Basin Hill Shoals

Total	65	sample points	100%
Live corals	63	"	96%
Dead corals	2	"	3%

Site 10. Turtle Rocks

Total	44	sample points	100%
Live corals	41	"	93%
Dead corals	3	"	6%

Table 11. Percentages of corals, healthy corals, white spotted corals and dead corals at 10 sites in the Key Largo Coral Reef Marine Sanctuary based upon photographic transect data.

Site 1. Molasses Reef			
Transect 1.			
Total number of corals	66	sample points	100%
Healthy corals (no spotting)	57	"	86%
Corals with dead areas	9	"	14%
Dead corals (50% dead areas)	1	"	2%
Transect 2.			
Total number of corals	57	sample points	100%
Healthy corals (no spotting)	50	"	87%
Corals with dead areas	7	"	12%
Dead corals (50% dead areas)	1	"	2%
Transect 3.			
Total number of corals	59	sample points	100%
Healthy corals (no spotting)	48	"	81%
Corals with dead areas	11	"	19%
Dead corals (50% dead areas)	0	"	0%
Site 2. White Bank Dry Rocks.			
Transect 1.			
Total number of corals	30	sample points	100%
Healthy corals (no spotting)	19	"	63%
Corals with dead areas	11	"	37%
Dead corals (50% dead areas)	5	"	17%
Transect 2.			
Total number of corals	58	sample points	100%
Healthy corals (no spotting)	30	"	52%
Corals with dead areas	28	"	48%
Dead corals (50% dead areas)	9	"	16%
Transect 3.			
Total number of corals	71	sample points	100%
Healthy corals (no spotting)	15	"	21%
Corals with dead areas	56	"	79%
Dead corals (50% dead areas)	18	"	22%

Site 3. French Reef.

Transect 1.

Total number of corals	37	sample points	100%
Healthy corals (no spotting)	21	"	57%
Corals with dead areas	34	"	43%
Dead corals (50% dead areas)	2	"	5%

Transect 2.

Total number of corals	23	sample points	100%
Healthy corals (no spotting)	19	"	83%
Corals with dead areas	34	"	17%
Dead corals (50% dead areas)	1	"	4%

Transect 3.

Total number of corals	39	sample points	100%
Healthy corals (no spotting)	30	"	77%
Corals with dead areas	9	"	23%
Dead corals (50% dead areas)	2	"	5%

Site 5. Grecian Rocks (1980)

Transect 1.

Total number of corals	49	sample points	100%
Healthy corals (no spotting)	25	"	51%
Corals with dead areas	24	"	49%
Dead corals (50% dead areas)	10	"	20%

Transect 2.

Total number of corals	40	sample points	100%
Healthy corals (no spotting)	8	"	20%
Corals with dead areas	32	"	80%
Dead corals (50% dead areas)	12	"	30%

Transect 3.

Total number of corals	31	sample points	100%
Healthy corals (no spotting)	4	"	13%
Corals with dead areas	27	"	87%
Dead corals (50% dead areas)	15	"	48%

Site 5. Grecian Rocks (1981)

Transect 1.

Total number of corals	71	sample points	100%
Healthy corals (no spotting)	45	"	63%
Corals with dead areas	26	"	37%
Dead corals (50% dead areas)	8	"	11%

Transect 2.

Total number of corals	14	sample points	100%
Healthy corals (no spotting)	4	"	29%
Corals with dead areas	10	"	71%
Dead corals (50% dead areas)	6	"	43%

Transect 3.

Total number of corals	36	sample points	100%
Healthy corals (no spotting)	4	"	11%
Corals with dead areas	32	"	89%
Dead corals (50% dead areas)	13	"	36%

Site 6. Key Largo Dry Rocks.

Transect 1.

Total number of corals	132	sample points	100%
Healthy corals (no spotting)	77	"	58%
Corals with dead areas	11	"	42%
Dead corals (50% dead areas)	2	"	2%

Transect 2.

Total number of corals	30	sample points	100%
Healthy corals (no spotting)	12	"	40%
Corals with dead areas	18	"	60%
Dead corals (50% dead areas)	11	"	37%

Transect 3.

Total number of corals	24	sample points	100%
Healthy corals (no spotting)	7	"	29%
Corals with dead areas	17	"	71%
Dead corals (50% dead areas)	9	"	38%

Site 7. The Elbow.

Transect 1.

Total number of corals	22	sample points	100%
Healthy corals (no spotting)	14	"	63%
Corals with dead areas	8	"	36%
Dead corals (50% dead areas)	1	"	4%

Transect 2.

Total number of corals	9	sample points	100%
Healthy corals (no spotting)	6	"	67%
Corals with dead areas	3	"	33%
Dead corals (50% dead areas)	0	"	0%

Transect 3.

Total number of corals	31	sample points	100%
Healthy corals (no spotting)	23	"	76%
Corals with dead areas	8	"	25%
Dead corals (50% dead areas)	3	"	9%

Site 8. Carysfort Reef.

Transect 1.

Total number of corals	63	sample points	100%
Healthy corals (no spotting)	50	"	79%
Corals with dead areas	13	"	21%
Dead corals (50% dead areas)	1	"	1%

Transect 2.

Total number of corals	36	sample points	100%
Healthy corals (no spotting)	32	"	88%
Corals with dead areas	4	"	12%
Dead corals (50% dead areas)	0	"	0%

Transect 3.

Total number of corals	17	sample points	100%
Healthy corals (no spotting)	15	"	88%
Corals with dead areas	2	"	12%
Dead corals (50% dead areas)	0	"	0%

Site 9. Basin Hill Shoals.

Transect 1.

Total number of corals	33	sample points	100%
Healthy corals (no spotting)	19	"	57%
Corals with dead areas	14	"	43%
Dead corals (50% dead areas)	2	"	6%

Transect 2.

Total number of corals	23	sample points	100%
Healthy corals (no spotting)	22	"	95%
Corals with dead areas	1	"	4%
Dead corals (50% dead areas)	0	"	0%

Transect 3.

Total number of corals	9	sample points	100%
Healthy corals (no spotting)	6	"	66%
Corals with dead areas	3	"	34%
Dead corals (50% dead areas)	0	"	0%

Site 10. Turtle Rocks.

Transect 1.

Total number of corals	0	sample points	0%

Transect 2.

Total number of corals	6	sample points	100%
Healthy corals (no spotting)	6	"	100%

Transect 3.

Total number of corals	38	sample points	100%
Healthy corals (no spotting)	18	"	47%
Corals with dead areas	20	"	53%
Dead corals (50% dead areas)	3	"	7%

Damage to Corals by Boats and Anchors

During this study an attempt was made to evaluate the amount and importance of damage to corals caused by boats and anchors in the waters of the Sanctuary and Park. All personnel working on the project were requested to note any damage seen. Twenty seven persons were employed as divers at one time or another on the project. Each was questioned specifically as to the presence of boat and anchor damage. None was seen by the divers working on the transects and quadrats. The two divers on the fish census reported a single case of boat damage -a gash in a coral head apparently caused by a propeller blade.

As the divers on the two studies covered a considerable area of the reefs, it must be assumed that (1) there is little boat and anchor damage on the reefs, or (2) there is noticeable damage but not in the areas observed by the divers, or (3) the divers did not distinguish such damage. The third alternative seems unlikely unless the damage to the corals was old and was already obscured. It seems more likely that there is some damage but because of the locations of the transects and quadrats the divers did not see it. If the latter is the case, it seems likely that boat and anchor damage is not a significant problem except in a few localized areas.

Boat and anchor damage is often difficult to distinguish from damage from natural causes (hurricanes, storm surges, heavy seas). Unless a clear gash across a brain coral or a long scar of a dragged anchor is visible, broken coral, toppled masses of elkhorn coral and overturned heads may be due to waves rather than boats. Tilmant et al. (unpublished report) have attempted to assess boat and anchor damage in the Biscayne National Park. They concluded "that the vast majority of coral damage observed on the reef was the result of natural causes". However, boat groundings or wreckings on the reefs caused significant local damage.

Dustan (1977) studied the effects of the 1974 wreck of a 38' catamaran at Key Largo Dry Rocks. The wreck site covered an area of about 6,000 square feet and Dustan called it "an ecological disaster." After one year little coral repair had occurred. Five other lesser groundings took place during his eighteen months study.

Hurricane damage can be very severe. Hurricane Donna in 1960 struck the vicinity of Key Largo Dry Rocks with winds of 160 kph with gusts to 240 kph (Ball, Shinn and Stockman, 1967). The reef was in such a state that it was thought recovery would take decades but within a year storm damage was visible only to an experienced observer and in 1965 the reef had completely recovered (Shinn, 1975; Voss, personal observations). In late 1965 Key Largo Dry Rocks was again struck by a hurricane (Perkins and Enos, 1968) with extensive coral destruction. By 1967 storm damage was not noticeable (Shinn, 1975). Today, Key Largo Dry Rocks still has the most beautiful stands of elkhorn and staghorn coral in the Sanctuary.

Antonius (1981c) has reported upon the condition of corals in the bombing range at Vieques Island, Puerto Rico. He found that despite the years of bomb explosions in the reefs, the coral damage was negligible when compared to natural damage from storm waves on control reefs and the health (percentage of diseased and/or dead corals) was better on the Vieques reefs.

Anchor damage may be severe in some localities. Dustan (1977) reported that on a busy day up to two hundred boats visit Molasses Reef, only two acres in areas, while the average is twenty to fifty boats. He estimated that anchors were dropped 15,000 times each year. Most of these are not on the reef proper but along its edge and on the reef flat. Nonetheless, visible damage to bottom life occurs. Davis (1977) surveyed bottom damage by anchors at the Fort Jefferson National Monument, the Dry Tortugas, and found twenty percent of an extensive staghorn coral reef badly damaged. Staghorn coral with its slender branches and low tensile

strength can be smashed to rubble by uncaring swimmers and boat groundings. It is fortunate that this easily damaged coral is also one of the fastest growing species in the Florida reefs and can quickly reestablish itself (Shinn, 1966, 1975).

Corals may also be extensively damaged by physical contact (standing on branches or heads to rest, bumping against them, kicking them with swim fins). After less than five years use, snorkeling trails laid out at the St. Johns National Park and Buck Island National Monument had to be changed because of coral deterioration (Robins, Randall, personal communication).

The ability of corals to grow and repair damage has been greatly underestimated by some workers because of the fact that Florida corals are living at or near their northern limits (Smith, 1948). This does not mean, however, that they grow slower as Antonius (1978) and others have stated. A vivid pictorial rebuttal is given by Shinn (1975) who also has documented growth rates at Key Largo Dry Rocks. Hudson (1981 and personal communication) has indicated that the growth rates of some corals depend more on local ecological conditions rather than on geographical distribution and has found that some corals in the Key Largo Coral Reef Marine Sanctuary grow faster than in certain locations in the Caribbean.

Whether fragmentation occurs naturally due to storms or unnaturally due to boat and anchor damage, much of the coral regrows, new colonies are formed and the reef continues to thrive. Fragmentation, by whatever means, is another method of coral proliferation. Even with anchor damage shown by Davis (1977) at the Dry Tortugas, the one hundred year resurvey by Davis (1982) shows that coral growth has continued and the reefs are more extensive today than when A. Agassiz first surveyed them (Agassiz, 1883).

Today, the corals of the Florida Keys are under both ecological and user impact. Boat and anchor damage that may be at acceptable levels today will

greatly increase with the predicted population increase of South Florida. It may already be the cause of part of the deterioration of Grecian Rocks, Key Largo Dry Rocks and Looe Key. It requires constant monitoring and the possibility exists that user impact may have to be controlled by limiting the number of visitors to disturbed areas or by using mooring systems that do not injure the coral reefs.

Species Diversity

The expression of species diversity takes a number of forms and has various meanings. Species diversity alone is best expressed by the simple number of species found at a given place. This type of species diversity is shown directly in the tabulation of the transects and quadrats and is perhaps the most reliable.

For each transect and quadrat the number of specimens of each species was tabulated and these data were then used to calculate the Shannon Weaver Species Diversity Index of H'. H' shows not only the diversity of species but the evenness of the number of specimens of each. While it neither reflects the number of species nor the number of individuals, it does afford a number which, used with caution, can be compared with other numbers to give an indication of the richness of one sample to another.

Table 12 shows both the diversity as indicated by the actual number of species and the species diversity calculated for H'. An examination of the data in the table presents no surprises. In general the transects show a higher diversity for the outer reefs with that of Molasses Reef the highest. Key Largo Dry Rocks has the lowest diversity figures for an outer reef probably because of the large expanse of living coral represented by the two species of Acropora. The transects in the turtle grass sites have the lowest because of the uniformity of the grass beds. Almost without exception the quadrat figures show that the coral quadrats have the highest diversity. Eight coral quadrats out of 11 had indices above 3.00; 3 hard bottom quadrats out of 5 exceeded 3.00. Only 3 of 13 grass quadrats exceeded 1.00. The lowest quadrat indices were from the sand areas; none of the 8 attained 1.00.

Indices calculated on collections of smaller individuals such as are retained by a 1 mm^2 aperture sieve would yield higher indices in some habitats, especially in the Thalassia meadows.

Table 12. Species diversity of transects and 4 m^2 quadrats from 18 sites. Number of species is taken from data in appendix 1. H' was calculated using the Shannon Weaver Species Diversity Index as given under Methodology.

	Site	No. of species	H'
1.	**Molasses Reef**		
	Transect 1	32	3.02
	Transect 2	27	2.76
	Transect 3	46	3.18
	Coral	52	3.19
	Rubble	23	2.66
	Hard bottom	48	3.17
	Sand	5	1.23
2.	**White Banks**		
	Transect 1	34	2.96
	Transect 2	30	2.18
	Transect 3	28	2.46
	Coral	40	3.19
	Rubble	40	2.66
	Grass	25	2.58
	Sand	7	1.91
3.	**French Reef**		
	Transect 1	35	2.86
	Transect 2	18	2.31
	Transect 3	24	2.66
	Coral quadrat	47	3.07
	Rubble	37	2.72
	Hard bottom	45	3.01
	Sand	5	1.00
4.	**Mosquito Bank**		
	Transect 2	22	2.05
	Transect 2	19	1.84
	Transect 3	41	2.53
	Coral	66	3.48
	Grass	40	3.36
5.	**Grecian Rocks**		
	Transect 1	17	2.44
	Transect 2	29	2.85
	Transect 3	18	2.52
	Coral	28	2.53
	Rubble	55	1.85
	Grass	54	2.90
	Sand	6	.98
6.	**Key Largo Dry Rocks**		
	Transect 1	16	2.20
	Transect 2	16	1.52
	Transect 3	17	2.34
	Coral	43	2.80
	Rubble	53	3.01
	Grass	34	3.04
	Sand	30	1.98

7.	**The Elbow**		
	Transect 1	25	2.45
	Transect 2	32	2.68
	Transect 3	26	2.52
	Coral	50	3.08
	Rubble	45	2.98
	Hard bottom	45	2.65
	Sand	10	1.28

8.	**Carysfort Reef**		
	Transect 1	32	2.51
	Transect 2	33	2.66
	Transect 3	18	2.46
	Coral	54	3.19
	Rubble	43	2.90
	Hard bottom	53	3.23
	Sand	9	1.14

9.	**Basin Hill Shoal**		
	Transect 1	28	2.16
	Transect 2	10	.75
	Transect 3	15	1.64
	Coral	35	2.57
	Grass	17	1.53
	Sand	14	2.43

10.	**Turtle Rocks**		
	Transect 1	22	2.51
	Transect 2	16	1.94
	Transect 3	33	2.59
	Coral	53	3.35
	Grass	43	2.81
	Sand	12	1.98

11.	**Ocean Reef**		
	Transect 1	9	.80
	Transect 2	7	.62
	Transect 3	2	.63
	Grass	13	2.35

12.	**Turtle Harbor**		
	Transect 1	1	.00
	Transect 2	5	.37
	Transect 3	12	1.02
	Grass	24	2.61

13.	**North Channel**		
	Transect 1	19	2.42
	Transect 2	12	1.02
	Transect 3	23	2.58
	Hard bottom	14	1.21
	Grass	52	2.74

14.	**South Channel**		
	Transect 1	16	2.56
	Transect 2	10	2.56
	Transect 3	16	2.29
	Grass	66	3.33

die-back occurred. The fine, loose soft sediments of which the mounds are composed contribute to the turbidity of shallow waters during periods of strong wave action. The vast extent of the sea grass meadows, however, seems at present little disturbed and probably still functions well as a nursery ground for shrimp, crawfish, finfish and other organisms. Further and more extensive deterioration should be viewed with alarm and steps taken to counteract it.

The extensive sand areas within the Santuary were only studied along the line transects but sieving of the sands in the 4 m^2 quadrats revealed a surprisingly low faunal biomass. Sieving with fine screens (1 mm^2 or less) would undoubtedly yield a much larger number of small organisms but nowhere in the present study were there indications of an expected brittlestar community or significant numbers of polychaetes. The explanation may be two-fold. First, the calcareous sands along the outer third of the reef tract have a low organic component offering little nourishment for infaunal animals. Second, and more important, the calcareous sands along the bank margin are in relatively shallow water and are subject to scouring and movement by storm waves. Shifting sand offers a poor and even dangerous environment for many infaunal animals.

The hard bottom of the Sanctuary and Park includes not only the hard bottom itself but also the rubble and reef areas. The inner hard bottom of the Park was studied at sites 13 and 14 at the two entrances to Largo Sound. The North Channel hard bottom bar at present has only moderate boat traffic over it. Even so, changes have taken place over the last thirty years most obvious of which has been the loss of most of the extensive beds of Sargassum weed, one of the most extensive beds of this alga in the keys. Only at this site was the green alga Enteromorpha encountered. This alga is often considered to be a pollution indicator, growing where nutrient levels are abnormally high. Its presence here may denote the effects of shore run off. Increased amounts of this alga as the

development of North Key Largo accelerates could be an indication of increasing pollution or eutrophication of inshore waters.

The hard bottom at South Channel and the surrounding grass beds showed signs of stress. This area bears the heaviest boat traffic within the Park waters causing continuous turbidity from boat wakes, with resulting siltation. The turtle grass reflected this disturbance in its present poor appearance as did the algae on the bar. Increased boat traffic will have an increasing detrimental effect. This area warrants monitoring.

The offshore hard bottom and rubble areas in the Sanctuary appeared to be in good health and showed no visible indications of deterioration. Damage by boat groundings and anchors was negligible in the areas surveyed.

The condition of the reefs is well indicated by the data given in Tables 2, 9, 10, 11 and 12. The outer reefs in general appear to be healthy. Corals, as cited earlier, have a surprising resiliency to detrimental factors and, when conditions again become favorable, recover quickly from even severe damage. It is therefore a cause for concern that Grecian Rocks has yet to recover from die-off in 1978. This is in direct contrast to coral destruction on other reefs in two hurricanes where recovery was nearly complete in three to five years. Both Grecian Rocks and Key Largo Dry Rocks sit somewhat inshore of the outer reef line and are perhaps somewhat more exposed to the waters of the Hawk Channel than the open sea. The slow recovery, if it is occurring, may be due to the lower quality of the inshore waters. Shinn reported that coral growth was slower at Grecian Rocks during the earlier periods of dredge and fill activities along the keys but increased after the moratorium on dredge and fill was enforced. This slow growth was probably due to increased silt loads from higher turbidity. The slow recovery of these reefs now may be an indication of increasing turbidity of the waters due to heavier boat traffic.

While the outer reefs in general appear in good condition, the stresses apparent at several sites need careful study and continuous monitoring and evaluation to determine if more extensive stresses appear with resultant degradation of the reefs. Since these studies were completed, the very warm weather of the summer of 1983 may have again stressed the reefs. Bleaching of corals has been reported and extensive kills of the sea urchin Diadema antillarum have occurred throughout the keys. The causes of their death and the coral bleaching have not been determined but warm water temperatures are suspect along with resultant blooms of pathogenic microorganisms perhaps brought on by the warmer waters. The long term effect upon the reefs is unknown.

The patch reefs, more adapted to inshore waters, do not show obvious stress signs, at least those surveyed in this study. It is apparent, however, that water quality is changing in the keys.

Water clarity over much of the reef tract today is much reduced from former years (Voss, person. observ.) and undoubtedly plays an important part in the stresses seen today over the Sanctuary and Park. Water quality may well be reduced significantly as the proposed shore development of Key Largo continues. That and increased human contact will inexorably effect the reefs detrimentally. Their future viability is questionable without controls to safeguard them.

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Appendix A

Transect Data and Quadrat Counts

The recording system used here is slightly modified from that used by Antonius (1974) but permits comparisons with his data. The transect heading "Meter Mark" refers to the 5 m label number on the line. 0 refers to the unlabeled starting point of the line. Meter mark 1 is 5 m from 0, 2 is 10 m from 0, and so on. The end of the 400 m line is at meter mark 80. "Depth meters" is the bottom depth read from the calibrated diver depth guage at each meter mark. "Bottom type and species" follows Antonius's method in which "bottom type" is given only when there was no organism under the meter marker. Bottom type is listed as sand, silty sand, mud, rock, hard bottom, rubble and dead coral. Organisms listed are those found under the 2 cm wide meter marker. When more than one species is listed, the meter marker lay on top of a piece of small rubble covered with sessile and adhering organisms in which case the piece of rubble was collected, all specimens identified, and their names given at the indicated meter mark in the lists.

Quadrats are given according to the zone in which they were sampled: coral, hard bottom, rubble, sand and grass. Species counts are given for each square meter and arranged in four separate columns. At a few stations the samples from all four quadrats were inadvertently combined; in these cases only a single column, representing counts from all four quadrats, is given. Similarly, when only two columns occur, each column represents two combined quadrats. The letter "x" was used by the divers when small specimens of a species were very numerous and were difficult to count accurately <u>in situ</u>. In the analyses "x" was arbitrarily given the value of 25.

Site 1. Molasses Reef

Transect 1. 625 m long run on a heading of 308° true ending at pipe on back reef. 9 June 1980

Meter mark	Depth meters	Bottom type and species
1	16.0	Algal mat
2	16.0	Aiolochroia crassa
3	15.7	Ophiothrix lineata, Niphates digitalis
4	15.4	Galaxaura obtusata, filamentous algae
5	15.0	Hard bottom
6	15.0	Dictyota
7	14.8	Green alga, Galaxaura obtusata
8	14.8	Aiolochroia crassa
9	14.8	Pseudopterogorgia americana
10	14.5	Montastrea annularis
11	13.9	Thin veneer of sediment on hard bottom
12	14.2	Hard bottom, Porites furcata, rubble
13	14.5	Pseudopterogorgia acerosa
14	14.2	Dictyosphaeria cavernosa, Pocockiella variegata
15	13.9	Spinosella vaginalis, Halimeda opuntia
16	13.9	Muricea elongata
17	13.5	Dictyota sp.
18	12.9	Red encrusting sponge
19	12.6	Eunicea mammosa, Ophiothrix oerstedi, Dictyota sp.
20	12.0	Dictyota, Amphiroa fragilissima
21	12.0	Dictyota, Laurencia, golden sponge, rubble
22	11.7	Sediment, Dictyota

Site 1. Molasses Reef, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
23	11.7	Sediment, Dictyota
24	11.4	Meandrina meandrites with Dictyota on dead spot
25	11.8	Hard bottom, Dictyota
26	11.4	Hard bottom, Dictyota
27	11.7	Pseudopterogorgia acerosa, Dictyota
28	11.7	Millepora alcicornis, Dictyota
29	10.5	Spinosella vaginalis, Eunicea mammosa, Ophiothryx lineata
30	9.9	Hard bottom, Dictyota
31	9.9	Dictyota
32	9.5	Pseudopterogorgia americana
33	9.5	P. americana
34	9.2	Dilophus alternans
35	8.9	Encrusting coralline
36	8.3	Dictyota, coralline
37	7.7	Dictyota, coralline
38	7.7	Hard bottom, Cliona delitor, corallines
39	7.1	Hard bottom, corallines
40	7.4	Sediment, Halimeda plates
41	6.8	Rubble, corallines
42	6.5	Hard bottom, rubble, Dictyota
43	6.8	Agaricia agaricites (white spotting about 5%)
44	6.8	Pseudopterogorgia americana
45	6.8	Coral rubble

Site 1. Molasses Reef, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
46	6.5	Rubble, Dictyota
47	6.4	Pseudopterogorgia acerosa, Dictyota
48	6.2	P. acerosa, Dictyota
49	7.1	Rubble, corallines
50	5.9	Acropora palmata (about 2% white spotting), Meandrina
51	5.2	Gorgonia ventalina
52	5.2	Pseudopterogorgia americana
53	5.2	Acropora palmata (white spotting about 2%)
54	7.1	Filamentous green alga
55	7.1	Pseudopterogorgia americana
56	6.8	Hard bottom, corallines
57	6.2	Hard bottom, corallines
58	5.9	Halimeda opuntia minor
59	5.5	H. minor
60	5.9	Rubble, Cliona delitor
61	4.9	Hard bottom, rubble
62	4.0	Gorgonia ventalina
63	4.3	Rubble
64	4.0	Porites astreoides (about 10% white spotting)
65	4.0	Hard bottom
66	4.0	Hard bottom
67	3.7	Hard bottom
68	3.7	Hard bottom

Site 1. Molasses Reef, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
69	3.7	Gorgonia ventalina
70	3.7	Hard bottom
71	3.4	Rubble with corallines
72	3.4	Hard bottom
73	3.4	Halimeda opuntia
74	3.4	H. opuntia
75	3.4	Hard bottom, Dictyota
76	3.4	Green tufted alga
77	3.4	Hard bottom, Dictyota
78	3.4	Hard bottom; Dictyota
79	3.1	Hard bottom, Dictyota
80	3.1	Hard bottom, rubble
81	3.1	Hard bottom, rubble
82	2.7	Rubble
83	2.7	Rubble
84	2.7	Rubble, Dictyota
85	2.7	Tufted green alga
86	2.7	Hard bottom, Dictyota
87	2.7	Rubble, tufted green alga
88	2.7	Rubble, Dictyota
89	2.7	Rubble
90	2.7	Rubble, Dictyota
91	2.7	Rubble, Dictyota

Site 1. Molasses Reef, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
92	2.2	Rubble, Dictyota
93	2.2	Rubble, coralline
94	2.2	Rubble, Dictyota
95	2.2	Rubble, Dictyota
96	2.2	Rubble, Dictyota, Laurencia papillosa
97	2.2	Porites astreoides
98	2.2	Rubble, Laurencia papillosa
99	2.5	Dasycladus vermicularis, Laurencia papillosa
100	2.5	Rubble, Laurencia papillosa
101	2.5	Thalassia, Laurencia papillosa
102	2.5	Thalassia, Syringodium, Caulerpa prolifera
103	2.5	Thalassia
104	2.5	Thalassia, Syringodium
105	2.5	Thalassia, Syringodium
106	2.5	Thalassia, Syringodium, Penicillus capitatus
107	2.5	Thalassia, Syringodium
108	2.8	Thalassia, Syringodium
109	3.1	Thalassia, calcareous sediments
110	3.1	Thalassia, Syringodium
111	3.1	Dasycladus vermicularis, rubble
112	3.1	Syringodium
113	3.1	Siderastrea radians, Pterogorgia citrina, Halimeda tuna, Dictyosphaeria cavernosa, Amphiroa fragilissima, Dictyota

Site 1. Molasses Reef, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
114	3.1	Dictyosphaeria cavernosa, Thalassia
115	3.1	Thalassia, Syringodium
116	3.1	Thalassia
117	3.1	Halimeda tuna, Ophiothryx oerstedi, Amphiroa fragilissima, bryozoans and corallines
118	3.1	Pterogorgia citrina, bryozoans and sponge
119	3.4	Thalassia, Syringodium, sponge
120	3.4	Halimeda incrassata, Syringodium
121	3.4	Thalassia, Syringodium
122	3.7	Thalassia, Syringodium
123	3.7	Halimeda incrassata, Syringodium
124	4.0	Thalassia, Syringodium

Site 1. Molasses Reef

Transect 2. 525 m long run on a heading of 308° true 300 m west of Transect 1.
2 November 1980

Meter mark	Depth meters	Bottom type and species
0	17.5	Hard bottom, filamentous red alga, sponge
1	17.4	Hard bottom
2	17.5	Red finger sponge
3	17.4	Red finger sponge
4	17.5	Pseudopterogorgia bipinnata
5	17.5	Tedania ignis
6	15.	Hard bottom, sponge
7	16.2	Millepora alcjcornis
8	16.2	Hard bottom, Homotrema rubrum
9	16.2	Hard bottom, filamentous red alga
10	15.9	Millepora alcicornis
11	15.5	M. alcicornis
12	15.5	Hard bottom, filamentous red alga
13	15.5	Dilophus alternans, red alga
14	15.5	Pseudopterogorgia elisabethae
15	15.5	Solitary coral (less than 1 cm)
16	15.5	Dilophus alternans
17	14.3	Pseudopterogorgia acerosa
18	14.6	Aluminum chair, Udotea sp., Homotrema rubrum
19	14.3	Porites astreoides
20	14.3	Red alga
21	14.3	Dilophus alternans

Site 1. Molasses Reef, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
22	14.0	Red alga
23	14.0	Dilophus alternans, solitary coral
24	14.0	Gorgonia ventalina
25	14.0	Sand, Homotrema rubrum, red alga
26	13.1	Orange sponge
27	13.1	Orange sponge, red alga
28	13.1	Dilophus alternans
29	12.8	Spinosella vaginalis
30	12.8	S. vaginalis
31	12.8	Udotea sp.
32	12.5	Orange sponge, Erythropodium caribaeorum, 3 polychaete worms, Goniolithon sp., Stylaster roseus, Placospongia sp.
33	12.5	Udotea sp.
34	12.2	Udotea sp.
35	12.2	Pseudopterogorgia acerosa
36	12.2	Hard bottom, Udotea sp.
37	12.2	Udotea sp.
38	11.6	Udotea sp.
39	10.6	Millepora alcicornis, Agelas schmidti, Eunice cf. mutilata, brittlestar
40	11.0	Pseudopterogorgia acerosa
41	11.0	Solitary coral

Site 1. Molasses Reef, Transect 2.- continued

Meter mark	Depth meters	Bottom type and species
42	12.8	Sand
43	12.5	Sand
44	12.5	Sand
45	11.9	Millepora alcicornis
46	11.6	Siderastrea radians
47	10.7	Rubble, red algae
48	10.0	Red alga
49	10.4	Rubble, red alga
50	8.8	Montastrea cavernosa (white spotting 10%)
51	8.5	Hard bottom
52	8.5	Udotea sp.
53	8.2	Pseudopterogorgia acerosa
54	7.9	Hard bottom, Homotrema rubrum
55	7.6	Palythoa mammillosa
56	7.3	Pseudopterogorgia elisabethae
57	7.3	P. acerosa
58	7.0	P. acerosa
59	6.7	Hard bottom, Udotea sp.
60	7.0	Pseudopterogorgia acerosa
61	7.9	P. acerosa
62	8.5	P. acerosa
63	8.5	Red alga

Site 1. Molasses Reef, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
64	8.8	Hard bottom, Udotea sp.
65	8.8	Red alga
66	8.8	Hard bottom
67	8.8	Rubble
68	8.5	Millepora alcicornis, Palythoa mammillosa
69	7.6	Red alga
70	7.6	Pseudopterogorgia acerosa
71	6.4	Gorgonia ventalina
72	6.0	Hard bottom, red alga, dead coral
73	6.0	Hard bottom, red alga
74	6.0	Sand, rubble
75	7.0	Sand, rubble
76	7.0	Pseudopterogorgia acerosa
77	7.6	Millepora complanata
78	7.0	M.complanata
79	7.6	Pseudopterogorgia blanquillensis
80	7.6	Gorgonia ventalina, Pseudopterogorgia acerosa
81	5.8	Pseudopterogorgia kallos
82	8.2	Rubble, red algae
83	7.6	Rubble, red algae
84	7.9	Rubble, Udotea sp.
85	7.9	Hard bottom, red alga

Site 1. Molasses Reef, Transect 2.- continued

Meter mark	Depth meters	Bottom type and species
86	7.9	Hard bottom, Udotea sp.
87	7.9	Hard bottom, red alga
88	8.2	Rubble, Homotrema rubrum
89	8.8	Rubble, dead Halimeda
90	9.1	Rubble, dead Halimeda
91	9.4	Rubble, red alga
92	9.4	Dead coral head rubble
93	9.4	Coral rubble, sand, Homotrema rubrum
94	9.1	Coral rubble, sand, H. rubrum
95	9.1	Coral rubble, sand
96	8.5	Rubble, red alga, Homotrema rubrum
97	8.5	Rubble
98	8.5	Gorgonia ventalina
99	8.5	G. ventalina, Pseudopterogorgia acerosa
100	8.5	Rubble, sand
101	8.5	Coral rubble, Homotrema rubrum
102	8.5	Siderastrea radians (10% white spotting)
103	8.5	Rubble, Homotrema rubrum
104	8.5	Dead coral head, rubble
105	8.5	Sand, coral rubble
106	8.5	Sand, coral rubble
107	8.5	Rubble, Homotrema rubrum
108	8.5	Rubble

Site 1. Molasses Reef

Transect 3. About 600 m long run on a heading of 308° true 300 m east of Transect 1. 28 May 1981.

Meter mark	Depth meters	Bottom type and species
0	16.5	Dilophus alternans
1	16.5	Xestospongia muta
2	15.2	Sand
3	14.0	Millepora alcicornis
4	14.3	Dilophus alternans
5	13.7	Erythropodium caribaeorum
6	13.7	Dilophus alternans
7	14.0	Filamentous red alga
8	14.3	Dilophus alternans
9	14.3	Pseudopterogorgia americana, Dilophus alternans
10	14.0	Sand
11	13.7	Dictyota cervicornis, Dilophus alternans
12	14.0	Dilophus alternans
13	14.0	Sand
14	14.0	Xestospongia muta
15	14.0	Sand
16	14.6	Sand
17	14.0	Sand
18	13.7	Sand, Dilophus alternans
19	13.4	Hard bottom under ⅛" sand
20	13.4	Dictyota cervicornis
21	13.4	Sand, rubble

Site 1. Molasses Reef, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
22	12.8	Sand, buried Dasycladus vermicularis
23	12.8	Sand, rubble
24	12.8	Hard bottom under sand, red alga
25	12.8	Sand
26	12.8	Sand
27	12.8	Sand
28	12.1	Sand
29	12.1	Dasycladus vermicularis
30	12.2	Sand, rubble
31	12.2	Sand, rubble, Homotrema rubrum
32	12.2	Hard bottom under sand
33	12.2	Sand
34	12.2	Sand, red alga
35	12.2	Sand, rubble, Homotrema rubrum
36	12.2	Sand
37	12.2	Sargassum hystrix var. buxifolium
38	12.2	Sand, Dictyota alternans
39	12.2	Sargassum hystrix
40	12.2	Sand, rubble, Homotrema rubrum
41	12.8	Neofibularia nolitangere
42	13.7	Sand
43	13.4	Sand

Site 1. Molasses Reef, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
44	13.7	Sand, rubble
45	13.7	Dasycladus vermicularis
46	13.7	Dilophus alternans
47	13.7	D. alternans, red alga, Halimeda opuntia triloba
48	13.1	Galaxaura sp.
49	13.1	Galaxaura sp., Dilophus alternans, Dictyota cervicornis
50	12.2	Muriceopsis flavida
51	13.1	Penicillus capitatus
52	13.1	Hard bottom under sand
53	12.8	Dictyota cervicornis
54	12.8	D. cervicornis
55	12.8	Pseudopterogorgia americana
56	12.8	Hard bottom, red alga
57	11.9	Hard bottom, red alga
58	11.9	Galaxaura sp.
59	11.9	Hard bottom, red alga
60	11.9	Millepora alcicornis, Siderastrea radians
61	11.9	Aiolochroia crassa
62	11.9	Halimeda tuna
63	11.6	Sand
64	11.6	Sand
65	10.6	Stypopodium zonale

Site 1. Molasses Reef, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
66	10.6	Dilophus alternans
67	10.6	Pseudopterogorgia americana
68	10.6	Sand, Dasycladus vermicularis
69	12.2	Rubble, Dictyota sp., Vania sp., sand
70	10.6	Hard bottom, Dictyota cevicornis
71	10.6	Hard bottom, Dilophus alternans
72	10.6	Hard bottom, D. alternans
73	10.6	Hard bottom, Siderastrea michilini
74	9.6	Hard bottom, Pseudopterogorgia bipinnata
75	9.1	Hard bottom
76	9.1	Hard bottom, Dilophus alternans
77	8.5	Hard bottom, Pseudopterogorgia americana
78	8.5	Hard bottom, Dilophus alternans
79	8.5	Favia fragum
80	7.0	Hard bottom
81	7.3	Millepora alcicornis
82	6.7	Montastrea cavernosa (5% white spotting)
83	6.7	Hard bottom
84	6.7	Hard bottom, Dilophus alternans
85	6.4	Hard bottom
86	6.4	Hard bottom, pink encrusting alga
87	6.1	Acropora palmata (5% white spotting)

Site 1. Molasses Reef, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
88	6.1	Pseudopterogorgia americana
89	6.1	P. americana
90	5.8	Millepora complanata
91	5.5	M. complanata
92	5.5	Gorgonia ventalina
93	5.5	Agaricia agaricites
94	5.5	Dilophus alternans
95	6.2	Pseudopterogorgia americana
96	6.2	Hard bottom
97	6.0	Dictyota cervicornis
98	6.4	Hard bottom, Halimeda opuntia triloba
99	6.0	Millepora alcicornis
100	5.4	Gorgonia ventalina
101	5.4	G. ventalina
102	5.4	G. ventalina
103	5.2	G. ventalina
104	4.9	Hard bottom
105	4.6	Gorgonia ventalina
106	4.6	Dilophus alternans, Halimeda incrassata
107	5.2	Sand
108	5.2	Sand
109	4.3	Dilophus alternans

Site 1. Molasses Reef, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
110	4.3	Gorgonia ventalina, Siderastrea siderea
111	4.3	Halimeda incrassata
112	3.9	Hard bottom
113	3.7	Rubble
114	3.7	Rubble
115	3.7	Hard bottom
116	3.7	Rubble
117	3.7	Hard bottom
118	3.6	Rubble, Homotrema rubrum
119	3.6	Rubble
120	3.6	Rubble

Site 1. Molasses Reef Hard Bottom Quadrats
21 September 1980

Species	Quadrats 1-2	Quadrats 3-4
PROTOZOA		
Homotrema rubrum	1	0
ALGAE		
Halimeda tuna	15	5
H. incrassata	4	0
Dilophus alternans	3	1
Encrusting coralline	1	0
Matted alga	3	0
Dictyota sp.	0	14
Matted alga	0	14
Encrusting coralline	0	1
PORIFERA		
Ircinia strobilina	1	0
Spinosella vaginalis	1	0
Agelas schmidti	1	1
Keratosa indet.	1	0
Haliclona compressa	1	2
Niphates erecta	0	2
Niphates digitalis	1	0
Geodia gibberosa	1	0
Aplysina cauliformis	1	0

Site 1. Molasses Reef Hard Bottom Quadrats - continued

Species	Quadrats 1 - 2	3 - 4
COELENTERATA		
Millepora cervicornis	16	12
Meandrina meandrites	1	0
Dichocoenia stokesii	2	0
Montastrea annularis	4	0
M. cavernosa	0	4
Porites porites	1	1
Agaricia agaricites	0	1
Siderastrea radians	1	0
Pseudopterogorgia rigida	3	0
P. americana	3	0
P. acerosa	0	2
Alcyonarian sp.	1	0
Plexaurella fusifera	0	1
P. flexuosa	0	15
Muriceopsis flavida	0	5
Eunicea sp. A	0	1
E. sp. B	0	1
Pterogorgia citrina	1	0
POLYCHAETA		
Sabellidae	1	0

Site 1. Molasses Reef Hard Bottom Quadrats - continued

Species	Quadrats 1 - 2	3 - 4
ARTHROPODA		
Paguristes wassi	1	0
Gonobactrius sp.	1	0
Pagurus provenzanoi	2	0
ECHINODERMATA		
Diadema antillarum	2	0
Echinometra viridis	0	1
Ophiocoma echinata	1	0
Burrowing shrimp	3	0
BRYOZOA		
Colonial bryozoan	1	1
ASCIDIACEA		
Solitary tunicate Ascidea sp.	1	0
Didemnum candidum	1	0

Site 1. Molasses Reef Coral Quadrats
29 May 1981

Species	Quadrats			
	1	3	3	4
PROTOZOA				
Homotrema rubrum	1	0	0	7
ALGAE				
Halimeda incrassata	1	0	0	24
H. tuna	0	0	0	1
Dilophus alternans	1	0	0	0
Lithothamnion sp.	1	0	0	0
Red alga	0	0	0	0
Alga	0	0	1	3
Galaxaura marginata	0	5	3	0
G. cylindrica	0	0	0	1
PORIFERA				
Demospongea sp.	5	0	0	0
Cliona sp.	1	0	0	0
Higginsia sp.	1	0	0	0
Agelas ensifer	0	0	2	0
Ircinia strobilina	0	0	1	0
Dysidea sp.	0	0	1	0
Xestospongia sp.	0	0	1	0
Dysidea etheria	0	0	0	0
D. sp.	0	1	0	0

Site 1. Molasses Reef Coral Quadrats - continued

Species	Quadrats			
	1	2	3	4
COELENTERATA				
Millepora complanata	4	4	13	26
M. alcicornis	0	7	0	3
Gorgonia ventalina	4	5	4	1
Pseudopterogorgia kallos	7	13	4	5
P. americana	1	0	0	0
Plexaurella dichotoma	3	0	0	0
Eunicea succinea	4	0	4	0
E. mammosa	0	3	0	2
Agaricia agaricites	4	7	6	20
Favia fragum	2	0	0	1
Siderastrea siderea	1	0	0	0
S. radians	3	12	0	0
Monastrea cavernosa	2	2	6	1
Porites astreoides	0	0	4	7
Acropora palmata	0	0	0	1
POLYCHAETA				
Sabellidae A	2	3	0	10
Sabellidae B	2	3	5	10
Sabellidae C	2	3	12	10
Serpulidae A	0	0	1	0

Site 1. Molasses Reef Coral Quadrats - continued

Species	Quadrats			
	1	2	3	4
MOLLUSCA				
Cyphoma gibbosa	0	2	0	1
Thais deltoides	0	1	0	0
Tridachia crispata	0	1	0	0
Leucozonia nassa	0	0	1	0
Nudibranch sp.	0	0	0	1
ECHINODERMATA				
Diadema antillarum	0	4	14	10
Eucidaris tribuloides	0	1	1	1
Brittlestar A	0	0	1	0
Brittlestar B	0	0	2	2
Brittlestar C	0	0	0	2
CRUSTACEA				
Hermit crab	0	0	0	2
Thunor rathbuni	0	0	0	2
Paraliomera longimana	0	0	0	1
BRYOZOA				
Bryozoan	1	0	0	0
ASCIDIACEA				
Ascidia	1	0	0	0

Site 1. Molasses Reef Rubble Quadrat
21 September 1983

Species	Quadrats 1-2	3-4
PROTOZOA		
Homotrema rubrum	1	0
ALGAE		
Halimeda incrassata	0	1
H. sp.	9	0
H. opuntia	0	1
Algal mat	0	1
Goniolithon sp.	1	1
PORIFERA		
Tricheurypon viride	0	1
Siphonodictyon siphonum	1	0
Homaxinella rudis	1	0
COELENTERATA		
Millepora complanata	1	0
M. alcicornis	0	2
Siderastrea siderea	3	2
S. radians	0	6
Meandrina meandrites	1	0
Porites porites	1	2
Agaricia agaricites	0	1
Favia fragum	0	1
Pseudopterogorgia kallos	1	0

Site 1. Molasses Reef Rubble Quadrats - continued

Species	Quadrats 1 - 2	3 - 4
P. acerosa	12	1
Gorgonia ventalina	3	0
NEMERTEA		
Nemertina sp.	1	0
POLYCHAETA		
Eunice longicirrata	0	1

Site 1. Molasses Reef Sand Quadrats
21 September 1980

Species	Quadrats 1-4
ALGAE	
Halimeda tuna	1
Goniolithon sp.	1
POLYCHAETA	
Eunice sp.	6
ARTHROPODA	
Iridiopagurus sp.	1
Cycloes bairdi	1

Site 2. White Bank Dry Rocks

Transect 1. About 400 m long run on a heading of 298° true.
10 June 1981.

Meter mark	Depth meters	Botton type and species
1	9.5	Thalassia, Syringodium
2	9.5	Halimeda incrassata
3	9.2	Ascidian
4	9.2	Thalassia, Syringodium
5	9.2	Thalassia, Syringodium
6	9.5	Halimeda sp.
7	9.5	Thalassia, Syringodium
8	9.2	Thalassia, Syringodium
9	9.5	Thalassia, Syringodium
10	9.2	Silty sand
11	9.5	Syringodium
12	9.8	Red alga
13	9.5	Syringodium
14	9.2	Penicillus capitatus
15	9.2	Didemnum sp.
16	9.2	Lost
17	9.2	Thalassia
18	9.2	Thalassia
19	9.5	Silty sand
20	9.2	Silty sand
20	9.2	Silty sand
21	9.2	Silty sand

Site 2. White Bank Dry Rocks, Transect 1. - continued

Meter mark	Depth meters	Botton type and species
22	9.2	Thalassia
23	9.2	Thalassia
24	9.2	Thalassia
25	9.2	Thalassia, Syringodium
26	9.2	Thalassia, Syringodium
27	9.2	Thalassia, Syringodium, Erythropodium caribaeorum, keratose sponge
28	9.2	Thalassia, Syringodium, red coralline
29	8.5	Thalassia, Syringodium
30	8.5	Thalassia, Syringodium
31	8.5	Thalassia, Syringodium, Didemnum
32	7.9	Thalassia, Syringodium, Eucidaris tribuloides
33	7.6	Thalassia
34	7.6	Montastrea annularis
35	7.6	Sand
36	7.6	Millepora alcicornis
37	6.1	Sand
38	6.1	Sand, rubble, Homotrema rubrum
39	7.3	Red coralline alga
40	7.0	Plexaurella grisea
41	6.7	Dictyota cervicornis
42	6.1	Dilophus alternans

Site 2. White Bank Dry Rocks, Transect 1. - continued

Meter mark	Depth meters	Botton type and species
43	6.1	Rubble, Homotrema rubrum, Goniolithon sp., Clathrina coriacea
44	5.5	Dilophus alternans
45	5.5	Sand
46	4.9	Pseudopterogorgia bipinnata
47	4.9	P. americana, Gorgonia ventalina, Laurencia sp., Pocockiella variegata
48	4.3	Laurencia sp.
49	3.7	Pseudopterogorgia americana
50	3.4	Palythoa mammillosa, Muriceopsis flavida
51	3.1	Pseudopterogorgia americana
52	3.1	Erythropodium caribaeorum
53	3.4	Acropora cervicornis, rubble
54	4.6	Plexaura homomalla
55	4.0	Dilophus alternans, Galaxaura cylindrica
56	4.6	Acropora cervicornis
57	4.3	Pseudopterogorgia americana
58	4.3	Plexaura homomalla
59	4.0	Gorgonia ventalina
60	3.7	Briareum asbestinum
61	3.7	Millepora alcicornis
62	3.7	Stypopodium zonale

Site 2. White Bank Dry Rocks, Transect 1. - continued

Meter mark	Depth meters	Botton type and species
63	3.7	Pseudopterogorgia bipinnata
64	3.7	Dead coral
65	4.0	Stypopodium zonale
66	4.0	Pseudopterogorgia americana
67	3.7	Red coralline alga
68	4.0	Thalassia
69	4.6	Rubble
70	4.6	Dasycladus vermicularis, Dysidea etheria
71	4.6	Thalassia, red coralline
72	4.6	Thalassia
73	4.6	Thalassia
74	4.6	Homotrema rubrum on rubble
75	4.6	Thalassia
76	4.6	Halimeda incrassata
77	4.6	Rubble, Homotrema rubrum
78	4.6	Hard bottom
79	4.6	Keratose sponge
80	4.9	Dasycladus vermicularis

Site 2. White Bank Dry Rocks

Transect 2. About 400 m long run on a heading of 298° true, 300 m west of Transect 1. 29 July 1981

Meter mark	Depth meters	Bottom type and species
0	5.4	Haliclona compressa
1	5.4	Gorgonia ventalina
2	4.9	Millepora alcicornis
3	4.3	Porites porites
4	4.3	Gorgonia ventalina
5	4.0	Plexaura flexuosa
6	3.7	Pseudopterogorgia acerosa
7	3.1	Dictyota cervicornis, Amphiroa tribulus
8	3.1	Diadema, Haliclona compressa
9	4.6	Rubble
10	4.0	Rubble
11	3.1	Porites astreoides
12	3.	Rubble
13	3.	Rubble
14	3.	Rubble
15	3.1	Acropora cervicornis
16	3.1	Rubble
17	3.1	Grogonia ventalina
18	3.1	Dilophus alternans, Dictyota cervicornis
19	3.1	Rubble
20	3.7	Rubble
21	3.7	Udotea, Stypopodium zonale

Site 2. White Bank Dry Rocks, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
22	4.0	Millepora alcicornis
23	3.7	Rubble
24	4.6	Eunicea tourneforti
25	5.5	Rubble
26	4.6	Sand
27	4.0	Sand
28	3.1	Rubble
29	3.1	Montastrea annularis
30	3.1	M. annularis
31	4.6	M. annularis
32	6.1	M. annularis
33	6.1	Thalassia
34	6.1	Thalassia, Syringodium
35	5.8	Thalassia, Syringodium
36	6.1	Thalassia, Syringodium
37	6.1	Thalassia, Syringodium
38	6.1	Thalassia, Syringodium
39	6.1	Thalassia, Syringodium
40	6.1	Thalassia, Syringodium
41	6.1	Thalassia, Syringodium, Clypeaster rosaceus
42	6.1	Thalassia, Syringodium
43	6.1	Thalassia, Syringodium

Site 2. White Bank Dry Rocks, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
44	6.1	Thalassia, Syringodium
45	6.1	Thalassia, Syringodium
46	6.1	Thalassia, Syringodium
47	6.1	Thalassia, Syringodium, Halimeda opuntia triloba
48	6.1	Thalassia, Syringodium, Halimeda monile
49	6.1	Thalassia, Syringodium,
50	6.1	Thalassia, Syringodium, Halimeda incrassata
51	6.1	Thalassia, Syringodium, Halimeda incrassata
52	6.1	Thalassia, Syringodium
53	6.1	Thalassia, Syringodium, Penicillus capitatus
54	6.1	Thalassia, Syringodium
55	6.1	Thalassia, Syringodium
56	6.1	Thalassia, Syringodium
57	6.1	Thalassia, Syringodium
58	6.1	Thalassia, Syringodium, Didemnum amethysteum
59	6.1	Thalassia, Syringodium
60	6.1	Thalassia, Syringodium, calcareous red alga
61	6.1	Thalassia, Syringodium
62	6.1	Thalassia, Syringodium
63	6.1	Thalassia, Syringodium, Dysidea sp.
64	6.1	Thalassia Syringodium
65	6.1	Thalassia, Syringodium, Americardia media

Site 2. White Bank Dry Rocks, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
66	6.1	Thalassia, Syringodium, red alga
67	6.1	Thalassia, Syringodium
68	6.1	Thalassia, Syringodium
69	6.1	Thalassia, Syringodium
70	6.1	Thalassia, Syringodium
71	6.1	Thalassia, Syringodium
72	6.1	Thalassia
73	6.1	Pseudopterogorgia americana
74	6.1	Rubble
75	6.1	Gorgonia ventalina
76	6.1	Acropora cervicornis
77	6.1	Briareum asbestinum
78	6.1	Rubble, Dilophus alternans, Dictyota cervicornis
79	6.1	Thalassia
80	6.1	Thalassia

Site 2. White Banks Dry Rocks

Transect 3. About 400 m long run on a heading of 298° true 300 m west of Transect 2. 29 July 1981

Meter mark	Depth meters	Bottom type and species
1	8.5	Trididemnum savignyi
2	8.2	Sand
3	8.2	Thalassia Syringodium
4	7.9	Thalassia Syringodium
5	7.3	Thalassia Syringodium
6	7.3	Thalassia Syringodium
7	7.3	Thalassia, Syringodium, Halimeda incrassata
8	7.3	Thalassia, Syringodium
9	7.0	Sand
10	7.0	Thalassia, Syringodium, Dasycladus vermicularis
11	7.0	Thalassia, Syringodium
12	7.0	Thalassia, Syringodium
13	6.7	Sand
14	6.7	Sand
15	6.7	Thalassia
16	6.7	Thalassia
17	6.1	Montastrea annularis
18	5.5	Erythropodium caribaeorum
19	5.2	Millepora alcicornis
20	3.7	Pseudopterogorgia americana
21	3.0	Hard bottom
22	6.0	Sand

Site 2. White Banks Dry Rocks, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
23	4.9	Pseudopterogorgia americana
24	5.5	Plexaura homomalla
25	5.5	Rock
26	4.9	Aplysina cauliformis
27	3.0	Hard bottom
28	3.0	Gorgonia ventalina
29	3.0	Porites astreoides
30	3.0	Acropora cervicornis
31	3.0	Millepora complanata
32	3.0	Sand
33	3.0	Acropora cervicornis
34	3.4	Millepora alcicornis
35	3.4	M. alcicornis
36	3.0	Acropora cervicornis
37	3.0	A. cervicornis
38	3.0	Rock
39	3.0	Rock
40	3.0	Eunicea tourneforti
41	3.0	Aplysina fistularis
42	3.0	Acropora cervicornis
43	3.0	Rock
44	3.0	Erythropodium caribaeorum

Site 2. White Banks Dry Rocks, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
45	3.4	Acropora cervicornis
46	3.0	A. cervicornis
47	3.0	A. cervicornis
48	3.0	Plexaura flexuosa
49	3.0	Rubble, sand
50	3.0	Rubble, Thalassia
51	3.0	Thalassia
52	3.0	Thalassia, Batophora
53	3.0	Thalassia
54	3.0	Sand
55	3.0	Thalassia
56	3.0	Thalassia, Dasycladus vermicularis, Halimeda tuna, Ophionereis squamosa, Polychaete
57	3.0	Thalassia, Valonia sp.
58	3.0	Thalassia, Halimeda incrassata, Ophionereis squamosa
59	3.0	Batophora
60	3.7	Sand
61	3.0	Thalassia, Syringodium, Halimeda tuna
62	3.0	Thalassia, Syringodium
63	3.0	Thalassia, Syringodium, Dasycladus vermicularis, Tridemnum savignyi
64	3.0	Thalassia, Syringodium

Site 2. White Banks Dry Rocks, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
65	3.0	Rock
66	3.0	Sand
67	3.0	Thalassia, Syringodium, Batophora
68	3.0	Thalassia, Syringodium
69	3.0	Thalassia, Syringodium, Batophora, Dictyota cervicornis
70	3.0	Thalassia, Syringodium
71	3.0	Thalassia, Syringodium, Halimeda monile
72	3.0	Thalassia, Syringodium
73	3.0	Thalassia, Syringodium
74	3.0	Thalassia, Syringodium, Dilophus alternans, Dictyota cervicornis
75	3.0	Plexaurella dichotoma
76	3.0	Dictyota cervicornis, Dilophus alternans, Amphiroa rigida antillensis
77	3.0	Dictyota cervicornis, Amphiroa rigida
78	3.0	Halimeda incrassata
79	3.7	Thalassia, Syringodium
80	4.0	Thalassia, Syringodium

Site 2. White Bank Dry Rocks Coral Quadrats.
12 August 1981

Species	Quadrats 1	2	3	4
PROTOZOA				
Homotrema rubrum	x	x	x	x
ALGAE				
Halimeda incrassata	0	0	3	0
H.	5	0	0	5
Dictyota cervicornis	0		0	2
Goniolithon sp.	x	x	x	x
Lithothamnion sp.	x	x	x	x
PORIFERA				
Spinosella vaginalis	0	1	1	0
S. vaginalis forma?	0	0	1	0
Aplysina cauliformis	0	0	1	0
Haliclona compressa	8	4	2	0
Aiolochroia crassa	0	3	1	0
Spinosella sp.	0	1	0	0
Keratosa indet.	0	1	0	0
Axinellid	0	1	0	0
Spongia sp.	1	0	0	0
Niphates sp.	0	0	0	8
COELENTERATA				
Briareum asbestinum	3	4	5	6
Erythropodium caribaeorum	0	0	0	1
Palythoa mammillosa	0	0	0	5

Site 2. White Bank Dry Rocks Coral Quadrats. - continued

Species	Quadrats 1	2	3	4
Anemones	0	1	0	0
Plexaura flexuosa	0	1	0	1
Plexaura homomalla	1	0	0	0
Pseudopterogorgia americana	1	0	0	1
P. acerosa	0	0	5	0
Muriceopsis flavida	0	1	0	1
Euncea mammosa	0	1	1	0
E. tourneforti	0	0	1	0
Gorgonia ventalina	1	0	4	1
Diploria labyrinthiformis	1	1	0	0
Montastrea annularis	1	6	6	9
M. cavernosa	0	5	1	0
Siderastrea radians	0	4	2	0
Agaricia agaricites	0	3	5	1
Eusmilia fastigiata	0	0	1	0
Isophyllia sinuosa	0	1	0	0
Millepora alcicornis	1	0	0	1
WORMS				
Serpulid	1	0	0	0
Tube worm	0	1	0	0
Sabellids	0	0	3	0
CRUSTACEANS				
Hermit crab	0	0	0	1

Site 2. White Bank Dry Rocks Rubble Quadrats.
26 August 1981

Species	Quadrats 1	2	3	4
PROTOZOA				
Homotrema rubrum	0	1	0	0
ALGAE				
Halimeda opuntia	8	15	22	4
Dilophus alternans	13	1	0	0
Valonia sp.	4	0	3	0
Dictyota cervicornis	2	0	5	0
Batophora oerstedi	1	0	0	0
Stypopodium zonale	2	1	10	0
Amphiroa sp.	0	1	0	0
Goniolithon sp.	0	2	0	0
PORIFERA				
Ircinia strobilina	1	0	1	0
Haliclona compressa	1	0	0	0
Thalysias sp.	0	0	1	0
Aplysina sp.	1	1	1	0
Cliona sp.	0	0	0	1
Callyspongia sp.	0	1	0	0
Mycale sp.	0	1	0	0
Chondrilla nucula	0	0	1	0

Site 2. White Bank Dry Rocks Rubble Quadrats. - continued

Species	Quadrats 1	2	3	4
COELENTERATA				
Favia fragum	2	0	1	0
Siderastrea siderea	1	2	0	1
Agaricia agaricites	1	0	0	0
Diploria clivosa	1	0	0	0
Porites porites	1	0	2	0
Acropora cervicornis	0	1	0	1
Pseudopterogorgia americana	1	0	3	0
Plexaura flexuosa	0	1	0	0
Gorgonia ventalina	0	0	3	0
WORMS				
Worms spp.	10	0	3	1
Sabellid	0	1	0	0
Eunice kingergi	0	1	0	0
Eunice sp.	0	0	4	0
Amphinomid	0	0	0	4
SIPUNCULIDA				
Sipunculid	0	1	0	0
MOLLUSCA				
Cerithium eburneum	0	0	6	0
C. guinaicum	0	1	0	0
C. litteratum	0	2	0	4
CRUSTACEA				
Isopod indet.	0	2	0	0

Site 2. White Bank Dry Rocks Rubble Quadrats. - continued

Species	Quadrats 1	2	3	4
BRYOZOA				
Bryozoan sp.	0	1	0	1
ECHINODERMATA				
Brittle stars	5	36	4	0
Eucidaris tribuloides	0	0	1	0
Diadema antillarum	0	0	1	0

Site 2. White Bank Dry Rocks Grass Quadrats.
10 June 1981

Species	Quadrats 1	2	3	4
ALGAE				
Penicillus capitatus	5	2	6	5
Halimeda incrassata	0	4	2	2
H. lacrimosa	5	1	3	6
Red alga A	1	1	0	0
Red alga B	0	1	0	0
Red alga C	0	1	0	0
Dilophus alternans	0	0	1	0
Dasycladus vermicularis	0	0	0	4
PORIFERA				
Aplysina sp.	1	0	0	0
Foliolina peltata	0	2	2	1
Sponge A	0	0	0	1
COELENTERATA				
Millepora alcicornis	0	1	0	0
MOLLUSCA				
Murex recurvirostris rubidus	1	0	0	0
Nudibranch (not collected)	1	0	0	0
Glycimeris pectinata	0	0	1	0
Nudibranch (not collected)	0	0	0	1
Laevicardium laevigatum	1	0	0	0
ECHINODERMATA				
Eucidaris tribuloides	1	0	0	0

Site 2. White Bank Dry Rocks Grass Quadrats. - continued

Species	Quadrats 1	2	3	4
Clypeaster rosaceus	1	0	0	0
WORMS				
Sabellid	0	0	1	0
CRUSTACEA				
Shrimp sp. A	0	0	1	0
ASCIDIACEA				
Styelid	1	0	0	0
Didemnum candidum	0	8	2	1
Symplegma sp.	4	1	1	1
Didemnum sp.	0	1	0	0

Site 2. White Bank Dry Rocks Sand Quadrats.
21 August 1981

Species	Quadrats 1	2	3	4
WORMS				
Phascolion sp.	0	0	0	1
Worm indet.	0	0	0	1
MOLLUSCA				
Terebra hastata	0	0	1	0
Olivella nivea	0	0	2	1
CRUSTACEA				
Cycloes bairdii	1	0	0	0
Paguristes sp.	1	0	0	0
ECHINODERMATA				
Ophiothrix oerstedi	0	0	1	0

Site 3. French Reef

Transect 1. About 720 m long run on a heading of 308° true past the stake on the reef tract. 10 June 1980

Meter Mark	Depth Meters	Bottom type and species
1	18.5	Montastrea annularis (white spotting about 5%)
2	17.9	Erythropodium caribaeorum
3	16.9	Halimeda opuntia, Dictyota
4	16.0	Eunicea calyculata forma coronata
5	16.0	Dictyota
6	15.4	Amphiroa rigida antillana, red sponge
7	15.4	Pseudopterogorgia americana
8	15.4	Goniolithon strictum, Dilophus alternans
9	14.8	Cladophora sp.
10	14.8	Montastrea annularis (white spotting about 2%)
11	14.2	Dictyota, Cladophota sp.
12	13.9	Dictyota, Cladophota sp.
13	13.9	Filamentous green alga, red sponge
14	13.9	Siderastrea siderea (white spotting less than 1%)
15	13.9	Melobesia on rubble
16	16.9	Rubble
17	16.6	Millepora alcicornis
18	16.3	Sediment on hard bottom
19	16.0	Hard bottom, Homotrema, red sponge
20	15.4	Amphiroa, Dictyota, Ophiothryx sp., black sponge
21	15.4	Black sponge
22	15.4	Thin sediment on rock

Site 3. French Reef, Transect 1. - continued

Meter Mark	Depth Meters	Bottom type and species
23	15.1	Dictyota, Melobesia
24	14.8	Acropora cervicornis
25	14.8	Sediment, Melobesia
26	14.5	Sediment
27	14.5	Coral rubble, Melobesia
28	14.5	Coral rubble, Melobesia
29	14.2	Coral rubble
30	13.9	1½" sediment (Halimeda plates, etc.)
31	13.2	Sediment, coral rubble
32	12.9	Pseudopterogorgia americana
33	12.3	Dictyota
34	11.1	Dictyota on old coral heads
35	10.5	Dictyota
36	8.3	Dead section of Montastrea annularis (90% white spotting)
37	7.1	Acropora palmata (white spotting less than 1%)
38	8.3	Dead coral with encrusting Melobesia, tufted green alga
39	11.1	Diploria strigosa
40	11.1	Sediments (between spurs)
41	10.8	Hard bottom, Pseudopterogorgia americana
42	10.8	P. americana
43	8.6	Millepora alcicornis
44	9.2	Agaricia agaricites

Site 3. French Reef, Transect 1. - continued

Meter Mark	Depth Meters	Bottom type and species
45	9.2	Old coral head with Melobesia & Dictyota
46	8.0	Porites astreoides (white spotting about 30%)
47	8.3	Melobesia, Dictyota
48	6.8	Hard bottom, Melobesia
49	6.8	Dictyota
50	6.2	Dictyota, hard bottom (in spur)
51	8.9	Sand in groove
52	8.9	Sand in groove
53	8.9	Sand in groove
54	8.9	Sand in groove
55	8.9	Sand in groove
56	8.9	Halimeda opuntia
57	8.6	Coral rubble, Melobesia
58	8.3	Sand
59	8.2	Sand, coral rubble, Melobesia
60	7.7	Rubble with Melobesia
61	7.7	Rubble with Melobesia
62	6.8	Melobesia on rubble
63	6.8	Sand
64	7.1	Sand
65	7.1	Dictyota
66	7.1	Sand

Site 3. French Reef, Transect 1. - continued

Meter Mark	Depth Meters	Bottom type and species
67	6.8	Sand, rubble
68	6.8	Dictyota, rubble, sabellid worm
69	5.9	Pseudopterogorgia americana
70	6.2	Brick red sponge, Melobesia, sand
71	7.1	Sand
72	6.2	Brick red sponge, Dictyota
73	6.2	Sand
74	6.2	Sand
75	6.2	Sand
76	6.2	Sand
77	5.9	Chaetomorpha sp., rubble, Laurencia sp.
78	5.9	Sand
79	5.9	Laurencia sp., filaments with rhizoids on rubble
80	5.9	Sand, Melobesia on rubble
81	5.5	Sand
82	5.5	Sand
83	4.9	Halimeda opuntia, rubble
84	4.3	Gorgonia ventalina
85	3.4	Ceramium nitens, Cliona delitrix, rubble
86	3.4	Rubble
87	3.5	Sand, rubble, Cladophora sp., Amphiroa rigida antillana
88	4.3	Sand, Cladophora sp.

Site 3. French Reef, Transect 1. - continued

Meter Mark	Depth Meters	Bottom type and species
89	3.7	Old coral head, Melobesia, Ceramium nitens
90	3.7	Sand
91	3.4	Rubble, Cladophora
92	3.4	Sand
93	3.4	Rubble, Melobesia
94	3.1	Millepora alcicornis
95	3.1	Rubble, sand, Ceramium nitens
96	3.1	Rubble, Laurencia sp.
97	3.1	Rubble, Melobesia, sand
98	2.5	Rubble, unidentified sponge fragment
99	1.9	Rubble, Melobesia
100	1.9	Rubble, Ceramium nitens, Melobesia
101	1.9	Rubble, Ceramium nitens
102	2.2	Rubble, encrusting orange sponge
103	2.2	Rubble
104	1.9	Halimeda opuntia
105	1.9	Rubble, Melobesia
106	1.9	Rubble and sand
107	1.9	Green tufted alga
108	1.2	Green tufted alga, rubble
109	1.2	Rubble, Melobesia
110	0.6	Dictyota

Site 3. French Reef, Transect 1. - continued

Meter Mark	Depth Meters	Bottom type and species
111	0.6	Rubble
112	0.6	Halimeda tuna, Dictyota sp., rubble
113	0.6	Orange sponge, rubble
114	0.6	Dictyota, sand, rubble
115	0.6	Rubble, sand
116	0.6	Rubble, Melobesia
117	0.6	Dasycladus, sand, rubble
118	0.6	Rubble, Dictyota
119	0.9	Rubble
120	0.9	Dictyota, rubble
121	1.2	Rubble
122	1.2	Rubble, Dictyota
123	1.5	Rubble
124	1.5	Dasycladus, rubble, Padina, Dictyota
125	1.2	Rubble, Melobesia. Dasycladus, Laurencis
126	1.2	Gracilaria ferox, Dasycladus vermicularis, rubble
127	1.2	Rubble, Dictyota
128	1.2	Dasycladus, Dictyota, rubble
129	1.2	Homotrema rubrum, Melobesia rubble
130	1.2	Laurencia poitei, rubble
131	1.2	Laurencia sp., green tufted alga, rubble
132	1.2	Padina

Site 3. French Reef, Transect 1. - continued

Meter Mark	Depth Meters	Bottom type and species
133	1.2	Sand
134	1.2	Pocockiella variegata, filamentous alga on rubble
135	1.5	Rubble, Melobesia, Homotrema rubrum
136	1.5	Rubble, Homotrema
137	1.5	Laurencia, rubble
138	1.5	Laurencia, rubble
139	1.5	Laurencia, rubble
140	1.5	Dasycladus, rubble
141	1.5	Green alga, rubble, Laurencia, Dasycladus, Amphiroa rigida antillana
142	1.5	Padina, rubble
143	1.5	Rubble
144	1.5	Laurencia

Site 3. French Reef

Transect 2. About 400 m long run on a heading of 308° true and 300 m to the west of Transect 1. 1 November 1983

Meter mark	Depth meters	Bottom type and species
0	16.8	Montastrea annularis
1	15.9	Pseudopterogorgia bipinnata
2	15.5	Dilophus annularis
3	15.5	Montastrea annularis
4	15.2	Sand, hard bottom
5	15.0	Sponge
6	15.0	Rubble, Dilophus alternans
7	14.6	Pseudopterogorgia elisabethae
8	14.3	Dilophus alternans
9	14.3	Dilophus alternans, Christmastree worm
10	14.0	Dilophus alternans, hard bottom, Homotrema rubrum
11	13.7	Dilophus alternans, hard bottom
12	13.4	Amphiroa fragilissima
13	15.2	Pseudopterogorgia bipinnata
14	15.2	Hard bottom
15	15.2	Hard bottom
16	15.2	Hard bottom
17	15.2	Hard bottom
18	15.2	Hard bottom, Halimeda sp.
19	14.3	Dilophus alternans
20	14.3	Dilophus alternans, red algal mat
21	14.0	Dilophus alternans, hard bottom

Site 3. French Reef, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
22	13.7	Sponge
23	13.4	Hard bottom, Homotrema rubrum
24	13.4	Rubble, hard bottom
25	13.4	Sand, hard bottom
26	12.5	Hard bottom
27	12.2	Hard bottom
28	11.9	Spinosella vaginalis
29	10.7	Colpophyllia natans (white spot 10%)
30	10.1	Favia fragum
31	9.8	Pseudopterogrogia bipinnata
32	9.1	Dilophus alternans
33	8.8	Dilophus alternans
34	8.2	Hard bottom, Homotrema rubrum
35	8.2	Spongia cerebriformis
36	7.3	Dilophus alternans
37	8.5	Halimeda opuntia minor
38	9.1	Dilophus alternans, Millepora alcicornis
39	9.4	Sand
40	9.4	Pseudopterogorgia bipinnata
41	7.0	Hard bottom, Dilophus alternans
42	7.0	Pseudopterogorgia bipinnata
43	6.7	Hard bottom

Site 3. French Reef, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
44	6.7	Dilophus alternans
45	6.7	Dilophus alternans
46	6.4	Dilophus alternans
47	6.1	Muriceopsis flavida, Dilophus alternans
48	6.4	Udotea, hard bottom
49	6.4	Udotea, hard bottom
50	6.4	Udotea, hard bottom
51	6.4	Gorgonid
52	6.4	Millepora alcicornis
53	7.0	Rubble
54	7.0	Hard bottom
55	7.0	Udotea, hard bottom
56	6.7	Millepora alcicornis
57	6.1	Pseudopterogorgia americana
58	6.4	Pseudopterogorgia americana
59	6.7	Hard bottom, Udotea
60	6.4	Hard bottom, Udotea
61	6.4	Haimeda opuntia minor, Udotea
62	6.1	Hard bottom, Udotea
63	6.7	Brown alga
64	6.7	Hard bottom, Udotea
65	6.4	Hard bottom, Udotea

Site 3. French Reef, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
66	6.7	Hard bottom, Udotea
67	6.7	Calcareous alga, orange sponge, Udotea
68	6.7	Rubble, Udotea
69	6.7	Udotea
70	6.4	Udotea, rubble
71	6.4	Hard bottom, Udotea
72	6.4	Sand, rubble
73	6.4	Sand, rubble
74	6.7	Sand
75	6.4	Sand, rubble
76	6.7	Sand
77	6.4	Pseudopterogorgia bipinnata
78	6.4	Rubble
79	6.4	Udotea, Pseudopterogorgia bipinnata
80	6.4	Rubble

Site 3. French Reef

Transect 3. About 610 m run on a heading of 308° true, 300 m. east of Transect 1. 30 May 1981

Meter mark	Depth meters	Bottom type and species
1	15.2	Dilophus alternans
2	14.6	Pseudopterogorgia elisabethae
3	14.6	Acropora cervicornis
4	14.6	Sargassum sp.
5	14.3	Siderastrea radians
6	13.7	Alga, Sargassum
7	12.8	Pseudopterogorgia americana
8	12.8	Dilophus alternans
9	12.8	Millepora alcicornis
10	12.8	Pseudopterogorgia americana
11	12.8	Dilophus alternans
12	12.8	Favia fragum
13	12.5	Pseudopterogorgia elisabethae
14	12.2	Muricea pinnata
15	12.2	Alga
16	12.2	Dictyota cervicornis
17	12.2	Dilophus alternans
18	11.9	Millepora alcicornis
19	11.9	Dictyota cervicornis
20	12.2	Pseudopterogorgia americana
21	11.9	Dilophus alternans, Dictyota cervicornis
22	11.6	Sargassum

Site 3. French Reef, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
23	11.6	Sand, Dictyota cervicornis
24	11.6	Dictyota cervicornis
25	11.6	Acropora cerivcornis
26	11.6	Sargassum, Dilophus alternans
27	11.6	Hard bottom
28	11.6	Hard bottom, Sargassum
29	11.6	Hard bottom
30	11.6	Dictyota cervicornis
31	11.6	Dilophus alternans
32	11.6	Hard bottom
33	11.6	Halimeda tuna
34	10.7	Eunicea tourneforti
35	10.7	Sargassum
36	10.7	Dictyota cervicornis
37	10.7	Siderastrea radians
38	10.7	Favia fragum
39	10.7	Sand
40	10.7	Coarse sand
41	10.7	Dilophus alternans, Dictyota cervicornis
42	10.7	Agaricia agaricites
43	10.7	Hard bottom, pink encrusting alga
44	10.7	Dilophus alternans

Site 3. French Reef, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
45	10.7	Dictyota cervicornis
46	10.7	Coarse sand
47	10.7	Spinosella vaginalis, Ophiothrix suensoni
48	10.7	Pseudopterogorgia americana
49	10.7	Sand
50	10.7	Plexaura flexuosa
51	9.8	Dictyota cervicornis
52	9.8	Sand
53	9.8	Hard bottom
54	9.8	Acropora cervicornis
55	9.8	Dilophus alternans
56	9.8	Sand
57	10.7	Eunicea tourneforti
58	9.1	Pseudopterogorgia americana
59	9.1	P. bipinnata
60	9.1	Halimeda tuna
61	9.1	Siderastrea siderea
62	9.1	Stypopodium zonale
63	9.1	Hard bottom, Dilophus alternans
64	9.1	Rubble
65	9.1	Dictyota cervicornis
66	9.1	Pseudopterogorgia americana

Site 3. French Reef, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
67	9.1	Hard bottom
68	8.8	Coarse sand, pink encrusting alga
69	8.8	Hard bottom
70	8.8	Hard bottom, Dilophus alternans
71	8.8	Stypopodium zonale
72	8.5	Hard bottom
73	8.5	Rubble
74	8.5	Dilophus alternans
75	8.5	Dictyota cervicornis
76	8.5	Rubble
77	7.6	Rubble, Homotrema rubrum
78	7.6	Dilophus alternans
79	7.6	Rubble
80	7.6	Halimeda tuna
81	7.6	Rubble
82	7.6	Rubble
83	7.6	Rubble
84	7.6	Rubble
85	7.6	Rubble, Homotrema rubrum
86	6.7	Pseudopterogorgia americana
87	6.7	Rubble
88	6.7	Rubble

Site 3. French Reef, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
89	6.7	Gorgonia ventalina
90	6.7	Dilophus alternans
91	6.7	Rubble
92	5.5	Rubble
93	5.5	Halimeda incrassata
94	5.5	Muricea pinnata
95	5.5	Rubble
96	5.2	Rubble
97	5.5	Stypopodium zonale
98	5.5	Stypopodium zonale
99	5.2	Green alga
100	5.2	Stypopodium zonale
101	4.9	Rubble, Homotrema rubrum
102	5.5	Rubble, Homotrema rubrum
103	5.5	Alga
104	4.0	Dilophus alternans
105	3.7	Stypopodium zonale
106	3.4	Stypopodium zonale, rubble
107	3.0	Dictyota cervicornis
108	3.0	Stypopodium zonale
109	3.0	Rubble, alga

Site 3. French Reef, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
110	3.0	Rubble, Homotrema rubrum, Dilophus alternans, Dictyota sp.
111	5.5	Dictyota cervicornis
112	5.5	Stypopodium zonale
113	4.9	Stypopodium zonale
114	1.8	Plexaurella dichotoma
115	1.8	Rubble, Dictyota cervicornis
116	1.8	Gorgonia ventalina
117	1.8	Acropora cervicornis
118	1.8	Halimeda incrassata
119	1.5	Rubble, Homotrema rubrum
120	1.5	Dictyota cervicornis
121	1.5	Halimeda incrassata
122	1.5	Dilophus alternans

Site 3. French Reef Coral Quadrats
13 September 1981

Species	Quadrats 1	2	3	4
PROTOZOA				
Homotrema rubrum	0	0	0	1
ALGAE				
Filamentous algae	2	2	0	1
Galaxaura sp.	1	0	1	0
Halimeda incrassata	1	0	1	0
H. opuntia minor	1	0	2	30
Dictyota sp.	1	1	0	0
Slimy red alga	0	3	0	0
Amphiroa rigida antillana	0	2	0	0
Amphiroa sp.	1	1	0	0
Goniolithon sp.	0	0	1	0
Lithothamnion sp.	0	0	1	0
PORIFERA				
Agelas schmidti	10	0	1	0
Agelas sp.	0	3	1	0
Ircinia strobilina	0	2	0	1
Foliolina peltata	0	3	0	0
Niphates erecta	0	0	0	3
Black sponge, indet.	1	0	0	0
Encrusting yellow sponge	0	0	1	0
COELENTERATA				
Pseudopterogorgia americana	0	1	0	0

Site 3. French Reef Coral Quadrats. - continued

Species	Quadrats 1	2	3	4
P. kallos	0	0	4	0
Erthyropodium caribaeorum	1	0	1	0
Briarum asbestinum	0	0	1	0
Millepora alcicornis	11	3	0	2
M. complanata	0	0	1	0
Anemone indet.	1	6	1	40
Montastrea annularis	1	2	1	3
Acropora palmata	1	8	1	8
A. cervicornis	1	0	1	0
Agaricia agaricites	1	0	6	2
A. lamarckiana	0	0	0	1
Mycetophyllia lamarckana	0	0	0	1
M. ferox	0	0	1	0
Porites porites	0	6	1	0
P. astreoides	0	0	1	4
WORMS				
Sabellid A	1	0	0	0
Sabellid B	1	0	0	0
Xmas-tree worm, yellow	0	1	0	2
Xmas-tree worm, blue	0	3	0	2
CRUSTACEANS				
Crab A	1	0	0	0
Crab B	0	1	0	0

Site 3. French Reef Coral Quadrats. - continued

Species	Quadrats 1	2	3	4
Mithrax spinossissimus	1	0	0	0
ECHINODERMATA				
Ophionereis squamosa	0	1	0	0
Ophiothrix sp.	1	0	0	0
Brittlestars	1	0	0	0
Eucidaris tribuloides	1	0	0	0

Site 3. French Reef Rubble Quadrats.
1 November 1980

Species	Quadrats 1 - 2	3 - 4
PROTOZOA		
Homotrema rubrum	2	4
ALGAE		
Halimeda opuntia minor	1	0
H. incrassata	29	0
H. opuntia	0	3
Dictyosphaeria cavernosa	1	0
Pink coralline	x	x
Laurencia spp.	1	1
Branching coralline	0	1
Algal mat	0	1
Amphiroa rigida antillana	1	0
PORIFERA		
Callyspongia sp.	1	0
COELENTERATA		
Gorgonia ventalina	3	0
Millepora complanata	1	0
Siderastrea radians	3	0
WORMS		
Maldanid	1	0
Eunice longicirrata	2	2
Glycera sp.	1	0
Phyllodocid	1	0

Site 3. French Reef Rubble Quadrats. - continued

Species	Quadrats 1 - 2	3 - 4
Terebellid	1	0
Sabellid	0	1
MOLLUSCA		
Polinices lactea	1	0
Barbatia candida	1	0
Cerithium litteratum	3	1
C. eburneum	2	1
Stenoplax floridana	0	2
Ischnochiton erythronotus	1	2
ARTHOPODA		
Shrimp	2	0
Mithrax forceps	0	1
ECHINODERMATA		
Eucidaris tribuloides	1	0
Ophiocoma echinata	1	0
Brittlestars	2	0
Diadema antillarum	1	0
Brittlestars	0	1
ASCIDIACEA		
Didemnum candidum	0	1

Site 3. French Reef Rubble Quadrats. - continued

Species	Quadrats 1 - 2	3 - 4
BRYOZOA		
Bryozoan	0	1
White encrusting form	0	1
Encrusting	1	0

Site 3. French Reef Hard Bottom Quadrats.
1 November 1980

Species	Quadrats 1 - 2	3 - 4
PROTOZOA		
Homotrema rubrum	6	0
ALGAE		
Halimeda opuntia	0	2
Dilophus alternans	0	1
Dictyota sp.	11	0
Amphiroa sp.	1	0
Coralline	x	0
PORIFERA		
Aiolochroia crassa	16	0
Niphates erecta	1	2
Niphates digitalis	2	0
Cliona sp.	1	0
Orange encrusting sponge	2	0
Aplysina sp.	2	0
Aplysina fistularis	8	0
Aplysina cauliformis	0	22
Spinosella vaginalis	0	1
Aplysina sp.	0	1
Porifera indet.	0	1
Axinellis	0	1
Murocionid	1	0

Site 3. French Reef Hard Bottom Quadrats. - continued

Species	Quadrats 1 - 2	3 - 4
COELENTERATA		
Millepora alcicornis	25	13
Pseudopterogorgia americana	4	36
P. acerosa	13	0
P. rigida	6	0
Pseudoplexaura sp.	2	0
Pterogorgia citrina	1	0
Briareum asbestinum	1	0
Eunicea calyculata	3	0
Muriceopsis flavida	1	0
Erythropodium caribaeorum	2	1
Porites astreoides	2	0
Porites furcata	0	4
Porites form?	0	1
Agaricia agaricites	4	2
Eusmilia fastigiata	1	0
Siderastrea siderea	3	2
S. radians	0	2
Dichocoenia stokesii	0	1
Montastrea cavernosa	0	2
Diploria labyrinthiformis	0	1
WORMS		
Lumbrinereis	1	0

Site 3. French Reef Hard Bottom Quadrats. - continued

Species	Quadrats 1 - 2	3 - 4
BRYOZOA		
Encrusting bryozoan	1	0
MOLLUSCA		
Cerithium litteratum	1	0
Nudibranch	0	1
ECHINODERMATA		
Ophiothrix lineata	0	1
Brittlestars	2	0

Site 3. French Reef Sand Quadrats.
1 November 1980

Species	Quadrats 1 - 4
WORMS	
Ophelids	1
Sipunculids	3
MOLLUSCA	
Terebra hastata	2

Site 4. Mosquito Bank

Transect 1. About 400 m long run on a heading of 303° true.
11 June 1981

Meter mark	Depth meter	Bottom type and species
1	3.7	Thalassia, Syringodium
2	3.7	Thalassia, Syringodium, Halimeda monile
3	3.7	Syringodium, H. monile, Aplysina sp.
4	3.7	Thalassia, Syringodium, H. incrassata
5	3.7	Thalassia, Syringodium, H. monile
6	3.7	Thalassia, Syringodium, H. opuntia triloba
7	3.7	Thalassia, Syringodium
8	3.7	Thalassia, Syringodium
9	3.4	Thalassia, Syringodium
10	3.4	Thalassia
11	3.0	Thalassia
12	3.0	Dictyota sp., H. monile
13	3.0	Sand, hard bottom
14	2.4	Halimeda tuna, Dictyota sp., coralline
15	2.1	Millepora alcicornis
16	1.8	Siderastrea siderea
17	1.8	Pseudoplexaura porosa
18	1.8	Acanthophora sp.
19	1.8	Halimeda tuna, Dictyota sp.
20	3.0	Chondrilla nucula
21	3.0	Thalassia
22	3.3	Thalassia

Site 4. Mosquito Bank, Transect 1. - continued

Meter mark	Depth meter	Bottom type and species
23	3.7	Thalassia
24	3.7	Thalassia
25	3.7	Thalassia
26	3.7	Thalassia, Halimeda opuntia triloba
27	3.7	Thalassia
28	3.7	Thalassia
29	3.7	Thalassia, Syringodium, Lytechinus
30	3.7	Thalassia, Syringodium
31	3.7	Thalassia, Syringodium, Halimeda monile
32	3.7	Thalassia, Syringodium
33	3.7	Penicillus dumetosus
34	4.3	Halimeda incrassata, H. opuntia triloba
35	4.3	Thalassia, Syringodium, Penicillus lamourouxi
36	4.0	Thalassia, Syringodium, Halimeda opuntia triloba
37	4.0	Thalassia
38	4.0	Thalassia
39	4.0	Syringodium, Halimeda tuna, Penicillus dumetosus
40	4.0	Loimia sp.
41	4.3	Thalassia, crab
42	4.3	Thalassia, Loimia sp.
43	4.3	Thalassia, Halimeda incrassata
44	4.3	Halodule, H. incrassata

Site 4. Mosquito Bank, Transect 1. - continued

Meter mark	Depth meter	Bottom type and species
45	4.0	Halodule, Thalassia, Halimeda incrassata
46	3.4	Thalassia, H. incrassata, Ascidinella sp.
47	3.4	Penicillus capitatus
48	4.0	Thalassia, Loimia sp.
49	4.0	Thalassia, Loimia sp.
50	4.0	Thalassia, green alga
51	4.0	Thalassia
52	4.0	Thalassia, Halimeda incrassata, H. opuntia triloba
53	4.0	Syringodium
54	4.0	Thalassia, Syringodium, Loimia sp.
55	4.0	Thalassia, Syringodium
56	4.0	Thalassia, Syringodium, Halimeda opuntia triloba
57	4.0	Thalassia, Syringodium
58	4.0	Thalassia, Syringodium, Loimia sp.
59	4.0	Thalassia
60	4.0	Thalassia, Loimia sp.
61	4.0	Thalassia, Lytechinus variegatus
62	4.0	Thalassia
63	4.0	Thalassia, Acetabularia crenulata
64	4.3	Thalassia, Loimia sp.
65	4.3	Thalassia, Loimia sp., Penicillus capitatus
66	4.3	Thalassia

Site 4. Mosquito Bank, Transect 1. - continued

Meter mark	Depth meter	Bottom type and species
67	4.3	Thalassia
68	4.0	Thalassia, Halimeda incrassata, H. opuntia triloba
69	4.0	Thalassia
70	4.0	Thalassia
71	4.0	Thalassia, Penicillus capitatus
72	4.0	Thalassia
73	4.0	Thalassia, Syringodium
74	4.6	Thalassia, Syringodium
75	4.0	Thalassia
76	4.0	Thalassia, Syringodium
77	4.0	Thalassia, Syringodium
78	4.0	Thalassia, Syringodium
79	4.0	Thalassia, Syringodium
80	4.0	Thalassia, Loimia sp.

Site 4. Mosquito Bank

Transect 2. About 400 m long run on a heading of 303° true 300 m west of Transect 1. 11 June 1981

Meter mark	Depth meters	Bottom type and species
0	2.7	Sand, hard bottom
1	2.7	Plexaura flexuosa
2	3.0	Pseudoplexaura porosa
3	3.0	Pseudopterogorgia americana
4	3.0	Sand
5	3.0	Halimeda incrassata
6	3.4	Penicillus lamourouxi
7	3.7	Sand
8	3.7	Thalassia
9	3.7	Thalassia
10	4.0	Thalassia
11	4.0	Thalassia, Penicillus lamourouxi
12	4.0	Thalassia
13	4.0	Thalassia, Loimia
14	4.0	Thalassia
15	4.0	Thalassia, Halimeda opuntia triloba
16	4.0	Thalassia
17	4.0	Thalassia
18	4.0	Thalassia
19	4.0	Thalassia
20	4.0	Thalassia
21	4.0	Thalassia, Syringodium

Site 4. Mosquito Bank, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
22	4.0	Thalassia, Syringodium
23	3.7	Thalassia
24	3.7	Thalassia, Syringodium
25	3.7	Thalassia, Syringodium
26	3.7	Thalassia, Syringodium
27	3.7	Thalassia, Syringodium
28	3.3	Thalassia, Lytechinus variegatus
29	3.3	Thalassia, Syringodium
30	3.3	Thalassia, Porites furcata, Halimeda incrassata
31	3.3	Thalassia, Syringodium
32	3.3	Thalassia, Syringodium, H. incrassata
33	3.3	Thalassia, Syringodium, H. monile
34	3.3	Thalassia
35	3.3	Thalassia, Syringodium
36	3.3	Thalassia, Syringodium, Penicillus capitatus
37	3.7	Thalassia, Syringodium, H. monile, Tagelus sp. Adoria
38	3.7	Thalassia
39	3.7	Thalassia, Loimia, H. monile
40	3.7	Thalassia
41	4.0	Thalassia, Syringodium, Penicillus lamourouxi
42	4.0	Thalassia

Site 4. Mosquito Bank, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
43	4.0	Thalassia, Syringodium
44	4.0	Thalassia
45	4.0	Thalassia
46	4.0	Thalassia
47	3.7	Thalassia
48	3.4	Pseudoplexaura porosa
49	3.0	Colpophyllia natans
50	3.0	Pseudoplexaura porosa
51	3.0	P. porosa
52	3.4	Siderastrea siderea
53	3.7	Sand
54	4.0	Thalassia
55	4.0	Sand
56	4.0	Thalassia
57	4.0	Thalassia
58	4.0	Sand
59	4.0	Thalassia
60	4.3	Thalassia
61	4.3	Thalassia, Loimia sp.
62	4.3	Thalassia, Lytechinus variegatus
63	4.3	Thalassia
64	4.3	Thalassia

Site 4. Mosquito Bank, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
65	4.0	Thalassia, Loimia sp.
66	4.3	Thalassia
67	4.3	Thalassia, Loimia sp.
68	4.3	Thalassia
69	4.3	Thalassia, Halimeda incrassata, Adoria
70	4.3	Thalassia, H. incrassata, Lytechinus variegatus
71	4.3	Thalassia, Loimia
72	4.3	Thalassia
73	4.3	Thalassia
74	4.3	Thalassia, Anadara notabilis
75	4.3	Thalassia, Loimia
76	4.6	Thalassia, Halodule
77	4.6	Syringodium, Halodule
78	4.3	Thalassia, Syringodium, Halimeda incrassata
79	4.3	Thalassia, Syringodium, Anadara notabilis
80	4.3	Thalassia, Halimeda monile

Site 4. Mosquito Bank

Transect 3. About 400 m long run on a heading of 303° true, 300 m west of Transect 2. 12 June 1981.

Meter mark	Depth meters	Bottom type and species
1	3.4	Sand
2	3.4	Pseudopterogorgia americana
3	3.4	Pseudoplexaura porosa
4	3.0	Pseudopterogorgia rigida
5	3.0	Sand
6	3.0	Millepora alcicornis, Plexaurella grisea
7	3.4	Sand
8	3.4	Thalassia
9	3.4	Thalassia
10	3.4	Thalassia
11	3.7	Thalassia, Udotea spinulosa
12	3.7	Thalassia, Syringodium
13	3.7	Thalassia, Syringodium, Didemnum candidum
14	3.7	Thalassia, Syringodium
15	3.7	Thalassia, Syringodium
16	4.0	Thalassia, Syringodium
17	4.0	Thalassia, Syringodium, Lytechinus, Batophora, Avrainvillea nigricans
18	4.0	Thalassia, Aplysina, Porites furcata, Avrainvillea nigricans
19	3.7	Thalassia, Halodule
20	3.7	Thalassia, Syringodium, Halodule, Halimeda monile
21	3.7	Thalassia, Syringodium, Lytechinus variegatus

Site 4. Mosquito Bank, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
22	3.7	Thalassia, Haliclona viridis, Halimeda incrassata
23	3.7	Thalassia, Halodule
24	3.7	Thalassia, Manicina areolata
25	3.7	Thalassia, Lytechinus variegatus
26	3.7	Thalassia, Syringodium, Halimeda incrassata
27	3.7	Thalassia, Syringodium
28	3.7	Thalassia, Syringodium
29	3.7	Thalassia, Syringodium, crab
30	3.7	Thalassia, Syringodium
31	3.4	Thalassia, Syringodium, Lytechinus variegatus
32	3.4	Thalassia, Syringodium
33	3.4	Thalassia, Syringodium, Halimeda monile, ascidian
34	3.4	Thalassia, Syringodium
35	3.4	Thalassia, Syringodium
36	3.4	Thalassia, Syringodium, Halimeda incrassata
37	3.4	Thalassia, Syringodium
38	3.4	Thalassia, Syringodium, Lytechinus variegatus
39	3.4	Thalassia, Syringodium, Halimeda opuntia, Codakia orbicularis
40	3.4	Thalassia
41	3.4	Thalassia
42	3.0	Thalassia, Aplysina

Site 4. Mosquito Bank, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
43	2.7	Ircinia strobilina
44	2.4	Pseudopterogorgia americana, Dichocoenia stokesii
45	2.4	Thalassia, Halimeda incrassata, Batophora, Udotea, Pseudopterogorgia acerosa, Eunice filamentosa
46	2.4	Aplysina cauliformis
47	2.1	Thalassia, Batophora
48	2.1	Thalassia, Batophora, Phascolion sp., Dasycladus vermicularis, bryozoan
49	2.1	Thalassia, Avrainvillea nigricans
50	2.1	Thalassia, Millepora alcicornis, Pseudopterogorgia americana
51	2.1	Thalassia, Millepora alcicornis, Siderastrea siderea, Pseudoplexaura porosa
52	2.1	Porites porites, Dictyota, Halimeda tuna, Siderastrea siderea
53	3.0	Thalassia, Aplysina cauliformis, Halimeda incrassata Batophora
54	3.0	Thalassia, Acetabularia crenulata
55	3.0	Thalassia, Clypeaster rosaceus
56	3.0	Thalassia
57	3.0	Thalassia
58	3.0	Thalassia
59	3.0	Thalassia

Site 4. Mosquito Bank, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
60	3.3	Sand
61	3.3	Thalassia, Penicillus capitatus, Halimeda monile
62	3.0	Thalassia, Codakia orbicularis
63	3.3	Thalassia
64	3.3	Thalassia
65	3.3	Thalassia
66	3.3	Thalassia, Loimia
67	3.3	Thalassia
68	3.3	Thalassia
69	3.3	Thalassia
70	3.3	Thalassia, Anthosigmella varians
71	3.3	Thalassia
72	3.3	Thalassia
73	3.3	Thalassia
74	3.3	Thalassia
75	3.3	Thalassia, Codakia orbicularis
76	3.3	Thalassia, Arca sp.
77	3.3	Thalassia
78	3.0	Thalassia
79	3.3	Thalassia
80	3.3	Thalassia, Halimeda incrassata, Loimia sp.

Site 4. Mosquito Bank Coral Quadrats.

Species	Quadrats 1	2	3	4
ALGAE				
Halimeda incrassata	6	10	15	15
H. tuna	7	6	13	2
H. opuntia triloba	4	0	0	0
H. monile	2	2	0	0
H. lacrimosa	0	1	0	0
Dilophus alternans	17	7	14	7
Udotea conglutinata	1	8	8	4
Neomeris annulata	1	0	0	0
Batophora oerstedii	0	2	0	0
Jania sp.	0	1	0	0
Valonia sp.	0	0	1	0
PORIFERA				
Haliclona compressa	1	1	12	2
Ircinia felix	0	2	0	2
I. strobilina	1	1	4	0
I. campana	2	0	0	0
Aplysina cauliformis	5	1	0	0
Dysidea etheria	0	2	0	25
Niphates erecta	0	1	0	0
Keratosa indet.	0	1	0	0
Demonspongia indet.	0	1	0	0
Chondrilla nucula	0	3	4	0

Site 4. Mosquito Bank Coral Quadrats. - continued

Species	Quadrats 1	2	3	4
Callyspongia fallax	0	0	4	0
Spinosella vaginalis	0	0	0	4
Epipolasis sp.	0	0	0	4
Epipolasis sp.	0	0	0	6
COELENTERATA				
Millepora alcicornis	1	5	4	5
Gorgonia ventalina	1	3	1	2
Pseudopterogorgia americana	7	3	8	1
P. rigida	0	1	0	0
Pterogorgia anceps	0	0	0	1
Pseudoplexaura porosa	1	0	5	5
P. flagellosa	0	0	0	1
Plexaurella dichotoma	0	1	0	3
P. pumila (?)	0	0	0	2
P. fusifera	6	0	0	0
Muricea muricata	6	1	0	2
Eunicea fusca	1	0	0	0
E. mammosa	0	0	2	0
Plexaura homomalla	4	9	0	0
Erthyropodium caribaeorum	3	1	06	
Eunicea clavigera	0	0	2	0
Plexaura flexuosa	0	1	5	0
Siderastrea siderea	3	5	0	5
S. radians	1	1	1	0

Site 4. Mosquito Bank Coral Quadrats. - continued

Species	Quadrats 1	2	3	4
Dichocoenia stokesii	0	2	0	0
Porites porites	4	1	0	0
Porites astreoides	0	0	0	1
Stephanocoenia michelini	0	1	0	0
Diploria strigosa	2	0	1	0
Anemone	0	1	0	0
Lebrunia danae	0	0	0	5
WORMS				
Eunice filamentosa	3	0	0	0
Eunice rubra	0	0	1	0
Sabellids not collected	0	4	0	0
Sabellids	0	0	2	0
Sabellids	0	0	1	0
Terebellid	0	1	0	0
MOLLUSCA				
Pinctada radiata	0	0	0	1
Ostrea frons	0	0	0	3
CRUSTACEA				
Alpheid (not collected)	0	1	0	0
Crab (not collected)	0	1	0	0
Alpheus hemphilli	0	0	0	1
ECHINODERMATA				
Echinometra viridis	1	0	0	0

Site 4. **Mosquito Bank Coral Quadrats.** - continued

Species	Quadrats 1	2	3	4
Ophiothrix oerstedi	0	0	0	2
Astrophyton muricatum	0	0	0	1
Brittlestar (not collected)	1	0	0	0

Site 4. Mosquito Bank Grass Quadrats.
12 June 1981

Species	Quadrats 1	2	3	4
ALGAE				
Penicillus capitatus	1	0	0	0
Halimeda incrassata	2	0	2	3
H. opuntia triloba	0	1	2	0
H. tuna	0	1	0	0
H. monile	0	0	6	0
PORIFERA				
Haliclona viridis	2	0	7	2
Aplysina cauliformis	4	1	4	0
Foliolina peltata	1	0	1	5
Porifera sp.	1	0	1	0
Ircinia strobilina	0	2	0	0
Haliclona sp.	0	1	1	0
Porifera sp.	0	0	0	1
Hymeniaciden sp.	0	0	0	1
Dysidea sp.	0	0	0	1
Haliclona compressa	3	0	0	0
Siphonodictyon siphonum	0	0	0	1
COELENTERATA				
Porites furcata	4	0	0	5
P. porites	0	1	0	0
Hydroidea indet.	0	0	x	0

Site 4. Mosquito Bank Grass Quadrats. - continued

Species	Quadrats 1	2	3	4
WORMS				
Polychaete indet.	1	0	0	0
Terebellid	3	0	0	1
Flabelligerid	0	1	0	0
Sabellid A	0	0	0	1
Sabellid B	0	0	0	1
MOLLUSCA				
Lenga pensylvanica	1	0	4	0
Modiolus americana	1	0	4	0
Astraea phoebia	0	0	3	3
Astraea tecta	1	0	0	0
Tegula fasciata	0	1	0	2
Laevicardium laevigatum	0	0	0	1
Glycimeris pectinata	2	0	0	1
Crepidula aculeata	1	0	0	1
Cerithium eburneum algicola	0	0	0	1
Arca zebra	1	1	0	1
CRUSTACEA				
Crab	0	0	0	1
Green shrimp	0	0	0	1
ECHINODERMATA				
Lytechinus variegatus	7	5	8	0
Actinopyga agassizi	0	0	1	0

Site 4. Mosquito Bank Grass Quadrats. - continued

Species	Quadrats 1	2	3	4
ASCIDIACEA				
Styelid	0	0	4	0
Compound ascidian indet.	1	0	0	0

Site 5. Grecian Rocks

Transect 1. About 400 m long run on a heading of 308° true on a line with the buoy WOR"E" and the microwave tower.
25 June 1980

Meter mark	Depth meter	Bottom type and species
1	10	Sand, algal mat, pink coralline alga
2	9.5	Sand
3	9.0	Sand, Homotrema rubrum on rubble, Goniolithon sp.
4	9.0	Sand
5	9.0	Sand
6	8.8	Sand
7	8.8	Sand, rubble with Homotrema rubrum
8	8.7	Sand, rubble with H. rubrum
9	8.7	Sand, Batophora oerstedi, rubble, Homotrema
10	8.7	Sand
11	9.0	Sand, Homotrema, brick red bryozoan
12	9.0	Sand, red coralline, mustard color bryozoan, Batophora oerstedi, Laurencia sp.
13	8.8	Sand
14	8.5	Sand, Homotrema, coralline
15	8.6	Sand
16	8.6	Sand
17	8.6	Sand
18	8.6	Sand
19	8.6	Sand
20	8.5	Sand, Batophora oerstedi, Laurencia sp., pink coralline
21	8.5	Sand

Site 5. Grecian Rocks, Transect 1. - continued

Meter mark	Depth meter	Bottom type and species
22	8.5	Sand
23	8.5	Sand, coralline on rubble
24	8.4	Sand, coralline on rubble
25	8.6	Sand
26	8.2	Sand, unident. alga on dead gorgonian, Pterogrogia americana
27	8.2	Pseudopterogorgia acerosa
28	7.8	Dictyota sp. on old coral
29	7.3	Dictyota
30	7.0	Dictyota
31	5.5	Palythoa mammilosa
32	4.2	Old dead coral with encrusting coralline
33	4.5	Old dead coral with encrusting coralline
34	4.5	Millepora complanata
35	4.1	Gorgonia ventalina
36	4.2	Halimeda opuntia
37	3.5	Encrusting pink coralline
38	3.5	Encrusting pink coralline on dead portion of Acropora cervicornis
39	1.2	Encrusting pink coralline on old coral
40	1.0	Encrusting pink coralline on old coral
41	1.3	Acropora palmata

Site 5. Grecian Rocks, Transect 1. - continued

Meter mark	Depth meter	Bottom type and species
42	2.0	Sand and rubble between live coral stands
43	1.2	Coralline on old coral
44	1.5	Coralline on old coral
45	1.0	Coralline on old coral
46	1.0	Gorgonia ventalina
47	1.5	Gorgonia ventalina
48	1.1	Coralline on old coral
49	1.1	Coralline on old coral
50	1.0	Coralline on old coral
51	1.0	Coralline on old coral
52	0.5	Coralline on old coral
53	1.0	Sand
54	1.1	Acropora cervicornis
55	1.0	Rubble with Homotrema
56	1.0	Porites astreoides
57	0.5	Acropora cervicornis
58	1.0	Halimeda opuntia
59	0.5	Rubble with coralline
60	0.3	Acropora cervicornis
61	0.2	Old coral with Dictyota sp.
62	0.1	Dead Acropora palmata with coralline
63	0.1	Sand, rubble with associated microfauna

Site 5. Grecian Rocks, Transect 1. - continued

Meter mark	Depth meter	Bottom type and species
64	0.4	Sand, Thalassia
65	0.8	Sand, Thalassia
66	0.6	Sand, Thalassia
67	0.3	Sand, Thalassia
68	1.2	Sand, rubble
69	1.5	Sand
70	1.5	Sand, rubble
71	1.8	Sand, rubble
72	1.8	Sand, Thalassia
73	1.8	Dead stand of Acropora cervicornis with encrusting corallines
74	1.9	Thalassia, Syringodium
75	2.1	Thalassia, Syringodium
76	2.3	Thalassia, Syringodium
77	2.8	Thalassia, Syringodium
78	2.6	Thalassia, Syringodium
79	2.5	Thalassia, Syringodium
80	2.4	Thalassia, Syringodium

Site 5. Grecian Rocks

Transect 2. About 400 m long run on a heading of 308° true 200 m west of Transect 1. 25 June 1980

Meter mark	Depth meters	Bottom type and species
1	9.5	Sand, coralline on rubble
2	9.5	Sand, coralline on rubble
3	9.5	Sand, corraline on rubble, Batophora oerstedi
4	9.5	Sand, coralline on rubble, Dasycladus vermicularis
5	9.5	Sand
6	9.6	Sand, Meoma ventricosa
7	9.5	Sand, coralline on rubble
8	9.5	Sand
9	9.0	Sand, coralline on rubble
10	9.0	Sand, rubble with small algae
11	9.0	Sand, rubble with small algae
12	9.0	Sand, rubble with corallines
13	9.0	Sand, rubble, Batophora oerstedi
14	9.0	Sand
15	9.0	Sand
16	9.0	Sand, rubble, Batophora
17	9.0	Sand, rubble with Neomeris annulata, Gracilaria cylindrica, Homotrema rubrum
18	9.0	Sand
20	9.1	Sand
21	8.5	Old coral with corallines
22	8.4	Millepora alcicornis

Site 5. Grecian Rocks, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
23	8.4	Old coral with corallines
24	8.4	Sand
25	8.3	Sand, rubble with Goniolithon
26	8.3	Sand
27	8.3	Sand, old coral with corallines
28	8.0	Old coral with corallines
29	7.3	Sand
30	7.3	Pseudopterogorgia americana
31	7.2	Dichocoenia stokesii
32	5.6	Old coral with corallines
33	5.3	Palythoa mammillosa
34	4.7	Millepora complanata
35	3.6	Pseudopterogorgia acerosa
36	3.3	Muriceopsis flavida
37	3.2	Millepora complanata
38	3.2	Chondrilla nucula
39	3.0	Old coral with corallines
40	3.0	Porites porites
41	3.7	Plexaura flexuosa
42	2.2	Old coral with corallines
43	2.2	Old coral with corallines
44	4.1	Gorgonia ventalina

Site 5. Grecian Rocks, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
45	3.2	Old coral with corallines, Dictyota sp.
46	4.2	Old coral with corallines
47	3.5	Old coral with corallines
48	3.0	Gorgonia ventalina
49	1.2	Old coral with corallines
50	1.5	Acropora palmata
51	1.2	Palythoa mammillosa
52	1.1	Gorgonia ventalina
53	1.1	Acropora palmata
54	1.1	A. palmata
55	1.1	A. palmata
56	1.0	A. palmata
57	0.3	A. palmata
58	0.1	Dead Millepora complanata with corallines
59	0.1	M. complanata
60	0.5	Old coral with corallines, Aplysina, Laurencia, Dictyota
61	0.4	Halimeda opuntia, Dictyota
62	0.3	Old coral with corallines
63	0.3	Old coral with corallines
64	0.2	Old coral with corallines

Site 5. Grecian Rocks, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
65	0.2	Porites astreoides
66	0.2	Dead portion of Acropora palmata
67	1.2	A. palmata
68	1.8	Sand
69	2.0	Rubble, Goniolithon, Dictyota
70	2.1	Rubble with corallines
71	2.3	Sand, rubble
72	1.0	Sand, rubble
72	2.6	Sand, rubble
73	2.6	Montastrea annularis
74	2.7	Sand
75	2.6	Sand, rubble, Thalassia
76	2.6	Sand, Thalassia
77	2.5	Sand, Thalassia
78	2.5	Syringodium
79	2.5	Syringodium
80	2.5	Syringodium

Site 5. Grecian Rocks

Transect 3. Approximately 400 m long run on a heading of 308° true east of Transect 1. 29 June 1980

Meter Mark	Depth meters	Bottom type and species
1	10.5	Hard bottom
2	9.3	Orange sponge, Dictyota sp.
3	9.3	Erythropodium caribaeorum
4	10.5	Sand, Rubble
5	10.8	Sand, Rubble
6	11.0	Sand, Rubble
7	11.1	Sand
8	11.1	Sand
9	11.0	Sand
10	10.9	Red algal mat
11	10.9	Sand, Rubble
12	10.8	Sand
13	10.9	Sand
14	11.0	Sand
15	11.2	Sand
16	11.4	Sand
17	11.6	Algal mat
18	11.3	Syringodium
19	11.0	Thalassia
20	10.8	Sand, Thalassia
21	10.9	Sand

Site 5. Grecian Rocks, Transect 3. - continued

Meter Mark	Depth meter	Bottom and species
22	10.9	Sand
23	10.9	Sand
24	10.8	Sand
25	10.8	Sand, Dilophus alternans, Dictyota sp.
26	10.8	Sand
27	10.8	Sand
28	10.8	Sand
29	10.8	Sand
30	10.8	Sand, Dictyota sp.
31	10.8	Sand
32	10.8	Sand
33	10.8	Sand
34	10.8	Sand
35	10.8	Sand
36	10.8	Hard bottom with encrusting algae
37	9.6	Acropora cervicornis
38	8.4	A. cervicornis
39	8.4	Palythoa mammillosa
40	9.0	Amphiroa rigida, corallines, Gracilaria sp., Dictyota sp., Dilophus alternans
41	9.0	Amphiroa rigida, Dilophus alternans, Dictyota cervicornis, Gracilaria sp., Xytopsues griseus
42	9.0	Dictyota cervicornis
43	9.1	Sand

Site 5. Grecian Rocks, Transect 3. - continued

Meter Mark	Depth meter	Bottom and species
44	9.3	Sand
45	9.6	Sand, Rubble
46	9.6	Palythoa mammillosa
47	10.8	Dictyota
48	6.0	Sand
49	7.3	Pseudopterogorgia acerosa
50	6.5	Muriceopsis flavida
51	5.0	Dictyota cervicornis
52	4.5	Dead A. palmata with algae
53	4.3	Acropora palmata
54	4.7	Dictyota
55	6.0	Acropora palmata
56	6.3	Rubble with Dictyota cervicornis, Dilophus alternans
57	6.0	Rubble
58	5.0	Millepora complanata
59	4.5	Rock with corallines and filamentous green algae
60	3.0	Millepora complanata
61	3.0	Montastrea annularis
62	3.2	Pseudopterogorgia americana
63	3.9	Halimeda opuntia
64	4.2	Coral rubble with corallines
65	4.5	Acropora cervicornis rubble with corallines
66	4.5	Coral rubble with corallines
67	4.0	Acropora cervicornis rubble with pink corallines

Site 5. Grecian Rocks, Transect 3. - continued

Meter mark	Depth meter	Bottom and species
68	3.6	A. cervicornis rubble with corallines
69	4.7	Sand
70	4.9	Acropora cervicornis
71	4.9	Halimeda opuntia
72	4.9	Sand, Rubble
73	4.9	Sand, Rubble
74	4.8	Sand, Rubble
75	4.8	Sand
76	4.7	Rubble
77	4.8	Thalassia
78	4.8	Thalassia
79	5.0	Dictyota sp., Cladophora sp., Pseudaxinella sp.
80	5.5	Sand

Site 5. Grecian Rocks Coral Quadrats
24 July 1980

Species	Quadrats 1	2	3	4
PROTOZOA				
Homotrema rubrum	4	4	0	0
ALGAE				
Halimeda opuntia	7	10	4	2
H. incrassata	1	0	0	0
Goniolithon sp.	1	0	0	0
Dictyota sp.	7	0	0	0
Amphiroa sp.	x	x	x	x
Coralline alga	x	x	x	xx
Valonia sp.	3	0	0	0
PORIFERA				
Chondrilla nucula	1	8	1	0
Haliclona sp.	8	15	7	5
Thalysias juniperina	2	9	2	1
Callyspongia fallax	0	0	0	1
COELENTERATA				
Millepora complanata	3	5	0	0
Gorgonia ventalina	0	0	1	0
Eunicea mammosa	0	3	0	0
Acropora palmata	1	3	4	5
Porites porites	11	7	6	12
Siderastrea siderea	0	0	1	0
Anemone	4	0	0	4
Palythoa mammillosa	0	2	0	1

Site 5. Grecian Rocks Coral Quadrats - continued

Species	Quadrats 1	2	3	4
WORMS				
Sabellids spp.	4	0	0	1
Serpulid sp.	1	0	0	0
CRUSTACEA				
Stomatopod	1	0	0	0
Crabs (not collected)	3	0	0	0
MOLLUSCA				
Thais deltoides	0	0	0	1
ECHINODERMATA				
Diadema antillarum	4	4	0	1
Ophiothrix oerstedi	1	0	0	0
Brittlestar	1	0	0	0

Site 5. Grecian Rocks Rubble Quadrats
24 July 1980

Species	Quadrats 1 - 4
PROTOZOA	
Homotrema rubrum	12
ALGAE	
Dictyota sp.	266
Halimeda opuntia	17
Stypopodium zonale	2
Valonia ventricosa	3
Laurencia sp.	2
Goniolithon sp.	2
Amphiroa sp.	1
Amphiroa rigida antillana	2
Dilophus alternans	1
Galaxaura cylindrica	1
PORIFERA	
Haliclona compressa	6
Aplysina cauliformis	1
Spinosella vaginalis	1
Ircinia campana	1
Thalysias juniperina	1
Keratose indet.	1
Merriamium tortugaensis	1
Dysidea sp.	1
Niphates erecta	3

Site 5. Grecian Rocks Rubble Quadrats - continued

Species	Quadrats 1 - 4
Spongia cerebriformis	1
Spinosella vaginalis vaginalis	1
Pseudaxenella sp.	1
COELENTERATA	
Millepora alcicornis	3
Pseudopterogorgia americana	11
Plexaurella dichotoma	2
Plexaura flexuosa	2
Eunicea tourneforti	1
E. fusca	1
E. mammosa	1
Muriceopsis flavida	2
Montastrea annularis	2
Dichocoenia stokesii	3
Palythoa mammillosa	1
Mycetophyllia lamarckana	1
WORMS	
Eunice schenocephala	3
E. kinbergi	9
Eunice sp.	9
Marphysa sp.	2
Terebellid	3
Sipunculid	1
Nematodes	3

Site 5. Grecian Rocks Rubble Quadrats - continued

Species	Quadrats 1 - 4
MOLLUSCA	
Lima pellucida	1
Plicatula gibbosa	1
Lepidochiton liozonas	4
Arca sp.	1
ECHINODERMATA	
Diadema antillarum	1
Eucidaris tribuloides	1
Ophiocoma echinata	1
O. pumila	2
Ophiothrix oerstedi	1
O. sp.	1
Ophiozona impressa	1
BRYOZOAN	
Encrusting colonial	1
ASCIDIACEA	
Solitary tunicate	1

Site 5. Grecian Rocks Grass Quadrats
24 July 1980

Species	Quadrats 1 - 4
ALGAE	
Penicillus capitatus	27
Halimeda incrassata	55
H. tuna	5
H. monile	3
H. lacrimosa	4
Udotea flabellum	8
Udotea sp. A	1
Udotea sp. B	1
Amphiroa fragilissima	13
PORIFERA	
Tedaniid	4
Dysidea etheria	1
Dysidea sp.	1
Dysidea sp.	1
Dysidea sp.	5
Dysidea sp.	2
Porifera indet.	58
Porifera indet.	4
Porifera indet.	2
Porifera indet.	1
Porifera indet.	1

Site 5. Grecian Rocks Grass Quadrats - continued

Species	Quadrats 1 - 4
MOLLUSCA	
Astraea phoebia	3
Trivia pediculus	1
Crepidula aculeata	5
C. plana	1
Columbella mercatoris	8
Lima pellucida	1
Chama congregata	1
Papyridea semisulcata	1
Modulus modulus	1
Tricolia affinis	2
Strombus raninus	1
Musculus lateralis	6
WORMS	
Eunice longicirrata	1
Sabellis	1
Megalomma sp.	1
CRUSTACEA	
Pagurus brevidactylus	1
Hermit crab	1
Crab	1
Mithrax forceps	5
Processa sp.	1

Site 5. Grecian Rocks Grass Quadrats - continued

Species	Quadrats 1 - 4
Processa fimbriata	3
Shrimp	1
Isopod	4
Isopod	3
Leucothoe spinicarpa	1
Paguristes grayi	1
Pitho Lherminieri	1
ECHINODERMATA	
Diadema antillarum	1
Ophiothrix suensoni	1
Ascidiacea	
Colonial tunicate sp. A	1
Colonial tunicate sp. B	1
Colonial tunicate sp. C	1
Colonial tunicate sp. D	1
Colonial tunicate sp. E	1
Didemnum candidum	1

Site 5. Grecian Rocks Sand Quadrats
24 July 1980

Species	Quadrats 1 - 4
PROTOZOA	
Homotrema rubrum	1
WORMS	
Capitellid	3
Flabelligerid	1
Nematodes	19
MOLLUSCA	
Calliostoma jujubinum	1
CRUSTACEA	
Cycloes bairdi	1

Site 5. Grecian Rocks Rerun
Transect 1. 10 September 1981

Meter mark	Depth meters	Bottom type and species
0	.3	Halimeda tuna
1	.6	Rubble
2	.6	Lithothamnion
3	.6	Millepora complanata
4	.6	Palythoa mammillosa
5	.6	Halimeda tuna
6	.6	Filamentous green
7	1.2	Porites astreoides
8	1.5	Filamentous alga
9	1.5	Red alga
10	2.4	Acropora cervicornis, rubble
11	2.1	A. cervicornis (70% dead)
12	2.4	Filamentous green
13	2.4	A. cervicornis
14	1.8	Palythoa mammillosa, Millepora complanata
15	2.1	M. complanata
16	2.4	Dictyota cervicornis
17	1.8	Green algal balls
18	1.8	Halimeda incrassata
19	3.6	Lithothamnion, Dictyota cervicornis

Site 5. Grecian Rocks Rerun, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
20	3.7	Rubble
21	2.4	Rubble
22	4.6	Coarse sand
23	3.6	Palythoa mammillosa
24	3.0	Gorgonia ventalina
25	3.6	Montastrea annularis
26	4.6	M. annularis
27	6.0	Dictyota cervicornis
28	6.0	Gorgonia ventalina
29	6.0	Rubble, sand
30	6.9	Rubble, sand
31	7.0	Sand
32	7.6	Sand
33	7.6	Sand
34	7.6	Sand
35	7.6	Sand
36	7.6	Sand
37	7.6	Sand
38	7.6	Sand
39	7.6	Sand
40	7.6	Sand
41	7.6	Sand

Site 5. Grecian Rocks Rerun, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
42	7.6	Sand
43	7.6	Sand
44	7.6	Sand
45	7.6	Sand
46	7.6	Sand, Dasycladus vermicularis
47	7.6	Sand
48	7.6	Sand
49	7.6	Sand
50	7.6	Sand
51	7.6	Sand
52	7.6	Sand
53	7.6	Sand
54	7.6	Sand
55	7.6	Sand
56	7.6	Sand
57	7.6	Sand
58	7.6	Sand
59	7.6	Sand
60	7.6	Sand
61	7.6	Pseudopterogorgia americana
62	7.0	Rubble
63	7.0	Pseudopterogorgia americana

Site 5. Grecian Rocks Rerun, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
64	6.7	Briareum asbestinum
65	6.7	Hard bottom
66	6.7	Sand
67	6.7	Pseudopterogorgia americana
68	6.7	Sand
69	6.7	Sand
70	6.7	Hard bottom
71	6.7	Pseudopterogorgia americana
72	6.7	P. americana
73	6.7	Hard bottom
74	6.7	Sand
75	7.6	Sand
76	7.6	Sand, rubble
77	7.6	Sand, rubble
78	7.6	worm (not found in collections)
79	7.6	Sand
80	7.6	Sand

Site 5. Grecian Rocks Rerun
Transect 2. 10 September 1981

Meter mark	Depth meters	Bottom type and species
1	2.4	Thalassia
2	2.4	Thalassia
3	2.4	Brown epiphyte
4	2.4	Thalassia
5	2.4	Thalassia
6	2.4	Thalassia, Dictyota cervicornis
7	2.4	Thalassia
8	2.4	Dictyota cervicornis, Dasycladus vermicularis
9	2.4	Thalassia, Dictyota cervicornis
10	2.4	Rubble
11	2.4	Rubble
12	2.4	Sand
13	2.4	Sand
14	2.4	Sand
15	2.7	Sand, Acropora cervicornis (70% dead)
15	2.7	Sand
17	3.0	Sand, rubble
18	3.0	Rubble
19	3.0	Rubble
20	3.9	Acropora cervicornis
21	3.0	A. cervicornis (30% dead)
22	3.0	Dictyota cervicornis

Site 5. Grecian Rocks Rerun, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
23	3.0	Dictyota cervicornis
24	3.0	Sand
25	3.6	Favia fragum
26	3.6	Dictyota cervicornis
27	3.6	D. cervicornis
28	3.6	Sand
29	3.6	Acropora cervicornis
30	3.6	Sand
31	3.6	Millepora alcicornis
32	3.6	Gorgonia ventalina
33	4.0	Dictyota, Dilophus
34	4.6	Haliclona compressa
35	4.6	Red alga
36	4.6	Dictyota cervicornis
37	4.6	D. cervicornis
38	4.6	D. cervicornis
39	5.2	Dictyota, Dilophus
40	5.5	Sand
41	6.1	Sand
42	6.1	Dictyota cervicornis
43	6.4	Coarse sand
44	6.4	Pseudopterogorgia americana

Site 5. Grecian Rocks Rerun, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
45	6.4	Sand, rubble
46	6.7	Sand
47	6.7	Sand
48	6.7	Sand
49	6.7	Sand
50	6.7	Sand
51	6.7	Sand
52	6.7	Sand
53	6.7	Sand
54	6.7	Sand
55	6.7	Sand
57	6.7	Sand
58	6.7	Sand
59	6.7	Meoma ventricosa
60	6.7	M. ventricosa
61	6.7	Worm
62	6.7	Sand
63	6.7	Sand
64	6.7	Sand
65	6.7	Sand
66	6.7	Sand
67	6.7	Sand

Site 5. Grecian Rocks Rerun, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
68	6.7	Sand
69	6.7	Sand
70	6.7	Sand
71	6.7	Sand
72	6.4	Thalassia
73	6.4	Sand, rubble
74	6.4	Sand
75	6.4	Sand
76	6.4	Sand
77	6.4	Sand
78	6.4	Sand
79	6.4	Sand
80	6.4	Sand
81	6.4	Sand

Site 5. Grecian Rocks Rerun
Transect 3. 10 September 1981

Meter mark	Depth meters	Bottom type and species
0	5.3	Thalassia, Syringodium
1	4.9	Thalassia, Syringodium
2	4.9	Thalassia, Syringodium
3	4.9	Thalassia, Syringodium
4	4.6	Thalassia
5	4.6	Thalassia
6	4.6	Thalassia
7	4.3	Thalassia
8	4.3	Thalassia
9	4.3	Thalassia, Syringodium
10	3.6	Thalassia, Syringodium
11	3.6	Thalassia, Syringodium
12	3.6	Thalassia, Syringodium
13	3.6	Thalassia, Syringodium
14	3.6	Thalassia, Syringodium
15	3.6	Thalassia
16	3.6	Thalassia
17	3.6	Thalassia
18	4.3	Rubble
19	4.6	Pseudopterogorgia americana
20	4.6	Dictyota cervicornis
21	4.6	Dictyota, Dilophus

Site 5. Grecian Rocks Rerun, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
22	4.6	Dictyota, Dilophus
23	4.6	Thalassia
24	4.6	Thalassia, Dilophus alternans
25	4.6	Thalassia, Syringodium
26	4.6	Thalassia, Syringodium
27	4.6	Thalassia, Syringodium
28	4.6	Dilophus alternans
29	4.6	Rubble
30	4.6	Dictyota, Dilophus
31	4.6	Halimeda incrassata, Dictyota, brittlestar
32	4.6	Thalassia, Dilophus alternans
33	4.9	Thalassia
34	4.9	Dictyota cervicornis
35	4.8	Thalassia, Dilophus alternans
36	5.9	Thalassia, D. alternans
37	5.8	Thalassia
38	6.1	Thalassia, filamentous alga, Dictyota
39	6.1	Thalassia, Dictyota
40	6.1	Thalassia
41	6.1	Thalassia
42	6.1	Thalassia
43	6.1	Thalassia, Syringodium

Site 5. Grecian Rocks Rerun, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
44	6.1	Thalassia, Syringodium
45	5.5	Thalassia
46	5.5	Sand
47	5.5	Thalassia, Syringodium, filamentous alga
48	5.5	Thalassia, Syringodium
49	4.9	Thalassia, filamentous alga
50	4.6	Thalassia
51	4.6	Pseudopterogorgia americana
52	4.6	Dilophus alternans
53	4.6	D. alternans
54	4.6	Dictyota, Dilophus
55	4.6	Rubble
56	3.6	Favia fragum
57	3.3	Dictyota, Dilophus
58	3.0	Rubble
59	3.0	Millepora complanata
60	3.0	Dictyota, Dilophus, Halimeda incrassata
61	2.4	Dictyota, Dilophus
62	3.0	Dictyota cervicornis, Amphiroa sp.
63	2.4	Palythoa mammillosa
64	1.8	Millepora alcicornis
65	1.8	Dictyota, Dilophus

Site 5. Grecian Rocks Rerun, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
66	1.8	Favia fragum
67	1.8	Dictyota, Dilophus
68	1.8	Plexaura flexuosa
69	1.5	Gorgonia ventalina
70	1.5	Rubble
71	1.5	Pseudopterogorgia americana
72	1.5	Acropora palmata
73	1.5	A. palmata
74	1.5	Rubble
75	1.5	Dictyota, Dilophus
76	3.0	Sand
77	6.7	Sand
78	6.7	Sand
79	6.7	Sand
80	6.1	Acropora cervicornis
81	6.7	Pseudopterogorgia americana

Site 6. Key Largo Dry Rocks.

Transect 1. About 400 m long run on a heading of 278o true past Dry Rocks buoy "D". 30 July 1981

Meter mark	Depth meter	Bottom type and species
0	10.7	Laurencia, Dictyota, Gracilaria
1	10.7	Sand
2	10.7	Sand
3	10.7	Sand
4	11.3	Sand
5	11.3	Sand
6	10.7	Sand
7	10.7	Sand
8	10.7	Sand
9	10.7	Sand
10	10.7	Sand
11	10.4	Sand
12	9.1	Dilophus alternans, Dictyota cervicornis
13	9.1	Dictyota cervicornis
14	7.6	Dilophus alternans, Dictyota cervicornis
15	6.1	Gorgonia ventalina
16	5.5	Rubble
17	4.6	Dictyota cervicornis
18	4.0	Dilophus alternans, Dictyota cervicornis
19	6.1	Sand
20	7.6	Colpophyllia natans
21	6.1	Rubble

Site 6. Key Largo Dry Rocks, Transect 1. - continued

Meter mark	Depth meter	Bottom type and species
22	6.1	Acropora palmata
23	5.5	Red alga
24	4.6	Rubble
25	4.0	Red alga
26	1.5	Millepora complanata
27	1.5	Palythoa mammillosa
28	1.5	Millepora complanata
29	1.5	Halimeda opuntia minor
30	1.5	Acropora palmata
31	1.5	A. palmata
32	1.5	A. palmata
33	1.5	A. palmata
34	1.5	A. palmata
35	1.5	A. palmata
36	1.5	A. palmata
37	1.5	A. palmata
38	1.5	Halimeda opuntia
39	1.5	H. opuntia, Dictyota cervicornis
40	1.5	Acropora cervicornis
41	1.5	Rubble
42	1.5	Halimeda incrassata, Dictyota cervicornis
43	1.5	Acropora cervicornis

Site 6. Key Largo Dry Rocks, Transect 1. - continued

Meter mark	Depth meter	Bottom type and species
44	1.5	Acropora palmata
45	1.5	Rubble
46	1.5	Rubble
47	1.5	Acropora cervicornis
48	1.5	A. palmata
49	1.5	A. cervicornis
50	1.5	A. palmata
51	1.5	A. palmata
52	3.4	A. palmata
53	3.0	A. cervicornis
54	4.6	Thalassia, Dilophus alternans
55	4.6	Thalassia, Dilophus alternans, Dictyota cervicornis
56	3.4	Thalassia, Dilophus alternans, Dictyota cervicornis
57	3.4	Thalassia, Dilophus alternans, Dictyota cervicornis
58	3.4	Thalassia, Dilophus alternans, Dictyota cervicornis
59	5.5	Thalassia, Dilophus alternans, Dictyota cervicornis
60	5.5	Thalassia, Syringodium
61	5.5	Thalassia, Syringodium
62	5.8	Thalassia, Syringodium
63	6.1	Thalassia, Syringodium
64	6.1	Thalassia
65	6.1	Thalassia

Site 6. Key Largo Dry Rocks, Transect 1. - continued

Meter mark	Depth meter	Bottom type and species
66	6.1	Thalassia
67	6.1	Thalassia, Syringodium
68	6.1	Thalassia, Syringodium
69	6.1	Thalassia, Syringodium
70	6.1	Thalassia, Syringodium
71	6.1	Thalassia, Syringodium
72	6.1	Penicillus dumetosus
73	6.1	Thalassia
74	6.1	Thalassia
75	6.1	Thalassia
76	5.5	Thalassia
77	5.5	Thalassia, Syringodium, Halimeda monile
78	5.5	Thalassia
79	5.5	Thalassia
80	5.5	Thalassia, Syringodium

Site 6. Key Largo Dry Rocks

Transect 2. About 400 m long run on a heading of 278o true and 300 m east of Transect 1.
30 July 1981

Meter mark	Depth meter	Bottom type and species
1	10.4	Thalassia
2	10.7	Halimeda lacrimosa
3	10.7	Thalassia
4	10.4	Thalassia
5	10.4	Red alga
6	10.4	Thalassia
7	10.4	Thalassia
8	10.7	Thalassia
9	10.7	Thalassia
10	10.7	Thalassia
11	10.7	Sand
12	10.7	Sand
13	10.7	Thalassia, Syringodium
14	10.7	Thalassia, Syringodium
15	10.7	Thalassia, Syringodium
16	10.7	Thalassia, Syringodium
17	10.7	Thalassia, Syringodium
18	10.7	Thalassia, Syringodium
19	10.7	Thalassia, Syringodium
20	10.7	Thalassia, Syringodium
21	10.7	Sand
22	10.7	Sand

Site 6. Key Largo Dry Rocks, Transect 2. - continued

Meter mark	Depth meter	Bottom type and species
23	10.7	Sand
24	10.7	Sand
25	10.7	Sand
26	10.7	Filamentous alga
27	10.7	Sand
28	10.1	Thalassia
29	10.1	Thalassia, Syringodium
30	10.1	Thalassia, Syringodium
31	10.1	Thalassia, Syringodium
32	9.1	Thalassia, Syringodium
33	9.1	Thalassia, Syringodium
34	8.8	Thalassia, Syringodium
35	8.8	Thalassia, Syringodium
36	8.8	Thalassia, Syringodium
37	8.5	Thalassia, Syringodium
38	8.2	Thalassia, Syringodium
39	7.9	Thalassia, Syringodium
40	7.9	Thalassia, Syringodium
41	7.9	Thalassia, Syringodium
42	7.3	Thalassia, Syringodium, Murex recurvirostris rubidus
43	7.3	Thalassia, Syringodium
44	7.3	Thalassia, Syringodium

Site 6. Key Largo Dry Rocks, Transect 2. - continued

Meter mark	Depth meter	Bottom type and species
45	7.3	Thalassia, Syringodium
46	7.6	Thalassia, Syringodium
47	7.6	Halimeda lacrimosa
48	7.6	Thalassia, Syringodium
49	7.6	Thalassia, Syringodium
50	7.3	Thalassia, Syringodium
51	7.3	Thalassia, Syringodium
52	7.3	Thalassia
53	6.4	Dilophus alternans, Dictyota cervicornis, Gorgonia ventalina
54	6.4	Acropora cervicornis
56	7.0	A. cervicornis
56	7.0	Dictyota cervicornis
57	7.0	Acropora cervicornis
58	7.0	Dictyota cervicornis
59	7.0	Porites porites
60	7.6	Dictyota cervicornis
61	7.6	Thalassia
62	7.6	Thalassia
63	7.6	Thalassia, Syringodium
64	7.6	Thalassia, alga indet.
65	7.6	Thalassia, Syringodium
66	7.6	Dilophus alternans, alga indet.

Site 6. Key Largo Dry Rocks, Transect 2. - continued

Meter mark	Depth meter	Bottom type and species
67	7.6	Thalassia, Syringodium
68	7.6	Filamentous algal mat
69	7.6	Plexaura flexuosa
70	7.6	Thalassia, Syringodium
71	7.6	Thalassia, Syringodium
72	7.6	Thalassia, Syringodium
73	7.6	Thalassia, Syringodium
74	7.6	Thalassia, Syringodium, Dilophus alternans
75	7.6	Thalassia
76	7.6	Thalassia
77	7.6	Thalassia
78	7.6	Sand
79	7.6	Thalassia, Syringodium, Batophora, Dasycladus vermicularis
80	7.6	Thalassia, Syringodium

Site 6. Key Largo Dry Rocks

Transect 3. About 400 m long run on a heading of 278° true and 300 m west of Transect 1.
31 July 1981

Meter mark	Depth meters	Bottom type and species
0	9.1	Sand
1	9.1	Sand
2	9.1	Dilophus alternans, Dictyota sp.
3	9.1	Halimeda incrassata, Dictyota sp.
4	7.6	Dilophus alternans
5	6.1	Dilophus alternans
6	6.1	Acropora cervicornis
7	6.1	Niphates digitalis
8	6.1	Sand
9	6.1	Sand
10	6.1	Sand
11	6.1	Sand
12	6.1	Sand
13	6.1	Sand
14	6.1	Sand
15	9.1	Sand
16	9.1	Thalassia, Syringodium
17	9.1	Thalassia, algae spp., Dictyota
18	9.1	Sand
19	9.1	Sand
20	9.1	Sand
21	9.1	Sand

Site 6. Key Largo Dry Rocks, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
22	7.6	Sand
23	7.6	Sand
24	7.6	Sand
25	7.6	Sand
26	7.6	Sand
27	7.6	Sand
28	7.6	Sand
29	7.6	Sand
30	7.6	Sand
31	7.6	Sand
32	7.6	Dictyota sp.
33	7.6	Sand
34	7.6	Sand
35	7.6	Sand
36	7.6	Thalassia
37	7.6	Thalassia
38	7.6	Sand
39	7.6	Sand
40	7.6	Sand
41	7.6	Sand
42	7.6	Hydroid indet., sponge indet.
43	7.6	Sand

Site 6. Key Largo Dry Rocks, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
44	7.6	Sand
45	7.6	Sand
46	7.6	Sand
47	7.6	Sand
48	7.6	Sand
49	7.6	Sand
50	7.6	Sand
51	7.6	Sand
52	7.6	Sand
53	7.6	Sand
54	7.6	Sand
55	7.6	Sand
56	7.6	Crustacean
57	7.6	Sand
58	7.6	Sand
59	7.6	Sand
60	7.6	Sand
61	7.6	Eunicea calyculata
62	7.6	Rubble
63	7.6	Dilophus alternans
64	7.6	Dilophus alternans, Acropora cervicornis
65	6.1	Dilophus alternans

Site 6. Key Largo Dry Rocks, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
66	6.1	Dilophus alternans, Porites porites
67	6.1	Ircinia felix
68	6.1	Rubble
69	6.1	Pseudopterogorgia americana
70	6.1	Dilophus alternans, Gorgonia ventalina
71	6.1	Aplysina cauliformis
72	6.1	Dilophus alternans, Acropora cervicornis
73	6.1	Dilophus alternans
74	6.1	Alga indet.
75	6.1	Thalassia
76	6.1	Thalassia
77	6.1	Rubble
78	6.1	Thalassia
79	6.1	Thalassia
80	6.1	Thalassia

Site 6. Key Largo Dry Rocks Coral Quadrats
26 August 1981

Species	Quadrats 1	2	3	4
PROTOZOA				
Homotrema rubrum	x	x	x	x
ALGAE				
Halimeda opuntia	1	0	0	0
Avrainvillea nigricans	0	24	5	18
Dictyota cervicornis	0	1	0	4
Sargassum hystrix	0	51	0	0
Galaxaura sp.	0	0	3	0
PORIFERA				
Agelas schmidti	8	0	2	1
Aplysina fistularis	0	0	8	0
A. cauliformis	0	0	3	0
Verongula ardis	0	0	0	1
Ircinia strobilina	0	0	0	1
Niphates digitalis	0	1	2	0
Haliclona compressa	0	0	1	0
Chondrilla nucula	0	1	0	1
Sponge indet.	5	0	0	0
Cliona sp.	0	12	0	0
COELENTERATA				
Gorgonia ventalina	4	0	0	0
Pseudopterogorgia acerosa	1	4	4	3
P. americana	0	1	4	1

Site 6. Key Largo Dry Rocks Coral Quadrats. - continued

Species	Quadrats 1	2	3	4
Muriceopsis flavida	0	1	0	0
Eunicea tourneforti	1	0	0	0
Palythoa mammillosa	0	0	0	1
Zoanthus sp.	0	0	1	0
Hydroid sp.	1	0	0	0
Acropora cervicornis	0	0	1	0
Agaricia agaricites	1	0	0	3
Porites porites	0	0	1	0
P. astreoides	0	2	2	0
Montastrea annularis	x	0	1	x
M. cavernosa	0	0	1	0
Siderastrea siderea	0	0	3	6
Mycetophyllia ferox	2	0	0	1
M. lamarckana	0	0	1	0
Diploria labyrinthiformis	0	0	4	0
Eusmilia fastigiata	0	0	1	0
MOLLUSA				
Lopha frons	1	0	0	0
WORMS				
Featherdusters	6	3	4	1
Christmas tree worms	0	2	0	0
CRUSTACEA				
Paguristes cadenati	0	0	1	0

Site 6. Key Largo Dry Rocks Coral Quadrats. - continued

Species	Quadrats 1	2	3	4
ECHINODERMATA				
Diadema antillarum	0	0	1	0
Brittlestar	1	0	0	0
ASCIDIACEA				
Colonial sp.	0	1	0	0
Ascidean sp.	0	1	0	0

Site 6. Key Largo Dry Rocks Rubble Quadrats
1 August 1981

Species	Quadrats 1	2	3	4
PROTOZOA				
Homotrema rubrum	x	x	x	x
ALGAE				
Halimeda incrassata	1	0	2	2
H. tuna	0	1	0	0
H. sp.	0	3	0	0
Dilophus alternans	1	0	0	0
Valonia ventricosa	1	0	0	0
Dictyota cervicornis	x	x	0	x
Caulerpa sp.	0	0	1	0
Stypopodium zonale	3	0	0	1
PORIFERA				
Iotrochota birotulata	4	2	0	9
Niphates erecta	1	3	4	0
Aplysina cauliformis	4	2	2	0
A. fistularis	14	0	3	0
Spinosella vaginalis	1	0	0	0
Callyspongia fallax	1	0	0	1
Ircinia strobilina	1	0	0	0
I. felix	0	1	0	0
Microcionid	13	12	2	0
Porifera indet.	11	0	0	0

Site 6. Key Largo Dry Rocks Rubble Quadrats. - continued

Species	Quadrats 1	2	3	4
COELENTERATA				
Pseudopterogorgia rigida	6	1	0	0
P. bipinnata	0	0	0	1
P. acerosa	0	0	1	0
P. elisabethae	0	0	1	0
Plexaura flexuosa	1	0	0	1
P. homomalla	0	1	0	0
Eunicea tourneforti	0	0	1	0
Muriceopsis flavida	0	0	0	1
Gorgonia ventalina	4	0	0	0
Palythoa mammillosa	5	0	3	0
Millepora alcicornis	0	1	3	1
Acropora cervicornis	3	3	0	0
Porites porites	2	0	0	0
Siderastrea siderea	0	0	0	2
Agaricia agaricites	1	0	0	0
WORMS				
Eunice mutilata	1	0	0	0
E. longicirrata	1	0	0	0
E. kinbergi	0	1	0	0
E. sp. A	1	1	0	1
E. sp. B	1	0	0	0
Sabellid	0	1	0	1

Site 6. Key Largo Dry Rocks Rubble Quadrats. - continued

Species	Quadrats 1	2	3	4
MOLLUSCA				
Nudibranch	1	0	0	0
Periglyphus listeri	1	0	0	0
Vasum muricatum	0	0	0	1
ECHINODERMATA				
Diadema antillarum	0	1	0	0
Echinometra viridis	0	1	0	1
Eucidaris tribuloides	3	0	0	0
Ophiothrix oerstedi	1	0	0	0
Crinoid sp. (no sample)	1	0	0	0
CRUSTACEA				
Paguristes wassi	1	0	0	0
BRYOZOA				
Bryozoan indet.	0	1	0	0
ASCIDIACEA				
Didemnum candidum	1	1	0	1

Site 6. Key Largo Dry Rocks Grass Quadrats
1 August 1981

Species	Quadrats 1	2	3	4
ALGAE				
Dictyota sp.	8	1	0	0
Halimeda tuna	13	0	4	1
H. lacrimosa	0	0	0	1
Penicillus capitatus	0	1	1	2
P. dumetosus	10	0	0	0
Udotea flabellum	0	0	4	2
Udotea sp.	0	0	0	0
Rhipocephalus phoenix	0	0	4	3
Valonia ventricosa	0	0	1	0
Anadyomene stellata	0	0	0	1
Amphiroa sp.	0	0	0	1
Goniolithon sp.	0	0	0	1
Algal mat	0	0	0	1
Encrusting alga	0	1	0	0
PORIFERA				
Foliolina peltata	0	0	3	1
Dysidea etheria	0	0	1	0
Haliclona sp.	0	0	0	1
COELENTERATA				
Muricea muricata	0	1	0	0
Eunicea mammosa	0	0	0	1
Plexaurella dichotoma	0	0	0	1

Site 6. Key Largo Dry Rocks Grass Quadrats. - continued

Species	Quadrats 1	2	3	4
WORMS				
Eunice kinbergi	0	0	4	0
Terebellid	0	0	2	0
Amphiromid	0	0	1	0
Hesione picta	0	0	1	0
Terebellid	0	0	1	0
Eupholae sp.	0	0	1	0
Sabellid	0	0	1	0
MOLLUSCA				
Glycimeris sp.	0	0	1	0
Diplodonta punctata	0	0	1	0
ECHINODERMATA				
Eucidaris tribuloides	1	0	2	1
ASCIDIACEA				
Didemnum candidum	0	1	1	0
D. amethysteum	0	1	0	0
Ascidian sp. A	1	0	0	0
Ascidian sp. B	0	0	5	0

Site 6. Key Largo Dry Rocks Sand Quadrats
31 July 1981

Species	Quadrats 1	2	3	4
ALGAE				
Laurencia sp.	1	0	0	0
Dasycladus vermicularis	20	3	18	7
Acetabularia crenulata	6	0	0	4
Encrusting alga	1	0	0	0
Red alga	0	0	0	0
Alga sp. A	0	0	0	1
Alga sp. B	0	0	0	1
Alga sp. C	0	0	1	0
Alga sp. D	0	0	1	0
WORMS				
Hesionid	1	0	0	0
Capitellid	1	0	0	0
Glycera sp.	1	0	0	0
Terebellid	1	0	0	0
Phascolion sp.	3	0	0	0
Sabellid	3	0	0	0
Capitellid	0	0	1	0
Flabelligerid	0	0	1	0
Lumbrinereid	0	0	1	0
Goniadid	0	0	1	0
Cirratulid	0	0	0	1
Sabellid	0	0	0	1

Site 6. Key Largo Dry Rocks Sand Quadrats. - continued

Species	Quadrats 1	2	3	4
Nereid	0	0	0	1
Onuphid	0	0	0	1
Nereid	0	0	1	0
MOLLUSCA				
Crepidula aculeata	1	0	0	0
Olivella nivea	1	1	0	1
Dentalium calamus	0	0	0	1
ECHINODERMATA				
Meoma ventricosa	0	1	0	0
Holothuria indet.	1	0	0	0
ASCIDIACEA				
Solitary tunicate	0	0	0	1

Site 7. The Elbow

Transect 1. About 590 m long run on a heading of 278° true passing alongside of the light and over the wreck.
12 June 1980

Meter mark	Depth meter	Bottom type and species
1	18.3	Sand
2	18.3	Acropora cervicornis
3	18.3	Dictyota sp.
4	16.8	Pagurus sp., Halimeda opuntia minor, Pockiella variegata
5	16.8	Millepora alcicornis, red algal mat
6	16.8	Millepora alcicornis, Dictyota sp.
7	16.8	Pocockiella variegata
8	16.8	Acropora cervicornis
9	16.8	Homotrema rubrum
10	16.8	Dictyota
11	15.2	Dictyota, algal mat, Pocockiella variegata
12	15.2	Hard bottom
13	13.7	Hard bottom, Dictyota
14	13.7	Halimeda sp., Placospongia sp.
15	13.7	Amphiroa fragilissima, Enteromorpha sp.
16	13.7	Hard bottom
17	13.7	Enteromorpha
18	13.7	Dictyota sp.
19	13.7	Dictyota sp.
20	13.7	Sand
21	13.7	Dictyota

Site 7. The Elbow, Transect 1. - continued

Meter mark	Depth meter	Bottom type and species
22	13.7	Dictyota
23	13.7	Pseudopterogorgia acerosa
24	13.1	Red alga
25	13.1	Pseudopterogorgia americana
26	13.1	P. acerosa
27	13.1	Pocockiella variegata
28	13.1	Spinosella vaginalis, Millepora alcicornis
29	12.2	Siderastrea siderans
30	13.4	Dictyota sp.
31	12.2	Rubble, Caulerpa, hydroid, Amphiroa, Dictyota, Laurencia, Eunice, Aplysina, Halimeda
32	12.2	Dictyota sp.
33	12.2	Dictyota sp.
34	12.2	Sand
35	12.2	Rubble
36	12.2	Homotrema rubrum
37	11.6	Dictyota
38	11.6	Dictyota, red alga
39	11.3	Dictyota,
40	10.9	Dictyota, Millepora alcicornis
41	10.9	Dictyota, Homotrema rubrum, red alga
42	11.9	Millepora alcicornis

Site 7. The Elbow, Transect 1. - continued

Meter mark	Depth meter	Bottom type and species
43	10.7	Dictyota
44	10.1	Dictyota, Homotrema rubrum
45	10.1	Dictyota, Homotrema rubrum, Agaricia agaricites
46	9.8	Dictyota, Halimeda opuntia
47	9.8	Homotrema rubrum
48	9.8	H. rubrum, red alga
49	9.4	Dictyota sp.
50	9.4	Homotrema rubrum
51	9.1	Pseudopterogorgia acerosa
52	9.1	Dictyota, Homotrema rubrum
53	8.8	H. rubrum
54	10.7	Dictyota, Pseudopterogorgia acerosa
55	10.4	Homotrema rubrum
56	9.8	Sand, H. rubrum
57	10.1	Agaricia agaricites
58	8.8	Rubble
59	8.6	Dictyota, Homotrema rubrum, filamentous red alga
60	8.2	Dictyota
61	10.4	Sand
62	10.1	Sand
63	10.1	Sand
64	10.1	Sand

Site 7. The Elbow, Transect 1. - continued

Meter mark	Depth meter	Bottom type and species
65	10.1	Sand, rubble
66	9.1	Sand, rubble
67	10.4	Dictyota sp.
68	10.7	Rubble
69	10.4	Sand
70	9.8	Sand, rubble
71	9.4	Sand, rubble
72	9.4	Rubble
73	10.1	Dictyota
74	9.8	Sand
75	8.8	Dictyota
76	9.4	Rubble
77	9.4	Sand
78	9.4	Sand
79	9.4	Rubble, Haliclona sp.
80	9.4	Rubble
81	9.4	Sand
82	9.4	Sand
83	8.8	Rubble
84	8.8	Dictyota, Homotrema rubrum
85	8.5	Dictyota, H. rubrum
86	7.9	Rubble

Site 7. The Elbow, Transect 1. - continued

Meter mark	Depth meter	Bottom type and species
87	7.6	Rubble
88	6.1	Rubble
89	7.9	Thais deltoidea (wreck)
90	6.7	Rubble
91	7.6	Rubble, Pocockiella variegata
92	7.6	Rubble
93	7.6	Rubble
94	7.6	Sand, rubble, Laurencia, Dictyota, Amphiroa
95	7.3	Sand
96	7.3	Rubble
97	7.0	Cliona deletrix, rubble
98	4.9	Gorgonia ventalina
99	3.7	Acropora palmata
100	4.6	Pseudopterogorgia acerosa
101	4.6	Acropora palmata
102	6.1	Halimeda opuntia
103	6.1	Rubble, Dasycladus vermicularis
104	6.1	Rubble, Homotrema rubrum
105	5.8	Dictyota
106	5.8	Dictyota
107	5.8	Dictyota
108	5.5	Rubble

Site 7. The Elbow, Transect 1. - continued

Meter mark	Depth meter	Bottom type and species
109	5.5	Rubble, Dictyota
110	5.8	Rubble, Homotrema rubrum
111	5.5	Rubble, H. rubrum
112	5.5	Rubble, H. rubrum
113	5.2	Rubble, H. rubrum
114	5.5	Rubble, H. rubrum
115	4.9	Rubble, H. rubrum
116	4.6	Rubble, H. rubrum
117	4.6	Rubble, H. rubrum
118	4.3	Rubble, H. rubrum

Site 7. The Elbow

Transect 2. About 540 m long run on a heading of 278° true and 300 m west of Transect 1.
28 June 1980

Meter mark	Depth meters	Bottom type and species
1	16.5	Dictyota
2	17.1	Sand
3	17.1	Millepora alcicornis
4	17.1	Dictyota
5	15.8	Dictyota
6	15.8	Sand
7	15.8	Pocockiella variegata
8	15.8	Dictyota
9	15.1	Dictyota
10	15.1	Pocockiella variegata
11	15.1	Dictyota, Amphiroa fragilissima
12	15.1	Spheciospongia vesparia, Parazoanthus sp.
13	15.1	Dictyota
14	14.6	Dictyota
15	14.0	Dictyota, Cerithium litteratum, Amphiroa fragilissima
16	14.0	Dictyota, Amphiroa fragilissima, Dilophus alternans, Laurencis sp., brittlestar
17	14.0	Coralline indet.
18	14.0	Dictyota
19	14.0	Porites divaricata, Amphiroa rigida antillana
20	13.1	Amphiroa rigida, Dictyota sp.

Site 7. The Elbow, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
21	13.1	Amphiroa rigida, Dictyota sp.
22	13.1	Pocockiella variegata
23	12.8	Dictyota
24	12.8	Pocockiella variegata
25	12.8	Dictyota
26	12.5	Siderastrea radians, Dictyota
27	12.5	Porites astreoides
28	11.6	Dictyota
29	11.6	Stypopodium zonale, Dilophus alternans, Dictyot
30	11.6	Solenaster hyades
31	11.6	Sand
32	11.6	Dictyota
33	12.2	Dictyota
34	11.6	Sand
35	10.7	Dictyota
36	10.4	Amphiroa sp.
37	10.4	Muriceopsis flavida
38	10.4	Pterogorgia citrina
39	10.4	Dictyota
40	10.4	Coralline
41	8.5	Dictyota
42	8.5	Dictyota

Site 7. The Elbow, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
43	8.5	Coralline
44	7.9	Dictyota
45	7.9	Dictyota
46	7.9	Coralline
47	9.1	Dichocoenia stokesi
48	8.2	Rock
49	6.1	Sand
50	6.1	Dictyota
51	6.1	Dictyota
52	6.1	Coralline
53	6.1	Dictyota.
54	6.1	Rubble
55	7.6	Rock
56	8.2	Dictyota
57	8.2	Dictyota
58	8.2	Coralline
59	8.2	Hard bottom
60	7.3	Favia fragum
61	6.4	Rubble, Goniolithon sp., Homotrema rubrum
62	6.4	Sand
63	6.1	Dictyota
64	6.1	Hard bottom

Site 7. The Elbow, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
65	6.1	Hard bottom
66	6.1	Halimeda opuntia
67	6.1	Goniolithon sp.
68	6.7	Sand
69	6.7	Hard bottom
70	6.7	Gorgonia ventalina
71	6.1	G. ventalina
72	6.1	Rubble
73	6.1	Sand
74	6.1	Rubble, Goniolithon, Homotrema rubrum
75	4.6	Rubble, Goniolithon, H. rubrum
76	4.6	Rubble, Goniolithon, H. rubrum,(wreck)
77	4.6	Pseudopterogorgia americana
78	4.9	Haliclona compressa
79	4.9	Gorgonia ventalina
80	4.9	Rubble
81	4.9	Diadema antillarum
82	4.9	Rock
83	4.9	Palythoa mammillosa
84	4.9	Rubble, Penicillus capitatus
85	4.9	Rubble
86	3.4	Dictyota

Site 7. The Elbow, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
87	3.4	Halimeda opuntia, Dictyota, Dilophus, Jania
88	3.4	Rubble, Goniolithon
89	3.4	Rubble, Goniolithon
90	4.0	Sand
91	4.0	Rubble
92	3.0	Penicillus capitatus
93	3.0	Gorgonia ventalina
94	3.0	Rubble
95	3.0	Sand
96	3.0	Rubble
97	3.0	Sand
98	2.7	Dictyota
99	2.7	Rubble
100	2.7	Dictyota
101	2.7	Rubble
102	2.1	Dilophus
103	2.1	Dilophus
104	2.1	Rubble
105	1.5	Stypopodium zonale
106	1.5	Dilophus
107	1.5	Rubble
108	1.5	Dilophus

Site 7. The Elbow, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
109	1.5	Dilophus
110	1.5	Dilophus
111	1.5	Halimeda opuntia

Site 7. The Elbow

Transect 3. About 410 m long run on a heading of 278° true and 300 m to the east of Transect 1.
19 July 1981

Marker mark	Depth meters	Bottom type and species
1	13.7	Pseudopterogorgia rigida
2	13.1	Dilophus alternans, Dictyota cervicornis
3	13.1	Dilophus alternans, Dictyota cervicornis
4	13.1	Dilophus alternans, Dictyota cervicornis
5	12.8	Algal mat
6	12.8	Montastrea annularis
7	12.8	Dilophus, Dictyota
8	12.8	Dictyota cervicornis, algal mat
9	13.7	Sand
10	13.7	Pseudopterogorgia americana
11	12.1	Favia fragum
12	12.2	Rock
13	11.3	Pseudaxinella longichaeta
14	11.0	Hard bottom
15	10.7	Dilophus, Dictyota
16	11.3	Pseudopterogorgia americana, Acropora cervicornis
17	10.4	Higginsia strigulata
18	10.1	Dilophus, Dictyota
19	9.8	Dilophus, Dictyota
20	9.4	Dictyota cervicornis
21	11.9	Bartholomea, Stenorhynchus seticornis
22	12.5	Sand

Site 7. The Elbow, Transect 3. - continued

Marker mark	Depth meters	Bottom type and species
23	12.2	Sand
24	12.2	Sand
25	12.2	Dilophus, Dictyota, Millepora alcicornis
26	12.2	Sand
27	12.2	Sand
28	12.2	Meandrina meandrites
29	12.2	Tethya crypta
30	11.9	Sand
31	11.9	Millepora alcicornis
32	11.9	Sand, Dictyota
33	11.6	Dilophus, Dictyota, Sargassum
34	11.6	Rubble
35	11.6	Rubble
36	11.6	Sand
37	11.6	Siderastrea siderea
38	11.6	Sand
39	11.6	Dictyota
40	11.3	Dilophus, Dictyota
41	11.6	Sand, Lithothamnion
42	11.6	Spinosella vaginalis
43	11.6	Rubble
44	11.6	Pseudopterogorgia americana

Site 7. The Elbow, Transect 3. - continued

Marker mark	Depth meters	Bottom type and species
45	10.7	Halimeda opuntia minor
46	10.7	Briareum asbestinum
47	11.3	Dilophus, Dictyota
48	11.3	Sand
49	11.3	Pseudopterogorgia americana
50	11.0	Rock
51	10.4	Dilophus, Dictyota
52	9.8	Rock
53	10.1	Millepora alcicornis, Dictyota
54	10.1	Algal mat
55	11.6	Pterogorgia citrina
56	11.3	Rubble
57	11.3	Rock
58	11.3	Sand, rubble
59	11.3	Sand
60	11.3	Pseudopterogorgia americana
61	11.0	Dilophus, Dictyota, rock
62	10.7	Alga
63	10.4	Sand
64	11.0	Alga
65	11.0	Sand
66	11.0	Sand

Site 7. The Elbow, Transect 3. - continued

Marker mark	Depth meters	Bottom type and species
67	10.4	Rubble
68	10.1	Sand
69	9.8	Sand
70	9.8	Dilophus alternans
71	9.8	Dilophus alternans, Sand
72	9.8	Plexaurella dichotoma
73	9.8	Sand, rubble
74	9.8	Sand, rubble
75	10.1	Sand, rubble
76	10.1	Dasycladus vermicularis
77	10.1	Sand
78	10.1	Dasycladus vermicularis
79	10.1	Sand
80	10.1	Filamentous green
81	10.1	Dasyclacus vermicularis
82	10.1	Algal mat

Site 7. The Elbow Coral Quadrats
30 August 1981

Species	Quadrats 1	2	3	4
ALGAE				
Dilophus alternans	x	0	x	0
Dictyota cervicornis	x	12	x	2
Amphiroa tribulus	0	0	0	2
A. fragilissima	0	1	0	0
A. sp.	0	1	0	0
Goniolithon sp.	0	0	1	0
Jania sp.	0	1	0	0
Lithothamnion sp.	0	1	0	0
PORIFERA				
Aplysina cauliformis	0	1	1	0
Agelas schmidti	0	0	0	3
Ircinia strobilina	0	1	0	0
Haliclona compressa	0	1	0	0
Niphates erecta	0	3	0	4
Chondrilla nucula	1	0	0	5
Dysidea sp.	0	1	0	7
Cliona sp.	0	6	0	0
Spongia sp.	0	0	1	0
Siphonodictyon sp.	0	0	0	1
Microciona sp.	0	1	0	0
Myxellid sp.	0	1	0	0
Sponge sp. A	1	0	0	0

Site 7. The Elbow Coral Quadrats. - continued

Species	Quadrats 1	2	3	4
Sponge sp. B	1	0	0	0
Sponge sp. C	0	0	1	0
COELENTERATA				
Millepora alcicornis	1	0	1	1
Hydroid sp.	x	0	0	0
Anemone	0	12	0	13
Erythropodium caribaeorum	1	3	0	0
Pseudopterogorgia acerosa	0	0	0	5
P. kallos	1	0	0	0
Plexaura flexuosa	1	0	0	0
Gorgonia ventalina	0	0	0	1
Acropora palmata	x	x	x	17
Agaricia agaricites	5	15	4	8
Favia fragum	1	0	1	0
Helioseris cucullata	2	3	0	6
Mycetophyllia lamarckana	1	2	1	1
Siderastrea siderea	11	0	1	0
Montastrea annularis	0	x	0	0
Dichocoenia stokesi	0	0	0	2
WORMS				
Bristle worm	1	0	0	1
Tube worm	0	0	0	2
Sabellid	1	1	0	0

Site 7. The Elbow Coral Quadrats. - continued

Species	Quadrats 1	2	3	4
MOLLUSCA				
Nudibranch	2	0	1	0
CRUSTACEA				
Pagurus provenzanoi	1	1	1	0
Paguristes cadenati	0	1	0	0
MOLLUSCA				
Nudibranch	2	0	1	0
ECHINODERMATA				
Diadema antillarum	1	1	1	3

Site 7. The Elbow Rubble Quadrats
19 July 1981

Species	Quadrats 1	2	3	4
PROTOZOA				
Homotrema rubrum	x	x	x	x
ALGAE				
Halimeda incrassata	7	8	6	9
Neomeris annulata	4	3	5	0
Dictyota cervicornis	0	1	0	0
Anadyomene stellata	0	0	5	0
Valonia ventricosa	0	0	4	0
Penicillus capitatus	0	0	1	0
Dasycladus vermicularis	0	2	2	0
Filamentous green	x	0	x	1
Lithothamnion sp.	x	0	x	0
Goniolithon sp.	1	0	2	0
Amphiroa sp.	1	0	0	1
Filamentous red alga	0	1	0	0
Alga indet	0	0	5	0
Padina sp.	0	0	0	1
PORIFERA				
Cliona sp.	1	0	0	x
Dysidea spp.	1	0	2	0
Sponges indet.	0	0	4	0
COELENTERATA				
Pseudopterogorgia americana	0	0	1	2

Site 7. The Elbow Rubble Quadrats. - continued

Species	Quadrats 1	2	3	4
Bartholomea sp.	0	0	0	1
Diploria labyrinthiformis	0	1	0	0
Favia fragum	2	4	2	0
Porites porites	0	2	0	0
Siderastrea radians	2	1	0	3
WORMS				
Sabellid sp.	1	1	0	1
Serpulid sp.	1	0	0	0
Featherduster	3	0	0	0
Worm indet.	0	1	0	0
MOLLUSCA				
Chiton sp.	2	0	1	0
Lithophaga sp.	0	0	0	1
Cerithium algicola	0	0	1	0
CRUSTACEA				
Snapping shrimp	0	0	0	1
Mantis shrimp	0	0	0	1
Crab	1	1	0	0
Hermit crab	1	0	0	0
BRYOZOA				
Orange bryozoans	3	0	2	1
ECHINODERMATA				
Eucidaris tribuloides	0	0	0	1

Site 7. The Elbow Rubble Quadrats. - continued

Species	Quadrats 1	2	3	4
Ophiothrix oerstedi	0	1	0	2
Brittlestars spp.	2	0	4	1
Ophiocoma echinata	0	1	0	0
ASCIDIACEA				
Tunicata sp. A	1	0	0	0
Tunicate sp. B	0	1	0	0
Tunicate sp. C	0	1	2	0
Ascidia nigra	0	1	0	0
Didemnum candidum	0	3	0	1

Site 7. The Elbow Hard Bottom Quadrats
30 August 1981

Species	Quadrats 1	2	3	4
ALGAE				
Padina sp.	23	23	21	8
Dilophus alternans	x	x	x	x
Udotea flabellum	4	15	6	6
Halimeda tuna	2	1	20	7
H. incrassata	0	0	0	11
Laurencia sp.	0	0	0	1
Amphiroa tribulus	0	0	0	1
A. sp. A	0	0	0	1
PORIFERA				
Haliclona compressa	1	0	0	0
H. sp.	1	0	1	0
Niphates digitalis digitalis	1	0	0	0
Epipolasis sp.	1	0	0	0
Aplysina cauliformis	0	1	0	0
Tethya crypta	0	0	0	1
Ircinia strobilina	0	0	1	0
COELENTERATA				
Millepora alcicornis	6	5	6	2
Erythropodium caribaeorum	2	0	0	0
Plexaura homomalla	3	0	0	0
Pseudopterogorgia americana	6	6	6	3
P. acerosa	3	0	1	0

Site 7. The Elbow Hard Bottom Quadrats. - continued

Species	Quadrats 1	2	3	4
Plexaurella dichotoma	2	1	3	0
P. grisea	0	2	0	0
Pterogorgia citrina	12	6	15	1
P. anceps	0	1	0	0
Eunicea calyculata calyculata	0	1	0	0
Plexaura sp.	0	1	0	0
Porites porites	2	0	0	0
Favia fragum	2	0	0	0
Siderastrea siderea	0	2	0	2
S. radians	1	0	1	0
Acropora cervicornis	0	x	0	x
Dichocoenia stokesi	0	0	0	1
Porites astreoides	0	0	0	1
Diploria labyrinthiformis	0	0	0	1
Zooanthids sp. A	0	1	0	1
Zoanthus sp. B	0	0	0	1
Anemone	0	0	0	2
WORMS				
Sabellid	1	0	1	1
Serpulid	0	0	0	0
Arabella sp.	1	0	0	0
Nereid	1	0	0	0
Eunice kinbergi	1	0	0	0

Site 7. The Elbow Hard Bottom Quadrats. - continued

Species	Quadrats 1	2	3	4
CRUSTACEA				
Crab	1	0	0	0
Hermit crab	0	0	0	1
ECHINODERMATA				
Ophionereis squamulosa	0	1	0	0

Site 7. The Elbow Sand Quadrats
30 August 1981

Species	Quadrats 1	2	3	4
PROTOZOA				
Homotrema rubrum	14	17	7	0
WORMS				
Phascolion sp.	3	0	0	0
Sipunculid indet.	1	0	0	0
Eunice sp.	1	1	0	1
Glycera sp.	1	0	0	0
Nephthys sp.	0	1	0	0
Sequalionid	0	1	0	0
MOLLUSCA				
Dentalium calamus	3	2	3	0
Olivella nivea	1	0	0	0
Tellina listeri	1	0	0	0

Site 8. Carysfort Reef

Transect 1. About 785 m long run on a heading of 293o true to and past Carysfort Light. 15 July 1981

Meter mark	Depth meters	Bottom type and species
0	16.8	Dictyota cervicornis
1	16.8	Dictyota cervicornis, Amphiroa fragilissima.
2	16.5	Algal mat
3	16.2	Dictyota cervicornis
4	16.2	Dilophus alternans
5	16.5	Sand
6	16.2	Spinosella vaginalis
7	16.2	Dilophus, Dictyota
8	15.8	Dictyota cervicornis
9	15.8	Dasycladus vermicularis
10	15.5	Rock
11	15.0	Dilophus, Dictyota
12	15.0	Dilophus, Dictyota
13	14.9	Filamentous red
14	14.9	Dictyota cervicornis
15	14.9	Galaxaura obtusata, Dictyota cervicornis
16	14.6	Dilophus alternans
17	14.0	Sargassum hystrix
18	14.6	Sand
19	14.6	Sand
20	13.7	Halimeda tuna
21	13.4	Dilophus alternans

Site 8. Carysfort Reef, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
22	13.4	Rock
23	13.4	Dilophus alternans, Dictyota cervicornis
24	13.4	Sand
25	13.1	Dictyota cervicornis, Amphiroa tribulus
26	12.8	Dictyota cervicornis, Galaxaura obtusata
27	12.5	Dilophus, Dictyota
28	12.8	Sand over rock
29	12.8	Sand over rock
30	12.5	Sand
31	12.2	Sand
32	11.9	Dictyota cervicornis
33	11.9	Millepora alcicornis
34	11.6	Halimeda tuna, Dictyota cervicornis
35	11.6	Dilophus alternans, Dictyota cervicornis
36	11.6	Dilophus alternans, Dictyota cervicornis
37	11.3	Dilophus alternans, Dictyota cervicornis
38	11.3	Sand
39	11.0	Galaxaura obtusata, Cerithium litteratum, Dilophus, Dictyota
40	10.7	Sand
41	10.7	Sand
42	10.7	Rock

Site 8. Carysfort Reef, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
43	9.8	Sponge
44	9.1	Rock
45	9.1	Dilophus alternans
46	9.1	Dictyota cervicornis
47	8.5	Anthosigmella varians
48	8.5	Cerithium litteratum, algal mat
49	9.1	Rock
50	9.1	Rock
51	9.8	Galaxaura obtusata
52	10.7	Pseudopterogorgia bipinnata
53	11.0	Algal mat
54	11.0	Millepora complanata
55	11.0	Sand, rubble
56	11.3	Dilophus, Dictyota, Amphiroa tribulus
57	11.6	Dilophus, Dictyota
58	11.6	Dilophus alternans
59	12.2	Dilophus, Dictyota
60	13.7	Sand
61	13.7	Sand
62	15.5	Sand
63	15.5	Algal mat
64	16.2	Algal mat, rubble

Site 8. Carysfort Reef, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
65	16.8	Algal mat, rubble
66	16.8	Halimeda incrassata
67	16.8	Dictyota, Amphiroa fragilissima, Jania sp.
68	16.8	Sand, rubble
69	16.8	Algal mat
70	16.8	Sand
71	16.8	Sand
72	16.5	Pseudaxinella lunaecharta
73	15.2	Sand
74	14.9	Coralline
75	13.7	Dictyota cervicornis
76	12.5	Dictyota cervicornis
77	11.9	Dictyota cervicornis
78	11.3	Dictyota cervicornis
79	11.0	Dilophus, Dictyota
80	11.0	Erythropodium caribaeorum
81	10.7	Acropora cervicornis
82	11.0	Acropora cervicornis, Pseudopterogorgia americana
83	11.0	Hard bottom
84	11.0	Dictyota cervicornis
85	10.4	Dilophus, Dictyota
86	10.4	Siderastrea siderea

Site 8. Carysfort Reef, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
87	11.0	Dictyota cervicornis
88	10.7	Rubble
89	10.7	Dictyota cervicornis
90	9.8	Acropora cervicornis
91	8.	Algal mat
92	7.6	Dilophus, Dictyota
93	7.6	Hard bottom
94	7.6	Dilophus alternans
95	7.6	Dilophus, Dictyota
96	7.6	Dilophus, Dictyota
97	7.3	Dilophus, Dictyota
98	6.7	Montastrea annularis
99	6.4	Dilophus alternans
100	7.0	D. alternans
101	6.4	D. alternans
102	6.1	D. alternans
103	6.4	Algal mat
104	6.4	Dilophus, Dictyota
105	6.4	Millepora complanata
106	6.4	Gorgonian
107	4.6	Hard bottom
108	4.6	Hard bottom

Site 8. Carysfort Reef, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
109	6.1	Hard bottom
110	4.6	Hard bottom
111	6.1	Hard bottom
112	6.1	Hard bottom
113	6.1	Hard bottom
114	3.0	Millepora complanata
115	4.6	M. complanata
116	3.7	Plexaura mammosa
117	2.7	P. mammosa, Gorgonia ventalina
118	2.1	Gorgonia ventalina
119	3.0	G. ventalina
120	2.1	Hard bottom
121	1.8	Hard bottom
122	1.8	Porites porites
123	1.8	Porites porites
124	1.8	Hard bottom
125	1.2	Hard bottom
126	0.6	Acropora palmata
127	0.3	Rubble
128	0.1	Acropora palmata
129	0.1	A. palmata
130	0.1	A. palmata

Site 8. Carysfort Reef, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
131	0.1	A. palmata
132	0.1	A. palmata
133	0.1	A. palmata
134	0.1	A. palmata
135	0.1	A. palmata
136	0.1	A. palmata
137	0.1	A. palmata
138	0.1	Plexaura mammosa
139	0.1	Acropora palmata
140	0.1	Dead coral
141	0.1	Acropora palmata
142	0.1	Dead coral
143	0.1	Dead coral
144	0.1	Dead coral
145	0.1	Dead coral
146	0.1	Acropora palmata
147	0.1	Dead coral
148	0.1	Dictyota cervicornis
149	0.1	Halimeda incrassata
150	0.1	Algal mat
151	0.1	Diploria strigosa
152	0.2	Dead coral

Site 8. Carysfort Reef, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
153	0.2	Pseudopterogorgia americana
154	0.2	Acropora cervicornis
155	0.1	Sand
156	0.1	Condylactis gigantea
157	0.1	Dilophus alternans

Site 8. Carysfort Reef

Transect 2. About 780 m long run on a heading of 293o true and 300 m east of Transect 1.
16 July 1981

Meter mark	Depth meters	Bottom type and species
1	17.1	Sargassum hystrix
2	16.5	Dictyota cervicornis
3	16.5	Sargassum hystrix
4	15.8	Dictyota cervicornis
5	15.8	Rock
6	15.2	Dictyota cervicornis
7	15.2	Rock
8	15.2	Halimeda opuntia minor, Dilophus alternans
9	15.2	Sand
10	15.0	Dictyota cervicornis
11	15.0	Pseudopterogorgia elisabethae
12	15.2	Rubble
13	14.6	Coralline alga
14	14.6	Hard bottom
15	14.3	Amphiroa fragilissima, Dictyota sp., sponge
16	14.0	Dictyota cervicornis
17	14.0	Algal mat
18	13.7	Sponge
19	13.7	Sand
20	13.7	Sand
21	13.7	Siderastrea siderea
22	13.7	Dictyota cervicornis

Site 8. Carysfort Reef, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
1	17.1	Sargassum hystrix
2	16.5	Dictyota cervicornis
3	16.5	Sargassum hystrix
4	15.8	Dictyota cervicornis
5	15.8	Rock
6	15.2	Dictyota cervicornis
7	15.2	Rock
8	15.2	Halimeda opuntia minor, Dilophus alternans
9	15.2	Sand
10	15.0	Dictyota cervicornis
11	15:0	Pseudopterogorgia elisabethae
12	15.2	Rubble
13	14.6	Coralline alga
14	14.6	Hard bottom
15	14.3	Amphiroa fragilissima, Dictyota sp., sponge
16	14.0	Dictyota cervicornis
17	14.0	Algal mat
18	13.7	Sponge
19	13.7	Sand
20	13.7	Sand
21	13.7	Siderastrea siderea
22	13.7	Dictyota cervicornis

Site 8. Carysfort Reef, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
23	13.4	Dictyota cervicornis, calcareous alga
24	12.8	Agaricia agaricites
25	12.8	Sargassum hystrix, Dictyota cervicornis
26	12.8	Hard bottom
27	12.8	Dictyota cervicornis
28	1.25	D. cervicornis
29	12.2	D. cervicornis
30	12.2	Hard bottom, Homotrema rubrum
31	12.2	Dictyota cervicornis
32	12.2	Halimeda sp.
33	11.9	Udotea flabellum
34	11.0	Sargassum hystrix
35	11.0	Hard bottom
36	10.7	Hard bottom
37	10.7	Dictyota cervicornis, coralline
38	10.4	Halimeda sp., Dictyota sp.
39	10.4	Dilophus alternans
40	10.4	Dictyota cervicornis
41	9.8	Dilophus alternans
42	9.1	Pseudopterogorgia americana
43	9.1	Niphates sp.
44	9.1	Dilophus alternans, Sargassum hystrix

Site 8. Carysfort Reef, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
45	9.1	Dictyota cervicornis
46	9.1	Dictyota cervicornis, Sargassum hystrix
47	9.8	Dilophus alternans
48	10.7	Dilophus alternans
49	11.0	Dictyota cervicornis
50	11.6	Plexaurella dichotoma
51	12.2	Hard bottom
52	12.2	Pseudopterogorgia elisabethae
53	12.2	Hard bottom, H. rubrum
54	12.2	Dictyota cervicornis
55	12.2	Hard bottom
56	12.8	Pseudopterogorgia americana
57	12.8	Sand, rubble
58	12.8	Sand, rubble
59	12.8	Sand, rubble
60	12.8	Sand, rubble
61	12.8	Sand
63	13.1	Sand, rubble
64	12.8	Syringodium
65	12.8	Pseudopterogorgia elisabethae, green alga
66	12.8	Syringodium
67	13.1	Halimeda, Pseudopterogorgia elisabethae

Site 8. Carysfort Reef, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
68	13.4	Dictyota, Halimeda
69	13.4	Sand
70	13.4	Alga
71	14.6	Sand
72	14.3	Sand
73	14.0	Dilophus alternans
74	14.3	Agaricia agaricites, Dictyota, Lithothamnion
75	14.3	Sand
76	14.0	Dasycladus vermicularis
77	14.3	Sand
78	14.6	Sand
79	14.6	Sand
80	14.6	Sand
81	14.6	Sand
82	13.1	Dictyota cervicornis
83	12.2	Dilophus, Dictyota
84	11.6	Calcareous alga
85	10.7	Udotea flabellum, Dilophus alternans
86	10.1	Dilophus, Dictyota
87	9.4	Dilophus alternans
88	9.1	Dilophus, Dictyota
89	8.8	Dilophus, Dictyota

Site 8. Carysfort Reef, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
90	8.5	Dilophus, Dictyota
91	7.9	Dilophus, Dictyota
92	7.9	Dilophus, Dictyota
93	7.6	Dilophus, Dictyota, Agaricia agaricites
94	7.0	Meandrina meandrites
95	6.1	Dictyota cervicornis
96	6.1	Dilophus, Dictyota
97	6.1	Rock
98	6.1	Rock
99	6.1	Dilophus alternans
100	5.5	Eunicea succinea
101	6.4	Dictyota cervicornis, Gorgonia ventalina
102	6.4	Dictyota cervicornis
103	5.8	Dilophus alternans
104	5.5	Pseudopterogorgia americana
105	5.8	Porites astreoides
106	4.6	Gorgonia ventalina
107	3.7	Pseudoplexaura porosa
108	4.3	Palythoa mammillosa
109	3.4	P. mammillosa
110	2.4	Hard bottom
111	2.7	Millepora complanata

Site 8. Carysfort Reef, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
112	2.4	Halimeda incrassata
113	2.4	Gorgonia ventalina
114	2.1	Sand
115	2.4	Rock
116	3.4	Gorgonia ventalina, Diploria clivosa
117	3.0	Halimeda incrassata
118	3.4	Rubble
119	2.4	Dictyota cervicornis
120	2.4	Rubble
121	2.7	Dictyota cervicornis, H. incrassata
122	2.7	Rubble
123	2.4	Acropora cervicornis
124	1.8	Rubble
125	1.8	Rubble
126	1.5	Filamentous algal mat
127	1.5	Dictyota cervicornis
128	1.5	D. cervicornis
129	1.5	D. cervicornis
130	1.2	Porites astreoides
131	1.2	Halimeda incrassata
132	1.2	Rubble
133	1.5	Rubble

Site 8. Carysfort Reef, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
134	1.5	Porites astreoides
135	1.5	Dictyota cervicornis
136	1.8	Filamentous alga

Site 8. Carysfort Reef

Transect 3. About 210 m long run on a heading of 293o true and 300 m west of Transect 1.
17 July 1981

Meter mark	Depth meters	Bottom type and species
1	21.9	Amphiroa fragilissima, Dictyota sp., Jania sp.
2	21.9	Amphiroa fragilissima, Dictyota sp., Jania sp.
3	18.5	Sand
4	18.3	Dictyota cervicornis
5	16.5	D. cervicornis
6	15.5	Erythropodium caribaeorum, Dysidea sp., Dictyota sp.
7	14.9	Erythropodium caribaeorum, Dictyota sp.
8	13.7	Dictyota sp., D. cervicornis
9	13.1	Dilophus alternans, Sargassum hystrix, Galaxaura obtusata
10	12.2	Rubble
11	10.7	Siderastrea siderea
12	9.1	Dilophus alternans
13	8.5	Dilophus alternans, Dictyota cervicornis
14	7.6	Dilophus alternans, Dictyota cervicornis
15	6.7	Dilophus alternans, Dictyota cervicornis, brittle stars
16	6.7	Dilophus alternans, Plexaura flexuosa
17	5.5	Pseudopterogorgia kallos
18	4.9	Millepora alcicornis
19	5.8	Erythropodium caribaeorum
20	4.8	Rubble
21	6.1	Pseudopterogorgia kallos
22	5.5	Coral indet.

Site 8. Carysfort Reef, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
23	4.6	Siderastrea siderea
24	4.3	Rock
25	6.1	Millepora alcicornis
26	5.5	M. alcicornis
27	4.6	Rubble
28	3.4	Filamentous algal mat
29	2.7	Pseudopterogorgia kallos
30	2.7	Millepora alcicornis
31	4.6	Rock
32	4.9	Rock
33	3.0	Pseudopterogorgia americana
34	3.	Sand
35	3.0	Millepora complanata
36	2.4	Palythoa mammillosa
37	2.4	P. mammillosa
38	4.3	Hard bottom
39	5.5	Palythoa mammillosa
40	7.0	Gorgonia ventalina
41	7.6	Dilophus, Dictyota
42	7.6	Dilophus, Dictyota

Site 8. Carysfort Reef Coral Quadrats
18 July 1981

Species	Quadrats 1	2	3	4
ALGAE				
Halimeda opuntia triloba	1	x	2	1
Valonia ventricosa	0	1	0	4
Dictyota cervicornis	0	x	1	7
Dilophus alternans	0	1	0	1
Amphiroa tribulus	0	1	0	1
Lithothamnion sp.	1	0	x	0
Green alga A	0	0	1	0
Filamentous alga	0	4	0	1
Red coralline	0	1	0	0
PORIFERA				
Chondrilla nucula	0	2	0	0
Chondrosia collectrix	0	0	1	0
Dysidea sp.	0	1	0	0
Aplysina	0	4	0	0
Aplysella sp.	0	0	3	6
Dark orange sponge A	12	0	1	0
Light orange sponge B	6	0	2	0
COELENTERATA				
Eunicea mammosa	4	0	1	1
E. tourneforti	0	1	0	0
E. calyculata	0	1	0	0
E. succinea	0	1	0	0

Site 8. Carysfort Reef Coral Quadrats. - continued

Species	Quadrats 1	2	3	4
Muricea muricata	1	0	1	0
Pseudoplexaura porosa	5	1	1	1
Gorgonia ventalina	0	0	4	0
Briareum asbestinum	0	0	3	3
Palythoa mammillosa	0	x	1	2
Millepora alcicornis	0	0	0	1
M. complanata	9	x	6	x
Favia fragum	1	0	0	0
Agaricia agaricites	17	13	20	13
Porites porites	7	x	16	x
P. astreoides	7	3	4	x
Siderastrea siderea	2	0	0	1
Dichocoenia stokesi	1	0	0	5
Diploria strigosa	0	0	4	0
Mycetophyllia sp.	0	0	0	1
Anemones	3	0	2	1
WORMS				
Sabellid A	3	0	1	0
Sabellid B	0	0	0	2
MOLLUSCA				
Thais deltoides	0	0	0	3
Cyphoma gibbosum	0	0	0	2
Gastropod sp.	0	2	0	0

Site 8. Carysfort Reef Coral Quadrats. - continued

Species	Quadrats 1	2	3	4
Nudibranch	2	0	1	0
Lima lima	0	0	0	1
Lithophaga sp.	0	0	0	1
ECHINODERMATA				
Diadema antillarum	7	1	5	6
Eucidaris tribuloides	1	1	2	2
Ophiothrix oerstedi	0	1	0	0
Ophioderma sp.	0	0	0	1
Large brittlestars	0	0	5	0
Brittlestars	0	0	0	1
BRYOZOA				
Bryozoan indet.	0	1	0	1
CRUSTACEA				
Paguristes tortugae	0	1	0	1
ASCIDIACEA				
Ascidian, compound	0	1	0	x

Site 8. Carysfort Reef Hard Bottom Quadrats
18 July 1981

Species	Quadrats 1	2	3	4
ALGAE				
Halimeda opuntia minor	0	0	1	1
H. incrassata	0	0	0	2
H. lacrimosa	0	0	0	2
H. sp.	17	0	0	0
Udotea flabellum	8	5	0	8
Dilophus alternans	x	x	x	x
Dictyota cervicornis	x	x	x	x
Valonia ventricosa	0	0	1	0
Neomeris annulata	8	0	4	0
Sargassum hystrix hystrix	6	0	7	10
S. h. buxifolium	0	7	0	1
Goniolithon sp.	5	0	0	0
Amphiroa brasiliana	0	10	0	0
Alga indet.	x	x	6	x
Red epiphyte	1	0	0	0
Filamentous alga	0	0	0	1
Calcareous alga indet.	0	0	17	0
PORIFERA				
Spinosella vaginalis	2	1	1	1
Ircinia strobilina	2	0	0	3
Niphates sp.	0	1	0	1
Axinellid	0	0	0	1

Site 8. Carysfort Reef Hard Bottom Quadrats. - continued

Species	Quadrats 1	2	3	4
Black sponge	3	0	0	0
Sponge indet.	0	0	0	1
COELENTERATA				
Eunicea tourneforti	4	0	0	0E
Eunicea sp.	0	5	0	1
Pseudopterogorgia americana	3	3	4	2
P. acerosa	1	2	4	14
P. kallos	1	0	0	0
P. bipinnata	0	9	0	14
P. rigida	0	0	1	0
Plexaurella dichotoma	4	1	2	1
Plexaura flexuosa	0	1	0	2
Muriceopsis flavida	0	1	0	0
Pterogorgia citrina	1	0	0	1
Erythropodium caribaeorum	5	0	1	1
Briareum asbestinum	0	1	0	3
Zoanthus sp.	0	1	0	2
Millepora alcicornis	9	2	4	4
Montastrea cavernosa	0	0	0	1
Agaricia agaricites	0	0	1	3
Porites porites	0	2	0	0
P. astreoides	0	0	1	0
P. furcata	2	0	2	0

Site 8. Carysfort Reef Hard Bottom Quadrats. - continued

Species	Quadrats 1	2	3	4
Favia fragum	1	0	0	0
Siderastrea radians	2	0	0	0
Bartholomea sp.	1	3	0	0
WORMS				
Sabellid	0	1	0	0
MOLLUSCA				
Cerithium eburneum	1	1	1	0
CRUSTACEA				
Periclimenes pedersoni	0	5	0	0
Stenorhynchus seticornis	0	2	0	0
Alpheid shrimp	0	3	0	0
Snapping shrimp	1	0	8	0
Hermit crab	0	2	0	0

Site 8. Carysfort Reef Sand Quadrats

Species	Quadrats 1	2	3	4
PROTOZOA				
Homotrema rubrum	28	16	21	17
WORMS				
Eunice sp.	40	19	7	9
Glycera sp.	0	3	1	0
Capitellid	0	0	2	1
Phascolion sp.	1	0	0	0
MOLLUSCA				
Olivella nivea	0	1	4	5
CRUSTACEA				
Processa fimbriata	1	0	0	0
Iridiopagurus sp.	1	0	0	0
Shrimp sp.	1	0	0	0

Site 8. Carysfort Reef Rubble Quadrats
16 July 1981

Species	Quadrats 1	2	3	4
PROTOZOA				
Homotrema rubrum	x	x	x	x
ALGAE				
Halimeda incrassata	4	10	2	x
Dictyota cervicornis	x	x	0	0
Laurencia sp.	0	1	0	0
Goniolithon sp.	0	1	1	1
Lithothamnion sp.	0	0	1	0
Amphiroa sp.	0	1	1	1
Alga sp. A	3	0	x	0
Alga sp. B	0	x	0	0
Algal mats	0	x	0	0
Filamentous red alga	0	x	0	x
PORIFERA				
Leucosella floridana	0	1	0	0
Cliona sp.	0	1	0	0
Microcionid	1	0	0	0
Sponge indet.	1	1	0	0
COELENTERATA				
Gorgonia ventalina	13	0	0	0
Palythoa mammillosa	2	1	0	0
Millepora complanata	1	0	0	0
Anemone	0	1	0	1

Site 8. Carysfort Reef Rubble Quadrats. - continued

Species	Quadrats 1	2	3	4
Porites porites	4	0	0	0
P. astreoides	0	14	6	3
Dilporia clivosa	0	0	0	1
WORMS				
Sabellid	0	4	1	0
Polychates indet.	1	0	0	1
MOLLUSCA				
Ischnochiton sp.	2	2	1	1
Nudibranch	1	0	0	0
Thais deltoides	2	1	0	4
Cerithium sp.	0	0	1	0
Gorio sp.	0	0	1	0
Barbatia domingensis	1	0	0	0
Anadara notabilis	0	1	0	1
Bivalve indet.	0	3	1	0
ECHINODERMATA				
Eucidaris tribuloides	1	0	0	1
Ophiothrix sp.	0	1	0	0
Brittlesars spp.	1	3	2	0
Starfish (juv.)	0	1	0	0
CRUSTACEA				
Xantha denticulata	0	0	1	0
Calcinus tibicens	4	0	0	0

Site 8. Carysfort Reef Rubble Quadrats. - continued

Species	Quadrats 1	2	3	4
BRYOZOA				
Bryozoans indet.	0	1	0	0
ASCIDIACEA				
Styelid sp.	0	1	0	0
Tunicate A	0	1	0	0
Tunicate B	0	0	0	1
Tunicate C	0	0	0	1

Site 9. Basin Hill Shoals

Transect 1. About 400 m long run on a heading of 288o true ending at day marker BH19. 26 June 1980

Meter mark	Depth meters	Bottom type and species
1	4.3	Thalassia
2	4.3	Thalassia
3	4.3	Thalassia
4	4.3	Sand
5	4.3	Sand
6	4.3	Thalassia
7	4.3	Thalassia
8	3.7	Thalassia, Chirodota sp.
9	3.4	Thalassia, red alga
10	3.4	Thalassia
11	3.4	Thalassia
12	3.4	Thalassia
13	3.4	Thalassia
14	3.4	Thalassia, Syringodium, Halimeda tuna
15	3.0	Thalassia
16	3.0	Thalassia
17	3.0	Dasycladus vermicularis
18	3.0	Mud
19	2.1	Mud
20	2.1	Pseudoplexaura crucis
21	1.5	Millepora alcicornis
22	2.1	M. alcicornis

Site 9. Basin Hill Shoals, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
23	2.1	Thalassia, Syringodium
24	2.1	Thalassia, Halimeda incrassata, Dasycladus vermicularis
25	2.1	Thalassia, filamentous alga
26	2.1	Thalassia
27	2.1	Thalassia, Syringodium
28	2.1	Silty sand
29	2.1	Pseudoplexaura crucis
30	2.1	Sand
31	2.1	Thalassia, Syringodium, Dasycladua vermicularis
32	2.1	Thalassia, Syringodium
33	2.1	Thalassia, Syringodium
34	2.7	Thalassia, Syringodium
35	2.7	Thalassia, Syringodium
36	2.7	Thalassia, Syringodium, Halimeda incrassata, Dasycladua vermicularis
37	2.7	Thalassia
38	2.7	Montastrea annularis
39	2.4	Halimeda tuna
40	2.4	Sand
41	2.4	Pseudoplexaura crucis
42	2.4	Thalassia
43	2.4	Thalassia, Syringodium

Site 9. Basin Hill Shoals, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
44	2.4	Thalassia
45	2.4	Thalassia, Syringodium, Didemnum candidum
46	2.4	Thalassia, Syringodium
47	2.4	Montastrea annularis
48	1.5	Pseudopterogorgia americana
49	1.5	Plexaurella homomalla
50	2.7	Sand
51	2.7	Eunicea calyculata
52	2.7	Thalassia, Dasycladus vermicularis
53	2.7	Thalassia, D. vermicularis
54	2.7	Thalassia
55	2.4	Thalassia
56	2.4	Pseudopterogorgia americana
57	2.4	Thalassia, Syringodium
58	2.4	Plexaura flexuosa
59	2.4	Pseudoplexaura americana
60	2.4	Thalassia, Pterogorgia anceps
61	2.4	Thalassia, Syringodium
62	2.4	Thalassia, Syringodium, Paguristes tortugae
63	2.4	Thalassia, Syringodium
64	2.4	Thalassia, Syringodium
65	2.4	Thalassia, Halimeda monile

Site 9. Basin Hill Shoals, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
66	2.4	Thalassia
67	2.4	Thalassia, Dictyosphaeria cavernosa, Anthosigmella varians, Ircinia sp.
68	2.4	Thalassia, Haminoea
69	2.4	Thalassia
70	2.4	Thalassia
71	2.4	Thalassia, Haminoea
72	2.4	Thalassia
73	2.4	Thalassia, Haminoea
74	2.4	Thalassia, Dysidea crawshayi
75	2.4	Thalassia
76	2.4	Thalassia, Syringodium
77	2.4	Thalassia, Syringodium, Haminoea, Porites porites, hydroid, flabelligerid, sipunculid
78	2.4	Thalassia, Syringodium
79	2.4	Thalassia, Didemnum candidum
80	2.4	Thalassia, D. candidum
81	2.4	Thalassia, D. candidum

Site 9. Basin Hill Shoals

Transect 2. About 400 m long run on a heading of 288o true and 300 m to the west of Transect 1.
26 June 1980

Meter mark	Depth meters	Bottom type and species
0	6.0	Sand
1	6.0	Thalassia
2	6.0	Thalassia
3	6.0	Silty mud, Argopecten gibbosa
4	6.0	Silty mud
5	6.0	Silty mud, Thalassia
6	5.5	Silty mud, Thalassia
7	5.5	Silty mud
8	5.5	Silty mud, Thalassia
9	5.5	Silty mud, Thalassia
10	5.5	Silty mud
11	5.5	Silty mud
12	5.5	Thalassia
13	5.5	Silty mud
14	5.5	Thalassia
15	5.5	Silty mud
16	5.5	Silty mud
17	5.5	Thalassia
18	5.5	Thalassia
19	5.5	Thalassia
20	5.5	Thalassia
21	4.9	Silty mud

Site 9. Basin Hill Shoals, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
22	4.9	Thalassia
23	4.9	Thalassia
24	4.6	Thalassia
25	4.6	Thalassia
26	4.6	Thalassia
27	4.6	Mud
28	4.6	Thalassia
29	4.6	Thalassia
30	4.3	Silty mud
31	4.3	Thalassia
32	4.3	Thalassia
33	4.0	Thalassia
34	4.0	Thalassia
35	4.0	Thalassia, silty mud
36	3.7	Thalassia
37	3.7	Thalassia
38	3.7	Thalassia, Cistinides gouldi
39	3.7	Mud
40	3.4	Thalassia
41	3.4	Thalassia
42	3.4	Thalassia
43	3.4	Thalassia

Site 9. Basin Hill Shoals, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
44	3.0	Thalassia, Didemnum candidum
45	3.0	Thalassia
46	2.7	Thalassia
47	2.7	Mud
48	2.4	Thalassia, Codakia orbicularis
49	2.4	Mud
50	2.1	Mud, Thalassia
51	2.1	Thalassia
52	2.1	Thalassia
53	1.8	Thalassia
54	1.8	Thalassia, tunicate
55	1.8	Thalassia
56	1.8	Thalassia, Codakia orbicularis
57	1.8	Thalassia
58	1.5	Thalassia
59	1.5	Thalassia
60	1.5	Thalassia
61	1.5	Thalassia, Syringodium
62	1.5	Thalassia
63	1.5	Thalassia
64	1.5	Thalassia
65	1.5	Thalassia, mud

Site 9. Basin Hill Shoals - continued

Meter mark	Depth meters	Bottom type and species
66	1.5	Mud
67	1.5	Pseudoplexaura crucis
68	1.5	Diploria strigosa
69	1.5	Halimeda opuntia
70	1.3	Thalassia
71	1.3	Thalassia
72	1.3	Thalassia
73	1.3	Thalassia
74	1.3	Thalassia
75	1.3	Thalassia
76	1.3	Thalassia
77	1.3	Thalassia
78	1.3	Thalassia, Syringodium
79	1.3	Thalassia
80	1.3	Thalassia

Site 9. Basin Hill Shoals

Transect 3. About 400 m long run on a heading of 288o true and 300 m to the west of Transect 1.
29 June 1980

Meter mark	Depth meters	Bottom type and species
1	5.2	Silty mud
2	5.2	Silty mud
3	5.2	Silty mud
4	5.2	Thalassia
5	5.2	Thalassia, silty mud
6	5.2	Thalassia
7	.2	Silty mud
8	5.2	Silty mud
9	5.2	Thalassia
10	5.2	Syringodium
11	5.2	Syringodium, Thalassia
12	5.2	Syringodium
13	5.2	Silty mud
14	5.2	Syringodium
15	5.2	Syringodium
16	5.2	Thalassia
17	4.6	Syringodium
18	4.6	Syringodium
19	4.6	Syringodium
20	4.6	Silty mud
21	4.3	Thalassia
22	4.3	Thalassia

Site 9. Basin Hill Shoals, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
23	4.3	Syringodium
24	4.3	Thalassia
25	4.3	Thalassia
26	4.3	Syringodium
27	3.7	Thalassia
28	3.7	Thalassia
29	3.7	Thalassia
30	3.7	Thalassia, Batophora oerstedi
31	3.7	Silty mud
32	3.7	Thalassia
33	3.7	Thalassia, Syringodium
34	3.7	Thalassia
35	3.7	Thalassia
36	3.7	Thalassia
37	3.7	Thalassia, Trididemnum savignyi
38	3.7	Thalassia
39	3.7	Thalassia
40	3.7	Thalassia
41	3.7	Silty sand
42	3.7	Thalassia
43	3.7	Thalassia, Syringodium
44	3.7	Thalassia, Syringodium

Site 9. Basin Hill Shoals, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
45	3.7	Silty mud
46	3.7	Dasycladus vermicularis
47	3.7	Syringodium, Dasycladus vermicularis
48	2.4	Sand
49	2.4	Sand
50	2.4	Rubble
51	2.4	Rubble
52	2.4	Pseudoplexaura crucis
53	3.0	Sand
54	3.0	Thalassia
55	3.0	Thalassia, Dasycladus vermicularis
56	3.0	Thalassia
57	3.0	Thalassia
58	3.0	Dasycladus vermicularis, Haminoea sp.
59	2.7	Thalassia
60	3.0	Dasycladus vermicularis, Halimeda tuna, Anadyomene stellata, terebellid, Dysidea sp.
61	3.0	Dasycladus vermicularis, Haminoea sp., Thalassia, polychaete worm
62	3.0	Thalassia
63	3.0	Thalassia, Dasycladus vermicularis
64	3.0	Dasycladus vermicularis

Site 9. Basin Hill Shoals, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
65	3.0	Sand
66	3.0	Dasycladus vermicularis, Haminoea sp.
67	3.0	Thalassia
68	3.0	Thalassia
69	3.0	Thalassia, Syringodium, Haminoea sp.
70	3.0	Thalassia, Trididemnum savignyi
71	3.0	Mud, Thalassia
72	3.0	Thalassia, Syringodium
73	3.0	Thalassia
74	3.0	Anthosigmella varians
75	3.0	Sand
76	3.0	Thalassia
77	3.0	Thalassia, Syringodium
78	3.0	Clypeaster rosaceus
79	3.0	Sand
80	3.0	Thalassia
81	3.0	Thalassia

Site 9. Basin Hill Shoals Coral Quadrats
21 July 1980

Species	Quadrats 1	2	3	4
ALGAE				
Halimeda tuna	16	40	35	4
H. opuntia	0	0	5	0
Goniolithon sp.	0	0	1	0
PORIFERA				
Chondrilla nucula	9	5	1	0
Ircinia strobilina	2	0	0	0
I. felix	0	0	1	0
Haliclona compressa	0	4	0	0
Aplysina cauliformis	0	2.	6	0
A. sp.	0	0	1	0
Haliclona sp.	0	0	0	4
Cliona sp.	0	0	0	3
Spongia sp.	0	0	0	1
COELENTERATA				
Millepora alcicornis	4	6	0	0
Pseudoplexaura flagellosa	3	1	0	3
P. porosa	1	5	0	0
Eunicea mammosa	1	3	0	1
E. calyculata coronata	0	0	1	1
E. knighti	0	0	1	1
Gorgonia ventalina	1	0	0	1
Plexaura homomalla	1	1	3	0

Site 9. Basin Hill Shoals Coral Quadrats. - continued

Species	Quadrats 1	2	3	4
P. flexuosa	3	2	0	0
Pseudopterogorgia americana	0	0	0	4
Muricea muricata	0	1	0	0
Plexaurella dichotoma	0	0	1	1
Briareum asbestinum	1	2	0	0
Erythropodium caribaeorum	6	12	0	2
Diploria strigosa	3	1	0	0
Siderastrea siderea	0	2	0	0
Porites astreoides	0	0	1	1
Dichocoenia stokesi	0	1	0	0
Montastrea cavernosa	0	0	0	1
WORMS				
Polychaete indet.	0	0	0	1
MOLLUSCA				
Barbatia cancellaria	0	1	0	0
ECHINODERMATA				
Ophiothrix oerstedi	0	0	2	0
ASCIDIACEA				
Ascidian indet.	0	1	0	0

Site 9. Basin Hill Shoals Grass Quadrats
21 July 1980

Species	Quadrats 1	2	3 - 4
ALGAE			
Dasycladus vermicularis	24	38	73
Halimeda incrassata	9	17	26
H. tuna	6	11	5
H. monile	0	0	7
Amphiroa fragilissima	1	0	0
Udotea flabellum	2	1	3
Acetabularia sp.	0	1	0
PORIFERA			
Aplysina cauliformis	1	0	1
Dysidea sp. A	2	0	0
Dysidea sp. B	1	1	0
Dysidea sp. C	1	0	0
COELENTERATA			
Plexaurella dichtoma	1	0	0
P. fusiformis	0	0	1
WORMS			
Polychaete indet.	8	0	0
MOLLUSCA			
Columbella mercatoria	1	0	0
ECHINODERMATA			
Brittlestars	3	0	0

Site 9. Basin Hill Shoals Grass Quadrats. - continued

Species	Quadrats 1	2	3 - 4
ASCIDIACEA			
Colonial tunicate indet.	4	0	0

Site 9. Basin Hill Shoals Sand Quadrats
21 July 1980

Species	Quadrats 1 - 2	3 - 4
PORIFERA		
Aplysina cauliformis	2	0
Ircinia strobilina	0	1
Mycale angulosa	1	0
COELENTERATA		
Millepora alcicornis	1	0
Plexaura homomalla	1	0
Eunicea tourneforti	1	0
Siderastrea siderea	6	0
Favia fragum	1	1
Agaricia agaricites	0	2
Porites astreoides	0	1
WORMS		
Polychaete indet.	0	1
MOLLUSCA		
Chama macerophylla	0	2
Arca imbricata	0	2
ASCIDIACEA		
Solitary tunicate indet.	0	1

Site 10. Turtle Rocks

Transect 1. About 400 m long run on a heading of 238° true due east of marker "6". 13 August 1981

Meter mark	Depth meters	Bottom type and species
0	3.0	Millepora alcicornis
1	3.0	Sand, Thalassia
2	3.0	Sand, rubble, Amphiroa sp.
3	3.0	Pseudopterogorgia americana
4	3.7	Plexaurella mammosa
5	3.7	Amphiroa sp.
6	3.7	Halimeda tuna
7	3.7	Rock, Amphiroa sp.
8	4.0	Pseudopterogorgia americana
9	4.3	Iotrochota birotulata
10	4.3	Sand, Thalassia
11	4.0	Sand, Thalassia
12	3.7	Sand, Thalassia
13	3.7	Sand, Thalassia
14	3.7	Eunicea tourneforti
15	3.4	Spinosella vaginalis
16	3.4	Chondrilla nucula
17	3.4	Chondrilla, Thalassia
18	3.7	Chondrilla, Syringodium
19	3.7	Chondrilla
20	3.7	Didemnum amethysteum
21	4.3	Dasycladus vermicularis

Site 10. Turtle Rocks, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
22	4.3	Sand
23	4.3	Thalassia, Syringodium
24	4.3	Thalassia, Syringodium
25	4.3	Anadara sp.
26	4.3	Thalassia, Syringodium
27	4.3	Thalassia, Syringodium
28	4.3	Thalassia, Syringodium
29	4.3	Green ball alga
30	4.3	Thalassia, Syringodium
31	4.3	Thalassia, Syringodium
32	4.3	Thalassia, sand
33	4.3	Thalassia, sand
34	4.3	Dilophus alternans
35	4.3	Anthosigmella varians
36	4.3	Dilophus alternans
37	4.3	Thalassia
38	4.3	Rubble, Dasycladus vermicularis
39	4.3	Didemnum amethysteum
40	4.3	Sand
41	4.3	Thalassia, Dilophus alternans
42	4.3	Thalassia, Dilophus alternans
43	4.3	Dasycladus vermicularis

Site 10. Turtle Rocks, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
44	4.3	Spinosella vaginalis
45	4.0	Dasycladus vermicularis
46	4.0	Didemnum amethysteum
47	4.0	Dictyota cervicornis
48	4.0	Thalassia, Syringodium, Halimeda incrassata
49	4.0	Thalassia, Syringodium, Halimeda incrassata
50	4.0	Halimeda incrassata
51	4.0	Chondrilla nucula, Ophiothrix sp.
52	4.0	Thalassia, Syringodium, sand
53	4.0	Sand
54	4.0	Sand
55	4.0	Sand
56	4.0	Sand
57	4.0	Dasycladus vermicularis
58	4.0	Thalassia, sand
59	4.0	Sand
60	4.0	Sand
61	4.0	Sand
62	4.0	Dasycladus vermicularis
63	4.0	Didemnum amethysteum
64	4.0	Sand
65	4.0	Sand

Site 10. Turtle Rocks, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
66	4.0	Thalassia, Syringodium, Homotrema rubrum
67	4.0	Thalassia, Syringodium, Homotrema rubrum
68	4.0	Dasycladus vermicularis
69	4.3	D. vermicularis, Thalassia
70	4.6	D. vermicularis, Rhipocephalus phoenix
71	4.6	Goniolithon sp.
72	4.6	Sand
73	4.6	Sand
74	4.6	Sand
75	4.6	Sand
76	4.6	Sand
77	4.6	Sand
78	4.6	Sand
79	4.6	Sand
80	4.6	Halimeda incrassata

Site 10. Turtle Rocks

Transect 2. About 400 m long run on a heading of 238° true and 300 m east of Transect 1.
13 August 1981

Meter mark	Depth meters	Bottom type and species
0	6.8	Thalassia, Syringodium
1	6.8	Thalassia, Syringodium
2	6.8	Thalassia, Syringodium, Dictyota cervicornis
3	6.8	Thalassia, Syringodium, sand
4	6.8	Thalassia, Syringodium
5	6.1	Thalassia, Syringodium, Didemnum amethysteum
6	6.1	Thalassia, Syringodium, Dilophus alternans
7	5.5	Thalassia, Syringodium
8	5.5	Sand
9	5.5	Rubble, Dysidea, Dictyota, Halimeda, bryozoan, chiton
10	5.5	Thalassia, Syringodium
11	5.2	Rubble, Didemnum amethysteum
12	4.0	Didemnum amethysteum
13	4.6	Thalassia, Syringodium, Dictyota cervicornis
14	4.6	Thalassia, Syringodium, Dictyota cervicornis
15	4.6	Porites porites, Dasycladus vermicularis
16	4.6	Penicillus sp.
17	4.6	Dilophus alternans, Didemnum amethysteum
18	4.6	Thalassia
19	4.6	Rubble
20	4.6	Filamentous alga
21	4.6	Thalassia

Site 10. Turtle Rocks, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
23	4.6	Didemnum amethysteum
24	4.6	Thalassia, Syringodium
25	4.6	Dasycladus vermicularis
26	4.6	Thalassia, rubble
27	4.6	Thalassia, Syringodium, Didemnum amethysteum
28	4.6	Thalassia
29	4.6	Dasycladus vermicularis
30	4.6	Thalassia
31	4.6	Thalassia
32	4.6	Dasycladus vermicularis
33	4.6	Sand
34	4.6	Sand
35	3.7	Sand
36	3.7	Sand, Thalassia
37	3.7	Sand, Thalassia
38	3.7	Didemnum amethysteum
39	3.7	Sand
40	3.7	Thalassia, sand
41	3.7	Dilophus alternans
42	3.7	D. alternans
43	3.7	Sand, Thalassia, Syringodium
44	3.7	Sand

Site 10. Turtle Rocks, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
45	3.7	Thalassia
46	4.6	Sand, Thalassia, Dilophus alternans
47	4.6	Sand, Thalassia
48	4.6	Sand, Thalassia
49	4.6	Thalassia
50	4.6	Thalassia, sand
51	4.6	Anthosigmella varians
52	4.6	Thalassia
53	4.6	Porites porites
54	4.6	Dysidea etheria, Didemnum amethysteum
55	4.6	Thalassia, sand
56	4.6	Thalassia
57	4.6	Thalassia
58	4.6	Clypeaster rosaceus
59	4.6	Thalassia
60	4.6	Dysidea etheria
61	4.6	Thalassia
62	4.6	Dictyota cervicornis, Dilophus alternans
63	4.6	Thalassia
64	4.6	Thalassia
65	4.6	Thalassia
66	4.6	Dysidea etheria

Site 10. Turtle Rocks, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
67	4.6	Thalassia
68	4.6	Thalassia
69	4.6	Dilophus alternans
70	4.6	Filamentous alga
71	4.6	Thalassia
72	4.6	Thalassia
73	4.6	Olivella nivea
74	4.6	Sand
75	4.6	Sand
76	4.6	Sand
77	4.6	Sand
78	4.6	Sand
79	4.6	Sand
80	4.6	Sand

Site 10. Turtle Rocks

Transect 3. About 400 m long run on a heading of 238° true and 300 m east of Transect 2.
13 August 1981

Meter mark	Depth meters	Bottom type and species
1	3.0	Pseudopterogorgia americana
2	3.0	Pseudoplexaura porosa
3	3.0	Briareum asbestinum
4	2.4	Red coralline, Dictyota cervicornis
5	2.4	Pseudopterogorgia americana
6	1.8	Acropora palmata (50% white spot)
7	1.8	A. cervicornis
8	1.8	Sand
9	1.8	Plexaura flexuosa
10	1.8	Acropora cervicornis
11	1.8	Muricea muricata
12	1.8	Hard bottom
13	1.8	Siderastrea radians
14	1.8	Filamentous alga
15	1.8	Plexaura homomalla
16	1.8	Porites porites
17	1.8	Rubble
18	1.8	Laurencia sp.
19	1.8	Acropora cervicornis (50% white spot)
20	1.8	Sand
21	1.8	Porites porites
22	1.8	Laurencia sp.

Site 10. Turtle Rocks, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
23	1.8	Diploria strigosa
24	1.8	Montastrea cavernosa
25	1.8	Muricea muricata
26	1.8	Sand, rubble
27	1.8	Muricea muricata
28	1.8	Rubble, sand
29	1.8	Rubble, sand
30	3.0	Rubble, Thalassia
31	3.0	Rubble, Homotrema rubrum on rubble
32	3.0	Dasycladus vermicularis
33	3.0	Thalassia
34	3.0	Halimeda incrassata, Dilophus alternans
35	3.0	Millepora alcicornis
36	3.0	Cistenides regalis
37	3.0	Tedania ignis
38	3.0	Dilophus alternans
39	3.0	Syringodium, Dilophus alternans
40	3.0	Thalassia
41	3.0	Thalassia
42	3.0	Thalassia
43	3.0	Thalassia
44	3.0	Thalassia

Site 10. Turtle Rocks, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
45	3.0	Thalassia
46	3.0	Thalassia, Syringodium
47	3.0	Thalassia, Syringodium
48	3.0	Anadyomene stellata, Dictyota, solitary tunicate
49	3.0	Thalassia
50	3.0	Thalassia
51	3.0	Dysidea sp.
52	3.0	Thalassia
53	3.0	Thalassia
54	3.0	Halimeda opuntia triloba, Chondrilla nucula
55	3.0	Laurencia
56	3.0	Thalassia
57	3.0	Halimeda incrassata
58	3.0	Thalassia
59	3.0	Thalassia
60	3.0	Halimeda monile
61	3.0	Thalassia
62	3.0	Thalassia
63	3.0	Thalassia
64	3.0	Thalassia
65	3.0	Thalassia
66	3.0	Thalassia

Site 10. Turtle Rocks, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
67	3.0	Clypeaster rosaceus
68	3.0	Thalassia
69	3.0	Thalassia
70	3.0	Thalassia
71	3.0	Thalassia
72	3.0	Thalassia
73	3.0	Thalassia
74	3.0	Thalassia
75	3.0	Thalassia
76	3.0	Thalassia
77	3.0	Thalassia
78	3.0	Rhipocephalus phoenix
79	3.0	Thalassia
80	3.0	Thalassia

Site 10. Turtle Rocks Coral Quadrats
3 October 1981

Species	Quadrats 1	2	3	4
ALGAE				
Thalassia	5	3	15	0
Halimeda incrassata	0	4	2	0
H. tuna	0	0	2	0
Dilophus alternans	0	1	0	1
Dictyota cervicornis	2	3	x	1
Valonia ventricosa	0	5	2	3
Amphiroa sp.	0	1	0	1
Algal mat	x	0	0	0
Filamentous red	0	1	0	0
PORIFERA				
Aplysina sp.	0	0	0	1
Chondrilla nucula	2	0	5	1
Haliclona compressa	1	0	0	0
H. oculata	1	0	0	0
Ircinia strobilina	2	2	0	2
Niphates erecta	1	1	1	0
Spinosella vaginalis	0	0	4	0
Thalysias juniperina	0	6	0	1
Keratose indet.	1	0	3	1
Orange sponge indet.	0	0	1	0
COELENTERATA				
Gorgonia ventalina	2	2	0	0

Site 10. Turtle Rocks Coral Quadrat. - continued

Species	Quadrats 1	2	3	4
Pseudopterogorgia americana	4	x	3	0
P. acerosa	0	1	0	0
Pseudoplexaura flagellosa	3	2	3	0
P. crucis	1	0	0	0
P. porosa	2	1	0	0
Plexaura homomalla	1	1	1	0
P. flexuosa	1	0	2	0
Eunicea mammosa	1	1	1	0
E. fusca	0	0	1	0
Muricea muricata	0	1	0	0
Briareum asbestinum	3	3	2	1
Erythropodium caribaeorum	2	0	5	0
Palythoa mammillosa	0	0	0	1
Millepora alcicornis	4	2	4	4
Porites astreoides	4	7	6	10
P. porites	1	1	0	1
Favia fragum	4	0	1	0
Agaricia agaricites	1	0	0	0
Diploria clivosa	1	0	1	0
Acropora cervicornis	x	x	x	2
Dichocoenia stokesi	0	1	0	0
Siderastrea siderea	0	1	0	2
S. radians	0	0	2	0

Site 10. Turtle Rocks Coral Quadrat. - continued

Species	Quadrats 1	2	3	4
Diploria labyrinthiformis	0	0	1	x
Montastrea annularis	0	0	0	x
WORMS				
Polychaetes spp.	0	1	0	0
Sabellids	0	0	3	1
Serpulid	0	0	0	2
MOLLUSCA				
Coralliophila caribaea	0	1	0	0
Snail sp.	0	1	0	0
Barbatia cancellaria	0	0	0	2
Isognomon sp.	0	0	0	1
CRUSTACEA				
Paguristes sp.	0	1	0	0
ECHINODERMATA				
Brittle star	1	1	0	0
Eucidaris tribuloides	0	0	0	?
ASCIDIACEA				
Solitary tunicate	0	0	0	1

Site 10. Turtle Rocks Grass Quadrats
27 August 1981

Species	Quadrats 1	2	3	4
ALGAE				
Halimeda incrassata	19	0	0	0
H. tuna	2	0	3	0
H. opuntia triloba	0	23	14	17
H. discoides	0	0	0	6
Penicillus capitatus	0	1	0	1
P. dumetosus	0	0	0	4
Batophora oerstedi	0	0	0	5
Dictyosphaeria cavernosa	0	3	0	0
Valonia ventricosa	0	3	0	0
Udotea flabellum	2	0	2	0
Dilophus alternans	22	30	20	16
Rhipocephalus phoenix	0	2	1	4
PORIFERA				
Dysidea etheria	8	10	7	8
Dysidea sp.	0	3	2	4
Tedania ignis	7	18	0	18
Chondrilla nucula	4	0	5	0
Ircinia strobilina	0	3	0	0
Anthosigmella vaginalis	0	1	0	1
Haliclona viridis	0	0	0	1
Choristida sp.	0	0	0	2
Red sponge indet.	0	0	3	0
Sponge indet.	0	0	0	2
Sponge indet.	0	0	0	2

Site 10. Turtle Rocks Grass Quadrats. - continued

Species	Quadrats 1	2	3	4
COELENTERATA				
Manicina areolata	0	1	0	0
Cladocora arbuscula	0	1	2	1
Porites porites	0	1	0	2
Siderastrea siderea	0	0	0	2
WORMS				
Feather worms	2	0	4	4
Tube worms in sponges	0	5	0	0
Hermodice carunculata	0	5	0	0
MOLLUSCA				
Astraea phoebia	2	0	1	0
Tegula fasciata	0	0	1	0
Murex recurvirostris	0	0	0	4
CRUSTACEA				
Crab (got away)	0	1	0	0
ECHINODERMATA				
Clypeaster rosaceus	0	1	0	0
Lytechinus variegatus	0	0	0	1
Eucidaris tribuloides	0	1	0	0
Ophiothrix oerstedi	0	1	1	0
Brittlestar indet.	1	3	0	5
Starfish	0	0	1	0

Site 10. Turtle Rocks Grass Quadrats. - continued

Species	Quadrats 1	2	3	4
ASCIDIACEA				
Didemnum candidum	0	1	0	1
D. amethysteum	0	2	0	0

Site 10. Turtle Rocks Sand Quadrats
27 August 1981

Species	Quadrats 1	2	3	4
ALGAE				
Penicillus capitatus	6	0	0	2
P. sp.	3	0	0	2
Dasycladus vermicularis	1	8	0	1
Caulerpa prolifera	0	0	0	1
Bostrychia montagnei	0	1	0	0
Alga sp. A	0	1	0	0
Alga sp. B	0	0	1	0
Alga sp. C	0	0	1	0
Alga sp. D	0	0	0	1
ECHINODERMATA				
Astropecten duplicatus	1	0	0	0
Lytechinus variegatus	0	1	0	0
Mellita sexiesperforata	0	0	1	0

Site 11. Ocean Reef

Transect 1. About 400 m long run on a heading of 288° true ending 500 m from navigation marker "2".
27 July 1980

Meter mark	Depth meters	Bottom type and species
1	4.0	Thalassia
2	4.0	Thalassia
3	4.0	Sand, silty
4	4.0	Halimeda monile
5	4.0	H. tuna
6	4.0	Thalassia
7	4.0	Silty sand
8	4.0	Thalassia
9	4.0	Thalassia
10	4.0	Thalassia
11	4.0	Silty sand
12	4.0	Thalassia
13	4.0	Silty sand
14	4.0	Thalassia
15	4.0	Silty sand with small fecal pellets
16	4.0	Thalassia
17	4.0	Silty sand
18	4.0	Silty sand, Thalassia
19	4.0	Silty sand mound
20	4.0	Thalassia
21	4.0	Thalassia
22	4.0	Silty sand

Site 11. Ocean Reef, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
23	4.0	Thalassia
24	4.0	Thalassia
25	4.0	Thalassia, Codakia orbicularis
26	4.0	Thalassia
27	4.0	Thalassia
28	4.0	Halimeda monile
29	4.0	Thalassia
30	4.0	Thalassia
31	4.0	Thalassia
32	4.0	Silty sand
33	4.0	Halimeda monile
34	4.0	Silty sand
35	4.0	Silty sand mound
36	4.0	Thalassia
37	4.0	Penicillus capitatus
38	4.0	Silty sand
39	4.0	Thalassia
40	4.0	Thalassia
41	4.0	Thalassia
42	4.0	Silty sand
43	4.0	Halimeda incrassata
44	4.0	Thalassia

Site 11. Ocean Reef, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
45	4.0	Thalassia
46	4.0	Thalassia
47	4.0	Silty sand
48	4.0	Silty sand, Thalassia
49	4.0	Thalassia
50	4.0	Silty sand mound
51	4.0	Thalassia
52	4.0	Silty sand mound
54	4.0	Thalassia
55	4.0	Thalassia
56	4.0	Halimeda sp.
57	4.0	Silty mound
58	4.0	Thalassia
59	4.0	Silty sand mound
60	4.0	Thalassia
61	4.0	Thalassia
62	4.0	Thalassia
63	4.0	Silty sand mound
64	4.0	Thalassia
65	4.0	Silty sand
66	4.0	Thalassia
67	4.0	Thalassia

Site 11. Ocean Reef, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
68	4.0	Thalassia
69	4.0	Hydroid
70	4.0	Thalassia
71	4.0	Haliclona viridis
72	4.0	Thalassia
73	4.0	Thalassia
74	4.0	Thalassia
75	4.0	Thalassia
76	4.0	Silty sand
77	4.0	Silty sand
78	4.0	Thalassia
79	4.0	Thalassia
80	4.0	Silty sand mound

Site 11. Ocean Reef

Transect 2. About 400 m long run on a heading of 288° true and 300 m east of Transect 1.
23 August 1980

Meter mark	Depth meters	Bottom type and species
1	4.0	Thalassia
2	4.0	Thalassia
3	4.0	Thalassia
4	4.0	Thalassia, Tegula fasciata
5	4.0	Thalassia
6	4.0	Sand mound
7	4.0	Thalassia
8	4.0	Thalassia
9	4.0	Thalassia
10	4.0	Thalassia
11	4.0	Thalassia
12	4.0	Thalassia
13	4.0	Thalassia
14	4.0	Thalassia, Plexaura lamourouxi
15	4.0	Thalassia, sand mound
16	4.0	Thalassia, sand mound
17	4.0	Thalassia, Demospongia indet.
18	4.0	Thalassia
19	4.0	Thalassia
20	4.3	Thalassia, Codakia orbicularis
21	4.3	Thalassia
22	4.3	Thalassia, sand mound

Site 11. Ocean Reef Club, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
23	4.3	Thalassia, sand mound
24	4.3	Thalassia
25	4.3	Thalassia
26	4.3	Thalassia
27	4.3	Sand
28	4.3	Thalassia
29	4.3	Thalassia
30	4.3	Thalassia
31	4.3	Thalassia, Codakia orbicularis
32	4.3	Thalassia, Halimeda sp.
33	4.3	Thalassia
34	4.3	Thalassia
35	4.3	Sand mound, Codakia orbicularis
36	4.3	Thalassia
37	4.3	Thalassia
38	4.3	Thalassia, Codakia orbicularis
39	4.3	Thalassia
40	4.6	Thalassia
41	4.6	Thalassia
42	4.6	Thalassia
43	4.6	Thalassia
44	4.6	Thalassia, sand mound

Site 11. Ocean Reef, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
45	4.6	Thalassia
46	4.6	Thalassia
47	4.6	Thalassia, Codakia orbicularis
48	4.6	Thalassia
49	4.6	Thalassia
50	4.6	Thalassia, Halimeda incrassata
51	4.6	Thalassia, H. incrassata
52	4.6	Thalassia
53	4.6	Thalassia
54	4.6	Sand
55	4.6	Thalassia
56	4.6	Thalassia
57	4.6	Thalassia
58	4.6	Thalassia
59	4.6	Thalassia
60	4.6	Thalassia
61	4.6	Thalassia
62	4.2	Thalassia
63	4.2	Thalassia
64	4.2	Thalassia
65	4.2	Thalassia
66	4.2	Sand

Site 11. Ocean Reef, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
67	4.2	Thalassia
68	4.2	Thalassia
69	4.2	Thalassia, sand
70	4.6	Thalassia
71	4.6	Thalassia
72	4.6	Thalassia
73	4.6	Thalassia
74	4.6	Thalassia
75	4.6	Thalassia
76	4.6	Thalassia
77	4.6	Thalassia
78	4.6	Halimeda incrassata
79	4.6	Thalassia
80	4.6	Thalassia

Site 11. Ocean Reef

Transect 3. About 400 m long run on a heading of 288o true and 300 m west of Transect 1.
23 August 1980

Meter mark	Depth meters	Bottom type and species
0	3.7	Thalassia
1	3.7	Thalassia, Codakia orbicularis
2	3.7	Thalassia
3	3.7	Sand mound
4	3.7	Thalassia, Codakia orbicularis
5	3.7	Thalassia
6	3.7	Thalassia
7	3.7	Thalassia
8	3.7	Thalassia
9	3.7	Thalassia, Halimeda
10	3.7	Thalassia
11	3.7	Thalassia
12	3.7	Sand mound
13	3.7	Sand
14	3.7	Thalassia
15	3.7	Thalassia
16	3.7	Thalassia, Halimeda
17	3.7	Thalassia
18	4.0	Thalassia
19	4.0	Thalassia
20	4.0	Thalassia, Codakia orbicularis
21	4.0	Thalassia, C. orbicularis

Site 11. Ocean Reef, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
22	4.0	Thalassia
23	4.0	Thalassia
24	4.0	Thalassia
25	4.0	Sand
26	4.0	Thalassia, sand
27	4.0	Thalassia
28	4.0	Sand mound
29	4.0	Thalassia
30	4.0	Thalassia
31	4.0	Thalassia
32	4.0	Thalassia
33	4.0	Sand mound
34	4.0	Thalassia
35	4.0	Thalassia
36	4.0	Thalassia
37	4.0	Thalassia
38	4.0	Thalassia
39	4.0	Sand
40	4.0	Thalassia, Codakia orbicularis
41	4.0	Sand mound
42	4.0	Thalassia
43	4.0	Thalassia

Site 11. Ocean Reef, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
44	4.0	Thalassia
45	4.0	Sand mound, Codakia orbicularis
46	4.0	Sand mound, C. orbicularis
47	4.0	Thalassia
48	4.0	Thalassia
49	4.0	Thalassia
50	4.0	Thalassia
51	4.0	Thalassia, Halimeda incrassata
52	4.0	Thalassia
53	4.0	Sand mound
54	4.0	Thalassia
55	4.0	Sand mound
56	4.0	Sand
57	4.0	Sand mound
58	4.0	Halimeda incrassata
59	4.0	Thalassia
60	4.0	Thalassia
61	4.0	Sand mound
62	4.0	Sand mound
63	4.0	Thalassia, Codakia orbicularis
64	4.0	Thalassia
65	4.0	Thalassia

Site 11. Ocean Reef, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
66	4.0	Sand mound, Codakia orbicularis
67	4.0	Sand mound
68	4.0	Thalassia
69	4.0	Thalassia, Codakia orbicularis
70	4.0	Thalassia
71	4.0	Sand mound, Codakia orbicularis
72	4.0	Sand mound
73	4.0	Thalassia
74	4.0	Thalassia
75	4.0	Thalassia
76	4.0	Sand mound
77	4.3	Thalassia
78	4.3	Thalassia
79	4.3	Thalassia
80	3.0	Thalassia

Site 11. Ocean Reef Grass Quadrats
23 August 1980

Species	Quadrats 1	2	3	4
ALGAE				
Rhipocephalus phoenix	0	0	0	1
Halimeda incrassata	7	0	0	0
Penicillus capitatus	3	0	0	0
Penicillus sp.	0	0	0	2
PORIFERA				
Chondrilla nucula	0	1	0	0
Desmacella sp.	1	0	0	0
MOLLUSCA				
Modulus modulus	1	0	0	8
Astraea phoebia	1	0	0	0
A. tecta tecta	1	0	0	0
Codakia orbicularis	1	2	0	3
Anadara floridana	1	2	0	3
Glycimeris pectinata	0	0	1	0
Laevicardium laevigatum	0	0	1	1
ECHINODERMATA				
Schizaster orbignyana	0	0	0	1
ASCIDIACEA				
Microcosmus jelleri	0	0	2	0

Site 12. Turtle Harbor

Transect 1. About 400 m long run on a heading of 318° true starting 100 m inshore of marker "27" on a range with Carysfort Light.
28 August 1981

Meter mark	Depth meters	Bottom type and species
0	4.3	Thalassia, muddy sand
1	4.3	Thalassia
2	4.3	Muddy sand
3	4.5	Thalassia
4	4.5	Muddy sand
5	4.5	Thalassia
6	4.5	Thalassia
7	4.5	Muddy sand
8	4.5	Muddy sand
9	4.5	Thalassia
10	4.5	Thalassia
11	4.5	Thalassia
12	4.5	Thalassia
13	4.5	Thalassia
14	4.5	Thalassia
15	4.5	Muddy sand
16	4.5	Thalassia
17	4.5	Muddy sand
18	4.5	Muddy sand
19	4.5	Thalassia
20	4.5	Thalassia
21	4.5	Muddy sand

Site 12. Turtle Harbor, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
22	4.5	Thalassia
23	4.5	Thalassia
24	4.5	Thalassia
25	4.5	Thalassia
26	4.5	Muddy sand
27	4.5	Thalassia
28	4.5	Muddy sand
29	4.3	Thalassia
30	4.5	Thalassia
31	4.5	Thalassia
32	4.5	Thalassia
33	4.5	Muddy sand
34	4.5	Muddy sand
35	4.5	Muddy sand
36	4.5	Thalassia
37	4.5	Thalassia
38	4.5	Muddy sand
39	4.5	Thalassia
40	4.5	Thalassia
41	4.5	Thalassia
42	4.5	Thalassia
43	4.5	Thalassia

Site 12. Turtle Harbor, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
44	4.5	Thalassia
45	4.5	Thalassia
46	4.5	Muddy sand
47	4.5	Thalassia
48	4.5	Thalassia
49	4.5	Muddy sand
50	4.5	Thalassia
51	4.5	Thalassia
52	4.5	Lytechinus variegatus
53	4.5	Thalassia
54	4.5	Muddy sand
55	4.5	Muddy sand
56	4.5	Thalassia
57	4.5	Muddy sand
58	4.5	Muddy sand
59	4.5	Thalassia
60	4.5	Thalassia
61	4.5	Thalassia
62	4.5	Thalassia
63	4.5	Thalassia
64	4.5	Muddy sand
65	4.5	Thalassia

Site 12. Turtle Harbor, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
66	4.5	Muddy sand
67	4.5	Muddy sand
68	4.5	Thalassia
69	4.5	Thalassia
70	4.5	Thalassia
71	4.5	Thalassia
72	4.5	Thalassia
73	4.5	Thalassia
74	4.5	Thalassia
75	4.5	Muddy sand
76	4.5	Thalassia
77	4.5	Thalassia
78	4.5	Thalassia
79	4.5	Thalassia
80	4.5	Muddy sand

Site 12. Turtle Harbor

Transect 2. About 400 m long run on a heading of 318° true and 300 m west of Transect 1.
28 August 1981

Meter mark	Depth meters	Bottom type and species
1	5.5	Thalassia
2	5.5	Muddy sand
3	5.5	Thalassia
4	5.5	Thalassia
5	5.5	Muddy sand
6	5.5	Thalassia
7	5.5	Muddy sand
8	5.5	Thalassia
9	5.5	Muddy sand
10	5.5	Muddy sand
11	5.5	Muddy sand
12	5.5	Thalassia
13	5.5	Syringodium
14	5.5	Thalassia
15	5.5	Thalassia
17	5.5	Muddy sand
18	5.5	Muddy sand
19	5.5	Thalassia
20	5.5	Sand
21	5.5	Thalassia
22	5.5	Thalassia
23	5.5	Muddy sand

Site 12. Turtle Harbor, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
24	5.5	Thalassia
25	5.5	Thalassia
26	5.5	Muddy sand
27	5.5	Thalassia
28	5.5	Muddy sand
29	5.5	Thalassia
30	5.5	Thalassia
31	5.5	Muddy sand
32	5.5	Muddy sand
33	5.5	Thalassia
34	5.5	Thalassia
35	5.5	Thalassia
36	5.5	Thalassia
37	5.5	Penicillus dumetosus
38	5.5	Thalassia
39	5.5	Andara notabilis
40	5.5	Muddy sand
41	5.5	Muddy sand
42	5.5	Thalassia
43	5.5	Thalassia
44	5.5	Muddy sand
45	5.5	Muddy sand

Site 12. Turtle Harbor, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
46	5.5	Cistenides regalis
47	5.5	Thalassia
48	5.5	Thalassia
49	5.5	Thalassia
50	5.5	Muddy sand
51	5.5	Thalassia
52	5.5	Thalassia
53	5.5	Muddy sand
54	5.5	Muddy sand
55	5.5	Thalassia
56	5.5	Muddy sand
57	5.5	Thalassia
58	5.5	Thalassia
59	5.5	Thalassia
60	5.5	Sand
61	5.5	Muddy sand
62	5.5	Thalassia
63	5.5	Thalassia
64	5.5	Thalassia
65	5.5	Thalassia
66	5.5	Muddy sand
67	5.5	Thalassia

Site 12. Turtle Harbor, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
68	5.5	Thalassia
69	5.5	Muddy sand
70	5.5	Thalassia
71	5.5	Thalassia
72	5.5	Muddy sand
73	5.5	Thalassia
74	5.5	Thalassia
75	5.5	Muddy sand
76	5.5	Muddy sand
77	5.5	Thalassia
78	5.5	Thalassia
79	5.5	Thalassia
80	5.5	Muddy sand

Site 12. Turtle Harbor

Transect 3. About 400 m long run on a heading of 318° true and 300 m east of Transect 1.
28 August 1981

Meter mark	Depth meters	Bottom type and species
0	6.1	Halimeda incrassata
1	6.1	Thalassia
2	6.1	Thalassia
3	6.1	Thalassia, Laevicardium laevigatum
4	6.1	Thalassia
5	6.1	Thalassia
6	6.1	Thalassia, Penicillus capitatus, Codakia orbicularis
7	6.1	Thalassia
8	6.1	Thalassia
9	6.1	Thalassia, Dorid nudibranch
10	6.1	Spheciospongia vesparia
11	6.1	Thalassia
12	6.1	Thalassia, Halimeda incrassata
13	6.1	Thalassia
14	6.1	Thalassia
15	6.1	Thalassia
16	6.1	Thalassia, Halimeda monile
17	6.1	Thalassia
18	6.1	Thalassia
19	6.1	Thalassia
20	6.1	Thalassia
21	6.1	Penicillus capitatus

Site 12. Turtle Harbor, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
22	6.1	Thalassia
23	6.1	Thalassia
24	6.1	Thalassia
25	6.1	Sand
26	6.1	Thalassia
27	6.1	Thalassia, Halimeda incrassata
28	6.1	Thalassia
29	6.1	Thalassia, Linga pensylvanica
30	6.1	Thalassia, Penicillus capitatus
31	6.1	Thalassia
32	6.1	Thalassia
33	6.1	Thalassia
34	6.1	Thalassia
35	6.1	Thalassia
36	6.1	Thalassia
37	6.1	Thalassia, Halimeda incrassata
38	6.1	Thalassia, Lytechinus variegatus
39	6.1	Thalassia
40	6.1	Thalassia
41	6.1	Thalassia
42	6.1	Thalassia
43	6.1	Thalassia

Site 12. Turtle Harbor, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
44	6.1	Thalassia
45	6.1	Thalassia
46	6.1	Thalassia
47	6.1	Thalassia, Codakia orbicularis
48	6.1	Thalassia
49	6.1	Thalassia
50	6.1	Thalassia, Penicillus dumetosus
51	6.1	Thalassia, Halimeda incrassata, Codakia orbicularis
52	6.1	Thalassia, sand burrows
53	6.1	Thalassia
54	6.1	Thalassia
55	6.1	Thalassia
56	6.1	Thalassia, Penicillus capitatus
57	6.1	Thalassia
58	6.1	Thalassia
59	6.1	Thalassia
60	6.1	Thalassia, Astraea sp.
61	6.1	Thalassia
62	6.1	Thalassia
63	6.1	Thalassia
64	6.1	Thalassia
65	6.1	Thalassia

Site 12. Turtle Harbor, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
66	6.1	Thalassia
67	6.1	Thalassia
68	6.1	Thalassia
69	6.1	Thalassia
70	6.1	Thalassia
71	6.1	Thalassia
72	6.1	Thalassia
73	6.1	Thalassia
74	6.1	Thalassia
75	6.1	Thalassia, Halimeda monile
76	6.1	Thalassia, Halimeda incrassata
77	6.1	Thalassia
78	6.1	Thalassia
79	6.1	Thalassia, Halimeda incrassata
80	6.1	Thalassia

Site 12. Turtle Harbor Grass Quadrats
19 August 1981

Species	Quadrats 1	2	3	4
ALGAE				
Halimeda incrassata	3	0	5	0
H. sp.	0	1	0	9
Penicillus capitatus	5	3	10	6
P. lamourouxi	0	0	1	0
P. sp.	0	2	0	1
Udotea flabellum	5	0	0	0
Avrainvillea nigricans	5	0	0	0
WORMS				
Loimia sp.	0	0	3	0
Terebellid A	2	0	0	0
Terebellid B	0	0	0	1
Sabella melanostigma	1	0	0	0
MOLLUSCA				
Modulus modulus	2	5	1	1
Astraea tecta	0	0	1	1
A. phoebia	0	1	0	0
Modiolus americanus	1	1	0	0
Glycimeris pectinata	1	0	0	0
Arca zebra	0	0	1	0
Codakia orbicularis	0	0	0	1
Pecten antillarum	0	0	1	0
Laevicardium laevigatum	0	0	0	1

Site 12. Turtle Harbor Grass Quadrats. - continued

Species	Quadrats 1	2	3	4
CRUSTACEA				
Paguristes puncticeps	1	0	0	0
P. sp. A	1	0	0	0
Callianassid sp.	0	0	0	6
ECHINODERMATA				
Actinopyga agassizi	1	0	0	1

Site 13. North Channel

Transect 1. About 400 m long run on a heading of 278° true starting at the base of marker "32".
11 June 1980

Meter mark	Depth meters	Bottom type and species
0	4.6	Thalassia
1	4.6	Mud
2	4.6	Thalassia
3	3.7	Thalassia, Manicina areolata, sponge indet.
4	3.7	Thalassia
5	3.7	Silty mud
6	3.7	Silty mud, Halimeda incrassata
7	3.5	Thalassia
8	3.7	Thalassia
9	3.7	Thalassia, silty mud
10	3.7	Silty mud
11	3.7	Thalassia
12	3.7	Thalassia, silty mud
13	3.7	Silty mud
14	3.7	Halimeda sp., Ophionereis squamulosa
15	3.7	Thalassia
16	3.7	Thalassia
17	3.7	Aplysina cauliformis
18	3.7	Silty mud on hard bottom
19	3.7	Silty mud on hard bottom
20	3.7	Silty mud on hard bottom
21	3.7	Silty mud on hard bottom

Site 13. North Channel, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
22	3.7	Silty mud on hard bottom
23	3.7	Millepora alcicornis
24	3.7	Udotea, Ircinia felix
25	3.7	Enteromorpha, Halimeda sp.
26	3.7	Thalassia
27	3.7	Arca zebra, Homotrema rubrum
28	3.7	Halimeda incrassata
29	3.7	Silty mud over hard bottom
30	3.7	Halimeda sp.
31	3.7	Aplysina cauliformis, Enteromorpha, Dasycladus vermicularis
32	3.7	Silty mud
33	3.7	Silty mud
34	1.8	Silty mud
35	1.8	Gracilaria ferox, Dasycladus vermicularis
36	1.8	Dasycladus vermicularis
37	1.8	Halimeda sp.
38	1.8	Halimeda sp., Dasycladus vermicularis
39	1.8	Gracilaria ferox, Dasycladus
40	3.0	Dasycladus
41	3.0	Ophionereis squamulosa
42	3.0	Sargassum pteropleuron

Site 13. North Channel, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
43	3.0	Sand
44	3.0	Sand mud
45	3.0	Enteromorpha, Dasycladus
46	3.0	Dasycladus
47	3.0	Sandy mud
48	3.0	Ircinia felix
49	3.0	Dasycladus
50	3.0	Sandy mud over hard bottom
51	3.0	Enteromorpha
52	3.0	Dasycladus
53	3.0	Gracilaria ferox, Enteromorpha
54	3.0	Sponge
55	3.0	Enteromorpha
56	3.0	Enteromorpha, Acetabularia crenulata
57	3.0	Thalassia, Enteromorpha, Dictyosphaerea cavernosa
58	3.0	Enteromorpha
59	1.8	Dasycladus
60	1.8	Sargassum pteropleuron
61	3.0	Enteromorpha
62	3.0	Enteromorpha
63	3.0	Ircinia felix
64	3.0	Siderastrea siderea

Site 13. North Channel, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
65	3.0	Dasycladus
66	3.0	Enteromorpha
67	3.0	Gracilaria ferox
68	3.0	Enteromorpha
69	1.8	Enteromorpha
70	1.8	Enteromorpha, Halimeda sp.
71	1.8	Dasycladus
72	1.8	Enteromorpha
73	1.8	Sargassum pteropleuron
74	1.5	Dasycladus
75	1.5	Enteromorpha, Halimeda sp.
76	1.5	Dasycladus
77	1.5	Muddy sand, hard bottom, Caulerpa prolifera
78	1.5	Sandy mud, Cliona deletrix
79	1.5	Thalassia
80	1.5	Acetabularia crenulata, Halimeda incrassata

Site 13. North Channel

Transect 2. About 400 m long run on a heading of 278° true and 300 m west of Transect 1.
13 June 1980

Meter mark	Depth meters	Bottom type and species
1	4.6	Thalassia, silty mud
2	4.6	Thalassia
3	4.6	Thalassia
4	4.6	Thalassia
5	4.6	Mud, Chione paphia
6	4.6	Thalassia
7	4.6	Thalassia
8	4.6	Thalassia
9	4.6	Thalassia
10	4.6	Thalassia
11	4.6	Thalassia
12	4.6	Thalassia
13	4.6	Thalassia
14	4.6	Thalassia
15	4.6	Thalassia
16	4.6	Silty mud
17	4.6	Silty mud
18	4.6	Thalassia, silty mud
19	4.6	Thalassia
20	4.1	Thalassia
21	4.1	Thalassia
22	4.1	Thalassia, Cistenides gouldi

Site 13. North Channel, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
23	4.1	Thalassia
24	4.1	Mud
25	4.1	Thalassia, silty mud
26	4.1	Silty mud
27	4.1	Thalassia
28	4.9	Thalassia
29	4.9	Thalassia
30	4.9	Thalassia
31	4.9	Thalassia, silty mud
32	4.6	Thalassia
33	4.6	Thalassia
34	4.3	Thalassia, Glycimeris pectinata
35	4.3	Thalassia, silty mud
36	4.3	Silty mud
37	4.3	Silty mud
38	4.3	Thalassia
39	4.3	Thalassia
40	4.3	Thalassia
41	4.3	Thalassia
42	4.3	Thalassia, Manicina areolata
43	4.3	Thalassia
44	4.3	Thalassia, Porites divaricata

Site 13. North Channel, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
45	4.3	Thalassia
46	4.3	Thalassia
47	4.3	Thalassia
48	4.3	Thalassia
49	4.3	Silty mud
50	4.3	Thalassia
51	4.3	Thalassia
52	4.3	Thalassia, silty mud
53	4.3	Haliclona coerulescens
54	4.3	Thalassia
55	4.6	Thalassia
56	4.6	Silty mud
57	4.6	Thalassia
58	4.6	Thalassia
59	4.3	Silty mud
60	4.3	Thalassia
61	3.7	Silty mud
62	3.7	Thalassia
63	3.7	Thalassia
64	3.7	Thalassia
65	3.7	Thalassia
66	3.7	Halimeda incrassata

Site 13. North Channel, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
67	3.7	Sand over hard bottom
68	3.7	Dasycladus, Laurencia, Homotrema rubrum
69	3.7	Dasycladus
70	3.7	Clypeaster rosaceus
71	3.7	Sand on hard bottom
72	3.7	Halimeda incrassata
73	3.7	H. incrassata
74	3.7	Dasycladus
75	3.7	Sand over hard bottom
76	3.7	Halimeda incrassata
77	3.7	H. incrassata
78	3.7	Laurencia, Halimeda sp.
79	3.7	Sand over hard bottom
80	4.2	Sand over hard bottom

Site 13. North Channel

Transect 3. About 400 m long run on a heading of 278° true and 300 m east of Transect 1.
13 June 1980

Meter mark	Depth meters	Bottom type and species
0	4.3	Thalassia, silty mud
1	4.3	Thalassia, silty mud
2	4.0	Thalassia
3	4.0	Thalassia, silty mud
4	4.0	Thalassia, silty mud
5	3.7	Silty mud
6	3.7	Silty mud
7	3.7	Silty mud, Thalassia
8	3.7	Silty mud, Thalassia
9	3.7	Thalassia
10	3.7	Thalassia
11	3.7	Silty mud
12	3.7	Ircinia felix
13	3.7	Aplysina cauliformis
14	3.7	Porites divaricata
15	4.0	Briareum asbestinum, Millepora alcicornis
16	4.0	Thalassia
17	3.7	Aplysina cauliformis
18	3.7	Hard bottom
19	4.0	Hard bottom
20	4.0	Silty mud
21	4.0	Thalassia

Site 13. North Channel, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
22	4.0	Silty mud
23	3.4	Silty mud
24	3.4	Hard bottom
25	3.4	Hard bottom
26	3.4	Thalassia
27	3.4	Thalassia, Halimeda incrassata
28	3.4	Hard bottom
29	3.4	Enteromorpha, Laurencia, Dasycladus
30	3.4	Dasycladus
31	3.4	Dasycladus
32	3.4	Halimeda incrassata
33	3.4	Dasycladus, Enteromorpha, polynoid, Amphiroa rigida
34	3.4	Halimeda incrassata, Pseudopterogorgia rigida
35	3.4	Pomatostegus stellatus, Marphysa sp., Dasycladus
36	3.4	Hard bottom
37	3.4	Hard bottom
38	3.4	Hard bottom
39	3.4	Hard bottom
40	3.4	Halimeda incrassata, Acetabularia crenulata
41	3.4	Enteromorpha
42	3.4	Hard bottom
43	3.4	Penicillus capitatus

Site 13. North Channel, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
44	3.0	Ophionereis squamulosa
45	3.0	Halimeda incrassata, Laurencia
46	3.0	Laurencia, Dasycladus
47	3.0	Dasycladus
48	2.8	Hard bottom
49	2.8	Halimeda incrassata
50	2.8	Dasycladus
51	2.8	Dasycladus
52	2.8	Halimeda tuna, Acetabularia crenulata
53	2.8	Halimeda, Enteromorpha
54	2.8	Sargassum pteropleuron
55	2.8	Sargassum, Laurencia
56	2.8	Verongia longissima, Aplysina cauliformis
57	2.8	Udotea flabellum, Laurencia
58	2.8	Halimeda incrassata
59	2.8	Halimeda, Enteromorpha
60	2.8	Sargassum pteropleuron
61	2.8	Pseudopterogorgia acerosa
62	2.8	Enteromorpha
63	2.8	Halimeda incrassata, Enteromorpha
64	2.8	Hard bottom
65	2.5	Penicillus capitatus

Site 13. North Channel, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
66	2.5	Halimeda incrassata
67	2.5	Enteromorpha
68	2.5	Hard bottom
69	2.5	Thalassia, Laurencia
70	2.5	Dasycladus
71	2.5	Enteromorpha
72	2.5	Enteromorpha
73	2.5	Enteromorpha
74	2.5	Dasycladus
75	1.8	Dasycladus, Halimeda incrassata
76	1.8	Halimeda incrassata, Sargassum pteropleuron
77	1.8	Dasycladus
78	1.8	Enteromorpha
79	1.8	Thalassia
80	1.5	Thalassia

Site 13. North Channel Hard Bottom Quadrats
21 September 1980

Species	Quadrats 1 - 2	3 - 4
ALGAE		
Penicillus dumetosus	6	0
P. capitatus	1	0
P. pyriformis	0	20
Acetabularia crenulata	1	0
Rhipocephalus phoenix	1	0
Anadyomene stellata	1	0
Halimeda incrassata	32	45
H. monile	0	1
H. tuna	72	63
Dasycladus vermicularis	12	1200
Dictyota sp.	80	0
Udotea flabellum	0	8
Udotea sp.	5	0
Caulerpa cupressoides	0	12
Colpomenia sinuosa	3	0
Laurencia sp.	0	8
Sargassum pteropleuron	10	60
Filamentous red	32	37
PORIFERA		
Ircinia strobilina	1	2
I. felix	1	1
Aplysina cauliformis	6	0

Site 13. North Channel Hard Bottom Quadrats. - continued

Species	Quadrats 1 - 2	Quadrats 3 - 4
Spongia sp.	2	0
Sponge sp.	1	0
Niphates digitalis	0	5
COELENTERATA		
Millepora alcicornis	3	0
Pseudoplexaura flagellosa	1	1
Pseudopterogorgia acerosa	1	0
P. rigida	0	1
Pterogorgia anceps	0	1
Siderastrea siderea	3	2
Porites furcata	1	0
WORMS		
Amphinomid	1	0
Sipunculid	1	0
MOLLUSCA		
Arca zebra	0	1
Glycimeris pectinata	6	0
CRUSTACEA		
Paguristes sp.	2	0
ECHINODERMATA		
Clypeaster rosaceus	1	4
Brittle star sp. A	2	0
Brittle star sp. B	0	6

Site 13. North Channel Grass Quadrats
21 September 1980

Species	Quadrats 1	2	3 - 4
ALGAE			
Halimeda monile	2	0	7
H. incrassata	x	x	x
H. sp.	1	4	0
Acetabularia crenulata	1	0	0
Penicillus pyriformis	0	0	4
Udotea flabellum	0	0	14
Avrainvillea nigricans	1	0	0
Rhipocephalus phoenix	1	1	5
Dictyosphaerea cavernosa	0	0	1
Colpomenia sinuosa	0	0	1
PORIFERA			
Aplysina cauliformis	3	6	1
Haliclona viridis	0	4	0
Chondrilla nucula	0	2	2
Myriastra kallitetilla	0	0	1
Ircinia felix	0	0	1
Haliclona sp.	0	0	1
Lissodendorix sp.	0	0	3
Siphonodictyon siphonum	0	0	1
COELENTERATA			
Manicina areolata	2	5	4
Porites porites	0	0	1

Site 13. North Channel Grass Quadrats. - continued

Species	Quadrats 1	2	3 - 4
WORMS			
Polychaete fragment	0	0	1
Sabellid	0	0	1
MOLLUSCA			
Ark shells	0	3	0
Arca zebra	0	0	7
Bivalve sp.	0	2	0
Laevicardium laevigatum	0	0	3
Anadara notabilis	0	0	1
Codakia orbicularis	0	0	1
Chione cancellata	0	0	1
ECHINODERMATA			
Lytechinus variegatus	2	0	6
Clypeaster rosaeceus	0	0	1
Brittle star sp.	0	0	1

Site 14. South Channel

Transect 1. About 400 m long run on a heading of 328° true starting at navigation marker "2".
13 September 1981

Meter mark	Depth meters	Bottom type and species
0	4.6	Thalassia
1	4.6	Acanthophora, Batophora, Udotea flabellum
2	4.6	Halimeda monile
3	4.6	Thalassia
4	4.6	Astraea tecta, Thalassia, Udotea
5	4.6	Thalassia
6	4.6	Thalassia
7	4.6	Thalassia
8	4.6	Thalassia
9	4.6	Thalassia, Avrainvillea nigricans
10	4.6	Thalassia, Astraea tecta
11	4.6	Thalassia
12	4.6	Thalassia, Penicillus
13	4.6	Thalassia
14	4.6	Thalassia
15	4.6	Thalassia
16	4.6	Thalassia
17	4.6	Thalassia, Codakia orbicularis
18	4.4	Thalassia
19	4.4	Thalassia
20	4.4	Udotea flabellum
21	4.4	Sargassum pteropleuron, Halimeda incrassata

Site 14. South Channel, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
22	4.4	Sand
23	4.4	Porites divaricata, Batophora, Acanthophora
24	4.4	Halimeda monile, Ulva lactuca
25	4.4	Thalassia, Dasycladus
26	4.4	Alga sp.
27	4.0	Alga sp.
28	4.0	Alga sp.
29	4.0	Dasycladus, Aplysina cauliformis
30	4.0	Sand
31	4.0	Udotea, Halimeda tuna
32	4.0	Acanthophora, Udotea, Batophora
33	4.0	Acanthophora
34	4.0	Acanthophora, Udotea
35	4.0	Thalassia
36	4.0	Acanthophora, Halimeda tuna
37	4.0	Acanthophora, Udotea
38	4.0	Dasycladus
39	4.0	Acanthophora, Caulerpa sp.
40	4.0	Udotea, Halimeda tuna, Dasycladus
41	4.0	Halimeda monile, Acanthophora, Glycimeris pectinata
42	4.0	Udotea alga sp.
43	4.0	Alga sp.

Site 14. South Channel, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
44	4.0	Dasycladus
45	4.0	Acanthophora, Dasycladus
46	4.0	Thalassia
47	4.0	Dasycladus
48	4.0	Dasycladus, Haliclona viridis, Geodia gibberosa
49	4.0	Sand
50	3.9	Udotea, Valonia, Dasycladus
51	3.9	Porites divaricata, Dasycladus
52	3.9	Udotea, Halimeda tuna
53	3.9	Udotea
54	3.9	Thalassia
55	3.9	Dasycladus
56	3.9	Dasycladus
57	3.9	Dasycladus, Acanthophora
58	3.9	Udotea
59	3.9	Dasycladus
60	3.9	Avrainvillea nigricans
61	3.9	A. nigricans
62	3.9	Dasycladus
63	3.9	Dasycladus
64	3.9	Acanthophora
65	3.9	Acanthophora

Site 14. South Channel, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
66	3.9	Dasycladus
67	3.9	Avrainvillea nigricans
68	3.9	A. nigricans
69	3.9	Alga sp.
70	3.7	Thalassia
71	3.7	Dasycladus
72	3.7	Dasycladus
73	3.7	Millepora alcicornis
74	3.7	Dasycladus
75	3.7	Siderastrea radians, Halimeda sp.
76	3.7	Acanthophora
77	3.7	Sargassum pteropleuron
78	3.7	Udotea
79	3.7	Thalassia
80	3.7	Halimeda tuna

Site 14. South Channel

Transect 2. About 400 m long run on a heading of 328° true and 300 m east of Transect 1. 14 September 1981

Meter mark	Depth meters	Bottom type and species
0	4.0	Ircinia campana
1	4.0	Acanthophora
2	3.7	Halimeda monile
3	3.7	Alga sp.
4	3.7	Alga sp.
5	3.7	Dasycladus
6	4.0	Dasycladus
7	4.3	Batophora
8	4.3	Batophora, Avrainvillea
9	4.3	Alga sp.
10	4.3	Halimeda monile
11	4.3	Alga sp.
12	4.3	Dasycladus, Batophora
13	4.3	Siderastrea radians
14	4.3	Halimeda monile
15	4.3	Cinachyra sp.
16	4.3	Sargassum pteropleuron
17	4.3	Alga sp.
18	4.3	Alga sp.
19	4.3	Thalassia
20	4.3	Alga sp.
21	4.3	Alga sp.

Site 14. South Channel, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
22	4.3	Halimeda tuna
23	4.3	H. tuna
24	4.3	Sand
25	4.3	Halimeda tuna
26	4.3	Alga sp.
27	4.3	Udotea
28	4.0	Halimeda monile, Ulva lactuca
29	4.0	H. monile
30	4.0	Cinachyra sp.
31	4.0	Halimeda globosa
32	4.0	Udotea
33	4.3	Batophora, Halimeda tuna
34	4.3	Sand
35	4.3	Halimeda monile
36	4.3	Thalassia
37	4.3	Sand
38	4.3	Alga sp.
39	4.3	Siderastrea radians
40	4.3	Alga sp.
41	4.3	Halimeda lacrimosa
42	4.3	H. lacrimosa
43	4.3	Sand

Site 14. South Channel, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
44	4.3	Batophora
45	4.3	Thalassia
46	4.0	Sargassum pteropleuron
47	4.0	Alga sp.
48	4.0	Alga sp.
49	4.3	Sand
50	3.7	Halimeda monile
51	3.7	Batophora, Valonia
52	3.7	Penicillus capitatus
53	3.7	Sargassum pteropleuron
54	3.7	Udotea
55	3.7	Thalassia
56	3.7	Udotea
57	3.7	Thalassia, Halimeda monile
58	3.7	Alga sp.
59	3.7	Thalassia
60	3.7	Sand
61	3.7	Sand
62	3.7	Thalassia
63	3.7	Halimeda opuntia triloba
64	3.7	H. monile
65	3.7	Udotea

Site 14. South Channel, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
66	3.7	Sand
67	3.7	Thalassia, Modulus modulus
68	3.7	Alga sp.
69	3.7	Penicillus capitatus
70	3.7	Halimeda tuna
71	3.7	Sand
72	3.7	Rhipocephalus phoenix
73	3.7	Cinachyra sp.
74	3.7	Alga sp.
75	3.7	Alga sp.
76	3.7	Sargassum pteropleuron
77	3.7	Alga sp.
78	3.7	Halimeda tuna
79	3.7	H. tuna
80	3.7	Alga sp.

Site 14. South Channel

Transect 3. About 400 m long run on a heading of 328o true and 300 m east of Transect 2. 4 October 1981.

Meter mark	Depth meters	Bottom type and species
0	3.7	Codakia orbicularis
1	4.0	Thalassia
2	3.7	Thalassia
3	3.7	Thalassia
4	3.7	Thalassia
5	3.7	Thalassia, Codakia orbicularis
6	3.7	Thalassia
7	3.7	Thalassia
8	3.7	Thalassia
9	3.7	Halimeda sp.
10	3.4	Halimeda sp.
11	3.4	Thalassia
12	3.4	Sand, hard bottom
13	3.4	Sand, hard bottom
14	3.4	Dasycladus
15	3.4	Algal ball
16	3.4	Siderastrea siderea
17	3.4	Laurencia sp.
18	3.4	Laurencia sp.
19	3.4	Algal ball
20	3.4	Laurencia
21	3.4	Laurencia

Site 14. South Channel, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
22	3.4	Laurencia
23	3.4	Alga sp.
24	3.4	Laurencia
25	3.4	Halimeda incrassata
26	3.4	H. monile
27	3.4	Laurencia
28	3.4	Laurencia
29	3.4	Siderastrea siderea
30	3.4	Avrainvillea
31	3.4	Spheciospongia vesparia
32	3.4	Laurencia
33	3.4	Sargassum pteropleuron, Laurencia
34	3.4	Hard bottom
35	3.4	Algal mat
36	3.4	Siderastrea siderea
37	3.4	Hard bottom
38	3.4	Hard bottom
39	3.4	Aplysina cauliformis
40	3.4	Alga sp.
41	3.4	Laurencia sp.
42	3.4	Aplysina cauliformis
43	3.4	Halimeda tuna

Site 14. South Channel, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
44	3.4	Laurencia
45	3.4	Laurencia
46	3.4	Laurencia, Halimeda tuna
47	3.4	Plexaurella grisea
48	3.4	Halimeda tuna
49	3.4	Hard bottom
50	3.4	Laurencia
51	3.4	Halimeda monile, Dasycladus
52	3.4	Alga sp.
53	3.4	Hard bottom
54	3.4	Dasycladus
55	3.4	Penicillus capitatus
56	3.4	Hard bottom
57	3.4	Avrainvillea
58	3.4	Hard bottom
59	3.4	Laurencia
60	3.4	Algal mat
61	3.4	Laurencia
62	3.4	Hard bottom
63	3.4	Laurencia
64	3.4	Hard bottom
65	3.4	Thalassia

Site 14. South Channel, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
66	3.4	Dasycladus
67	3.4	Hard bottom
68	3.4	Avrainvillea
69	3.4	Dasycladus
70	3.4	Hard bottom
71	3.4	Alga sp.
72	3.4	Alga sp.
73	3.4	Alga sp.
74	3.4	Thalassia
75	3.4	Hard bottom
76	3.4	Hard bottom
77	3.4	Hard bottom
78	3.4	Thalassia
79	3.4	Thalassia
80	3.4	Halimeda tuna

Site 14. South Channel Grass Quadrats
14 September 1981

Species	Quadrats 1	2	3	4
ALGAE				
Udotea flabellum	12	10	4	x
Batophora oerstedi	11	x	x	x
Dictyosphaerea cavernosa	4	0	2	1
Acetabularia crenulata	3	3	0	1
Anadyomene stellata	3	0	0	0
Avrainvillea nigricans	4	1	0	0
Valonia ventricosa	1	3	0	2
Penicillus capitatus	0	2	0	0
P. dumetosus	0	3	0	1
Dasycladus vermicularis	0	0	0	x
Ulva lactuca	0	2	0	0
Halimeda tuna	0	1	0	0
H. incrassata	0	1	0	0
Caulerpa sp.	0	0	1	0
Halimeda monile	16	11	16	4
Dictyota sp.	0	1	0	1
Acanthophora sp.	1	x	0	0
Sargassum pteropleuron	7	6	0	0
Alga	10	x	12	x
Alga	0	1	x	x
Alga	0	x	x	0
Alga	0	1	0	0

Site 14. South Channel Grass Quadrats. - continued

Species	Quadrats 1	2	3	4
Alga	0	1	0	0
Alga	0	0	5	0
Filamentous red	0	1	0	1
PORIFERA				
Dysidea etheria	8	1	0	0
Aplysina cauliformis	4	6	4	0
Ircinia strobilina	0	4	1	0
Chondrilla nucula	0	0	1	0
Niphates sp.	1	0	1	0
Spongia sp.	2	0	1	0
Ircinia sp.	0	0	0	1
Cinachyra sp.	0	0	0	1
Keratosa indet.	0	1	0	0
Sponge A	0	1	0	0
Sponge B	0	3	0	0
Sponge C	0	0	0	4
COELENTERATA				
Briareum asbestinum	1	2	1	1
Plexaurella dichotoma	0	2	1	1
Pterogorgia americana	0	0	2	0
Stephanocoenia michelini	1	0	1	0
Solenastrea hyades	0	0	3	0
Favia fragum	0	0	1	0
Siderastrea radians	0	0	0	3

Site 14. South Channel Grass Quadrats. - continued

Species	Quadrats 1	2	3	4
Anemone	0	1	0	1
WORMS				
Polychaete sp.	0	1	0	0
Sabellid	0	0	0	1
MOLLUSCA				
Nudibranch sp.	1	1	0	0
Astraea tecta	1	0	0	2
Modulus modulus	0	0	2	0
Cerithium sp.	0	1	0	0
Anadara notabilis	1	0	0	0
Arca zebra	4	0	0	6
Glycimeris pectinata	0	0	0	1
Pecten sp.	0	0	1	0
CRUSTACEA				
Paguristes puncticeps	4	1	1	1
Panulirus argus	0	0	0	1
Pagurid sp.	0	1	0	0
ECHINODERMATA				
Lytechinus variegatus	0	3	0	0
Ophiothrix orestedi	1	0	0	0
Ophioderma rubicundum	0	0	0	1
Brittlestar A	0	0	2	0
Brittlestar B	0	0	0	6

Site 15. Rodriguez Key

Transect 1. About 400 m long run on a heading of 278° true starting approximately 1400 m north east of navigation buoy "J". 7 June 1980

Meter mark	Depth meters	Bottom type and species
0	2.7 to 3.0	Thalassia, Halimeda incrassata
1	2.7 to 3.0	Thalassia
2	2.7 to 3.0	Thalassia
3	2.7 to 3.0	Thalassia
4	2.7 to 3.0	Thalassia
5	2.7 to 3.0	Thalassia
6	2.7 to 3.0	Thalassia, Lytechinus variegatus
7	2.7 to 3.0	Thalassia
8	2.7 to 3.0	Thalassia
9	2.7 to 3.0	Thalassia
10	2.7 to 3.0	Thalassia, Acetabularia crenulata, Halimeda incrassata
11	2.7 to 3.0	Thalassia
12	2.7 to 3.0	Thalassia
13	2.7 to 3.0	Thalassia
14	2.7 to 3.0	Thalassia, Penicillus lamourouxi

Site 15. Rodriguez Key, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
15	2.7 to 3.0	Aplysina cauliformis, Penicillus dumetosus, P. lamourouxi
16	2.7 to 3.0	Penicillus dumetosus
17	2.7 to 3.0	Thalassia
18	2.7 to 3.0	Thalassia
19	2.7 to 3.0	Thalassia, Penicillus lamourouxi, Udotea flabellum
20	2.7 to 3.0	Thalassia, Halimeda monile
21	2.7 to 3.0	Thalassia
22	2.7 to 3.0	Thalassia
23	2.7 to 3.0	Thalassia, Penicillus pyriformis
24	2.7 to 3.0	Thalassia, Udotea flabellum
25	2.7 to 3.0	Thalassia
26	2.7 to 3.0	Thalassia
27	2.7 to 3.0	Thalassia
28	2.7 to 3.0	Thalassia
29	2.7 to 3.0	Thalassia

Site 15. Rodriguez Key, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
30	2.7 to 3.0	Thalassia
31	2.7 to 3.0	Thalassia
32	2.7 to 3.0	Thalassia
33	2.7 to 3.0	Thalassia
34	2.7 to 3.0	Thalassia
35	2.7 to 3.0	Thalassia
36	2.7 to 3.0	Thalassia, Avrainvillea nigricans, Lytechinus variegatus, Aplysina cauliformis
37	2.7 to 3.0	Thalassia
38	2.7 to 3.0	Thalassia
39	2.7 to 3.0	Thalassia
40	2.7 to 3.0	Thalassia, Avrainvillea nigricans
41	2.7 to 3.0	Thalassia, Aplysina cauliformis
42	2.7 to 3.0	Thalassia
43	2.7 to 3.0	Thalassia
44	2.7 to 3.0	Thalassia

Site 15. Rodriguez Key, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
45	2.7 to 3.0	Thalassia, Porites divaricata, Avrainvillea nigricans
46	2.7 to 3.0	Thalassia, Halimeda incrassata
47	2.7 to 3.0	Thalassia
48	2.7 to 3.0	Thalassia
49	2.7 to 3.0	Thalassia, Halimeda incrassata
50	2.7 to 3.0	Thalassia, Astraea tecta
51	2.7 to 3.0	Thalassia
52	2.7 to 3.0	Thalassia
53	2.7 to 3.0	Thalassia
54	2.7 to 3.0	Thalassia
55	2.7 to 3.0	Thalassia
56	2.7 to 3.0	Thalassia
57	2.7 to 3.0	Thalassia
58	2.7 to 3.0	Thalassia
59	2.7 to 3.0	Thalassia, Ircinia felix

Site 15. Rodriguez Key, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
60	2.7 to 3.0	Thalassia
61	2.7 to 3.0	Thalassia
62	2.7 to 3.0	Thalassia
63	2.7 to 3.0	Thalassia
64	2.7 to 3.0	Thalassia, Aplysina cauliformis
65	2.7 to 3.0	Thalassia
66	2.7 to 3.0	Thalassia
67	2.7 to 3.0	Thalassia, Lytechinus variegatus
68	2.7 to 3.0	Thalassia
69	2.7 to 3.0	Thalassia
70	2.7 to 3.0	Thalassia
71	2.7 to 3.0	Thalassia, Haliclona viridis
72	2.7 to 3.0	Thalassia
73	2.7 to 3.0	Thalassia
74	2.7 to 3.0	Thalassia

Site 15. Rodriguez Key, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
75	2.7 to 3.0	Thalassia, Halimeda incrassata
76	2.7 to 3.0	Thalassia
77	2.7 to 3.0	Thalassia, Rhipocephalus phoenix
78	2.7 to 3.0	Thalassia, Halimeda incrassata
79	2.7 to 3.0	Thalassia
80	2.7 to 3.0	Thalassia

Site 15. Rodriguez Key

Transect 2. About 400 m long run on a heading of 278° true and 300 m east of Transect 1. 8 June 1980

Meter mark	Depth meters	Bottom type and species
0	2.7 to 3.0	Thalassia
1	2.7 to 3.0	Thalassia, Astraea tecta
2	2.7 to 3.0	Thalassia
3	2.7 to 3.0	Thalassia
4	2.7 to 3.0	Thalassia
5	2.7 to 3.0	Thalassia
6	2.7 to 3.0	Thalassia
7	2.7 to 3.0	Thalassia
8	2.7 to 3.0	Thalassia
9	2.7 to 3.0	Thalassia
10	2.7 to 3.0	Thalassia, mud
11	2.7 to 3.0	Thalassia
12	2.7 to 3.0	Thalassia
13	2.7 to 3.0	Thalassia
14	2.7 to 3.0	Thalassia, Aplysina cauliformis, Haliclona sp.

Site 15. Rodriguez Key, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
15	2.7 to 3.0	Thalassia
16	2.7 to 3.0	Thalassia, Astraea phoebia
17	2.7 to 3.0	Thalassia
18	2.7 to 3.0	Thalassia
19	2.7 to 3.0	Thalassia, Halimeda incrassata
20	2.7 to 3.0	Thalassia
21	2.7 to 3.0	Thalassia
22	2.7 to 3.0	Thalassia
23	2.7 to 3.0	Thalassia, Halimeda incrassata
24	2.7 to 3.0	Thalassia
25	2.7 to 3.0	Thalassia
26	2.7 to 3.0	Thalassia
27	2.7 to 3.0	Thalassia
28	2.7 to 3.0	Thalassia, Halimeda incrassata, Tegula fasciata
29	2.7 to 3.0	Thalassia, Astraea phoebia, brittle star

Site 15. Rodriguez Key, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
30	2.7 to 3.0	Thalassia, Chondrilla nucula
31	2.7 to 3.0	Thalassia, Haliclona compressa
32	2.7 to 3.0	Thalassia, Haliclona compressa
33	2.7 to 3.0	Burrows in mud
34	2.7 to 3.0	Burrows in mud
35	2.7 to 3.0	Thalassia
36	2.7 to 3.0	Thalassia
37	2.7 to 3.0	Thalassia
38	2.7 to 3.0	Thalassia
39	2.7 to 3.0	Thalassia, Chondrilla nucula
40	2.7 to 3.0	Thalassia, Syringodium, burrows
41	2.7 to 3.0	Thalassia
42	2.7 to 3.0	Thalassia
43	2.7 to 3.0	Thalassia
44	2.7 to 3.0	Thalassia, Syringodium

Site 15. Rodriguez Key, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
45	2.7 to 3.0	Thalassia, Haliclona sp., Ircinia strobilina
46	2.7 to 3.0	Thalassia, Syringodium
47	2.7 to 3.0	Thalassia, Lytechinus variegatus
48	2.7 to 3.0	Thalassia
49	2.7 to 3.0	Thalassia, Haliclona compressa
50	2.7 to 3.0	Thalassia
51	2.7 to 3.0	Thalassia
52	2.7 to 3.0	Thalassia, Ophioderma brevispinum
53	2.7 to 3.0	Thalassia
54	2.7 to 3.0	Thalassia, Tethya sp.
55	2.7 to 3.0	Thalassia
56	2.7 to 3.0	Thalassia, Chondrilla nucula
57	2.7 to 3.0	Thalassia
58	2.7 to 3.0	Mound
59	2.7 to 3.0	Thalassia

Site 15. Rodriguez Key, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
60	2.7 to 3.0	Thalassia
61	2.7 to 3.0	Thalassia, Porites furcata
62	2.7 to 3.0	Thalassia
63	2.7 to 3.0	Thalassia
64	2.7 to 3.0	Thalassia
65	2.7 to 3.0	Thalassia
66	2.7 to 3.0	Thalassia, Porites furcata
67	2.7 to 3.0	Thalassia
68	2.7 to 3.0	Thalassia, Halimeda incrassata
69	2.7 to 3.0	Thalassia
70	2.7 to 3.0	Thalassia, Halimeda incrassata
71	2.7 to 3.0	Thalassia
72	2.7 to 3.0	Thalassia, Halimeda incrassata
73	2.7 to 3.0	Thalassia
74	2.7 to 3.0	Thalassia

Site 15. Rodriguez Key, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
75	2.7 to 3.0	Thalassia
76	2.7 to 3.0	Thalassia
77	2.7 to 3.0	Halimeda incrassata
78	2.7 to 3.0	Thalassia, Porites furcata
79	2.7 to 3.0	Thalassia
80	2.7 to 3.0	Thalassia

Site 15. Rodriguez Key

Transect 3. About 400 m long run on a heading of 278° true and 300 m east of Transect 2. 8 June 1980

Meter mark	Depth meters	Bottom type and species
0	3.4 to 4.0	Thalassia
1	3.4 to 4.0	Thalassia
2	3.4 to 4.0	Thalassia
3	3.4 to 4.0	Thalassia, Aplysina cauliformis
4	3.4 to 4.0	Thalassia
5	3.4 to 4.0	Thalassia
6	3.4 to 4.0	Thalassia
7	3.4 to 4.0	Thalassia
8	3.4 to 4.0	Thalassia
9	3.4 to 4.0	Thalassia, Halimeda incrassata
10	3.4 to 4.0	Thalassia
11	3.4 to 4.0	Thalassia
12	3.4 to 4.0	Thalassia
13	3.4 to 4.0	Thalassia
14	3.4 to 4.0	Thalassia

Site 15. Rodriguez Key, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
15	3.4 to 4.0	Thalassia
16	3.4 to 4.0	Halimeda incrassata
17	3.4 to 4.0	Thalassia, Aplysina cauliformis
18	3.4 to 4.0	Thalassia
19	3.4 to 4.0	Thalassia
20	3.4 to 4.0	Thalassia
21	3.4 to 4.0	Thalassia
22	3.4 to 4.0	Thalassia
23	3.4 to 4.0	Thalassia
24	3.4 to 4.0	Thalassia
25	3.4 to 4.0	Thalassia
26	3.4 to 4.0	Mud
27	3.4 to 4.0	Dictyosphaerea carvernosa
28	3.4 to 4.0	Mud
29	3.4 to 4.0	Thalassia

Site 15. Rodriguez Key, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
30	3.4 to 4.0	Thalassia
31	3.4 to 4.0	Astichopus multifidus
32	3.4 to 4.0	Rhipocephalus phoenix
33	3.4 to 4.0	Thalassia
34	3.4 to 4.0	Thalassia
35	3.4 to 4.0	Cladocora arbuscula, Dictyosphaerea vanbosseae
36	3.4 to 4.0	Thalassia
37	3.4 to 4.0	Thalassia
38	3.4 to 4.0	Thalassia
39	3.4 to 4.0	Thalassia
40	3.4 to 4.0	Thalassia
41	3.4 to 4.0	Thalassia, Halimeda incrassata, Didemnum candidum
42	3.4 to 4.0	Thalassia
43	3.4 to 4.0	Penicillus pyriformis
44	3.4 to 4.0	Thalassia, Halimeda opuntia triloba

Site 15. Rodriguez Key, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
45	3.4 to 4.0	Udotea flabellum
46	3.4 to 4.0	Thalassia
47	3.4 to 4.0	Gracilaria sp.
48	3.4 to 4.0	Mud
49	3.4 to 4.0	Thalassia, Halimeda incrassata
50	3.4 to 4.0	Thalassia
51	3.4 to 4.0	Thalassia
52	3.4 to 4.0	Thalassia, Haliclona viridis, Halimeda incrassata
53	3.4 to 4.0	Thalassia
54	3.4 to 4.0	Thalassia, Halimeda incrassata
55	3.4 to 4.0	Thalassia
56	3.4 to 4.0	Thalassia
57	3.4 to 4.0	Thalassia
58	3.4 to 4.0	Thalassia
59	3.4 to 4.0	Thalassia

Site 15. Rodriguez Key, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
60	3.4 to 4.0	Thalassia
61	3.4 to 4.0	Mud
62	3.4 to 4.0	Thalassia
63	3.4 to 4.0	Thalassia, Halimeda incrassata
64	3.4 to 4.0	Thalassia
65	3.4 to 4.0	Thalassia
66	3.4 to 4.0	Thalassia
67	3.4 to 4.0	Thalassia, Dictyosphaerea vanbosseae
68	3.4 to 4.0	Thalassia
69	3.4 to 4.0	Sponge
70	3.4 to 4.0	Thalassia
71	3.4 to 4.0	Thalassia
72	3.4 to 4.0	Thalassia
73	3.4 to 4.0	Thalassia
74	3.4 to 4.0	Thalassia

Site 15. Rodriguez Key, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
75	3.4 to 4.0	Thalassia
76	3.4 to 4.0	Thalassia
77	3.4 to 4.0	Thalassia
78	3.4 to 4.0	Thalassia
79	3.4 to 4.0	Thalassia, Haliclona viridis
80	3.4 to 4.0	Thalassia

Site 15. Rodriguez Key Grass Quadrats
8 June 1980

Species	Quadrats 1	2	3	4
ALGAE				
Halimeda incrassata	8	13	22	21
H. opuntia triloba	1	0	0	0
Penicillus capitatus	0	0	1	0
Avrainvillea nigricans	0	1	0	0
PORIFERA				
Aplysina cauliformis	1	1	0	1
Haliclona compressa	1	1	0	2
H. viridis	0	0	1	5
Lissodendoryx sigmata	0	0	1	0
COELENTERATA				
Porites divaricata	1	0	0	0
P. furcata	0	0	1	0
P. sp.	0	0	1	0
Manicina areolata	0	1	0	0
MOLLUSCA				
Calliostoma jujubinum	0	1	0	0
ECHINODERMATA				
Lytechinus variegatus	1	0	0	3

Site 16. Point Elizabeth

Transect 1. About 400 m long run on a heading of 308° true. 14 August 1981

Meter mark	Depth meters	Bottom type and species
0	4.6	Halimeda opuntia triloba
1	4.6	Sand mound
2	4.6	Sand mound
3	4.6	Sand mound
4	4.6	Sand mound
5	4.6	Sand mound
6	4.6	Haliclona molitba
7	4.6	Thalassia
8	4.6	Thalassia
9	4.6	Sabella melanostigma, Eunice unifrons
10	4.6	Mytilid
11	4.6	Thalassia
12	4.6	Thalassia
13	4.6	Sand mound
14	4.6	Diplodonta punctata
15	4.6	Sand mound
16	4.6	Thalassia
17	4.6	Thalassia
18	4.6	Thalassia
19	4.6	Thalassia
20	4.6	Thalassia
21	4.6	Halimeda opuntia triloba

Site 16. Point Elizabeth, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
22	4.6	Thalassia
23	4.6	Thalassia
24	4.6	Sand mound
25	4.6	Sand mound
26	4.6	Thalassia
27	4.6	Halimeda opuntia triloba
28	4.6	Sand mound
29	4.6	Halimeda o. triloba
30	4.6	Codakia orbicularis
31	4.6	Thalassia
32	4.6	Sand mound
33	4.6	Thalassia
34	4.6	Thalassia
35	4.6	Thalassia
36	4.6	Sand mound
37	4.6	Thalassia, onuphid
38	4.6	Thalassia, onuphid
39	4.6	Sand mound
40	4.3	Thalassia
41	4.3	Haliclona sp.
42	4.3	Sand mound
43	4.3	Thalassia

Site 16. Point Elizabeth, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
44.	4.6	Sand
45	4.6	Thalassia
46	4.6	Modiolus modiolus squamosus
47	4.6	Sand mound
48	4.6	Sand mound
49	4.6	Codakia
50	4.6	Sand mound
51	4.6	Sand mound
52	4.6	Thalassia
53	4.6	Halimeda o. triloba
54	4.6	Thalassia
55	4.6	Algal mat
56	4.6	Linga pensylvanica
57	4.3	Codakia orbicularis
58	4.3	Thalassia
59	4.3	Sand mound
60	4.3	Thalassia
61	4.3	Thalassia
62	4.3	Thalassia
64	4.3	Codakia orbicularis
65	4.3	Penicillus capitatus
66	4.3	Thalassia

Site 16. Point Elizabeth, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
67	4.3	Sand mound
68	4.3	Codakia orbicularis
69	4.3	Codakia orbicularis
70	4.3	Thalassia
71	4.3	Thalassia
72	4.3	Thalassia
73	4.3	Terrebellid
74	4.3	Sand mound
75	4.3	Sand mound
76	4.3	Haliclona sp., Octopus sp.
77	4.3	Thalassia, green algal mat
78	4.3	Green algal mat
79	4.3	Thalassia
80	4.3	Thalassia

Site 16. Point Elizabeth

Transect 2. About 400 m long run on a heading of 308° true. 14 August 1981.

Meter mark	Depth meters	Bottom type and species
0	4.3	Codakia orbicularis
1	4.3	Halimeda tuna
2	4.3	Thalassia
3	4.3	Thalassia
4	4.3	Holothurian
5	4.3	Thalassia
6	4.3	Thalassia, onuphid
6	4.3	Thalassia
7	4.3	Thalassia
8	4.3	Thalassia
9	4.3	Thalassia
10	4.3	Thalassia
11	4.3	Thalassia
12	4.3	Thalassia
13	4.3	Thalassia
14	4.3	Thalassia
15	4.3	Thalassia
16	4.3	Thalassia, sand mound
17	4.3	Thalassia
18	4.3	Thalassia
19	4.3	Thalassia
20	4.3	Codakia orbicularis

Site 16. Point Elizabeth, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
21	4.3	Thalassia
22	4.3	Thalassia
23	4.3	Thalassia
24	4.3	Thalassia
25	4.3	Thalassia, onuphid
26	4.3	Thalassia
27	4.3	Sand mound
28	4.3	Thalassia
29	4.3	Thalassia
30	4.3	Thalassia
31	4.3	Thalassia
32	4.3	Thalassia, onuphid
33	4.3	Thalassia
34	4.3	Thalassia
35	4.3	Thalassia
36	4.3	Thalassia
37	4.3	Thalassia
38	4.3	Thalassia
39	4.3	Thalassia
40	4.0	Thalassia
41	4.0	Thalassia
42	4.0	Holothurian

Site 16. Point Elizabeth, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
43	4.0	Codakia
44	3.7	Thalassia
45	4.3	Codakia
46	3.7	Thalassia
47	3.7	Thalassia
48	3.7	Thalassia
49	3.7	Strombus raninus
50	3.7	Thalassia
51	3.7	Thalassia
52	3.7	Thalassia
53	3.7	Thalassia
54	3.7	Thalassia, onuphid
55	3.7	Sand mound
56	3.7	Thalassia
57	3.7	Sand mound
58	3.7	Thalassia
59	3.7	Thalassia
60	3.7	Codakia orbicularis
61	3.7	C. orbicularis
62	3.7	Algal mat
63	3.7	Penicillus capitatus
64	3.7	Thalassia

Site 16. Point Elizabeth, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
65	3.7	Sand mound
66	3.7	Lytechinus variegatus
67	3.7	Sand mound
68	3.7	Thalassia
69	3.7	Thalassia
70	3.7	Thalassia
71	3.7	Sand mound
72	3.7	Thalassia
73	3.7	Codakia orbicularis
74	3.7	Codakia orbicularis
75	3.7	Thalassia
76	3.7	Codakia orbicularis
77	3.7	Thalassia
78	3.7	Thalassia
79	3.7	Thalassia
80	3.7	Sand mound

Site 16. Point Elizabeth

Transect 3. About 400 m long run on a heading of 308° true.
15 August 1981

Meter mark	Depth meters	Bottom type and species
0	4.0	Thalassia
1	4.0	Thalassia
2	4.0	Callyspongia fallax
3	4.0	Thalassia
4	4.0	Thalassia
5	4.0	Thalassia
6	4.0	Thalassia
7	4.0	Penicillus capitatus
8	4.0	Thalassia
9	4.0	Thalassia, onuphid
10	4.0	Thalassia
11	4.0	Thalassia
12	4.0	Thalassia
13	4.0	Codakia orbicularis
14	4.0	Sand mound
15	4.0	Thalassia
16	4.0	Thalassia
17	4.0	Halimeda tuna
18	4.0	Thalassia
19	4.0	Thalassia
20	4.0	Thalassia
21	4.0	Callyspongia fallax

Site 16. Point Elizabeth, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
22	4.0	Codakia orbicularis
23	4.0	Thalassia
24	4.0	Codakia orbicularis
25	4.0	Thalassia
26	4.0	Codakia orbicularis
27	4.0	Thalassia
28	4.0	Thalassia
29	4.0	Codakia orbicularis
30	4.0	Thalassia
31	4.0	Thalassia
32	4.0	Thalassia
33	4.0	Thalassia
34	4.0	Thalassia
35	4.0	Thalassia
36	4.0	Thalassia
37	4.0	Thalassia
38	4.0	Sand mound
39	4.0	Thalassia
40	4.0	Thalassia
41	4.0	Thalassia
42	4.0	Thalassia
43	4.0	Thalassia

Site 16. Point Elizabeth, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
44	4.0	Thalassia
45	4.0	Thalassia
46	4.0	Thalassia
47	4.0	Thalassia
48	4.0	Thalassia
49	4.0	Thalassia
50	4.0	Thalassia
51	4.0	Onuphid
52	4.5	Penicillus capitatus
53	4.5	Sand mound
54	4.5	Sand mound
55	4.0	Thalassia
56	4.0	Thalassia
57	4.0	Thalassia
58	4.0	Sand mound
59	4.0	Thalassia
60	4.0	Codakia orbicularis
61	4.0	Thalassia
62	4.0	Thalassia
63	4.0	Sand mound
64	4.0	Thalassia, Codakia orbicularis
65	4.0	Thalassia

Site 16. Point Elizabeth, Transect 3. - continued

Meter mark	Depth meters	Bottom type and species
66	4.0	Thalassia
67	4.0	Penicillus capitatus
68	4.0	Sand mound
69	4.0	Codakia orbicularis
70	4.0	Thalassia
71	4.0	Thalassia
72	4.0	Thalassia
73	4.0	Penicillus capitatus
74	4.0	Thalassia
75	4.0	Thalassia
76	4.0	Thalassia
77	4.0	Thalassia
78	4.0	Thalassia
79	4.0	Thalassia
80	4.0	Thalassia

Site 16. Point Elizabeth Grass Quadrats
16 August 1981

Species	Quadrats 1	2	3	4
ALGAE				
Rhipocephalus phoenix	3	0	0	0
Penicillus capitatus	1	0	0	3
P. sp.	1	0	0	0
Udotea flabellum	0	6	0	0
Halimeda incrassata	0	4	0	0
PORIFERA				
Desmacella sp.	1	0	3	0
Tethya sp.	1	0	0	0
Dysidea sp.	0	0	0	1
Sponge indet.	0	1	0	0
WORMS				
Sabellid	0	1	0	0
Terebelid	1	1	0	0
MOLLUSCA				
Calliostoma jujubinum	0	0	1	0
Astraea phoebia	0	0	1	0
Modulus modulus	0	0	0	1
Codakia orbicularis	0	0	0	1
Chione cancellata	1	0	1	0
Diplodonta punctata	1	0	0	0
Linga pensylvanica	0	0	2	0
Anadara notabilis	0	0	1	0
Octopus joubini	0	0	0	1

Site 16. Point Elizabeth Grass Quadrats - continued

Species	Quadrats 1	2	3	4
CRUSTACEA				
Paguristes sp. A	0	0	6	1
ASCIDIACEA				
Didemnum candidum	0	0	0	1

Site 17. Angelfish Creek

Transect 1. About 400 m long run on a heading of 278° true from marker "2" toward marker "PA" at the creek entrance. 22 July 1980

Meter mark	Depth meters	Bottom type and species
0	4.3	Thalassia
1	4.3	Thalassia
2	4.9	Syringodium
3	4.9	Amphiroa, H. tuna, Dictyota, Dysidea
4	4.9	Thalassia
5	4.9	Thalassia
6	4.9	Thalassia, Syringodium
7	4.9	Thalassia
8	4.9	Dasycladus
9	4.9	Dasycladus, Siderastrea siderea
10	5.5	Thalassia
11	5.5	Clypeaster rosaceus
12	5.5	C. rosaceus
13	5.5	Syringodium
14	5.5	Syringodium, Thalassia
15	5.5	Dasycladus, Udotea, sponge
16	5.5	Dictyota, Enteromorpha
17	5.5	Janea sp.
18	5.5	Dasycladus
19	6.1	Dictyota
20	6.1	Dysidea sp., Halimeda tuna
21	6.1	Batophora oerstedi, Anadyomene stellata, Ophionereis squamulosa

Site 17. Angelfish Creek, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
22	6.1	Alga sp.
23	6.1	Thalassia, Haminoea
24	6.1	Thalassia
25	6.1	Rubble, Amphiroa fragilissima, H. tuna, Dysidea sp.
26	5.4	Thalassia
27	5.4	Thalassia
28	5.4	Thalassia
29	5.4	Thalassia
30	5.4	Thalassia
31	5.4	Thalassia
32	5.4	Thalassia
33	5.4	Thalassia
34	5.4	Thalassia, Syringodium, Halimeda lacrimosa
35	5.4	Thalassia
36	5.4	Dasycladus
37	5.4	Halimeda incrassata, Haminoea, Dictyota
38	5.4	Syringodium
39	5.4	Syringodium, Thalassia
40	5.4	Syringodium, Thalassia
41	5.4	Syringodium, Thalassia
42	4.9	Syringodium, Thalassia
43	4.9	Clypeaster rosaceus

Site 17. Angelfish Creek, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
44	4.9	Anthosigmella varians
45	4.9	Dasycladus
46	4.9	Thalassia
47	4.9	Sand
48	4.9	Thalassia
49	4.9	Thalassia
50	4.9	Thalassia, Syringodium, Didemnum candidum
51	4.9	Thalassia
52	4.9	Thalassia
53	4.9	Thalassia, Syringodium
54	4.9	Thalassia, Dysidea, Jania
55	4.9	Thalassia, Amphiroa, Ophioderma brevispinum, Ophionereis squamulosa
56	4.3	Thalassia
57	4.3	Thalassia, Syringodium
58	4.3	Halimeda opuntia, Ophionereis squamulosa
59	4.3	Thalassia
60	3.7	Thalassia
61	3.7	Syringodium
62	3.7	Thalassia, Jania
63	3.7	Thalassia, Syringodium
64	3.4	Thalassia, Syringodium

Site 17. Angelfish Creek, Transect 1. - continued

Meter mark	Depth meters	Bottom type and species
65	3.4	Thalassia, Syringodium
66	3.4	Thalassia, Syringodium
67	3.4	Thalassia, Aplysina cauliformis
68	3.4	Thalassia, Syringodium
69	3.4	Thalassia, Syringodium, Cystenides gouldi
70	3.4	Thalassia, Syringodium
71	3.7	Syringodium, Halimeda lacrimosa
72	3.7	Syringodium, H. lacrimosa
73	3.0	Syringodium, Ophiothrix oerstedi
74	3.0	Syringodium, H. lacrimosa, Didemnum candidum
75	3.0	Thalassia, D. candidum
76	3.0	Thalassia
77	3.0	Sand
78	3.0	Plexaurella grisea
79	3.0	P. grisea
80	3.0	Sand

Site 17. Angelfish Creek

Transect 2. About 400 m long run on a heading of 278° true and 300 m east of Transect 1. 22 July 1980

Meter mark	Depth meters	Bottom type and species
0	6.1	Thalassia
1	6.1	Thalassia
2	6.1	Thalassia
3	6.1	Thalassia
4	6.1	Modiolus m. squamosus
5	6.1	Thalassia
6	6.1	Thalassia
7	6.1	Thalassia
8	6.1	Halimeda incrassata
9	6.1	Thalassia
10	6.1	Thalassia
11	6.1	Thalassia
12	6.1	Thalassia
13	6.1	Thalassia
14	6.1	Thalassia, Halimeda incrassata
15	6.1	Thalassia
16	6.1	Thalassia
17	6.1	Thalassia, Syringodium
18	6.1	Thalassia
19	6.1	Thalassia
20	6.1	Thalassia
21	6.1	Thalassia, Dasycladus vermicularis

Site 17. Angelfish Creek, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
22	6.1	Sand
23	6.1	Syringodium
24	6.1	Sand
25	6.1	Sand
26	6.1	Thalassia
27	6.1	Thalassia
28	6.1	Thalassia
29	6.1	Thalassia
30	6.1	Thalassia, Modiolus m. squamulosa
31	6.1	Thalassia
32	6.1	Sand
33	6.1	Thalassia
34	6.1	Thalassia
35	6.1	Thalassia
36	6.1	Sand, Halimeda incrassata
37	6.1	Thalassia
38	6.1	Sand
39	6.1	Thalassia
40	6.1	Thalassia
41	6.1	Sand
42	6.1	Syringodium
43	6.1	Sand

Site 17. Angelfish Creek, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
44	6.1	Thalassia
45	6.1	Sand
46	6.1	Thalassia
47	6.1	Thalassia
48	6.1	Thalassia
49	6.1	Thalassia
50	6.1	Thalassia
51	6.1	Dasycladus, Porites divaricata, Chondrilla nucula, Amphiroa
52	6.1	Thalassia, Dysidea
53	6.1	Sand
54	6.1	Thalassia
55	6.1	Halimeda incrassata
56	6.1	Thalassia
57	6.1	Dasycladus, Halimeda tuna
58	6.1	Thalassia
59	6.1	Thalassia
60	6.1	Thalassia
61	6.1	Sand
62	6.1	Thalassia
63	6.1	Thalassia
64	6.1	Thalassia

Site 17. Angelfish Creek, Transect 2. - continued

Meter mark	Depth meters	Bottom type and species
65	6.1	Sand
66	6.1	Dasycladus, Halimeda tuna
67	6.1	Sand
68	6.1	Thalassia
69	6.1	Thalassia
70	6.1	Thalassia
71	6.1	Thalassia
72	6.1	Thalassia
73	6.1	Thalassia
74	6.1	Thalassia
75	6.1	Thalassia
76	6.1	Thalassia
77	6.1	Thalassia, Syringodium
78	6.1	Thalassia
79	6.5	Pitho anisodon
80	6.5	Syringodium

Site 17. Angelfish Creek

Transect 3. About 400 m long run on a heading of 278° true and 300 m west of Transect 2. 22 July 1980

Meter mark	Depth meters	Botton type and species
0	6.7	Sand
1	6.7	Thalassia
2	6.7	Thalassia
4	6.7	Thalassia
5	6.7	Syringodium
6	6.7	Aplysina cauliformis
7	6.7	Thalassia
8	6.7	Thalassia
9	6.7	Thalassia
10	6.7	Thalassia
11	6.7	Sand
12	6.7	Thalassia, Syringodium
13	6.7	Sand
14	6.7	Thalassia, Syringodium
15	6.7	Thalassia
16	6.7	Sand
17	6.7	Thalassia
18	6.7	Sand, Americardia media
19	6.7	Thalassia
20	6.7	Thalassia
21	6.7	Thalassia
22	6.7	Thalassia

Site 17. Angelfish Creek, Transect 3. - continued

Meter mark	Depth meters	Botton type and species
23	6.7	Thalassia
24	6.7	Sand, Americardia media
25	6.7	Thalassia
26	6.7	Thalassia
27	6.7	Thalassia, Syringodium
28	6.7	Thalassia, Syringodium
29	6.7	Thalassia
30	6.7	Sand
31	6.7	Thalassia
32	6.7	Thalassia, Syringodium
33	6.7	Thalassia, Syringodium
34	6.7	Thalassia
35	6.7	Syringodium
36	6.7	Thalassia, Syringodium
37	6.7	Thalassia
38	6.7	Thalassia
39	6.7	Thalassia
40	6.7	Thalassia
41	6.7	Sand
42	6.7	Thalassia, Syringodium, Halimeda opuntia
43	6.7	Thalassia, Syringodium
44	6.7	Thalassia, Syringodium

Site 17. Angelfish Creek, Transect 3. - continued

Meter mark	Depth meters	Botton type and species
45	6.7	Thalassia, Syringodium
46	6.7	Thalassia
47	6.7	Thalassia
48	6.7	Thalassia
49	6.7	Thalassia, Syringodium
50	6.7	Thalassia
51	6.7	Thalassia, Syringodium
52	6.7	Thalassia
53	6.7	Thalassia, Syringodium
54	6.7	Thalassia, Syringodium, Aplysina cauliformis
55	6.7	Thalassia, Halimeda monile
56	6.7	Thalassia
57	6.7	Thalassia, Syringodium
58	6.7	Thalassia, Syringodium
59	6.7	Thalassia, Syringodium
60	6.7	Thalassia, Syringodium
61	6.7	Thalassia, Porites dicaricata
62	6.7	Thalassia, Syringodium
63	6.7	Syringodium
64	6.7	Thalassia, compound ascidean
65	6.7	Thalassia, Syringodium, Halimeda lacrimosa, amphinomid
66	6.7	Sand

Site 17. Angelfish Creek, Transect 3. - continued

Meter mark	Depth meters	Botton type and species
67	6.7	Thalassia, Syringodium, Halimeda lacrimosa
68	6.4	Thalassia, Syringodium
69	6.4	Thalassia, Syringodium
70	6.1	Thalassia, Syringodium
71	6.1	Thalassia, Aplysina cauliformis, Ophiothrix oerstedi
72	6.1	Thalassia, Dardanus venosus, Valonia ventricosa
73	6.1	Thalassia, Didemnum candidum
74	6.1	Thalassia, Syringodium
75	6.1	Thalassia, Halimeda lacrimosa
76	6.1	Thalassia, Syringodium
77	6.1	Syringodium, brittlestar, Halimeda sp.
78	6.1	Syringodium
79	6.1	Syringodium, Halimeda opuntia
80	6.1	Halimeda lacrimosa, H. incrassata, brittlestar, Syringodium, Amphiroa rigida

Site 17. Angelfish Creek Coral Quadrats
22 July 1980

Species	Quadrats 1 - 4
ALGAE	
Halimeda opuntia	1
H. o. minor	1
H. tuna	31
Dilophus alternans	3
Dictyota sp.	100
Laurencia sp.	9
Stypopodium zonale	6
Amphiroa fragilissima	10
PORIFERA	
Aplysina cauliformis	22
Haliclona compressa	23
Spinosella vaginalis vaginals	9
Spongia sp.	8
Higginsia sp.	1
Ircinia strobilina	5
Niphates erecta	36
Ircinia campana	2
Cliona deletrix	1
Chondrilla nucula	4
Microciona sp.	1
COELENTERATA	
Millepora alcicornis	22

Site 17. Angelfish Creek Coral Quadrats - continued

Species	Quadrats 1 - 4
Plexaurella grisea	5
P. fusifera	8
P. dichotoma	2
Pseudopterogorgia acerosa	1
P. bipinnata	1
P. americana	21
P. rigida	1
P. kallos	5
Plexaura flexuosa	14
P. homomalla	5
Muricea muricata	8
M. elongata	1
M. laxa	1
Pseudoplexaura wagenaari	1
P. porosa	16
P. flagellosa	2
Muriceopsis flavida	3
Eunicea calyculata	3
E. succinea succinea	2
E. succinea plantaginea	2
E. tourneforti	6
E. fusca	1

Site 17. Angelfish Creek Coral Quadrats - continued

Species	Quadrats 1 - 4
E. sp.	3
Gorgonia ventalina	15
Plexaura sp.	1
Plexaura sp.	1
Siderastrea siderea	18
Eusmilia fastigiata	2
Dichocoenia stokesi	13
Montastrea annularis	2
M. cavernosa	4
Porites astreoides	8
P. sp.	15
Agaricia agaricites	6
Stephanocoenia michelini	2
Oculina diffusa	1
Mussa angulosa	1
Palythoa mammillosa	1
Bartholomea sp.	1
Zoanthus sociatus	3
Lebrunea danae	1
WORMS	
Serpulid	3
Sabellid	17
Hesionid	1

Site 17. Angelfish Creek Coral Quadrats - continued

Species	Quadrats 1 - 4
MOLLUSCA	
Barbatia cancellaria	8
Ostrea (Lopha) frons	3
CRUSTACEA	
Synalpheus hemphilli	1
ECHINODERMATA	
Ophiothrix lineata	2
Brittlestars	2
ASCIDIACEA	
Didemnum candidum	1

Site 17. Angelfish Creek Grass Quadrats
22 July 1980

Species	Quadrats 1 - 4
ALGAE	
Halimeda incrassata	69
H. lacrimosa	1
H. tuna	7
H. monile	10
H. opuntia	2
Dasycladus vermicularis	63
Udotea flabellum	9
Rhipocephalus phoenix	11
Penicillus capitatus	16
Acetabularia crenulata	1
Caulerpa sp.	20
Amphiroa sp.	3
PORIFERA	
Dysidea sp.	8
Dysidea fragilis	16
Lissodendorix sp.	2
Foliolina peltata	1
COELENTERATA	
Millepora sp.	10
Plexaurella fusifera	1
WORMS	
Eunice sp.	1

Site 17. Angelfish Creek Grass Quadrats - continued

Species	Quadrats 1 - 4
Amphinomid	1
MOLLUSCA	
Strombus egg case	1
Acmaea sp.	1
Musculus lateralis	1
CRUSTACEA	
Paguristes tortugae	1
ECHINODERMATA	
Ophiothrix oerstedi	3
Brittlestar sp.	x
Brittlestar sp.	x
Clypeaster rosaceus	2
Eucidaris tribuloides	1
ASCIDIACEA	
Didemnum candidum	2
D. savigni	61
Styela sp.	1
Tunicate sp.	5

Site 18. Molasses Reef, Deep Sites

Transect 1. Molasses Reef Light bearing 328° true run on heading of 328° true. 30 November 1981

Meter marker	Depth meters	Bottom type and species
0	27.4	Sand
1	26.1	Halimeda triloba, Dictyota sp.
2	24.3	Sand
3	23.4	Filamentous algae
4	22.5	Pseudopterogorgia bipinnata
5	21.3	Filamentous algae
6	20.4	Anthosigmella varians
7	18.9	Halimeda tuna
8	16.1	Pocockiella variegata
9	14.9	Anthosigmella varians, Parazanthus sp.
10	14.3	Pseudoterogorgia americana
11	14.3	Xestospongia muta
12	14.3	Sand

Site 18. Molasses Reef Deep Sites

Transect 2. 300 m west of Transect 1 run on heading of 328o to 298o true.
30 November 1981

Meter marker	Depth meters	Bottom type and species
0	28.9	Muricea atlantica
1	28.0	Erythropodium cariboeorum
2	27.7	Spongia indet.
3	27.4	Agelas sp.
4	26.8	Sand
5	25.8	Plexaurella grisea
6	24.9	Sand
7	23.7	Iotrochota birotulata
8	22.8	I. birotulata
9	21.9	Lithothamnion sp., Haliclona viridis
10	21.9	Haliclona viridis
11	20.7	Rubble
12	20.7	Bryozoan (encrusted), filamentous algae

Site 18.

Transect 3. 300 m west of Transect 2 run on heading of 328° true.
1 December 1981

Meter marker	Depth meters	Bottom type and species
0	30.4	Sand
1	30.4	Filamentous algae
2	28.9	Pseudopterogorgia americana
3	28.0	Erythropodium cariboeorum
4	25.8	Halimeda tuna
5	25.2	Filamentous red alga
6	24.3	Galaxaura sp., Pocockiella variegata
7	23.4	Homaxinella sp.
8	21.3	Encrusting sponge
9	19.2	Tedaniid
10	18.5	Homaxinella sp.
11	18.2	Millepora alcicornis
12	18.2	Siderastrea siderea

Appendix B

Percentage Calculations of Organic and Bare Cover on Transects

The percentage calculations given here are in the form presented by Antonius (1974). This method was chosen to permit comparisons of the two studies. In the calculations Composition of Total Transect "total" equals the total number of sample (observation) points on the transect and is equivalent to 100 percent. Bare substrate is when the sample point was on bare sand, rubble, rock or hard bottom with no living organism present. Organic cover was when a living organism lay under the observation point. The number of samples of bare substrate and organic cover is indicated as a percentage of the total number of sample points. In the calculations Composition of Organic Portion the same methods are used. Only plants (algae or sea grasses), sponges, other coelenterates and reefbuilding corals are listed. "Other coelenterates" include sea anemones, hydroids and scleractinians, except stinging corals, Millepora. "Reefbuilding corals" include all of the stony corals and stinging corals.

When percentage figures in Composition of Organic Portion do not add up to 100 percent, the missing percentages are organisms that are not included in the four categories listed above. They are usually mollusks or tunicates. In cases where more than one group of organisms is listed at a sample point, the first group listed was arbitrarily used in the calculations as indicating the most prominent organism.

Site 1. Molasses Reef

Transect 1.

Composition of Total Transect

Total	124	sample points	100%
Bare substrate	21	"	17%
Organic cover	103	"	83%

Composition of Organic Portion

Total	103	sample points	100%
Plants	70	"	68%
Sponges	7	"	7%
Other coelenterates	16	"	16%
Reefbuilding corals	10	"	10%

Transect 2.

Composition of Total Transect

Total	109	sample points	100%
Bare substrate	29	"	27%
Organic cover	80	"	73%

Composition of Organic Portion

Total	80	sample points	100%
Plants	36	"	45%
Sponges	8	"	10%
Other coelentrates	22	"	27.5%
Reefbuilding corals	14	"	17.5%

Transect 3.

Composition of Total Transect

Total	120	sample points	100%
Bare substrate	40	"	33%
Organic cover	80	"	67%

Composition of Organic Portion

Total	80	sample points	100%
Plants	48	"	60%
Sponges	4	"	5%
Other coelenterates	16	"	20%
Reefbuilding corals	12	"	15%

Site 2. White Banks

Transect 1.

Composition of Total Transect

Total	80	sample points	100%
Bare substrate	15	"	19%
Organic cover	65	"	81%

Composition of Organic Portion

Total	65	sample points	100%
Plants	42	"	65%
Sponges	1	"	2%
Other coelenterates	14	"	22%
Reefbuilding corals	5	"	8%

Transect 2.

Composition of Total Transect

Total	81	sample points	100%
Bare substrate	13	"	16%
Organic cover	68	"	84%

Composition of Organic Portion

Total	68	sample points	100%
Plants	42	"	62%
Sponges	2	"	3%
Other coelenterates	14	"	21%
Reefbuilding corals	10	"	14%

Transect 3.

Composition of Total Transect

Total	81	sample points	100%
Bare substrate	16	"	20%
Organic cover	65	"	81%

Composition of Organic Portion

Total	65	sample points	100%
Plants	35	"	53%
Sponges	2	"	3%
Other coelenterates	9	"	13%
Reefbuilding corals	14	"	21%

Site 3. French Reef

Transect 1.

Composition of Total Transect

Total	144	sample points	100%
Bare substrate	65	"	45%
Organic cover	78	"	55%

Composition of Organic Portion

Total	78	sample points	100%
Plants	53	"	68%
Sponges	5	"	6%
Other coelenterates	8	"	10%
Reefbuilding corals	12	"	15%

Transect 2.

Composition of Total Transect

Total	81	sample points	100%
Bare substrate	23	"	28%
Organic cover	58	"	72%

Composition of Organic Portion

Total	58	sample points	100%
Plants	36	"	62%
Sponges	5	"	9%
Other coelenterates	11	"	19%
Reefbuilding corals	6	"	10%

Transect 3.

Composition of Total Transect

Total	122	sample points	100%
Bare substrate	36	"	30%
Organic cover	86	"	70%

Composition of Organic Portion

Total	86	sample points	100%
Plants	55	"	64%
Sponges	1	"	1%
Other coelenterates	18	"	21%
Reefbuilding corals	12	"	14%

Site 4. Mosquito Bank

Transect 1.

Composition of Total Transect

Total	80	sample points	100%
Bare substrate	1	"	1%
Organic cover	79	"	99%

Composition of Organic Portion

Total	79	sample points	100%
Plants	75	"	95%
Sponges	1	"	1%
Other coelenterates	1	"	1%
Reefbuilding corals	2	"	3%

Transect 2.

Composition of Total Transect

Total	81	sample points	100%
Bare substrate	6	"	7%
Organic cover	75	"	93%

Composition of Organic Portion

Total	75	sample points	100%
Plants	67	"	89%
Sponges	0	"	0%
Other coelenterates	6	"	8%
Reefbuilding corals	2	"	3%

Transect 3.

Composition of Total Transect

Total	80	sample points	100%
Bare substrate	4	"	5%
Organic cover	76	"	95%

Composition of Organic Portion

Total	76	sample points	100%
Plants	66	"	87%
Sponges	2	"	3%
Other coelenterates	6	"	7%
Reefbuilding corals	2	"	3%

Site 5. Grecian Rocks

Transect 1.

Composition of Total Transect

Total	80	sample points	100%
Bare substrate	47	"	59%
Organic cover	33	"	41%

Composition of Organic Portion

Total	33	sample points	100%
Plants	22	"	67%
Sponges	0	"	0%
Other coelenterates	5	"	15%
Reefbuilding corals	6	"	18%

Transect 2.

Composition of Total Transect

Total	80	sample points	100%
Bare substrate	38	"	48%
Organic cover	42	"	53%

Composition of Organic Portion

Total	80	sample points	100%
Plants	17	"	40%
Sponges	1	"	2%
Other coelenterates	9	"	21%
Reefbuilding corals	15	"	36%

Transect 3.

Composition of Total Transect

Total	80	sample points	100%
Bare substrate	46	"	58%
Organic cover	34	"	42%

Composition of Organic Portion

Total	34	sample points	100%
Plants	19	"	56%
Sponges	1	"	3%
Other coelenterates	6	"	17%
Reefbuilding corals	8	"	24%

Site 6. Key Largo Dry Rocks

Transect 1.

Composition of Total Transect

Total	81	sample points	100%
Bare substrate	18	"	22%
Organic cover	63	"	78%

Composition of Organic Portion

Total	63	sample points	100%
Plants	39	"	62%
Sponges	0	"	0%
Other coelenerates	2	"	3%
Reefbuilding corals	22	"	35%

Transect 2.

Composition of Total Transect

Total	80	sample points	100%
Bare substrate	9	"	11%
Organic cover	71	"	89%

Composition of Organic Portion

Total	71	sample points	100%
Plants	66	"	93%
Sponges	0	"	0%
Other coelenterates	1	"	1%
Reefbuilding corals	4	"	6%

Transect 3.

Composition of Total Transect

Total	81	sample points	100%
Bare substrate	52	"	64%
Organic cover	29	"	36%

Composition of Organic Portion

Total	29	sample points	100%
Plants	21	"	72%
Sponges	4	"	14%
Other coelenterates	2	"	7%
Reefbuilding corals	1	"	3%

Site 7. The Elbow

Transect 1.

Composition of Total Transect

Total	118	sample points	100%
Bare substrate	52	"	44%
Organic cover	66	"	56%

Composition of Organic Portion

Total	66	sample points	100%
Plants	49	"	74%
Sponges	3	"	5%
Other coelenterates	6	"	9%
Reefbuilding corals	9	"	14%

Transect 2.

Composition of Total Transect

Total	111	sample points	100%
Bare substrate	38	"	34%
Organic cover	73	"	66%

Composition of Organic Portion

Total	73	sample points	100%
Plants	56	"	77%
Sponges	2	"	3%
Other coelenterates	8	"	11%
Reefbuilding corals	7	"	10%

Transect 3.

Composition of Total Transect

Total	82	sample points	100%
Bare substrate	34	"	41%
Organic cover	48	"	59%

Composition of Organic Portion

Total	48	sample points	100%
Plants	28	"	58%
Sponges	4	"	8%
Other coelenterates	9	"	19%
Reefbuilding corals	6	"	13%

Site 10. Turtle Rocks

Transect 1.

Composition of Total Transect

Total	81	sample points	100%
Bare substrate	20	"	25%
Organic cover	61	"	75%

Composition of Organic Portion

Total	61	sample points	100%
Plants	41	"	67%
Sponges	8	"	13%
Other coelenterates	4	"	7%
Reefbuilding corals	1	"	2%

Transect 2.

Composition of Total Transect

Total	81	sample points	100%
Bare substrate	15	"	19%
Organic cover	66	"	81%

Composition of Organic Portion

Total	66	sample points	100%
Plants	53	"	80%
Sponges	1	"	2%
Other coelenterates	1	"	2%
Reefbuilding corals	2	"	3%

Transect 3.

Composition of Total Transect

Total	81	sample points	100%
Bare substrate	9	"	11%
Organic cover	72	"	89%

Composition of Organic Portion

Total	72	sample points	100%
Plants	47	"	65%
Sponges	1	"	1%
Other coelenterates	9	"	13%
Reefbuilding corals	10	"	14%

Site 12. Turtle Harbor

Transect 1.

Composition of Total Transect

Total	81	sample points	100%
Bare substrate	25	"	31%
Organic cover	56	"	69%

Composition of Organic Portion

Total	56	sample points	100%
Plants	55	"	98%
Sponges	0	"	0%
Other coelenterates	0	"	0%
Reefbuilding corals	0	"	0%

Transect 2.

Composition of Total Transect

Total	80	sample points	100%
Bare substrate	30	"	38%
Organic cover	50	"	62%

Composition of Organic Portion

Total	50	sample points	100%
Plants	48	"	96%
Sponges	0	"	0%
Other coelenterates	0	"	0%
Reefbuilding corals	0	"	0%

Transect 3.

Composition of Total Transect

Total	81	sample points	100%
Bare substrate	1	"	1%
Organic cover	80	"	99%

Composition of Organic Portion

Total	80	sample points	100%
Plants	79	"	99%
Sponges	1	"	1%
Other coelenterates	0	"	0%
Reefbuilding corals	0	"	0%

Site 14. South Channel

Transect 1.

Composition of Total Transect

Total	81	sample points	100%
Bare substrate	3	"	4%
Organic cover	78	"	96%

Composition of Organic Portion

Total	78	sample points	100%
Plants	74	"	95%
Sponges	0	"	0%
Other coelenterates	0	"	0%
Reefbuilding corals	4	"	5%

Transect 2.

Composition of Total Transect

Total	81	sample points	100%
Bare substrate	9	"	11%
Organic cover	72	"	89%

Composition of Organic Portion

Total	72	sample points	100%
Plants	66	"	92%
Sponges	1	"	1%
Other coelenterates	0	"	0%
Reefbuilding corals	2	"	3%

Transect 3.

Composition of Total Transect

Total	81	sample points	100%
Bare substrate	16	"	20%
Organic cover	65	"	80%

Composition of Organic Portion

Total	65	sample points	100%
Plants	57	"	88%
Sponges	3	"	5%
Other coelenterates	1	"	2%
Reefbuilding corals	3	"	5%

Site 16. Point Elizabeth

Transect 1.

Composition of Total Transect

Total	81	sample points	100%
Bare substrate	23	"	28%
Organic cover	58	"	72%

Composition of Organic Portion

Total	58	sample points	100%
Plants	42	"	72%
Sponges	3	"	5%
Other coelenterates	0	"	0%
Reefbuilding corals	0	"	0%

Transect 2.

Composition of Total Transect

Total	81	sample points	100%
Bare substrate	7	"	9%
Organic cover	74	"	91%

Composition of Organic Portion

Total	74	sample points	100%
Plants	63	"	85%
Sponges	0	"	0%
Other coelenterates	0	"	0%
Reefbuilding corals	0	"	0%

Transect 3.

Composition of Total Transect

Total	81	sample points	100%
Bare substrates	7	"	9%
Organic cover	74	"	91%

Composition of Organic Portion

Total	74	sample points	100%
Plants	64	"	86%
Sponges	2	"	3%
Other coelenterates	0	"	0%
Reefbuilding corals	0	"	0%

Site 17. Angelfish Creek

Transect 1.

Composition of Total Transect

Total	81	sample points	100%
Bare substrate	3	"	4%
Organic cover	78	"	96%

Composition of Organic Portion

Total	78	sample points	100%
Plants	71	"	91%
Sponges	1	"	1%
Other coelenterates	2	"	3%
Reefbuilding corals	0	"	0%

Transect 2.

Composition of Total Transect

Total	81	sample points	100%
Bare substrate	12	"	15%
Organic cover	69	"	85%

Composition of Organic Portion

Total	69	sample points	100%
Plants	66	"	96%
Sponges	0	"	0%
Other coelenterates	0	"	0%
Reefbuilding corals	0	"	0%

Transect 3.

Composition of Total Transect

Total	81	sample points	100%
Bare substrate	9	"	11%
Organic cover	72	"	89%

Composition of Organic Portion

Total	72	sample points	100%
Plants	70	"	97%
Sponges	1	"	1%
Other coelenterates	0	"	0%
Reefbuilding corals	0	"	0%

Site 18. Molasses Reef - Deep Dive

Transect 1.

Composition of Total Transect

Total	13	sample points	100%
Bare substrate	3	"	23%
Organic cover	10	"	77%

Composition of Organic Portion

Total	10	sample points	100%
Plants	5	"	50%
Sponges	2	"	20%
Other coelenterates	1	"	10%
Reefbuilding corals	0	"	0%

Transect 2.

Composition of Total Transect

Total	13	sample points	100%
Bare substrate	3	"	23%
Organic cover	10	"	77%

Composition of Organic Portion

Total	10	sample points	100%
Plants	2	"	20%
Sponges	4	"	40%
Other coelenterates	3	"	30%
Reefbuilding corals	0	"	0%

Transect 3.

Composition of Total Transect

Total	13	sample points	100%
Bare substrates	1	"	8%
Organic cover	12	"	92%

Composition of Organic Portion

Total	12	sample points	100%
Plants	4	"	33%
Sponges	4	"	33%
Other coelenterates	2	"	17%
Reefbuilding corals	2	"	17%

Appendix C

List of Fauna and Flora with Common Names

The following species list of the fauna and flora of the study area is compiled from the identifications of organisms from the transects, quadrats and poison stations. The scientific names conform to those given in the papers and monographs referred to by the specialists. In some cases name changes may have occurred later. The species names are accompanied by their author's names to facilitate cross-checking. Identification sources are cited in the species photographic card catalog deposited with NOAA.

Many algae and invertebrates have no common names. Rather than invent new ones, those without a known common name have been left blank. Common names of plants and invertebrates were taken from Voss (1980) Seashore Life of Florida and the Caribbean, Smith (1949) Atlantic Reef Corals and Warmke and Abbott (1969) Caribbean Seashells.

The common names of fishes were taken from Robins et al. (1980) A List of Common and Scientific Names of Fishes from the United States and Canada, fourth edition.

Plants

ALGAE

Greens

Acetabularia crenulata Lamouroux	Mermaid's Wine Glass
Anadyomene stellata (Wulfen) C. Agardh	Star Alga
Avrainvillea nigricans Decaisne	
Batophora oerstedi J. Agardh	Batophora
Caulerpa cupressoides (West) C. Agardh	
Caulerpa prolifera (Forsskal) Lamouroux	
Caulerpa sp.	
Chaetomorpha sp.	
Cladophora sp.	
Dasycladus vermicularis (Scopoli) Krasser	Worm Alga
Dictyosphaeria cavernosa (Forsskal) Borgesen	Green Bubble Alga
Dictyosphaeria vanbosseae Borgesen	
Enteromorpha sp.	
Halimeda discoidea Decaisne	
Halimeda lacrimosa Howe	
Halimeda incrassata (Ellis) Lamouroux	
Halimeda monile (Ellis and Solander) Lamouroux	
Halimeda opuntia (Linnaeus) Lamouroux	
Halimeda opuntia minor Vickers	
Halimeda opuntia triloba (Decaisne) Barton	
Halimeda tuna (Ellis and Solander) Lamouroux	
Neomeris annulata Dickie	
Penicillus capitatus Lamarck	Shaving Brush Alga
Penicillus dumetosus (Lamouroux) Blainsville	

Penicillus lamourouxi Decaisne	
Penicillus pyriformis A. and E.S. Gepp	
Rhipocephalus phoenix (Ellis and Solander) Kutzing	
Udotea conglutinata (Ellis and Solander) Lamouroux	
Udotea flabellum (Ellis and Solander) Lamouroux	Mermaid's Fan
Udotea spinulosa Howe	
Udotea sp.	
Ulva lactuca Linnaeus	Sea Lettuce
Valonia ventricosa J. Agardh	Sea Bottles
Valonia sp.	
Browns	
Dictyota cervicornis Kutzing	
Dictyota sp.	
Dilophus alternans J. Agardh	
Padina sanctaecrucis Borgesen	
Pocockiella variegata (Lamouroux) Papenfuss	
Sargassum hystrix J. Agardh	Gulfweed, Sargassum
Sargassum hystrix buxifolium (Chauvin) J. Agardh	Gulfweed, Sargassum
Sargassum pteropleuron Grunow	Gulfweed, Sargassum
Sargassum sp.	
Stypopodium zonale (Lamouroux) Papenfuss	
Reds	
Acanthophora sp.	
Amphiroa brasiliana Decaisne	
Amphiroa fragilissima (Linnaeus) Lamouroux	Fragile Coral
Amphiroa rigida antillana (Borgesen) Lamouroux	
Amphiroa tribulus (Ellis and Solander) Lamouroux	

Amphiroa sp.	
Bostrychia montagnei Harvey	
Ceramium nitens (C. Agardh) J. Agardh	
Colpomenia sinuosa (Roth) Derbes and Solier	
Galaxaura cylindrica (Ellis and Solander) Lamouroux	
Galaxaura marginata (Ellis and Solander) Lamouroux	
Galaxaura sp.	
Goniolithon strictum Foslie	Coralline
Goniolithon sp.	Coralline
Gracilaria cylindrica Borgesen	
Gracilaria ferox J. Agardh	
Gracilaria sp.	
Jania sp.	Coralline
Laurencia papillosa (Forsskal) Greville	
Laurencia poitei (Lamouroux) Howe	
Laurencia sp.	
Lithothamnion sp.	Coralline
Sea Grasses	
Diplanthera wrightii (Ascherson)	Cuban Shoal Grass
Syringodium filiforme Kutzing	Manatee Grass
Thalassia testudinum Koenig and Sims	Turtle Grass

INVERTEBRATES

PORIFERA

Agelas schmidti Wilson	Tub Sponge
Aiolochoia crassa (Hyatt)	
Anthosigmella varians (Duchassaing and Michelotti)	Variable Sponge
Aplysella sp.	
Aplysina cauliformis (Carter)	
Aplysina fistularis (Pallas)	Yellow Tube Sponge
Callyspongia fallax Duchassaing and Michelotti	Round Tube Sponge
Callyspongia sp.	
Chondrilla nucula Schmidt	Chicken Liver Sponge
Chondrosia collectrix (Schmidt)	
Choristida sp.	
Cinachyra sp.	
Cliona delitrix Rang	Red Boring Sponge
Desmacella sp.	
Dysidea etheria de Laubenfels	Heavenly Sponge
Dysidea fragilis (Montagu)	
Dysidea sp.	
Epipolasis sp.	
Foliolina peltata Schmidt	
Geodia gibberosa Lamarck	
Haliclona coerulescens Topsent	
Haliclona compressa Duchassaing and Michelotti	
H. oculata (Linnaeus)	
Haliclona viridis (Duchassaing and Michelotti)	Tube Sponge
Higginsia strigilata (Lamarck)	

Higginsia sp.	
Iotrochota birotulata (Higgin)	Purple Bleeding Sponge
Ircinia campana (Lamarck)	Vase Sponge
Ircinia felix (Duchassaing and Michelotti)	
Ircinia strobilina (Lamarck)	Pillow Stinking Sponge
Lissodendoryx sigmata (de Laubenfels)	
Merriamium tortugasensis de Laubenfels	
Microciona sp.	
Mycale sp.	
Myriastra kallitetilla de Laubenfels	
Neofibularia nolitangere (Duchassaing and Michelotti)	Do-not-touch Sponge
Niphates digitalis (Lamarck)	Gray Cornucopia Sponge
Niphates erecta Duchassaing and Michelotti	
Placospongia sp.	
Pseudaxinella lunaecharta (Ridley and Dendy)	
Siphonodictyon syphonum (de Laubenfels)	Boring Sponge
Siphonodictyon sp.	
Spheciospongia vesparia (Lamarck)	Loggerhead Sponge
Spinosella vaginalis (Lamarck)	Lavender Tube Sponge
Spinostrella sp.	
Spongia cerebriformis Duchassaing and Michelotti)	
Spongia sp.	
Tedania ignis (Duchassaing and Michelotti)	Fire Sponge
Tethya crypta (de Laubenfels)	
Tethya sp.	
Thalysias juniperina (Lamarck)	
Thalysias sp.	

Verongia longissima (Carter)	Branching Candle Sponge
Verongula ardis (de Laubenfels)	
Xestospongia muta (Schmidt)	Basket Sponge
COELENTERATA	
Hydrozoa	
Millepora alcicornis (Linnaeus)	Stinging Fire Coral
Millepora complanata (Lamarck)	Leafy Fire Coral
Stylaster roseus (Pallas)	Pink Cave Coral
Anthozoa	
Gorgonacea	
Briareum asbestinum (Pallas)	Corky Seafingers
Erythropodium caribaeorum (Duchassaing and Michelotti)	Encrusting Soft Coral
Eunicea calyculata Ellis and Solander	Warty Eunicea
Eunicea calyculata forma coronata Bayer	
Eunicea clavigera Bayer	
Eunicea fusca Duchassaing and Michelotti	
Eunicea knighti Bayer	
Eunicea mammosa Lamouroux	Mammillated Eunicea
Eunicea succinea forma plantaginea (Lamarck)	
Eunicea succinea forma succinea	
Eunicea tourneforti forma tourneforti	
Gorgonia ventalina Linnaeus	Sea Fan
Muricea elongata (Lamouroux)	
Muricea laxa Verrill	
Muricea muricata (Pallas)	Spiny Muricea
Muriceopsis flavida (Lamarck)	
Plexaura flexuosa Lamouroux	Sea Rod, Bent Plexaura

Plexaura homomalla (Esper)	Black Sea Rod
Plexaurella dichtoma (Esper)	Double-forked Plexaurella
Plexaurella fusifera Kunze	
Plexaurella grisea Kunze	Grey Plexaurella
Plexaurella pumila Verrill	
Pseudoplexaura crucis Bayer	
Pseudoplexaura flagellosa (Houttuyn)	
Pseudoplexaura porosa (Houttuyn)	
Pseudoplexaura wagenaari (Stiasny)	
Pseudopterogorgia acerosa (Pallas)	Purple Sea Plume
Pseudopterogorgia americana (Gmelin)	Slimy Sea Plume
Pseudopterogorgia bipinnata (Verrill)	Bipinnate Sea Feather
Pseudopterogorgia blanquillensis (Stiasny)	
Pseudopterogorgía elisabethae Bayer	
Pseudopterogorgia kallos (Bielschowsky)	
Pseudopterogorgia rigida (Bielschowsky)	
Pterogorgia anceps (Pallas)	Angular Sea Whip
Pterogorgia citrina (Esper)	Yellow Sea Whip
Actiniaria	
Bartholomea sp.	
Lebrunia danae (Duchassaing and Michelotti)	Giant Stinging Anemone
Palythoa mammillosa (Ellis and Solander)	Knobby Zoanthidean
Parazoanthus sp.	
Zoanthus sociatus Ellis	Green Sea Mat Anemone
Zoanthus sp.	
Scleractinia	
Acropora cervicornis (Lamarck)	Staghorn Coral

Acropora palmata (Lamarck)	Elkhorn Coral
Agaricia agaricites (Linnaeus)	Lettuce Coral
Agaricia lamarcki Milne Edwards and Haime	Sheet Coral
Cladocora arbuscula Lesueur	Tube Coral
Colpophyllia natans (Muller)	Brain Coral
Dichocoenia stokesii Edwards and Haime	Star Coral
Diploria clivosa (Ellis and Solander)	Knobbed Brain Coral
Diploria labyrinthiformis (Linnaeus)	Brain Coral
Diploria strigosa (Dana)	Brain Coral
Eusmilia fastigiata (Pallas)	Flower Coral
Favia fragum (Esper)	Star Coral
Helioseris cucullata (Ellis and Solander)	Saucer Coral
Isophyllia sinuosa (Ellis and Solander)	Sinous Cactus Coral
Manicina areolata (Linnaeus)	Rose Coral
Meandrina meandrites (Linnaeus)	Brain Coral
Montastrea annularis (Ellis and Solander)	Boulder Coral
Montastrea cavernosa (Linnaeus)	Large Star Coral
Mussa angulosa Pallas	Large Flower Coral
Mycetophyllia lamarckana (Edwards and Haime)	Large Cactus Coral
Mycetophyllia xerox Wells	Grooved Fungus Coral
Porites astreoides Lamarck	Porous Coral
Porites divaricata Lesueur	
Porites furcata Lamarck	Finger Coral
Porites porites (Pallas)	Clubbed Finger Coral
Siderastrea radians (Pallas)	Starlet Coral
Siderastrea siderea (Ellis and Solander)	Starlet Coral
Solenaster hyades (Dana)	Lobed Star Coral

Stephanocoenia michelini (Edwards and Haime)	Blushing Star Coral
WORMS	
Arabella sp.	
Cistenides regalis Verrill	Royal Tube Worm
Cistenides gouldi Verrill	Golden Tube Worm
Eunice filamentosa Grube	
Eunice kinbergi (Webster)	
Eunice longicirrata Webster	
Eunice rubra Grube	
Eunice schemacephala Schmarda	Atlantic Palolo
Eunice unifrons (Verrill)	
Eunice sp.	
Eupholae sp.	
Eurythoe complanata (Pallas)	
Glycera sp.	
Hermodice carunculata (Pallas)	Green Bristle Worm
Hesione picta	
Loimia sp.	
Lumbrinereis sp.	
Marphysa sp.	
Nephthys sp.	
Notopygos crinita Grube	
Phascolion sp.	
Sabella melanostigma Schmarda	Banded Feather Duster
MOLLUSCA	
Gastropoda	
Adoria sp.	

Aplysia parvula Morch	
Astraea phoebia Roding	Long-spined Star-shell
Astraea tecta americana (Gmelin)	American Star-shell
Calliostoma jujubinum (Gmelin)	Jujube Top-shell
Cerithium eburneum forma algicola C.B. Adams	Ivory Cerith
Cerithium guinaicum Philippi	Schwengel's Cerith
Cerithium litteratum Born	Stocky Cerith
Columbella mercatoria (Linnaeus)	Common Dove-shell
Coralliophila caribaea Abbott	Caribbean Coral-shell
Crepidula aculeata (Gmelin)	Spiny Slipper-shell
Crepidula plana Say	Eastern-white Slipper-shell
Cyphoma gibbosum (Linnaeus)	Flamingo Tongue
Gorio sp.	
Haminoea sp.	
Leucozonia nassa (Gmelin)	Chestnut Latirus
Modulus modulus (Linnaeus)	Atlantic Modulus
Murex recurvirostris rubidus F.C. Baker	Rose Murex
Nudibranch	
Olivella nivea (Gmelin)	West Indian Dwarf Olive
Papyridea semisulcata (Grey)	Frilled Paper Cockle
Polinices lacteus (Guilding)	Milk Moon-shell
Strombus raninus Gmelin	Hawk-winged Conch
Tegula fasciata Born	Smooth Atlantic Tegula
Terebra hastata (Gmelin)	Shiny Atlantic Auger
Thais deltoidea (Lamarck)	Deltoid Rock-shell
Tricolia affinis (C.B. Adams)	Checkered Pheasant
Tridachia crispata (Morch)	Common Lettuce Slug

Trivia pediculus (Linnaeus)	Coffee Bean Trivia
Vasum muricatum (Born)	Caribbean Vase
Pelecypoda	
Americardia media (Linnaeus)	Atlantic Strawberry Cockle
Anadara notabilis (Roding)	Eared Ark
Arca imbricata Bruguiere	Mossy Ark
Arca zebra (Swainson)	Turkey Wing
Argopecten gibbus (Linnaeus)	Calico Scallop
Barbatia cancellaria (Lamarck)	Red-Brown Ark
Barbatia candida (Helbling)	White Bearded Ark
Barbatia domingensis (Lamarck)	White Miniature Ark
Chama macerophylla (Gmelin)	Leafy Jewel Box
Chione cancellata (Linnaeus)	Cross-barred Venus
Chione paphia (Linnaeus)	King Venus
Codakia orbicularis (Linnaeus)	Tiger Lucina
Diplodonta punctata (Say)	Common Atlantic Diplodon
Glycimeris pectinata (Gmelin)	Comb Bittersweet
Laevicardium laevigatum (Linnaeus)	Common Egg Cockle
Lima lima (Linnaeus)	Spiny Lima
Lima pellucida C.B. Adams	Antillean Lima
Linga pensylvanica (Linnaeus)	Pennsylvania Lucina
Lithophaga sp.	
Lopha frons (Linnaeus)	Frons Oyster
Lyropecten antillarum (Recluz)	Antillean Scallop
Modiolus americanus (Leach)	Tulip Mussel
Modiolus modiolus squamosus Beauperthuy	False Tulip Shell
Musculus lateralis Say	Lateral Musculus

Ostrea frons Linnaeus	Coon Oyster
Pecten sp.	
Periglypta listeri Grey	Princess Venus
Pinctada radiata (Leach)	Atlantic Pearl Oyster
Plicatula gibbosa Lamarck	Kitten's Paw
Tagelus sp. Grey	
Tellina listeri Roding	Speckled Tellin
Amphineura	
Chiton sp.	
Ischnochiton sp.	
Lepidochiton liozonis (Dall and Simpson)	Puerto Rico Red Chiton
Stenoplax erythronota (C.B. Adams)	Ashy Slender Chiton
Stenoplax floridana (Pilsbry)	Florida Slender Chiton
Scaphopoda	
Dentalium calamus Dall	Reed Tusk
Octopoda	
Octopus joubini Adam	Joubin's Octopus
CRUSTACEA	
Isopoda	
Leucothoe spinicarpa (Abildgaard)	
Decapoda	
Natantia	
Alpheus amblyonyx Chace	Snapping shrimp
A. cristulifrons Rathbun	
A. formosus (Gibbes)	Striped snapping shrimp
A. normani Kingsley	
A. ridleyi Pocock	

A. sp. A	
A. sp. B	
Brachycarpus biunguiculatus (Lucas)	Two-clawed shrimp
Lysmata intermedia (Kingsley)	Cleaning shrimp
Periclemenes pedersoni Chase	Pederson's cleaning shrimp
Synalpheus fritzmuelleri Coutiere	Snapping shrimp
S. hemphilli Coutiere	
S. minus Say	
S. townsendi Coutiere	
Thor manningi Chace	
Thunor rathbunae (Schmitt)	
Reptantia	
Calcinus tibicens (Herbst)	
Dardanus venosus (Milne Edwards)	Bar-eyed Hermit Crab
Gonodactylus sp.	
Iridopagurus sp.	
Paguristes cadenati Provenzano	Red hermit crab
Paguristes grayi Benedict	
Paguristes puncticeps Benedict	
Paguristes tortugae Schmitt	
Paguristes wassi Provenzano	
Paguristes sp.	
Pagurus brevidactylus (Stimpson)	
Pagurus provenzanoi Forest and De Saint Laurent	
Panulirus argus Latreille	Crawfish, Spiny Lobster
Petrolisthes galathinus (BOSC)	Porcellan crab
Brachyura	

Cycloes bairdi Stimpson	
Mithrax spinosissimus (Lamarck)	Spiny Spider Crab
Mithrax forceps (A. Milne Edwards)	
Paraliomera longimana (A. Milne Edwards)	
Pitho anisodon (Von Martens)	Marten's Pitho
Pitho lherminieri (Schramm)	
Stenorhynchus seticornis (Herbst)	Arrow Crab
Xantho denticulata Stimpson	
ECHINODERMATA	
Ophiuroidea	
Astrophyton muricatum (Lamarck)	Basket Starfish
Ophiocoma echinata (Lamarck)	Spiny Ophiocoma
Ophioderma brevispinum Lutken	Snakeskin Brittle Star
Ophioderma rubicundum Lutken	
Ophionereis squamulosa Koehler	
Ophiothrix lineata Lyman	Lined Brittle Star
Ophiothrix oerstedi Lutken	Oersted's Brittle Star
Ophiothrix suensoni Lutken	Suenson's Brittle Star
Ophiozona impressa (Lutken)	Scaly Brittle Star
Echinoidea	
Clypeaster rosaceus (Linneaus)	Brown Sea Biscuit
Diadema antillarum (Philippi)	Long-spined Urchin
Echinometra viridis (Agassiz)	Green Rock-boring Urchin
Eucidaris tribuloides (Lamarck)	Slate-pencil Urchin
Lytechinus variegatus (Leske)	Variegated Urchin
Mellita sexiesperforata (Leske)	Six-holed Urchin
Meoma ventricosa (Lamarck)	West Indian Sea Biscuit

Holothuroidea	
Actinopyga agassizi (Selenka)	Agassiz's Sea Cucumber
Astichopus multifidus (Sluiter)	Furry Sea Cucumber
Chirodota sp.	Swarf Sea Cucumber
Asteroidea	
Astropecten duplicatus Grey	Two-spined Starfish
ASCIDIACEA	
Ascidea sp.	
Didemnum amethysteum Van Name	
Didemnum candidum Savigny	White Sponge Tunicate
Microcosmus helleri Herdman	Ragged Sea Squirt
Styela sp.	
Symplegma sp.	
Tridemnum savignyi (Herdman)	Encrusting Ascidian

VERTEBRATES

SHARKS AND RAYS

Ginglymostoma cirratum (Bonneterre)	Nurse Shark
Carcharhinus leucas (Valenciennes)	Bull Shark
Sphyrna tiburo (Linnaeus)	Bonnet Head
Dasyatis americana (Hildebrand and Schroeder)	Southern Stingray
Urolophus jamaicensis (Cuvier)	Yellow Stingray
Aetobatus narinari (Euphrasen)	Spotted Eagle Ray

BONY FISHES

Family Elopidae

Megalops atlanticus Valenciennes	Tarpon

Family Muraenidae

Gymnothorax funebris Ranzani	Green Moray
G. moringa (Cuvier)	Spotted Moray
G. vicinus (Castelnau)	Purplemouth Moray
Muraena miliaris (Kaup)	Goldentail Moray

Family Ophichthidae

Ahlia egmontis (Jordan)	Key Worm Eel
Myrichthys oculatus (Kaup)	Goldspotted Eel

Family Clupeidae

Harengula clupeola (Cuvier)	False Pilchard
Harengula sp.	
Jenkinsia sp.	
Sardinella aurita Valenciennes	Spanish Sardine

Family Synodontidae

Synodus intermedius (Agassiz)	Sand Diver

Family Batrachoididae	
Opsanus beta (Goode and Bean)	Gulf Toadfish
Family Gobiesocidae	
Gobiesox strumosus Cope	Skilletfish
Family Exocoetidae	
Hemiramphus brasiliensis (Linnaeus)	Ballyhoo
Family Belonidae	
Strongylura notata (Poey)	Redfin Needlefish
Tylosurus crocodilus (Peron and Lesueur)	Houndfish
Family Atherinidae	
Atherinomorus stipes (Muller and Troschel)	Hardhead Silverside
Family Holocentridae	
Holocentrus ascensionis (Osbeck)	Squirrelfish
H. rufus (Walbalm)	Longspine Squirrelfish
H. vexillarius (Poey)	Dusky Squirrelfish
Myripristis jacobus Cuvier	Cardinal Soldierfish
Family Aulostomidae	
Aulostomus maculatus Valenciennes	Trumpetfish
Family Sygnathidae	
Cosmocampus albirostris (Heckel)	Whitenose Pipefish
Hippocampus erectus Perry	Lined Seahorse
H. zosterae Jordan and Gilbert	Dwarf Seahorse
Family Centropomidae	
Centropomus undecimalis (Bloch)	Snook
Family Serranidae	
Diplectrum formosum (Linnaeus)	Sand Perch
Epinephelus adscensionis (Osbeck)	Rock Hind

E. afer (Bloch)	Mutton Hamlet
E. cruentatus (Lacepede)	Graysby
E. guttatus (Linnaeus)	Red Hind
E. itajara (Lichtenstein)	Jewfish
E. morio (Valenciennes)	Red Grouper
E. striatus (Bloch)	Nassau Grouper
Hypoplectrus unicolor (Walbaum)	Butter Hamlet
H. aberrans (Poey)	Yellowbelly Hamlet
H. gemma (Poey)	Blue Hamlet
H. chlorurus (Cuvier and Valenciennes)	Yellowtail Hamlet
H. guttavarius (Poey)	Shy Hamlet
H. indigo (Poey)	Indigo Hamlet
H. nigricans (Poey)	Black Hamlet
H. puella (Cuvier and Valenciennes)	Barred Hamlet
Liopropoma rubre Poey	Peppermint Bass
Mycteroperca bonaci (Poey)	Black Grouper
M. tigris (Valenciennes)	Tiger Grouper
M. venenosa (Linnaeus)	Yellowfin Grouper
Serranus baldwini (Evermann and Marsh)	Lantern Bass
S. tabacarius (Cuvier)	Tobaccofish
S. tigrinus (Bloch)	Harlequin Bass
Family Grammistidae	
Rypticus saponaceus (Schneider)	Greater Soapfish
Family Priacanthidae	
Priacanthus arenatus Cuvier	Bigeye
P. cruentatus (Lacepede)	Glasseye Snapper
Family Apogonidae	

Apogon binotatus (Poey)	Barred Cardinalfish
A. lachneri Bohlke	Whitestar Cardinalfish
A. maculatus (Poey)	Flamefish
A. pseudomaculatus Longley	Twospot Cardinalfish
A. townsendi (Breder)	Belted Cardinalfish
Astrapogon stellatus (Cope)	Conchfish
Phaeoptyx pigmentaria (Poey)	Dusky Cardinalfish
Family Malacanthidae	
Malacanthus plumieri (Bloch)	Sand Tilefish
Family Echeneidae	
Echeneis naucrates Linnaeus	Sharksucker
Family Carangidae	
Caranx bartholomaei Cuvier	Yellow Jack
C. crysos (Mitchill)	Blue Runner
C. ruber (Bloch)	Bar Jack
Oligoplites saurus (Schneider)	Leather Jack
Seriola dumerili (Risso)	Greater Amberjack
Trachinotus falcatus (Linnaeus)	Permit
Family Lutjanidae	
Lutjanus analis (Cuvier)	Mutton Snapper
L. apodus (Walbaum)	Schoolmaster
L. cyanopterus (Cuvier)	Cubera Snapper
L. griseus (Linnaeus)	Gray Snapper
L. jocu (Schneider)	Dog Snapper
L. mahogoni (Cuvier)	Mahogany Snapper
L. synagris (Linnaeus)	Lane Snapper
Ocyurus chrysurus (Bloch)	Yellowtail Snapper

Family Gerreidae	
Eucinostomus sp.	Mojarra
Eucinostomus sp.	Mojarra
Gerres cinereus (Walbaum)	Yellowfin Mojarra
Family Haemulidae	
Anisotremus surinamensis (Bloch)	Black Margate
A. virginicus (Linnaeus)	Porkfish
Haemulon album Cuvier	Margate
H. carbonarium Poey	Caesar Grunt
H. chrysargyreum Gunther	Smallmouth Grunt
H. flavolineatum (Desmarest)	French Grunt
H. macrostomum Gunther	Spanish Grunt
H. melanurum (Linnaeus)	Cottonwick
H. parrai (Desmarest)	Sailors Choice
H. plumieri (Lacepede)	White Grunt
H. sciurus (Shaw)	Bluestriped Grunt
Family Inermiidae	
Inermia vittata Poey	Boga
Family Sparidae	
Archosargus probatocephalus (Walbaum)	Sheepshead
A. rhomboidalis (Linnaeus)	Sea Beam
Calamus bajonado (Schneider)	Jolthead Porgy
C. calamus (Valenciennes)	Saucereye Porgy
C. penna (Valenciennes)	Sheepshead Porgy
Lagodon rhomboides (Linnaeus)	Pinfish
Family Sciaenidae	
Equetus acuminatus (Schneider)	High-hat

E. lanceolatus (Linnaeus)	Jackknife-fish
E. punctatus (Schneider)	Spotted drum
Odontoscion dentex (Cuvier)	Reef Croaker
Family Mullidae	
Mulloidichthys martinicus (Cuvier)	Yellow Goatfish
Pseudopeneus maculatus (Bloch)	Spotted Goatfish
Family Pempheridae	
Pempheris poey	Sweeper
P. schomburgki	Glassy Sweeper
Family Ephippidae	
Chaetodipterus faber (Broussonet)	Atlantic Spadefish
Family Chaetodontidae	
Chaetodon capistratus Linnaeus	Foureye Butterflyfish
C. ocellatus Bloch	Spotfin Butterflyfish
C. sedentarius Poey	Reef Butterflyfish
C. striatus Linnaeus	Banded Butterflyfish
Family Pomacanthidae	
Holocanthus bermudensis Goode	Blue Angelfish
H. ciliaris (Linnaeus)	Queen Angelfish
H. tricolor (Bloch)	Rock Beauty
Pomacanthus arcuatus (Linnaeus)	Gray Angelfish
P. paru (Bloch)	French Angelfish
Family Pomacentridae	
Abudefduf saxatilis (Linnaeus)	Sergeant Major
Chromis cyaneus (Poey)	Blue Chromis
C. insolatus (Cuvier)	Sunshinefish
C. multilineatus (Guichenot)	Brown Chromis

M. sp.	
Paraclinus marmoratus (Steindachner)	Marbled Blenny
Paraclinus sp.	Blenny
Starksia ocellata (Steindacher)	Checkered Blenny
Stathmonotus hemphilli Bean	Blackbelly Blenny
Family Blenniidae	
Hypleurochilus aequipinnis (Gunther)	Oyster Blenny
H. bermudensis Beebe and Tee-Van	Barred Blenny
Ophioblennius atlanticus (Valenciennes)	Redlip Blenny
Parablennius marmoreus (Poey)	Seaweed Blenny
Scartella cristata (Linnaeus)	Molly Miller
Family Callionymidae	
Callionymus bairdi Jordan	Lancer Dragonet
C. pauciradiatus Gill	Spotted Dragonet
Family Gobiidae	
Barbuilifer sp.	Goby
Coryphopterus dicrus Bohlke and Robin	Colon Goby
C. glaucofraenum Gill	Bridled Goby
C. lipernes Bohlke and Robins	Peppermint Goby
C. personatus (Jordan and Thompson)	Masked Goby
Gnatholepis thompsoni Jordan	Goldspot Goby
Gobionellus saepepallens Gilbert and Randall	Dash Goby
Gobiosoma grosvenori (Robins)	Rockcut Goby
G. macrodon Beebe and Tee-Van	Tiger Goby
G. oceanops (Jordan)	Neon Goby
Ioglossus callurus Bean	Blue Goby
Microgobius carri Fowler	Seminole Goby

M. microlepis Longley and Huldebrand	Banner Goby
Nes longus (Nichols)	Orangespotted Goby
Family Acanthuridae	
Acanthurus bahianus Castelnau	Ocean Surgeon
A. chirurgus (Bloch)	Doctorfish
A. coeruleus Schneider	Blue Tang
Family Scombridae	
Scomberomorus regalis (Bloch)	Cero
Family Scorpaenidae	
Scorpaena plumieri Bloch	Spotted Scorpionfish
Family Bothidae	
Bothus lunatus (Linnaeus)	Peacock Flounder
B. sp. 1	
B. sp. 2	
Family Balistidae	
Aluterus schoepfi (Walbaum)	Orange Filefish
A. scriptus (Osbeck)	Scrawled Filefish
Balistes capriscus Gmelin	Gray Triggerfish
B. vetula Linnaeus	Queen Triggerfish
Cantherhines macrocerus (Hollard)	Whitespotted Filefish
C. pullus (Ranzani)	Orangespotted Filefish
Canthidermis sufflamen (Mitchill)	Ocean Triggerfish
Monacanthus ciliatus (Mitchill)	Fringed Filefish
M. tuckeri Bean	Slender Filefish
Family Ostraciidae	
Lactophyrs bicaudalis (Linnaeus)	Spotted Trunkfish
L. polygonia (Poey)	Honeycomb Cowfish

L. quadricornis (Linnaeus)	Scrawled Cowfish
L. trigonus (Linnaeus)	Trunkfish
L. triqueter (Linnaeus)	Smooth Trunkfish
Family Tetraodontidae	
Canthigaster rostrata (Bloch)	Sharpnose Puffer
Sphoeroides spengleri (Bloch)	Bandtail Puffer
Family Diodontidae	
Diodon holocanthus Linnaeus	Balloonfish
D. hystrix Linnaeus	Porcupinefish

ASSESSMENT OF FISH COMMUNITIES IN JOHN PENNEKAMP CORAL REEF STATE PARK AND KEY LARGO CORAL REEF MARINE SANCTUARY WITH COMMENTS ON THE USE OF A RAPID VISUAL TECHNIQUE

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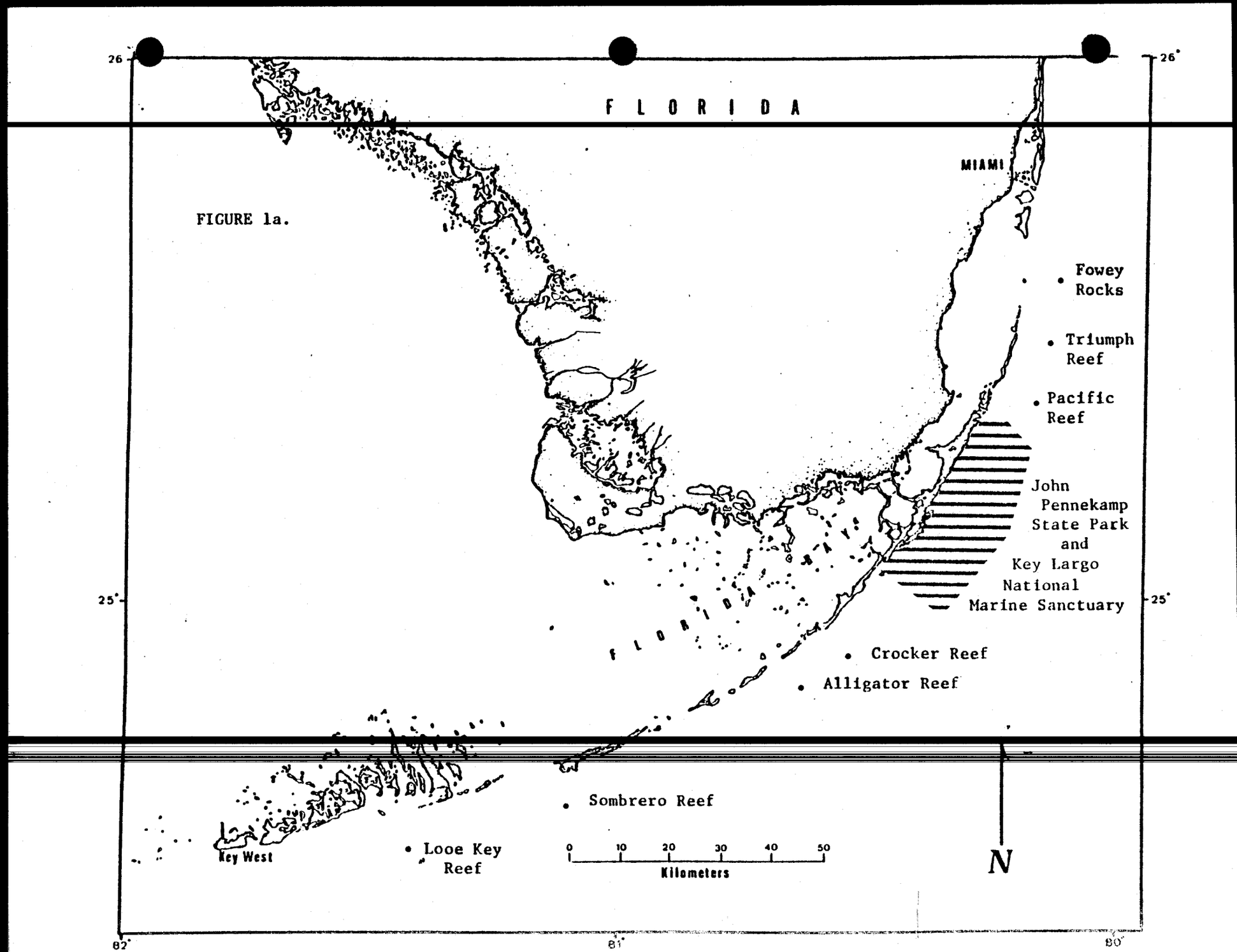
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INTRODUCTION

High species richness, high species diversity and high density of individuals are characteristics of the fish fauna of coral reefs. Coral reef habitat and associated fish fauna are present in only a limited area near the continental United States. The only extensive living coral reef on the continental shelf of the United States is the Florida reef tract, the majority of which extends approximately from Fowey Light off Miami 241 km southwest to Key West (Smith, 1971; Hoffmeister, 1974) (Fig. 1a). The reef tract terminates approximately 65 km west of Key West, although, well developed, living coral reefs surround the Dry Tortugas, 97 km west of Key West.

Public concern over the preservation of coral reefs has led to the establishment of four conservation areas on the tract, John Pennekamp Coral Reef State Park in 1961, Key Largo National Coral Reef Marine Sanctuary in 1975, Biscayne National Park in 1980 (established from Biscayne National Monument which originated in 1968), and the Looe Key National Marine Sanctuary in 1981. Biologists and natural resource managers are recognizing the importance of developing effective, non-destructive methods of obtaining qualitative and quantitative data in order to properly monitor and manage fish communities in these areas.

Much of the early work on fish community assessment involved collection of specimens using ichthyocides (Randall, 1963; Starck, 1966; Wass, 1967; Emery, 1973; Smith, 1973, and others) or explosives (Starck, 1966; Talbot and Goldman, 1973). Visual methods, until recently, consisted of enumeration of fishes over measured areas (transects,


FLORIDA
MIAMI
FIGURE 1a.
Fowey Rocks
Triumph Reef
Pacific Reef
John Pennekamp State Park and Key Largo National Marine Sanctuary
FLORIDA BAY
Crocker Reef
Alligator Reef
Sombrero Reef
Looe Key Reef
Key West
0 10 20 30 40 50
Kilometers
N
26°
25°
82°
81°
80°

quadrats, or other fixed areas). Brock (1954), Ebeling et al. (1971), Risk (1972), Key (1973), McCain and Peck (1973), Smith and Tyler (1973), Hobson (1974), Chave and Eckert (1974), Itzkowitz (1974), Jones and Chase (1975), and Alevizon and Brooks (1975) are among those who have either developed or used methods in this category.

Jones and Thompson (1978) pioneered a simple, rapid, visual technique that alleviated most of the equipment and time-comsuming measurements required by previous methods. Thompson and Schmidt (1977) and Bohnsack (1979) have used this method for studies on Florida reefs, and it is the method used in this study pursuant to the specifications of NOAA contract no. NA-79-SAC-00813.

Several authors have demonstrated weaknesses in the species/time technique (STT) of Jones and Thompson (1978) subsequent to the time this contract was written (DeMartini and Roberts 1982, Sanderson and Solonsky 1980). While the STT is superior to other methods for efficient and rapid enumeration of species, the use of species scores to characterize community structure of reef fishes is suspect. Bohnsack and Bannerot (1983) have developed and tested a visual method which produces data more appropriate for analysis of community structure, but is more time consuming than the STT.

The general purpose of this study was to describe and compare the fish fauna at seventeen sites within the boundaries of John Pennekamp State Park and Key Largo Marine Sanctuary off Key Largo, Florida Keys. The STT provides data on species diversity which is adequate in most cases for this purpose. Sites from a number of habitats representative of the area were selected. The habitats were grouped into four major

categories (1) offshore reefs (2) intermediate reefs (3) inshore patch reefs and (4) turtle grass and hardground sites. Extent and type of usage by the public varied between sties. In addition to the primary objective of describing and comparing fish faunas specified in the contract, we have attempted to qualitatively assess possible differences between sites due to user impact and to point out problems with using species scores from the STT to characterize fish community structure. All data were collected between March and October of 1980 and 1981.

THE STUDY AREA

Figure 1b shows the area encompassed by Pennekamp Park and Key Largo Marine Sanctuary including the study sites. Table 1[1] defines habitat types and describes the approximate type and degree of usage at each site. Voss (1983) gives detailed descriptions of each of the sites. Features of these habitats important to the fish censuses are described below.

Offshore Reefs

The offshore reef sites include Carysfort, French, and Molasses Reefs and the Elbow. Jones and Thompson (1978) provide general habitat descriptions of the first three. The latter three are similar in that the major hard coral complexes of the fore-reef slope give way to sandy plateaus in the offshore direction at approximately 10.7.m depth. Among these, Molasses Reef and the Elbow each have fairly similar spur and groove structure on the outer face and extensive back reef rubble zones. The spur and groove at French Reef is less defined; the spurs are dominated by massive Montastrea annularis growth and are often interlaced with caves and passages. Carysfort Reef exhibits a typical Caribbean reef zonation (Goreau, 1959), unlike the other offshore sites, although it lacks any extensive shallow spur and groove formation offshore of the Acropora palmata stands of the reef crest. The fore-reef slope gives way to a narrow gently sloping octocorallian community that ends abruptly in extensive thickets of Acropora cervicornis (at approximately 14 m depth) which are not found on any of the other offshore reef sites.

FIGURE 1b. Map showing John Pennekamp State Park and Key Largo National Marine Sanctuary. The number and name for each of the 17 study sites are given at the respective locations.

FIGURE 1b.

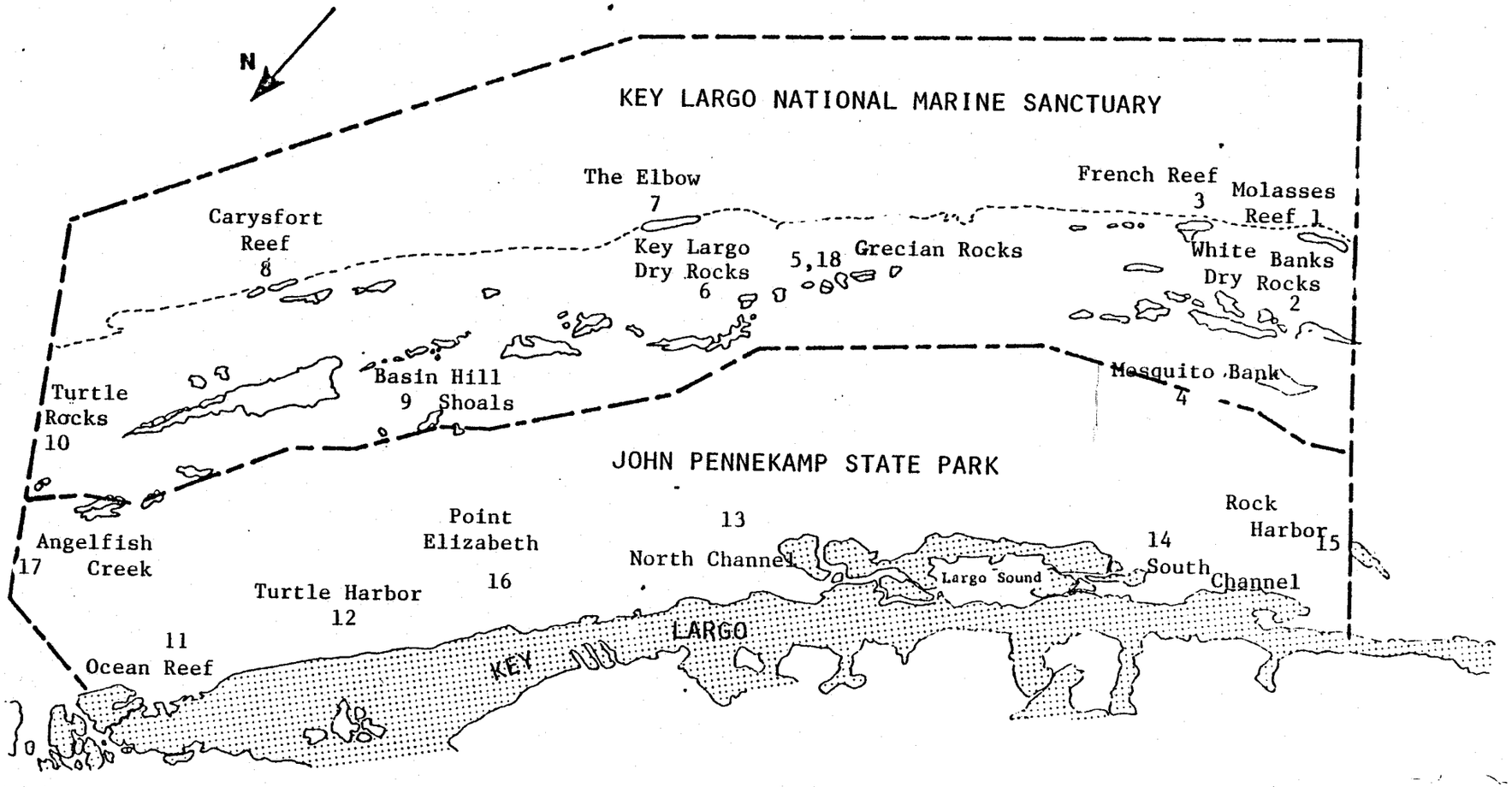

N
KEY LARGO NATIONAL MARINE SANCTUARY
The Elbow
7
French Reef
3
Molasses
Reef 1
Carysfort
Reef
8
Key Largo
Dry Rocks
6
5,18
Grecian Rocks
White Banks
Dry Rocks
2
Mosquito Bank
4
Basin Hill
9 Shoals
Turtle
Rocks
10
JOHN PENNEKAMP STATE PARK
Point
Elizabeth
16
13
North Channel
Rock
Harbor
15
14
South
Channel
Largo Sound
Angelfish
Creek
17
Turtle Harbor
12
11
Ocean Reef
KEY
LARGO

TABLE 1. List of study sites by number and name with habitat type, depth range of fish census, and approximate extent and type of usage by visitors. Habitat definitions are (1) offshore reef (OR) - a major aggregation of scleractinian corals occurring on a contour approximately 6 km offshore defined by the outermost lighthouses on the Florida reef tract; (2) intermediate reef (IR) - a scleractinian coral aggregation usually within 1 km of the offshore reef line; (3) inshore patch reef (IPR) - an aggregation or group of various sized aggregations of scleractinian corals usually at least 2 km inshore of the outer reef line; (4) turtle grass (TG) - an area dominated by turtle grass, Thalassia testudinum, bottom; (5) hardground (H) - bedrock areas featuring numerous octocorals, various sponges, and encrusting and small head scleractinian corals. The term "diving" includes non-consuming recreational SCUBA and snorkeling, the only consumptive usuage being the taking of lobsters in season. "Fishing" refers only to hook and line fishing, most of which is recreational (spearfishing and fish traps are illegal in both conservation areas). Boat traffic is only considered for turtle grass or hardground sites less than 4.9 m depth where bottom disturbance from wakes and prop turbulence is most noticeable. The extent of the various activities are strictly subjective impressions obtained by one of the authors during 6 years of diving experience in the area and by both authors during the course of the study (no quantitative data such as boat counts were obtained on a regular basis). H = heavy usage, M = moderate usage, L = light usage, 0 = very little or no usage.

SITE NO.	NAME	HABITAT	DEPTH RANGE OF FISH CENSUS(m)	APPROX. EXTENT AND TYPE OF USAGE		
				DIVING	FISHING	BOAT TRAFFIC
1	Molasses Reef	OR	3.1-12.8	H	M	---
2	White Bank Dry Rocks	IR	0.6-7.6	M	L	---
3	French Reef	OR	4.0-13.7	H	M	---
4	Mosquito Bank	IPR	0.9-4.6	L	M to L	---
5	Grecian Rocks	IR	0.3-9.1	H	L	---
6	Key Largo Dry Rocks	IR	0.6-10.7	H	L	---
7	The Elbow	OR	2.4-9.1	H to M	M	---
8	Carysfort Reef	OR	4.6-15.2	M	M to L	---
9	Basin Hill Shoals	IPR	0.2-2.4	L	L	---
10	Turtle Rocks	IPR	4.6-6.1	L	L	---
11	Ocean Reef	TG	3.1-3.7	0	0	M
12	Turtle Harbor	TG	3.7-4.7	0	0	L
13	North Channel	TG/H	2.7-4.3	0	0	M
14	South Channel	TG/H	4.0	0	0	H
15	Rock Harbor	TG	2.4-3.4	0	0	H to M
16	Point Elizabeth	TG/H	4.0-4.6	0	0	L
17	Angelfish Creek	IPR	3.1-5.8	L	L	---

Intermediate Reefs

White Bank Dry Rocks, Grecian Rocks, and Key Largo Dry Rocks are categorized as intermediate reefs based on their structure and distance from the offshore margin of the Florida reef tract. Each of these sites is 2.6 km or less from the 60 ft (18.3 m) contour. The environmental characteristics are intermediate between those of the offshore reefs and sites further inshore. Visibility, for example, at these sites is often not as good as visibility at offshore locations but better than the visibility at inshore locations.

Size and complexity of coral formations at the intermediate reef sites are less than that found at offshore reef sites. Key Largo Dry Rocks and Grecian Rocks are the most similar to offshore sites of the group. Grecian Rocks has a back-reef, a well-defined reef crest consisting primarily of densely packed A. palmata, and a short fore-reef slope ending in a flat, sandy plateau at around 8.2 m depth. Key Largo Dry Rocks lacks a well-defined reef crest, but does have a back reef-rubble zone area and large scleractinian coral development that approximates spur and groove formation.

White Bank Dry Rocks, unlike Key Largo Dry Rocks and Grecian Rocks, lacks any morphological similarity to offshore reefs. White Bank Dry Rocks, however, is a more consolidated patch reef area than those sites in the next category.

Inshore Patch Reefs

Basin Hill Shoals, Mosquito Bank, Turtle Rocks, and Angelfish Creek are patch reef sites occurring over 2.7 km away from the 60 ft (18.3 m)

contour. The former two are large, shallow banks of turtle grass dotted with patches of mixed scleractinian and octocorallian corals. Turtle Rocks is a loose aggregation of patch reefs consisting of a variety of scleractinian coral species separated by turtle grass (Thalassia testudinium) beds and sand. Angelfish Creek is an isolated patch reef surrounded by turtle grass.

Turtle Grass and Hardground

Six sites were located within 1.8 km of shore. Site numbers 11, 12, and 15 were on bottom dominated by turtle grass. Site numbers 13, 14, and 16 were in areas of turtle grass mixed with regions termed hardground. Hardground consisted of bedrock featuring numerous octocorals, sponges, and small head corals (primarily genus Siderastrea).

These sites are probably more affected by boat traffic than other study sites due to their shallow depth and location near channels and navigation routes. While the purpose of the study was to describe the fish fauna at each of these sites, we believe it is useful to give some idea of possible boating impact on the different areas. It is possible that such impact could be one of several variables responsible for differences in fish communities at these sites.

Each of these six sites represented a unique combination of habitat type and extent of user impact caused by boat traffic. Depth does not exceed 16 ft (4.9 m) at any site, and turbulence from power boat propellors and wakes causes varying degrees of agitation of sediments and disturbance of plant and animal communities depending on the size of the boat.

Site 15 (Rock Harbor) experiences the most boat traffic of the three turtle grass sites (11, 12, 15). The site is just offshore of Port Largo. A large number of private boats, several dive and charter fishing boats, and a number of commercial fishing boats must pass through this vicinity to go offshore.

Site 11 (Ocean Reef) is just off the entrance to an exclusive private resort club (Ocean Reef Club) on northern Key Largo. A number of larger yachts and offshore sport fishing vessels traverse this site as they enter or leave the club. While the average size of the vessels is somewhat larger than at Rock Harbor, the number passing through is smaller.

Site 12 (Turtle Harbor) is not near any main channel or passage route to popular offshore fishing or diving areas. No docks or marinas occur directly inshore of it. As a result it experiences very little boat traffic.

Site 14 (South Channel) is subjected to more boat traffic than the other turtle grass/hardground sites (13, 14, 16), followed by site 13 (North Channel). Most of the traffic from Largo Sound and Pennekamp Park Marina passes through this channel to go to the more popular dive sites such as Molasses Reef, French Reef, and the Benwood Wreck. The traffic includes a large sight-seeing vessel, dive charter boats, private boats, and a fleet of rental boats from park headquarters. The channel is narrow, forcing all traffic through a small area. For these reasons site 14 probably experiences more impact from boats than any other of the six sites near shore.

Site 13 (North Channel) also has considerable traffic. Private, dive charter, and commercial fishing boats from Largo Sound and Garden Cove Marina use this channel. The inshore section of North Channel is nearly as narrow as South Channel, but depths between this section and the most offshore channel marker (red number 2) allows safe passage of boats of most sizes over a wide area, lessening the impact of whatever traffic occurs at this channel.

Site 16 (Point Elizabeth) is not immediately offshore of any development or marina and, like site 12 (Turtle Harbor), has fewer boats passing through.

METHODS

The STT of Jones and Thompson (1978) was used without modification at all study sites. Jones and Thompson discuss the adaptation of the technique from species-area (Oosting, 1956) and species-time (Beals, 1960) techniques used in other sub-disciplines of ecology. A single STT count consisted of a 50 min SCUBA dive during which the diver actively searched for and recorded as many species as possible. Species were recorded in order of encounter, being listed only once per count. Counts were subdivided into 10 minute intervals. Fish species were then assigned scores based on the first interval in which they were observed within each 50 minute count. Species observed during the first 10 minutes of a count received a score of 5, with second, third, fourth and fifth interval species receiving scores of 4, 3, 2, and 1, respectively.

We recorded all species with pencil on underwater paper attached to aluminum clipboards. Most species were identified on sight. Species that we could not identify by inspection were collected, usually following the STT count, and brought back to the laboratory for identification.

Jones and Thompson (1978) used the P_k statistic of Gaufin et al. (1956) to choose a priori the number of samples needed to census 90% or more of the fish species at their offshore reef sites. They chose 8 replicates per site. We used 8 replicates per site during 1980, in which we sampled the 9 odd-numbered sites. We were able to obtain 12 replicates per site during 1981 at which time we sampled the 8 even-numbered sites. We also sampled site 5 (Grecian Rocks) a second time in

1981 in an attempt to get some idea of year to year variability in a fish community as determined by using the STT. A total of 180, 10 min. STT counts were made during the two year study (9 sites x 8 replicates for 1980 + 9 sites x 12 replicates for 1981), resulting in over 150 man-hours of bottom time.

Data analysis follows the general procedure of Jones and Thompson (1978), as specified by NOAA contract No. NA-79-SAC-00813. Using this procedure also provides a comparison with their first test of the STT. We will, however, discuss some of their assumptions in greater detail.

Fish communities at each of the 18 sites (9 sites in 1980, 8 new sites plus one repeat site in 1981) were compared on the basis of mean number of species and mean scores using one-way analysis of variance (ANOVA). We considered each site to be a unique entity rather than a randomly sampled representative of a certain class; e.g., site 11 (Ocean Reef) is a turtle grass community subjected to a unique level of boat traffic; the structural features and locations of Carysfort, French, and Molasses Reefs and the Elbow make each a unique site; and so on for the other sites. The result is that our data approximately conform to the specifications of Model I rather than Model II ANOVA (Eisenhart, 1947; Sokal and Rohlf, 1981). Thus we analyzed the data according to the general model

$$Y_{ij} = \mu + \alpha_i + \varepsilon_{ij} \qquad (1)$$

where i = site number, j = individual STT count number, Y_{ij} = number of species (or total species score) at site i on the STT count j, μ = mean number of species or mean total score over all STT counts at all sites,

α_i = the "treatment effects" of being at site i (i.e. the influence that being at site i has on the mean number of species observed or mean total score of species observed) and ε_{ij} = an independent, normally distributed random error term. The variable ε_{ij} represents the stochastic nature of differences in number of species (or total species scores) at different sites due to recruitment, colonization, and extinction of species on a relatively short time horizon. For these comparisons, 1980 and 1981 sample sizes were equalized by randomly selecting 8 of 12 possible counts per species for each of the 1981 sites.

Multiple comparisons to distinguish which means or groups of means are significantly different from others were carried out subsequent to the ANOVA. A number of applicable multiple comparison procedures exist and are discussed by Federer (1955), Harter (1957, 1970), Steel and Torrie (1960), Dunnett (1970), Boardman and Moffit (1971), Carmer and Swanson (1973), Zar (1974), and Kleinbaum and Kupper (1978). Several other procedures are suitable for our data but the contract specifies Duncan's Multiple Range Test (DMRT), which also provides a comparison with the results of Jones and Thompson (1978).

Further between-site comparisons were made using the Shannon-Weaver diversity function, evenness values of Pielou (1966), and the Bray and Curtis Index (1957). We followed the community ordination procedure adapted from Bray and Curtis (1957) by Beals (1960), as did Jones and Thompson (1978). We computed the Shannon-Weaver diversity function using base 10 logs and species scores, denoted H' to distinguish these

values from the conventional H computed from species abundance. Jones and Thompson (1978) defend the substitution of STT scores for counts of individuals in the Shannon-Weaver diversity function. We believe this substitution is questionable but worth presenting to provide a third tool for between-site comparisons, in addition to the ANOVA-DMRT and Bray and Curtis Index-ordination comparison methods. For all between-site Bray and Curtis Index comparisons, 1980 and 1981 site sample sizes were made equal by randomly selecting 8 of 12 possible counts per species for each of the 1981 sites as for the ANOVA-DMRT.

We prepared a rank order of all species censused over all sites and STT counts during the two year study. We also prepared a ranked list of species censused for each of the four major habitat categories: (1) offshore reefs (2) intermediate reefs (3) inshore patch reefs and (4) turtle grass and hardground based on summed species scores. Scores presented in these tables were rounded to the nearest integer. In calculating these summed species scores, 1981 site scores were adjusted to equalize the number of counts used per site with 1980 scores. Rather than eliminate 4 STT counts for rank order analysis of 1981 sites, which would have entailed loss of some species, we adjusted 1981 data for effort by multiplying individual scores by 8/12 (0.67).

RESULTS AND DISCUSSION

Descriptive Information on Species Composition

All fish species are listed in taxonomic order following Robins et al. (1980). Table 2 lists the fish species censused in 1980, total score per species per site by site number, and total score per species for all sites. The highest possible total score over all sites in 1980 is 360.

Table 3 lists the fish species censused in 1981. Note that site 18 is Grecian Rocks, which is site 5 in 1980. The highest possible total score over all sites in 1981 is 540. No species attained these maximum total scores in either 1980 or 1981. This is not surprising considering the wide variety of habitats censused and the relatively low fish abundance and diversity at some of the sites.

The data in Tables 2 and 3 show that 198 and 202 total species were censused in 1980 and 1981 respectively, compared to 146 species observed off Key Largo by Jones and Thompson (1978). The greater number of species observed in the present study may be due primarily to the larger number of man-hours of bottom time (over 150 compared to 50) and the wider variety of habitats sampled. For example, members of families Batrachoididae, Ophichthidae, Gobiesocidae, Syngnathidae, and Dactyioscopidae were censused in habitats not sampled by Jones and Thompson (1978). A number of blenniids, clinids, and gobiids were also recorded from inshore areas. In other cases, our longer list appears to be due to increased bottom time resulting in observations of relatively uncommon offshore reef inhabitants (for example Apogon robinsi, A.

TABLE 2. List of fish species censused in 1980, total score per species by site number, and total score per species for all sites.

TIME SCORES BY SPECIES - 1980

SPECIES	site numbers									
	1	3	5	7	9	11	13	15	17	TOTAL
SPHYRNIDAE:										
Sphyrna tiburo					4					4
DASYATIDAE:										
Dasyatis americana		2			5					7
Urolophus jamaicensis	5			8			13		10	36
MYLIOBATIDAE:										
Aetobatus narinari			1							1
ELOPIDAE:										
Megalops atlanticus		5								5
MURAENIDAE:										
Gymnothorax funebris	11			6	5					22
Gymnothorax moringa		1			10		3		4	18
Gymnothorax vicinus					2					2
Muraena miliaris			8							8
OPHICHTHIDAE:										
Ahlia egmontis						1				1
CLUPEIDAE:										
Harengula clupeola					5					5
Jenkinsia lamprotaenia			1							1
Jenkinsia species					11					11
SYNODONTIDAE:										
Synodus intermedius	5	7		4			4		4	24
BATRACHOIDIDAE:										
Opsanus beta						3		5		8
EXOCOETIDAE:										
Hemiramphus brasiliensis					5					5
BELONIDAE:										
Tylosurus crocodilus	5		20		5					30
ATHERINIDAE:										
Atherinomorus stipes			2					4		6
HOLOCENTRIDAE:										
Holocentrus ascensionis	12	24		7						43
Holocentrus rufus	4	19		9					7	39
Holocentrus vexillarius	21	35		10						66
Myripristis jacobus	16	16								32

TIME SCORES BY SPECIES - 1980

SPECIES	site numbers								
	1	3	5	7	9	11	13	17	TOTAL
AULOSTOMIDAE:									
Aulostomus maculatus	36	22	21	36				5	120
SYNGNATHIDAE:									
Cosmocampus albirostris									3
Hippocampus erectus						5			5
Hippocampus zosterae									4
CENTROPOMIDAE:									
Centropomus undecimalis	3	1							4
SERRANIDAE:									
Diplectrum formosum						23	21		50
Epinephelus adscensionis		1							1
Epinephelus cruentatus	34	32	18	18				11	113
Epinephelus guttatus	1	5		2	3				11
Epinephelus itajara		4							4
Epinephelus morio			2				4		6
Epinephelus striatus	12	18	13	10	22		3		78
Hypoplectrus aberrans	2	3							5
Hypoplectrus gemma	18	29		3	16			24	90
Hypoplectrus indigo				4				9	13
Hypoplectrus nigricans		15		8	3			3	29
Hypoplectrus puella	5	10	1	10	25			5	56
Hypoplectrus unicolor	23	36	17	28	24			33	161
Liopropoma rubre	3	8	3	2					16
Mycteroperca bonaci	14	4	16	10	17			8	69
Mycteroperca tigris		3		2					5
Serranus baldwini	5	8	6	8				10	37
Serranus tabacarius		13		2				4	19
Serranus tigrinus	34	37	15	31				23	140
GRAMMISTIDAE:									
Rypticus saponaceus	7	12		9					28
PRIACANTHIDAE:									
Priacanthus arenatus	4	7							11
Priacanthus cruentatus	20	15	5	30					70

TIME SCORES BY SPECIES - 1980

SPECIES	site numbers									
	1	3	5	7	9	11	13	15	17	TOTAL
APOGONIDAE:										
Apogon binotatus		6	4	7						17
Apogon maculatus	7	2	13		3		1	1	5	32
Apogon townsendi	7	5	3							15
Astrapogon stellatus								6	1	7
MALACANTHIDAE:										
Malacanthus plumieri	9	11		18						38
ECHENEIDAE:										
Echeneis naucrates	6	20	1	11	3				4	45
CARANGIDAE:										
Caranx bartholomaei					12		15	4	5	36
Caranx crysos					1	9	2			12
Caranx ruber	31	10	34	31	33	5	6	5	17	172
Oligoplites saurus								3		3
Seriola dumerili			3							3
Trachinotus falcatus				3						3
LUTJANIDAE:										
Lutjanus analis	15	3	33	17	6		6	3		83
Lutjanus apodus	23	24	27	24	10					108
Lutjanus griseus	39	27	33	40	33			9		181
Lutjanus jocu	14	19	8	10						51
Lutjanus mahogoni	35	29	13	36						113
Lutjanus synagris		26		5			3	13		47
Ocyurus chrysurus	40	40	36	40	40	4	15	8	40	263
GERREIDAE:										
Gerres cinereus					5					5
HAEMULIDAE:										
Anisotremus surinamensis	19	19	15	11			1		5	70
Anisotremus virginicus	30	33	25	24	39		12	3	31	197
Haemulon album	12	6								18
Haemulon aurolineatum			6			1		10		17
Haemulon carbonarium	37	38	31	40						146
Haemulon chrysargyreum	39	30	30	40					3	142
Haemulon flavolineatum	40	40	39	39	39		11	28	25	261
Haemulon macrostomum	33	34	19	29						115
Haemulon melanurum			6	6			4			16
Haemulon parrai	1	23	23	37						84
Haemulon plumieri	31	38	32	30	40	6	18	12	40	247
Haemulon sciurus	40	34	35	40	35		5	8	35	232
Haemulon species1									5	5

TIME SCORES BY SPECIES - 1980

SPECIES	site numbers 1	3	5	7	9	11	13	15	17	TOTAL
SPARIDAE:										
Calamus bajonado	3		6		7		5			21
Calamus calamus	8	22	22	3	35	2	9		36	142
Lagodon rhomboides						2				4
SCIAENIDAE:										
Equetus acuminatus	10	5	9	7	13		35	1	16	107
Equetus lanceolatus		7								7
Equetus punctatus	3	7	4	12	10		2			38
Odontoscion dentex	31	33		22	3					89
MULLIDAE:										
Mulloidichthys martinicus	35	29	37	38						139
Pseudupeneus maculatus	14	27	10	31					16	98
PEMPHERIDAE:										
Pempheris schomburgki	34	39	38	40						151
KYPHOSIDAE:										
Kyphosus sectatrix	19	34	29	39						121
EPHIPPIDAE:										
Chaetodipterus faber	3	4			9	4				20
CHAETODONTIDAE:										
Chaetodon capistratus	32	39	6	29	31		7		10	154
Chaetodon ocellatus	33	23	14	27	5		1		19	122
Chaetodon sedentarius	5		21	5	5		4			40
Chaetodon striatus	30	27		10					21	88
POMACANTHIDAE:										
Holacanthus bermudensis	9	3	15		28		6		34	95
Holacanthus tricolor	38	40	3	25						106
Holocanthus ciliaris	25	16	31	22	14		4		21	136
Pomacanthus arcuatus	20	21	25	15	27	7	31	1	40	197
Pomacanthus paru	18	13	31	12			5			86
POMACENTRIDAE:										
Abudefduf saxatilis	40	39	39	39	39		1		30	227
Chromis cyaneus	34	40	5	40						119
Chromis insolatus	4									4
Chromis multilineatus	27	25	13	37						102
Chromis scotti	6	18		3						27
Microspathodon chrysurus	30	39	40	40						149
Pomacentrus diencaeus	33	39	38	32	19				2	163
Pomacentrus leucostictus	6	5	22	7	35		15		24	116
Pomacentrus partitus	40	40	40	40	39				40	239
Pomacentrus planifrons	39	38	40	40	40				38	235
Pomacentrus variabilis	20	10	29	17	40		21	1	39	188

TIME SCORES BY SPECIES - 1980

SPECIES	site numbers									
	1	3	5	7	9	11	13	15	17	TOTAL
CIRRHITIDAE:										
Amblycirrhitus pinos	8	10		8						26
LABRIDAE:										
Bodianus rufus	28	36	30	40						134
Clepticus parrai	17	19	1	13						50
Halichoeres bivattatus	26	24	37	32	18	2	5		38	182
Halichoeres garnoti	40	40	25	39	1				5	150
Halichoeres maculipinna	40	40	40	37	3				40	200
Halichoeres poeyi			4		2					6
Halichoeres radiatus	33	17	40	36	8				23	157
Hemipteronotus martinicensis									10	10
Hemipteronotus novacula		10		6						16
Hemipteronotus splendens	5	25	24	25			5			84
Lachnolaimus maximus	8	22	21	37	34		14	5	34	175
Thalassoma bifasciatum	40	40	40	40	39		2		40	241
SCARIDAE:										
Cryptotomus roseus			13			5		10	11	39
Scarus coelestinus	20	23	33	24	29				18	147
Scarus coeruleus	25	32	25	7	38		5		14	146
Scarus croicensis	36	30	40	39	40	1	16	22	40	264
Scarus guacamaia	17	10	13	11	7					58
Scarus taeniopterus	28	26	25	21					14	114
Scarus vetula	35	40	34	35						144
Sparisoma aurofrenatum	40	40	39	38	20				40	217
Sparisoma chrysopterum	35	30	38	35	32	9	25	14	39	257
Sparisoma radians	10	28	16	12	21		8	5	28	128
Sparisoma rubripinne	24	30	39	18	9				30	150
Sparisoma viride	40	35	40	40	40		4	8	40	247
SPHYRAENIDAE:										
Sphyraena barracuda	34	16	32	15	31	4	5		18	155
OPISTOGNATHIDAE:										
Opistognathus aurifrons	19	12		12					10	53
Opistognathus maxillosus							14		2	16

TIME SCORES BY SPECIES - 1980

SPECIES	site numbers									
	1	3	5	7	9	11	13	15	17	TOTAL
DACTYLOSCOPIDAE:										
Gillellus rubrocinctus					3					3
CLINIDAE:										
Acanthemblemaria sp2				1	1				9	11
Acanthemblemaria sp3									16	16
Acanthemblemaria sp4									4	4
Hemiemblemaria simulus	4	15							7	26
Malacoctenus aurolineatus			2							2
Malacoctenus roseus					8					8
Malacoctenus species 1					6		5		10	21
Malacoctenus triangulatus					3				4	7
Paraclinus species 1						1	17	11		29
BLENNIIDAE:										
Blenniidae juv spp							4			4
Blenniidae species1					6		1			7
Chioblennius atlanticus	5			3						8
Parablennius marmoreus			3						3	6
Scartella cristata			16		19		6		2	43
CALLIONYMIDAE:										
Callionymus bairdi	4	5							3	12
GOBIIDAE:										
Barbulifer species								5		5
Coryphopterus dicrus	7	14	12	13	16		10		23	95
Coryphopterus glaucofraenum	21	22	18	21	36		25	33	20	196
Coryphopterus personatus	11	28		18	14					71
Gnatholepis thompsoni	27	34	21	28	21		1		38	170
Gobionellus saepepallens								5		5
Gobiosoma grosvenori					8	19	15	9		51
Gobiosoma macrodon					5	1	34	5		45
Gobiosoma oceanops	13	24	30	13	37		11		22	150
Ioglossus calliurus	12	12	8	8					15	55
Microgobius carri		15	5				12			32
Microgobius microlepis					4	2	16	38		60

TIME SCORES BY SPECIES - 1980

SPECIES	site numbers									
	1	3	5	7	9	11	13	15	17	TOTAL
ACANTHURIDAE:										
Acanthurus bahianus	40	40	39	40	32		13	3	40	247
Acanthurus chirurgus	21	31	33	16	34		15		34	184
Acanthurus coeruleus	40	40	40	40	36				38	234
SCOMBRIDAE:										
Scomberomorus regalis	1	15		10	2	2				30
SCORPAENIDAE:										
Scorpaena plumieri					3					3
BOTHIDAE:										
Bothus lunatus							1			1
Bothus species 1									2	2
Bothus species 2							4			4
BALISTIDAE:										
Aluterus schoepfi									4	4
Aluterus scriptus	16	9	10	16	1				6	58
Balistes capriscus						5	3			8
Balistes vetula				5					13	18
Cantherhines macrocerus	3									3
Cantherhines pullus	23	38	12	18						91
Canthidermis sufflamen	3		6	20					14	43
Monacanthus ciliatus						13				13
Monacanthus tuckeri	5		2							7
OSTRACIIDAE:										
Lactophrys bicaudalis	3	6	5	13	5					32
Lactophrys polygonia									5	5
Lactophrys quadricornis							4			4
Lactophrys trigonus		3								3
Lactophrys triqueter	11	18	9	25	8				19	90
TETRAODONTIDAE:										
Canthigaster rostrata	35	34	17	33	4				19	142
Sphoeroides spengleri							5			5

TIME SCORES BY SPECIES - 1980

SPECIES	site numbers 1	3	5	7	9	11	13	15	17	TOTAL
DIODONTIDAE:										
Diodon holocanthus	5			5	1	4			1	16
Diodon hystrix	5	3	2	8	4				2	24

TABLE 3. List of the fish species censused in 1981, total score per species by site number, and total score per species for all sites.

TIME SCORES BY SPECIES - 1981

SPECIES	site numbers 2	4	6	8	10	12	14	16	18	TOTAL
ORECTOLOBIDAE:										
Ginglymostoma cirratum		8						1		9
CARCHARHINIDAE:										
Carcharhinus leucas			4						5	9
DASYATIDAE:										
Dasyatis americana			2	1	3					6
Urolophus jamaicensis	13	8			16		13	9	4	63
MYLIOBATIDAE:										
Aetobatus narinari			5	1					1	7
MURAENIDAE:										
Gymnothorax funebris	8		9							17
Gymnothorax moringa		5	4	2	9		4			24
Muraena miliaris	2			3					2	7
CLUPEIDAE:										
Harengula clupeola		5					3			8
Harengula species		7								7
Jenkinsia lamprotaenia	9		15	4					5	33
Jenkinsia species				1			1			2
Sardinella aurita		9					11			20
SYNODONTIDAE:										
Synodus intermedius	9	17	8	5		2	1	3		45
BATRACHOIDIDAE:										
Opsanus beta								5		5
GOBIESOCIDAE:										
Gobiesox strumosus						4		2		6
EXOCOETIDAE:										
Hemiramphus brasiliensis	4									4
BELONIDAE:										
Strongylura notata							16			16
Tylosurus crocodilus			5	3					23	31
ATHERINIDAE:										
Atherinomorus stipes				5			1			6

TIME SCORES BY SPECIES - 1981

SPECIES	site numbers 2	4	6	8	10	12	14	16	18	TOTAL
HOLOCENTRIDAE:										
Holocentrus ascensionis			2	7						9
Holocentrus rufus	1	5	8	16	5				1	36
Holocentrus vexillarius				6						6
AULOSTOMIDAE:										
Aulostomus maculatus	33	8	34	50	28				46	199
SYNGNATHIDAE:										
Cosmocampus albirostris						1				1
Hippocampus erectus						8				8
SERRANIDAE:										
Diplectrum formosum			1		1	43	28	18	3	94
Epinephelus afer			1							1
Epinephelus cruentatus	25	5	32	48	20				34	164
Epinephelus guttatus				3	2					5
Epinephelus morio			2		21		15	21		59
Epinephelus striatus	9	5	13	13	9				10	59
Hypoplectrus aberrans				12						12
Hypoplectrus chlorurus				2						2
Hypoplectrus gemma	10	5	4	51	7				5	82
Hypoplectrus guttavarius				10						10
Hypoplectrus indigo			14	12					4	30
Hypoplectrus nigricans	3	13	18	21	4				12	71
Hypoplectrus puella	33	15	23	13	7				15	106
Hypoplectrus unicolor	39	23	34	50	15		4		23	188
Liopropoma rubre			2	6						8
Mycteroperca bonaci	13	23	32	14	7		2	5	18	114
Mycteroperca tigris			3							3
Mycteroperca venenosa		2								2
Serranus baldwini				8	5					13
Serranus tabacarius	2		5						2	9
Serranus tigrinus	25		53	47	15				36	176

TIME SCORES BY SPECIES - 1981

SPECIES	site numbers 2	4	6	8	10	12	14	16	18	TOTAL
GRAMMISTIDAE:										
Rypticus saponaceus	2			4					4	10
PRIACANTHIDAE:										
Priacanthus cruentatus	14		5	15					14	48
APOGONIDAE:										
Apogon binotatus			3	18					3	24
Apogon lachneri			5							5
Apogon maculatus	4	9	11	12	1				20	57
Apogon pseudomaculatus			4							4
Apogon robinsi									4	4
Apogon townsendi				13					5	18
Astrapogon stellatus				4			16			20
MALACANTHIDAE:										
Malacanthus plumieri			3						3	6
ECHENEIDAE:										
Echeneis naucrates	30		9	10	7	7			36	99
CARANGIDAE:										
Caranx bartholomaei	9	15	7		4		17		9	61
Caranx crysos		10			7	11	48	2		102
Caranx ruber	57	57	56	37	34	9	47	1	50	365
Trachinotus falcatus				2						2
LUTJANIDAE:										
Lutjanus analis	26	13	13	18	4		5		30	109
Lutjanus apodus	47	30	41	40	24				53	235
Lutjanus cyanopterus			7							7
Lutjanus griseus	46	58	47	26	10	4	43		40	274
Lutjanus jocu	8		8	2					10	28
Lutjanus mahogoni	31	10	34	49		10			23	158
Lutjanus synagris		40	11	7		3	19	2		109
Ocyurus chrysurus	59	49	60	57	57		4		58	348
GERREIDAE:										
Eucinostomus species1						2	1		4	10
Eucinostomus species2								1		10
Gerres cinereus		14	2				39		28	83

TIME SCORES BY SPECIES - 1980 & 1981

SPECIES	site numbers																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	TOTAL
SYNODONTIDAE:																			
Synodus intermedius	5	9	7	17		8	4	5				2	4	1		3	4		69
BATRACHOIDIDAE:																			
Opsanus beta											3				5	5			13
GOBIESOCIDAE:																			
Gobiesox strumosus												4				2			6
EXOCOETIDAE:																			
Hemiramphus brasiliensis		4							5										9
BELONIDAE:																			
Strongylura notata														16					16
Tylosurus crocodilus	5				20	5		3	5									23	61
ATHERINIDAE:																			
Atherinomorus stipes					2			5						1	4				12
HOLOCENTRIDAE:																			
Holocentrus ascensionis	12		24			2	7	7											52
Holocentrus rufus	4	1	19	5		8	9	16		5							7	1	75
Holocentrus vexillarius	21		35				10	6											72
Myripristis jacobus	16		16																32
AULOSTOMIDAE:																			
Aulostomus maculatus	36	33	22	8	21	34	36	50		28					–		5	46	319
SYNGNATHIDAE:																			
Cosmocampus albirostris												1			3				4
Hippocampus erectus											5	8							13
Hippocampus zosterae															4				4
CENTROPOMIDAE:																			
Centropomus undecimalis	3		1																4

TIME SCORES BY SPECIES - 1980 & 1981

SPECIES	site numbers																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	TOTAL
SERRANIDAE:																			
Diplectrum formosum						1				1	23	43	21	28	6	18		3	144
Epinephelus adscensionis			1																1
Epinephelus afer						1													1
Epinephelus cruentatus	34	25	32	5	18	32	18	48		20							11	34	277
Epinephelus guttatus	1		5				2	3	3	2									16
Epinephelus itajara			4																4
Epinephelus morio					2	2				21			4	15		21			65
Epinephelus striatus	12	9	18	5	13	13	10	13	22	9			3					10	137
Hypoplectrus aberrans	2		3					12											17
Hypoplectrus chlorurus								2											2
Hypoplectrus gemma	18	10	29	5		4	3	51	16	7							24	5	172
Hypoplectrus guttavarius								10											10
Hypoplectrus indigo						14	4	12									9	4	43
Hypoplectrus nigricans		3	15	13		18	8	21	3	4							3	12	100
Hypoplectrus puella	5	33	10	15	1	23	10	13	25	7							5	15	162
Hypoplectrus unicolor	23	39	36	23	17	34	28	50	24	15				4			33	23	349
Liopropoma rubre	3		8		3	2	2	6											24
Mycteroperca bonaci	14	13	4	23	16	32	10	14	17	7				2		5	8	18	183
Mycteroperca tigris			3			3	2												8
Mycteroperca venenosa				2															2
Serranus baldwini	5		8		6		8	8		5							10		50
Serranus tabacarius		2	13			5	2										4	2	28
Serranus tigrinus	34	25	37		15	53	31	47		15							23	36	316
GRAMMISTIDAE:																			
Rypticus saponaceus	7	2	12				9	4										4	38

TIME SCORES BY SPECIES - 1980 & 1981

SPECIES	site numbers																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	TOTAL
PRIACANTHIDAE:																			
Priacanthus arenatus	4		7																11
Priacanthus cruentatus	20	14	15		5	5	30	15										14	118
APOGONIDAE:																			
Apogon binotatus			6		4	3	7	18										3	41
Apogon lachneri						5													5
Apogon maculatus	7	4	2	9	13	11		12	3	1			1		1		5	20	89
Apogon pseudomaculatus						4													4
Apogon robinsi																		4	4
Apogon townsendi	7		5		3			13										5	33
Astrapogon stellatus								4						16	6		1		27
MALACANTHIDAE:																			
Malacanthus plumieri	9		11			3	18											3	44
ECHENEIDAE:																			
Echeneis naucrates	6	30	20		1	9	11	10	3	7		7					4	36	144
CARANGIDAE:																			
Caranx bartholomaei		9		15		7			12	4			15	17	4		5	9	97
Caranx crysos				10					1	7	9	11	2	48		26			114
Caranx ruber	31	57	10	57	34	56	31	37	33	34	5	9	6	47	5	18	17	50	537
Oligoplites saurus															3				3
Seriola dumerili					3														3
Trachinotus falcatus							3	2											5
LUTJANIDAE:																			
Lutjanus analis	15	26	3	13	33	13	17	18	6	4			6	5	3			30	192
Lutjanus apodus	23	47	24	30	27	41	24	40	10	24								53	343
Lutjanus cyanopterus						7													7
Lutjanus griseus	39	46	27	58	33	47	40	26	33	10		4		43	9			40	455
Lutjanus jocu	14	8	19		8	8	10	2										10	79
Lutjanus mahogoni	35	31	29	10	13	34	36	49				10				1		23	271
Lutjanus synagris			26	40		11	5	7				3	3	19	13	29			156
Ocyurus chrysurus	40	59	40	49	36	60	[illegible]	57	40	57	4	[illegible]	15	4	8	4	[illegible]	58	611

TIME SCORES BY SPECIES - 1980 & 1981

SPECIES	site numbers																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	TOTAL
GERREIDAE:																			
Eucinostomus species1												2		1		3		4	10
Eucinostomus species2																10			10
Gerres cinereus				14		2			5					39				28	88
HAEMULIDAE:																			
Anisotremus surinamenis	19	31	19		15		11	9		8			1				5	17	135
Anisotremus virginicus	30	48	33	41	25	41	24	42	39	31			12	21	3	22	31	34	477
Haemulon album	12	4	6			6												1	29
Haemulon aurolineatum		45		59	6	34		32		26	1				10			59	272
Haemulon carbonarium	37	45	38	2	31	37	40	47		21								55	353
Haemulon chrysargyreum	39	45	30		30	38	40	32		4							3	51	312
Haemulon flavolineatum	40	59	40	57	39	60	39	60	39	58		5	11	5	28		25	60	625
Haemulon macrostomum	33	47	34		19	53	29	46		5								51	317
Haemulon melanurum					6		6	1		18			4						35
Haemulon parrai	1	16	23		23	23	37	17		10								29	179
Haemulon plumieri	31	56	38	60	32	59	30	53	40	60	6	46	18	36	12	55	40	55	727
Haemulon sciurus	40	56	34	60	35	57	40	55	35	31			5	42	8	4	35	54	591
Haemulon species1												2				8	5		15
Haemulon species2																7			7
SPARIDAE:																			
Archosargus probatocephalus				4															4
Archosargus rhomboides				2								5		10					17
Calamus bajonado	3	9		9	6	3			7	28		7	5	4				4	85
Calamus calamus	8	17	22	11	22	2	2		25	20	2		0	2	5		36	8	203
Calamus penna		1																	1
Lagodon rhomboides											2	37			2				41

TIME SCORES BY SPECIES - 1980 & 1981

SPECIES	site numbers																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	TOTAL
SCIAENIDAE:																			
Equetus acuminatus	10	28	5	19	9	19	7	2	13	34			35	26	12	33	16	23	291
Equetus lanceolatus			7			15		8										3	33
Equetus punctatus	3		7		4	3	12	3	10				2						44
Odontoscion dentex	31	46	33	4		1	22	13	3	6									159
MULLIDAE:																			
Mulloidichthys martinicus	35	26	29		37	47	38	44		12								52	320
Pseudupeneus maculatus	14	40	27	17	10	11	31	19		40							16	33	258
PEMPHERIDAE:																			
Pempheris poeyi		1																	1
Pempheris schomburgki	34	46	39		38	27	40	41										51	316
KYPHOSIDAE:																			
Kyphosus sectatrix	19	42	34	7	29	30	39	30										24	254
EPHIPPIDAE:																			
Chaetodipterus faber	3		4						9		4								20
CHAETODONTIDAE:																			
Chaetodon capistratus	32	25	39	44	6	35	29	52	31	12			7	4		1	10	26	353
Chaetodon ocellatus	33	25	23	28	14	26	27	41	5	29			1	5		5	19	22	303
Chaetodon sedentarius	5	10		8	21	20	5	31	5	39			4					19	167
Chaetodon striatus	30	9	27	8		1	10	15		18							21	13	152
POMACANTHIDAE:																			
Holacanthus bermudensis	9	3	3	39	15			4	28	16			6	6			34	13	176
Holacanthus tricolor	38	1	40		3	20	25	49		9								21	206
Holocanthus ciliaris	25	41	16	9	31	14	22	32	14	49			4	14	3		21	32	327
Pomacanthus arcuatus	20	46	21	47	25	37	15	36	27	53	7	10	31	25	11	5	40	29	485
Pomacanthus paru	18	32	13		31	28	12	44		37			5		7			50	277

TIME SCORES BY SPECIES 1980 & 1981

SPECIES	site numbers																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	TOTAL
POMACENTRIDAE:																			
Abudefduf saxatilis	40	55	39	49	39	59	39	56	39	6			1	9			30	60	521
Chromis cyaneus	34	2	40		5		40	50		5									176
Chromis insolatus	4							5											9
Chromis multilineatus	27	13	25		13	22	37	26										15	178
Chromis scotti	6	6	18			7	3	10											50
Microspathodon chrysurus	30	51	39		40	60	40	57		5								59	381
Pomacentrus diencaeus	33	48	39	42	38	48	32	53	19								2	53	407
Pomacentrus leucostictus	6	30	5	30	22	16	7	20	35	20			15	21	2	8	24	33	294
Pomacentrus partitus	40	60	40	31	40	60	40	55	39	50						2	40	60	557
Pomacentrus planifrons	39	55	38	60	40	55	40	58	40	47							38	60	570
Pomacentrus variabilis	20	47	10	51	29	53	17	32	40	30			21	42	12	12	39	44	499
CIRRHITIDAE:																			
Amblycirrhitus pinos	8		10				8												26
LABRIDAE:																			
Bodianus rufus	28	59	36	9	30	43	40	36		11								46	338
Clepticus parrai	17		19		1	3	13	49										3	105
Halichoeres bivattatus	26	54	24	56	37	50	32	29	18	59	2	3	5	11		19	38	60	523
Halichoeres garnoti	40	37	40		25	25	39	57	1	41							5	34	344
Halichoeres maculipinna	40	56	40		40	58	37	48	3	60							40	47	469
Halichoeres poeyi		20			4				2	37								2	65
Halichoeres radiatus	33	51	17	10	40	53	36	40	8	49							23	55	415
Hemipteronotus martinicensis						1											10	1	12
Hemipteronotus novacula			10			1	6			4								3	24
~~Hemipteronotus splendens~~	~~5~~	~~14~~	~~25~~	~~2~~	~~24~~	~~4~~	~~25~~	~~5~~		~~14~~			~~5~~	~~3~~	~~—~~			~~10~~	~~136~~
~~Lachnolaimus maximus~~	~~8~~	~~28~~	~~22~~	~~40~~	~~21~~	~~30~~	~~37~~	~~13~~	~~34~~	~~47~~			~~14~~	~~22~~	~~5~~	~~5~~	~~34~~	~~24~~	~~384~~
Thalassoma bifasciatum	40	60	40	46	40	60	40	60	39	60			2				40	50	577

TIME SCORES BY SPECIES - 1980 & 1981

SPECIES	site numbers																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	TOTAL
SCARIDAE:																			
Cryptotomus roseus		5			13	3				1	5	4			10		11	1	53
Scarus coelestinus	20	40	23	41	33	37	24	48	29	33							18	24	370
Scarus coeruleus	25	35	32	45	25	19	7	19	38	21			5				14	23	308
Scarus croicensis	36	50	30	30	40	53	39	55	40	30	1		16	7	22	11	40	58	558
Scarus guacamaia	17	26	10	15	13	16	11	18	7	32								21	186
Scarus taeniopterus	28	31	26		25	47	21	42		27		5					14	35	301
Scarus vetula	35	44	40		34	53	35	58		8								51	358
Sparisoma aurofrenatum	40	60	40	59	39	60	38	59	20	60		19		23		22	40	55	634
Sparisoma chrysopterum	35	21	30	30	38	1	35	29	32	30	9	22	25	28	14	16	39	20	454
Sparisoma radians	10	27	28	10	16	18	12	42	21	54		4	8		5	5	28	11	299
Sparisoma rubripinne	24	35	30	11	39	41	18	36	9	50							30	57	380
Sparisoma viride	40	60	35	59	40	60	40	55	40	58			4		8	2	40	60	601
SPHYRAENIDAE:																			
Sphyraena barracuda	34	48	16	2	32	26	15	15	31	18	4		5	34			18	37	335
OPISTOGNATHIDAE:																			
Opistognathus aurifrons	19	8	12			4	12	3									10	6	74
Opistognathus maxillosus													14				2		16
Opistognathus species 1														3					3
Opistognathus whitehursti														2		2			4
DACTYIOSCOPIDAE:																			
Gillellus rubrocinctus									3										3
CLINIDAE:																			
Acanthemblemaria chaplini		9		11		7		3		14								7	51
Acanthemblemaria sp2		12		10		5	1		1	23							9	12	73
Acanthemblemaria sp3				17													16		33
Acanthemblemaria sp4		5		4													4		13
Chaenopsis ocellatus				5						2						3			10
Emblemaria pandionis		2																	2
Hemiemblemaria simulus	4		15			2		4		4							7		36
Malacoctenus aurolineatus					2														2
Malacoctenus roseus				2					8										10
Malacoctenus species 1		4							6				5						25
Malacoctenus triangulatus		3				4		3	3	5							4	5	27
Paraclinus species 1											1		17	6	11	2			37

TIME SCORES BY SPECIES - 1980 & 1981

SPECIES	site numbers 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	TOTAL
BLENNIIDAE:																			
Blenniidae juv spp													4						4
Blenniidae species1		5		1					6				1	5					18
Hypleurochilus aequipinnis														11					11
Hypleurochilus bermudensis														2					2
Ophioblennius atlanticus	5	4				4	3	4										9	29
Parablennius marmoreus					3												3		6
Scartella cristata				8	16				19	5			6				2	7	63
CALLIONYMIDAE:																			
Callionymus bairdi	4	2	5			1				2							3		17
Callionymus pauciradiatus																1			1
GOBIIDAE:																			
Barbulifer species															5				5
Coryphopterus dicrus	7	46	14	44	12	48	13	6	16	16			10	5			23	24	284
Coryphopterus glaucofraenum	21	39	22	50	18	30	21	50	36	31		7	25	45	33	29	20	44	521
Coryphopterus lipernes								11											11
Coryphopterus personatus	11	5	28	10		25	18	36	14									7	154
Gnatholepis thompsoni	27	50	34	46	21	37	28	46	21	22			1	1			38	49	421
Gobionellus saepepallens														5	5				10
Gobiosoma grosvenori				4					8		19	20	15	38	9	11			124
Gobiosoma macrodon				9					5		1	3	34	37	5	33			127
Gobiosoma oceanops	13	49	24	48	30	49	13	32	37	16			11	4			22	43	391
Ioglossus calliurus	12	32	12		8	18	8	4		19							15	23	151
Microgobius carri		6	15	1	5	1				1			12						41
~~Microgobius microlepis~~									4		2		16	52	38	28			130
~~Nes longus~~				6										32		6			44

TIME SCORES BY SPECIES - 1980 & 1981

SPECIES	site numbers																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	TOTAL
ACANTHURIDAE:																			
Acanthurus bahianus	40	55	40	33	39	59	40	60	32	45			13	8	3	13	40	60	580
Acanthurus chirurgus	21	27	31	47	33	20	16	9	34	30			15	30		17	34	30	394
Acanthurus coeruleus	40	60	40	47	40	59	40	52	36	60							38	60	572
SCOMBRIDAE:																			
Scomberomorus regalis	1	12	15			8	10	19	2	9	2							7	85
SCORPAENIDAE:																			
Scorpaena plumieri				5					3										8
BOTHIDAE:																			
Bothus lunatus													1						1
Bothus species 1																	2		2
Bothus species 2													4						4
BALISTIDAE:																			
Aluterus schoepfi																	4		4
Aluterus scriptus	16		9		10	4	16	10	1	8							6	2	82
Balistes capriscus											5		3						8
Balistes vetula							5			5							13		23
Cantherhines macrocerus	3	4																	7
Cantherhines pullus	23	19	38		12	14	18	32		5								29	190
Canthidermis sufflamen	3				6	5	20	22		5							14	1	76
Monacanthus ciliatus											13	28				21			62
Monacanthus tuckeri	5	4			2	5		5		2								2	25
OSTRACIIDAE:																			
Lactophrys bicaudalis	3	5	6		5	2	13	15	5									13	67
Lactophrys polygonia										5							5	5	15
Lactophrys quadricornis		4				5							4	5		5			23
Lactophrys trigonus			3					5											8
Lactophrys triqueter	11	10	18	7	9	12	25	25	8	16							19	14	174

TIME SCORES BY SPECIES - 1980 & 1981

SPECIES	site numbers																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	TOTAL
TETRAODONTIDAE:																			
Canthigaster rostrata	35	42	34	3	17	53	33	54	4	37							19	41	372
Sphoeroides spengleri				3								16	5	2		4			30
DIODONTIDAE:																			
Diodon holocanthus	5	9		7		4	5		1		4	2		4			1		42
Diodon hystrix	5		3	6	2	4	8	3	4	1							2	14	52

diencaeus. Thus, scores for P. mellis actually represented counts of juvenile P. diencaeus. In addition, adult P. diencaeus are often difficult to distinguish from adult dusky damselfish, P. dorsopunicans, in the field. Therefore, scores for juvenile and adult P. dorsopunicans were combined with an unknown proportion of adult P. diencaeus (as well as P. mellis) and listed as P. diencaeus.

Other systematic difficulties exist with Coryphopterus personatus and C. hyalinus. These two species are difficult to distinguish in the field. Because C. hyalinus normally occurs deeper than 30 m, we should have observed mostly C. personatus in this survey. The scores for C. personatus may, however, include some C. hyalinus.

Robins et al. (1980) no longer recognize two other gobies, Ioglossus calliurus and I. helenae, as separate species. Therefore, our counts for the two Ioglossus species were combined and listed as I. calliurus.

We had problems in 1980 counts with misidentifying Sparisoma aurofrenatum as S. chrysopterum on offshore reefs where S. chrysopterum is quite rare. This problem was corrected in 1981 by using the somewhat more blunt head morphology and difference in nasal cirri in S. chrysopterum as key characters. The result of this error was erroneously high scores for S. chrysopterum in 1980 on offshore reef sites. Jones and Thompson (1978) appear to have made the same error. On our last dive at Turtle Rocks we also noted another species of parrotfish, S. atomarium, mixed in with individuals we had been identifying as all S. radians. Thus the scores for S. radians at this site may include an occasional S. atomarium observation.

Several other species were identified only to genus in the field, such as some Acanthemblemaria species. We felt that taking the time to collect such individuals during the 50 min. STT count was an unacceptable expenditure of time that would bias the results. These fish were not identified to species level in cases where we could not relocate and collect the individual after the count. In at least two instances rare species were fleetingly observed in caves. They could not be identified with confidence to the family level and were omitted from the data. However, we believe that these very cryptic or completely nocturnal species cannot be reasonably sampled with this type of visual technique.

Analysis of Fish Community Composition

Table 5 is a data summary for all study sites. Note that odd-numbered sites were censused in 1980, even-numbered sites in 1981, and that Grecian Rocks was site 5 in 1980 and site 18 in 1981. The mean number of species per SST count per site was 48.0 for 1980, 45.8 for 1981, and 46.7 for both years. Mean number of species per STT count at Grecian Rocks was 65.8 and 67.8 in 1980 and 1981 respectively, showing little difference between years despite a total species number of 108 in 1980 and 126 in 1981. Shannon-Weaver diversity index (H') and equitability of distribution (J') values were similar to but slightly higher than the values obtained by Jones and Thompson (1978) for Molasses, French, and Carysfort Reefs. We censused more species than they did at each of these three sites (123 vs. 120, 126 vs. 118, 134 vs. 104 respectively). The greater number of replicates at Carysfort Reef

TABLE 5. Data summary for all study sites. Odd numbers correspond to 1980 sites, even numbers to 1981 sites, and site 5 (1980) = site 18 (1981) = Grecian Rocks. Shannon-Weaver indices (H ') were computed using base 10 logs and species scores, rather than absolute species abundance.

SITE NO.	NAME	TOTAL SPECIES	TOTAL SCORES	SHANNON-WEAVER INDEX (H ')	EQUITABILITY OF DISTRIBUTION (J ')
1	Molasses Reef	123	2384	4.55	.95
2	White Bank Dry Rocks	121	3232	4.48	.94
3	French Reef	126	2672	4.63	.96
4	Mosquito Bank	98	2169	4.20	.92
5	Grecian Rocks (1980)	108	2137	4.43	.95
6	Key Largo Dry Rocks	134	3040	4.48	.92
7	The Elbow	118	2409	4.53	.95
8	Carysfort Reef	131	3342	4.54	.93
9	Basin Hill Shoals	91	1549	4.16	.92
10	Turtle Rocks	109	2356	4.34	.93
11	Ocean Reef	26	140	2.87	.88
12	Turtle Harbor	31	349	2.98	.87
13	North Channel	64	598	3.82	.92
14	South Channel	65	1036	3.75	.90
15	Rock Harbor	42	362	3.42	.91
16	Point Elizabeth	48	570	3.47	.90
17	Angelfish Creek	90	1629	4.21	.93
18	Grecian Rocks (1981)	126	3233	4.50	.93

in our study (12 vs. 8) probably explains most of the greater number of total species counted at that site. We had the same number of replicates (8) as Jones and Thompson (1978) at Molasses and French Reefs. Our total species score at Molasses Reef was less (2,84 vs. 2627) and at French Reef greater (2672 vs. 2640) than Jones and Thompson (1978). French Reef had the highest H' in our study, whereas Molasses Reef was the highest H' in their study. Our H' values indicated that species diversity is highest on offshore reefs, and generally decreases in proportion to the distance between these sites and the shore. The turtle grass sites (Ocean Reef, Turtle Harbor, and Rock Harbor) were the least diverse in terms of fish species.

Tables 6, 7, 8, 9 and 10 rank species according to total score over all STT counts in the two year study (after weighting 1981 data for effort) for offshore reefs, intermediate reefs, inshore patch reefs, turtle grass/hardground, and total for all habitats respectively. Jones and Thompson (1978) give a similar table and refer to the species with higher total scores as "dominant." We do not interpret the species with highest rank according to STT scores as necessarily ecologically dominant components of the censused communities. DeMartini and Roberts (1982) demonstrated that STT scores tend to overemphasize the importance of widespread, rare species and underemphasize patchy, abundant species. They did, however, find a high correlation between STT scores and frequency of occurrence. Thus tables 6-9 provide, with some exceptions, a rough characterization of the readily visible component of fish communities within major habitat types. Several examples of these

Table 6. Rank order of species on offshore reef sites by species time score (with 1981 data adjusted for effort).

Relative Species Abundances Ranked by Species Scores

Offshore Reef Sites

Rank	Score	Species	Rank	Score	Species
1	160	Acanthurus bahianus	51	85	Pseudupeneus maculatus
2	160	Thalassoma bifasciatum	52	84	Holocanthus ciliaris
3	159	Haemulon flavolineatum	53	84	Hypoplectrus gemma
4	158	Ocyurus chrysurus	54	82	Clepticus parrai
5	157	Pomacentrus partitus	55	81	Coryphopterus personatus
6	157	Halichoeres garnoti	56	80	Pomacanthus arcuatus
7	157	Sparisoma aurofrenatum	57	78	Sparisoma radians
8	156	Pomacentrus planifrons	58	77	Scarus coeruleus
9	155	Abudefduf saxatilis	59	77	Chaetodon striatus
10	155	Acanthurus coeruleus	60	76	Lachnolaimus maximus
11	152	Sparisoma viride	61	75	Sphyraena barracuda
12	151	Haemulon sciurus	62	75	Priacanthus cruentatus
13	149	Halichoeres maculipinna	63	74	Acanthurus chirurgus
14	149	Scarus vetula	64	72	Pomacanthus paru
15	147	Chromis cyaneus	65	72	Haemulon parrai
16	147	Microspathodon chrysurus	66	71	Gobiosoma oceanops
17	146	Haemulon carbonarium	67	71	Lactophrys triqueter
18	142	Scarus croicensis	68	70	Holocentrus vexillarius
19	140	Pempheris schomburgki	69	68	Pomacentrus variabilis
20	139	Pomacentrus diencaeus	70	58	Hemipteronotus splendens
21	138	Canthigaster rostrata	71	55	Anisotremus surinamenis
22	136	Holacanthus tricolor	72	50	Scarus guacamaia
23	135	Chaetodon capistratus	73	49	Epinephelus striatus
24	134	Haemulon plumieri	74	48	Holocentrus ascensionis
25	133	Lutjanus mahogoni	75	48	Aluterus scriptus
26	133	Serranus tigrinus	76	47	Lutjanus analis
27	131	Mulloidichthys martinicus	77	45	Opistognathus aurifrons
28	130	Haemulon chrysargyreum	78	44	Lutjanus jocu
29	128	Bodianus rufus	79	44	Echeneis naucrates
30	127	Haemulon macrostomum	80	43	Holocentrus rufus
31	127	Aulostomus maculatus	81	39	Scomberomorus regalis
32	123	Lutjanus griseus	82	38	Canthidermis sufflamen
33	120	Hypoplectrus unicolor	83	38	Coryphopterus dicrus
34	120	Gnatholepis thompsoni	84	38	Malacanthus plumieri
35	119	Sparisoma chrysopterum	85	37	Hypoplectrus nigricans
36	116	Epinephelus cruentatus	86	37	Mycteroperca bonaci
37	115	Anisotremus virginicus	87	36	Lutjanus synagris
38	113	Halichoeres radiatus	88	35	Ioglossus calliurus
39	112	Kyphosus sectatrix	89	34	Chromis scotti
40	110	Chaetodon ocellatus	90	34	Hypoplectrus puella
41	106	Chromis multilineatus	91	33	Calamus calamus
42	103	Scarus taeniopterus	92	32	Myripristis jacobus
43	101	Halichoeres bivattatus	93	32	Lactophrys bicaudalis
44	100	Cantherhines pullus	94	31	Rypticus saponaceus
45	99	Scarus coelestinus	95	31	Pomacentrus leucostictus
46	98	Lutjanus apodus	96	31	Chaetodon sedentarius
47	97	Caranx ruber	97	29	Inermia vittata
48	97	Coryphopterus glaucofraenum	98	26	Serranus baldwini
49	96	Sparisoma rubripinne	99	26	Amblycirrhitus pinos
50	95	Odontoscion dentex	100	25	Apogon binotatus

Relative Species Abundances Ranked by Species Scores

Offshore Reef Sites

Rank	Score	Species
101	24	Equetus punctatus
102	23	Equetus acuminatus
103	22	Hemiemblemaria simulus
104	21	Haemulon aurolineatum
105	21	Apogon townsendi
106	19	Synodus intermedius
107	18	Haemulon album
108	18	Diodon hystrix
109	17	Gymnothorax funebris
110	17	Apogon maculatus
111	17	Liopropoma rubre
112	16	Hemipteronotus novacula
113	15	Microgobius carri
114	15	Serranus tabacarius
115	15	Holacanthus bermudensis
116	13	Hypoplectrus aberrans
117	13	Urolophus jamaicensis
118	12	Hypoplectrus indigo
119	12	Equetus lanceolatus
120	11	Priacanthus arenatus
121	11	Ophioblennius atlanticus
122	10	Diodon holocanthus
123	10	Epinephelus guttatus
124	9	Callionymus bairdi
125	8	Monacanthus tuckeri
126	7	Hypoplectrus guttavarius
127	7	Tylosurus crocodilus
128	7	Haemulon melanurum
129	7	Chaetodipterus faber
130	7	Chromis insolatus
131	7	Coryphopterus lipernes
132	6	Lactophrys trigonus
133	5	Balistes vetula
134	5	Mycteroperca tigris
135	5	Megalops atlanticus
136	4	Epinephelus itajara
137	4	Centropomus undecimalis
138	4	Trachinotus falcatus
139	3	Calamus bajonado
140	3	Atherinomorus stipes
141	3	Jenkinsia lamprotaenia
142	3	Astrapogon stellatus
143	3	Cantherhines macrocerus
144	3	Dasyatis americana
145	2	Malacoctenus triangulatus
146	2	Acanthemblemaria chaplini
147	2	Gymnothorax moringa
148	2	Muraena miliaris
149	1	Jenkinsia species
150	1	Epinephelus adscensionis
151	1	Hypoplectrus chlorurus
152	1	Acanthemblemaria sp2
153	1	Aetobatus narinari

Table 7. Rank order of species on intermediate reef sites by species time score (with 1981 data adjusted for effort).

Relative Species Abundances Ranked by Species Scores

Intermediate Reef Sites

Rank	Score	Species
1	160	Sparisoma viride
2	160	Pomacentrus partitus
3	159	Acanthurus coeruleus
4	158	Haemulon flavolineatum
5	156	Sparisoma aurofrenatum
6	155	Acanthurus bahianus
7	155	Abudefduf saxatilis
8	154	Pomacentrus planifrons
9	154	Ocyurus chrysurus
10	153	Microspathodon chrysurus
11	153	Thalassoma bifasciatum
12	147	Scarus croicensis
13	147	Halichoeres maculipinna
14	146	Halichoeres radiatus
15	146	Halichoeres bivattatus
16	146	Haemulon sciurus
17	145	Haemulon plumieri
18	142	Caranx ruber
19	137	Pomacentrus diencaeus
20	132	Scarus vetula
21	129	Bodianus rufus
22	127	Sparisoma rubripinne
23	125	Gobiosoma oceanops
24	124	Pomacentrus variabilis
25	123	Haemulon carbonarium
26	122	Lutjanus griseus
27	121	Pempheris schomburgki
28	120	Mulloidichthys martinicus
29	120	Lutjanus apodus
30	119	Haemulon chrysargyreum
31	119	Haemulon macrostomum
32	112	Gnatholepis thompsoni
33	107	Canthigaster rostrata
34	107	Anisotremus virginicus
35	106	Sphyraena barracuda
36	104	Pomacanthus paru
37	101	Scarus coelestinus
38	100	Scarus taeniopterus
39	100	Pomacanthus arcuatus
40	98	Haemulon aurolineatum
41	97	Aulostomus maculatus
42	93	Kyphosus sectatrix
43	93	Coryphopterus glaucofraenum
44	91	Coryphopterus dicrus
45	91	Serranus tigrinus
46	90	Halichoeres garnoti
47	88	Holocanthus ciliaris
48	84	Acanthurus chirurgus
49	81	Hypoplectrus unicolor
50	79	Epinephelus cruentatus
51	79	Lutjanus analis
52	76	Lachnolaimus maximus
53	76	Scarus coeruleus
54	75	Pomacentrus leucostictus
55	72	Lutjanus mahogoni
56	68	Haemulon parrai
57	66	Pseudupeneus maculatus
58	66	Sparisoma chrysopterum
59	63	Chaetodon ocellatus
60	63	Chaetodon capistratus
61	58	Mycteroperca bonaci
62	56	Equetus acuminatus
63	56	Ioglossus calliurus
64	55	Scarus guacamaia
65	54	Chaetodon sedentarius
66	53	Sparisoma radians
67	53	Cantherhines pullus
68	51	Echeneis naucrates
69	48	Hypoplectrus puella
70	47	Chromis multilineatus
71	47	Anisotremus surinamenis
72	43	Hemipteronotus splendens
73	39	Calamus calamus
74	38	Tylosurus crocodilus
75	36	Apogon maculatus
76	35	Epinephelus striatus
77	33	Lactophrys triqueter
78	32	Odontoscion dentex
79	31	Holacanthus tricolor
80	26	Holacanthus bermudensis
81	26	Priacanthus cruentatus
82	25	Lutjanus jocu
83	25	Coryphopterus personatus
84	22	Hypoplectrus nigricans
85	21	Scartella cristata
86	20	Jenkinsia lamprotaenia
87	20	Gerres cinereus
88	19	Cryptotomus roseus
89	19	Acanthemblemaria sp2
90	18	Halichoeres poeyi
91	18	Lactophrys bicaudalis
92	18	Scomberomorus regalis
93	17	Calamus bajonado
94	17	Caranx bartholomaei
95	16	Chaetodon striatus
96	16	Acanthemblemaria chaplini
97	14	Aluterus scriptus
98	14	Diodon hystrix
99	13	Hypoplectrus gemma
100	12	Hypoplectrus indigo

Relative Species Abundances Ranked by Species Scores

Intermediate Reef Sites

Rank	Score	Species
101	12	Equetus lanceolatus
102	12	Opistognathus aurifrons
103	12	Ophioblennius atlanticus
104	12	Urolophus jamaicensis
105	11	Gymnothorax funebris
106	11	Synodus intermedius
107	10	Muraena miliaris
108	10	Microgobius carri
109	10	Canthidermis sufflamen
110	9	Diodon holocanthus
111	9	Monacanthus tuckeri
112	9	Chromis scotti
113	8	Haemulon album
114	8	Apogon binotatus
115	8	Malacoctenus triangulatus
116	7	Holocentrus rufus
117	7	Lutjanus synagris
118	6	Haemulon melanurum
119	6	Chromis cyaneus
120	6	Equetus punctatus
121	6	Apogon townsendi
122	6	Serranus baldwini
123	6	Lactophrys quadricornis
124	6	Carcharhinus leucas
125	5	Aetobatus narinari
126	5	Serranus tabacarius
127	5	Clepticus parrai
128	5	Lutjanus cyanopterus
129	4	Rypticus saponaceus
130	4	Liopropoma rubre
131	4	Malacanthus plumieri
132	3	Apogon pseudomaculatus
133	3	Apogon lachneri
134	3	Apogon robinsi
135	3	Seriola dumerili
136	3	Diplectrum formosum
137	3	Epinephelus morio
138	3	Gymnothorax moringa
139	3	Hemiramphus brasiliensis
140	3	Eucinostomus species1
141	3	Lactophrys polygonia
142	3	Cantherhines macrocerus
143	3	Malacoctenus species 1
144	3	Blenniidae species1
145	3	Parablennius marmoreus
146	3	Acanthemblemaria sp4
147	3	Hemipteronotus novacula
148	2	Hemipteronotus martinicensis
149	2	Malacoctenus aurolineatus
150	2	Callionymus bairdi
151	2	Atherinomorus stipes
152	2	Inermia vittata
153	2	Mycteroperca tigris
154	1	Epinephelus afer
155	1	Holocentrus ascensionis
156	1	Pempheris poeyi
157	1	Emblemaria pandionis
158	1	Hemiemblemaria simulus
159	1	Calamus penna
160	1	Dasyatis americana

Table 8. Rank order of species on inshore patch reef sites by species time score (with 1981 data adjusted for effort).

Relative Species Abundances Ranked by Species Scores

Inshore Patch Reef Sites

Rank	Score	Species
1	160	Haemulon plumieri
2	158	Sparisoma viride
3	151	Ocyurus chrysurus
4	150	Thalassoma bifasciatum
5	149	Pomacentrus planifrons
6	145	Acanthurus coeruleus
7	141	Haemulon flavolineatum
8	139	Sparisoma aurofrenatum
9	133	Pomacentrus variabilis
10	133	Pomacentrus partitus
11	133	Pomacanthus arcuatus
12	132	Halichoeres bivattatus
13	131	Haemulon sciurus
14	126	Lachnolaimus maximus
15	124	Acanthurus bahianus
16	120	Scarus croicensis
17	119	Acanthurus chirurgus
18	118	Anisotremus virginicus
19	111	Caranx ruber
20	111	Sparisoma chrysopterum
21	110	Coryphopterus glaucofraenum
22	106	Abudefduf saxatilis
23	105	Gnatholepis thompsoni
24	102	Gobiosoma oceanops
25	99	Holacanthus bermudensis
26	96	Scarus coeruleus
27	96	Scarus coelestinus
28	92	Sparisoma radians
29	92	Pomacentrus leucostictus
30	91	Calamus calamus
31	83	Halichoeres maculipinna
32	82	Hypoplectrus unicolor
33	79	Lutjanus griseus
34	79	Sparisoma rubripinne
35	79	Coryphopterus dicrus
36	78	Chaetodon capistratus
37	74	Holocanthus ciliaris
38	71	Halichoeres radiatus
39	65	Equetus acuminatus
40	62	Chaetodon ocellatus
41	62	Sphyraena barracuda
42	56	Haemulon aurolineatum
43	54	Pseudupeneus maculatus
44	50	Canthigaster rostrata
45	49	Pomacentrus diencaeus
46	48	Hypoplectrus gemma
47	46	Lutjanus apodus
48	45	Hypoplectrus puella
49	45	Mycteroperca bonaci
50	43	Lactophrys triqueter
51	38	Scarus guacamaia
52	38	Chaetodon striatus
53	36	Chaetodon sedentarius
54	33	Serranus tigrinus
55	33	Halichoeres garnoti
56	32	Scarus taeniopterus
57	32	Acanthemblemaria sp2
58	32	Calamus bajonado
59	31	Epinephelus striatus
60	30	Caranx bartholomaei
61	29	Aulostomus maculatus
62	29	Scartella cristata
63	28	Ioglossus calliurus
64	27	Acanthemblemaria sp3
65	27	Halichoeres poeyi
66	27	Epinephelus cruentatus
67	27	Lutjanus synagris
68	26	Urolophus jamaicensis
69	25	Pomacanthus paru
70	23	Gymnothorax moringa
71	21	Coryphopterus personatus
72	18	Hypoplectrus nigricans
73	18	Lutjanus analis
74	17	Canthidermis sufflamen
75	16	Balistes vetula
76	16	Malacoctenus species 1
77	16	Acanthemblemaria chaplini
78	15	Haemulon carbonarium
79	15	Apogon maculatus
80	15	Synodus intermedius
81	14	Epinephelus morio
82	14	Gerres cinereus
83	13	Bodianus rufus
84	13	Holocentrus rufus
85	13	Caranx crysos
86	13	Serranus baldwini
87	12	Echeneis naucrates
88	12	Haemulon melanurum
89	12	Cryptotomus roseus
90	12	Aluterus scriptus
91	11	Diodon hystrix
92	11	Gobiosoma macrodon
93	11	Gobiosoma grosvenori
94	11	Jenkinsia species
95	10	Anisotremus surinamenis
96	10	Odontoscion dentex
97	10	Equetus punctatus
98	10	Malacoctenus triangulatus
99	10	Hemipteronotus splendens
100	10	Hemipteronotus martinicensis

Relative Species Abundances Ranked by Species Scores

Inshore Patch Reef Sites

Rank	Score	Species
101	10	Hemiemblemaria simulus
102	10	Opistognathus aurifrons
103	9	Malacoctenus roseus
104	9	Chaetodipterus faber
105	9	Hypoplectrus indigo
106	8	Harengula clupeola
107	8	Mulloidichthys martinicus
108	8	Scomberomorus regalis
109	8	Lactophrys polygonia
110	7	Diodon holocanthus
111	7	Blenniidae species1
112	7	Acanthemblemaria sp4
113	7	Lutjanus mahogoni
114	7	Haemulon parrai
115	7	Dasyatis americana
116	6	Haemulon chrysargyreum
117	6	Holacanthus tricolor
118	6	Sardinella aurita
119	6	Scorpaena plumieri
120	5	Lactophrys bicaudalis
121	5	Scarus vetula
122	5	Kyphosus sectatrix
123	5	Haemulon species1
124	5	Harengula species
125	5	Gymnothorax funebris
126	5	Hemiramphus brasiliensis
127	5	Tylosurus crocodilus
128	5	Ginglymostoma cirratum
129	4	Sphyrna tiburo
130	4	Epinephelus guttatus
131	4	Serranus tabacarius
132	4	Callionymus bairdi
133	4	Chaenopsis ocellatus
134	4	Microgobius microlepis
135	4	Nes longus
136	4	Aluterus schoepfi
137	3	Cantherhines pullus
138	3	Archosargus probatocephalus
139	3	Gillellus rubrocinctus
140	3	Parablennius marmoreus
141	3	Hemipteronotus novacula
142	3	Inermia vittata
143	3	Haemulon macrostomum
144	3	Chromis cyaneus
145	3	Microspathodon chrysurus
146	2	Gymnothorax vicinus
147	2	Opistognathus maxillosus
148	2	Microgobius carri
149	2	Sphoeroides spengleri
150	2	Bothus species 1
151	1	Diplectrum formosum
152	1	Astrapogon stellatus
153	1	Monacanthus tuekeri
154	1	Mycteroperca venenosa
155	1	Archosargus rhomboides

Table 9. Rank order of species on turtle grass and hardground sites by species time score (with 1981 data adjusted for effort).

Relative Species Abundances Ranked by Species Scores

Turtle Grass and Hardground Sites

Rank	Score	Species	Rank	Score	Species
1	128	Haemulon plumieri	51	11	Chaetodon capistratus
2	112	Coryphopterus glaucofraenum	52	11	Haemulon aurolineatum
3	110	Diplectrum formosum	53	10	Archosargus rhomboides
4	108	Microgobius microlepis	54	10	Holacanthus bermudensis
5	93	Sparisoma chrysopterum	55	10	Hippocampus erectus
6	89	Gobiosoma macrodon	56	10	Lactophrys quadricornis
7	88	Gobiosoma grosvenori	57	8	Balistes capriscus
8	86	Equetus acuminatus	58	8	Gobionellus saepepallens
9	76	Pomacanthus arcuatus	59	8	Diodon holocanthus
10	69	Pomacentrus variabilis	60	8	Synodus intermedius
11	67	Caranx crysos	61	8	Lutjanus mahogoni
12	65	Caranx ruber	62	7	Eucinostomus species2
13	51	Scarus croicensis	63	7	Chaetodon ocellatus
14	50	Lutjanus synagris	64	7	Abudefduf saxatilis
15	46	Acanthurus chirurgus	65	7	Sardinella aurita
16	46	Monacanthus ciliatus	66	7	Hypleurochilus aequipinnis
17	45	Haemulon flavolineatum	67	7	Hemipteronotus splendens
18	44	Haemulon sciurus	68	6	Scartella cristata
19	44	Anisotremus virginicus	69	6	Haemulon species1
20	43	Sparisoma aurofrenatum	70	6	Gymnothorax moringa
21	41	Lutjanus griseus	71	5	Atherinomorus stipes
22	37	Lachnolaimus maximus	72	5	Echeneis naucrates
23	36	Pomacentrus leucostictus	73	5	Haemulon species2
24	34	Paraclinus species 1	74	5	Malacoctenus species 1
25	33	Ocyurus chrysurus	75	5	Barbulifer species
26	32	Sphyraena barracuda	76	5	Scarus coeruleus
27	30	Acanthurus bahianus	77	4	Gobiesox strumosus
28	30	Caranx bartholomaei	78	4	Blenniidae species1
29	29	Lagodon rhomboides	79	4	Blenniidae juv spp
30	29	Halichoeres bivattatus	80	4	Bothus species 2
31	28	Epinephelus morio	81	4	Haemulon melanurum
32	28	Urolophus jamaicensis	82	4	Eucinostomus species1
33	26	Gerres cinereus	83	4	Chaetodon sedentarius
34	25	Nes longus	84	4	Chaetodipterus faber
35	20	Sphoeroides spengleri	85	4	Mycteroperca bonaci
36	19	Sparisoma radians	86	4	Cosmocampus albirostris
37	18	Cryptotomus roseus	87	4	Hippocampus zosterae
38	18	Calamus calamus	88	3	Epinephelus striatus
39	17	Astrapogon stellatus	89	3	Hypoplectrus unicolor
40	16	Holocanthus ciliaris	90	3	Oligoplites saurus
41	14	Opistognathus maxillosus	91	3	Scarus taeniopterus
42	14	Gobiosoma oceanops	92	2	Thalassoma bifasciatum
43	13	Coryphopterus dicrus	93	2	Opistognathus species 1
44	13	Sparisoma viride	94	2	Opistognathus whitehursti
45	13	Calamus bajonado	95	2	Chaenopsis ocellatus
46	12	Lutjanus analis	96	2	Gnatholepis thompsoni
47	12	Pomacanthus paru	97	2	Scomberomorus regalis
48	12	Microgobius carri	98	2	Apogon maculatus
49	11	Opsanus beta	99	2	Harengula clupeola
50	11	Strongylura notata	100	2	Equetus punctatus

Relative Species Abundances Ranked by Species Scores

Turtle Grass and Hardground Sites

Rank	Score	Species
101	1	Pomacentrus partitus
102	1	Anisotremus surinamenis
103	1	Ahlia egmontis
104	1	Jenkinsia species
105	1	Bothus lunatus
106	1	Callionymus pauciradiatus
107	1	Hypleurochilus bermudensis
108	1	Ginglymostoma cirratum

Table 10. Rank order of species for all sites surveyed by species time score (with 1981 data adjusted for effort).

Relative Species Abundances Ranked by Species Scores

Total for All Sites

Rank	Score	Species	Rank	Score	Species
1	567	Haemulon plumieri	51	238	Scarus taeniopterus
2	503	Haemulon flavolineatum	52	234	Pomacentrus leucostictus
3	496	Ocyurus chrysurus	53	230	Equetus acuminatus
4	495	Sparisoma aurofrenatum	54	222	Epinephelus cruentatus
5	483	Sparisoma viride	55	221	Coryphopterus dicrus
6	472	Haemulon sciurus	56	220	Lutjanus mahogoni
7	469	Acanthurus bahianus	57	213	Pomacanthus paru
8	465	Thalassoma bifasciatum	58	210	Kyphosus sectatrix
9	460	Scarus croicensis	59	205	Pseudupeneus maculatus
10	459	Acanthurus coeruleus	60	186	Haemulon aurolineatum
11	459	Pomacentrus planifrons	61	181	Calamus calamus
12	451	Pomacentrus partitus	62	173	Holacanthus tricolor
13	423	Abudefduf saxatilis	63	156	Chromis cyaneus
14	415	Caranx ruber	64	156	Lutjanus analis
15	412	Coryphopterus glaucofraenum	65	156	Cantherhines pullus
16	408	Halichoeres bivattatus	66	153	Chromis multilineatus
17	394	Pomacentrus variabilis	67	150	Holacanthus bermudensis
18	389	Pomacanthus arcuatus	68	147	Haemulon parrai
19	389	Sparisoma chrysopterum	69	147	Lactophrys triqueter
20	384	Anisotremus virginicus	70	145	Hypoplectrus gemma
21	379	Halichoeres maculipinna	71	144	Mycteroperca bonaci
22	365	Lutjanus griseus	72	143	Scarus guacamaia
23	339	Gnatholepis thompsoni	73	137	Odontoscion dentex
24	330	Halichoeres radiatus	74	131	Chaetodon striatus
25	325	Pomacentrus diencaeus	75	127	Hypoplectrus puella
26	323	Acanthurus chirurgus	76	127	Coryphopterus personatus
27	315	Lachnolaimus maximus	77	125	Chaetodon sedentarius
28	312	Gobiosoma oceanops	78	120	Lutjanus synagris
29	303	Microspathodon chrysurus	79	119	Ioglossus calliurus
30	302	Sparisoma rubripinne	80	118	Hemipteronotus splendens
31	296	Scarus coelestinus	81	118	Epinephelus striatus
32	295	Canthigaster rostrata	82	114	Diplectrum formosum
33	287	Chaetodon capistratus	83	113	Anisotremus surinamensis
34	286	Hypoplectrus unicolor	84	112	Echeneis naucrates
35	286	Scarus vetula	85	112	Microgobius microlepis
36	284	Haemulon carbonarium	86	101	Priacanthus cruentatus
37	280	Halichoeres garnoti	87	100	Gobiosoma macrodon
38	275	Sphyraena barracuda	88	99	Gobiosoma grosvenori
39	270	Bodianus rufus	89	87	Clepticus parrai
40	264	Lutjanus apodus	90	80	Caranx crysos
41	262	Holocanthus ciliaris	91	79	Urolophus jamaicensis
42	261	Pempheris schomburgki	92	77	Caranx bartholomaei
43	259	Mulloidichthys martinicus	93	77	Hypoplectrus nigricans
44	257	Serranus tigrinus	94	74	Aluterus scriptus
45	255	Haemulon chrysargyreum	95	70	Apogon maculatus
46	254	Scarus coeruleus	96	70	Holocentrus vexillarius
47	253	Aulostomus maculatus	97	69	Lutjanus jocu
48	249	Haemulon macrostomum	98	67	Scomberomorus regalis
49	242	Chaetodon ocellatus	99	67	Opistognathus aurifrons
50	242	Sparisoma radians	100	65	Canthidermis sufflamen

Relative Species Abundances Ranked by Species Scores

Total for All Sites

Rank	Score	Species
101	65	Calamus bajonado
102	63	Holocentrus rufus
103	60	Gerres cinereus
104	56	Scartella cristata
105	55	Lactophrys bicaudalis
106	53	Synodus intermedius
107	52	Acanthemblemaria sp2
108	50	Tylosurus crocodilus
109	49	Holocentrus ascensionis
110	49	Cryptotomus roseus
111	46	Monacanthus ciliatus
112	45	Halichoeres poeyi
113	45	Epinephelus morio
114	45	Serranus baldwini
115	43	Chromis scotti
116	43	Diodon hystrix
117	42	Equetus punctatus
118	42	Malacanthus plumieri
119	39	Microgobius carri
120	35	Rypticus saponaceus
121	34	Inermia vittata
122	34	Gymnothorax moringa
123	34	Paraclinus species 1
124	34	Acanthemblemaria chaplini
125	34	Diodon holocanthus
126	33	Hemiemblemaria simulus
127	33	Gymnothorax funebris
128	33	Apogon binotatus
129	33	Hypoplectrus indigo
130	32	Myripristis jacobus
131	29	Lagodon rhomboides
132	29	Haemulon melanurum
133	29	Nes longus
134	27	Acanthemblemaria sp3
135	27	Apogon townsendi
136	26	Haemulon album
137	26	Amblycirrhitus pinos
138	24	Equetus lanceolatus
139	24	Serranus tabacarius
140	24	Malacoctenus species 1
141	23	Ophioblennius atlanticus
142	23	Jenkinsia lamprotaenia
143	22	Hemipteronotus novacula
144	22	Sphoeroides spengleri
145	21	Balistes vetula
146	21	Liopropoma rubre
147	21	Astrapogon stellatus
148	20	Chaetodipterus faber
149	20	Malacoctenus triangulatus
150	18	Monacanthus tuckeri
151	16	Opistognathus maxillosus
152	16	Lactophrys quadricornis
153	15	Callionymus bairdi
154	14	Blenniidae species1
155	14	Epinephelus guttatus
156	13	Hypoplectrus aberrans
157	13	Jenkinsia species
158	13	Sardinella aurita
159	12	Hemipteronotus martinicensis
160	12	Muraena miliaris
161	11	Priacanthus arenatus
162	11	Archosargus rhomboides
163	11	Haemulon species1
164	11	Strongylura notata
165	11	Opsanus beta
166	11	Lactophrys polygonia
167	11	Dasyatis americana
168	10	Acanthemblemaria sp4
169	10	Harengula clupeola
170	10	Hippocampus erectus
171	10	Atherinomorus stipes
172	9	Malacoctenus roseus
173	8	Balistes capriscus
174	8	Gobionellus saepepallens
175	8	Hemiramphus brasiliensis
176	7	Mycteroperca tigris
177	7	Hypoplectrus guttavarius
178	7	Eucinostomus species2
179	7	Eucinostomus species1
180	7	Chromis insolatus
181	7	Hypleurochilus aequipinnis
182	7	Coryphopterus lipernes
183	6	Chaenopsis ocellatus
184	6	Parablennius marmoreus
185	6	Lactophrys trigonus
186	6	Scorpaena plumieri
187	6	Cantherhines macrocerus
188	6	Aetobatus narinari
189	6	Carcharhinus leucas
190	6	Ginglymostoma cirratum
191	5	Megalops atlanticus
192	5	Barbulifer species
193	5	Lutjanus cyanopterus
194	5	Haemulon species2
195	5	Harengula species
196	4	Cosmocampus albirostris
197	4	Hippocampus zosterae
198	4	Centropomus undecimalis
199	4	Epinephelus itajara
200	4	Trachinotus falcatus

Relative Species Abundances Ranked by Species Scores

Total for All Sites

Rank	Score	Species
201	4	Blenniidae juv spp
202	4	Gobiesox strumosus
203	4	Aluterus schoepfi
204	4	Bothus species 2
205	4	Sphyrna tiburo
206	3	Archosargus probatocephalus
207	3	Gillellus rubrocinctus
208	3	Apogon robinsi
209	3	Seriola dumerili
210	3	Oligoplites saurus
211	3	Apogon pseudomaculatus
212	3	Apogon lachneri
213	2	Gymnothorax vicinus
214	2	Bothus species 1
215	2	Opistognathus species 1
216	2	Opistognathus whitehursti
217	2	Malacoctenus aurolineatus
218	1	Emblemaria pandionis
219	1	Callionymus pauciradiatus
220	1	Hypleurochilus bermudensis
221	1	Bothus lunatus
222	1	Calamus penna
223	1	Ahlia egmontis
224	1	Epinephelus adscensionis
225	1	Hypoplectrus chlorurus
226	1	Epinephelus afer
227	1	Mycteroperca venenosa
228	1	Pempheris poeyi

exceptions (anomolous rankings) are discussed below. In most of these cases, the rankings are based on what a diver is more likely to see first as he gets in the water rather than ecological dominance of a species.

The maximum possible score for species listed in Table 6 was 160, attained only by Thalassoma bifasciatum and Acanthurus bahianus. Of the 155 species censused at the four offshore sites, the 43 that attained scores of 100 or greater are relatively widespread and easily seen due to their size, color, and/or behavior. Below this arbitrary cutoff, less ubiquitous, less colorful or more secretive species begin to appear. For example, apogonids are extremely numerous at these sites but hide in deep caves and crevices during the day and as a result did not receive substantial species scores. Conversely, Holocanthus ciliaris is relatively rare but colorful and widely distributed. This species attained a score of 84, compared to a score of only 12 for Acanthemblemaria chaplini, a more abundant but patchily distributed, cryptic species.

Species censused at intermediate reef sites are ranked in Table 7. Acanthurids, Pomacentrids, Labrids, Haemulids, and Lutjanids dominate these rankings as they did those from offshore reefs, although several species such as Caranx ruber, Pomacentrus variabilis and Gobiosoma oceanops attained considerably higher ranks at intermediate compared to offshore sites.

The same families that dominated offshore and intermediate sites in terms of species scores also topped the rankings at inshore patch reefs (Table 8). However, the proportion of the 156 species recorded at

inshore patch reefs which received high scores relative to the maximum possible score of 120 was less than in the preceding two habitat categories. Smaller, more cryptic species, such as members of the genus Acanthemblemaria, attained relatively higher ranks on inshore patch reefs. This may have been due to divers requiring less time to record the readily visible species (which were less numerous than those that dominated rankings in Tables 6 and 7). As a result, divers may have allocated more time earlier in each dive to searching for cryptic, secretive species, producing higher scores for these species. Other species, such as Scartella cristata and Microgobius microlepis, made their first appearance at inshore patch reefs.

Divers were able to spend virtually the entire time of the STT counts searching carefully for cryptic, small, or rare species at turtle grass/hardground sites due to the general lack of abundance of readily visible species. The maximum possible score for these six sites was 240, yet the highest score attained in Table 9 was only 128 (Haemulon plumieri). Thus no species was particularly dominant at these sites, and families that were relatively rare elsewhere attained much higher rankings. For example, four of the first ten species listed in Table 9 are gobiids. A number of species and families were unique to these habitats, including several gobies, clinids, Callionymus pauciradiatus, and the families Batrachoididae (Opsanus beta), Gobiesocidae (Gobiesox strumosus), Ophichthidae (Ahlia egmontis), and Cosmocampus albirostris, Hippocampus erectus, and Hippocampus zosterae of family Syngnathidae.

Between-Community Comparisons

In addition to computation of Shannon-Weaver diversity indicies (H') and equitability of distribution (J') for each site, different sites were compared using one-way ANOVA with multiple comparisons (Duncan's Multiple Range Test) and also by community ordination. ANOVA-DMRT on all sites combined was not possible due to presence of excessive heteroscedasticity ($p < 0.05$ for Cochran's C, $p < 0.001$ for Bartlett-Box F). This violation of the assumptions underlying ANOVA was eliminated or mitigated by doing one-way ANOVA separately on each of the four major categories of habitat. Tables 11 through 18 give the results of ANOVA-DMRT for mean species and mean scores for offshore reefs, intermediate reefs, inshore patch reefs, and turtle grass/hardground sites respectively. Tables 11, 13, 15, and 17, ANOVA-DMRT of mean numbers of species per site, are of primary interest. The ecological significance and statistical validity of utilizing species scores from the STT for ANOVA-DMRT are suspect. Thus, Tables 12, 14, 16, and 18 are included to fulfill the contract and to provide a comparison between groupings produced from number of species and from species scores.

Square root transformation of both mean number of species and mean species scores achieved homogeneity of variances for offshore reefs ($p > 0.05$ for both Cochran's C and Bartlett-Box F). The results of one-way ANOVA show a significant difference ($p < 0.01$) between one or more of the four offshore reefs on the basis of both mean species (Table 11) and mean scores (Table 12). Duncan's Multiple Range Test (DMRT) grouped reefs on the basis of no significant difference between means at $p < 0.05$ according to mean species (Table 11) and mean scores (Table 12).

TABLE 11. ANOVA-DMRT of mean species on offshore reefs. Sites grouped by bars show no significant differences among means; all others show significant difference at $\alpha = .05$.

ANOVA

Source of Variation	df	SS	MS	F*
Between groups	3	2.2796	.7599	4.678
Within groups	28	4.5478	.1624	
Total	31	6.8275		

(* $p < .01$)

DMRT

Site No.	Name	Mean Species	Square Root of Mean Species
8	Carysfort Reef	69.6	8.34
7	The Elbow	73.3	8.55
1	Molasses Reef	75.5	8.66
3	French Reef	82.5	9.07

TABLE 12. ANOVA-DMRT of mean species scores on offshore reefs. Sites grouped by bars show no significant differences among means; all others show significant difference at $\alpha = .05$.

ANOVA

Source of Variation	df	SS	MS	F*
Between groups	3	12.7097	4.2366	6.157
Within groups	28	19.2670	.6881	
Total	31	31.9767		

(* $p < .01$)

DMRT

Site No.	Name	Mean Score	Square Root of Mean Score
8	Carysfort Reef	272	8.34
7	The Elbow	301	8.55
1	Molasses Reef	298	8.68
3	French Reef	334	9.07

Carysfort Reef, the Elbow, and Molasses Reef comprised one group and Molasses and French Reefs another by the mean species criterion. ANOVA-DMRT of mean scores separated French Reef from the other three sites.

Jones and Thompson (1978) grouped Molasses and French Reefs and separated Carysfort Reef from these two by both mean species and mean scores using ANOVA-DMRT. Both studies, in addition to distinguishing Carysfort from the other two, recorded higher mean species at French Reef than any other study site. This result is consistent with our observation of the reef structure at this site. French Reef shares most of the basic physical attributes (back-reef, rubble zone, and approximate spur and groove fore-reef structure) with Molasses and Carysfort Reefs. It has a much more extensive network of tunnels and caves (such as under huge M. anularis heads) than either of the other sites. While Carysfort Reef has an extensive A. palmata crest, A. cervicornis thickets, and steep drop-off, it was our impression that the cave system and extension of major scleractinian heads further seaward on French Reef were more amenable to increased numbers of species than the unique features of Carysfort Reef. This contention was supported by some exceptionally high individual STT counts at French Reef not obtained in any other area (over 100 species in several instances, including one count of 109 species).

Tables 13 and 14 indicate that intermediate reefs were indistinguishable on the basis of both mean species and mean scores. Square root transforms of both species and scores reduced but did not eliminate heteroscedasticity problems ($p = 0.01$ and 0.005 for Cochran's

TABLE 13. ANOVA-DMRT of mean number of species on intermediate reefs. Sites grouped by bars show no significant differences among means; all others show significant difference at $\alpha = .05$.

ANOVA

Source of Variation	df	SS	MS	F*
Between groups	3	.2045	.0682	.464
Within groups	28	4.1107	.1468	
Total	31	4.3152		

(* $p > .10$)

DMRT

Site No.	Name	Mean Species	Square Root of Mean Species
5	Grecian Rocks (1980)	65.8	8.09
18	Grecian Rocks (1981)	66.1	8.13
6	Key Largo Dry Rocks	67.9	8.24
2	White Bank Dry Rocks	68.8	8.29

TABLE 14. ANOVA-DMRT of mean species scores on intermediate reefs. Sites grouped by bars show no significant differences among means; all others show significant difference at $\alpha = .05$.

ANOVA

Source of Variation	df	SS	MS	F*
Between groups	3	.4553	.1518	.260
Within groups	28	16.3641	.5844	
Total	31	16.8195		

(* $p > .10$)

DMRT

Site No.	Name	Mean Score	Square Root of Mean Score
5	Grecian Rocks (1980)	267	16.0
18	Grecian Rocks (1981)	260	16.1
6	Key Largo Dry Rocks	256	16.0
2	White Bank Dry Rocks	264	16.25

C and Bartlett-Box F respectively). Scheffé (1959), however, demonstrated that one-way ANOVA is fairly robust with a small number of groups and equal sample sizes. Furthermore, the confidence intervals around each mean overlap one another. Thus, we believe that there is no significant difference between intermediate reef sites by either the mean species or mean scores criterion. Intermediate reefs were less diverse than offshore reefs.

Tables 15 and 16 indicate a lack of significant differences between inshore patch reef sites by either the mean species or mean scores criterion. Common logarithmic transform (base 10) of both kinds of data achieved homogeneity of variance ($p > 0.05$ for both Cochran's C and Bartlett-Box F). While inshore patch reefs were indistinguishable from offshore reefs in terms of number of species, as were intermediate reefs, they were less diverse as a group than either intermediate or offshore reefs.

Logarithmic transformation of data on both number of species and species scores successfully eliminated heteroscedasticity ($p > 0.05$ for both Cochran's C and Bartlett-Box F) among the inshore sites. Tables 17 and 18 group turtle grass/hardground sites similarly based on mean species and mean scores. Ocean Reef, which is predominantly turtle grass, is significantly different from all other sites in this category. The mean species criterion groups Turtle Harbor and Rock Harbor, the two other turtle grass sites (Table 1), and North and South Channels, the two turtle grass/hardground sites. Point Elizabeth, a site consisting of part turtle grass and part hardground, is grouped with Rock Harbor.

TABLE 15. ANOVA-DMRT of mean number of species on inshore patch reefs. Sites grouped by bars show no significant differences among means; all others show significant difference at $\alpha = .05$.

ANOVA

Source of Variation	df	SS	MS	F*
Between groups	3	.0078	.0026	1.798
Within groups	28	.0404	.0014	
Total	31	.0482		

(* $p > .10$)

DMRT

Site No.	Name	Mean Species	Square Root of Mean Species
9	Basin Hill Shoals	46.3	1.97
4	Mosquito Bank	46.6	1.98
10	Turtle Rocks	46.8	1.98
17	Angelfish Creek	50.8	1.71

TABLE 16. ANOVA-DMRT of mean species scores on inshore patch reefs. Sites grouped by bars show no significant differences among means; all others show significant difference at $\alpha = .05$.

ANOVA

Source of Variation	df	SS	MS	F*
Between groups	3	.0076	.0025	2.037
Within groups	28	.0347	.0012	
Total	31	.0423		

(* $p > .10$)

DMRT

Site No.	Name	Mean Scores	Log Base 10 of Mean Scores
9	Basin Hill Shoals	194	2.29
4	Mosquito Bank	184	2:27
10	Turtle Rocks	190	2.28
17	Angelfish Creek	204	2.30

TABLE 17. ANOVA-DMRT of mean number of species on turtle grass/hardground sites. Sites grouped by bars show no significant differences among means; all others show significant difference at $\alpha = .05$.

ANOVA

Source of Variation	df	SS	MS	F*
Between groups	5	1.7346	.3469	21.818
Within groups	42	.6678	.0159	
Total	47	2.4024		

(* $p < .001$)

DMRT

Site No.	Name	Mean Species	Log Base 10 of Mean Species
11	Ocean Reef	5.8	0.8
12	Turtle Harbor	9.0	0.9
15	Rock Harbor	12.1	1.0
16	Point Elizabeth	12.9	1.1
13	North Channel	19.9	1.3
14	South Channel	23.5	1.3

TABLE 18. ANOVA-DMRT of mean species scores on turtle grass/hardground sites. Sites grouped by bars show no significant differences among means; all others show significant difference at $\alpha = .05$.

ANOVA

Source of Variation	df	SS	MS	F*
Between groups	5	1.7346	.4668	24.870
Within groups	42	.7882	.0188	
Total	47	3.1220		

(* $p < .001$)

DMRT

Site No.	Name	Mean Scores	Log Base 10 of Mean Scores
11	Ocean Reef	18	1.25
12	Turtle Harbor	34	1.55
15	Rock Harbor	45	1.63
16	Point Elizabeth	51	1.71
13	North Channel	75	1.84
14	South Channel	84	1.93

Bottom habitat appears to be a stronger influence on number of species at given sites than does boat traffic. Ocean Reef and North Channel experience similar levels of boat traffic, yet have significantly different numbers of species (Tables 1 and 17). Similarly, while intensity of boat traffic at Rock Harbor and South Channel is comparable, number of species is significantly less at the former site. Sites with hardground tended generally to harbor more species than sites with only turtle grass habitat.

Hardground habitats contained a number of different features amenable to habitation by fishes that were not found in turtle grass, including small head corals, various sponges, patches of octocorals, and small ledges of bedrock. In addition to greater proportions of hardground, North and South Channel each feature a navigation marker around which various fish species congregate. South Channel had the highest mean number of species of this group, due at least in part to fish inhabiting a large pile of discarded batteries around the marker at the mouth of the channel.

Most user impacts, including recreational diving, hook and line fishing, and boat traffic, do not appear to affect species diversity at sites where activity levels are high relative to sites where user activity is lower.

The DMRT analysis indicated that the habitat at a given site has the largest influence on fish species diversity. In terms of equation 1, α_i appears to be a stronger influence than ε_{ij} on Y_{ij}. It is evident that Jones and Thompson (1978) also believed this to be the case

in their study, because they explained their DMRT in terms of structural similarities between study areas. Species diversity was highly related to structural complexity and location of the study site. Thus, offshore reefs were the most diverse and near-shore turtle grass sites the least. Species diversity at study sites was generally inversely related to distance from offshore reefs. French Reef had higher fish diversity than any other site.

Two between-site analyses have been presented thus far: (1) Shannon-Weaver diversity functions - evenness of distribution indices (Table 5) and (2) ANOVA-DMRT (Tables 11 - 18). Jones and Thompson (1978) point out a potential weakness in both approaches. Although mean number of species may be statistically the same for two or more sites, they may be comprised of completely <u>different</u> species. Neither approach considers degree of overlap in species between sites. For this reason we compared sites using the ordination procedure of Beals (1960), based on the Bray and Curtis (1957) Index, in order to complement the other two analytical approaches.

The Bray and Curtis Index (C) was computed for each of the 153 possible pairwise combinations of the 18 sites (17 different sites, site 18 being the 1981 Grecian Rocks replicate). These similarity coefficients were placed below and to the left of the blank diagonal elements of a matrix of similarity and dissimilarity coefficients between pairs of sites (Table 17). Dissimilarity coefficients, computed as the maximum value of the similarity coefficient minus the observed value for each pair of sites, were placed above and to the right of the

blank diagonal elements of the matrix. The maximum theoretical value of the similarity coefficient was 1.00. Both Beals (1960) and Jones and Thompson (1978) used maximum values less than 1.00. We saw no reason to lower the dissimilarity coefficient values and therefore used a maximum value of 1.00.

Table 19 shows high similarity of fish communities between similar habitats. Similarity coefficient values are generally proportional to structural similarity and location of sites. For example, values of the similarity coefficient were .892 for French and Molasses reefs, .888 for the Elbow and Molasses Reef, .846 for Carysfort and Molasses Reefs, .844 between Carysfort and French Reefs, .869 between the Elbow and French Reef, and so on. Similarity coefficients were not as high between less diverse habitats, but were still generally proportional to the similarity between the pair of sites. This low diversity, low similarity relationship may be due largely to the lower effectiveness of the STT in lower diversity habitats for enumerating the species in a given area. A large proportion of the species at turtle grass sites, for example, were cryptic. Observations of many of these species during counts were chance sightings as an individual fish made a fast move or otherwise exposed itself from the cover of the turtle grass. This was the case for most gobiids, clinids, Opsanus beta, and syngnathids.

Two other factors contributing to lower similarities among less diverse sites were (1) the influence of random encounters with transient, non-resident species passing through the area (carangids, lutjanids, and haemulids) and (2) chance encounters with isolated structures, such as abandoned lobster traps or other artificial

Table 19. Similarity and dissimilarity coefficients based on the Bray and Curtis Index.

Bray - Curtis Index

Dissimilarity

Similarity

Site	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	+	.18	.11	.40	.20	.19	.11	.15	.36	.29	.84	.82	.55	.65	.72	.74	.35	.17
2	.82	+	.23	.31	.21	.18	.18	.20	.34	.23	.81	.81	.50	.62	.66	.72	.31	.15
3	.89	.77	+	.41	.23	.19	.13	.16	.39	.29	.85	.83	.56	.66	.71	.74	.36	.22
4	.60	.69	.59	+	.40	.40	.39	.39	.28	.31	.78	.76	.39	.43	.59	.59	.36	.33
5	.80	.78	.77	.60	+	.21	.21	.22	.38	.24	.84	.83	.49	.63	.65	.71	.36	.15
6	.81	.82	.81	.60	.79	+	.18	.20	.36	.30	.82	.81	.52	.63	.67	.71	.36	.17
7	.89	.82	.87	.61	.79	.83	+	.14	.38	.27	.85	.80	.55	.66	.71	.72	.33	.17
8	.85	.80	.84	.62	.78	.80	.86	+	.40	.29	.85	.82	.57	.68	.71	.74	.35	.18
9	.64	.66	.61	.72	.62	.64	.62	.60	+	.31	.73	.79	.41	.49	.61	.64	.35	.35
10	.71	.77	.71	.69	.76	.70	.73	.71	.69	+	.78	.81	.45	.56	.65	.66	.30	.23
11	.16	.19	.14	.22	.16	.18	.15	.15	.27	.22	+	.59	.64	.60	.53	.52	.81	.83
12	.18	.19	.17	.24	.17	.19	.20	.18	.21	.19	.41	+	.70	.67	.66	.57	.79	.84
13	.45	.50	.44	.61	.51	.48	.45	.43	.59	.55	.36	.30	+	.35	.45	.45	.48	.52
14	.35	.39	.34	.57	.37	.37	.34	.32	.51	.44	.39	.33	.65	+	.46	.40	.56	.62
15	.28	.34	.29	.41	.35	.33	.29	.29	.39	.35	.47	.34	.55	.54	+	.49	.65	.66
16	.26	.28	.26	.41	.29	.29	.28	.26	.36	.34	.48	.43	.55	.60	.51	+	.67	.72
17	.65	.69	.64	.64	.64	.64	.67	.65	.65	.70	.19	.21	.52	.44	.35	.33	+	.30
18	.83	.85	.78	.67	.84	.83	.83	.82	.65	.77	.17	.16	.48	.38	.34	.28	.70	+

habitats, in otherwise monotonous environments. During the Rock Harbor census, divers found two 55 gallon steel drums and two abandoned lobster traps during the course of eight counts at this turtle grass site. No such oasises for fish fauna were found at Ocean Reef, and only one lobster trap was found at Turtle Harbor. Because juvenile pomacanthids, haemulids, caranjids, lutjanids, and other fishes tended to congregate around these structures, the sites containing them were made more diverse for reasons beyond natural habitat. We contend, for example, that if we had found such structures at Ocean Reef, species numbers and scores here would likely have been more similar to other turtle grass sites. North and South Channels were less similar to Point Elizabeth because a number of species were added due to the presence of a navigation marker at these two sites around which fish congregated. Also, species composition at South Channel was influenced considerably by a pile of discarded batteries (not present at North Channel or Point Elizabeth).

In general, less diverse sites were less similar than those with higher diversity because of the relatively larger influence of three factors on species composition in the less diverse areas: uneven distribution of rare, species rich habitats, chance encounters with isolated groups of transient species, and the relative inefficiency of the STT for censusing cryptic species. An alternative sampling method should be used to replace or complement visual census techniques in future surveys at turtle grass/hardground sites. Small-mesh fish traps or isolated rotenone stations might serve this purpose. Otter trawls

would effectively sample these areas, but might be too destructive for use in an underwater preserve.

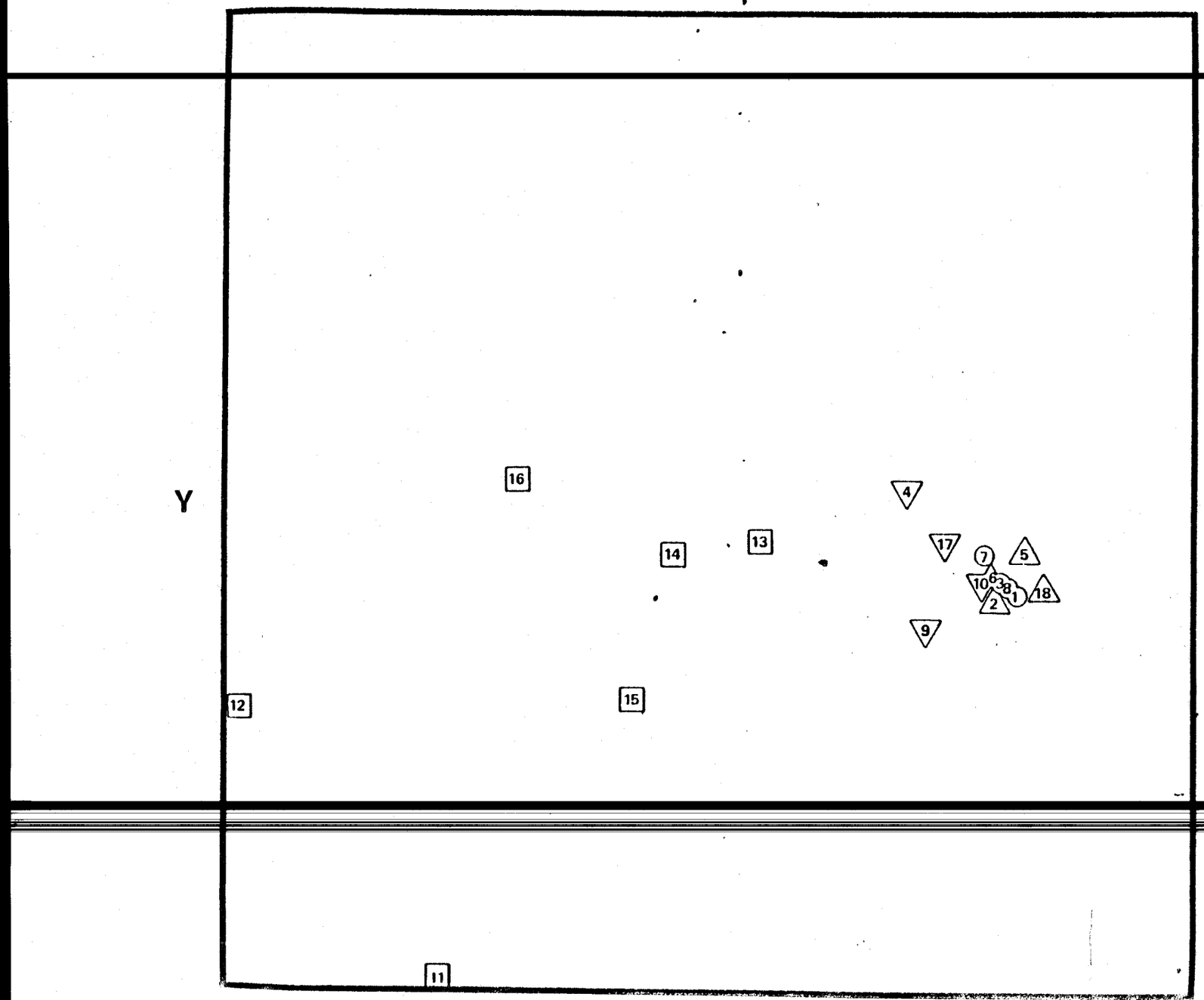
Grecian Rocks had a similarity coefficient of .845 between years, indicating a high consistency in sampling by the STT. A number of offshore reef pairs had slightly higher similarity coefficients than did Grecian rocks between years. However, the absolute difference between .845 and those values is probably negligible.

Figure 2 is the result of applying the community ordination procedure devised by Beals (1960) on the basis of the Bray and Curtis Index. Distance between communities on the two dimensional plot is proportional to dissimilarity between communities. The numbers near each point correspond to the 18 study site numbers. Study sites are positioned approximately by major habitat type, with less distance between higher-diversity locations than those with fewer species. The plot generally reflects the previously discussed lack of similarity between low-diversity sites. For example, the turtle grass sites (11, 12, and 15) are well separated from other habitat types but considerable dissimilarity is evident between the three. As discussed previously this is probably an artifact of the sampling procedure.

Comments on the STT

Jones and Thompson (1978) label the STT a "random" count. However, it is not random, because the divers choose their course throughout the 50 min counting period. We also noted that the course chosen had a large influence on which species received higher scores. For example, whether or not a count began on the back-reef or the fore-reef slope

FIGURE 2. Two-dimensional ordination of communities based on the Bray and Curtis Index. Numbers correspond to study sites 1 through 17, with number 18 corresponding to the second (1981) census of Grecian Rocks. Numbers are enclosed by a symbol corresponding to classification of the site into one of the four major habitat types: ○ = offshore reef; △ = intermediate reef; ▽ = inshore patch reef; □ = turtle grass/hardground.


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largely affected the scores assigned to the species more common to one or the other habitat. We attempted to resolve this problem by starting counts at different reef zones as equitably as possible.

Another non-random influence on individual counts is the technique used by the diver to count species. One can either swim over various habitats and zones and record species as they present themselves, or attempt to maximize time usage by developing specific search images and swimming to habitats or reef zones actively searching for species groups that have not yet been recorded. We felt that the latter approach consistently yielded higher counts than the former. This approach is relatively more demanding of diver knowledge of the systematics and life history of the fish fauna of an area, because of the increased degree of freedom of action during the STT compared to more restricted techniques such as transects.

The STT is an effective tool for rapidly enumerating species and drawing limited general conclusions about differences in species diversity between high diversity fish communities associated with coral reefs. The technique is not environmentally destructive. The technique is not as effective in low diversity environments such as turtle grass, nor is it effective for cryptic species. Also, ranking of species according to STT scores does not provide an accurate quantification of fish community structure.

We recommend that NOAA complement the STT fish survey in future monitoring studies with a more truely random and more quantitative technique in order to accurately quantify reef fish community structure

at the different study sites. Species diversity at different sites is not as important as accurate quantification of the relative abundance of different species and how this relative abundance of species dominance varies over time and with user impact. We refer NOAA to a study nearing completion by James A. Bohnsack of the Cooperative Institute for Marine and Atmospheric Studies, 4600 Rickenbacker Causeway, Miami, FL 33149 (who recently accepted a position as Fishery Biologist in charge of reef fish research, National Marine Fisheries Service, Southeast Fisheries Center, Miami Laboratory). He has used a technique developed and tested by Bohnsack and Bannerot (1983) to quantify reef fish community structure using a random visual approach to study the effects of predator removal by spearfishing with several non-spearfished reefs in the Key Largo National Marine Sanctuary, Looe Key National Marine Sanctuary, and Carrie Bow Cay, Belize. We feel strongly that this technique or one similar to it would provide NOAA with data more relevant to management of the fish fauna of John Pennekamp Coral Reef State Park and Key Largo National Marine Sanctuary than techniques that sample only species diversity.

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