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SOME ASPECTS OF THE ECOLOGY OF REEFS SURROUNDING ANEGADA, BRITISH VIRGIN ISLANDS

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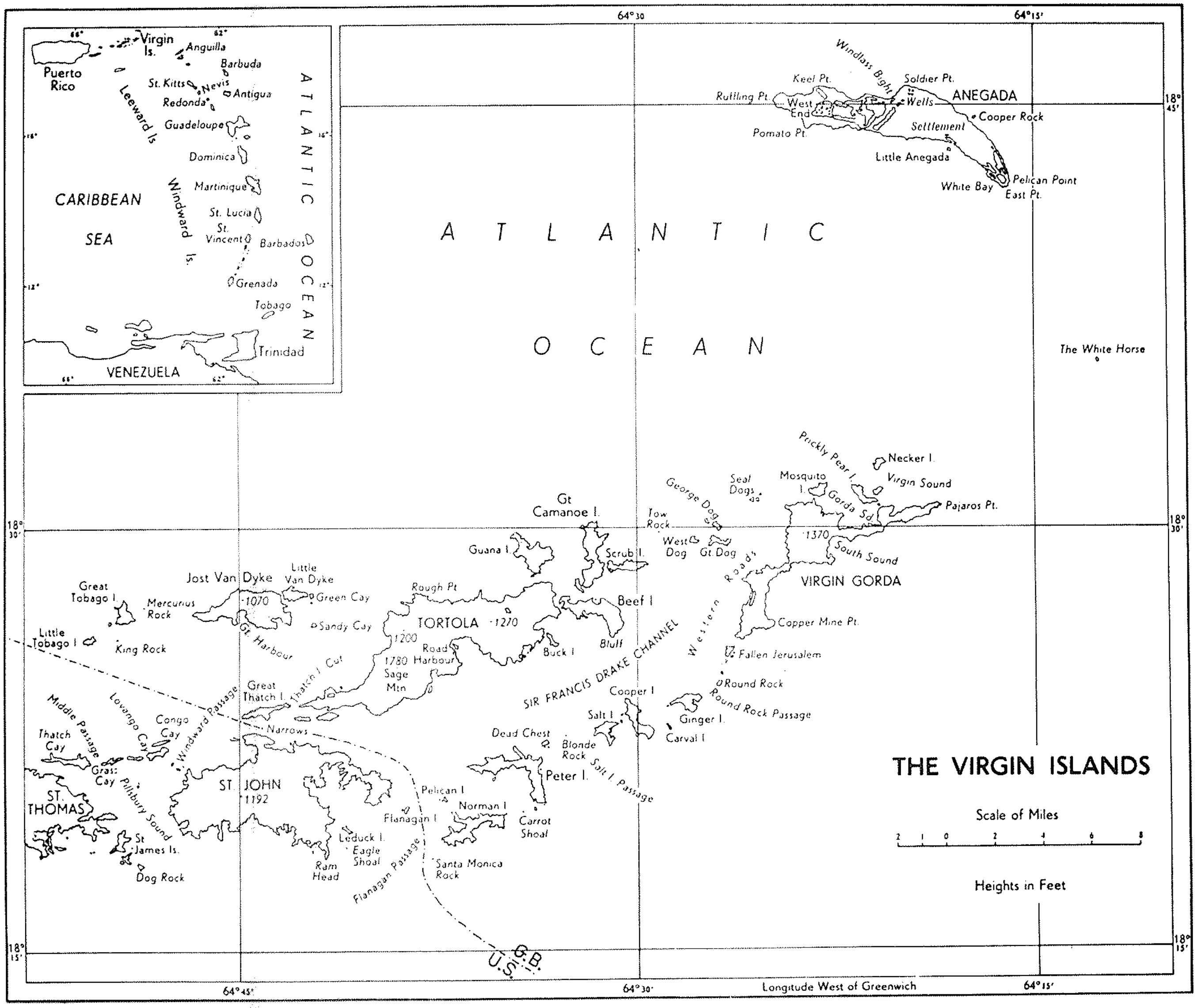
THE VIRGIN ISLANDS
Scale of Miles
Heights in Feet
ATLANTIC OCEAN
ANEGADA
VIRGIN GORDA
TORTOLA
ST JOHN
ST. THOMAS
Jost Van Dyke
SIR FRANCIS DRAKE CHANNEL
CARIBBEAN SEA
VENEZUELA
Puerto Rico
Virgin Is.
Leeward Is
Windward Is.
Longitude West of Greenwich
U.S.
G.B.

SOME ASPECTS OF THE ECOLOGY OF REEFS SURROUNDING ANEGADA, BRITISH VIRGIN ISLANDS

by R.P. Dunne[1.] and B.E. Brown[2.]

Introductory Description

Anegada is a most unique island from many aspects. Northernmost of the American and British Virgin Islands and easternmost of the Greater Antilles, it is a flat limestone island, 17 km long and 4 km wide with a total area of about 14.94 square miles (9,567 acres 54 sq km). It is set aside from the other British Virgin Islands, being some 19 km from Virgin Gorda, its closest neighbour. It lies in distinct contrast to the volcanic and mountainous landscapes of the Virgin Group, with a maximum elevation of only 8 metres. To the north and east (windward side) the island is edged by extensive reefs beyond which stretches the Atlantic Ocean. On the leeward side, a shallow sea (2 to 8 m) separates Anegada from the main Virgin Island Group.

History

Schomburgk (1832) is the earliest authority on the island, having visited it in 1831 when he completed a most extensive survey. He writes: 'Of its history little is known; there is no likelihood that it was settled early. Père Labat, the only early writer who speaks of the Lesser West India islands, observes, that aborigines used it as an occasional rendezvous, where they procured great quantities of conchs (Strombus gigas); and large piles of these shells are still to be seen at the east end of the island, but nowhere else; which seems to prove decidedly that it was not permanently occupied, but merely resorted to from time to time.' One of these heaps was again reported by Krieger (1938) during his visit to the Virgin Islands in 1937. Gross (1975) notes that for these conch the technique that has been used to extract the animal from its shell is distinctly aboriginal; quoting de Booy (1919) as the authority. Certainly it is not a technique used by the modern West Indian conch fisherman. Gross has also obtained radio carbon dates of AD 1245 +/- 80 for two samples of the conch shells.

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Schomburgk continues: 'At a later period the retired bays of the island served as a lurking place to buccaneers, Kirke and Bone being said to have especially frequented it: and the latter has bequeathed his name to a creek on the northern side, which appears to have been his favourite resort. Ultimately as the trade among the West Indian islands became more frequent, and repeated shipwrecks in this quarter held out hopes of advantage to those who might be in the neighbourhood to profit by them, settlers took up their permanent residence on the island, and were, at one time, more numerous than they are now. They found that the loose ground which covered it was capable of bearing provision crops, and even cotton; while the rearing of stock and sale of the underwood, which was progressively cleared away and which, being very full of gum, had a preference in the market of St. Thomas, furnished a further resource. The great object, however, always was and still is, the wreck of vessels.'

In their bibliography of the Shipwrecks of the Virgin Islands (1523-1825), Marx and Towle list some 82 recorded wrecks on Anegada. Schomburgk himself records 53 wrecks on the island between the years 1803-1833. It is clear, therefore, from these facts alone that the Island has been the unfortunate site of many wrecks, which have both served to support and add to the community.

In 1832 Schomburgk reported this community to number 11 white and 21 coloured families. It is fair to say that the total population of the island was about 132. Since then, the population has rarely risen above 300. The 1970 Census indicated a population of 271 people living on Anegada.

In the latter years this population has remained low because of the lack of any form of industrial development, and with fishing and agriculture on a small scale only, Anegadians have had to look elsewhere for employment. As the other major islands in the British Virgin Islands have not been experiencing full employment, Anegadians have tended to emigrate, mostly to the USA and in particular to New York, where today there exists an Anegada Progressive League. This League has some 100 members, but there are thought to be up to 800 Anegadians in New York. In many cases, whole families have departed and in others the working age element only. This has left a population that comprises mainly children, teenagers and elderly people.

Recent History

The latter days of Anegada's history are perhaps the more interesting.

In 1967 the Government entered into an agreement with a development company, called the Development Corporation of Anegada (DEVCAN), whereby the whole island, with the exception of 1,500 acres, was leased to the Corporation for 199 years. They would be permitted to develop the Island as they wished as a major tourist resort and commercial area.

Concern was subsequently expressed on the social and economic implications of the concessions granted to the corporation, particularly in relation to the extent to which the hands of future governments would be tied virtually indefinitely and the way in which the existing residents were being confined to a relatively small area around their village. Eventually, a commission of enquiry was held under the Chairmanship of Sir Derek Jakeway KCMG OBE which reported in November 1969 on both the Anegada and Wickhams Cay Agreements.

The report found that there were certain conditions in the agreements which could be regarded as unfair in national terms and suggested they should be renegotiated.

This solution proved unacceptable to the government and it was decided that the interests of all the companies concerned should be purchased. Agreement was finally reached in July 1971, for a price of $ 5.8 millions, of which $ 2.127 millions was attributable to interests held in Anegada.

Subsequent to the withdrawal of DEVCAN, the island was proposed as an oil storage and refining complex for the Virgin Islands Refinery Corporation. The Government rejected this proposal for several reasons. Firstly the company required a very large acreage at the West End; secondly, the Government were asked to sign an agreement before details of the proposal were known; and thirdly, the company wished exclusive right on all its activities. (British Virgin Islander, January 1974). The Government had also become cautious in its dealings over Anegada, and particularly felt that in this case insufficient steps had been taken to ensure protection of the environment.

In May 1973 preliminary discussions were held in Tortola between members of the Government and representatives of the Sterling Bank and Trust Company Ltd., of Grand Cayman concerning the future development of Anegada. As a result, the Government welcomed and approved a proposal by Sterling Bank to set up a Study Group whose purpose would be to investigate the feasibility of developing the western part of Anegada as a low density tourist/residential project aimed at supplying the needs of both the local and international markets. The Government's approach was cautious and no agreement had been signed before the unexpected overnight collapse of the Sterling Bank in late 1974. As a result all further work on Anegada has ceased and there is at present no likelihood of a continuation.

Since that date no further proposals have arisen and it seems unlikely that any further development schemes will arise for some time to come.

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ISLAND STRUCTURE

Introduction

Like many low limestone islands in tectonically active areas Anegada does not have an easily defineable history. The Island is an elevated coral reef, orientated parallel to the incoming wave trains like its modern counterpart. The mechanism which has caused this emergence provides a complex problem entailing at least two principal factors either alone or in combination. The discussion presents evidence in an attempt to identify the factors and mechanisms which have occurred.

Geological Origin of the Virgin Islands

The naturalist Schomburgk (1832) first discusses the origin of Anegada and the Virgin Islands. He states: 'The surface of the island is the production of the industrious tribe of lithophytae, based (it may be presumed) as usual on a submarine elevation; and, as it has been supposed that the West Indies have been detached from the Floridas by an eruption of the ocean, the whole may be considered as a chain of mountains projecting from the American Continent.'

Today we are naturally able to be more authoritative than Schomburgk about Anegada's structure and origin. Geologically the Virgin Islands belong to the Greater Antilles (Cuba, Hispaniola, Puerto Rico and Jamaica). They rise from a continental platform, the Puerto Rican Shelf, which is about 65 metres below sea level. Only the island of St. Croix is separated from the rest of the archipelago by the greater depths of the Anegada Passage, which is up to 4,500 metres deep. According to Blume (1974) the islands are composed of folded Cretaceous sedimentary rock as well as metamorphic and volcanic rocks and have a dome shaped or mountainous relief.

Heatwole and MacKenzie (1967) are the most recent authority on the geological origin and describe events in their chronological account (Fig. 1).

'The Puerto Rican Shelf resulted from vulcanism during the Cretaceous (Meyerhoff, 1933) and became emergent largely through orogenic movements in the lower Eocene. Subsequent sea flooding occurred in the Oligocene followed by raising during a middle Miocene orogenesis.'

According to one view, there was then a Pliocene upheaval (Butterlin, 1956). A tilting to the northeast then supposedly occurred which permitted the Atlantic and Caribbean to inundate part of the shelf, separating the Virgin Islands from Puerto Rico (Mitchell, 1954). Mitchell also suggests that the Anegada Passage, which separates St. Croix from the other islands, was formed in the Quaternary. He claims that at least one major subsidence, followed by emergence, occurred in the Pleistocene, with minor vertical oscillations into recent times.

Recent evidence indicates that the Caribbean area has been more stable in the late Tertiary and Quaternary than the above summary would suggest. Weaver (1961) suggests that vertical differential movements have been negligible in the Caribbean since the Miocene and that the stage by stage emergence of Puerto Rico resulted from eustatic sea level lowering rather than movements of land masses. Proceeding from the premise that Caribbean land masses have been relatively stable since the Miocene, Heatwole and MacKenzie constructed a paleogeographic map of the Puerto Rican Island Shelf for different periods using sea level curves (Fig. 2).

According to this analysis, Anegada has been connected to the Virgin Islands and Puerto Rico by a land bridge until between 10,000 - 8,000 BP (Before Present) and was subsequently of much greater area until between 8,000 - 6,000 BP when its present shape was attained. In their subsequent investigation of faunal similarity and endemism the results further suggest that this land bridge has existed until fairly recently. Carey (1972) concurs with this model in his investigations on the herpetofauna of Anegada. If these conclusions on the geological evolution and faunal similarity are correct, then it is clear that the island as it exists today was above sea level at least 8,000 years ago.

Topography

Anegada has a surface area of 9,567 acres (14.94 sq. miles; 33 sq km: Survey Department, Tortola). Topographically it is flat, with a maximum elevation of about 26 feet above mean level near the Settlement and on the northwestern shore at Cow Wreck Bay (Directorate of Overseas Surveys). In the past there has been much disagreement over the true height; Schomburgk (1832) mentions a height of 60 feet at the East End, Britton (1916) suggests 30 feet, Howard (1970), Carey (1972) and LaBastille (1973) all quote heights of between 24 and 27 feet, D'Arcy (1971) on the other hand reports that the greatest elevation today seems to be less than 15 feet with much of the island less than 10 feet above sea level. Actual authorities for these heights are unclear, and it would thus seem that the greatest reliance can be put on the Directorate of Overseas Surveys work in 1971 (Fig. 3).

Physiography

The island is described by Howard (1970). He notes that the island is composed entirely of limestone. Bedrock is exposed over 60% of the island and typically is characterised by a modified karst topography. Solution pits and sinkholes are abundant with maximum diameters of three feet and depths greater than eight feet (Plate 2). The western 40% of the island is mantled by loose carbonate sands with a moderate vegetative cover. He concludes that the island can be divided into five physiographic subdivisions: 1. Bedrock Ridge, 2. Bedrock Flat, 3. Stabilised Dune and Beach Ridge complex, 4. Salt Ponds, 5. Mangrove Marsh. (Fig. 3.) A further description of the island by Evans (1974) states that the western end is sand, stabilised dunes and internal ponds, to the east is upraised coral limestone with some loose rock, but very little eroded. Stabilised sand dunes run in storm ridges on the West End and all along the north coast at heights of 12 - 16 feet.

Geology

Howard states that Bedrock on the island is composed entirely of blue grey to dark grey limestones which range in nature from rudaceous biocalcarenite to arenaceous calcilutite. All exposures which he examined were highly recrystallised. Evidence of pre-modern sub aerial exposure was found in two localities where packets of highly oxidised silt containing terrestrial gastropods were preserved in solution sinks. D'Arcy (1975) records examination of samples yielded by recent quarrying to a depth of 20 - 30 feet on the limestone plain, and refers to the rock as bioclastic partially recrystallised limestone containing the foraminifer Archaias, which ranges in age from the Eocene to the Recent.

On the basis of lithologic and paleontologic variations Howard (1970) has delineated two distinct facies:

1. A high energy reef front.

2. A quiet water, relatively protected reef platform.

He describes the reef front as generally orientated N30 W, parallel to modern prevailing wave trains, with a series of irregular projections with a general orientation of N 70 E and which appear from aerial photographs to parallel modern spur and groove structures directly seaward of the ridge (Plate 1). Fossil remains from the reef front inland of Pelican Point (Fig. 3) show species of Montastrea and Diploria (Plate 3). Howard also notes the presence of the whelk Citarium pica. Further back on the reef platform remains of Acropora cervicornis are found (Plate 4) and Howard additionally notes the fossils of mollusca Codakia and Olivella, and corals Millepora, Diploria and Montastrea. Here the fossil corals are normally concentrated in relatively small areas which he interprets as representing small patch reefs developed locally on the platform.

Age

Sample dates have not been obtained for the Anegada limestone and estimates of age of the fossil reef are based on observations of previous workers. Howard (1970) classifies it as exclusively late Cenozoic limestone possibly of Pleistocene age. Further evidence to suggest that the reef is of the late Cenozoic era is furnished by the fact that during the late Mesozoic and early Tertiary the Atlantic and Pacific Oceans were connected through what is now central America; as a result, reef genera in both oceans were closely related, the closing of the Isthmus of Panama that occurred in the Miocene and the number of Atlantic genera decreased to less than 20 while Pacific genera increased to more than 80. (Milliman, 1973). Since the visible fossil evidence from Anegada is clearly a Caribbean fauna, the last reef growth has undoubtedly occurred since the Miocene segregation. Additionally, on the geological evidence of Heatwole and MacKenzie (1967) the Puerto Rican Shelf would have been in existence post the Miocene and possibly provided a shallow enough base for reef formation, although the water depths over this part of the shelf are probably not quite as clear cut as their model of sea level changes suggests.

Tectonics or Sea Level Stands

Anegada's emergence could have occurred as a result of two possible events, (1) tectonic activity causing local uplift, or (2) reef growth during the high sea level stands of the inter glacial. The evidence supporting these two postulates will now be examined.

Blume (1974) observes that low lying limestone plateaux in the Caribbean are frequently partly dissected marine abrasion platforms of Pleistocene age which have been uplifted by recent tectonic activity. Furthermore recent plate tectonics have established Anegada's position in a potentially active area, on the edge of the Caribbean plate under which the Atlantic plate is forced (Horsfield and Bennet Stone, 1972). If the origin is indeed tectonic uplift then by the results of faunal similarity (Heatwole and MacKenzie, 1967) it is probable that the reef would have been uplifted at some time before 10,000 BP in order for the land bridge to have existed.

The second possible mechanism is that of sea level change. Stoddart (1969) notes that evidence from marine terraces, especially in Europe, indicates a general Quaternary sea level regression from an early Pleistocene level 180 m above the present. Successively lower terraces correspond to successive inter glacial sea levels in this scheme. Reefs, therefore, could presumably have been built to higher levels than the present during each of these interglacials. In the western Atlantic, Broecker and Thurber (1965) have calculated dates from Bahaman and Florida Key limestones which indicate that periods of marine limestone formation existed at about 85,000, 130,000, and 190,000 years ago, and imply that the surface of the ocean was then slightly higher than at present. Stoddart (1969) also points out that slightly elevated reefs and lithified deposits of reef origin are common throughout the reef seas, and some of these exposures have been correlated with emergent terraces on Pacific high islands and referred to Holocene high stands of the sea. Uranium series dating of elevated coral limestones in the Indian and Pacific Oceans has given a date as last interglacial (circa 130,000 BP). He is cautious, however, to take account of certain cases where elevated deposits are attributable to local storm action, as in Micronesia (Shepard et al., 1967), or of local tectonic emergence, as on Guam. The former of these cautions is unlikely in the case of Anegada where both orientation and apparent zonation is in support of an entire elevated reef rather than rubble beds containing fossil corals.

Howard (1970) has apparently committed himself to an opinion that Anegada owes its existence to previous high sea level stands by suggesting that the emergent portion represents the maximum elevation attained by a series of periodically re-established barrier reef - carbonate platform complexes. Evidence for this is not forthcoming and remains unsubstantiated.

The problem in defining Anegada's emergence thus remains, until further light is cast by more detailed investigations.

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REEF STRUCTURE OF ANEGADA, BRITISH VIRGIN ISLANDS

The ecology of reef systems within the Northern Caribbean has now been extensively studied, particularly as a result of the work of Newell (1959); Newell et al (1951, 1959); Goreau (1959a, 1959b, 1966); Goreau and Wells (1967); Goreau and Goreau (1973); and Glynn (1973a and b). In a comprehensive survey of work in this area, Milliman (1973) states that the most distinctive difference between coral reef studies in the Caribbean and those in the Pacific has been the direction of emphasis. The most recent investigations in the Caribbean have centred around sedimentological and geological aspects of reef and bank environments whereas Pacific studies have had an essentially biological theme.

This difference in scientific approach is exemplified by work which has been carried out to date on the reefs around Anegada, one of the most northerly islands of the British Virgin Group. A brief mention of the geology of the island is recorded by Martin Kaye (1959) but more recently a reconnaissance of the geology of the island was carried out by Howard (1970). This paper describes the geological structure of Anegada and presents evidence for the origin of the island and its surrounding reefs. A recent paper by Adey and Burke (1976) on the Holocene bioherms of the Eastern Caribbean also includes a brief description of the reefs around Anegada. Although not specific to Anegada, this paper is also primarily concerned with the origin of Caribbean reef structures.

The following investigation is an attempt to describe the reefs surrounding Anegada from a biological standpoint. Because of the nature of the study, descriptive methods were adopted that were essentially similar to those used by Goreau (1959) in his original survey of the Ocho Rios reef off north-east Jamaica. In this way a semi-quantitative measure of diversity and abundance of coral species was obtained together with descriptions of unusual growth forms and distribution patterns.

SITE DESCRIPTION

Windward Shore

Along the windward shore of the island four main sites were selected. These were West End, Jack Bay, Loblolly Bay and East End (Fig. 4). In addition, Cow Wreck Bay and Bone Bay were also included in a preliminary reconnaissance survey and observations on these areas are included in the text.

Leeward Shore

Along the leeward shore nine patch reefs were studied in detail. The position of the selected study areas is shown in Fig. 4.

METHODS

Initially a brief preliminary survey of sites around the island was carried out in an attempt to ascertain which areas would benefit from more detailed study.

Windward Shore

At each selected site on the northern shore, an area approximately ½ km wide, was mapped from the shore, seawards across the reef. The shore was first mapped by theodolite and Tellurometer and temporary stations triangulated into the Directorate of Overseas Survey network. The seaward zone was mapped using an inflatable with echo sounder and reflective prisms for the Tellurometer instrument. A snorkel diver provided underwater information, which was recorded along with station fixes, by the boatman. The information obtained in this way correlated extremely well with detail taken from aerial photographs and also provided additional information about substrate type which enabled better interpretation of the photographs.

Transects were then laid from the shore across the reef as far as proved physically possible. In some cases transect length exceeded 600 m. The transect line was marked at 10 m intervals with buoyant coded tags and was aligned by the use of shore transect markers. Depth soundings were then taken at each tag marker along the full length of the transect and these later corrected by the use of simple tidal data recorded on the shore. A profile was then drawn by two divers swimming the transect and noting coral species, colony size and any other notable physical features. Detailed observations were also made on the dominant algae and the presence of gorgonids and sponges noted. The profiles were then employed to define any zonation on the reef. The zonation system chosen was based upon that used by Goreau and Goreau (1973), although not all zones were represented at the sites chosen on Anegada. Generally the following zones were recognised - Lagoon, Rear reef, Reef top and Buttress. At two sites - Jack Bay and East End it was necessary to include an inshore zone within the zonation scheme.

Within these zones the abundance of recorded coral species was noted. A system similar to that used by Goreau (1959) was adopted, in which relative abundances were assessed using the following notation:

Rare

Scarce

Common

Abundant

Working from the transect line within a zone, the area investigated fell in the range of vision from that marker. Underwater photographs were taken in representative areas and particular note was made of any unusual growth forms encountered during searches. Specimens of unidentified coral species were collected and returned to the field laboratory for later identification.

Leeward Shore

On the southern shore where discrete patch reefs are found, work concentrated on a total description of the patch together with an estimation of the abundance of observed coral species.

OBSERVATIONS

A notable feature of the windward shore reef is its continuity. Only at a few points along the 11 mile shoreline is it broken by narrow channels and only at one place does it appear to be absent - Deep Bay. Along its length there is considerable variation in the shoreline to reef distance (Fig. 4 and Plate 1). Starting at West End the main reef lies approximately 500 m offshore; at Windlass Bight 2 km; at Jack Bay only 200 m, and at Pelican Point the distance increases up to 3 km as the reef leaves the eastermost point of the island to form Horse Shoe Reef. At one location, Soldier Point, the reef comes within several metres of the shoreline.

The main reef system consists of a mixture of coral and algal ridge systems; the dominant coralline algae being crustose species such as *Lithophyllum* spp., *Porolithon* spp., and *Neogoniolithon* spp. One outstanding feature of the main reef system on the north-eastern side of Anegada is the patchiness of the *Acropora palmata* dominated rear reef, much of which is dead, extensively bored and coated by crustose coralline algae. Another significant feature of the reef structure is the lack of any 'drop-off' beyond the buttress zone. As noted earlier by Adey and Burke (1976) this region consists of a coralline dominated spur and groove fore-reef. Maximum depths, at the base of the spurs, are approximately 10 - 15 m, the bottom sloping away gently seawards. It has been suggested by Adey that a shallow bench exists at 10 - 15 m, sloping from west to east, upon which the reefs and ridges of Anegada are built.

There follows a general description of the main reef system of Anegada in terms of the zones described earlier for the windward shore, and comparative descriptions for selected patch reefs on the leeward shore.

Windward Shore

i) Inshore Zone

An inshore zone could only be defined at two locations along the windward shore of Anegada - at transect 2 in Jack Bay and Transects 5 and 9 at East End (Plates 16 and 18).

The profile for transect 2 at Jack Bay shows an inshore area of beach rock. This structure extended approximately 1 km along the western shore of Jack Bay but as the profile indicates, was limited in its extent seaward. The beach rock had abundant algal cover in the tidal pools, the dominant species being Turbinaria turbinata. Also recorded in this habitat were large numbers of the chiton Acanthopleura granulata (Gmelin).

In contrast, at the East End of the island the inshore zone was found to consist of a fringing reef (Plate 18). The structure extended approximately 2 km east of Pelican Point, around the eastern tip of the island, and approximately 400 m to the west of the Point - its seaward extent being approximately 50 - 100 m.

Profiles of this zone are illustrated in Fig. 11 where it can be seen that the structure may be divided into three areas: i) An inshore sand bottom, colonised by algae and spermatophytes (the dominant species being Penicillis capitatus, Halimeda incrassata and Syringodium filiforme and Thalassia testudinum respectively), ii) a coralline algae dominated section, and iii) an outer living coral region.

At a distance which varied between 10 - 15 m from the shore, two coralline algae species (identification still to be confirmed) became dominant. Thalassia, Halimeda and Penicillis were still present but were not as abundant as before.

At approximately 20 - 25 m from the shoreline small amounts of the coral Porites porites var. divaricata were found. Most of the coral found at this point was living and interspersed with coralline algae and sparse Thalassia. Beyond this distance along the profile, large amounts of Porites appeared to be dead (ratio live:dead approximately 1:3) and encrusted by coralline algae. Within this habitat, considerable numbers of echinoids were found, in particular Echinometra lucunter.

The components of the outer living edge of the inshore fringing reef varied, depending on the site chosen for study. East of Pelican Point and actually extending around the east end of the island, the outer rim of the reef consisted of Porites porites var. divaricata (ratio live:dead 1:1) which then gave way to Acropora palmata in the deeper waters (0.5 - 1.0 m) of the edge of the structure.

West of Pelican Point the outer part of the 'fringing' reef consisted predominantly of living Porites (Plate 6), which provided an excellent habitat for many small reef fish. Water depths at the base of the Porites bank were also in the range 0.5 - 1.0 m.

The inshore fringing reef was only found around the east end of Anegada. Both Almy and Carrion Torres (1963) and Glynn (1973a) have also described Porites divaricata Leseuer forming either separate colonies or a continuous cover at 0.5 - 1.0 m depths close to the coastline around Puerto Rico. Roos (1971) reports pavements of Porites porites var. divaricata in very shallow water at Arashi, Aruba.

ii) Lagoon Zone

The lagoon zone was the most extensive of all zones to be described on the windward shore. As mentioned earlier the reef distance from the shoreline varied considerably along the windward coast so that the lagoon may vary in its leeward extent from 50 m to 1.5 km. A comparison of the profiles drawn on the windward shore illustrates this well. Towards the west end of the island, i.e., West End, Cow Wreck Bay, Bone Bay, Windlass Bight, where the lagoon was at least 250 m wide, patch reefs were found which were up to 15 - 20 m diameter. At both Cow Wreck Bay and Bone Bay there were large numbers of well developed patch reefs. The depth of the lagoon at these two sites ranged between 2 - 4 m. Generally the inshore patch reefs supported little live coral growth, consisting of a dead coral base surrounded by sand and algae. Moving out across the lagoon towards the main reef, the percentage live coral cover increased; dominant encrusting species such as Porites astreoides, Siderasterea siderea, Siderasterea radians, and Diploria clivosa being replaced by Acropora palmata, Montastrea annularis and Diploria spp. as massive dominants in deeper water. It was noted that a large proportion of Acropora palmata, found on patch reefs in the outer lagoon, was dead.

A brief count of Strombus gigas, by a visiting scientist from the West Indies Laboratory, yielded 11 individuals/200 sq. m (Imsand - pers. comm.) in the lagoon of Bone Bay. This mollusc was found on a sand bottom, colonised by Thalassia and Halodule, at a depth of 2 - 3 m.

Tubastrea coccinea was recorded on the sheltered seaward edge of a patch reef in Bone Bay at a depth of 0.5 m.

Table 1 summarises the coral species found at sites around the island and also indicates the relative abundance of these species in each zone. The coral Manicina areolata, was recorded at only two sites along the windward shore, one of these being the lagoon zone at West End where it was noted as scarce. At West End the most notable feature of the lagoon was the extensive sandy areas covered by vascular plant species and algae. These included; Thalassia testudinum, Syringodium fileforme, Halimeda incrassata, Penicillis capitatus and Udotea flabellum. A species list for the area is given on page

At Jack Bay (transects 1 and 2) and Loblolly Bay (transect 3) where the lagoon was less extensive than in the above areas, i.e., 60 - 170 m seaward extent, less established patches of coral were found, ranging from individual coral heads to coral patches 10 - 20 m diameter. Generally the ratio of live to dead coral was low - 1:3, the dominant species being encrusting forms and those resistant to sedimentation. Acropora palmata, Montastrea annularis, Montastrea cavernosa, Porites porites and Acropora cervicornis were represented although their distribution was patchy. The live corals tended to be based on dead coral substrate which was colonised by algae species such as Padina sanctae-crucis, Codium spp., Turbinaria tricostata, Halimeda monile and Sporochnus pedunculatus.

At the east end of the island the lagoon area separated the main reef from the shore by a considerable distance - in excess of 1.5 km. From aerial photographs the lagoon at East End would appear to be an area in which there is considerable transport of sediment by currents, much of this material being deposited on the leeward side of the island. Within the lagoon area worked, similar features were noted as observed at West End. Such similarities included extensive areas of coralline derived sand colonised by Thalassia and Syringodium, interspersed by Penicillis, Halimeda and Udotea; also predominantly barren inshore areas with dead coral substrate covered by sand and algae. Two 90 m transects confirmed these general observations (Plate 18). Transect 6 was laid over an area covered by Thalassia with patchy and sparse coral cover. The most significant feature at this site was the abundance of Strombus gigas over a complete size range. At previous sites only large individuals had been noted within the lagoon (Bone Bay, Loblolly Bay). Also at East End several large specimens of the King Helmet shell, Cassis tuberosa, were recorded close to the shore at Pelican Point.

A second 90 m transect, approximately 1 km from the shore, traversed an area in which there were several well developed, isolated patches of Diploria labyrinthiformes, Montastrea annularis, Acropora cervicornis and Acropora palmata. Many specimens of Acropora palmata were actually detached from the original coral base but were still continuing to survive. Particular note was made of the non-hermatypic coral species, Tubastrea coccinea, which was recorded in several seaward facing overhangs of Montastrea annularis.

No quantitative measurements were made on the abundance of Diadema antillarum; most individuals were seen in the lagoon zone but at no site did numbers appear to equal the density of animals reported on the rear reef at Taque Bay, St. Croix. (Ogden et al. 1972).

iii) Rear Reef

The rear reef, at the major sites visited on the windward coast (West End, Jack Bay, Loblolly Bay and East End) extended between 70 - 100 m beyond the lagoon to the reef top. Depths of water over the rear reef ranged between 1-2 metres, with depths of 2-3 metres in sandy areas between the coral growths. Characteristically the rear zone was an area in which the dominant corals were Acropora palmata and to a lesser extent, Montastrea annularis.

Although as many as 27 coral species, out of a maximum of 31 recorded for the entire island, were noted in this zone, the distribution of coral was again very patchy with considerable amounts of dead coral and coral rubble interspersed between live specimens. The extent of dead coral within the rear reef is well illustrated in Figures 7, 8, 9 and 10, showing profiles of the windward shore. The sea-fan Gorgonia flabellum, and the sea-whips Pseudopterogorgia americana and Plexaura spp. were relatively common in the rear zone, particularly in Jack Bay and Loblolly Bay (Plate 7).

At West End the rear reef contained substantial dense patches of Thalassia (up to 900 sq. m), which was growing upon sand that had accumulated on dead coral substrate. Generally there was a paucity of live coral in this region; the majority of species being small specimens of encrusting forms such as Porites astreoides, Porites porites, Siderasterea radians, Siderasterea siderea, Diploria strigosa, Diploria clivosa, Agaricia agaricites, and Millepora squarrosa.

At East End there was a marked patchiness in the rear zone where much of the substrate consisted of dead coral rubble, particularly Acropora cervicornis. Colonies of live coral, however, were well established in contrast to the West End, and included Acropora palmata, Montastrea annularis and Acropora cervicornis. The relative abundance of Acropora cervicornis within this area was quite marked; large colonies (0.5 - 2 m diameter) of Diploria labyrinthiformes were also common.

Tubastrea coccinea was recorded in a particularly high energy environment - as indicated by extensive growth of Millepora squarrosa nearby (Plate 8) - at the seaward limit of the rear zone where it merged with the reef top. The coral was found in an overhand formed within a dead Acropora palmata colony. Several specimens were recorded in a similar situation in the area and although localised, the species was relatively common here.

iv) Reef Top

Division between rear reef and reef top was quite arbitrary at some points along the windward shore. At certain sites, such as West End, Jack Bay (transect 1), Loblolly Bay and East End there were zones which could quite easily be defined as reef top - however other sites such as Jack Bay (transect 2), Cow Wreck Bay, and Bone Bay did not appear to exhibit any clearly defined reef top zone.

The general water depth over the reef top of the former sites was relatively consistent, ranging from 0.1 - 0.5 m. At times of low diurnal tides, many colonies of Acropora palmata were fully exposed. This was particularly noticeable at West End and Jack Bay. Again this zone, like those described previously, was a region in which dead coral predominated - living colonies being mainly encrusting species. Table 1 gives full details of all species recorded in the area. Acropora palmata was again the dominant species, the ratio of live:dead being 1:5. One particularly outstanding feature of the reef top zone at Jack Bay was the existence of a coralline ridge composed of at least three coralline algae species (identification still to be confirmed). (Plates 9 and 10). This ridge,already identified by Adey and Burke (1976) is described as forming algal ridge lobes or 'cup-reefs' on the sides of grooves which extend landward into the reef-ridge system of the northeastern shore of the island. The coralline algal ridge supports numerous fleshy algae species including Dilophus guineensis which is particularly abundant, Dictyopteris delicatula, Polysiphonia sp., Hypnea spp. and Ceramium sp. The ridge also creates shelter for a diverse 'in-fauna' including molluscs (Gastropoda: Acmaea sp., Cremides barbadensis Gmelin., Lucapina sp., Tricolia thalassicola Robertson, Amphineura: Choneplax lata., Isnochiton sp.) echinoderms (Echinometra lucunter), sipunculid worms, and amphipod and decapod crustacea.

Inshore of this region the reef top at Jack Bay consisted of dead Acropora palmata which had been consolidated by the encrustations of coralline algae species and also extensively 'bored' (Plates 11 and 12). One of the organisms responsible for this effect is likely to be the rock boring bivalve, Lithophaga nigra Orbigny - specimens were collected from samples of coral returned to the field laboratory. Also found within the cavities created by boring were the bivalve mollusc Barbaitia pulchella Reeve and large numbers of Isnochiton sp.

Another feature of the reef top along the windward shore was the presence of a Millepora squarrosa ridge at two sites - at Loblolly Bay (transect 3) and also at East End (transect 8). At both sites Tubastrea coccinea was found; at Loblolly Bay the specimen was detached but at East End the coral was established upon dead Acropora palmata.

More abundant algal cover was again noted at West End where the dominant species recorded on the reef top was Turbinaria turbinata - other species noted were Padina sanctae-crucis, Halimeda incrassata, Udotea flabellum, and Dictyosphaeria cavernosa.

v) Buttress Zone

The 'buttress' or 'spur and groove' fore-reef was much more marked towards the west end of the island. Aerial photographs support this observation and together with mapping by the Expedition indicate that the spurs and grooves are aligned at an angle of 60^{o} to the shoreline, on a bearing N - S.

Observations of the 'buttress' zone at Jack Bay, Cow Wreck Bay and West End were quite extensive but at Loblolly it proved physically impossible to swim over the Millepora high energy region. Observations at East End were similarly limited although snorkellers did gain access to one section of the fore-reef.

At the West End site, the buttress zone did not appear to be so well developed as at sites a few km further east, i.e., West End - Cow Wreck Bay. On transect 4 the fore-reef sloped gently away to a maximum depth of approximately 4 m. On this slope dead coral pre-dominated although it was not extensively bored. Dominant corals in the region were typically those characteristic of a buttress zone, namely Diploria clivosa, Diploria strigosa, Acropora palmata, and Millepora squarrosa. Another marked feature of the slope was the abundance of gorgonians (Gorgonia flabellum and Pseudopterogorgia americana) and algae (Tubinaria turbinata, Stypopodium zonale and Dictyopteris justii).

The transect at West End (Plate 17) passed over the spur and groove system in a region where the maximum height of the spurs was only 1-2 m; the spurs consisted of dead coral and the grooves between them were filled by sand.

Further East at Cow Wreck Bay, a more developed spur and groove system (particularly to the West of the Bay) was again characterised by the dominant corals, Montastrea annularis, Acropora palmata, Millepora squarrosa and large colonies of Diploria spp. - Diploria strigosa colonies measuring up to and > 1 m. The corals, Millepora squarrosa, ('boxwork form' Stearn and Riding 1975) and Agaricia agaricites, var. crassa were particularly abundant at the edge of spurs where the water depth was approximately 1 m. These spurs measured up to 4-5 m in height and ranged from 4-10 m in width. Beyond this zone the bottom sloped gently away at 6-8 m with no marked drop off seaward.

In contrast to the previous areas, the buttress zone of Jack Bay (transects 1 and 2) yielded a much greater proportion of live coral together with a greater variety of coral species (Table 1). The spur and groove effect, however, was not as evident at Jack Bay as at sites towards the west end of the island. At the seaward end of transect 1 the dominant corals were similar to those quoted in the previous paragraph. Particular note was made of the growth form of Acropora palmata which was encrusting as opposed to branching. Species such as Isophyllia multiflora and Isophyllastrea rigida were recorded in the buttress zone but were limited in their abundance.

The buttress zone of transect 2 was particularly significant in terms of the presence of the plate-like form of Montastrea annularis and also the abundance of Agaricia agaricites, the more typical form with thick leaf-like outgrowings and corallites on all sides of the colony. Also on this transect, at a depth of 10 m, a record of Mussa angulosa was obtained - this was the only site at which the coral was recorded.

Beyond the buttresses formed by Montastrea annularis, the bottom levelled off at approximately 12 m, with evidence of an 'old' spur and groove formation at this depth. These spurs were aligned similarly to those recorded at West End, although their origins were not investigated by coring. The height of the spurs was 0.5 - 0.8 m above the sand filled grooves between them - the spurs themselves being covered by sand and algae, particularly Turbinaria spp. From the final marker on transect 2, snorkellers swam offshore, beyond the reef, for a distance of 1 km. The bottom was similar in type to that area just beyond the buttress zone, with intermittent large pillars of Montastrea annularis arising out of a sand substrate which was traversed by 'tongues' of rock outcrops covered by sand and algae. The depth gradually increased to 15 m about 2 km offshore at this point.

Leeward Shore

The southern and western patch reefs border on the shallow waters (2-8 m) of Gorda Sound. Charts of the area show a considerable number of coral heads breaking surface, for a distance of up to 3 km from the southern shore of the island, and patch reef development is quite extensive (Plates 1 and 13). The size of the patches varies from between 3-4 m diameter to over 100 - 200 m diameter. Profiles of the patch reefs are shown in Fig. 13.

The limited amount of time available for study resulted in the detailed description of only a small number of areas. Eight patch reefs were studied in all; their position relative to the island is shown in Fig. 4. Of those patch reefs investigated, the majority showed an essentially similar structure, independent of their size, apart from patch reefs III and IX which were situated in shallow waters (1-2 m) and were much closer inshore than the other sites visited. The basic structure of most of the patch reefs consisted of a central core of Acropora palmata surrounded on the outer edges by Montastrea annularis heads and large colonies of Diploria spp. The latter corals formed discrete heads which were based on sand in depths of water ranging from 5-6 m.

A comparison of the profiles obtained for each patch reef illustrates the similarity in basic structure. The dominant coral on all patches was Acropora palmata and was frequently dead and encrusted by coralline algae.

Generally both the abundance and diversity of coral species was greater on the leeward side of the island than on the windward shore (Table 1) with a maximum of 22 species recorded on patch reef II. The abundance of Acropora prolifera was particularly noticeable on the leeward shore especially on patch reefs II, VII and IX. In each case the colonies were all localised on the shoreward facing side of the patch.

Acropora cervicornis was also relatively abundant - particularly on patch reefs VI, VII and VIII. A notable feature on patch reef VIII was an intermediate form of Acropora palmata and Acropora cervicornis, in which cervicornis-like protuberances projected from Acropora palmata branches. Similar growth forms have been noticed by Roos (1971) on Bonaire and St. Martin and obviously such observations cast doubts about the species distinction.

A variety of growth forms of other corals were noted, e.g., on patch reef II and IV, two forms of Porites astreoides were observed - the typical encrusting form and also a plate-like variety (Plate 14). Roos (1967) has already shown that in localities where light is limiting the coral shows a conspicuous flattening in response to ambient light conditions.

Agaricia agaricites var. crassa and var. fragilis were also recorded on patch reef II. Generally Agaricia agaricites var. fragilis was restricted to overhangs and gullies and var. crassa to shallow water on top of the patch reef. Millepora also displayed several forms on this patch reef (Plate 15). In this example both the bladed Millepora complanata and the branching Millepora alcicornis are illustrated, in a water depth of 3 m.

At only one site did Montastrea annularis exhibit a vertical plate form similar to that recorded in the buttress zone of Jack Bay - this growth form is characteristic of the species when growing on shadowed vertical surfaces (Roos 1971).

Coral species which were either absent or rare at sites visited on the leeward side of the island included Mycetophyllia lamarkana, Isophyllastrea rigida, Tubastrea coccinea and Manicina areolata. The latter species, however, was rated as common on patch reef VI where detached specimens were found on the sand at 3-4 m water depth, between the pillars of Montastrea annularis surrounding the patch.

In general Gorgonids were abundant at all sites - the dominant species being Gorgonia flabellum, Pseudopteryogorgia americana and Plexaura spp.

Apart from patch reefs III and IX, relatively few algae species were recorded on the other patch reefs visited. Calcareous species noted in sand around the reefs included Halimeda opuntia, Penicillis capitatus and Udotea flabellum. The Queen conch, Strombus gigas, was recorded around patch reef IV (approximate density 8 per 200 sq. m.) and also around patch reef VI (5 per 200 sq. m.).

Patch reefs III and IX were unlike other sites visited on the leeward shore of the island since they were in much shallower water (1-2 m) and as a result were colonised by many algae species. Patch reef III at Pomato Point was located only 50 m from the shore and consisted of mainly dead Acropora palmata which had been encrusted and consolidated by coralline algae and also extensively bored. Coral species, resistant to sedimentation such as Siderasterea radians and Diploria clivosa were common.

Patch reef IX consisted of similar dominant coral species and was also covered by abundant algal growth with dense Thalassia between coral outcrops. A complete list of dominant algae species collected at these sites can be found in Table 2.

SUMMARY

Altogether 31 species of coral were recorded on Anegada - that is including sites visited on both the windward and leeward sides of the island. This figure compares with 37 species from Cuba (Duarte Bello 1961); 34 species from Puerto Rico (Almy and Carrion Torres 1963); 34 species from Barbados (Lewis 1960); 29 species from Curacao (Roos 1964); 62 species from Jamaica (Goreau and Wells 1967) and 46 Scleractinian species from Bonaire (Scatterday 1974). All these collections involved the use of similar skindiving/snorkelling techniques. However, as Goreau and Wells state in their paper on the shallow water Scleractinia of Jamaica, it is important to define the depth range in which these studies were carried out, e.g., Lewis worked to 10 m; Roos and Scatterday to 30 m, Goreau to 96 m, while other workers restricted their collections to depths of less than 10 m in areas that were mainly on the inner lagoon side of reefs. The maximum depth worked around Anegada by members of the Expedition was 10 m.

The apparent absence of Madracis decactis may be accounted for by the worked depth of only 10 m, since this species is usually restricted to deeper water, the shallowest record from material examined in the Netherland Antilles being 9.4 m (Roos 1971). Scatterday (1974) however reports abundant Madracis decactis colonies in well concealed cavities in shallow waters on the Kralendyk reefs of the Netherland Antilles.

Of those species noted on Anegada, the largest number recorded on the windward shore occurred within the rear zone of Jack and Loblolly Bay. Up to 24 species were observed here and these figures compare well with the numbers of coral species recorded on individual patch reefs on the leeward shore (17 - 24). The number of corals recorded on the reef top and buttress zone however was relatively low at all sites on the windward shore. Goreau (1973) describes similar results, in part, for the Jamaican north coast reefs where he shows that the rear zone is an area containing a varied Scleractinian community (i.e., 9 families: 17 genera: 29 species) and the reef flat Scleratinian fauna is impoverished (7 families: 10 genera: 22 species). However, in addition, the buttress zone is described as the richest habitat of the reef with 41 species of 23 genera of hermatypic Scleractinia and 2 species of Hydrocorallina. Certainly this is not the case in Anegada where the maximum number of species recorded within the buttress zone of Jack Bay was 15 (6 genera) as compared with the more diverse rear reef. There may be several reasons for this marked difference in observations: firstly, the buttress zone on Anegada is found in relatively shallow water, certainly not in excess of 10 m whereas similar zones in Jamaica extend down to depths of 20 m.

Secondly, the north coast of Jamaica may not be exposed to the same physical forces ensuing from wave action as the windward reef of Anegada where there is a considerable amount of dead and broken coral within the mixed coral/algal ridge system. The effect of wave action

is quite obvious, particularly at East End, where branches of Acropora palmata are found detached from their original bases. As reported by other workers (D'Arcy 1975) a 'ground-sea' during the winter months increases wave action considerably on the exposed northern shores of the island.

Thirdly, hurricane damage is quite possible, as noted elsewhere in the Caribbean (Stoddart 1963, 1974). The most recent hurricane to affect Anegada has been Hurricane Donna in 1960 which removed many houses from their foundations in the 'Settlement'. As a point of interest in this context, a severe tropical storm (later to become Hurricane Elouise) hit the island during the late summer of 1975 after the completion of the current survey. The resemblance of the Anegada rear reef to sites affected by hurricane damage on the British Honduras reefs is quite marked (Stoddart pers. comm.).

Although it is not perfectly clear why the buttress zone of the windward reef is so depauperate in terms of coral species, it should be mentioned that in a survey of Grand Cayman reefs, Roberts (1974) describes the upper fore-reef terrace of the northern fringing reef (water depths 5-10 m) as a 'barren plain'. He believes that the intense energy of the waves is dissipated in this zone and as a result only encrusting and low relief growth forms of coral are found here.

In terms of dominant coral species the most evident must surely be Acropora palmata which dominates both the rear reef and reef-flat on the north-eastern reef and also constitutes the central core of many of the leeward patch reefs. Such findings are in line with the observations of Milliman (1973) who states that although Acropora palmata may be the dominant coral in Northern Caribbean reefs (Newell et al. 1951, 1959; Ginsburg 1956; Shinn 1963; Logan 1969) and Montastrea annularis the dominant on south-western Caribbean atolls (Milliman 1969a) this generalisation does not always hold. For instance Acropora palmata has also been shown to be the dominant coral at St. Croix (V.I.) even though the climate resembles the southern rather than the northern Caribbean (Milliman 1973). With regard to the considerable amounts of dead Acropora palmata noticed on the windward reef of Anegada, it has been previously suggested by Shinn (1963) that dead Acropora on the Florida reefs is the result of 'over-crowding': Roos (1971) however does not attribute this cause to the death of colonies in Bonaire. In a more recent review of reefs around Bonaire Scatterday (1974) notes that prolific growth of this species is often limited to areas with heavy wave action (Goreau 1959; Storr 1964; Hoffmeister and Multer 1968). In Bonaire as in Anegada healthy Acropora palmata may be found on both the seaward margins of the reef as well as along channels (presumably there is sufficient wave action along channels to promote growth). According to Scatterday a similar situation exists in the windward reefs of the Caribbean Gulf of Mexico where parts of the colonies in more shoreward locations are killed as a result of being forced into a position where wave action is diminished to an intolerable level, in the lee of other colonies that are established seaward.

Further detailed observations obviously need to be obtained around Anegada, particularly on the leeward side of the island and along Horse Shoe Reef where patch reefs abound. In terms of coral growth, patch reefs in the lee of the island showed not only a relatively good diversity of coral species but also a relatively greater abundance of these species when compared with the northern reef - particularly large colonies of the following species being found: Acropora cervicornis, Acropora prolifera, Diploria labyrinthiformes and Diploria strigosa. Scatterday (1974) also reports vigorous reef growth in leeward areas of Bonaire. This is in contrast to many other Caribbean reef systems where reefs located on the leeward sides of islands are poorly developed when compared to those found on the exposed windward coasts (Milliman 1973).

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ERA	PERIOD	Epoch	
CENOZOIC	QUATERNARY	Pleistocene 1	Sea level change
	TERTIARY	Pliocene 10	Stability
		Miocene 15	Raising
		Oligocene 10	Sea flooding of shelf
		Eocene 19	Shelf becomes emergent
		Paleocene 15	
MESOZOIC	CRETACEOUS	60 million years	Vulcanism results in formation of Puerto Rican Shelf

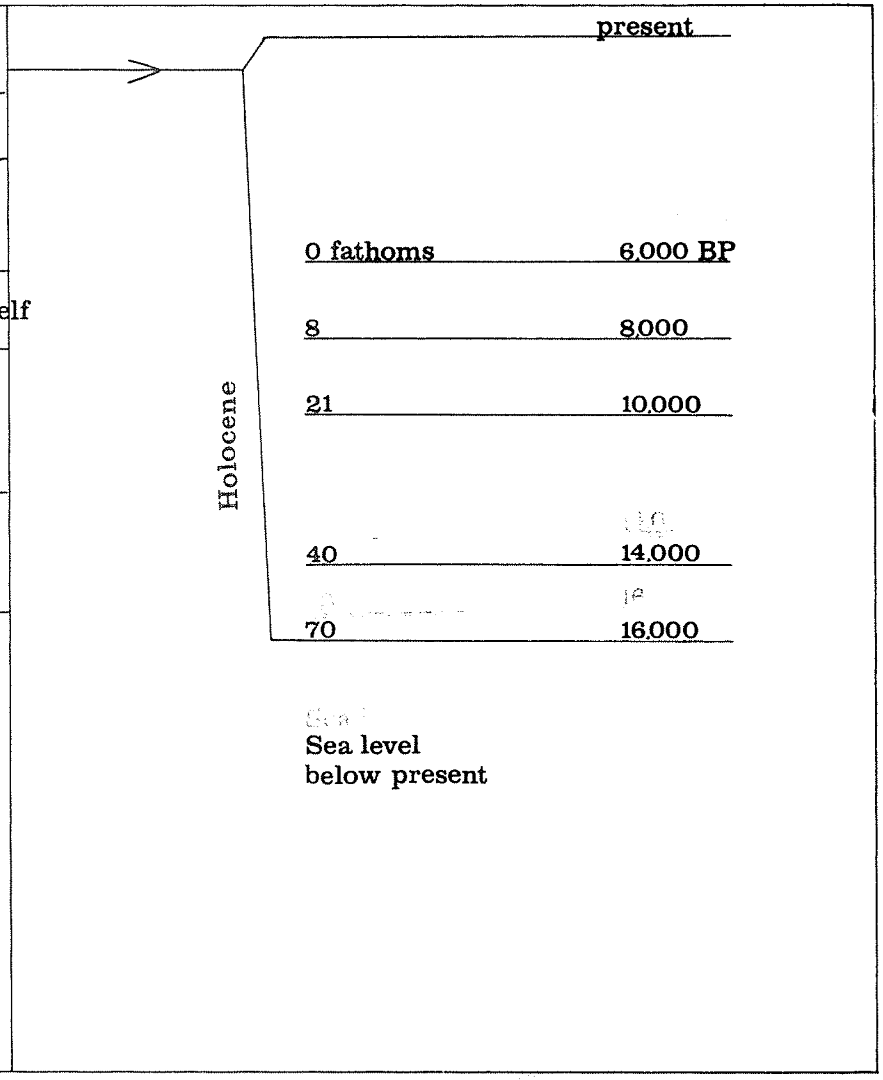
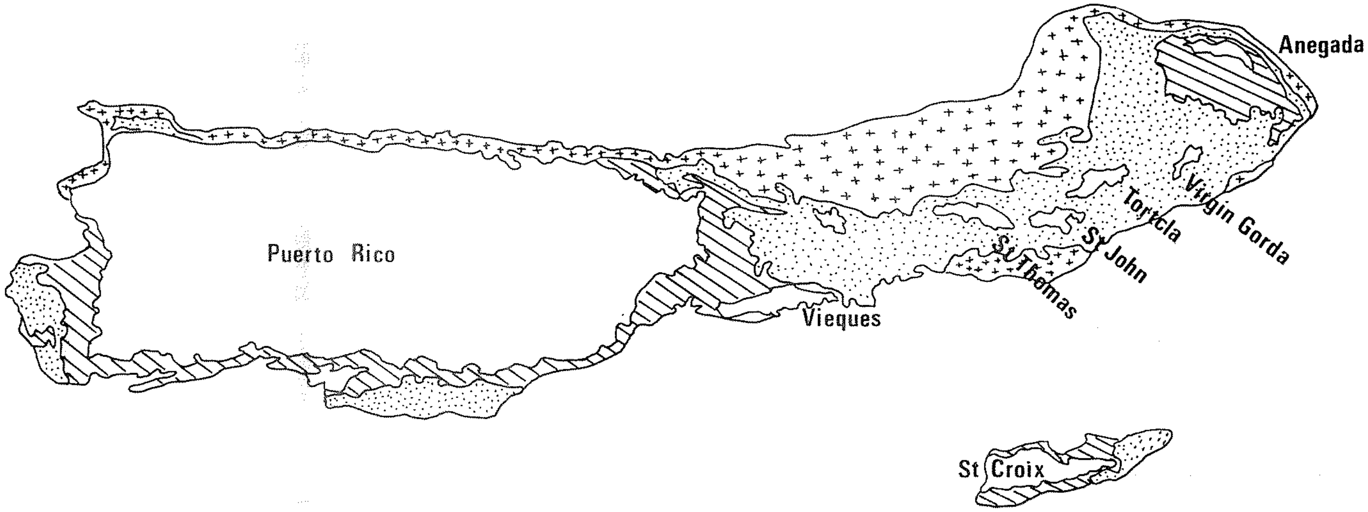


Fig 1 Origin of the Puerto Rican Shelf



Largest outline – max. sea level lowering during Pleistocene

areas submerged 14,000 – 10,000 BP

10,000 – 8,000

8,000 – 6,000

Smaller islands omitted for clarity

Fig 2 Paleogeographic Map of the Puerto Rican Shelf (after Heatwole and MacKenzie, 1967)

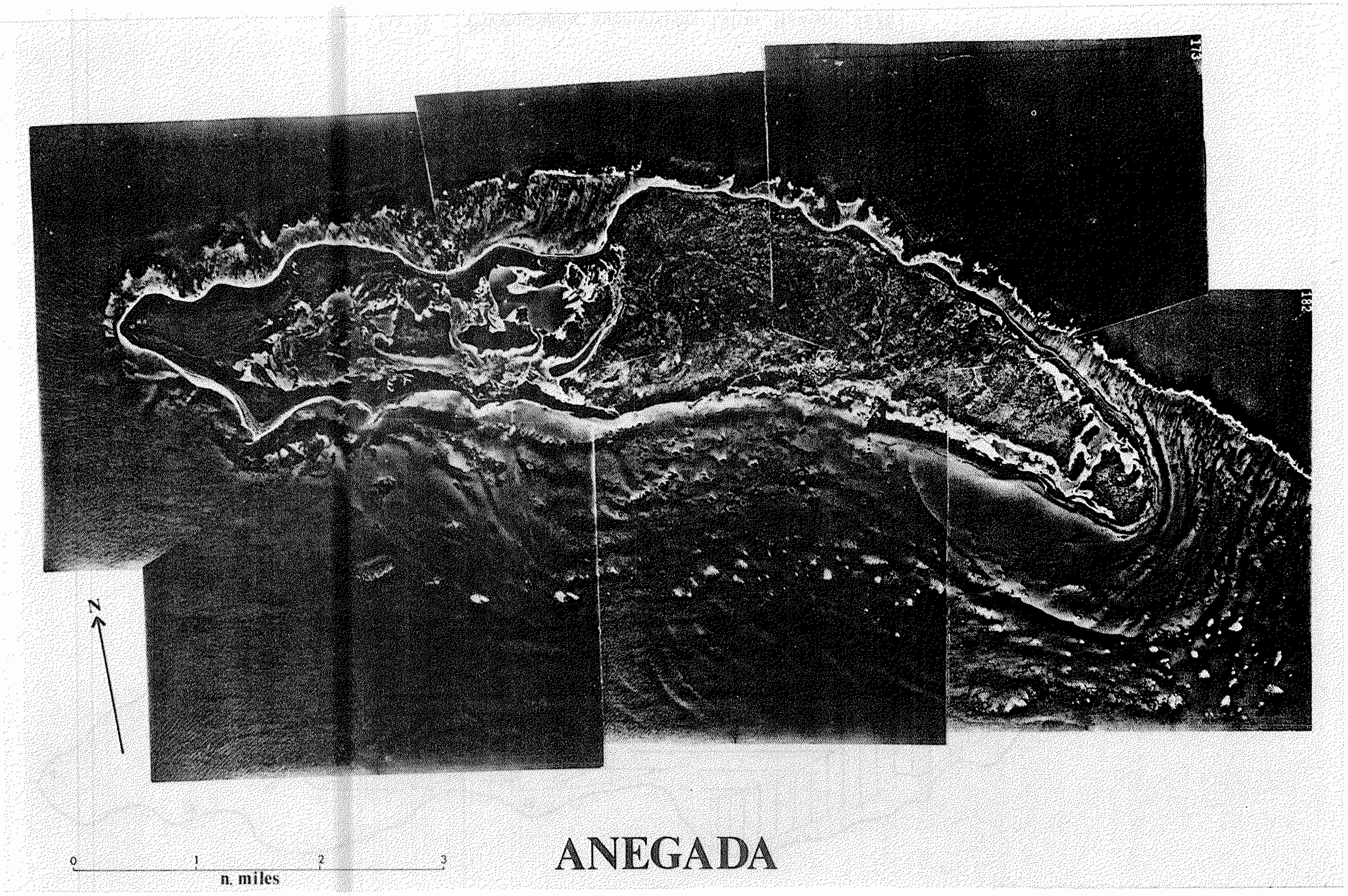


Plate 1. Aerial Mosaic: composed from 1959 USAF photos.

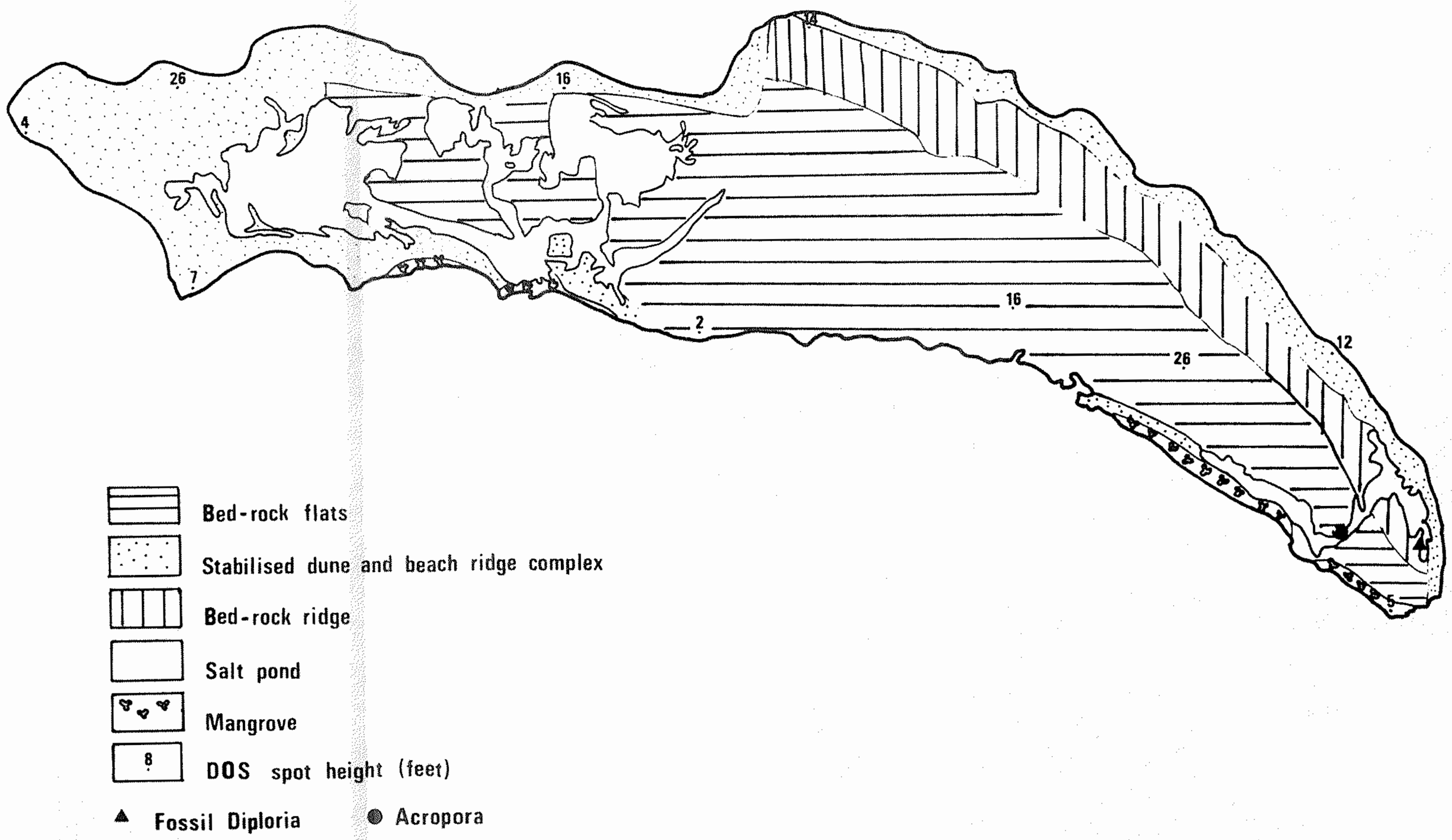


Fig 3 Physiographic subdivisions (after Howard, 1970)

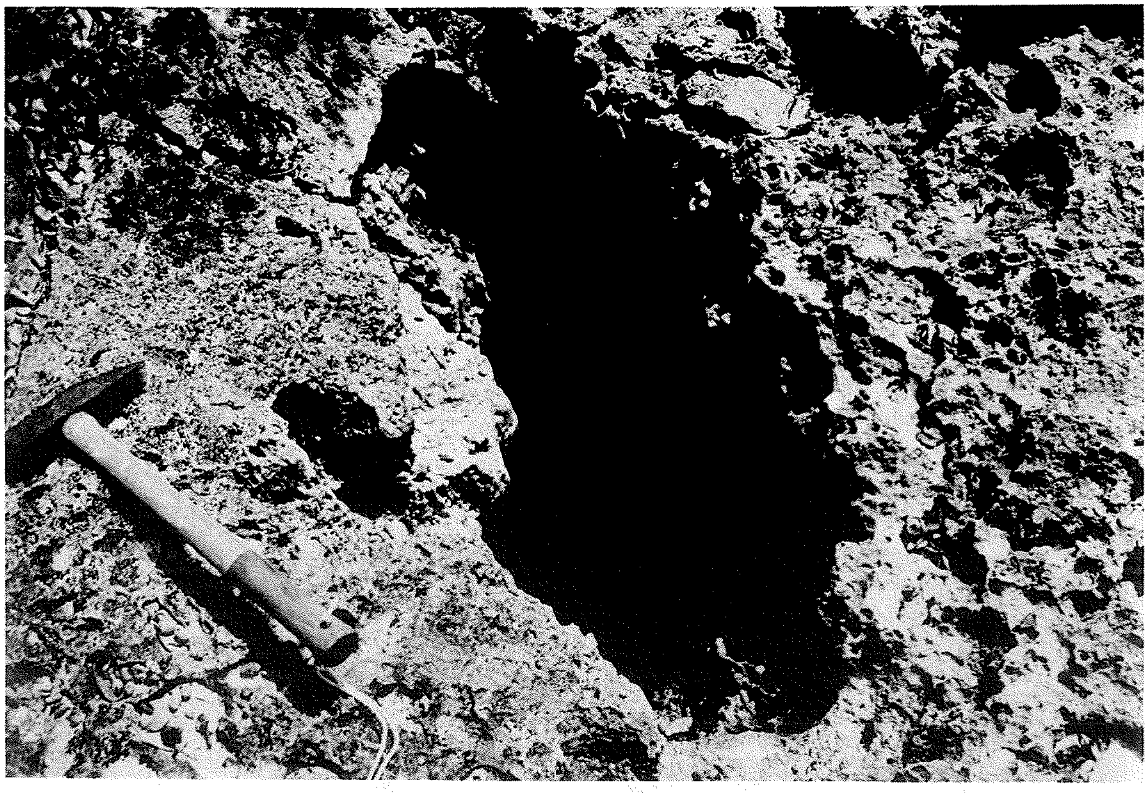


Plate 2 Potholes in Limestone: East End.

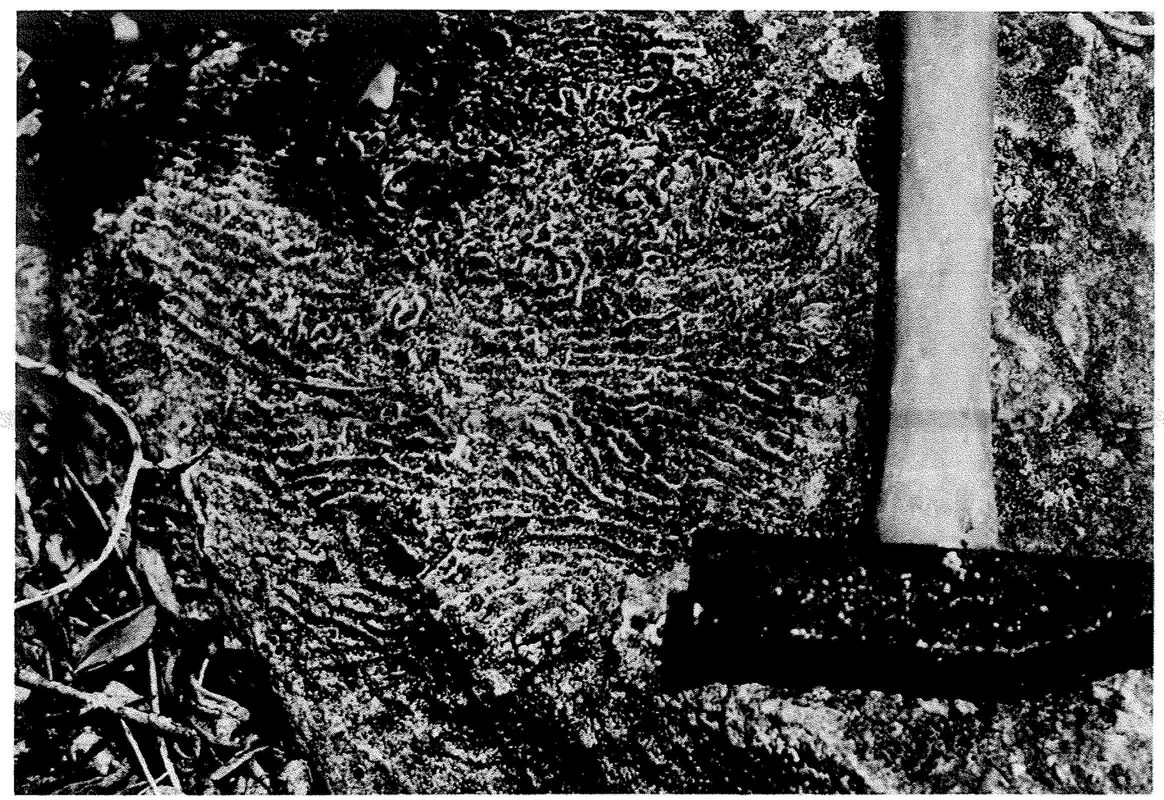


Plate 3 Fossil Diploria: Pelican Point.

Plate 4 Fossil Acropora cervicornis: Pelican Point.

Plate 5 Anegada from East End.

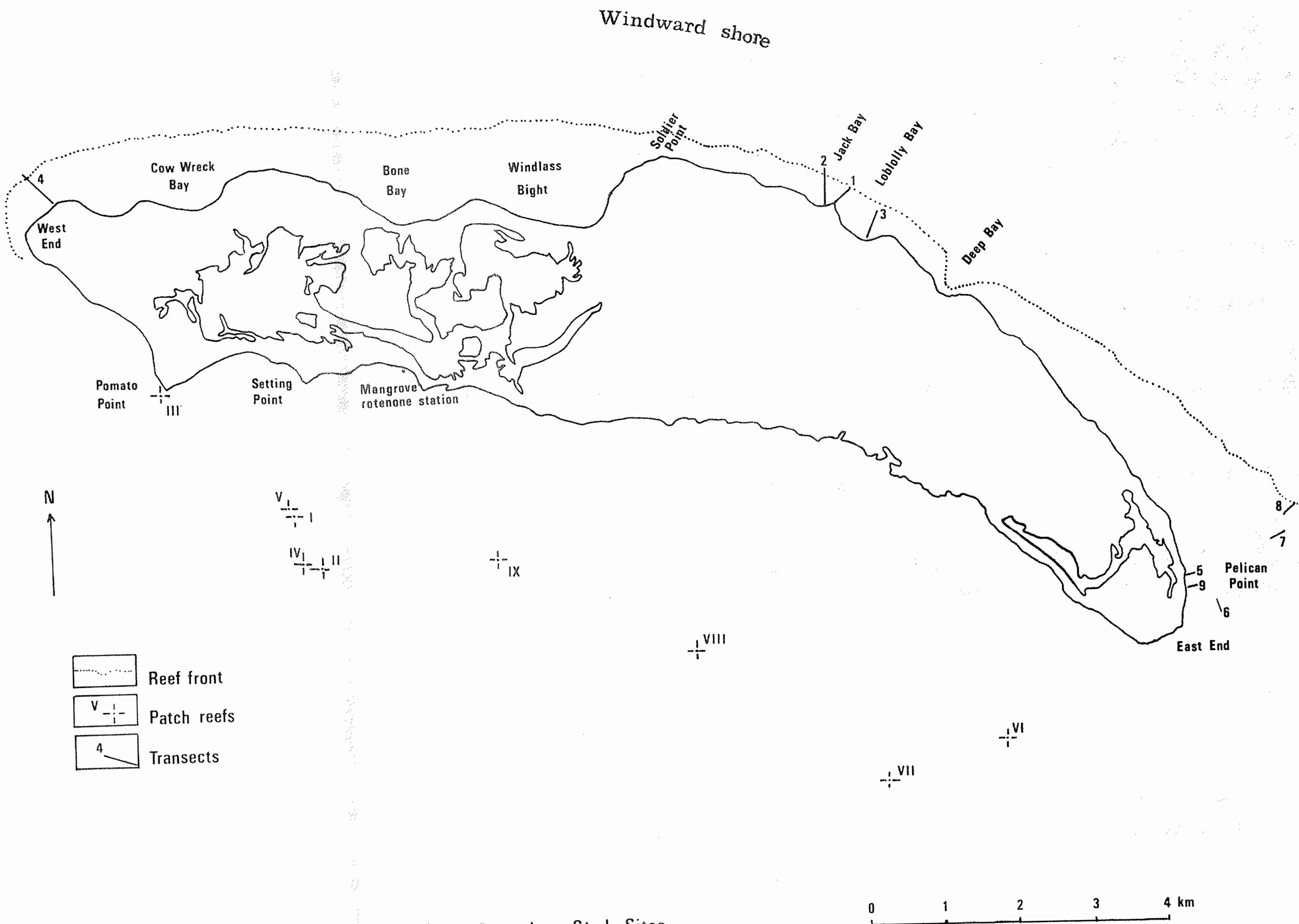


Fig 4 Anegada – Study Sites

TABLE 1 LIST OF CORAL SPECIES AND THEIR ABUNDANCE : ANEGADA, BRITISH VIRGIN ISLANDS.

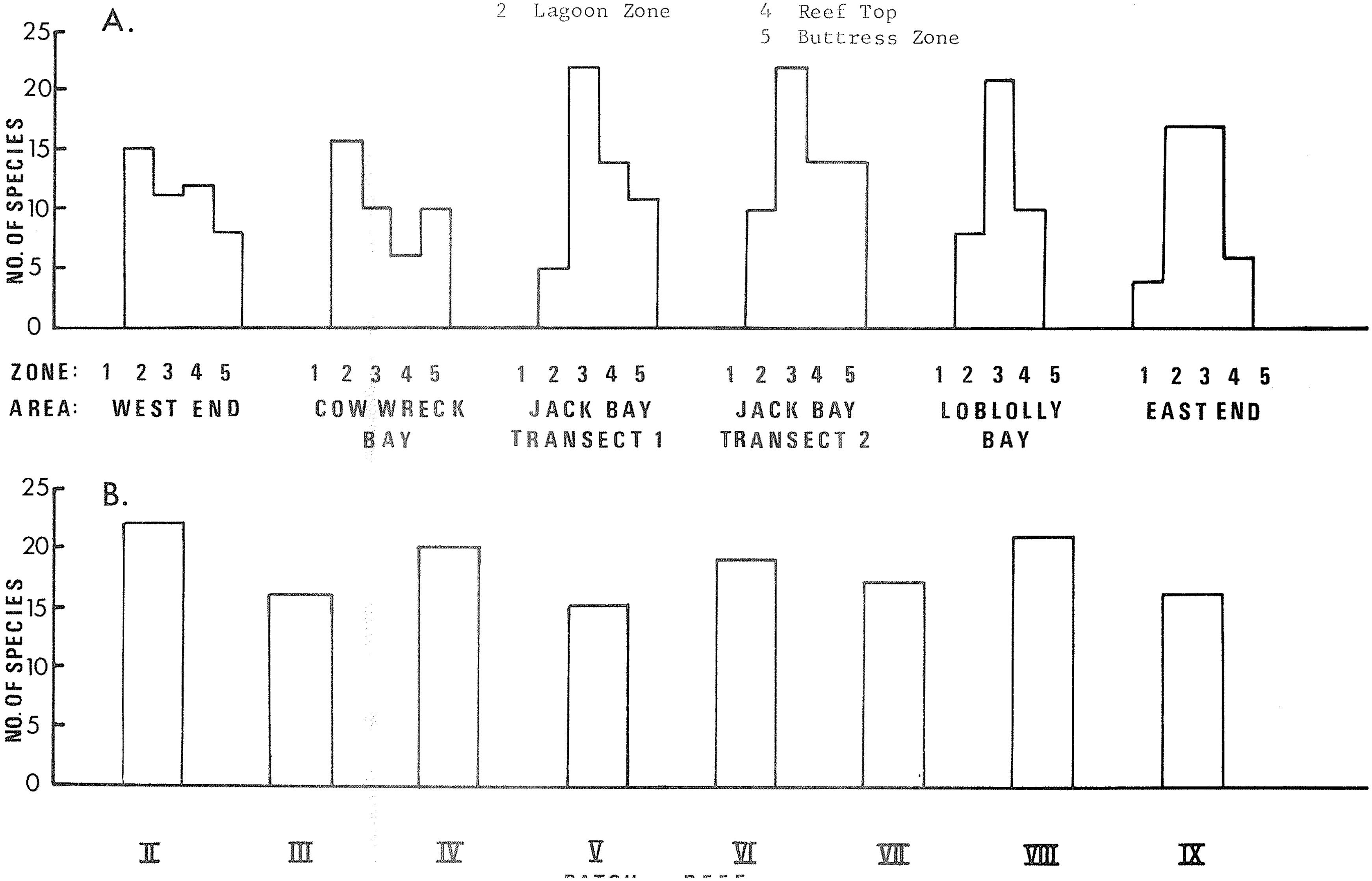
SPECIES	WINDWARD SHORE: WEST END Lagoon	WEST END Rear Zone	WEST END Reef Top	WEST END Buttress	COW WRECK BAY Lagoon	COW WRECK BAY Rear Zone	COW WRECK BAY Reef Top	COW WRECK BAY Buttress	JACK BAY TRANSECT 1 Lagoon	JACK BAY TRANSECT 1 Rear Zone	JACK BAY TRANSECT 1 Reef Top	JACK BAY TRANSECT 1 Buttress	JACK BAY TRANSECT 2 Lagoon	JACK BAY TRANSECT 2 Rear Zone	JACK BAY TRANSECT 2 Reef Top	JACK BAY TRANSECT 2 Buttress	LOBLOLLY BAY Lagoon	LOBLOLLY BAY Rear Zone	LOBLOLLY BAY Reef Top	EAST END Inshore	EAST END Lagoon	EAST END Rear Zone	EAST END Reef Top	LEEWARD SHORE PATCH REEFS II	III	IV	V	VI	VII	VIII	IX
ANTHOZOA SCLERACTINIA																															
ACROPORIDAE																															
Acropora cervicornis										●			●	●				●				●		●		●	●	●	●	●	
Acropora palmata	●		●	●	●		●	●		●	●	●	●	●	●	●		●	●	●	●	●		●	●	●	●	●	●	●	●
Acropora prolifera											●													●		●		●	●	●	●
AGARICIIDAE																															
Agaricia agaricites (var. crassa)	●		●	●	●			●		●	●	●	●	●	●	●		●	●		●	●	●	●	●	●	●	●	●	●	●
Agaricia agaricites (var. fragilis)																●		●						●	●				●	●	
SIDERASTREIDAE																															
Siderastrea radians	●		●	●	●					●	●		●	●	●			●		●	●	●	●	●	●	●		●		●	●
Siderastrea siderea	●		●	●	●			●		●			●	●				●						●	●	●				●	●
PORITIDAE																															
Porites astreoides	●		●		●		●	●		●	●		●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	
Porites porites (var. divaricata)																				●	●										
Porites porites (var. clavaria)	●		●		●		●			●				●	●			●				●	●	●	●	●	●	●	●	●	●
Porites porites (var. furcata)														●										●							
FAVIIDAE																															
Favia fragrum			●		●		●	●		●											●	●		●	●		●				
Diploria clivosa	●		●	●	●		●	●		●	●	●	●	●	●	●		●	●		●	●		●	●	●	●		●	●	●
Diploria strigosa	●		●	●	●			●		●	●	●	●	●	●	●		●	●		●	●	●	●	●	●	●	●	●	●	●
Diploria labyrinthiformis	●									●	●	●		●	●			●					●			●	●	●	●	●	●
Montastrea annularis	●			●	●			●		●	●	●	●	●	●	●		●	●		●	●	●	●	●	●	●	●	●	●	●
Montastrea cavernosa								●		●	●			●	●	●		●						●	●	●	●	●	●	●	●

SPECIES	Windward Shore: West End – Lagoon	West End – Rear Zone	West End – Reef Top	West End – Buttress	Cow Wreck Bay – Lagoon	Cow Wreck Bay – Rear Zone	Cow Wreck Bay – Reef Top	Cow Wreck Bay – Buttress	Jack Bay Transect 1 – Lagoon	Transect 1 – Rear Zone	Transect 1 – Reef Top	Transect 1 – Buttress	Jack Bay Transect 2 – Lagoon	Transect 2 – Rear Zone	Transect 2 – Reef Top	Transect 2 – Buttress	Loblolly Bay – Lagoon	Loblolly Bay – Rear Zone	Loblolly Bay – Reef Top	East End – Inshore	East End – Lagoon	East End – Rear Zone	East End – Reef Top	Leeward Shore: Patch Reefs – II	III	IV	V	VI	VII	VIII	IX
FAVIIDAE cont.																															
Colpophyllia breviserialis																		R													
Colpophyllia amaranthus																								S							
Colpophyllia natans										R		S		S				C				R	R					C	S	C	
Manicina areolata	S													R								R	R			R		C			S
TROCHOSMILIIDAE																															
Dichocoenia stokesii	S		S			C				C	S			S				S	S		S	S	S	S	S	S	S	S	R	R	C
MUSSIDAE																															
Scolymia lacera										R																					
Mussa angulosa																R															
Isophyllastrea rigida					C					S		R	S	S	S	R		S					R		R	S				S	
Isophyllia multiflora					S			R		S	S	R		S		S		C					R	R	R	C		S	R	C	C
Mycetophyllia lamarckana										R								S													
CARIOPHYLLIDAE																															
Eusmilia fastigiata	R				R					S				S				S				R		S			R	S	R	R	
DENDROPHYLLIIDAE																															
Tubastrea coccinea																			R			R	R								
<u>HYDROZOA</u> <u>MILLEPORINA</u>																															
MILLEPORIDAE																															
Millepora alcicornis			R		S					C	S	S		C	C	C							S	C	S	S	S	C	C	S	S
Millepora squarrosa	S		R	R	S		C	A		S	C	C		S	S	S		C	C		S	S	S	C	S	C	C	C	C	C	C
Millepora complanata										S														R							

KEY : Rare (R) Scarce (S) Common (C) Abundant (A)

Fig. 5 Number of coral species recorded on A.) the Windward shore and B.) the Leeward shore of Anegada.

Key: 1 Inshore Zone 3 Rear Reef
2 Lagoon Zone 4 Reef Top
5 Buttress Zone



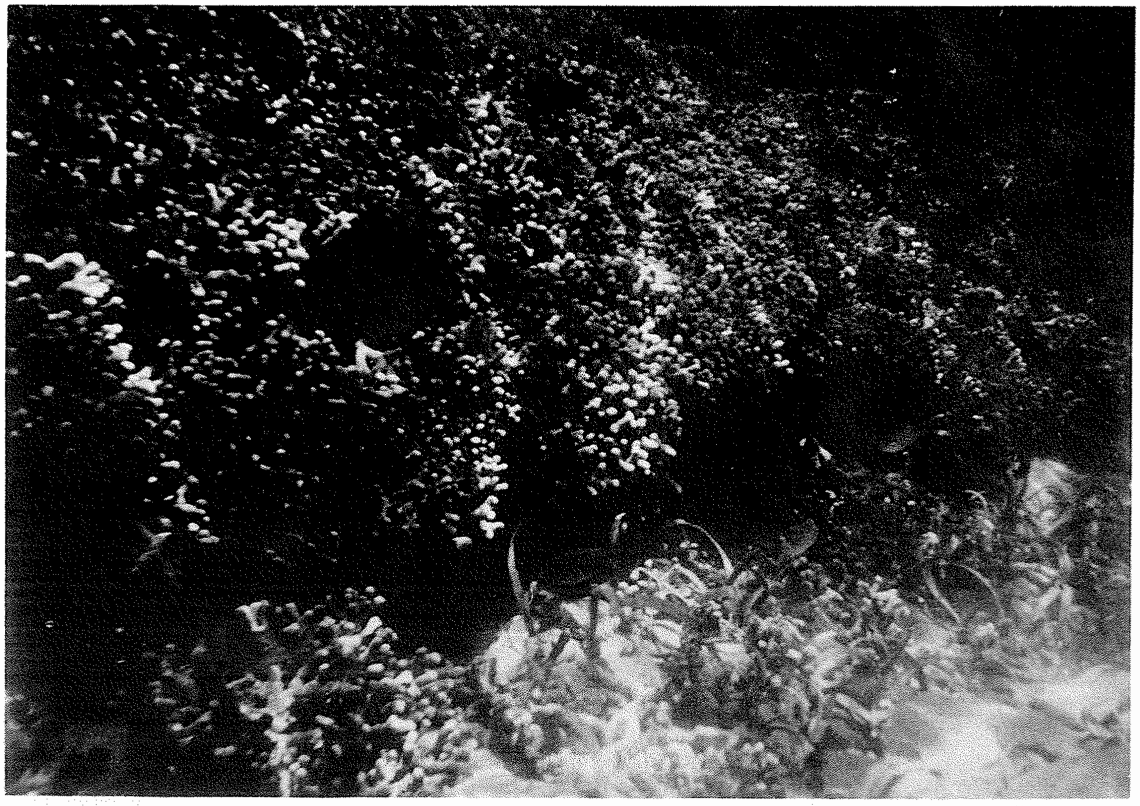


Plate 6 End of inshore transect: Pelican Point. Porites porites var. divaricata.

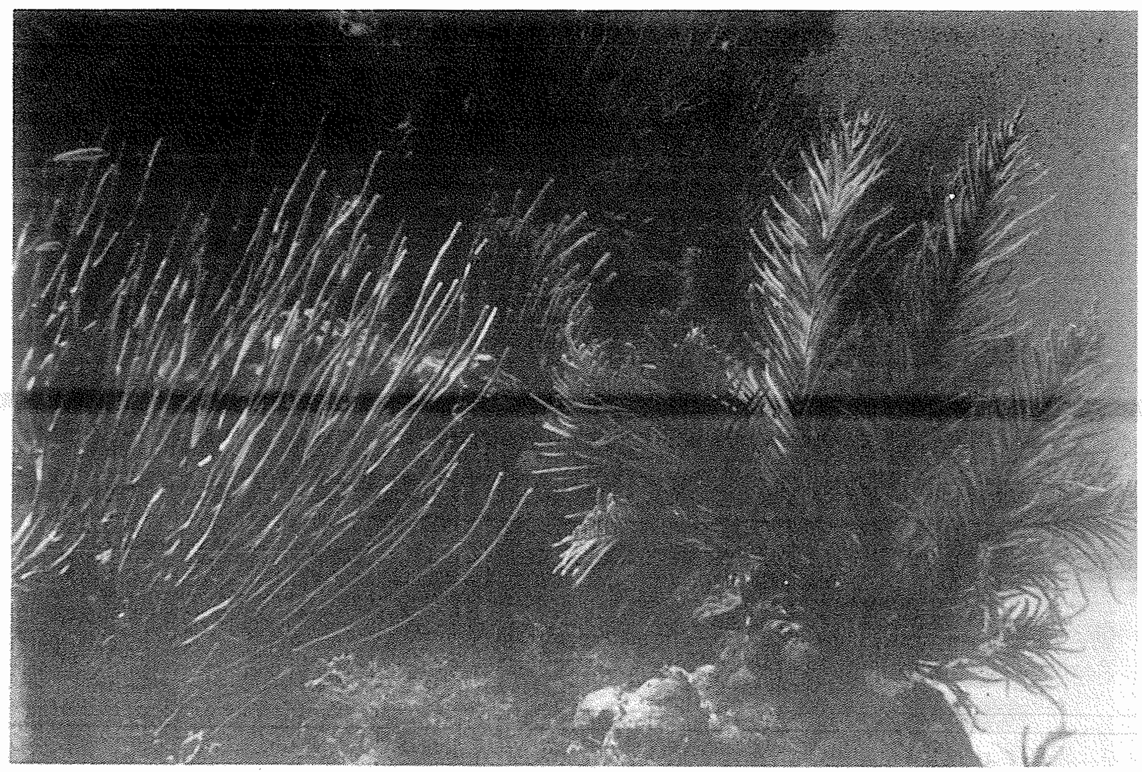


Plate 7 Sea-whips Plexaura spp. and Pseudopteragorgia americana in Jack Bay.

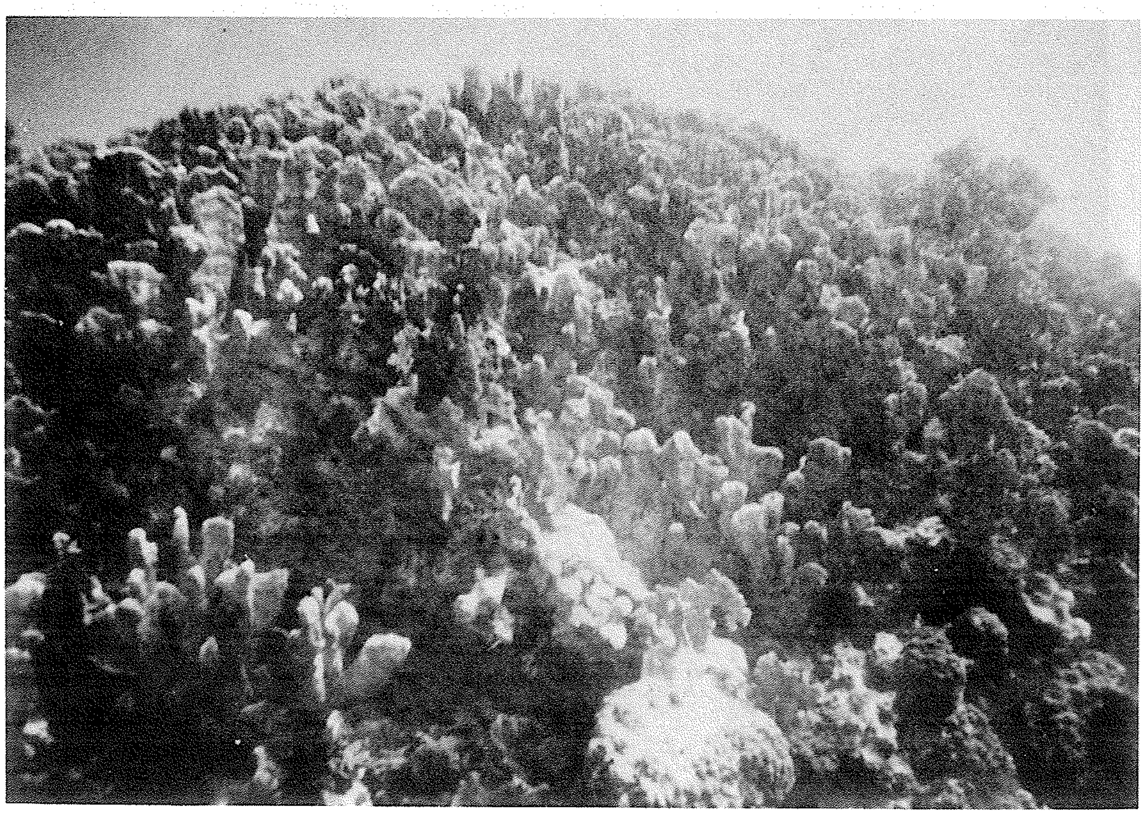


Plate 8 Millepora squarrosa on reef top at East End.

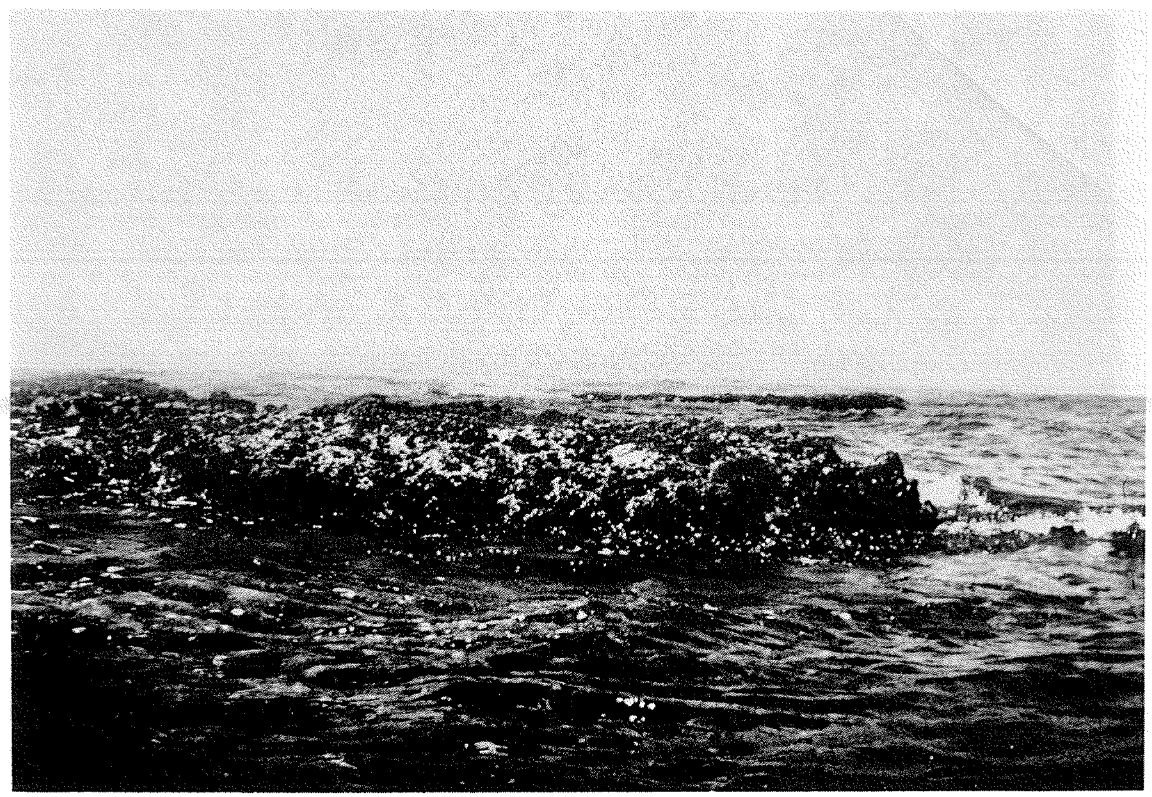


Plate 9 Algal ridges on seaward side of reef at Jack Bay.

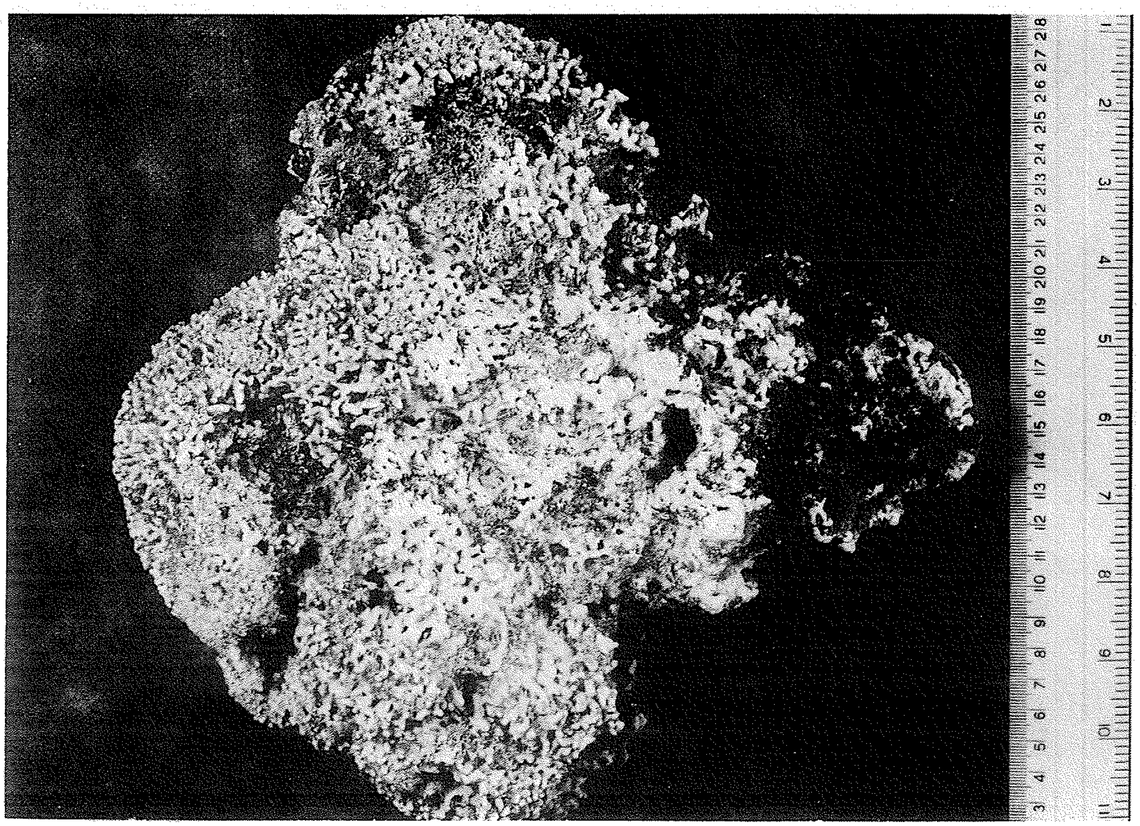


Plate 10 Specimen of algal ridge, Porolitheae.

Plate 11 Extensively bored <u>Acropora palmata</u> on reef top at Jack Bay.

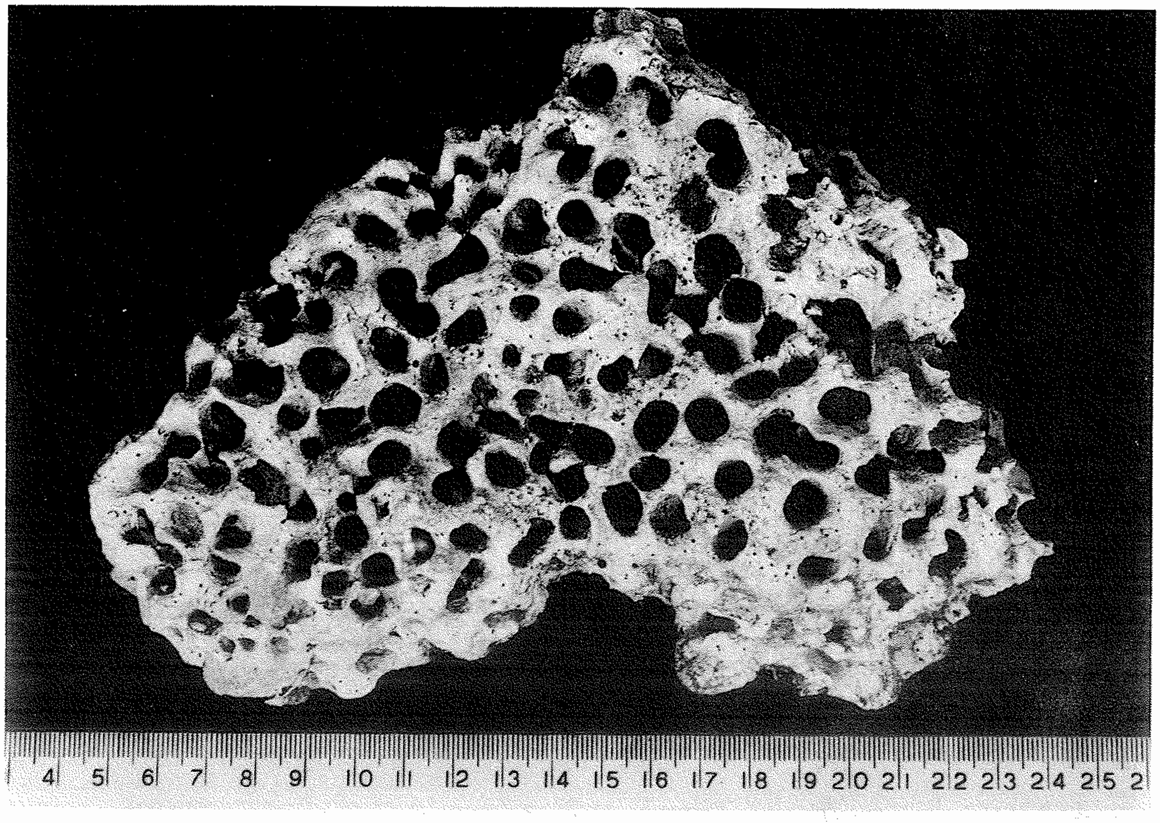


Plate 12 Specimen of bored Acropora palmata.

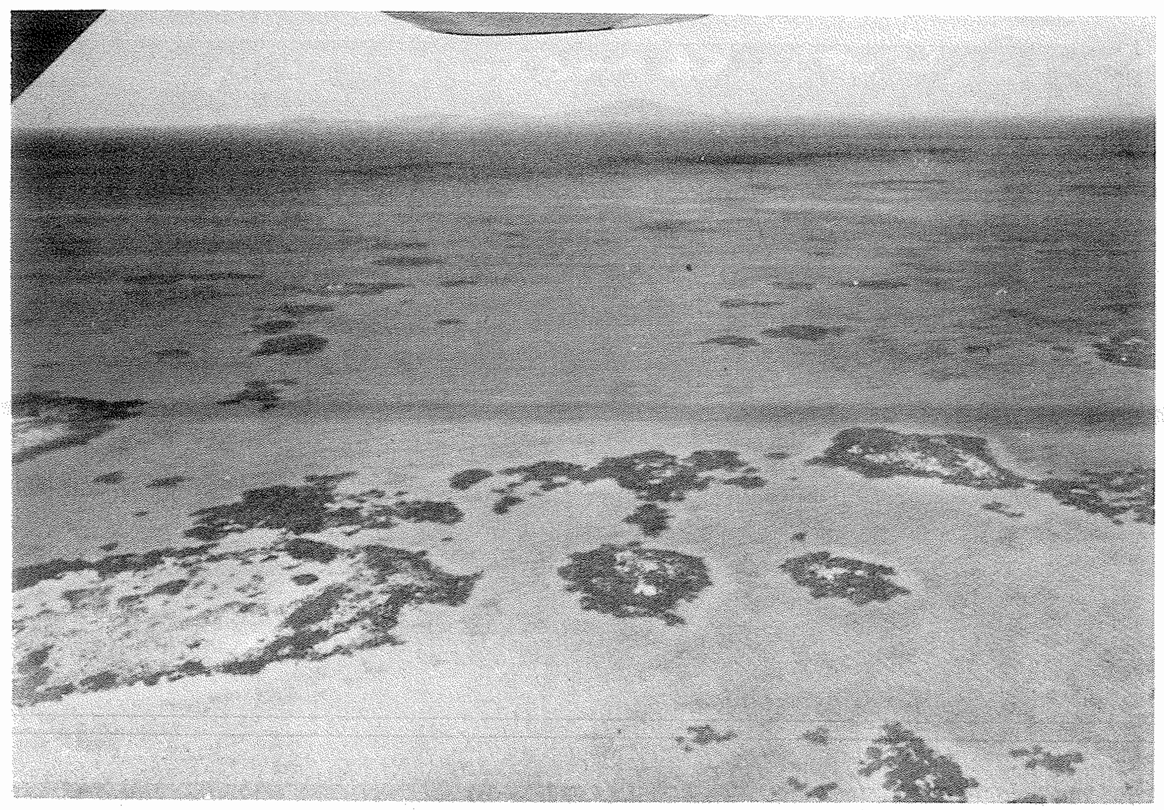


Plate 13 Patch reefs on leeward shore of Anegada (Virgin Gorda can be seen in the background).

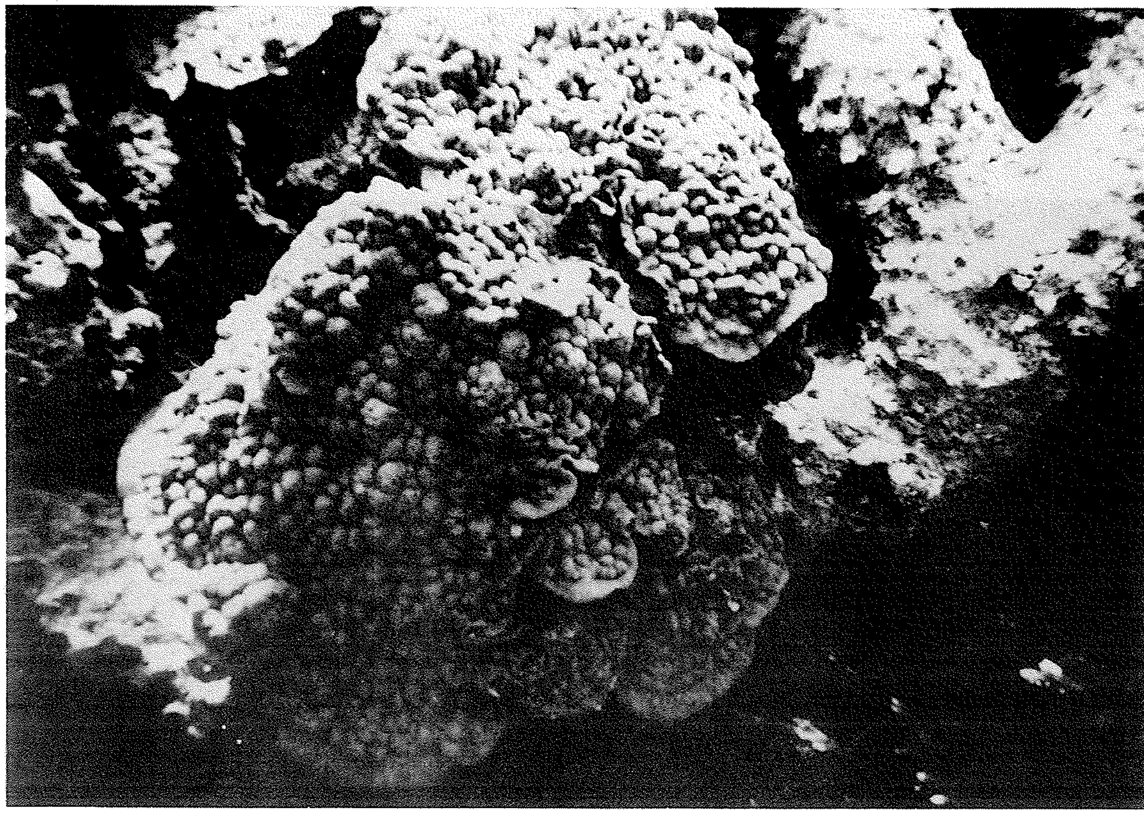


Plate 14 Plate like growth of Porites astreoides.

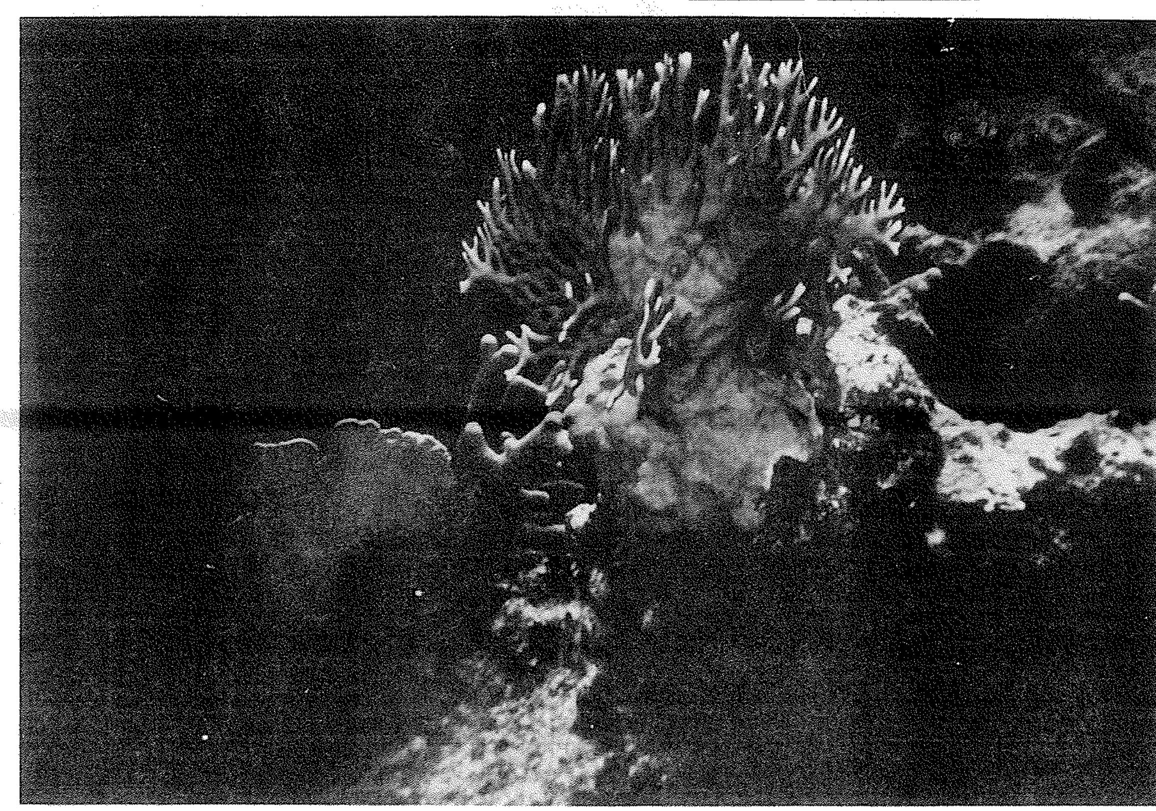


Plate 15 Bladed Millepora complanata and branched alcicornis on Patch Reef II.

Plate 16 Jack and Loblolly Bays; showing position of Transects 1, 2 and 3.

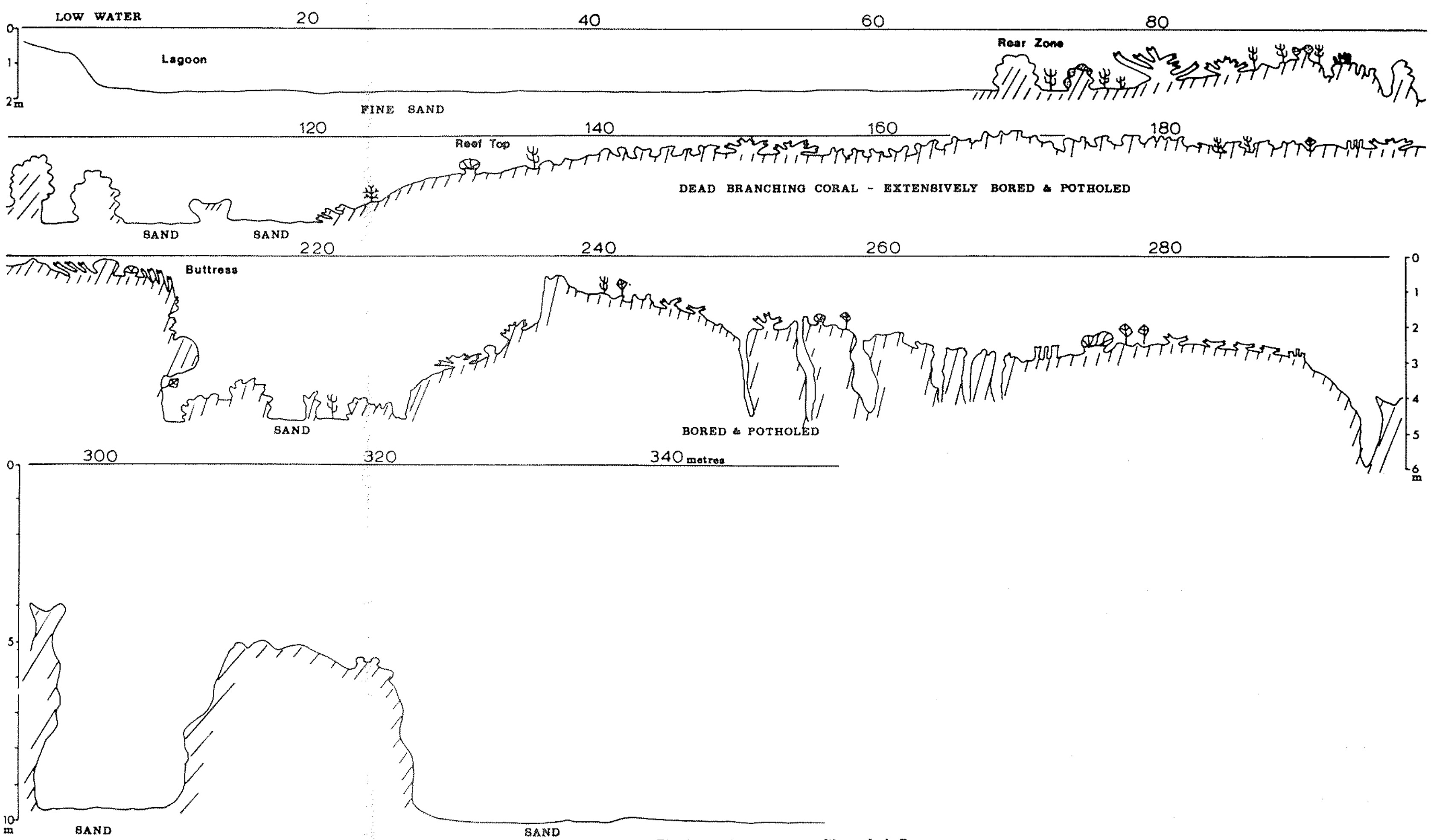


Fig 6 Transect 1 profile : Jack Bay

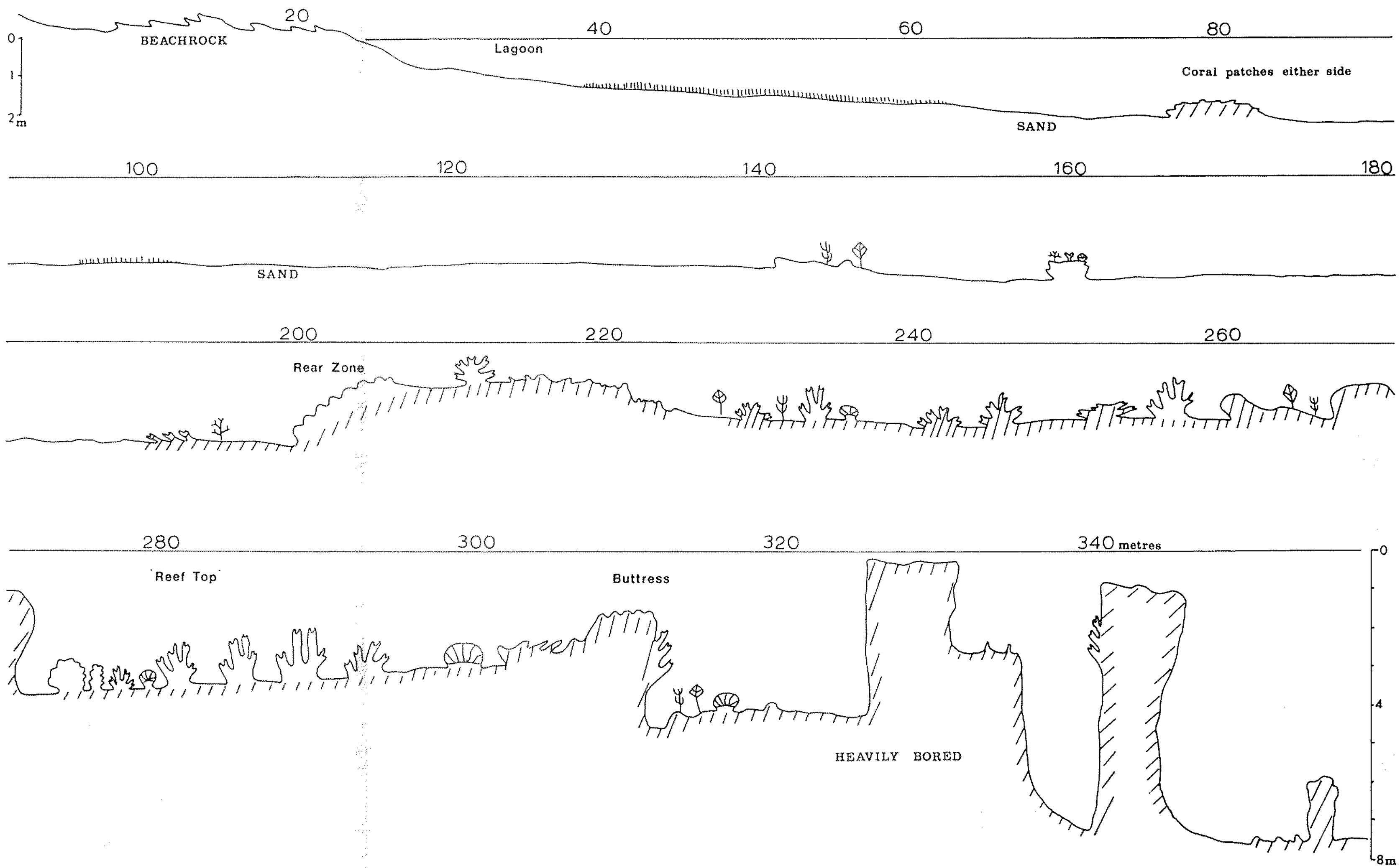


Fig 7 Transect 2 profile : Jack Bay

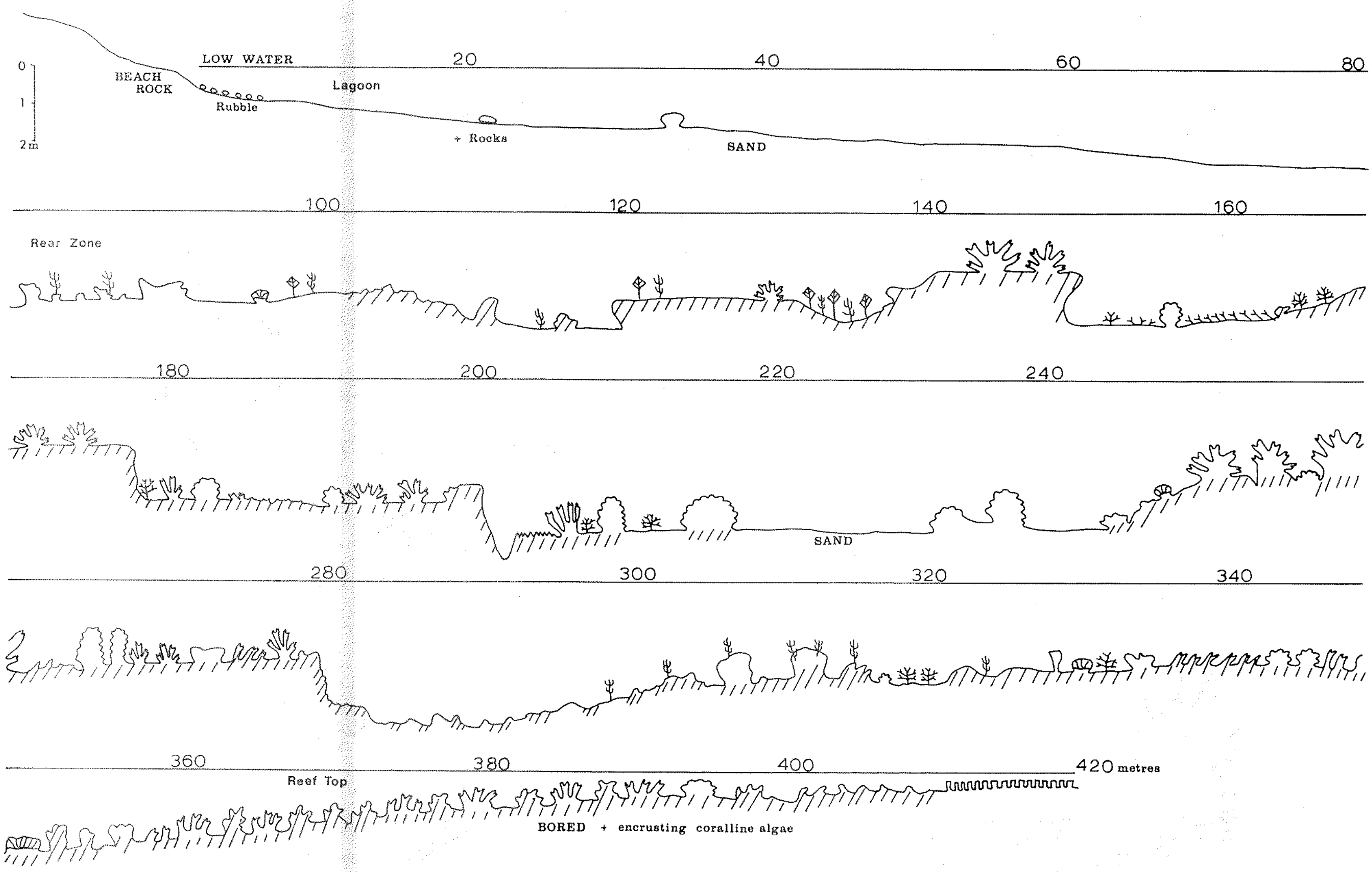


Fig 8 Transect 3 profile : Loblolly Bay

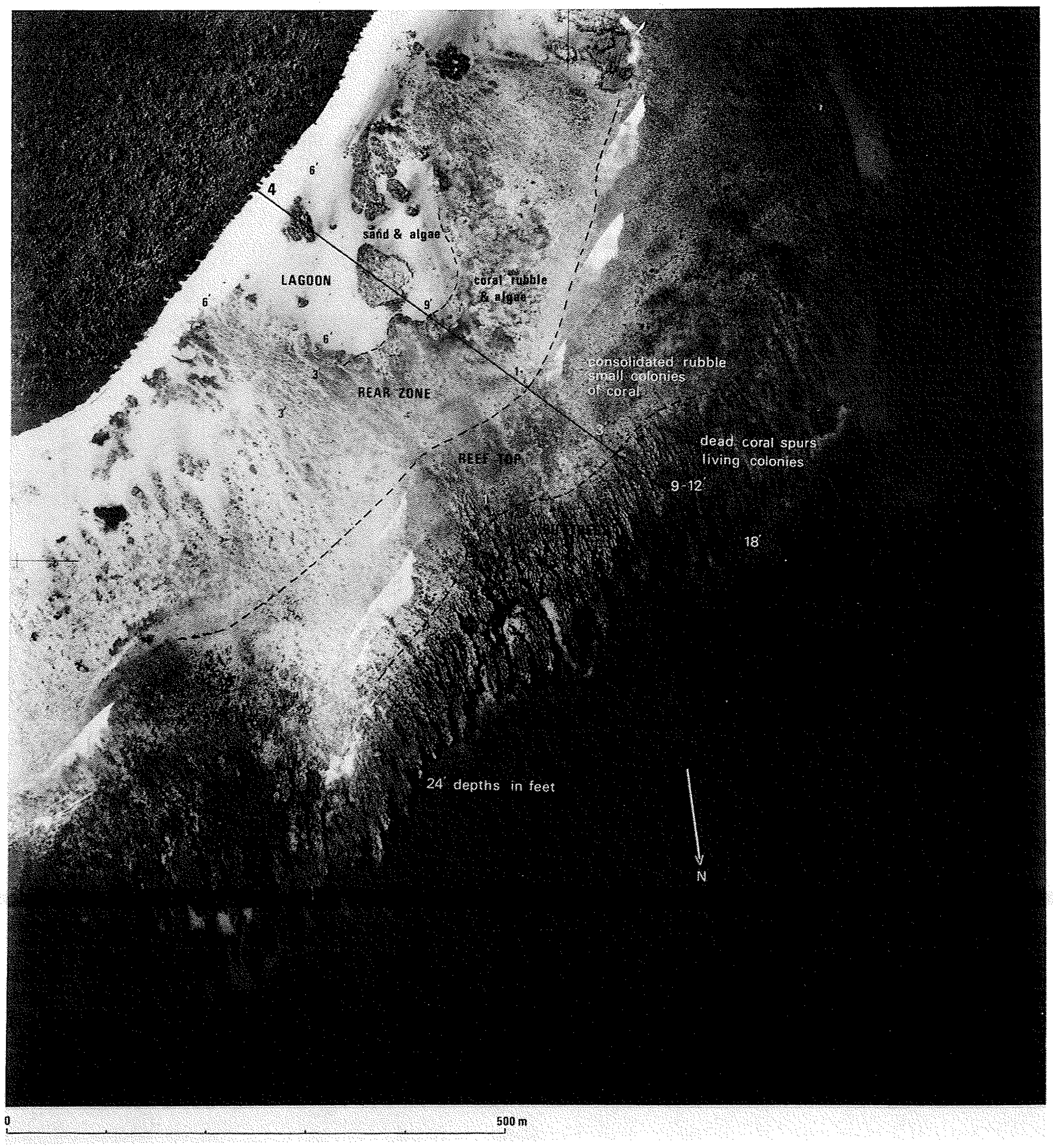


Plate 17 West End; showing position of transect 4.

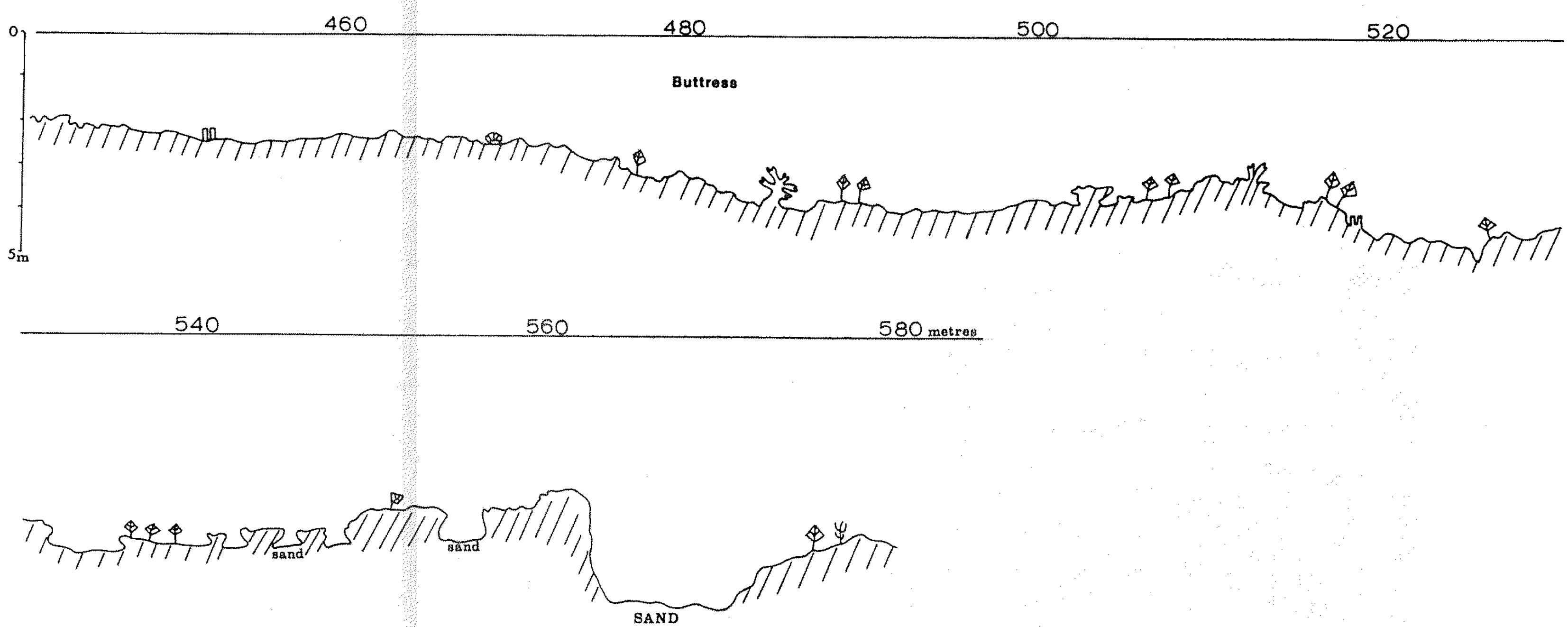


Fig.9 Transect 4 profile : West End

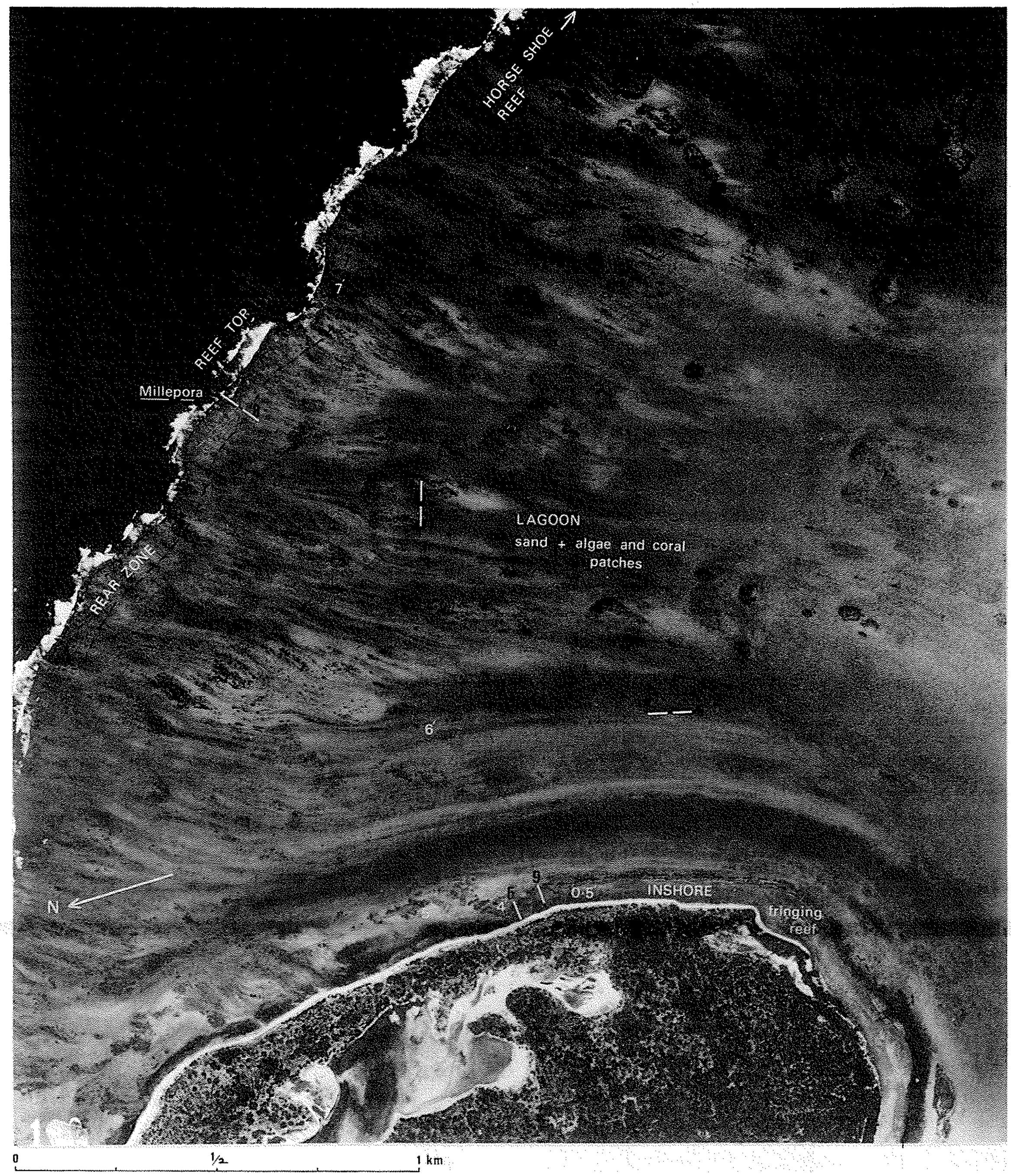


Plate 18 East End; showing position of Transects 5, 6, 7, 8 and 9.

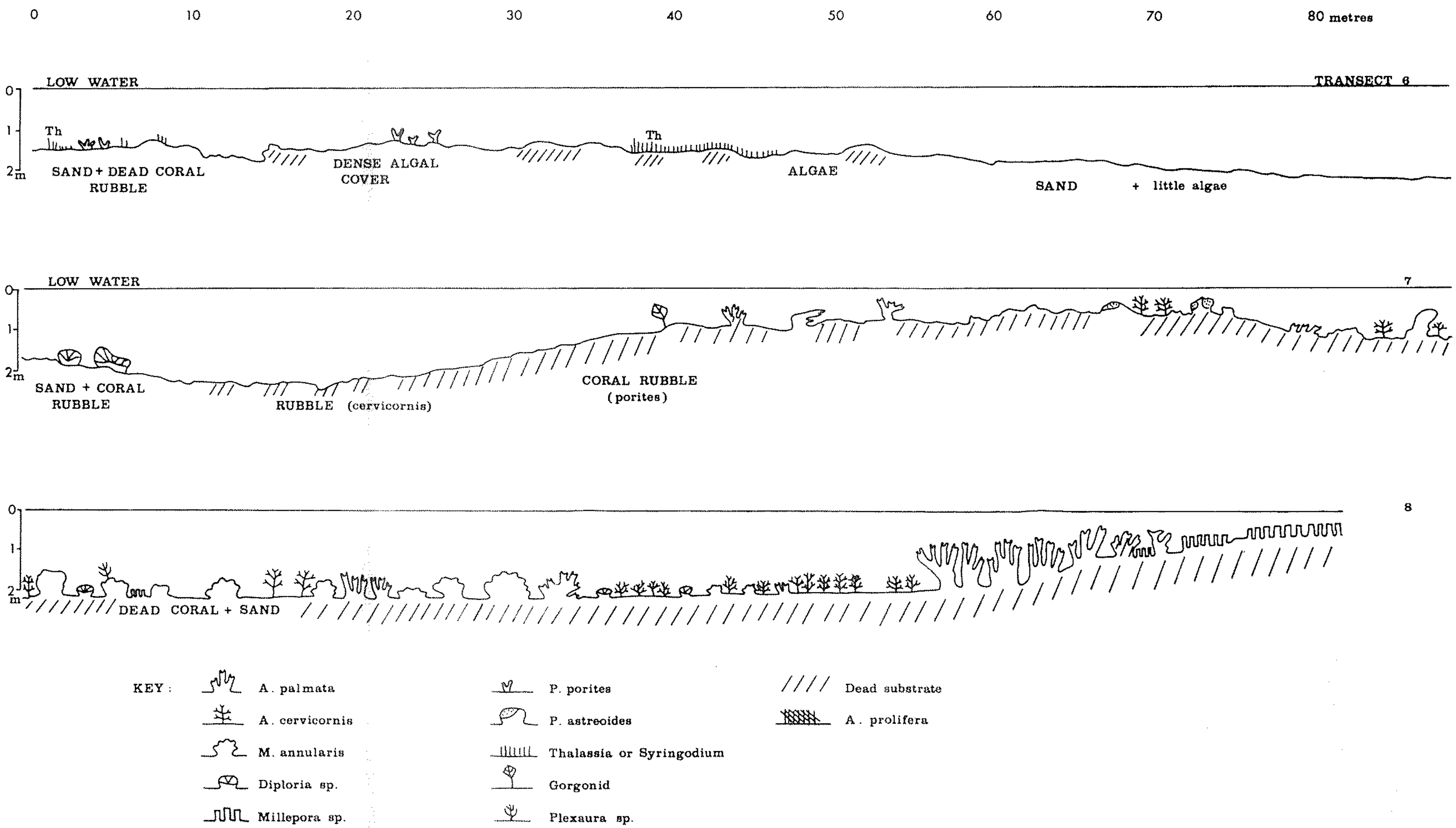


Fig 10 Transect profiles 6, 7 and 8 : Pelican Point, East End

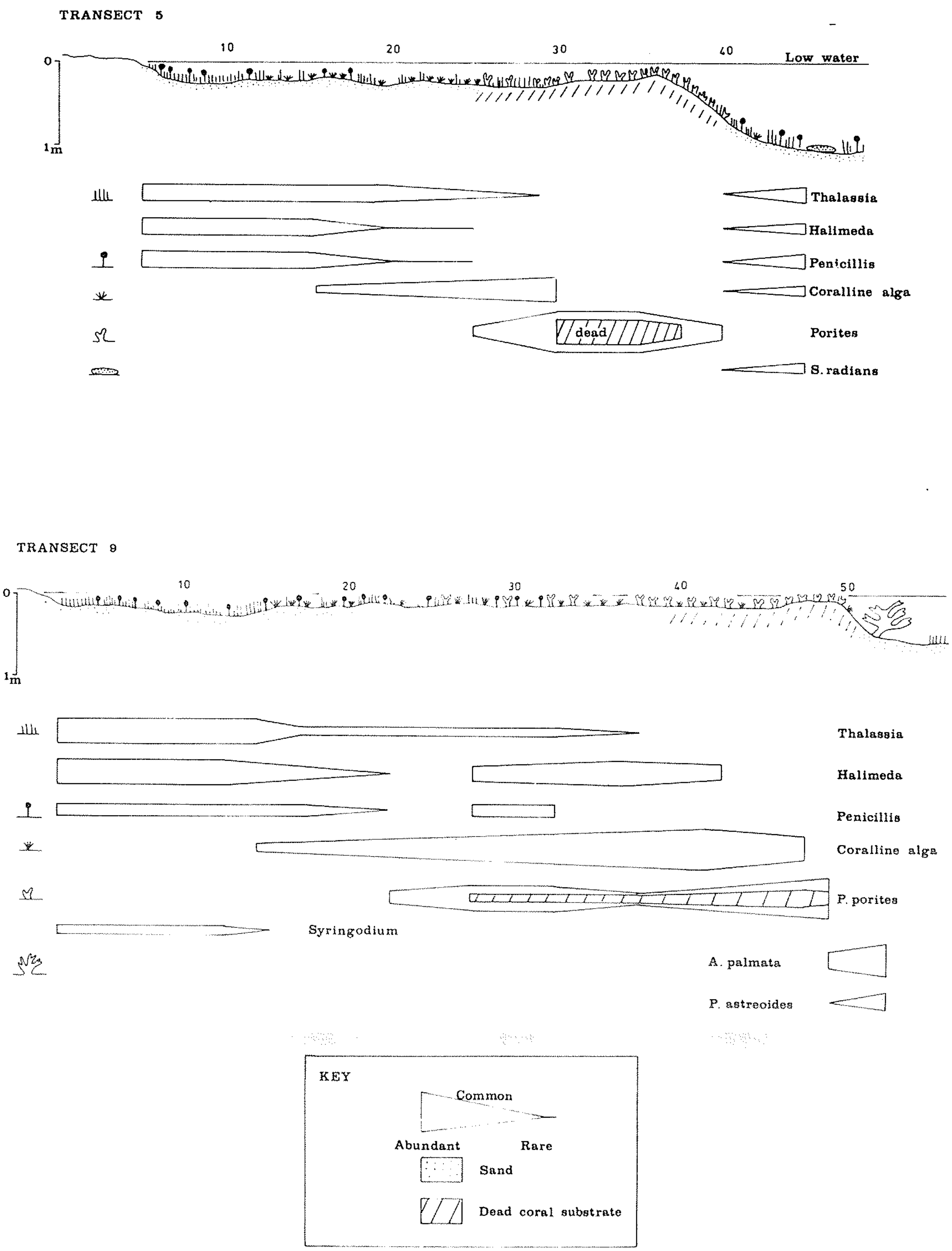


Fig. 11 Profiles of the inshore fringing reef at East End, Anegada, showing zonation and abundance of the dominant species :

SPERMATOPHYTA : Thalassia testudinum, Syringodium filiforme

ALGAE : Penicillis capitatus, Halimeda incrassata

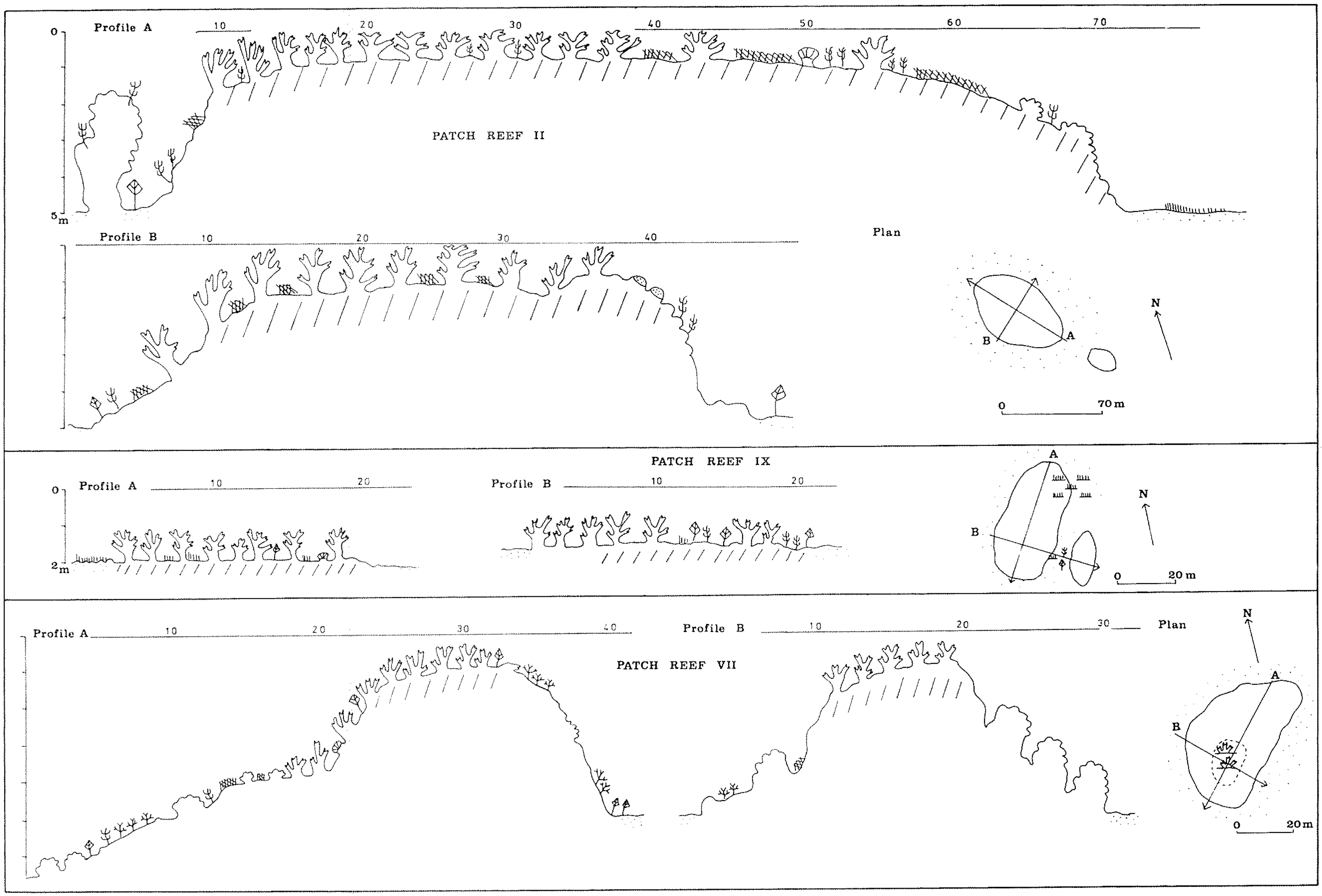
SCLERACTINIA · Acropora palmata, Porites porites var divaricata, Porites astreoides, Siderastrea radians.

Fig 12

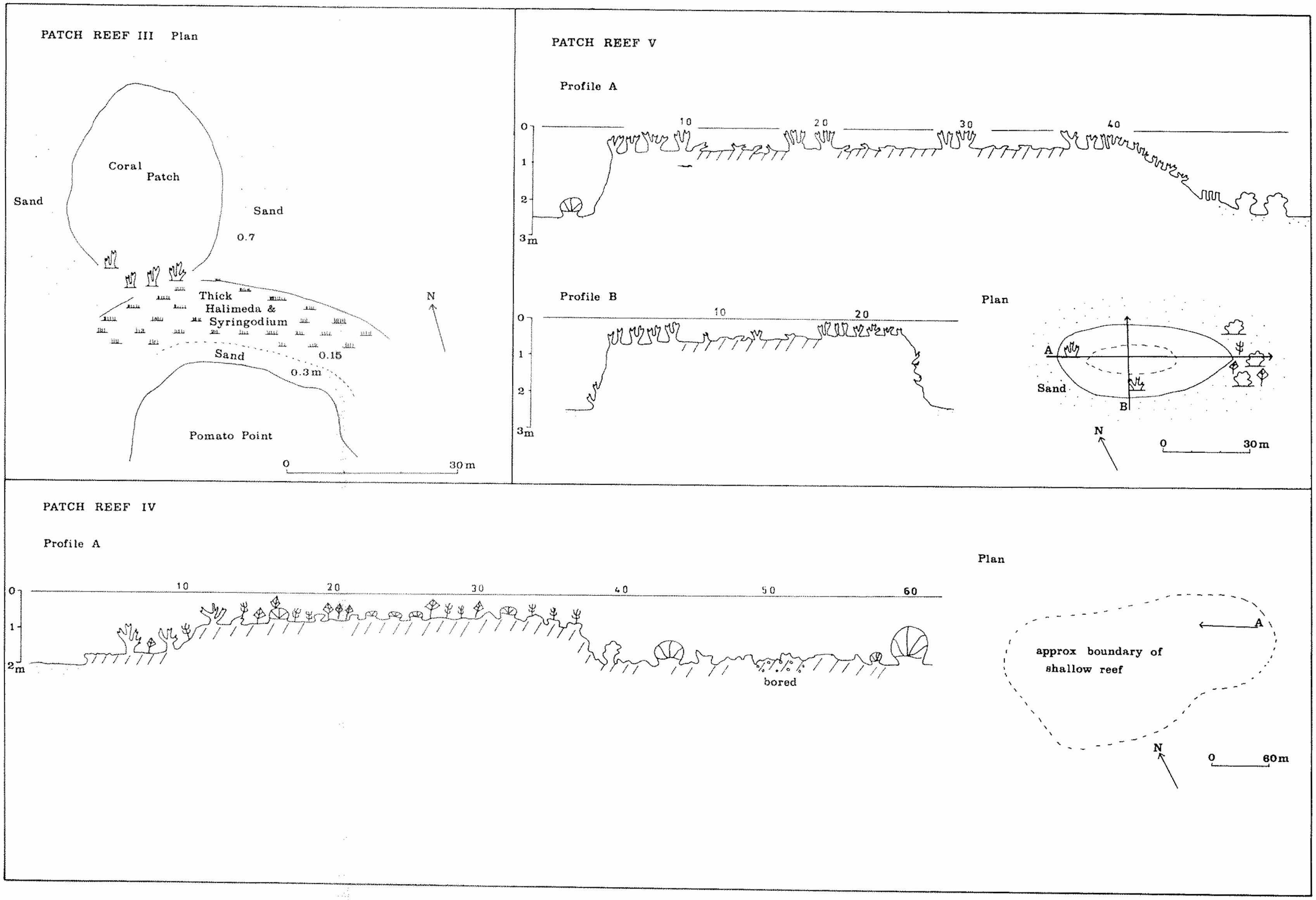
PATCH REEF PROFILES

The profiles are presented in an order corresponding to a geographical distribution running from West to East, see fig.4

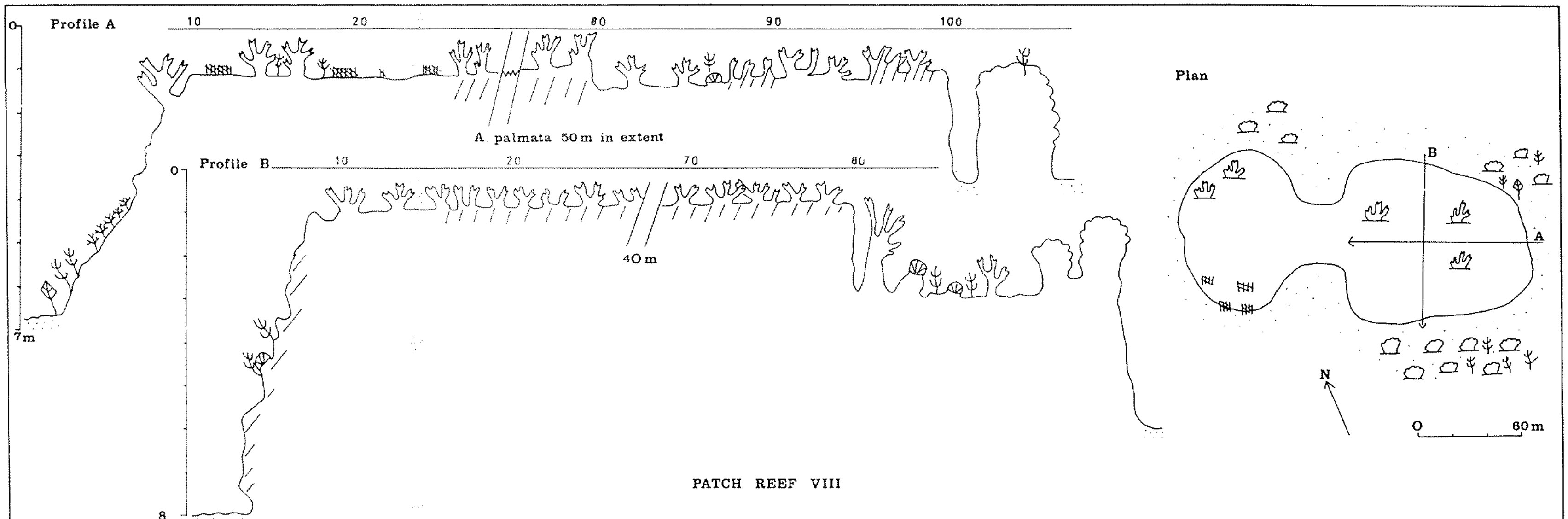
Patch Reef I was only used for a fish rotenone station and is not therefore represented here. Transects were not possible on Patch Reef III due to poor visibility but a plan view is available.



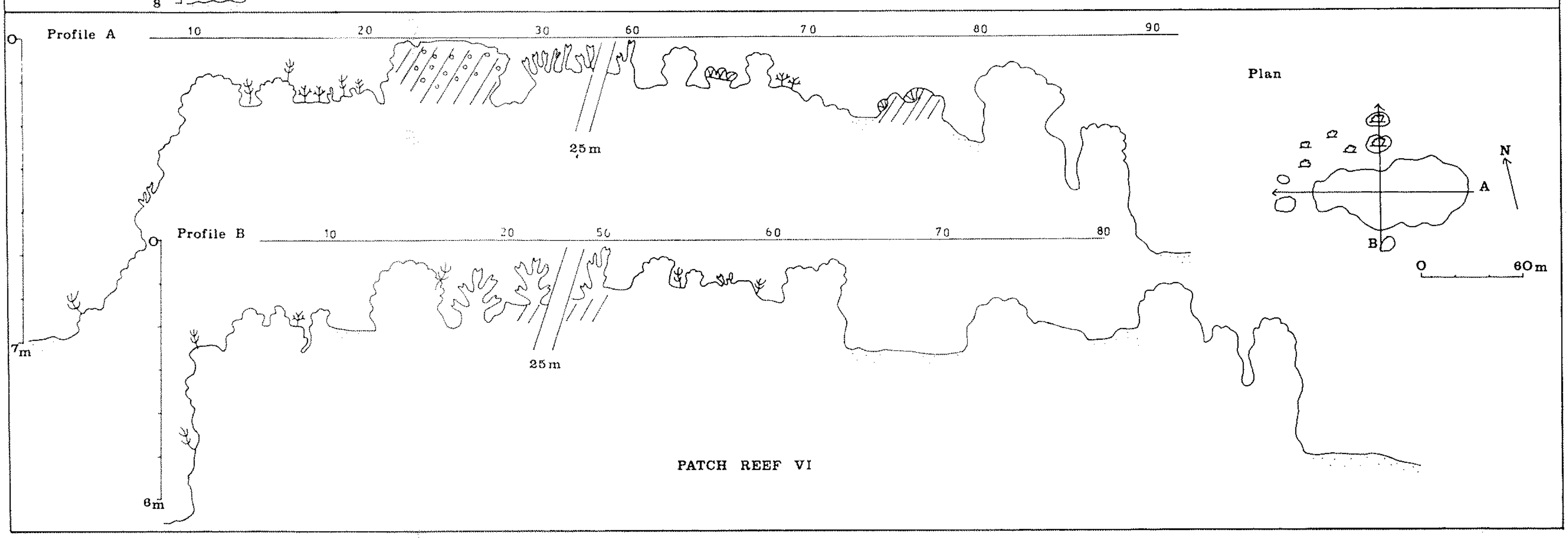
PATCH REEF II
Profile A
0
5 m
10
20
30
40
50
60
70
Profile B
10
20
30
40
Plan
N
A
B
0
70 m
PATCH REEF IX
Profile A
0
2 m
10
20
Profile B
10
20
N
A
B
0
20 m
PATCH REEF VII
Profile A
10
20
30
40
Profile B
10
20
30
Plan
N
A
B
0
20 m



PATCH REEF III Plan
Coral Patch
Sand
Sand
0.7
Thick Halimeda & Syringodium
Sand
0.15
0.3 m
Pomato Point
N
0
30 m
PATCH REEF V
Profile A
0
1
2
3 m
10
20
30
40
Profile B
0
1
2
3 m
10
20
Plan
A
B
Sand
N
0
30 m
PATCH REEF IV
Profile A
0
1
2 m
10
20
30
40
50
60
bored
Plan
A
approx boundary of shallow reef
N
0
60 m



Profile A
10
20
80
90
100
A. palmata 50m in extent
Profile B
10
20
70
80
40 m
Plan
B
A
N
O
60m
0
7m
8
PATCH REEF VIII



Profile A
10
20
30
60
70
80
90
25m
Profile B
10
20
50
60
70
80
25m
Plan
A
B
N
O
60m
7m
6m
PATCH REEF VI

NOTES ON THE ALGAE OF ANEGADA, BRITISH VIRGIN ISLANDS

The marine algae of the Virgin Islands have been extensively studied by Borgesen (1913-20). The most useful recent reviews include the manuals of Taylor (1967) and Chapman (1961, 1963), and both these works have been used in the identification of algae species collected on Anegada. More recently Earle (1972) has listed 154 species of plants from Lameshur Bay, St. John, including 26 species that were new records for the Virgin Islands.

The collection made is not intended as a comprehensive survey of the island's marine algae - only dominant species were collected along the transect lines and therefore the species list (Table 2) is certainly not exhaustive nor complete. A total of 46 species are recorded from 14 families. The data is presented in tabular form so that it can be readily used as both a total species list and for area reference.

Algae were mounted and preserved for taxonomic reference as dried specimens. The collection is now held for reference by the Cambridge Anegada Expedition, c/o Dr. B.E. Brown, Dove Marine Laboratory, University of Newcastle upon Tyne, Cullercoats, Northumberland.

TABLE 2

ALGAE and SPERMATOPHYTAE SPECIES LIST

SPECIES	WEST END	JACK & LOBLOLLY BAY	EAST END	PATCH REEF III	PATCH REEF IX
CHLOROPHYCEAE					
Cladophorales — Family : Cladophoraceae					
Chaetomorpha sp.	–	+	–	–	–
Cladophora crispula Vickers		+			
Siphonocladiales — Family : Dasycladaceae					
Acetabularia crenulata Lamouroux	+				
Family : Valoniaceae					
Dictyosphaeria cavernosa (Forsskål) Børgesen	+		+	+	+
Siphonales — Family : Caulerpaceae					
Caulerpa cupressoides var. mamillosa (Montagne) Weber-van Bosse			+		
Caulerpa sertularioides var. brevipes (J. Agardh) Svedelius			+	+	+
Caulerpa racemosa var. clavifera (Turner) Weber-van Bosse	+				+
Caulerpa racemosa var. occidentalis (J. Agardh) Børgesen				+	
Family : Codiaceae					
Avrainvillea (longicaulis) (Kutzing) Murray and Boodle			+		
Udotea conglutinata (Ellis and Solander) Lamouroux				+	
Udotea flabellum (Ellis and Solander) Lamouroux	+		+	+	
Penicillis capitatus Lamarck	+		+	+	+
Penicillis dumetosus (Lamouroux) Blainville	+			+	
Halimeda opuntia (Linnaeus) Lamouroux	+	+			
Halimeda tuna (Ellis and Solander) Lamouroux				+	
Halimeda incrassata (Ellis) Lamouroux	+		+	+	
Halimeda monile (Ellis and Solander) Lamouroux		+	+	+	
Codium (isthmocladium) Vickers		+			
PHAEOPHYCEAE					
Dictyotales — Family : Dictyotaceae					
Dilophus guineensis (Kützing) J. Agardh		+			
Dictyota dichotoma (Hudson) Lamouroux	+				
Dictyota divaricata Lamouroux	+			+	
Dictyota indica Sonder *in* Kützing			+		
Dictyopteris justii Lamouroux	+				
Dictyopteris delicatula Lamouroux		+			
Stypopodium zonale (Lamouroux) Papenfuss	+				
Lobophora variegata (Lamouroux) Papenfuss	+		+		
Padina sanctae-crucis Børgesen		+			+
Sporochnales — Family : Sporochnaceae					
Sporochnus pedunculatus (Hudson) C. Agardh		+			

ALGAE and SPERMATOPHYTAE SPECIES LIST

SPECIES continued		WEST END	JACK & LOBLOLLY BAY	EAST END	PATCH REEF III	PATCH REEF IX
<u>Fucales</u>	Family : Sargasseae					
Sargassum platycarpum Montagne					+	
Turbinaria tricostata Barton			+	+		
Turbinaria turbinata (Linnaeus) Kuntze		+	+	+		
RHODOPHYCEAE						
<u>Cryptonemiales</u>	Family : Corallinaceae Sub Family : Melobesieae					
Lithothamnion sp.		+	+	+	+	
Lithophyllum sp.		+	+	+	+	
Goniolithon sp.			+	+		
Porolithon sp.			+	+		
Amphiroa fragilissma (Linnaeus) Lamouroux				+		
Amphiroa rigida Lamouroux var. antillaria Børgesen					+	
<u>Gigartinales</u>	Family : Hypneaceae					
Hypnea sp.			+			
	Family : Gracilariaceae					
Gracilaria sp.		+				
<u>Rhodymeniales</u>	Family : Champiaceae					
Coelothrix irregularis (Harvey) Børgesen					+	
<u>Cermiales</u>	Family : Ceramiaceae					
Ceramium nitens (C. Agardh) J. Agardh			+			
Ceramium sp.			+			
	Family : Rhodomelaceae					
Polysiphonia sp.			+			
Bryothamnion triquetrum (Gmelin) Howe		+				
Acanthophora spicifera (Vahl) Børgesen				+		
Laurencia poitei (Lamouroux) Howe		+		+		
SPERMATOPHYTA						
Halophila baillonis Ascherson		+		+		
Syringodium filiforme Kutzing		+		+		
Thalassia testudinum Konig		+		+		

Acknowledgements

We are indebted to Nancy Ogden of the Fairleigh Dickinson West Indies Laboratory at St. Croix, for checking and correcting our identifications of the algae.

REFERENCES

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CORAL REEF FISH OF ANEGADA, BRITISH VIRGIN ISLANDS

The first mention of the abundant fish life around Anegada is that of Schomburgk (1832), but it was not until 1973 that any attempt was made to assess the fisheries and mariculture potential of the island (Iversen et al). During the latter survey a brief dive was carried out on patch reefs off East Point, Anegada and 30 species of reef fish were recorded.

Approximately 185 species (55 families) were recorded in the present survey at sites on both the windward and leeward sides of the island.

METHODS

Collection of information involved firstly, fishwatching to obtain estimates of easily visible fish on the reef; rotenone collections in selected areas to capture cryptic species and thirdly, photography of fish species so collected as a record and aid to later identification.

Fishwatching was carried out at selected sites. These included Jack Bay, Loblolly Bay, West End and East End on the northern shore and nine patch reefs on the southern shore. Brief surveys of Cow Wreck Bay and Bone Bay are also included in the summary of results.

At each site particular habitats were chosen that were representative of features in a zone, e.g., in the lagoon zone at East End such habitats included a sand substrate, a sand and algae region and an inshore fringing reef. Within these areas three pairs of divers would fishwatch for 60 minutes, noting not only the presence of fish species but also their abundance. The following scoring scheme was adopted for the survey:

	Number of individuals
Species allocated	1
to one of 6 groups	2-5
according to numbers	6-10
seen.	11-30
	31-100
	100+

During the 60 minute fishwatch, the first 20 minutes were spent in a general swim of the area; the second and third 20 minute periods were spent examining a relatively small area (approximately 10 m in extent) paying particular attention to cryptic and retiring fish species. Thus a general overall impression of relative abundance in the area was obtained.

Results obtained in the field from each pair of divers appeared to show surprisingly good agreement for each site visited. Note was also made during fishwatches of the presence/absence of juvenile fish and their abundance on the reef.

Several night dives were carried out both on the northern shore and on patch reefs on the leeward shore, in an attempt to describe any changes that might occur in the fish population on the reef after dark.

By assessing abundances in this way, factors such as time of day, state of tide, meterological conditions, etc., are likely to play an important role in determining numbers of fish on the reef at any one time. In this preliminary survey it was impossible to standardise all these factors and this limitation must be borne in mind in interpretation of the final results.

'Rotenone' or fish poison stations were carried out at a limited number of sites according to methods described by Randall (1963). Rotenone is an alkaloid with an empirical formula of $C_{23}H_{22}O_6$ and its effect upon fishes is to cause vasoconstriction of the capillaries of the gills (Hamilton 1941) and hence respiratory impairment. Powdered rotenone, however, has relatively little effect upon invertebrates except the groups Cephalopoda and Turbellaria.

In the present study rotenone was used in the form of derris powder (3-6% rotenone). The powder was mixed with water immediately before use, in the following proportions, for dispersal in approximately 10^3 m^3 seawater:

1.2 Kg derris powder/2.5 litres water

A pair of divers first selected the site of the poison station and then estimated the strength and direction of currents using fluoroscein dye. Appropriate quantities of the poison were released by the divers, and on its dispersal two additional pairs of divers assisted in the collection of fish by netting both on the surface and on the bottom. The specimens were then returned to the boat, moored nearby, where the collection was sorted and fish species placed in appropriate tanks of seawater before immediate return to the field laboratory on completion of the station. Time spent on each site varied between 3-4 hours. At patch reef I, the first poison station attempted, subsequent visits indicated that fish returned to the patch within 24 hours of application and dispersal of the poison.

On return to the laboratory the specimens were prepared for photography, according to methods used by Randall (1961). Each specimen was pinned out in a wax-bottom dissecting dish and the fins fixed in an erect position before applying formalin with a fine paint brush to the fins and other parts of the body such as the gill covers etc. A few minutes later the specimen was removed and covered with a small amount of water in a perspex container - a photographic record was then made. All specimens collected at rotenone or poison stations were weighed (net wt.), measured (standard length) and preserved in 10% formalin.

The fish collection is now housed at the British Museum (Natural History), Cromwell Road, South Kensington, London SW7.

Identification of specimens was made using Bohlke and Chaplin (1968); Randall (1968) and Chaplin and Scott (1972).

OBSERVATIONS

All results are contained in the species list (Table 3) for the island, where abundances are recorded for each habitat visited. Information is based on fishwatches during the day. The key at the end should provide a guide to information on the abundance of juvenile species; specimens collected in rotenone stations, etc.

TABLE 3 LIST OF FISH SPECIES ANEGADA. BRITISH VIRGIN ISLANDS

SPECIES	WEST END					COW WRECK	BONE BAY	JACK BAY				LOBLOLLY			EAST END					LEEWARD SHORE PATCH REEFS								
		A		C	D	D	A	A	B	C	D	A	B	C		A		B	D									
Substrate Type	Sand	Sand + Grass	Coral Patches				Coral Patches	Sand	Palmata	Algal Ridge		Sand	Palmata		Sand	Sand + Algae	Fringing Reef	Palmata		1	2	3	4	5	6	7	8	9
ORECTOLOBIDAE																												
Ginglymostoma cirratum (Bonnaterre) Nurse shark						•	P												•									
CARCHARHINIDAE																												
Carcharhinus springeri (Bigelow and Schroeder) Reef shark							P												•									
Carcharhinus limbatus (Valenciennes) Blacktip shark																			•									
Negaprion brevirostris (Poey) Lemon shark							P												•									
DASYATIDAE																												
Dasyatis americana Hildebrand and Schroeder Southern stingray					•			•				•			•	•					•							
MYLIOBATIDAE																												
Aetobatus narinari (Euphrasen) Spotted Eagle Ray						•				•	•		•						•									
ELOPIDAE																												
Megalops atlantica Valenciennes Tarpon					•																							
CLUPEIDAE																												
Harengula humeralis Cuvier Redear sardine								•							•												•	

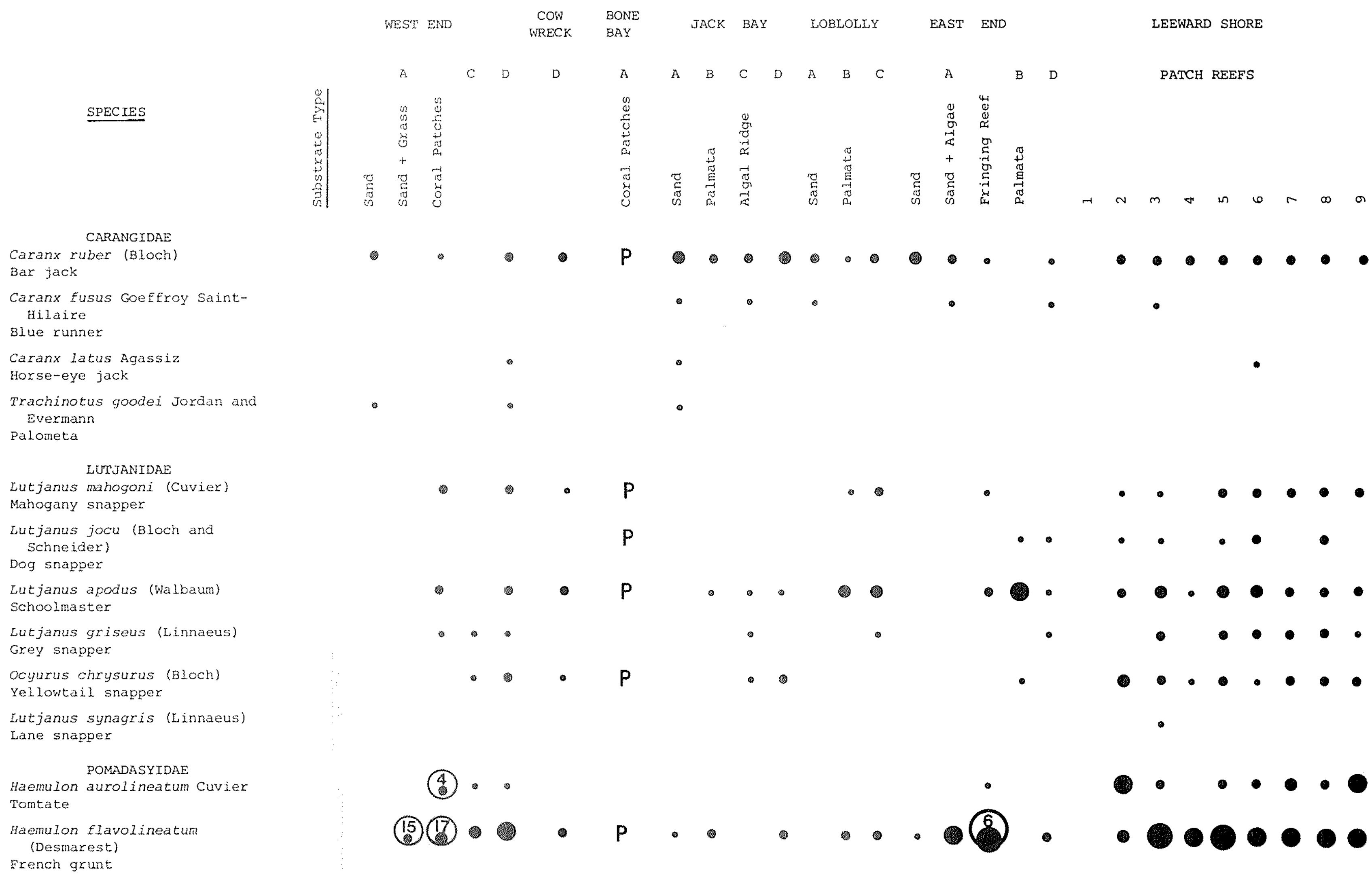
SPECIES	WEST END					COW WRECK	BONE BAY	JACK BAY				LOBLOLLY			EAST END					LEEWARD SHORE PATCH REEFS								
	A			C	D	D	A	A	B	C	D	A	B	C		A		B	D									
Substrate Type	Sand	Sand + Grass	Coral Patches				Coral Patches	Sand	Palmata	Algal Ridge		Sand	Palmata		Sand	Sand + Algae	Fringing Reef	Palmata		1	2	3	4	5	6	7	8	9
SYNODONTIDAE																												
Synodus synodus (Linnaeus) Red Lizardfish											(1)																	
Synodus foetens (Linnaeus) Inshore lizardfish					•										•													
Synodus intermedius (Agassiz) Sand diver	•							●	•	•	•	●	•					•			•		•	•			•	•
Trachinocephalus myops (Forster) Snakefish											(1)																	
MORINGUIDAE																												
Moringua edwardsi (Jordan and Bollman) Spaghetti eel																	(2)											
XENOCONGRIDAE																												
Chilorhinus suensoni Lütken Seagrass eel		(1)																										
Kaupichthys hyoproroides (Strömman) Reef eel																	(2)											
MURAENIDAE																												
Enchelycore sp. Chestnut moray																	(8)											
Gymnothorax funebris Ranzani Green moray																	•											
Gymnothorax moringa (Cuvier) Spotted moray																•	(1)			(1)								
Muraena miliaris (Kaup) Goldentail moray																												
Anarchias yoshiae Kanazawa Pygmy moray																	(6)			(3)								

SPECIES / Substrate Type	WEST END A Sand	WEST END A Sand + Grass	WEST END A Coral Patches	WEST END C	WEST END D	COW WRECK D	BONE BAY A Coral Patches	JACK BAY A Sand	JACK BAY B Palmata	JACK BAY C Algal Ridge	JACK BAY D	LOBLOLLY A Sand	LOBLOLLY B Palmata	LOBLOLLY C	EAST END A Sand	EAST END A Sand + Algae	EAST END A Fringing Reef	EAST END B Palmata	EAST END D	LEEWARD SHORE PATCH REEFS 1	2	3	4	5	6	7	8	9
OPHICHTHIDAE																												
Myrichthys oculatus (Kaup) Goldspotted eel																												
Ahlia egmontis (Jordan) Key worm eel											(1)																	
Myrophis punctatus Lütken Speckled worm eel		(1)																		Also found at mangrove rotenone station								
BELONIDAE																												
Strongylura notata (Poey) Redfin needlefish					●								●	●														
Tylosurus crocodilus (Peron and LeSueur) Houndfish								●															●				●	
Strongylura timucu (Walbaum) Atlantic needlefish																							●					
HEMIRAMPHIDAE																												
Hemiramphus brasiliensis (Linnaeus) Ballyhoo					●											●												
Hyporhamphus unifasciatus (Ranzani) Halfbeak													●						●									
ATHERINIDAE																												
Atherinomorus stipes (Müller and Troschel) Hardhead silverside					●											●											●	
HOLOCENTRIDAE																												
Holocentrus ascensionis (Osbeck) Longjaw squirrelfish			●	●	●		P							●		●	●	●			●	●		●	●			●
Adioryx coruscus (Poey) Reef squirrelfish		(2)	(4)													(1)	●				●	●						●

SPECIES	West End A Sand	West End A Sand + Grass	West End A Coral Patches	West End C	West End D	Cow Wreck D	Bone Bay A Coral Patches	Jack Bay A Sand	Jack Bay B Palmata	Jack Bay C Algal Ridge	Jack Bay D	Loblolly A Sand	Loblolly B Palmata	Loblolly C	East End A Sand	East End A Sand + Algae	East End A Fringing Reef	East End B Palmata	East End D	Leeward Shore Patch Reefs 1	2	3	4	5	6	7	8	9
Adioryx vexillarius (Poey) Dusky squirrelfish			(1) •	•									•				•	•				•			•			•
Plectrypops retrospinis (Guichenot) Cardinal soldierfish											(1)						(48)											
Holocentrus rufus (Walbaum) Squirrelfish	•	(1)	(2) •	•	•	•	P		•		•		•	•		•	(4) •	•	•	(1)	•	•	•	•	•	•	•	•
Myripristis jacobus Cuvier Blackbar soldierfish			(3) •	•	•		P		•		•		•	•			•		•		•	•	•	•	•	•	•	•
BROTULIDAE																												
Ogilbia sp.																				(1)								
OPHIDIIDAE																												
Parophidion schmidti (Woods and Kanazawa) Dusky cusk											(1)																	
AULOSTOMIDAE																												
Aulostomus maculatus Valenciennes Trumpetfish		(1)	•		•		P		•				•	•			•				•	•	•	•	•	•	•	•
SYNGNATHIDAE																												
Corythoichthys brachycephalus (Poey) Crested pipefish	Collected off Setting Point and at mangrove rotenone station																											
Syngnathus dunckeri Metzelaar Pugnose pipefish		(1)																		(1)								
Syngnathus elucens Poey Shortfin pipefish		(1)																										
SPHYRAENIDAE																												
Sphyraena barracuda (Walbaum) Great barracuda	•				•	•	P	•			•			•	•	•			•		•	•	•	•	•	•	•	•
Sphyraena picudilla Poey Southern sennet					•																							

SPECIES	WEST END					COW WRECK	BONE BAY	JACK BAY				LOBLOLLY			EAST END					LEEWARD SHORE PATCH REEFS								
	A	A	A	C	D	D	A	A	B	C	D	A	B	C	A	A	A	B	D									
Substrate Type	Sand	Sand + Grass	Coral Patches				Coral Patches	Sand	Palmata	Algal Ridge		Sand	Palmata		Sand	Sand + Algae	Fringing Reef	Palmata		1	2	3	4	5	6	7	8	9
MUGILIDAE																												
Mugil trichodon Poey Fantail mullet								•																				
BOTHIDAE																												
Bothus lunatus (Linnaeus) Peacock flounder	•			•				•				•			•	•							•					
Bothus ocellatus (Agassiz) Eyed flounder											(1)																	
APOGONIDAE																												
Apogon maculatus (Poey) Flamefish			(1)														(2)			(1)								
Apogon binotatus (Poey) Barred cardinalfish		(1)	(17)																									
Apogon conklini (Silvester) Freckled cardinalfish																	(13)											
Apogon pigmentarius (Poey) Dusky cardinalfish			(20)								(3)																	
Astrapogon stellatus (Cope) Conchfish												P																
SERRANIDAE																												
Cephalopholis fulva (Linnaeus) Coney				•	•	•	P		•	•	•		•	•		•		•	•		•							
Petrometopon cruentatum (Lacépède) Graysby							P																		•			
Serranus tigrinus (Bloch) Harlequin bass																•		•										
Hypoplectrus unicolor (Walbaum) Hamlet			•																•						•		•	
Epinephelus striatus (Bloch) Nassau grouper							P										•	•	•				•		•		•	

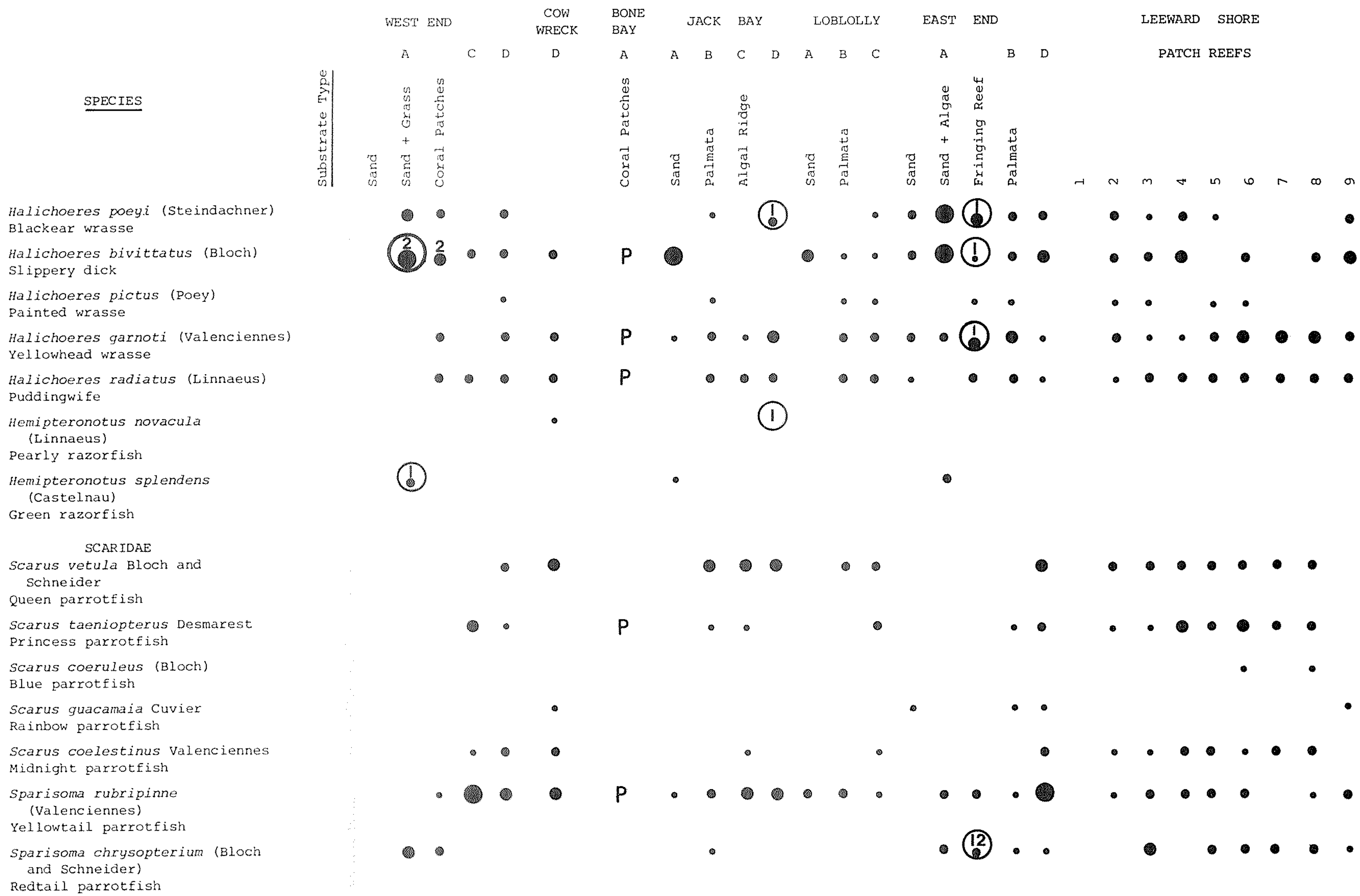
SPECIES	WEST END A Sand	WEST END A Sand + Grass	WEST END A Coral Patches	WEST END C	WEST END D	COW WRECK D	BONE BAY A Coral Patches	JACK BAY A Sand	JACK BAY B Palmata	JACK BAY C Algal Ridge	JACK BAY D	LOBLOLLY A Sand	LOBLOLLY B Palmata	LOBLOLLY C	EAST END A Sand	EAST END A Sand + Algae	EAST END A Fringing Reef	EAST END B Palmata	EAST END D	LEEWARD SHORE PATCH REEFS 1	2	3	4	5	6	7	8	9
Epinephelus adscensionis (Osbeck) Rock hind											●								●				●	●	●	●	●	
Epinephelus guttatus (Linnaeus) Red hind		(1)	●						●				●		●	●	(2)				●	●			●	●	●	●
Mycteroperca bonaci (Poey) Black grouper					●						●								●									
Chorististium rubre (Poey) Swissguard basslet											●																	
GRAMMISTIDAE																												
Pseudogramma bermudensis (Kanazawa) Foureye basslet																	(1)											
GRAMMIDAE																												
Gramma loreto Poey Fairy basslet			(2)		●									●				●	●		●				●	●	●	●
PRIACANTHIDAE																												
Priacanthus cruentatus (Lacépède) Glasseye snapper			●	●	●	●								●							●	●	●	●	●			●
Priacanthus arenatus Cuvier Bigeye					●				●																			
PEMPHERIDAE																												
Pempheris schomburgki Müller and Troscel Glassy sweeper																		●										
BRANCHIOSTEGIDAE																												
Malacanthus plumieri (Bloch) Sand tilefish					●			●							●					(1)					●			


WEST END
COW WRECK
BONE BAY
JACK BAY
LOBLOLLY
EAST END
LEEWARD SHORE
A C D
D
A
A B C D
A B C
A B D
PATCH REEFS
SPECIES
Substrate Type
Sand
Sand + Grass
Coral Patches
Coral Patches
Sand
Palmata
Algal Ridge
Sand
Palmata
Sand
Sand + Algae
Fringing Reef
Palmata
1 2 3 4 5 6 7 8 9
CARANGIDAE
Caranx ruber (Bloch)
Bar jack
Caranx fusus Geoffroy Saint-Hilaire
Blue runner
Caranx latus Agassiz
Horse-eye jack
Trachinotus goodei Jordan and Evermann
Palometa
LUTJANIDAE
Lutjanus mahogoni (Cuvier)
Mahogany snapper
Lutjanus jocu (Bloch and Schneider)
Dog snapper
Lutjanus apodus (Walbaum)
Schoolmaster
Lutjanus griseus (Linnaeus)
Grey snapper
Ocyurus chrysurus (Bloch)
Yellowtail snapper
Lutjanus synagris (Linnaeus)
Lane snapper
POMADASYIDAE
Haemulon aurolineatum Cuvier
Tomtate
Haemulon flavolineatum (Desmarest)
French grunt
P
4
15
17
6

SPECIES	West End A Sand	West End A Sand + Grass	West End A Coral Patches	West End C	West End D	Cow Wreck D	Bone Bay A Coral Patches	Jack Bay A Sand	Jack Bay B Palmata	Jack Bay C Algal Ridge	Jack Bay D	Loblolly A Sand	Loblolly B Palmata	Loblolly C	East End A Sand	East End A Sand + Algae	East End A Fringing Reef	East End B Palmata	East End D	Leeward Shore Patch Reefs 1	2	3	4	5	6	7	8	9
Haemulon album Cuvier Margate																					●		●		●			
Haemulon chrysargyreum Gunther Smallmouth grunt			●	●		●			●					●		●						●	●					
Haemulon plumieri (Lacépède) White grunt			●	●																	●	●		●	●	●	●	●
Haemulon carbonarium Poey Caesar grunt													●	●								●						
Haemulon sciurus (Shaw) Bluestriped grunt			●	●	●		P		●	●			●	●		●	③		●		●	●	●	●	●	●	●	●
Anisotremus virginicus (Linnaeus) Porkfish					●																	●		●	●			
Anisotremus surinamensis (Bloch) Black margate					●						●										●							
Haemulon macrostomum Gunther Spanish grunt						●															●	●		●			●	
SPARIDAE																												
Calamus bajonado (Bloch and Schneider) Jolthead porgy				●				●		●		●	●										●					●
GERREIDAE																												
Gerres cinereus (Walbaum) Yellowfin mojarra				●	●	●		●	●	●		●	●					●					●	●	●		●	●
Eucinostomus gula (Quoy and Gaimard) Silver jenny	Collected at mangrove rotenone station																											
Eucinostomus jonesii Günther Slender mojarra	●																											
Eucinostomus argenteus Baird and Girard Spotfin mojarra							P	●			●										●							

SPECIES	WEST END A Sand	WEST END A Sand + Grass	WEST END A Coral Patches	WEST END C	WEST END D	COW WRECK D	BONE BAY A Coral Patches	JACK BAY A Sand	JACK BAY B Palmata	JACK BAY C Algal Ridge	JACK BAY D	LOBLOLLY A Sand	LOBLOLLY B Palmata	LOBLOLLY C	EAST END Sand	EAST END A Sand + Algae	EAST END Fringing Reef	EAST END B Palmata	EAST END D	LEEWARD SHORE PATCH REEFS 1	2	3	4	5	6	7	8	9
SCIAENIDAE																												
Equetus punctatus (Bloch and Schneider) Spotted drum							P																					●
MULLIDAE																												
Mulloidichthys martinicus (Cuvier) Yellow goatfish	●		(I)		●	●	P	●		●		●	●	●	●		●	●	●		●	●	●	●	●	●	●	●
Pseudupeneus maculatus (Bloch) Spotted goatfish	●	●	●	●	●	●					●	●					●				●	●	●		●	●	●	●
KYPHOSIDAE																												
Kyphosus sectatrix (Linnaeus) Bermuda chub				●	●	●	P		●	●	●		●	●				●	●			●	●	●	●		●	●
EPHIPPIDAE																												
Chaetodipterus faber (Broussonet) Atlantic spadefish					●																	●						
CHAETODONTIDAE																												
Holacanthus tricolor (Bloch) Rock beauty			●	●	●	●	P		●	●			●	●				●	●						●		●	
Holacanthus ciliaris (Linnaeus) Queen angelfish																			●	(I)		●	●	●	●	●	●	●
Pomacanthus paru (Bloch) French angelfish						●				●			●	●					●			●		●			●	
Pomacanthus arcuatus (Linnaeus) Grey angelfish																					●		●				●	
Chaetodon capistratus (Linnaeus) Foureye butterflyfish			●	●	●					●			●	●		●	(I)				●	●	●	●	●	●	●	●
Chaetodon striatus Linnaeus Banded butterflyfish		●	●	●	●				●	●	●				●	●	●	●			●	●	●	●	●	●	●	●
POMACENTRIDAE																												
Microspathodon chrysurus (Cuvier) Yellowtail damselfish			●	●	●	●	P		●	●	●		●	●	●	●	●	●	●		●	●	●	●	●	●	●	

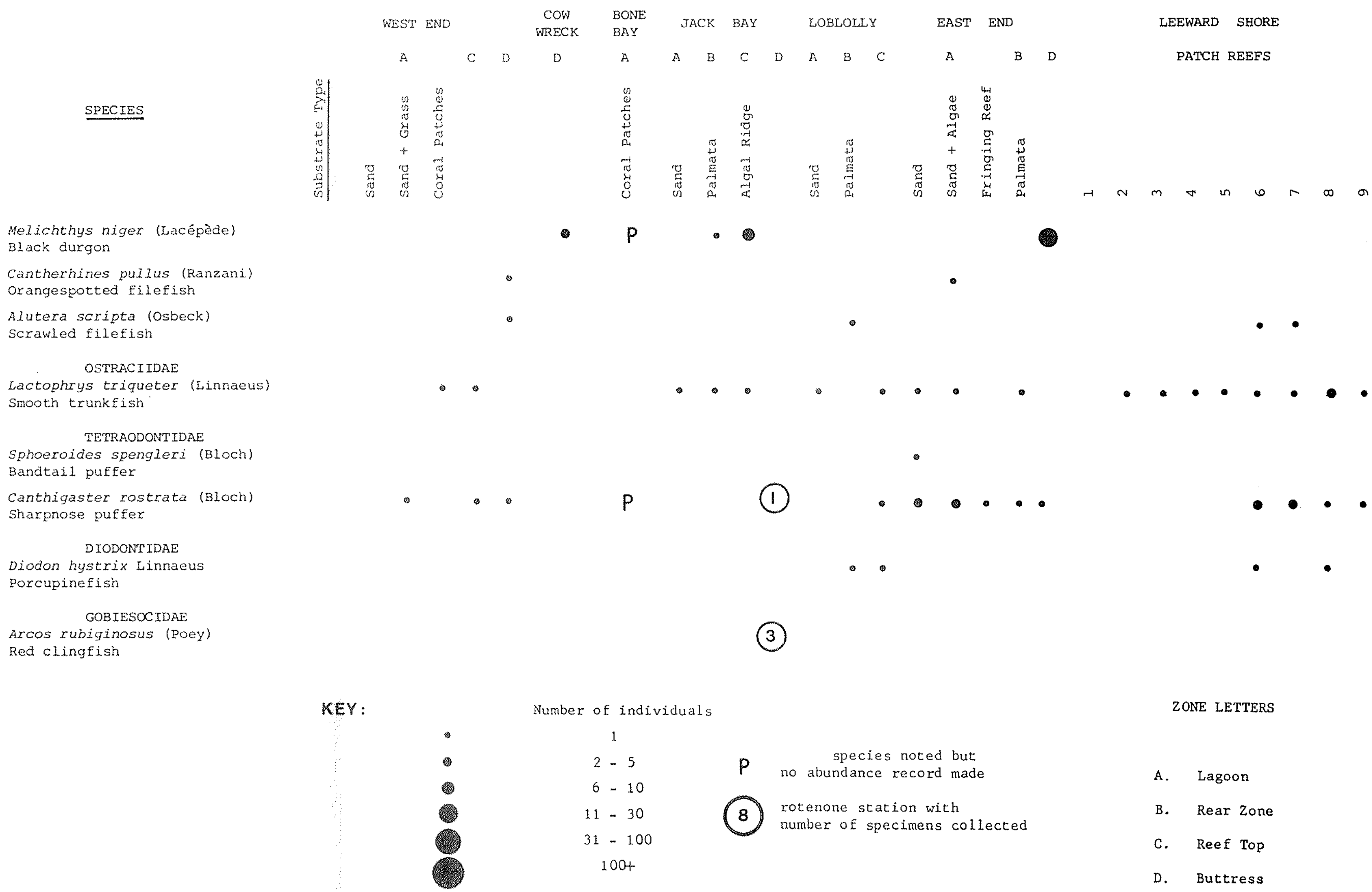
SPECIES	WEST END Sand	WEST END A Sand + Grass	WEST END A Coral Patches	WEST END C	WEST END D	COW WRECK D	BONE BAY A Coral Patches	JACK BAY A Sand	JACK BAY B Palmata	JACK BAY C Algal Ridge	JACK BAY D	LOBLOLLY A Sand	LOBLOLLY B Palmata	LOBLOLLY C	EAST END Sand	EAST END A Sand + Algae	EAST END Fringing Reef	EAST END B Palmata	EAST END D	LEEWARD SHORE PATCH REEFS 1	2	3	4	5	6	7	8	9
Eupomacentrus partitus (Poey) Bicolor damselfish					•	•	P			•			•	•		•	•	•	•						•	•		
Eupomacentrus dorsopinicans (Poey) Dusky damselfish			•		•		P	•	•	•	1		•	•		•	3	•	•	10	•	•		•	•	•	•	•
Eupomacentrus planifrons (Cuvier) Threespot damselfish					•		P		•				•	•			3	•			•		•	•	•	•	•	•
Eupomacentrus variabilis (Castelnau) Cocoa damselfish			•	•			P		•	•	•		•	•			•	•		1	•	•	•	•	•	•	•	•
Eupomacentrus sp. Honey damselfish		•	•	•					•	•			•					•		1	•	•	•	•	•			•
Eupomacentrus leucostictus (Müller and Troschel) Beaugregory		•	1	•	•		P	•	•	•	•		•	•	•	•	•	•			•	•	•	•	•	•		•
Abudefduf saxatilis (Linnaeus) Seargeant major			•	•	•	•	P		•	•	•		•	•			•	•	•		•	•	•	•	•	•	•	•
Chromis multilineata (Guichenot) Brown chromis					•		P				•			•					•									
Chromis cyanea (Poey) Blue chromis					•	•	P							•				•	•						•			
CIRRHITIDAE																												
Amblycirrhitus pinos (Mowbray) Redspotted hawkfish											5																	
LABRIDAE																												
Bodianus rufus (Linnaeus) Spanish hogfish			•	•	•	•	P		•	•	•		•	•				•	•			•			•	•		
Bodianus pulchellus (Poey) Spotfin hogfish										•																		
Thalassoma bifasciatum (Bloch) Bluehead		•	•	•	•	•	P	•	•	•	18		•	•		•	•	•	•	1	•	•	•	•	•	•	•	•
Halichoeres maculipinna (Muller and Troschel) Clown wrasse			•	•	•	•	P		•	•	3		•	•			1	•	•		•	•	•		•	•	•	•


WEST END
COW WRECK
BONE BAY
JACK BAY
LOBLOLLY
EAST END
LEEWARD SHORE
A
C
D
D
A
A
B
C
D
A
B
C
A
B
D
PATCH REEFS
SPECIES
Substrate Type
Sand
Sand + Grass
Coral Patches
Coral Patches
Sand
Palmata
Algal Ridge
Sand
Palmata
Sand
Sand + Algae
Fringing Reef
Palmata
1
2
3
4
5
6
7
8
9
Halichoeres poeyi (Steindachner)
Blackear wrasse
Halichoeres bivittatus (Bloch)
Slippery dick
Halichoeres pictus (Poey)
Painted wrasse
Halichoeres garnoti (Valenciennes)
Yellowhead wrasse
Halichoeres radiatus (Linnaeus)
Puddingwife
Hemipteronotus novacula
(Linnaeus)
Pearly razorfish
Hemipteronotus splendens
(Castelnau)
Green razorfish
SCARIDAE
Scarus vetula Bloch and
Schneider
Queen parrotfish
Scarus taeniopterus Desmarest
Princess parrotfish
Scarus coeruleus (Bloch)
Blue parrotfish
Scarus guacamaia Cuvier
Rainbow parrotfish
Scarus coelestinus Valenciennes
Midnight parrotfish
Sparisoma rubripinne
(Valenciennes)
Yellowtail parrotfish
Sparisoma chrysopterium (Bloch
and Schneider)
Redtail parrotfish
P
2
12
1

SPECIES	WEST END A Sand	WEST END A Sand + Grass	WEST END A Coral Patches	WEST END C	WEST END D	COW WRECK D	BONE BAY A Coral Patches	JACK BAY A Sand	JACK BAY B Palmata	JACK BAY C Algal Ridge	JACK BAY D	LOBLOLLY A Sand	LOBLOLLY B Palmata	LOBLOLLY C	EAST END A Sand	EAST END A Sand + Algae	EAST END Fringing Reef	EAST END B Palmata	EAST END D	LEEWARD SHORE PATCH REEFS 1	2	3	4	5	6	7	8	9
Sparisoma radians (Valenciennes) Bucktooth parrotfish			●						●						●													●
Sparisoma aurofrenatum (Valenciennes) Redband parrotfish			●	●	●		P	●	●	●		●									●	●	●	●	●	●	●	●
Scarus croicensis Bloch Mottlefin or Striped parrotfish		(1) ●	●	●	●	●			●	●			●	●		●	●	●	●		●		●	●	●	●	●	●
Sparisoma viride (Bonnaterre) Stoplight parrotfish				●	●	●	P			●				●					●		●	●	●	●	●	●	●	●
DACTYLOSCOPIDAE																												
Leurochilus acon Böhlke Smoothlip stargazer																												
Dactyloscopus tridigitatus Gill Sand stargazer											(26)				● ●	●									●			
Dactyloscopus crossotus Starks Bigeye stargazer																												
Gillellus rubrocinctus Longley Saddle stargazer											(5)																	
CLINIDAE																												
Labrisomus haitiensis Beebe and Tee-van Reef blenny																				(4)								
Labrisomus bucciferus (Poey) Puffcheek blenny																				(1)								
Labrisomus gobio (Valenciennes) Goggle-eye blenny											(21)																	
Labrisomus nuchipinnis (Quoy and Gaimard) Hairy blenny											(2)				●													
Malacoctenus versicolor (Poey) Barfin blenny																												
Paraclinus fasciatus (Steindachner) Banded blenny											(4)																●		●

SPECIES	WEST END A Sand	WEST END A Sand + Grass	WEST END A Coral Patches	WEST END C	WEST END D	COW WRECK D	BONE BAY A Coral Patches	JACK BAY A Sand	JACK BAY B Palmata	JACK BAY C Algal Ridge	JACK BAY D	LOBLOLLY A Sand	LOBLOLLY B Palmata	LOBLOLLY C	EAST END A Sand	EAST END A Sand + Algae	EAST END A Fringing Reef	EAST END B Palmata	EAST END D	LEEWARD SHORE PATCH REEFS 1	2	3	4	5	6	7	8	9
Labrisomus guppyi (Norman) Mimic blenny																				(3)								
Malacoctenus macropus (Poey) Rosy blenny																				(1)								
Paraclinus cingulatus (Evermann and Marsh) Coral blenny											●																	
Malacoctenus gilli (Steindachner) Dusky blenny																	(3)											
Acanthemblemaria maria Böhlke Secretary blenny											(4)																	
Chaenopsis ocellata Poey Bluethroat pikeblenny		(1)																										
TRIPTERYGIIDAE																												
Enneanectes pectoralis (Fowler) Redeye blenny											(29)																	
Enneanectes atrorus Rosenblatt Blackedge triplefin			(1)								(12)																	
BLENNIIDAE																												
Ophioblennius atlanticus (Valenciennes) Redlip blenny			●	●		●	P		●	●			●				●			(2)	●	●	●	●	●	●	●	
Blennius cristatus Linnaeus Molly Miller		●	●					●						●	●													
GOBIIDAE																												
Coryphopterus glaucofraenum Gill Bridled goby	●		(3) ●												●	●	(4)			(7)			●		●	●		●
Gobiosoma genie Böhlke and Robins Cleaning goby			●	●	●				●	●			●	●				●			●				●	●	●	●
Gobiosoma gemmatum (Ginsburg) Frecklefin goby		(2)	(3)												●	●	(1)	●			●				●			
Quisquilius hipoliti (Metzelaar) Rusty goby			(1)																	(1)								

SPECIES	West End: Sand	West End A: Sand + Grass	West End: Coral Patches	West End C	West End D	Cow Wreck D	Bone Bay A: Coral Patches	Jack Bay A: Sand	Jack Bay B: Palmata	Jack Bay C: Algal Ridge	Jack Bay D	Loblolly A: Sand	Loblolly B: Palmata	Loblolly C	East End: Sand	East End A: Sand + Algae	East End: Fringing Reef	East End B: Palmata	East End D	Leeward Shore Patch Reefs 1	2	3	4	5	6	7	8	9
Bathygobius soporator (Valenciennes) Frillfin goby																												
Coryphopterus alloides Böhlke and Robins Barfin goby																●												
Gnatholepis thompsoni Jordan Goldspot goby																												
Coryohopterus dicrus Böhlke and Robins Colon goby																				Collected at mangrove rotenone station								
Gobiosoma evelynae Böhlke and Robins Sharknose goby																				(1)								
Gobionellus boleosoma (Jordan and Gilbert) Darter goby																				Collected at mangrove rotenone station								
SCORPAENIDAE																												
Scorpaena inermis Cuvier Mushroom scorpionfish		(1)																										
ACANTHURIDAE																												
Acanthurus coeruleus Bloch and Schneider Blue tang			(1) ●	●	●	●	P	●	●	●		●	●	●		●	●	●	●	(1)	●	●	●	●	●	●	●	●
Acanthurus chirurgus (Bloch) Doctorfish							P			●					●							●	●	●	●	●	●	●
Acanthurus bahianus Castelnau Ocean surgeon		(6)				●	P											(9)	●		●	●	●	●	●	●	●	●
BALISTIDAE																												
Balistes vetula Linnaeus Queen triggerfish						●													●			●	●		●	●		●
Canthidermis sufflamen (Mitchill) Ocean triggerfish						●	●						●	●	●	●	●	●	●					●				


WEST END
COW WRECK
BONE BAY
JACK BAY
LOBLOLLY
EAST END
LEEWARD SHORE
PATCH REEFS
A C D D A A B C D A B C A B D
SPECIES
Substrate Type
Sand
Sand + Grass
Coral Patches
Coral Patches
Sand
Palmata
Algal Ridge
Sand
Palmata
Sand
Sand + Algae
Fringing Reef
Palmata
1 2 3 4 5 6 7 8 9
Melichthys niger (Lacépède)
Black durgon
Cantherhines pullus (Ranzani)
Orangespotted filefish
Alutera scripta (Osbeck)
Scrawled filefish
OSTRACIIDAE
Lactophrys triqueter (Linnaeus)
Smooth trunkfish
TETRAODONTIDAE
Sphoeroides spengleri (Bloch)
Bandtail puffer
Canthigaster rostrata (Bloch)
Sharpnose puffer
DIODONTIDAE
Diodon hystrix Linnaeus
Porcupinefish
GOBIESOCIDAE
Arcos rubiginosus (Poey)
Red clingfish
P
P
1
3
KEY:
Number of individuals
1
2 - 5
6 - 10
11 - 30
31 - 100
100+
P
species noted but no abundance record made
8
rotenone station with number of specimens collected
ZONE LETTERS
A. Lagoon
B. Rear Zone
C. Reef Top
D. Buttress

ADDENDUM TO FISH SPECIES LIST

Species	Site
SERRANIDAE	
Hypoplectrus puella (Cuvier and Valenciennes) Barred hamlet	Patch Reef 2
Hypoplectrus nigricans (Poey) Black hamlet	Patch Reef 6
Mycteroperca tigris (Valenciennes) Tiger grouper	East End Area D
LUTJANIDAE	
Lutjanus analis (Cuvier) Mutton snapper	Patch Reef 9
LABRIDAE	
Clepticus parrai (Bloch and Schneider) Creole wrasse	Patch Reef 6
OSTRACIIDAE	
Lactophrys bicaudalis (Linnaeus) Spotted trunkfish	Patch Reef 2 Patch Reef 7 Patch Reef 9 Bone Bay

Species changes at night

Observations at night indicated that a marked difference in distribution of fish on the reef occurred after dusk.

Although abundant during the day, members of the family Pomadysidae were strikingly absent from the reef at night as a 'fish watch' on patch reef V would indicate. Table 4 shows the relative abundance of reef species during the day (mid-day fishwatch) and at night (fishwatch during and immediately after the evening change-over) and the contrast in the number of species present is quite clear. Similar observations have already been recorded in some detail by members of the Tektite Program (Collette and Talbot 1972). During the evening change-over period the snappers (Lutjanidae) and the grunts (Pomadysidae) leave the reef, some in schools and some alone, for the sandflats and seagrass areas where they feed. It was also noticed that the grunts were accompanied in their excursions over the sand by the holocentrids, *Holocentrus rufus* and *Holocentrus coruscus*. *Myripristis jacobus* does not appear to move far away from the reef at night.

Results depicted in the Table also indicate the replacement of diurnal species by nocturnal species such as *Apogon maculatus*, *Apogon binotatus* and *Pempteris schomburgki* and such findings are in general agreement with the work of the Tektite Program in Lameshur Bay, St. John, U.S. Virgin Islands.

The mangrove area

Other interesting observations were made on a mangrove area, also on the leeward side of the island, approximately 1.5 km east of Setting point. Here, on a discrete mangrove patch (measuring approximately 25 m by 15 m in extent and situated in a depth of water of 1 m) a rotenone station yielded 22 species of fish (Fig. 13), the majority of which were juveniles. Paricularly abundant were the French grunts *Haemulon flavolineatum*, the Silver jenny *Eucinstomus gula*, the Ballyhoo *Hemiramphus brasiliensis* and the Yellowfin mojarra *Gerres cinereus*. As Fig. 14 shows, the mangrove area can be regarded as a 'nursery' with large numbers of juvenile fish recorded. Indeed, mangroves are known to be highly productive areas which also serve as shelters to young reef fish (Ogden, Yntema and Clavijo 1975).

SUMMARY

A total of 185 species (55 families) of reef fish were recorded on Anegada. A similar study on Tague Bay Reef, St. Croix, U.S. Virgin Islands, yielded 125 species (44 families) - Ogden et al (1972), although the total number of marine species for the entire island was estimated at 300 by Ogden, Yntema, and Clavijo (1975). Randall (1968), in 'Caribbean Reef Fishes', cites 300 common reef fish which may be found on reefs and sandflat/seagrass communities in the Caribbean - this figure

does not include many of the cryptic species which would be collected in a rotenone station.

Similar trends in the distribution of reef fish were observed on the northern shore of Anegada as those recorded in the Taque Bay study, St. Croix; with relatively greater numbers of species being found in the rear and buttress zones as compared to the shallow reef flat or reef top (Fig. 15). The increased number of species in these areas is probably due in part to the greater water depth and diversity of habitat provided by the regions. The highest number of species of reef fish recorded on the northern shore of Anegada was at West End in the buttress zone where 70 species were recognised. Particular note was made at this site of the spadefish Chaetodipterus faber and the tarpon, Megalops atlantica.

As is to be expected, generally lower numbers of fish species were recorded over the sand and sand/grass areas. Numbers of species ranged from 18-28 in the sandy lagoons of sites on the northern shore - predominant species including the jacks, (Carangidae); the mojarras (Gerridae); and the sanddivers (Synodontidae). In an area extensively colonised by algae, in the lagoon at East End, up to 40 species were noted; also at East End 44 species were recorded on the inshore fringing reef. The french grunt Haemulon flavolineatum, the reef squirrelfish Holocentrus coruscus, the bluehead Thalassona bifasciatum, and the striped parrotfish Scarus croicensis were particularly abundant at the latter site and a small rotenone station yielded 21 species, including large numbers of the dusky squirrelfish Holocentrus vexillarius, redtail parrotfish Sparisoma chrysopterium, striped parrotfish Scarus croicensis, ocean surgeon Acanthurus bahianis, freckled cardinalfish Apogon conklini and the chestnut moray Enchelycore sp.

On the leeward side of the island the number of species recorded varied between 54 - 78 on the nine patch reefs visited. The highest number of species was recorded on patch reef VI at the east end of the island. The most outstanding feature on the patch reefs was the general abundance of the Pomadsyidae - particularly Haemulon flavolineatum and Haemulon sciurus, both species being found shoaling in stands of Acropora prolifera and Acropora palmata.

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SPECIES	ABUNDANCE DAY	ABUNDANCE NIGHT
SYNODONTIDAE		
Synodus intermedius (Inshore lizardfish)	*	*
BELONIDAE		
Strongylura notata (Atlantic needlefish)	*	
Tylosurus crocodilus (Houndfish)	*	*
HOLOCENTRIDAE		
Holocentrus coruscus (Reef squirrelfish)		***
Holocentrus ascensionis (Longjaw squirrelfish)	***	
Holocentrus rufus (Squirrelfish)	**** (local)	**
Myripristis jacobus (Blackbar soldierfish)	**	**
AULOSTIMIDAE		
Aulostomus maculatus (Trumpetfish)	**	**
SPHYRAENIDAE		
Sphyraena barracuda (Barracuda)	**	
APOGONIDAE		
Apogon maculatus (Flamefish)		****
Apogon binotatus (Barred cardinalfish)		****
SERRANIDAE		
Cephalophilis fulva (Coney)	**	
Epinephelus adscensionis (Rock hind)	*	
PRIACANTHIDAE		
Priacanthus cruentatus (Glasseye snapper)	***	
PEMPHERIDAE		
Pempheris schomburgki (Glassy sweeper)		****
CARINGIDAE		
Caranx ruber (Bar jack)	**	
LUTJANIDAE		
Lutjanus mahogoni (Mahogony snapper)	**	
Lutjanus jocu (Dog snapper)	*	
Lutjanus apodus (Schoolmaster)	***	
Lutjanus griseus (Grey snapper)	** (off reef)	
Ocyurus chrysurus (Yellowtail snapper)	**	
POMADASYDAE		
Haemulon aurolineatum (Tomtate)	**	
Haemulon flavolineatum (French grunt)	***** (local)	*
Haemulon sciurus (Bluestriped grunt)	***	
Haemulon plumieri (White grunt)	***	
Haemulon macrostomum (Spanish grunt)	**	
Anisotremus virginicus (Porkfish)	**	
SPARIDAE		
Calamus bajonado (Jolthead porgy)	* (near reef)	
GERRIDAE		
Gerres cinereus (Yellowfin mojarra)	**	
Eucinostomus gula (Silver jenny)		**
MULLIDAE		
Mulloidichthys martinicus (Yellow goatfish)	**	
KYPHOSIDAE		
Kyphosus sectatrix (Bermuda chub)	***	
CHAETODONTIDAE		
Holacanthus ciliaris (Queen angelfish)	*	
Pomacanthus paru (French angelfish)	*	
Chaetodon capistratus (Foureye butterflyfish)	**	
Chaetodon striatus (Banded butterflyfish)	**	
POMACENTRIDAE		
Microspathodon chrysurus (Yellowtail damselfish)	**	*
Eupomacentrus dorsopunicans (Dusky damselfish)	***	**
Eupomacentrus variabilis (Cocoa damselfish)	***	
Eupomacentrus sp. (Honey dameelfish)	**	
Eupomacentrus leucostictus (Beaugregory)	**	
Abudefduf saxatilis (Seargeant major)	**	*
LABRIDAE		
Thalassoma bifasciatum (Bluehead wrasse)	***	
" " (" juvenile)	**	
Halichoeres poeyi (Blackear wrasse)	*	
Halichoeres radiatus (Puddingwife)	**	
Halichoeres garnoti (Yellowhead wrasse)	**	
SCARIDAE		
Scarus vetula (Queen parrotfish)	**	
Scarus taeniopterus (Princess parrotfish)	**	
Scarus coelestinus (Midnight parrotfish)	**	*
Sparisoma rubripinne (Yellowtail parrotfish)	**	*
Sparisoma chrysopterum (Redtail parrotfish)	**	
Sparisoma aurofrenatum (Redband parrotfish)	*	
Scarus croicensis (Striped parrotfish)	***	
Sparisoma viride (Stoplight parrotfish)	**	*
BLENNIDAE		
Ophioblennius atlanticus (Redlip blenny)	**	
ACANTHURIDAE		
Acanthurus coerulus (Blue tang)	***	**
Acanthurus chirurgus (Doctorfish)	**	
Acanthurus bahiansis (Ocean surgeon)	**	**
OSTRACIIDAE		
Lactophrys triqueter (Smooth trunkfish)	*	*
TOTAL SPECIES	**55**	**20**

Key: * 1; ** 2-5; *** 6-10; **** 11-30; ***** 31-100

Table 4 Relative abundance of reef fish on patch reef V by day and by night.

Fig. 13 Coral reef fish species list and numbers of individuals collected at a rotenone station - a mangrove patch on the leeward shore of Anegada.

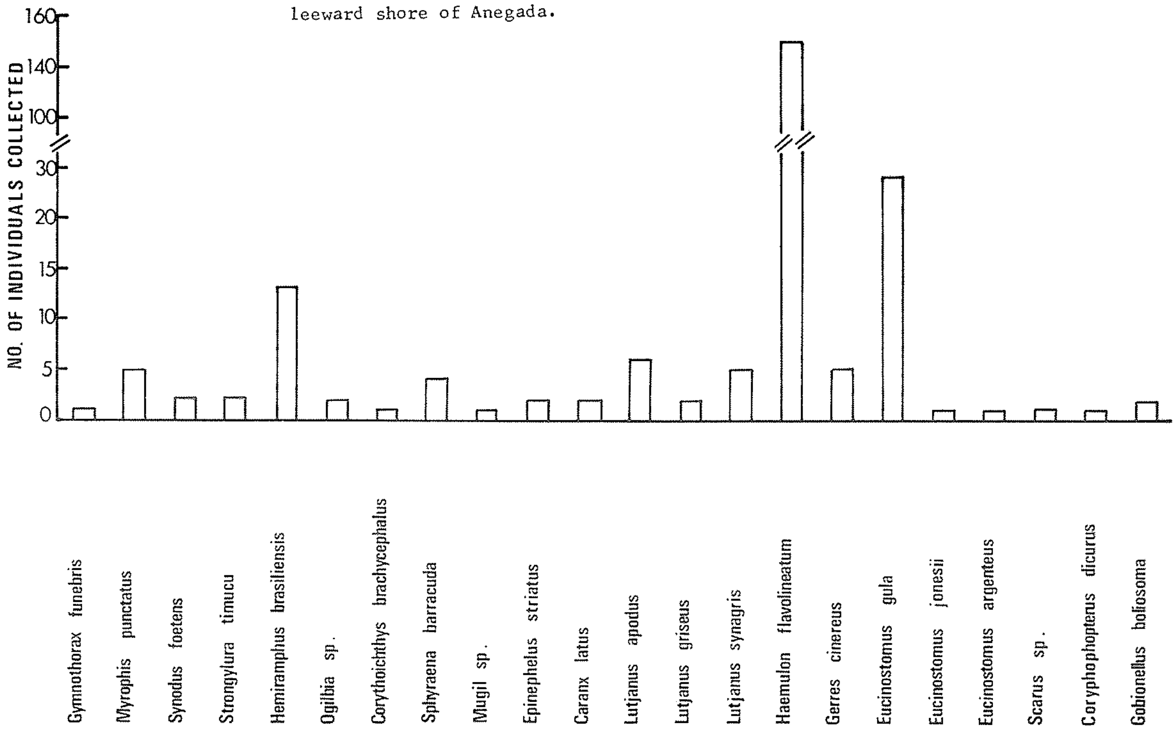

Fig.14 Length - frequency distribution of the French Grunt <u>Haemulon flavolineatum</u> at a rotenone station - a mangrove patch on the leeward shore of Anegada.

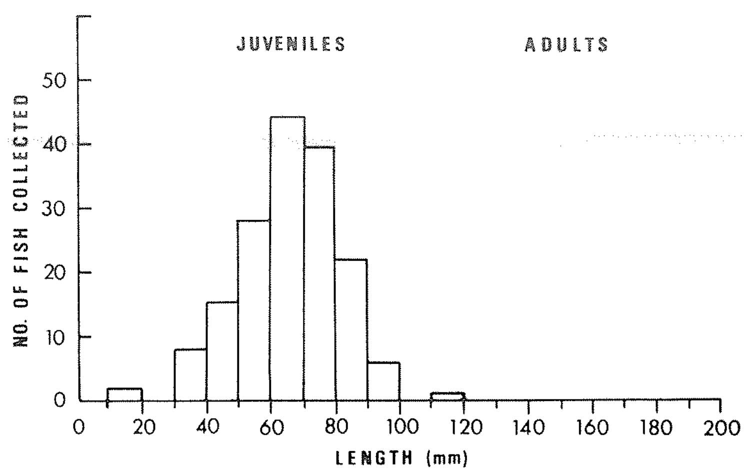

Fig. 15 Number of coral reef fish species recorded on A.) the Windward shore and B.) the Leeward shore of Anegada.