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CAYS OF THE BELIZE BARRIER REEF AND LAGOON

by

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CAYS OF THE BELIZE BARRIER REEF AND LAGOON

by D.R. Stoddart,[1] F.R. Fosberg,[2] and D.L. Spellman[3]

ABSTRACT

25 islands of the Belize barrier reef are mapped in this paper, together with 10 islands of the barrier reef lagoon. A further 4 barrier reef and 28 lagoon islands are described. For 22 islands comparative maps are presented showing topographic change between 1960-61 and 1972. Lists of vascular plants recorded from each island are given. Eleven types of island are recognised. Most of the islands have undergone erosion during the period of the surveys, notably during individual catastrophic hurricane events. The flora of the cays comprises 164 species. Vegetation units are briefly described, with special reference to the vegetation of dry mangrove cays and mangrove ranges, and to plant succession following major hurricane damage.

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1. INTRODUCTION

> "The whole extent of the main reef is ... studded with numerous islets of every variety of size and solidity: first the spot of sand, just raised above the water; then the more extended beach, which nurtures into trees the cocoa-nut cast upon its shores; next those places composed of sand and mud, where the mangrove springs out of the water, and which are in this neighbourhood called by the appropriate name of 'drowned cays'; and lastly, the island, a mile or more across, whose soil produces the grapewood tree, button-wood tree (very hard and valuable for cogs of wheels), and other species of trees, with a girth of more than 3 feet" (Allen 1841, p.85).

> " ... so deceitful are the different *keys* found from the general resemblance they bear to each other, that the most experienced seaman, when placed amongst them, often becomes fatally perplexed. ... A more particular description of these spots, so numerously scattered over the whole of this coast, would extend far beyond any moderate limits; nor could any material value be affixed to it, from the little characteristic difference that would be found connected with them" (Henderson 1811, pp. 20, 24).

This paper presents an account of the cays of the barrier reef and coastal shelf of Belize (British Honduras), Central America. It is based on data collected during five expeditions between 1959 and 1972. The first of these studied most of the barrier reef islands between St George's East Cay and Ragged Cay during the Cambridge Expedition to British Honduras 1959-60, when the field party consisted of Stoddart and J.D. Poxon. In 1961 Stoddart and S.P. Murray re-surveyed several of these islands, and also visited the Punta Gorda cays in the southernmost Gulf of Honduras, during a season supported by the Office of Naval Research and the Coastal Studies Institute, Louisiana State University. Following the catastrophic Hurricane Hattie of 30-31 October 1961, Stoddart remapped the barrier reef islands as far south as Carrie Bow Cay and also studied the numerous islands of the central coastal shelf between Placentia and Gladden Spit, during March-April 1962; this visit was supported by the Royal Society. The barrier and central shelf islands were again mapped, with Royal Society support, in March-April 1965, primarily to establish the nature of recovery following catastrophic hurricane damage. Finally, in June-July 1972 a comprehensive study was undertaken of the barrier and shelf cays (including the southernmostbarrier reef cays only briefly visited previously in 1960) as part of the Smithsonian Institution's IMSWE (Investigations of Marine Shallow Water Ecosystems) Programme centred on Carrie Bow Cay. The

field party consisted of Stoddart (responsible for mapping and geomorphology), Fosberg and Spellman (vegetation and flora), and Henry Pelzl (ornithology).

Some of the information presented here has appeared in preliminary form in earlier papers. The regional setting and environment were described, together with general features of the reefs, in an account of parallel studies of the Belize offshore atolls (Stoddart 1962a). Hurricane effects on the northern and central barrier reef cays were considered in a paper on Hurricane Hattie (Stoddart 1963). Island recovery in the northern and central areas was considered in an account of the 1965 re-survey (Stoddart 1969). A preliminary account has appeared (Stoddart 1974) of changes on five of the cays monitored in 1972. The southern barrier reef cays (south of the Silk Cays) and those of the Punta Gorda area in the Gulf of Honduras have received only incidental mention in the published literature (Stoddart 1962b, 1965), and studies on them appear here for the first time. With the publication of a full account of the vascular plants of the cays (Fosberg *et al.* 1981), the nomenclature used in previous papers is here revised, and lists are given of species recorded from each of the islands during successive surveys. An analysis of plant species diversity on the cays has been published by Stoddart and Fosberg (1981).

With a few exceptions, all of the islands here mapped were surveyed by pace-and-compass methods as described by Stoddart (1962a, p.129). Maps from successive surveys were related to each other by reference to prominent objects. Islands such as Rendezvous Cay and Carrie Bow Cay were also mapped by tape-and-compass methods, and the results used to calibrate the scales of the other maps. Oblique low-level air photographs were taken of many of the islands in 1960, 1961, 1962 and 1965. All the maps of cays in this report are orientated conventionally (i.e. with magnetic north at the top).

When this study began in 1959 virtually nothing was known of any of the islands of the Belize coast, or indeed of the reefs themselves. The first detailed hydrographic charts were made during the 1830s by Richard Owen, Edward Barnett and Bird Allen, but their ships carried no scientific men and only brief accounts were published (Owen 1838, Allen 1841). Darwin utilized their information and called the Belize barrier "the most remarkable reef in the West Indies" (1842, p.201), but this led to no further field investigation. Both Agassiz (1894, p.162) and Vaughan (1919, p.300) called on evidence from Belize in support of their own theories of reef development, but neither visited the area. Not until 1957 were the cays investigated, in a pioneer reconnaissance study by Vermeer (1959). Three major series of investigations have, however, subsequently made the Belize shelf and barrier reef one of the best known reef provinces in the world. The Rice University studies of shelf sediments directed by Edward G. Purdy during 1960-67, recently summarised by Wantland and Pusey (1975), led to Purdy's classic papers (1974a, 1974b) on reef structure and morphology. Deep-diving submersible and geophysical studies by James and Ginsburg (1960) have led to new insights into the form and evolution

of the central barrier reef. Finally the IMSWE investigations directed by Klaus Ruetzler at Carrie Bow Cay have greatly extended knowledge of reef biota, ecology and growth. The present paper is thus concerned only with the most recent and ephemeral accumulations of clastic carbonate sediments on the top of these massive reef structures; with their vegetation cover; and with their short-term variability in form and location in response to environmental events.

We thank the British Department of Scientific and Industrial Research, the Royal Society of London, the Office of Naval Research, and the Coastal Studies Institute of Louisiana State University for support of the investigations in 1959-1965, and the Smithsonian IMSWE Programme for that in 1972. The support of the Government of Belize has greatly assisted this work from the time of its initiation, and nothing would have been achieved without the practical assistance of many Belizeans. We are especially grateful to Mr M. Young and Mr R. Coe, of the Department of Geography, Cambridge University, for their cartographic and photographic skills over many years.

Several of the diagrams within this paper have been prepared from copies of charts and surveys provided by the Hydrographer of the Navy and with the sanction of Her Majesty's Stationery Office. It is a pleasure to thank successive Hydrographers, notably Rear Admiral Sir Edmund Irving and Rear Admiral D.W. Haslam, both surveyors of the Belize coast and reefs, for their interest in this work.

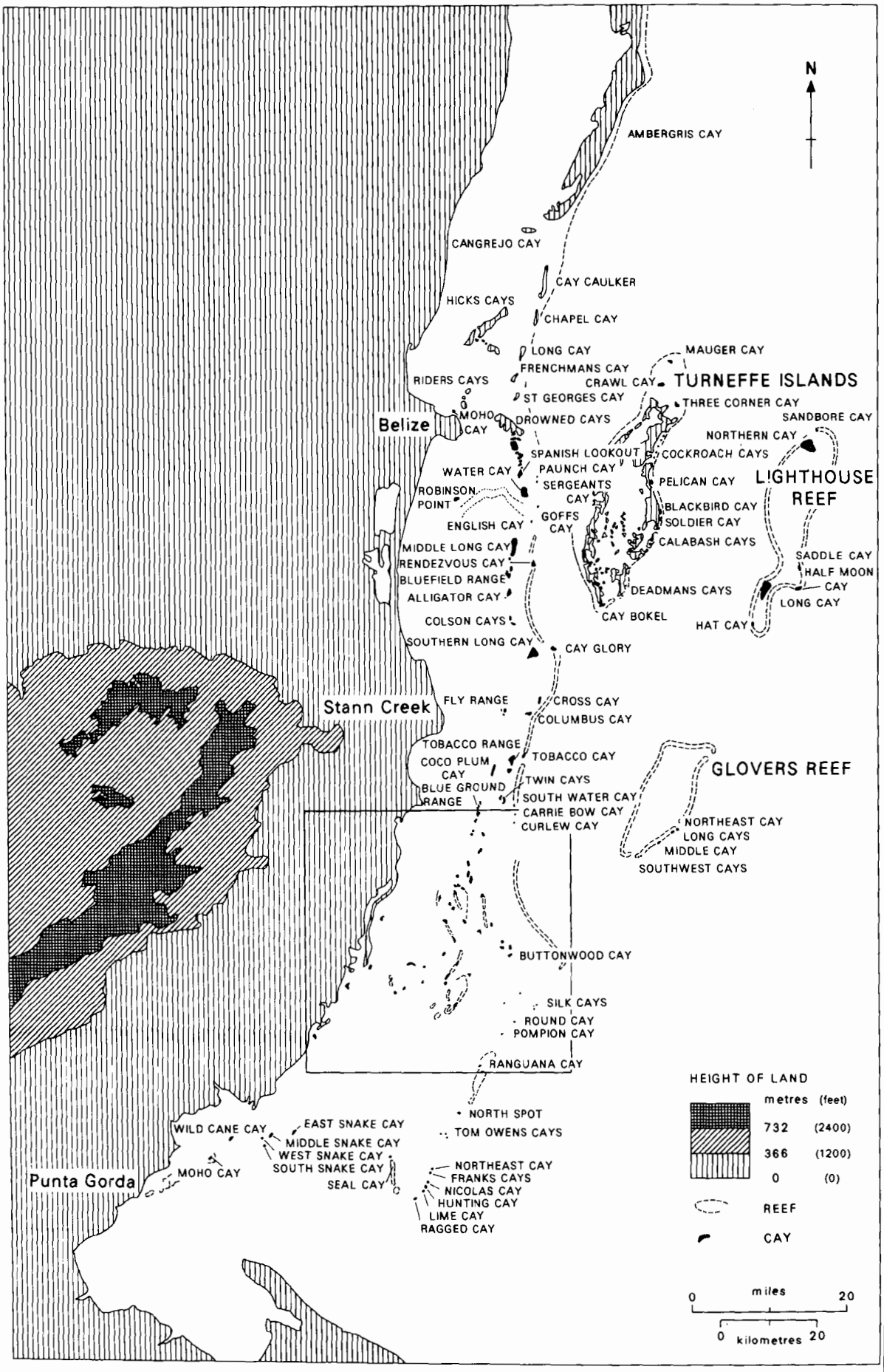

Figure 1. Location of the Belize reefs and cays
For detail of the enclosed area, see Figure 2

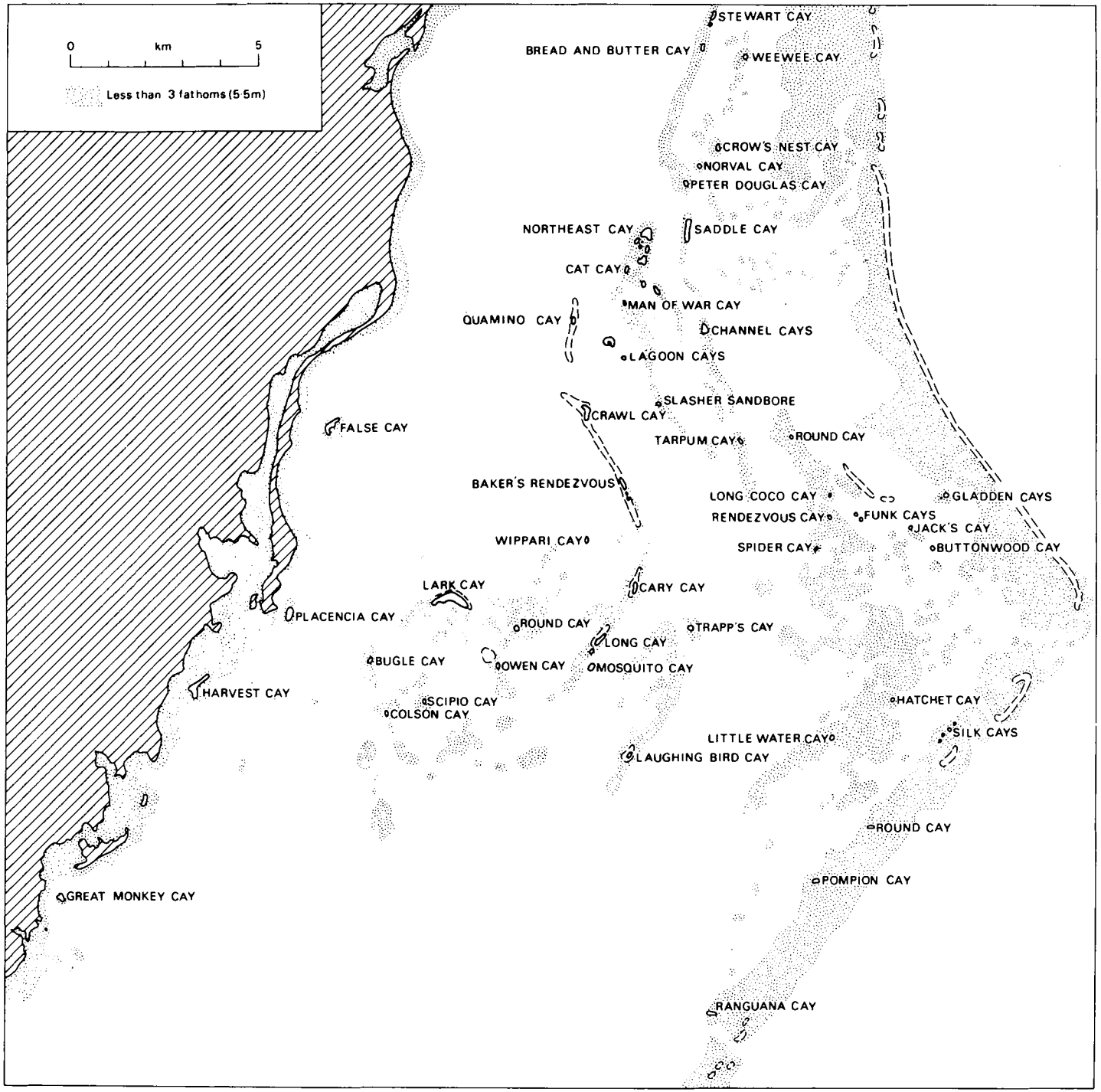

Figure 2. Reefs and cays of the central barrier reef lagoon

2. STRUCTURE AND ENVIRONMENT

Belize is located in the southeastern part of the Yucatan Peninsula, central America. The southern part of the country consists of an uplifted block of Palaeozoic metamorphosed sediments and instrusives, rising in the Maya Mountains to 1110 m above sea-level. The block is partly surrounded by hills of Cretaceous limestones, which are themselves overlain by low, flat-lying Cenozoic limestones which make up the greater part of the Yucatan Peninsula. The northern part of the east coast of the Peninsula, between Cabo Catoche and Ambergris Cay, is remarkably straight, formed by low cliffs with a fringing reef. South of Ambergris Cay, however, the Belize coastal shelf forms a major indentation up to 37 km wide. It is edged by a broadly arcuate barrier reef more than 200 km long. North of the city of Belize the shelf is generally less than 5 m deep; immediately south of Belize it increases to 10-12 m, and deepens southwards to depths of 45-55 m in the Gulf of Honduras. Seaward of the barrier reef the sea floor falls very steeply to more than 300 m, and depths of 1500 m are found within 6 km of the reef edge, except in the lee of the offshore atolls (Figure 1) (Dillon and Vedder 1973; James and Ginsburg 1980). Pronounced topographic lineations (notably connecting the southern barrier reef, the eastern side of Glover's Reef and the east side of Lighthouse Reef; the central barrier reef and the eastern side of Turneffe; and the coastline of Ambergris Cay) are clearly fault blocks aligned en echelon along the northern margin of the Cayman Trough, a major tectonic structure up to 7 km deep.

Purdy *et al.* (1975) have drawn attention to the very different characteristics of the shelf-edge reefs north and south of Belize City. To the north, where the shelf is shallow, there is a prominent chain of linear islands (Cay Caulker, Cay Chapel) located 2.5-4 km landward of the shelf edge; the edge itself is fringed by a discontinuous reef which lacks any well-developed reef flat. Purdy *et al.* (1975, 3) comment on the resemblance between this situation and that of the Bahama Banks. There are no true sand cays on these reefs north of latitude 17°33'N (the site of St George's East Cay which disappeared in 1961).

South of Belize City the deeper coastal shelf is edged by a barrier platform, in the terminology of Purdy *et al.* (1975). This has quite different characteristics north and south of Gladden Spit in latitude 16°30'N. In the northern sector, 80 km long, the shelf floor reaches depths of 20-24 m at distances of 8-15 km from the mainland coast; the shelf edge platform is 3-5 km wide and its upper surface 4-5 m deep. At its outer edge there is a well-developed reef flat 450-550 m wide, and there are numerous small patch reefs in its lee. South of Gladden Spit the same units are recognisable but with differing degrees of development. The shelf here has a constant width of 30 km,

and its maximum depth increases southwards from 35 to 77 m. The barrier platform maintains its depth on its upper surface of 4-5 m, but it is less than 2 km wide, is dissected by deep channels, and carries little surface reef. In spite of these differences in dimension, however, the volume of the barrier platform remains constant along the entire shelf edge (Stoddart 1977, p.47).

Within the coastal shelf there are three main groups of islands, in addition to those of the shelf edge reefs, which are considered here. The reefs of the Southern Triangles are developed at the inner end of the Belize Deepwater Channel. They are scattered isolated patch reefs, many of which have small mangrove cays on their upper surfaces. In the latitude of Gladden Spit there is a complex array of lenticular reefs, mostly slightly submerged (Stoddart 1963, figs. 35-36), fully described by Purdy (1974b), termed 'shelf atolls' by Purdy *et al.* (1975, p.15) and 'rhomboid platform atolls or faroes' by James and Ginsburg (1979). Surface reefs are irregularly developed on these structures, but where they do occur islands are common. Finally, small patch reefs rise from shallow water near the mainland coast in the Gulf of Honduras, north of Punta Gorda, and carry sand and mangrove cays.

Purdy (1974b) has shown that the present surface reefs at the Belize barrier are relatively thin Holocene structures capping an older antecedent and possibly karst-eroded reef topography. The Holocene reefs are 8-20 m thick, and average 12 m. The positive features on which they grow are presumed to be reefs of last interglacial age. In contrast to many other parts of the Caribbean there are no last interglacial reefs standing above present sea-level anywhere on the coast of Belize, though they are described at the usual heights of 2-4 m, with ages of 120-125,000 years, in northeastern Yucatan and Cozumel by Szabo *et al.* (1978). Their greater depth beneath the Belize reefs must indicate long-continued subsidence connected with the horst structures north of the Cayman Trough.

Modern reef growth on the Belize shelf must have post-dated the flooding of the antecedent topography on which the present reefs stand during the Holocene transgression, about 6000-8000 yr B.P. The deeper surface of the southern shelf would have flooded earlier, and Purdy (1974b, 854) has obtained dates of 6000-10,000 yr B.P. for shelf floor peats. Halley *et al.* (1977) have documented the sequence of Holocene reef growth on a pre-existing Pleistocene limestone prominence for a small patch reef of the central barrier reef. This and other Belize reefs have grown in the Holocene at rates of 1-2 m per 1000 yr (Purdy 1974a, p.67). The date at which reef flat development close to low-tide level could provide a platform on which clastic sediments could accumulate to form cays will thus be a function of the depth and dimensions of the reef foundations, governing both the time at which they were flooded by the Holocene transgression and the volume of constructional reef growth required for the reef to reach the present sea-level. The actual age of reef flat formation has yet to be determined for Belize reefs.

The Belize reefs lie in the zone of Northeast Trades, which blow with great constancy, especially during the summer months of April-September. At Belize, for the period 1917-1949, 56% of winds at 0600 hours came from the east and southeast and 23% from the northwest (means for the years), while at 1800 hours 75% came from the east and northeast. The Trades are interrupted during the months of November to February by 'northers', 4-5 day periods of northerly winds and low temperatures associated with the southerly extension of the North American high pressure system.

Rainfall over the east coast of the Yucatan Peninsula is about 1500 mm. June-September are the wettest months, and there is a pronounced dry season in February-April. Annual totals increase markedly southwards, to nearly 1900 mm at Belize, 2400 mm at Mango Creek, and 4200 mm at Punta Gorda (Table 1); the dry season is also very much less pronounced in these wetter areas. There are no rainfall records for any of the islands of the coastal shelf, but it is reasonable to presume that annual totals on the cays mirror those of coastal localities. Certainly there is evidence in the southernmost cays of much more humid conditions than in the north.

Minimum temperatures at Belize vary from 20°C in January and December (monthly means), with a mean maximum of 31.1°C in August. Mean temperatures range from 24° in winter to 27° in summer. Extreme temperatures recorded at Belize during 1951-60 were 9.4° and 36° (Portig 1976, p.470).

Hurricanes occur during the months of July to October. Especially destructive storms have been recorded in 1787, 1813, 1827, 1831, 1931, 1942, 1945, 1955 and 1961; for an annotated list of recorded storms see Stoddart (1963, pp. 127-130). The most recent significant storm to affect the reefs was Hurricane Greta in September 1978; this post-dated all the surveys reported here. The effects of the lesser Hurricane Fifi of October 1974 have been documented for Carrie Bow Cay by Miller and Macintyre (1977, p.27).

Mean tidal range at springs is only 0.2 m, and water level may be more affected by wave set-up and wind than by the astronomical tides. The main Caribbean current which flows from east to west from the Lesser Antilles is diverted northwards through the Yucatan Channel by the Yucatan Peninsula. Water movement on the coastal shelf is mainly to the south, into the Gulf of Honduras (Purdy *et al.* 1975, p.13).

Table 1. North-south variation in rainfall, east coast of the Yucatan Peninsula

Locality	Latitude	Length of record, yr	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Cozumel	23.31	10	83	31	57	54	177	177	76	127	213	302	121	85	1502
Chetumal	18.30	15	77	22	29	30	138	176	131	106	142	214	87	96	1247
Corozal	18.24	10	76	43	18	45	131	196	199	159	278	127	104	111	1487
Belize	17.30	39	136	63	38	51	105	206	163	168	235	307	209	185	1866
Stann Creek	16.58	10	146	70	75	77	138	262	291	253	276	265	257	155	2264
Mango Creek	16.33	10	121	77	48	47	133	363	382	290	335	288	195	115	2393
Toledo	16.25	10	193	70	109	72	146	556	766	613	468	292	201	153	3639
Punta Gorda	16.06	10	297	147	112	117	320	612	610	584	564	307	292	279	4239

Source: Wernstedt (1972, p.105); Romney *et al.* (1959, p.16).

3. SAND CAYS OF THE NORTHERN BARRIER REEF

This chapter describes the sand cays of the shelf-edge reefs between St George's East Cay in the north and Curlew Cay, south of Carrie Bow Cay, in the south, a distance of some 90 km. In each case, citations are given of previously published accounts, together with a list of plants recorded from the island. Since some of these cays have been treated in previous papers, the descriptions in this chapter are abbreviated.

St George's East Cay (17°33'N, 88°03'W) Plate 2

When mapped in 1960, this was an arcuate shingle ridge 110 m long with a maximum altitude of about 1 m. It had an area of 0.3 ha. The vegetation cover consisted of herbs and vines, with taller shrubs of *Tournefortia, Conocarpus* and *Borrichia* at the northeastern end. The island disappeared completely during Hurricane Hattie in 1961, and had not re-formed when the site was visited in April 1962. For a fuller account see Stoddart (1963, pp. 40-41). Plants recorded are:

Sesuvium portulacastrum 60S+	*Conocarpus erectus* 60S
Canavalia sp. 60S	*Ipomoea* sp. 60S
Euphorbia mesembrianthemifolia 60S	*Tournefortia gnaphalodes* 60S
Rhizophora mangle 60S (seedling)	*Borrichia arborescens* 60S

Paunch Cay (17°24'N, 88°02'W) Plate 1

Charted as Punchgut Kay by Speer (1771) and as Paunchgut by Jefferys (1775). It was vegetated in 1830 and in 1896-7 had coconut palms 10 m tall. The island was destroyed in the 1931 hurricane. When mapped in 1960 it was an unvegetated sandbore 45 m long, with three parallel lines of beachrock up to 45 m long on its south side. The sandbore disappeared but the relict beachrock survived the 1961 hurricane. No land was present in 1962 and the site has not been visited since. See Stoddart (1963, p.41 and fig. 21). The only

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+ In the plant lists the numeral refers to the year of record, and S or C refer to sight records or collections respectively. Species preceded by an asterisk are not native to the Belize cay flora, though this does not necessarily imply that they have been deliberately introduced on the cays where they occur.

plant recorded is:

**Cocos nucifera* 1896S

Sergeant's Cay (17°23½'N, 88°02'W) Figure 3, Plates 3-4

This island was charted by Speer (1771) and Jefferys (1775); at the time of the survey by H.M.S. *Rambler* in 1896-7 it had palm trees 15 m tall. It was first mapped in 1960, when it was a triangular sand cay with greatest length of 100 m and width of 45 m. Its area was 3680 sq m. The island was occupied by a large clubhouse, and the ground surface beneath the coconut palms was cleared. The cay was almost completely destroyed during Hurricane Hattie and was reported awash a few days later. In March 1962 a triangular sand cay had re-formed, with longest dimension of 70 m and area of 2000 sq m. The surface was colonised by patches of *Portulaca oleracea*, together with *Sesuvium portulacastrum* and *Euphorbia mesembrianthemifolia*. By 1965 the island was more elongate, but only 68 m long and with an area of 1640 sq m. The pioneer *Portulaca* had disappeared. A central area, occupying about 25 per cent of the surface and persisting from before the hurricane, had a continuous cover of *Ipomoea, Wedelia* and *Euphorbia*; *Sesuvium* was also absent. Shrubs were represented by three *Conocarpus* up to 3 m tall, six *Suriana* up to 1.5 m tall, and three *Tournefortia* less than 1 m tall; there was a single *Coccoloba* seedling. *Euphorbia* and *Ipomoea* were colonising fresh sand areas. The number of plant species had risen from 4 in 1962 to 13 in 1965. For further details, see Stoddart (1963, pp. 41-42, fig. 22; 1969, p.8, fig. 4) and Vermeer (1959, pp. 71-74).

The island was re-mapped on 11 July 1972, when it was 90 m long and 25 m wide, with an area of 1750 sq m. The vegetated area was still largely limited to that part of the surface inherited from before the hurricane: it was covered with a mat of *Euphorbia, Ipomoea, Vigna,* and *Sesuvium*. All the 1965 shrub species were present, but the *Coccoloba* was in danger of being undermined as the south shore continued to be eroded. Fresh sand to the west of the main vegetated area was being colonised by *Portulaca*. A new coloniser was *Spartina spartinae*, the only grass, forming a conspicuous clump near the centre of the island. Three species had become extinct since 1965: *Batis maritima, Euphorbia blodgettii* and *Eustoma exaltatum*. 14 species were present in 1972, bringing the total recorded for the island to 20:

Spartina spartinae 72C
Cocos nucifera 1896S 60S
Coccoloba uvifera 65S 72C
Batis maritima 65C
Philoxerus vermicularis 65S 72C
Portulaca oleracea 62C 72C
Sesuvium portulacastrum 62C 72C
Cakile lanceolata 65C 72C
Canavalia rosea 72C
Suriana maritima 65S 72C
Euphorbia blodgettii 65S
Euphorbia mesembrianthemifolia 62C 65S 72C
Rhizophora mangle 62S (seedling)

Conocarpus erectus 65S 72C
Eustoma exaltatum 65C
Ipomoea macrantha 65S 72C
Ipomoea pes-caprae 65S 72C
Tournefortia gnaphalodes 65S 72C
Avicennia germinans 60S
Wedelia trilobata 65S 72C

Curlew Cay (17°23'N, 88°02'W)

Curlew Cay is described by Speer (1765, 19) as "very low", with "only a few bushes", and comparable to Paunch Cay. The *Honduras Almanack* for 1830 stated that "there are no trees on Curlew, but bush, such as bay cedar [*Suriana maritima*] and lilly-root grass". It was charted by Owen in 1830 and by H.M.S. *Rambler* in 1896-7, but disappeared some time after that date, possibly in the 1931 hurricane. When visited in 1960 it was a small sandbore 20 m long and 0.6 m high; it was not seen in 1962. Plants recorded:

Gramineae indet. 1830S
Suriana maritima 1830S

Goff's Cay (17°21'N, 88°02'W) Figure 4, Plates 5-6

In February 1960 Goff's Cay was triangular, with sides 65-75 m long, built of grey sand, with a fresh sandspit at the north end. It was charted by Speer (1765, p.19 - a "small round Kay ... not so big as English Kay") Jefferys (1775), and H.M.S. *Rambler* in 1896-7, when it had coconuts 14 m tall. Coconuts dominated the vegetation in 1960. There were a few *Coccoloba* and *Avicennia* trees. The ground beneath the coconuts was sparesely covered with *Euphorbia, Ipomoea* and *Canavalia*; the fresh sand was being colonised by *Sesuvium, Ipomoea* and *Canavalia*. The area of the island was 2920 sq m, and 7 plant species were recorded. The island suffered severe erosion during Hurricane Hattie. The old island surface was reduced to about 800 sq m. By March 1962, however, marginal fresh sand accumulation had increased the surface area to 2280 sq m. Surface sand was stripped from the old island area; two or three coconuts and some broken *Coccoloba* survived. The only new coloniser was *Portulaca oleracea*. Relict beachrock, not previously visible, was exposed on the south and east sides of the cay. For further details of the island in 1960 and 1962, see Stoddart (1963, pp. 43-44, fig. 23). By 1965 slight recession of the south coast had been balanced by considerable aggradation on the north side, increasing the total area to 2870 sq m, approximately that of the pre-1961 island. Dense vegetation - a mat of *Euphorbia, Sesuvium, Ipomoea* and *Ernodea* - was limited to the surface area surviving from before the storm, though vines if *Ipomoea* were colonising fresh sand. Eighteen coconuts planted since 1961 were up to 1 m tall. In both 1962 and 1965 there was a small unvegetated sandbore about 400 m north of the main cay. For details of the island in 1965 see Stoddart (1969, p.8, fig. 4).

Goff's Cay was re-mapped on 11 July 1972. The core island remained, with some marginal erosion on the east side, but the marginal sand accumulations had considerably increased to give a total island area of 3190 sq m. The herb mat consisted of *Portulaca, Sesuvium, Ipomoea, Ernodea* and *Cakile*, and 17 coconuts survived. The eastern sand spit was being colonised by *Cakile*. A substantial concrete jetty had been built on the leeward side (the island is much used for recreational purposes), and a deep depression near the centre was presumably the sand source for the concrete. 10 plant species were recorded in 1972, compared with 2 in 1962 and 4 in 1965. No species became extinct either between 1962 and 1965 or between 1965 and 1972 except for the broken *Coccoloba* which did not survive. New colonisers in the first three years were *Cocos* (planted), *Sesuvium, Ipomoea* and *Euphorbia*; after 1965 they included two grasses (*Andropogon, Eragrostis*), a sedge (*Cyperus planifolius*), and *Cakile*. A total of 13 species is now recorded from the island:

Andropogon glomeratus 72C
Eragrostis prolifera 72C
Cyperus planifolius 72C
Cocos nucifera 1896S, 60S 65S 72S
**Coccoloba uvifera* 60S 62S
Portulaca oleracea 72C
Portulaca sp. 62S
Sesuvium portulacastrum 60S 65S 72C
Cakile lanceolata 72C
Canavalia sp. 60S
Euphorbia mesembrianthemifolia 72C
Euphorbia sp. 60S 65S
Ipomoea pes-caprae 72C
Ipomoea sp. 60S 65S
Avicennia germinans 60S
Erithalis fruticosa 65S 72C

Seal Cay (17°21'N, 88°02'W)

Seal Cay was noted by Speer (1766, p.19) as "a very low, small, sandy Kay". It was not charted by Owen in 1830, but the *Rambler* survey noted a sandbore awash at high water immediately on the north side of the entrance to the Belize Deepwater Channel. It was not seen during our own surveys. The seal in question was presumably the West Indian Monk Seal *Monachus tropicalis*, though the animal itself does not appear ever to have been recorded from the Belize coast, which is not included in King's (1956, p.217) map of the range of this species. That it was reasonably common in the eighteenth century is shown by the presence of other 'Seal Cays' on the barrier reef.

English Cay (17°20'N, 88°03'W) Figure 5, Plates 7-10

English Cay was charted by Speer (1765, p.19: "a short, round, bluff Kay"; 1771) and Jefferys (1775). It has been a lighthouse and pilot station for many years; the present lighthouse was built in 1935. In 1960 the island was triangular, with sides 75-90 m long, and with an area of 6510 sq m. The eastern shore was largely artificial, being partly a masonry wall and partly a ridge of conch shells. A leeward

sand spit seen in January 1960 was evidently a seasonal feature (Vermeer 1959, p.75). The vegetation was limited to coconuts 12-15 m tall, with the ground surface kept clear; there were two mature *Rhizophora* and one *Coccoloba* tree. During Hurricane Hattie in 1961 the island suffered severe marginal erosion and stripping of surface sand; its area was reduced to 3390 sq m. 90 of the 98 coconuts disappeared together with all the houses, but the lighthouse remained standing. *Rhizophora* survived but the *Coccoloba* was killed. No new plant species had colonised the island by March 1962 (see Stoddart 1963, pp. 44-45, fig. 24). By 1965 there had been virtually no change in the morphology of the island. 18 coconuts had been planted, and there was a patchy ground cover of *Sesuvium, Portulaca* and *Euphorbia*. The area of the cay was stable at 3520 sq m (Stoddart 1969, p.9, fig. 6). By 1972, however, walls had been built round almost the entire periphery of the cay, close to the position of the 1960 shoreline, and low-lying sand had accreted within this area. There were two main areas of *Euphorbia, Sesuvium, Portulaca* and *Ipomoea*, and several smaller patches; a strip of littoral *Sporobolus*; a single small shrub each of *Tournefortia* and *Suriana*; and 25 coconuts. The total dry-land area had increased to 4940 sq m, and the number of plant species from 2 in 1962 to 6 in 1965 and 18 in 1972. Two species recorded by Dwyer, Elias and Maxwell in 1967 (*Ernodea littoralis, Eclipta prostrata*) were not found either in 1965 or in 1972. Since the island is subject to continuous human interference it is clear that the vegetation is also much disturbed, notably by periodic clearing of the ground cover. Species recorded from English Cay are:

Paspalum distichum 72C
Sporobolus virginicus 72C
**Cocos nucifera* 60S 62S 65S 72S
Coccoloba uvifera 60S
Philoxerus vermicularis 65S 72C
Portulaca oleracea 67C 72C
Portulaca sp. 65S
Sesuvium portulacastrum 65S 67C 72C
**Tamarindus indica?* 72C (seedling)
Suriana maritima 72C
Euphorbia blodgettii 72C
Euphorbia mesembrianthemifolia 67C 72C
**Euphorbia thymifolia* 72C
Euphorbia sp. 65S
Phyllanthus amarus 72C
**Carica papaya* 65S
**Citrullus lanatus* 72C
Rhizophora mangle 60S 62S
Ipomoea pes-caprae 72C
Ipomoea stolonifera 72C (seedling)
Tournefortia gnaphalodes 72C
Ernodea littoralis 67C
Hedyotis corymbosa 72C
Eclipta alba 72C
Eclipta prostrata 67C

Sandbore south of English Cay (17°19½'N, 88°03'W)

H.M.S. *Vidal* charted this sandbore in 1957-8; it was not charted by H.M.S. *Rambler* in 1896-7 or earlier surveys. In 1960 it was 55 m long and up to 1 m high, and unvegetated. It has not been seen since.

Samphire Spot (17°17'N, 88°02½'W)

This was charted as Saphire Kay by Jefferys in 1775 but omitted by him in 1792 and 1800; it was not noted by Speer or Owen in 1765 and 1830, but appears as Samphire Spot following the 1896-7 *Rambler* survey. In 1959-61 it was a small unvegetated sandbore; it presumably disappeared during Hurricane Hattie, but in 1962 was again a small sandbore 23 m in diameter.

Rendezvous Cay (17°15'N, 88°03'W) Figure 6, Plates 11-15, 17-18

During the 1920s and 1930s this island was inhabited by a local fisherman, and in consequence is still locally known by some as 'Brown's Cay'. It was the headquarters of the Cambridge Expedition to British Honduras in 1959-60. At that time it was a slightly arcuate island, aligned north-south, 90 m long and 9-23 m wide. It was formed entirely of sand and its greatest height was less than 1 m. The leeward shore had been extended by accumulations of conch shells, giving a crenulate outline and forming small-boat harbours. The total area of the cay was 2610 sq m. Speer (1765, p.19) described it as "a low sand Kay, with only one bush on it". It was also charted by Jefferys in 1775 and Owen in 1830. In 1921-22 H.M.S. *Mutine* recorded coconuts 14 m high. In 1960 the taller coconuts reached almost 20 m; there were mature *Coccoloba* and *Avicennia* trees; and frequently cleared patches of *Sesuvium, Euphorbia* and *Sporobolus*. *Rhizophora* was represented by numerous seedlings round the shore. The island was greatly damaged during Hurricane Hattie. The house disappeared and all the coconuts were destroyed. The overall dimensions remained much the same, but the island shifted slightly to the west and the area was reduced to 2180 sq m. The *Avicennia* was killed and the *Coccoloba* much broken. By March-April 1962, however, there was a varied though patchy cover of herbs, grasses and sedges. *Portulaca* was the most common species, together with *Cyperus planifolius* and *Sporobolus*. *Sesuvium, Euphorbia mesembrianthemifolia* and *Ipomoea pes-caprae* were also widespread. Shrub species were represented by seedlings of *Suriana, Conocarpus* and *Tournefortia*. Stoddart planted over 40 young coconuts on the cay in April 1962. For further details, see Stoddart (1963, fig. 4; 1663, pp. 47-49, fig. 28).

In 1965 the cay was of similar dimensions but had continued to migrate lagoonwards: the seaward shore in 1965 stood 10-15 m westwards of its 1962 position, and the area had declined slightly to 2000 sq m. The planted coconuts were 3 m tall, and in the north there were low shrubs of *Tournefortia* and *Suriana*. The ground surface was covered with a dense mat of *Ipomoea* and *Euphorbia*, with areas of *Wedelia* and *Sesuvium*; *Portulaca* had become rare. There was a single *Casuarina* 2 m tall at the north end (Stoddart 1969, pp. 9-10, fig. 7).

In 1972 these trends had continued. The cay had maximum dimensions of 92 x 32 m, and an area of 1840 sq m. Both its seaward and lagoonward shores were located up to 10 m westward of their 1965 positions (and hence up to 16 m westward of their 1960 locations). Some of the coconuts were already bearing. The ground cover was dominated by *Euphorbia, Ipomoea, Philoxerus, Sesuvium, Portulaca, Cyperus, Sporobolus* and other grasses. One clump of *Coccoloba* still survived from before the hurricane, but the *Casuarina* had disappeared and the *Suriana* appeared dead. There were several clumps of *Conocarpus, Rhizophora* and *Avicennia*. A small hut had been built and appeared to be intermittently occupied. There was evidence that the conch fishery had been resumed.

The total number of species recorded from Rendezvous Cay is now 24. 7 were recorded in 1960, 16 in 1962, 16 in 1965 and 16 in 1972. The uniformity of these figures disguises considerable turnover, however, as the detailed records show. The following species are recorded:

Paspalum distichum 62C 72C
Sporobolus sp. 60S 62S 65S
Cyperus ligularis 62C
Cyperus planifolius 72C
Cyperus sp. 65S
Fimbristylis cymosa 62C 72C
**Cocos nucifera* 20S 60S 65S 72S
**Casuarina equisetifolia* 65S
Coccoloba uvifera 60S 62S 65S 72C
Philoxerus vermicularis 62C 72C
Portulaca oleracea 62C 65S 72C
Portulaca sp. 62S
Sesuvium portulacastrum 60S 62C 65S 72C
Cakile lanceolata 62C 65S
Suriana maritima 65S 72C
Euphorbia mesembrianthemifolia 62C 72C
Euphorbia sp. 60S 65S
Rhizophora mangle 60S 62S 65S 72C
Conocarpus erectus 65S 72C
Laguncularia racemosa 72C
Ipomoea pes-caprae 62S 72C
Ipomoea sp. 65S
Tournefortia gnaphalodes 65S 72S
Avicennia germinans 60S 72S
Solanum campechiense 62C
**Solanum lycopersicum* 62C
Ageratum sp. 65S
Wedelia trilobata 62S 65S

Jack's Cays (17°14'N, 88°02½'W)

These are intermittent sandbores 20-40 m long. One was often visible in 1959-60, the other was seen in 1962. They are unvegetated.

Skiff Sand (17°13'N, 88°03'W)

An ephemeral sandbore on the outer barrier, charted by H.M.S. *Mutine* in 1921-22, and occasionally visible; it is unvegetated.

Cay Glory (17°06'N, 88°01'W) Plate 16

Cay Glory was mapped in 1960: it was 105 m long, up to 21 m wide, and had an area of 1430 sq m. There was a single young coconut 1.2 m tall, and a small vegetated area covered with *Sesuvium, Euphorbia, Philoxerus, Cakile, Paspalum* and *Ipomoea*. The island was built of well-sorted beach sand (Stoddart 1964, figs. 4, 6) and its outline was clearly very variable. The island was previously larger. H.M.S. *Mutine* noted coconuts 21 m tall in 1922, but these must have been destroyed by either the 1931 or 1945 hurricanes. Beachrock relics of this older island are widespread north and west of the 1960 cay. The island disappeared entirely during Hurricane Hattie in 1961, and no land was seen on its site in 1962, 1965 or 1972. For further details, see Stoddart (1963, pp. 52-53, fig. 30). The following 7 plant species have been recorded:

Paspalum distichum 60C
**Cocos nucifera* 22S 60S
Philoxerus vermicularis 60C
Sesuvium portulacastrum 60C
Cakile lanceolata 60C
Euphorbia mesembrianthemifolia 60C
Ipomoea asarifolia 60C

Tobacco Cay (16°54½'N, 88°03½'W) Figures 8-9, Plates 19-21

Tobacco Cay lies on the north side of one of the most important entrances in the central barrier reef. It was charted by Speer in 1771 and Jefferys in 1775, and there is an unverified suggestion that the island is named after tobacco cultivation during the early years of the English settlement in 1630-40 (Winzerling 1946; Caiger 1951, 28-29). The most recent hydrographic chart of the area was made by Owen in 1834. The cay was mapped in 1960, 1961 (in July after Hurricane Abby), 1962 (April, after Hurricane Hattie), 1965, and 1972.

In 1960 the island was roughly triangular, with a greatest north-south dimension of 275 m and a greatest width of 140 m; its area was 2.74 ha. The whole island was built of sand, with a flat featureless surface at about 1.2 m above sea-level. There were ridges of fresh sand along the south shore, and relict strips of beachrock 35 m offshore. The cay was inhabited and densely vegetated. In 1834 Owen had noted coconut trees 20 m tall, and Smith (1842, p.732) described a fig tree 20 m tall near the northeast point. In 1960 many of the coconuts were old, reaching up to 25 m, and there were also mature trees of *Terminalia, Coccoloba* and *Cordia*. There was a dense ground cover of *Stachytarpheta, Wedelia, Ipomoea pes-caprae, Ipomoea stolonifera, Sesuvium, Hymenocallis, Euphorbia, Canavalia* and *Vigna*. Hurricane Abby on 15 July 1960 removed the fresh sand ridges and blew down a number of coconuts; the inhabitants also cleared a good deal of the ground vegetation.

During Hurricane Hattie there was severe marginal erosion, stripping of surface sand, and deposition of fresh sand along the south and west shores. At the southeast point these new deposits reached a

height of 2 m, and were up to 14 m wide. 70 per cent of the coconuts were felled, the trunks being aligned N40°E. *Coccoloba* and *Cordia* were much broken, though *Terminalia* was less damaged. Since the cay was not inundated by the storm surge the ground vegetation survived with little change, though shade-seeking *Wedelia* had given way to *Ipomoea* in many places. The fresh sand ridges were also colonised by *Ipomoea*. By 1965 the fallen trees had been cleared and *Wedelia* had greatly expanded. *Ipomoea* and *Sesuvium* had expanded on the sand ridges, where *Tournefortia* had also appeared. The general ground cover, however, was similar in composition, though not in pattern, to that seen in 1960. The cay had been reduced in size to 2.25 ha immediately after Hurricane Hattie; by 1965 it had increased to 2.30 ha. For further details, see Stoddart (1963, pp. 53-55, fig. 31; 1969, p.10, fig. 8).

The island was re-mapped on 24 June 1972. Its area had increased to 2.50 ha, largely because of the presence of a fresh sand spit at the north point; the southern sand ridges had disappeared. The area of the vegetated cay has, however, remained very largely constant since 1960. Many new coconuts were growing, together with tree species (*Terminalia, Coccoloba, Cordia*) surviving from before Hurricane Hattie. The ground cover beneath the coconuts again consisted of *Wedelia, Stachytarpheta, Sesuvium, Euphorbia, Vigna, Hymenocallis, Portulaca,* sedges and grasses, though the central part of the island had been recently cleared and was bare. The southern sand ridge was colonised by *Tournefortia, Suriana, Euphorbia* and *Ipomoea*. The prominent rubble ridge on the reef flat to the southeast of the cay supported small patches of *Philoxerus* and *Sesuvium*.

The number of plants species recorded in 1960 was 8, in 1961 12, 1962 13, 1965 21 and 1972 41; the total recorded for the island is 44. Undoubtedly this increase results from more thorough collecting rather than from new colonisation. There is only one certain extinction over this period of record: a single *Sophora tomentosa*, 0.7 m tall near the south point, had disappeared by 1972. The plants recorded are as follows:

**Eleusine indica* 62C 72C
Eragrostis ciliaris 62C
Paspalum distichum 72C
Phragmites cf. *australis* 72C
Spartina patens 72C
Sporobolus virginicus 65S 72C
Sporobolus sp. 65C
Cyperus ligularis 72C
Cyperus planifolius 72C
Cyperus sp. 61S 65S
**Cocos nucifera* 60S 61S 62S 65S 72S
Crinum amabile 72C
Hymenocallis littoralis 61S 62S 65S 72C
Ficus sp. 1842S
Coccoloba uvifera 61S 62S 65S 72C
Philoxerus vermicularis 72C
Portulaca oleracea 60C 61S 62S 65S 72C
Sesuvium portulacastrum 61S 65S 72C
Caesalpinia bonduc 72C (seedling)
Canavalia rosea 60C 72C
Sophora tomentosa 65S
Vigna luteola 60C 62C 65S 72C
Suriana maritima 72C
Euphorbia blodgettii 62C 72C
Euphorbia glomerifera 72C
Euphorbia mesembrianthemifolia 62C 72C
Euphorbia prostrata 72C

Euphorbia sp. 60S 65S
Phyllanthus amarus 72C
**Carica papaya* 65S 72S
Rhizophora mangle 62S 65S 72C
Conocarpus erectus 61S 65S 72C
**Terminalia catappa* 61S 62S 65S 72C
Bumelia retusa 65C 72S
**Catharanthus roseus* 72C
Ipomoea pes-caprae 62C 65S 72C
Ipomoea stolonifera 60C 72C
Ipomoea sp. 65S
Cordia sebestena 60C 61S 65S 72C
Tournefortia gnaphalodes 65S 72C
Avicennia germinans 61S 65S 72C
Stachytarpheta jamaicensis 60C 61S 65S 72C
Spermacoce assurgens 72C
Ageratum littorale 72C
Bidens cynapiifolia 72C
Melanthera nivea 72C
Pluchea symphytifolia 72C
Wedelia trilobata 60C 61S 62S 65S 72C

Purdy (1974b, pp. 841, 853) drilled a core hole 16.4 m deep on Tobacco Cay, the upper 14 m of the section being Holocene in age.

South Water Cay (16°49'N, 88°05'W) Figure 10, Plates 22-24

South Water Cay is the largest inhabited sand cay on the barrier reef. It is prominently marked on Jefferys's chart in 1775, and in 1830 Owen noted coconut trees 15 m tall. The island was mapped in 1960, visited again in 1961, and mapped again in 1962, 1965 and 1972. In addition to the collections made during these visits a large collection made by J. Pringle in 1979-80 considerably increased the recorded flora.

In 1960 the island had a north-south extent of about 640 m; its width varied from 70 to 180 m; and it had an area of 8.18 ha. The northern part, closest to the reef, was covered with a dense palm thicket and had an eastern shore of coral rubble. The rest of the island was settled, covered with open coconut woodland, and formed of sand. In the northern palm thicket the ground cover consisted of *Wedelia, Euphorbia, Ipomoea,* grasses and sedges, with *Sesuvium, Tournefortia* and *Suriana* along the coast. Both *Borrichia* and *Coccoloba* were common along the seaward margins of the woodland, and extended southwards along the east side of the island. The rest of the cay had a varied vegetation of planted exotics and weedy species which were frequently cleared.

During Hurricane Hattie the cay was subject to considerable marginal erosion, especially in the southwest bay and at the northeast point. There was considerable wind damage to coconuts, the mean direction of fall being N30-40°E, but the island was not overtopped by the storm surge. In the centre of the island about 80 per cent of the trees were felled. Along the shores *Coccoloba, Avicennia* and much *Borrichia* survived the storm. All the jetties and several houses were destroyed. For details, see Stoddart (1963, pp. 55-57, fig. 32).

By 1965 physiographic change had been slight. The seaward beaches had retreated slightly, but the leeward beaches had accreted; there had been continuing erosion at the south point. The vegetation of the northern part of the island was little changed, with *Wedelia, Ipomoea, Batis, Euphorbia* and *Sesuvium,* and thriving *Thrinax* and *Coccoloba* under the coconuts. In the centre of the island there was a dense growth of *Euphorbia, Ipomoea, Stachytarpheta, Ambrosia* and *Cassytha,* with some *Hymenocallis* and *Coccoloba.* Along the eastern shore there was bushy *Borrichia* with much *Cassytha,* a few *Tournefortia* seedlings, and a ground cover of *Sesuvium, Ipomoea, Euphorbia* and *Sporobolus.* Many young coconuts planted in the southern part of the cay after the hurricane were 3-4.5 m tall. Two juvenile *Casuarina* were growing by the lagoon shore, but there were many fewer *Rhizophora* seedlings round the shores and especially along the east coast than in 1960. A jetty and several new buildings had been erected and the effects of the hurricane were no longer obvious. For further details, see Stoddart (1969, p.11).

In 1972 the trends of erosion and accretion had continued. There was retreat at the south point, along the southwest bay and at the north point. The island had a maximum length of 660 m, a width varying from 55 to 175 m, and an area of 6.49 ha. Masonry and rubble walls had been inadequate to prevent continuing erosion both in the southwest bay and at the northeast point. Apart from a sector in the south, recently cleared, there was a dense ground cover of herbs, vines and grasses under the open coconut woodland. *Hymenocallis, Ipomoea stolonifera, Ambrosia* and *Wedelia* were all common and conspicuous. *Borrichia* was the most common shrub colonising the east shore, with *Sesuvium* as ground cover; a single seedling of *Morinda* was noted on the beach crest.

No attempt was made during the earlier visits to make a complete collection of plants from South Water Cay, and by 1965 only 26 species had been recorded. 68 were recorded in 1972, bringing the total to 69, and Pringle's collections in 1979-80 raise the total to 80. This is the highest number for any of the Belize cays, but clearly reflects the continuous and prolonged human disturbance of the vegetation. The following species have been recorded:

Andropogon glomeratus 61C 72C 79C
Anthephora hermaphrodita 79C
Cenchrus incertus 72C 79C
Distichlis spicata 79C
Eragrostis ciliaris 72C 79C
Eustachys petraea 72C 79C
Panicum virgatum 79C
Paspalum blodgettii 72C
Paspalum distichum 72C
Phragmites cf. *australis* 72C
Spartina patens 72C 79C
Spartina spartinae 72C
Sporobolus virginicus 72C 79C
Sporobolus sp. 60S 65S
Cyperus ligularis 72C
Cyperus peruvianus 72C 79C
Cyperus planifolius 72C 79C
Cyperus sp. 60S
Fimbristylis cymosa 72C 79C
**Cocos nucifera* 60S 61S 62S 65S 72S
Thrinax radiata 65S 72C
Agave sp. 72C
Crinum amabile 72C

Dracaena sp. 72C 79C
Hymenocallis littoralis 65S 72C 79C
**Casuarina equisetifolia* 65S 72C 79C
Coccoloba uvifera 60S 65S 72C 79C
Batis maritima 65S 72C 79C
Philoxerus vermicularis 72C 79C
Boerhavia coccinea 79C
Portulaca oleracea 72C 79C
Sesuvium portulacastrum 60S 65S 72C 79C
Cassytha filiformis 60S 65S 72C 79C
Cakile lanceolata 60S 72C 79C
Chrysobalanus icaco 72C
Canavalia rosea 72C 79C
Crotalaria retusa 72C 79C
Desmodium incanum 72C 79C
Desmodium tortuosum 79C
Erythrina sp. 72C
Sophora tomentosa 65S 72C 79C
Vigna luteola 72C 79C
Suriana maritima 60S 79C
Euphorbia blodgettii 60S 72C 79C
Euphorbia mesembrianthemifolia 72C 79C
Euphorbia trichotoma 72C 79C
Euphorbia sp. 60S 65S
Phyllanthus amarus 72C 79C
**Hibiscus rosa-sinensis* 72C
Waltheria indica 72C 79C
Passiflora suberosa 72C 79C
Rhizophora mangle 60S 65S 72C 79C
Conocarpus erectus 72C 79C
Laguncularia racemosa 72C 79C
**Terminalia catappa* 72C
**Psidium guajava* 72C
Polypremum procumbens 72C 79C
**Nerium oleander* 79C
**Plumeria rubra* 72C
Ipomoea macrantha 65S 79C
Ipomoea pes-caprae 72C 79C
Ipomoea stolonifera 65C 72C 79C
Ipomoea sp. 60S 65S
Jacquemontia havanensis 72C 79C
Cordia sebestena 72C 79C
Tournefortia gnaphalodes 60C 61S 65S 72C 79C
Avicennia germinans 60S 72C 79C
Lippia nodiflora 72C 79C
Stachytarpheta jamaicensis 65S 72C 79C
**Solanum lycopersicum* 79C
Erithalis fruticosa 72C 79C
Ernodea littoralis 72C 79C
Hedyotis corymbosa 72C
**Hedyotis lancifolia* 79C
Morinda citrifolia 72C
Spermacoce assurgens 72C 79C
Ageratum littorale 72C 79C
Ambrosia hispida 65S 72C 79C
Borrichia arborescens 60S 65S 72C 79C
Conyza canadensis 72C
Eclipta alba 79C
Emilia sonchifolia 79C
Melanthera nivea 72C
Wedelia trilobata 60S 65S 72C 79C

Carrie Bow Cay (16°48'N, 88°05'W) Figure 11, Plates 25-28

Carrie Bow Cay, named after the Bowman family of Stann Creek, was charted by Owen as "Jack Ellin's Cay" and appears on charts as "Ellen Cay". Owen noted "tops of bushes 20 feet", but by 1960 the cay was covered with an open coconut woodland surrounding large houses; the ground surface was kept cleared. The island was then 140 m long and 32-40 m wide, with an area of 5450 sq m. It was built of sand, its surface about 1 m above sea level, with several strips of relict beachrock 25-30 m off the east shore. During Hurricane Hattie there was some beach retreat, especially at the northern and southern ends, exposing fresh beachrock. Many coconuts were felled in a generally northerly direction. Immediately after the storm the main coloniser

was *Euphorbia*. For details see Stoddart (1963, pp. 57-58, fig. 33). By 1965 a number of young coconuts had been planted, and low *Tournefortia* bushes were growing along the northern part of the seaward shore. The ground cover comprised sparse *Euphorbia, Sesuvium* and *Ipomoea,* but was repeatedly cleared (Stoddart 1969, p.11).

By 1972 erosion had continued at the south point and along the southern end of the leeward shore, where the shore had retreated up to 15 m since 1962. Seasonal sandspits at both the northern and southern points partly mask the intensity of this continuing erosion. As a result the area of the island declined from 5450 sq m in 1960 to 4260 sq m in 1965 and 3940 sq m in 1972. A number of new coconuts had been planted, but the ground surface was kept bare, apart from two clumps of *Tournefortia* on the seaward shore. Further erosion occurred at the northern and southern points during Hurricane Fifi in December 1974, and the island was remapped by K. Ruetzler and H. Pulpan (in Miller and Macintyre 1977, p.27); its area was reduced to 2810 sq m. In spite of the fact that vegetation was regularly cleared from the cay surface, many seedlings germinate. Some were recorded in 1972, and others in a collection by J.D. Ferraris in May 1978. 22 species have now been recorded from Carrie Bow Cay, at least 9 of them only as seedlings. The list is as follows:

Paspalum distichum 72C
Cyperus planifolius 72C
Cocos nucifera 60S 62C 65S 72S
Eichhornia crassipes 78C (seedling)
Hymenocallis littoralis 78S (seedling) 79C
* *Casuarina equisetifolia* 78C
Coccoloba uvifera 72C 78C (seedling)
Suaeda linearis 78C
Philoxerus vermicularis 72C 78C
Portulaca oleracea 72C 78C
Sesuvium portulacastrum 65S 72C 78C
Cakile lanceolata 72C 78C (seedling)
Bursera simaruba 72C (seedling)
Euphorbia blodgettii 72C 78C
Euphorbia mesembrianthemifolia 72C 78C
Euphorbia sp. 60S 62S
* *Terminalia catappa* 72C (seedling)
Ipomoea pes-caprae 72C (seedling)
Ipomoea sp. 65S
Tournefortia gnaphalodes 65S 72C 78C (seedling)
Eclipta alba 78C
Wedelia trilobata 72C

Salvin visited South Water Cay in May 1863 and collected birds (Coues 1864, p.391).

Curlew Cay (16°47½'N, 88°05'W)

Owen (1830) noted bushes 6 m tall here, at a time when Curlew Cay must have closely resembled Carrie Bow Cay. In 1960 and 1961, however, the island was a low crescentic sandbore 36 m long and up to 9 m wide. It was unvegetated apart from two *Rhizophora* seedlings. There is extensive beachrock east of the present site of the cay. The date of destruction of the vegetated island is unknown; it may have been during the 1945 hurricane. The sandbore disappeared after Hurricane Hattie,

but had reappeared by April 1962. It was present in 1972, but clearly still ephemeral and of fluctuating dimensions. Its area in 1960 was 370 sq m. Only one species of plant is recorded:

Rhizophora mangle 60S

For further details see Stoddart (1963, p.58, fig. 34). Salvin visited this island in 1863 and collected birds (Coues 1864, p.391).

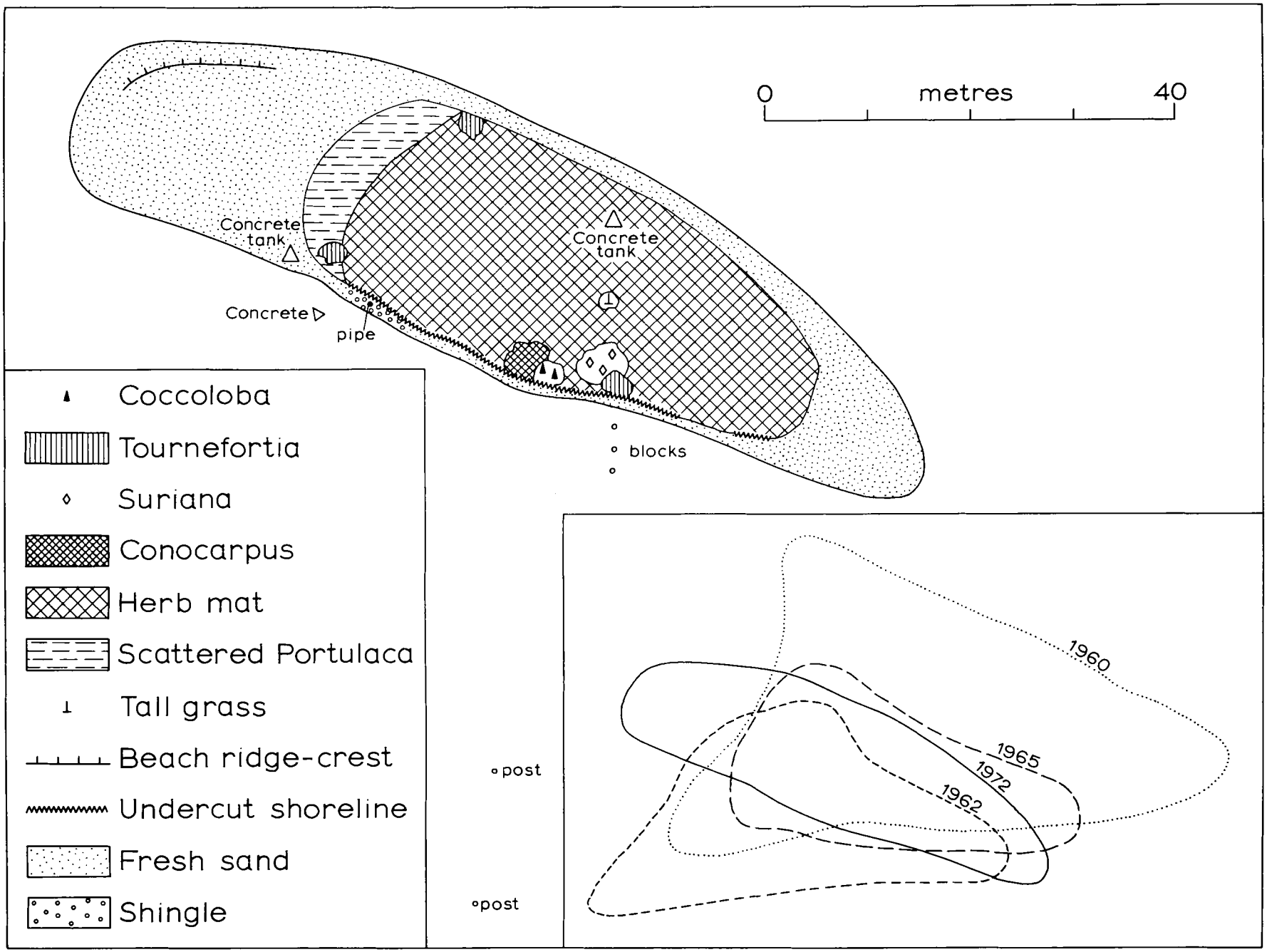


Figure 3. Sergeant's Cay 1972

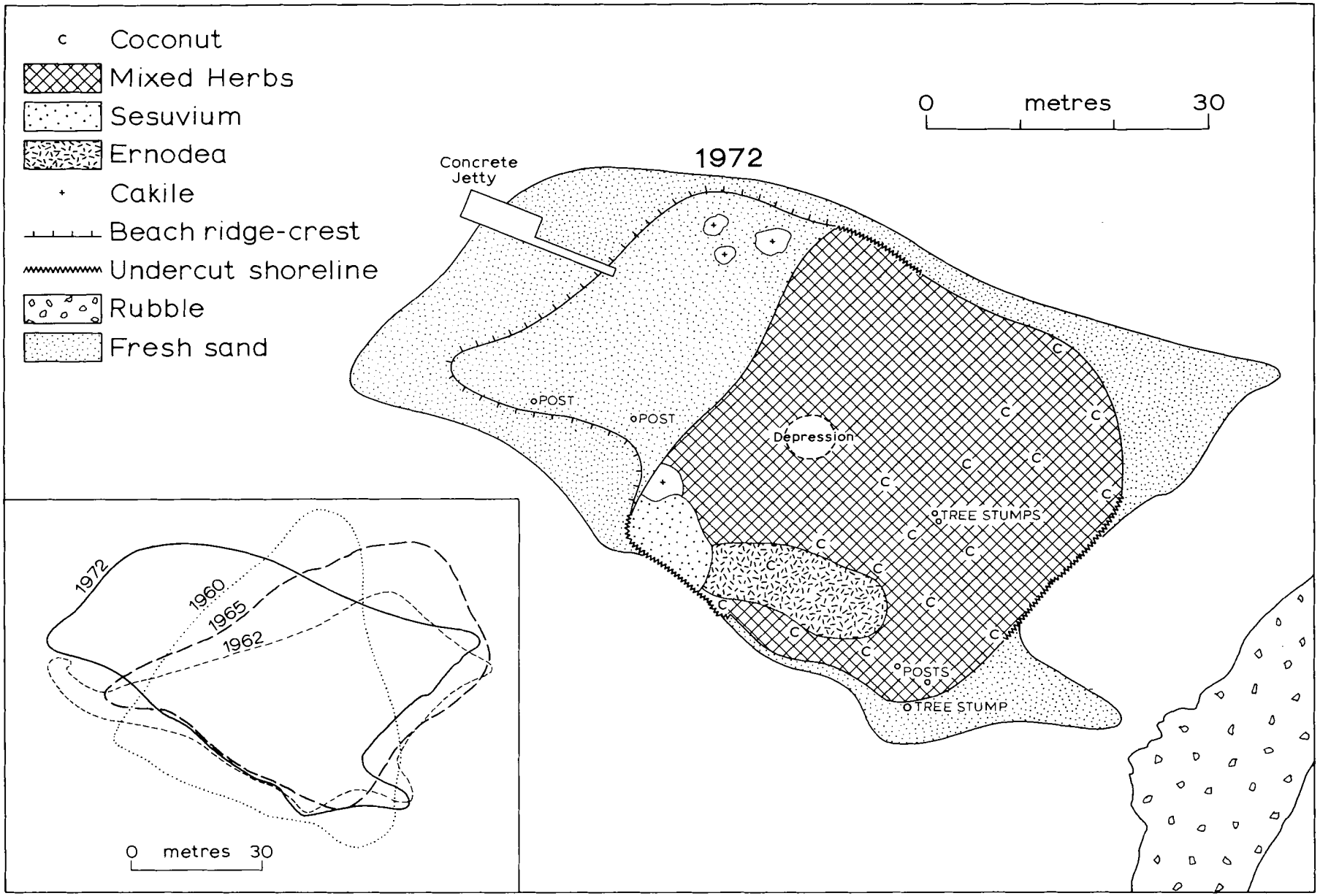


Figure 4. Goff's Cay 1972

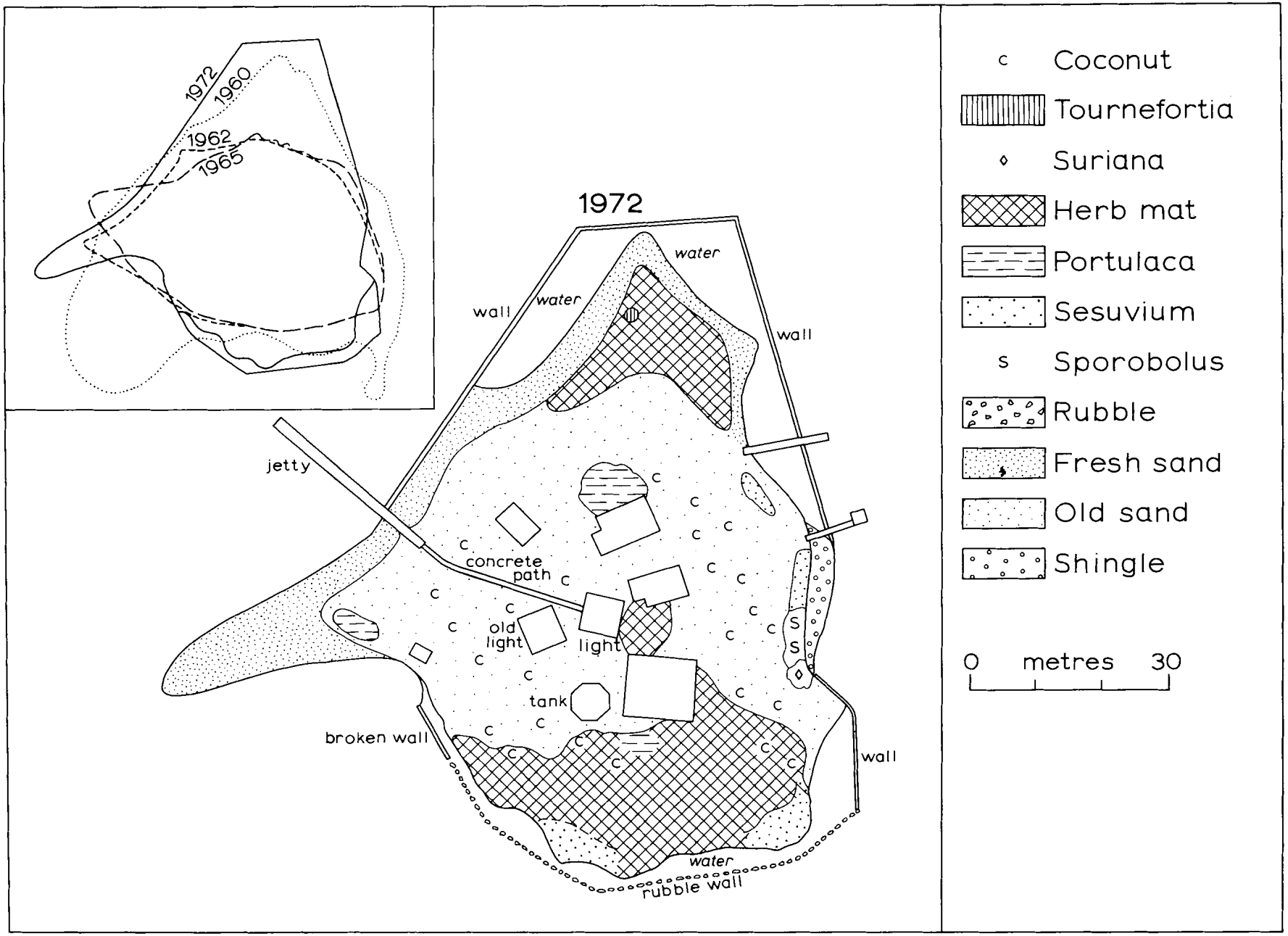


Figure 5. English Cay 1972

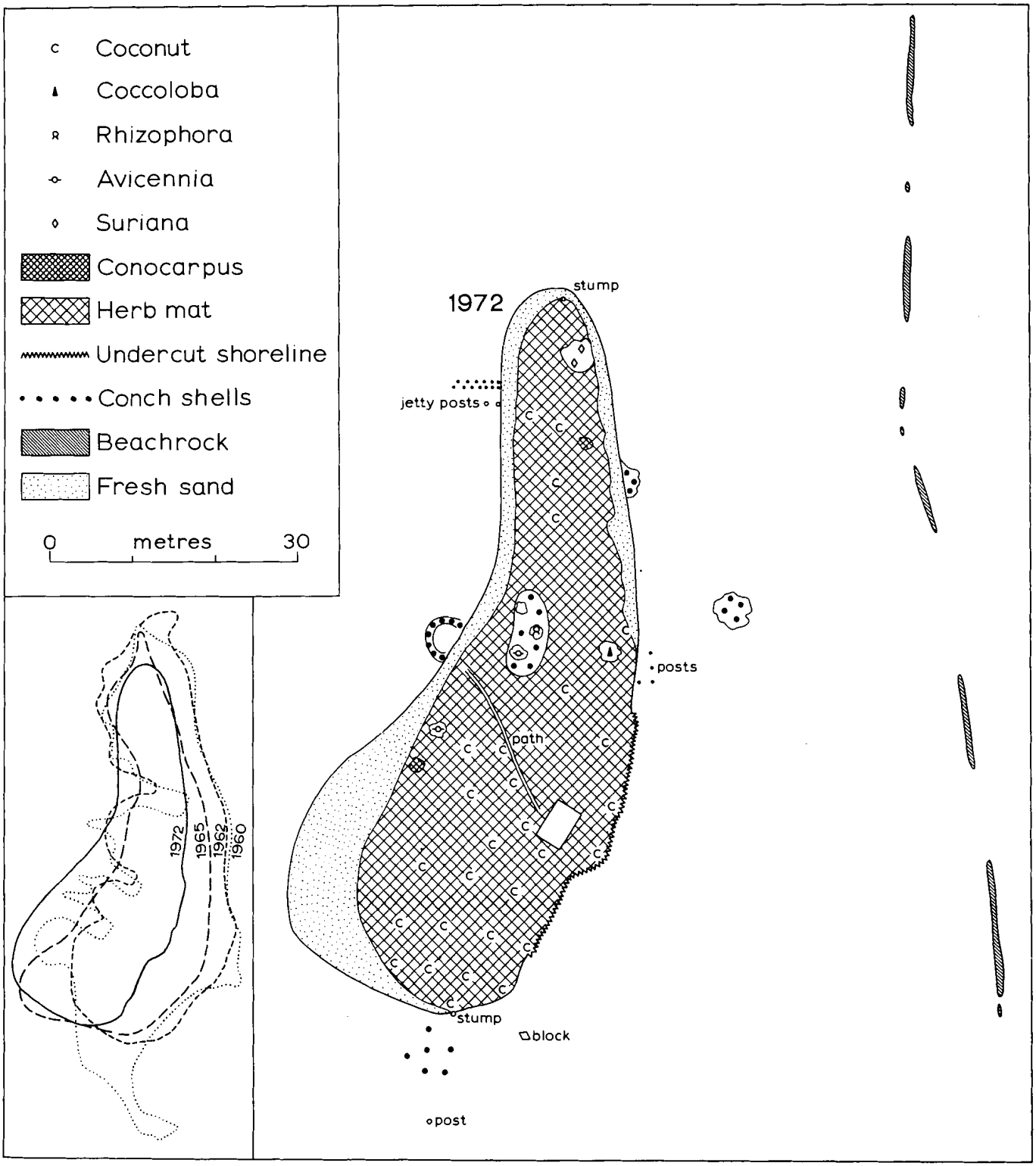


Figure 6. Rendezvous Cay 1972

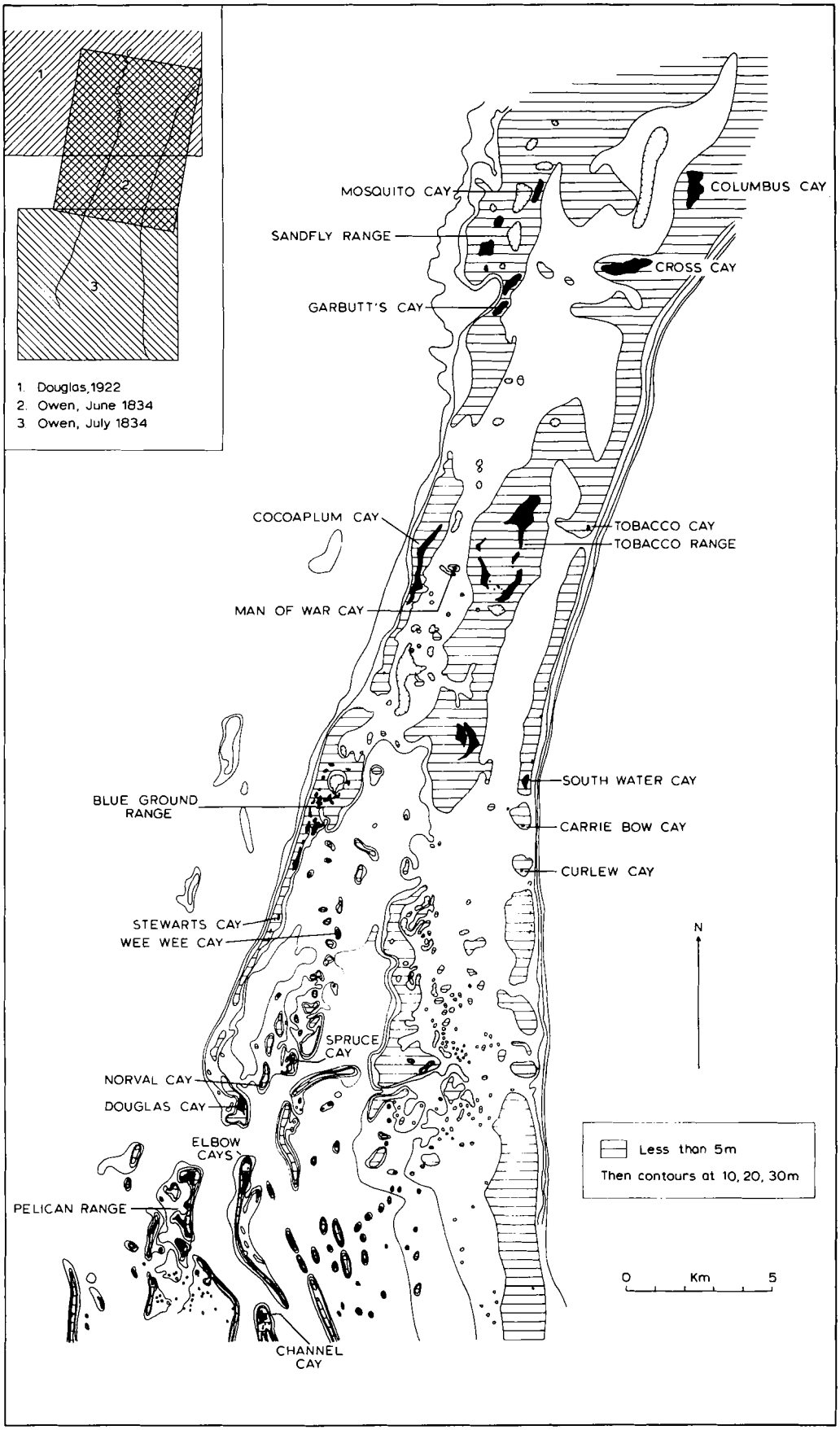


Figure 7. Reef topography between Columbus Cay and Channel Cay

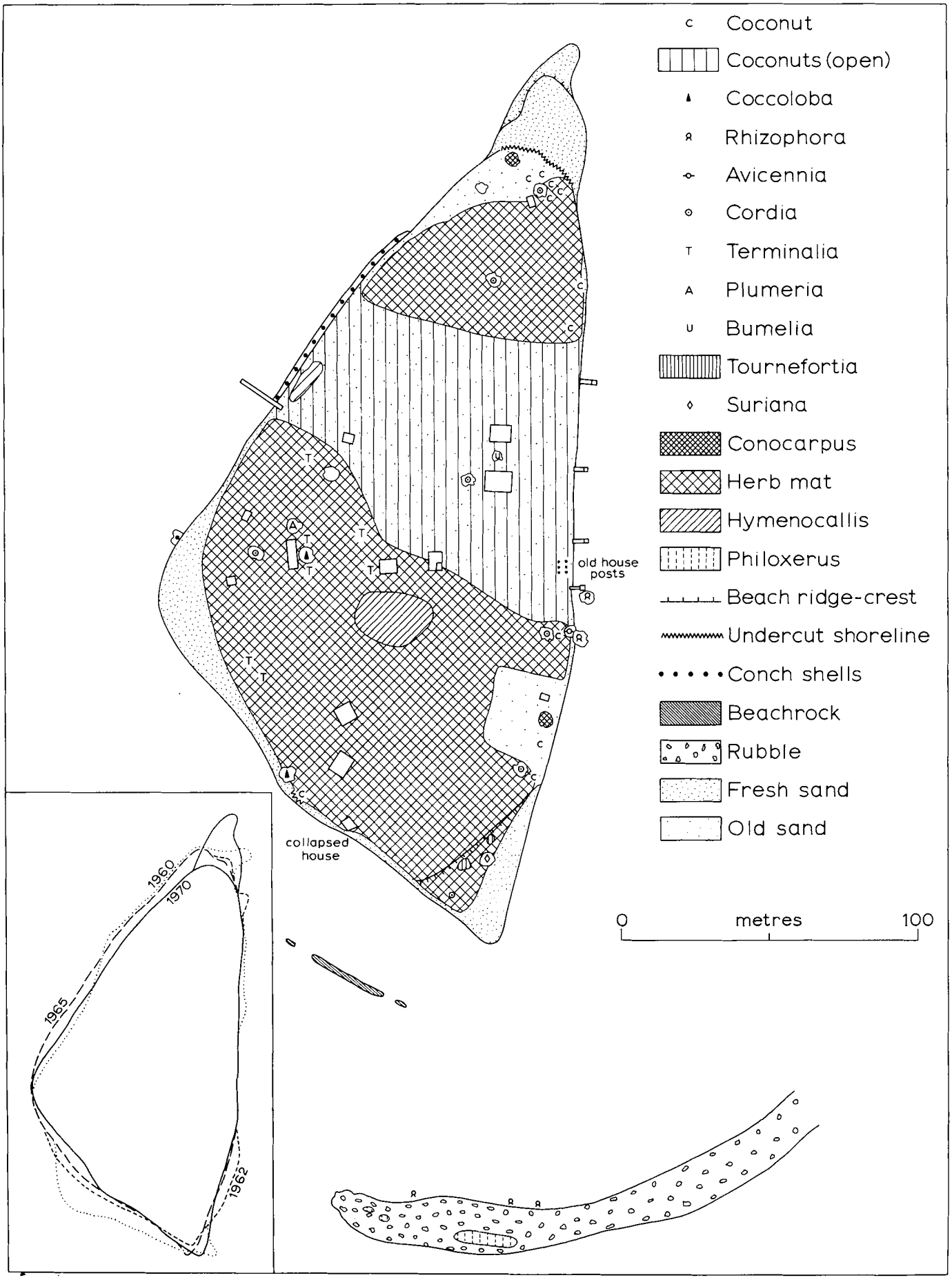


Figure 8. Tobacco Cay 1972

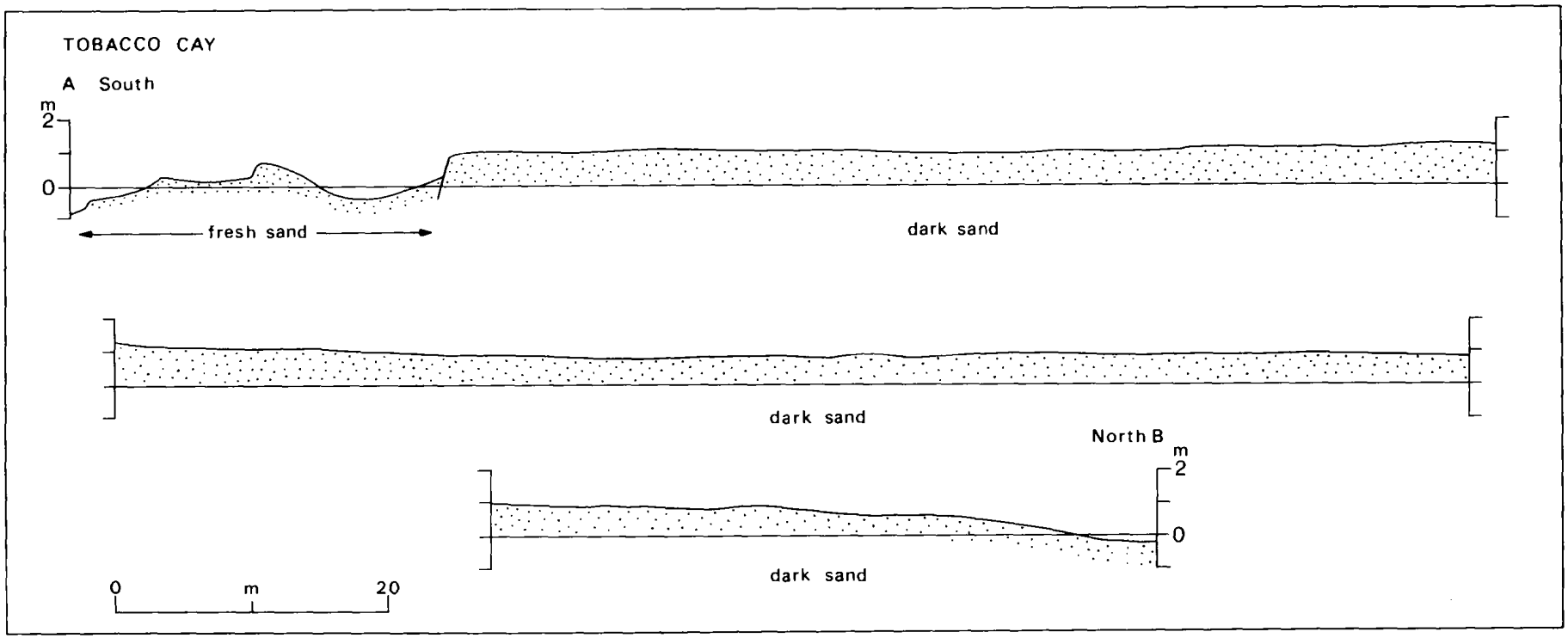


Figure 9. North-south profile of Tobacco Cay 1960

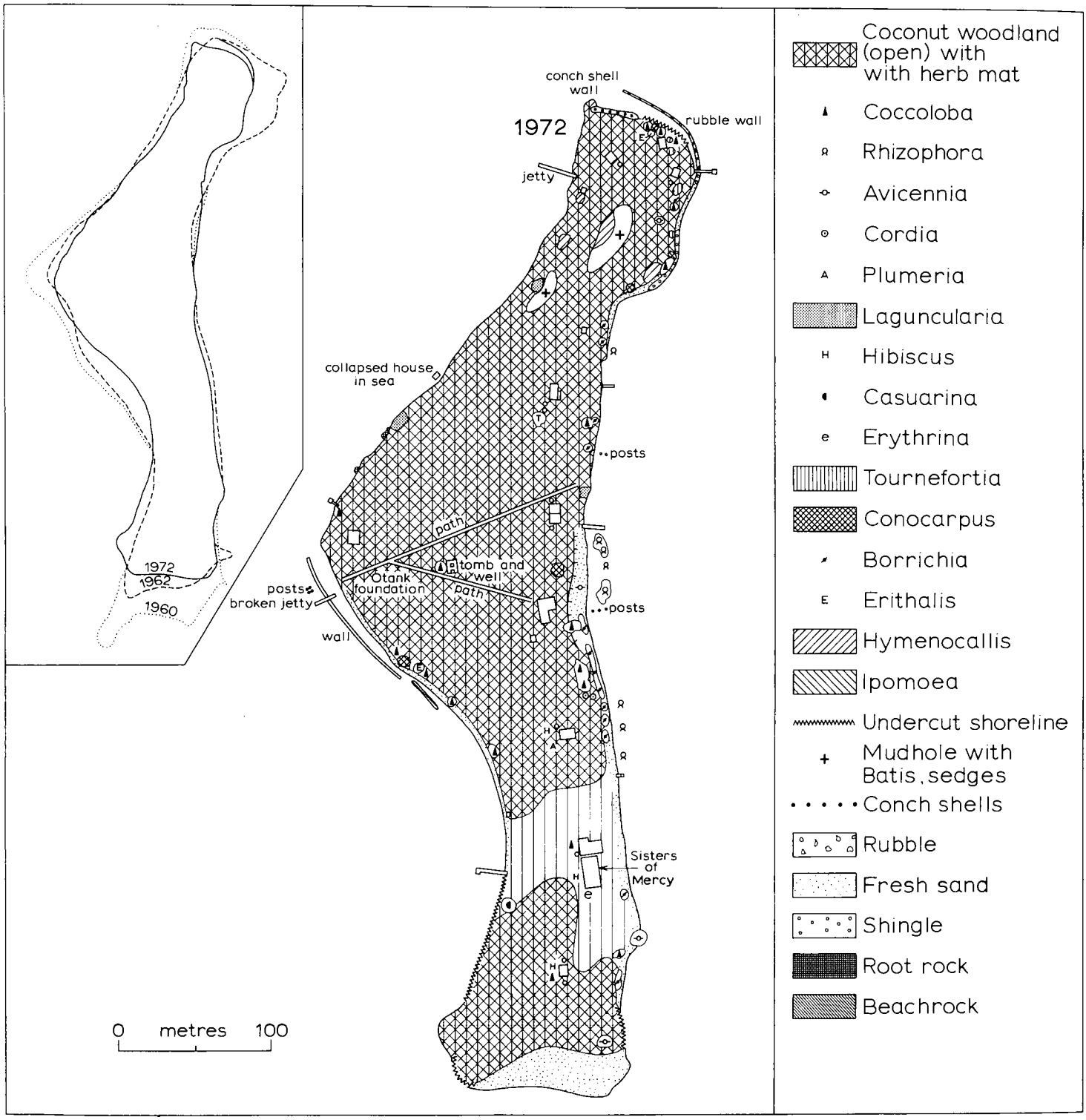


Figure 10. South Water Cay 1972

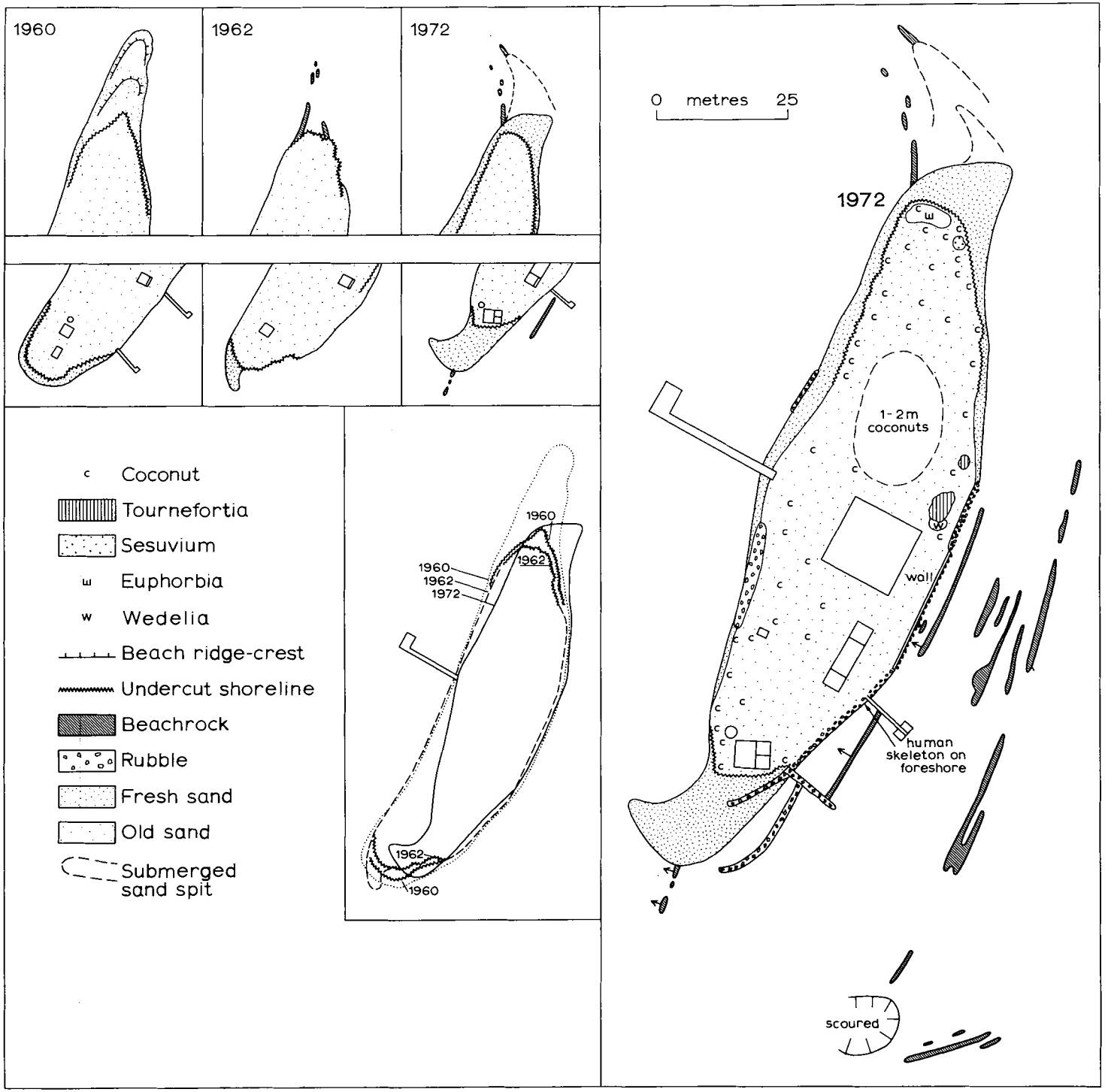


Figure 11. Carrie Bow Cay 1972

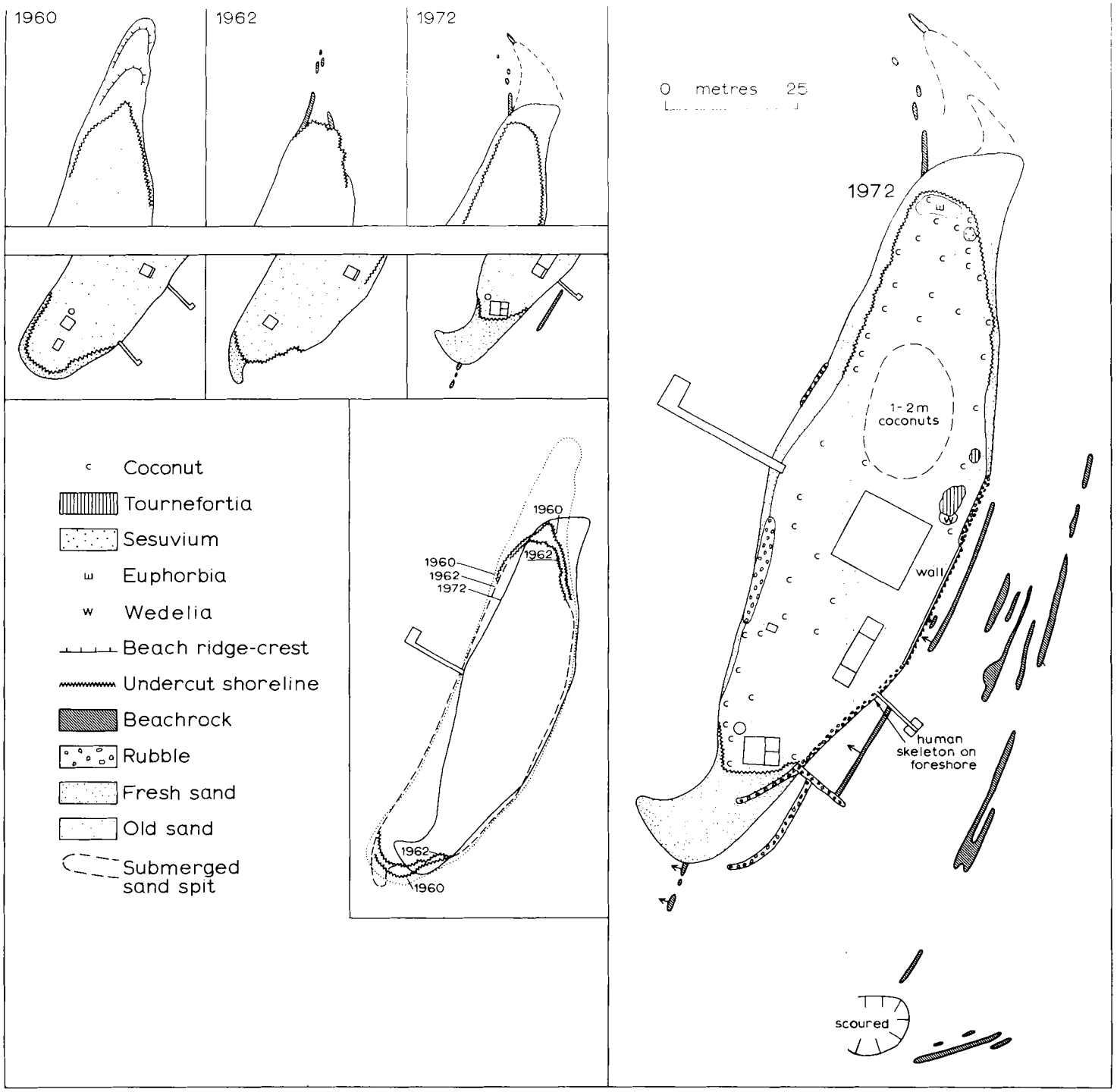


Figure 11. Carrie Bow Cay 1972

Plate 1. Paunch Cay: aerial view from the southeast 1961

Plate 2. St George's East Cay: aerial view from the northwest 1961

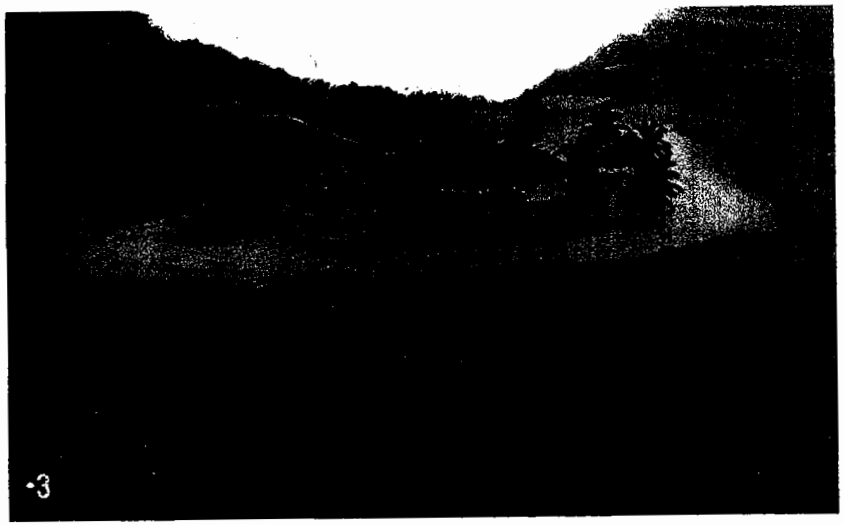
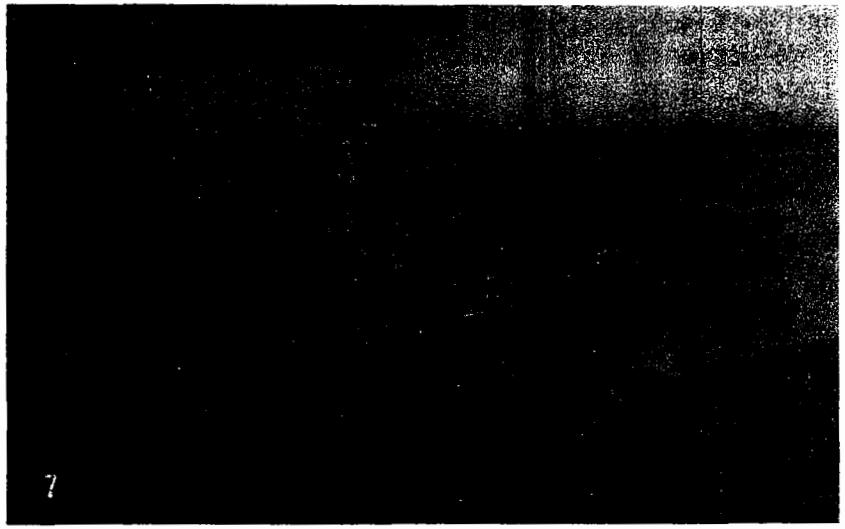
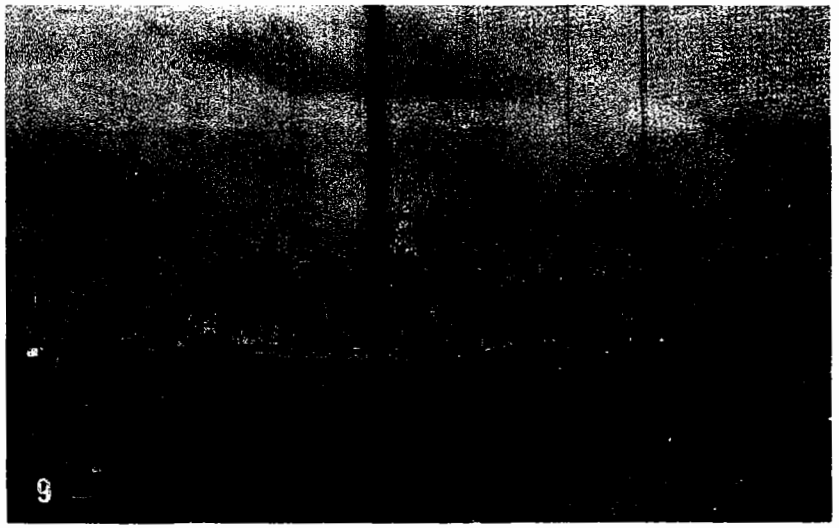
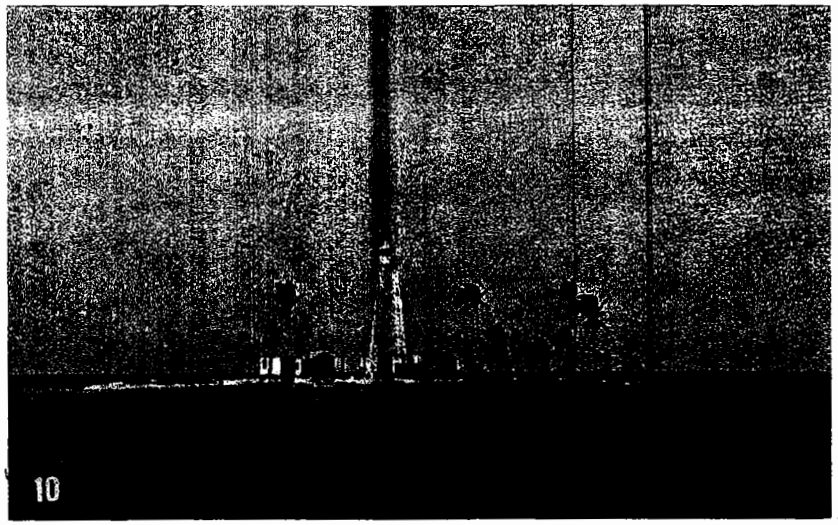


Plate 3. Sergeant's Cay: aerial view from the east 1961
Plate 4. Sergeant's Cay: aerial view from the east 1962
Plate 5. Goff's Cay: aerial view from the east 1961
Plate 6. Goff's Cay: aerial view from the east 1962







Plates 7 and 8. English Cav: rial views from the southeast 1961 and 1962

Plates 9 and th 1961 and 1962

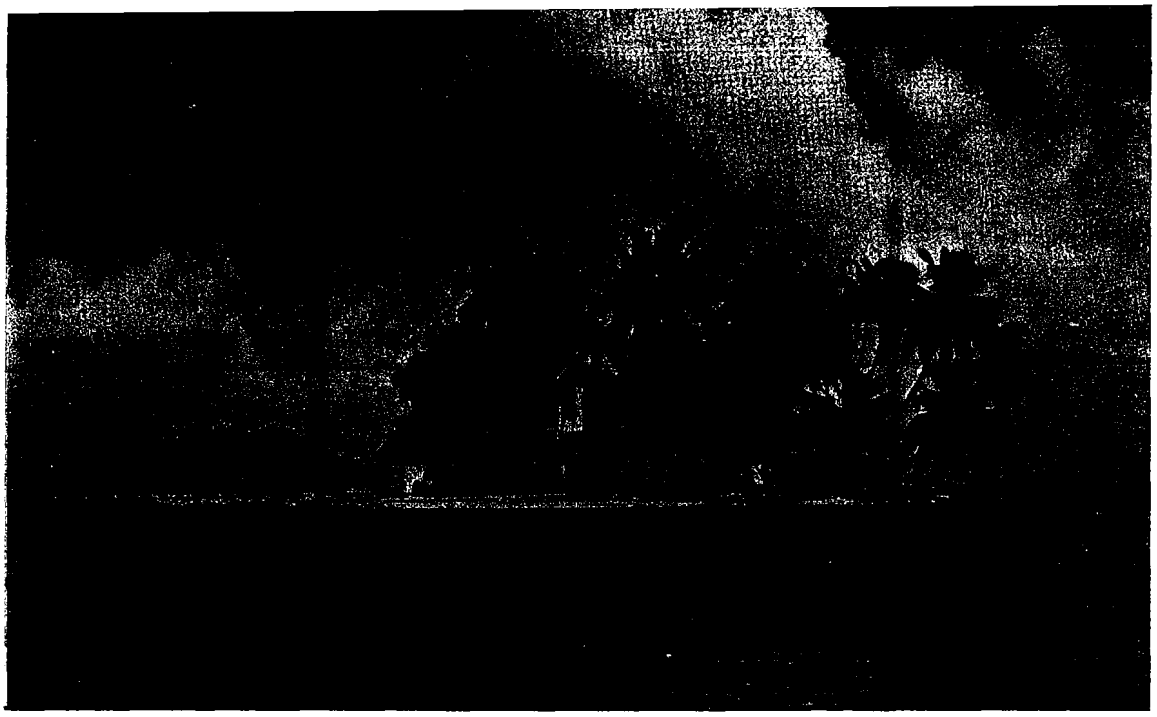


Plate 11. Rendezvous Cay from the south 1960

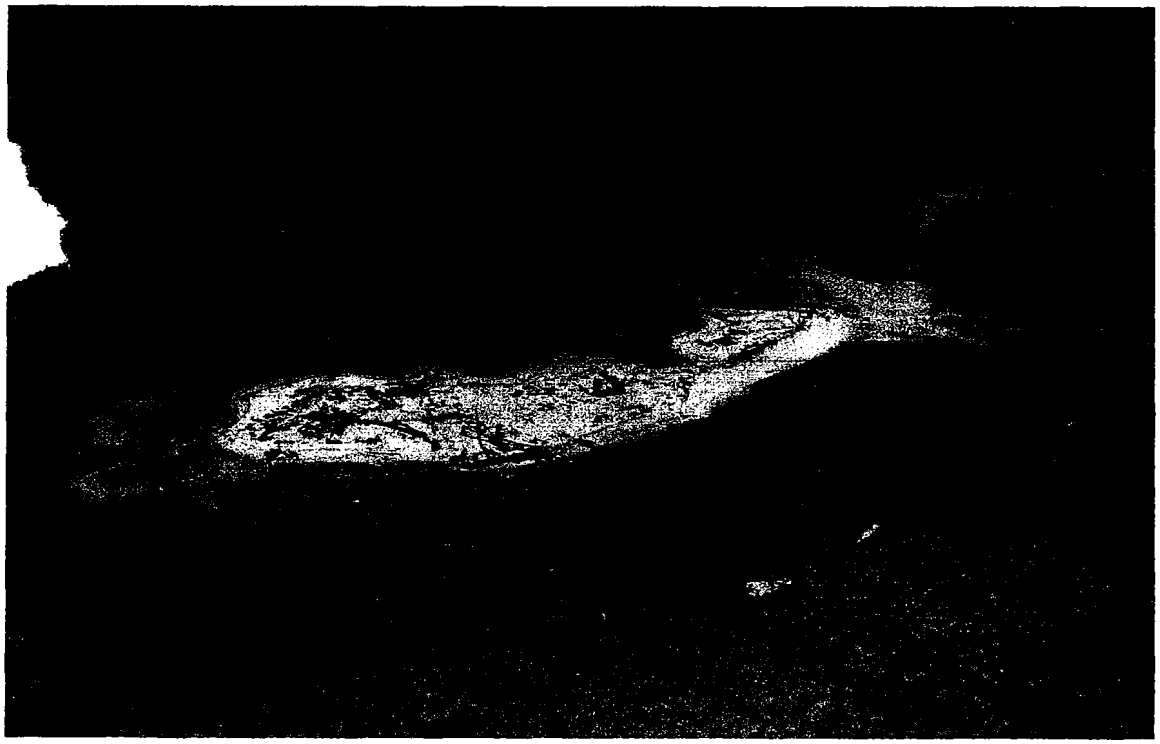


Plate 12. Rendezvous Cay: aerial view from the southeast 1962

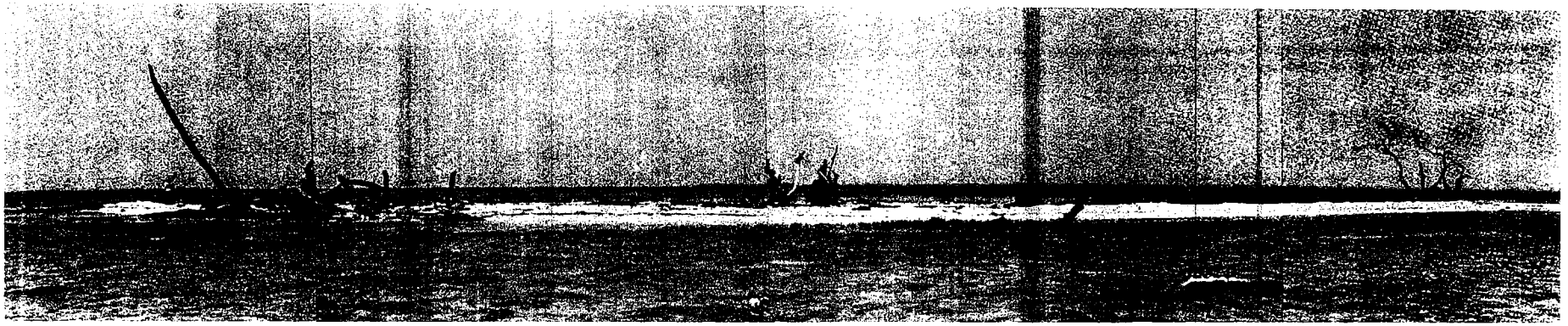


Plate 13. Rendezvous Cay from the east 1962

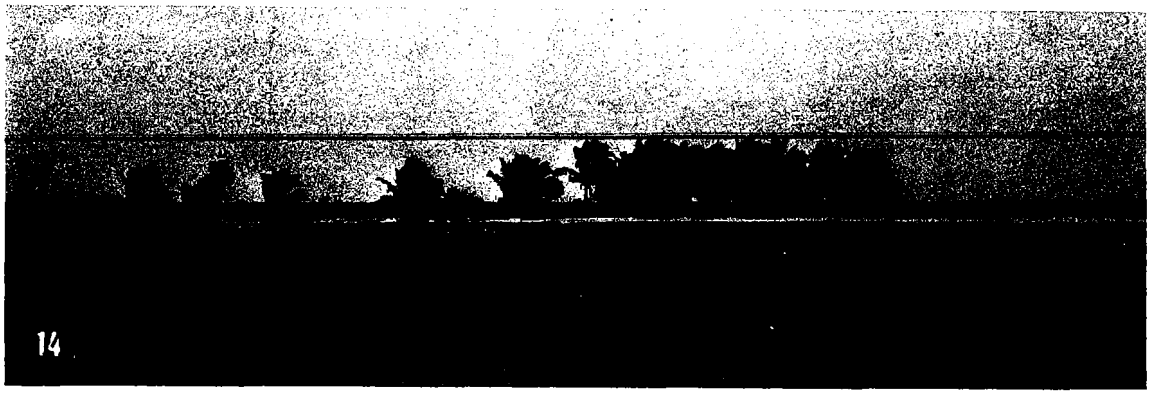


Plate 14. Rendezvous Cay from the west 1972
Plate 15. Rendezvous Cay from the southwest 1972
Plate 16. Cay Glory: aerial view from the east 1961

Plate 17. Rendezvous Cay: erosion on the east shore 1972

Plate 18. Rendezvous Cay: aggradation on the southwest shore 1972

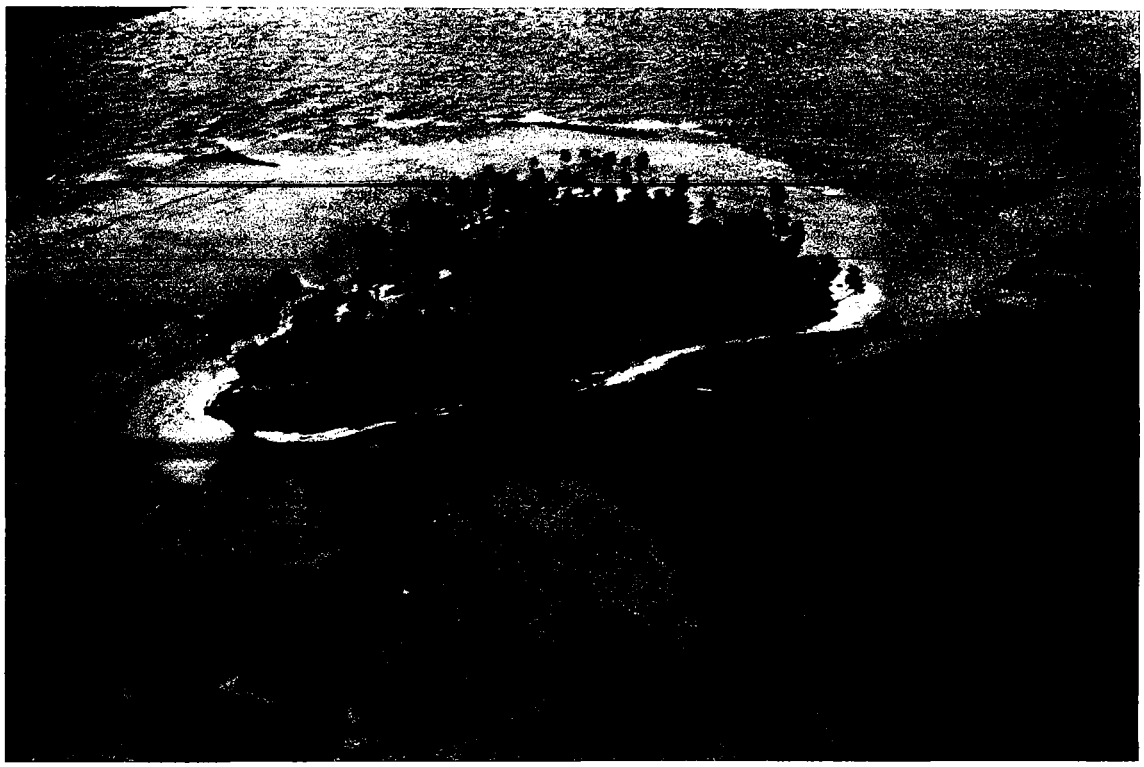


Plate 19. Tobacco Cay: aerial view from the northwest 1960

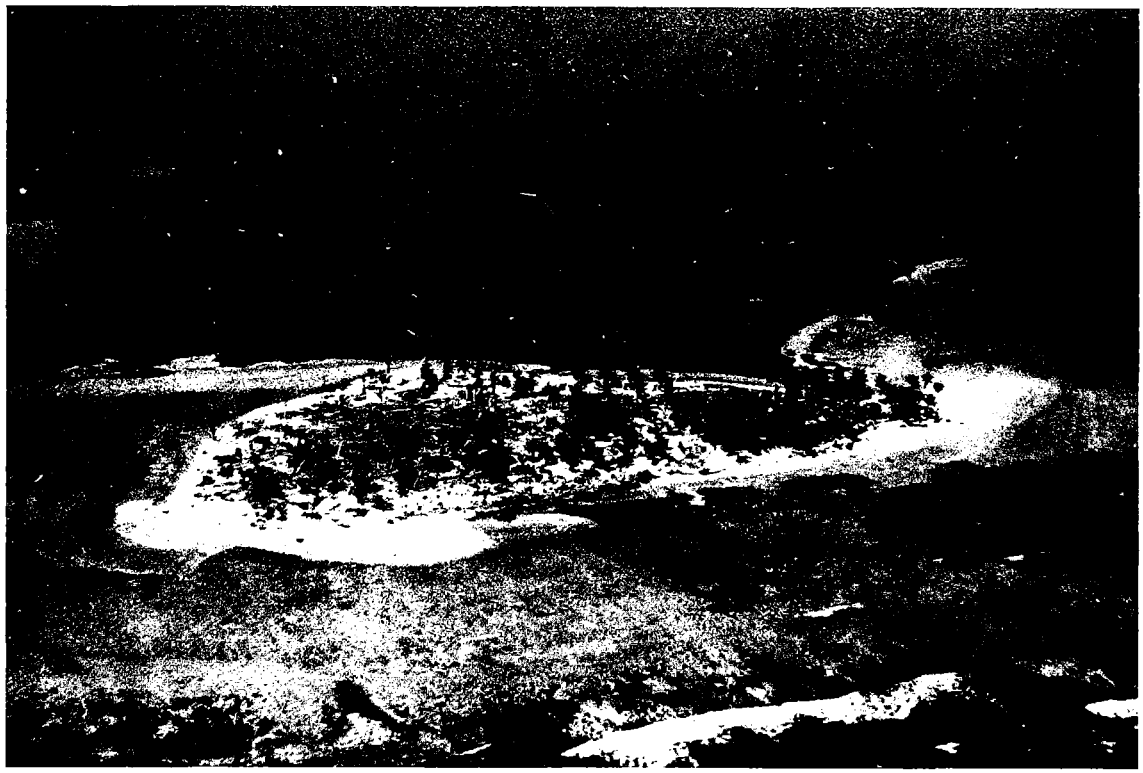


Plate 20. Tobacco Cay: aerial view from the east 1962

Plate 21. Tobacco Cay from the south, seen from the reef-crest rubble ridge 1960

Plate 22. South Water Cay: aerial view from the south 1961

Plate 23. South Water Cay: aggradation at the southwest point 1972

Plate 24. South Water Cay: erosion on the northwest shore 1972

Tournefortia and *Suriana*, and the ground cover included *Sesuvium, Ipomoea, Portulaca* and *Hymenocallis*. There were three young coconuts. No beachrock was seen during either survey. Altogether 13 species of plants have been recorded, 9 in 1961 and 12 in 1972. New records in the second survey included *Portulaca, Hymenocallis, Cocos* and *Paspalum; Erithalis* disappeared. The species recorded are as follows:

Paspalum distichum 72C
Cyperus planifolius 72C
Cyperus sp. 61S
**Cocos nucifera* 72S
Hymenocallis littoralis 72C
Portulaca oleracea 72C
Sesuvium portulacastrum 61S 72C
Suriana maritima 61S 72C
Rhizophora mangle 61S 72C
Conocarpus erectus 61S 72C
Ipomoea macrantha 72C
Ipomoea sp. 61S
Tournefortia gnaphalodes 61S 72C
Avicennia germinans 61S 72C
Erithalis fruticosa 61S

Middle Silk Cay (16°28'N, 88°02½'W) Figure 13, Plate 34

Middle Silk lies about 300 m southwest of North Silk Cay. In 1961 it was oblong in shape, with maximum dimensions of 80 x 45 m and an area of 0.43 ha. It was built of concentric sand ridges rising about 1 m above sea level, with sand spits extending to southeast, northeast and northwest. It stands on a small patch reef, the windward crest of which is outlined by emergent rubble. Relict beachrock off the southern side of the island indicated northerly migration of at least 50 m. The vegetation cover was restricted to a cluster of *Tournefortia* and *Suriana* bushes at the eastern end of the cay, some scattered shrubs of *Suriana*, and a few coconuts, with a ground cover of *Sesuvium, Ipomoea* and *Euphorbia*. By June 1972 there had been considerable changes. The island was now triangular, with a cliffed southern shore and aggradation on the northern side; one line of old beachrock was visible, passing beneath the cay sands. The area was reduced to 0.40 ha, but the vegetation cover had substantially increased. It was dominated by *Tournefortia, Suriana* and *Conocarpus* bushes, with three tall coconuts and about 20 recently planted juveniles. The ground surface was covered with *Euphorbia, Sesuvium, Ipomoea, Cyperus, Wedelia* and *Erithalis*. A temporary hut had been constructed in the middle of the island. Six species of plants were seen in 1961 and 7 more in 1972, making a total flora of 13 species:

Eragrostis prolifera 72C
Paspalum distichum 72C
Cyperus planifolius 72C
**Cocos nucifera* 61S 72S
Sesuvium portulacastrum 61S 72C
Suriana maritima 61S 72C
Euphorbia mesembrianthemifolia 72C
Conocarpus erectus 72C
Ipomoea macrantha 72C
Ipomoea pes-caprae 72C
Ipomoea sp. 61S
Tournefortia gnaphalodes 61S 72C
Erithalis fruticosa 72C
Wedelia trilobata 72C

South Silk Cay (16°27½'N, 88°03'W) Figure 14, Plates 30 and 35

South Silk Cay is situated 460 m southwest of Middle Silk Cay, and like it is built wholly of sand. In 1961 it was a lens-shaped island 90 m long and up to 32 m wide, with an area of 0.17 ha. Its surface stood about 1 m above sea level. It was covered by a scrub of *Suriana*, with *Hymenocallis* and *Sesuvium*, and less than a dozen scattered coconuts. There was a single *Coccoloba* tree at the eastern end. By June 1972 the island was of similar shape but had changed its orientation and location. The vegetated area had been eroded and cliffed at its eastern end, and then extended by a broad sandspit. The cay was then 110 m long and 30 m wide, with an area of 0.23 ha. The single *Coccoloba* tree survived, and as before the dominant vegetation was of *Suriana, Hymenocallis* and *Sesuvium*. There were six coconuts. No beachrock was seen during either survey. The extent of *Hymenocallis* is of particular interest on this cay. Five species of plants were noted in 1961 and a further four in 1972, giving a total of 9 for the island:

Eragrostis prolifera 72C
Cyperus planifolius 72C
**Cocos nucifera* 61S 72S
Hymenocallis littoralis 61S 72C
Coccoloba uvifera 61S 72C
Portulaca oleracea 72C
Sesuvium portulacastrum 61S 72C
Suriana maritima 61S 72C
Euphorbia mesembrianthemifolia 72C

Samphire Cay (16°26½'N, 88°03'W)

This was charted by Barnett in 1840, 1.6 km south of South Silk Cay, but had disappeared by 1913. It has not been seen since. It was apparently vegetated and must have resembled the Silk Cays. "Samphire" usually denotes *Sesuvium portulacastrum* in this area.

Round Cay (16°25'N, 88°05'W) Figures 15 and 17, Plate 31

Round Cay stands on a patch reef at the inner edge of the barrier platform, about 1.6 km from the shelf edge. In 1960 it was a lens-shaped island 120 m long, up to 45 m wide, and with an area of 0.25 ha. The northern and southern shores consisted of ridges of shingle and rubble, with coral boulders up to 0.3 m in diameter. The ridges rose to 1.8 m above sea level; the centre of the island, of sand and fine shingle, stood at about 1.5 m. The eastern end of the island was formed by a broad sand beach, overlooking a zone of broken intertidal rubble. The island was covered with a dense coconut woodland with marginal *Tournefortia* and *Suriana*. Under the coconuts there was a thick cover of *Hymenocallis* and grasses. There were two lines of beachrock along the southern shore. By 1972 the island had extended to 110 x 40 m, and its area increased to 0.31 ha. The southern shingle

shore had extended to cover the beachrock, and the eastern sand beach to largely cover the rubble zone. The island continued to be covered with a coconut woodland with *Hymenocallis* beneath. The marginal *Tournefortia* was much less extensive, however, presumably as a result of substrate erosion; and there was a large clump of *Conocarpus* at the south point. Nine species were noted in 1960 and 15 in 1972, giving a total flora of 16 species; only one (*Cakile lanceolata*) had disappeared between the surveys. Species recorded are:

Paspalum distichum 72C
Paspalum sp. 60S
Cyperus planifolius 72C
Cyperus sp. 60S
**Cocos nucifera* 60S 72C
Hymenocallis littoralis 60S 72C
Ficus sp. 72C
Rivina humilis 72C
Portulaca oleracea 72C
Sesuvium portulacastrum 60S 72C
Cakile lanceolata 60S
Suriana maritima 60S 72C
Euphorbia mesembrianthemifolia 72C
Euphorbia sp. 60S
Conocarpus erectus 72C
Ipomoea macrantha 72C
Ipomoea pes-caprae 72C
Tournefortia gnaphalodes 60S 72C
Morinda citrifolia 72C

Pompion Cay (16°24'N, 88°06½'W) Figures 16 and 17, Plates 32 and 40

Pompion Cay, like Round Cay, is situated on a reef patch rising from the inner edge of the barrier platform, 3.2 km southwest of Round Cay. It stands about 1.6 km from the seaward edge of the barrier platform, and with the exception of four small patch reefs nearby it is the only reef to reach the surface between Round and Ranguana Cays, a distance of 11.5 km. When the island was mapped in 1960 it was of simple outline, 115 m long and up to 50 m wide, with an area of 0.35 ha. The eastern end of the cay was low and sandy; the northern and western shores are built of shingle and rubble rising to 1.3 m above sea level. There was no beachrock. On the northwest side the beach crest was colonised by a mat of *Sesuvium* with scattered *Tournefortia*. To the northeast there is a clump of *Coccoloba*, and along the south shore mature trees of *Bursera* and *Cordia*. The main part of the cay was under coconut woodland with a ground cover of *Hymenocallis*, *Erithalis* and *Cakile*. By 1972 the island had expanded, both by sand accretion at the east end and shingle accretion at the west end, to a total length of 123 m; it was slightly narrower (45 m maximum), and had an area of 0.42 ha. The *Coccoloba* clump and trees of *Bursera* and *Cordia* could still be located. The area of *Hymenocallis* beneath the coconuts had expanded and coalesced; the rest of the vegetated surface was covered with *Sesuvium*, *Cyperus* and *Euphorbia*. The area of coconut woodland was very similar to that of 1960. Hydrographic charts mark a prominent "White Rock" to the west of the cay. This is a small shingle island, 40 m in diameter and 1 m above sea level, built of *Acropora* sticks in concentric ridges, situated about 500 m to the west of the cay. It is not vegetated and owes its colour to guano staining. Eleven plant species were noted on Pompion in 1960 and 19 in 1972, giving a total of 21 species. Of those noted in 1960, *Cakile* and *Erithalis* were not found in 1972. The species recorded are as follows:

Sporobolus virginicus 72C
Cyperus planifolius 72C
**Cocos nucifera* 60S 72C
Hymenocallis littoralis 60S 72C
Ficus sp. 72C
Coccoloba uvifera 60S 72C
Philoxerus vermicularis 72C
Rivina humilis 72C
Portulaca oleracea 72C
Sesuvium portulacastrum 60S 72C
Cakile lanceolata 60S
Suriana maritima 60S 72C
Bursera simaruba 60S 72C
Euphorbia mesembrianthemifolia 72C
Euphorbia sp. 60S
Rhizophora mangle 72C (seedling)
Conocarpus erectus 72C
Ipomoea pes-caprae 72C
Cordia sebestena 60S 72C
Tournefortia gnaphalodes 70S 72C
Erithalis fruticosa 60S
Morinda citrifolia 72C (seedling)

Ranguana Cay (16°20'N, 88°09½'W) Figure 18, Plates 36, 41 and 42

Ranguana Cay stands on the north side of a channel (Ranguana Entrance) through the barrier platform, carrying 6.7 m of water. It is located on a patch reef at the lagoonward side of the barrier platform about 1.8 km from the seaward edge. Speer (1766, p.24) noted the island, "called by the Baymen Renegado Kay", and Jefferys marks both names on his 1775 chart. Barnett's survey in 1840 noted trees 15 m tall.

In 1960 the island was 255 m long, with a constant width of 55 m, and had an area of 1.33 ha. About 80 per cent of the total area formed a core of older darker sand with cliffed margins, extended southeastwards by a fresh sand spit with pioneer vegetation. The whole of the northeast shore was cliffed, with fallen coconuts; the island surface here is at its highest, reaching 1.5 m. The vegetated area is dominated by coconut woodland. *Suriana, Coccoloba* and more rarely *Tournefortia* were found along the northeast shore, with *Hymenocallis*, sedges and grasses beneath the coconuts. The fresh sand spit was colonised by young *Tournefortia, Euphorbia* and grasses. By 1972 the cay had been much eroded at its eastern end, though it still consisted of an older core area and a southeastern sand spit. Its length was reduced to 240 m and its area to 1.12 ha. Much of the margin of the core area was cliffed. The coconut woodland had a ground cover of *Euphorbia*, grasses and sedges, with patches of *Hymenocallis*. There were several clumps of *Coccoloba* near the north point, one collapsed into the sea as a result of shore erosion. The sand spit was colonised by *Sesuvium*. In both 1960 and 1972 there was a rubble ridge about 25 m long located 45 m northwest of the north point of the cay; in 1972 this was colonised by *Philoxerus*.

In 1972 there were 35 pelicans at the cay (on 3 July), 30 boobies, 6 frigates, 16 sooty terns, and several shorebirds. 11 species of plants were noted in 1960 and 22 in 1972, giving a total of 24. In addition, one moss was collected (*Bryum coronatum* Schwaegr., Spellman and Stoddart 124). The plants recorded are:

Eragrostis prolifera 60S 72C
Eustachys petraea 72C
Paspalum distichum 72C
Paspalum sp. 60S
Sporobolus virginicus 72C
Sporobolus sp. 60S
Cyperus planifolius 72C
Cyperus sp. 60S
**Cocos nucifera* 57S 60S 72S
Hymenocallis littoralis 60S 72C
Coccoloba uvifera 60S 72C
Philoxerus vermicularis 72C
Portulaca oleracea 72C
Sesuvium portulacastrum 72C
Cassytha filiformis 72C
Cakile lanceolata 72C
Sophora tomentosa 60C
Vigna luteola 72C
Suriana maritima 60S
Euphorbia blodgettii 72C
Euphorbia mesembrianthemifolia 72C
Euphorbia sp. 60S
Rhizophora mangle 72C (seedling)
Terminalia catappa 72C (seedling)
Ipomoea macrantha 72C
Tournefortia gnaphalodes 60S 72C
Stachytarpheta jamaicensis 72C
Wedelia trilobata 72C

North Spot (16°15'N, 88°11'W) Figure 19, Plates 37, 38 and 44

North Spot lies 10 km southwest of Ranguana Cay, on the south side of a channel through the barrier platform which carries 6.4 m of water. It stands on a patch reef about 360 m wide. When mapped in 1960 the island was a ridge of *Acropora* shingle 85 m long, with a maximum width of 27 m and an area of 0.05 ha. It was orientated northeast-southwest. It was covered with a thick mat of *Sesuvium, Portulaca* and *Ipomoea*, with a single juvenile coconut and some grasses. Barnett's survey in 1840 noted that the island was "very low sand with grass and clump of cocoas". Presumably the coconuts had been destroyed during a hurricane and the cay re-formed. In 1972 the geomorphology was transformed. North Spot was then a near-circular island, with greatest dimensions of 53 x 35 m, and an area (0.13 ha) double that of 1960. The surface was covered with a mat of *Sesuvium* over coarse rubble, with patches of *Ipomoea*. In addition there were single trees of *Rhizophora* and *Avicennia*, and a clump of *Tournefortia*. The surviving coconut was about 5 m tall. There was a flock of about 100 sooty terns on the island on 4 July 1972. Three species of plants were recorded in 1960 and 7 in 1972, giving a total of 8:

**Cocos nucifera* 60s 72S
Philoxerus vermicularis 72C
Portulaca sp. 60S
Sesuvium portulacastrum 60S 72C
Rhizophora mangle 72C
Ipomoea macrantha 72C
Ipomoea pes-caprae 72C
Tournefortia gnaphalodes 72C

Red Rock and Black Rock (16°14'N, 88°11½'W; 16°13'N, 88°11½'W) of charts are unvegetated rubble islets between North Spot and Tom Owen's Cays.

"Tom Owen's Cay" (16°12'N, 88°13'W) Figures 20 and 21

South of 16°15'N the history and nomenclature of the barrier reef cays becomes complex. Owen in his 1835 survey charted three islands near the major channel which intersects the barrier platform in latitude 16°11½'N. One on the north side he named Tom Owen's Cay; it was described as having "one Cocoa N. Tree & Shrubs". Two small un-named islands on the south side were described as having "one large tree and high shrubs" (on the west) and "grass and bushes" (on the east) (Admiralty Ms L45). The northern cay has now disappeared, though still marked on Admiralty Chart 1573, and the name Tom Owen's Cays is now given locally to the two southern islands. Both are conspicuous islands, the eastern cay with a cluster of tall coconuts, and the western with a larger coconut woodland.

The earlier nomenclature of these islands is uncertain. Speer in his sailing directions (1766, p.24) mentions "a Kay called Cohune's Kay; and a very remarkable small Kay, that has many tall Palmetoe Trees on it; which look like so many round balls hanging in the air". He states that "Cohune's Kay, and the easternmost of the Sappatilla Kays [i.e. Northeast Sapodilla Cay], are N. by E. and S. by W. of each other; distance about 5 miles". This would bring Cohune's Kay to the position of the former Tom Owen's Cay; Speer carefully described the deep channel lying between the two. "Cohune's Kay", he continues, "is full of bushes and trees. A little to the eastward of Cohune's Kay there are two Sand Boors; but they join to one another, and to Cohune's Kay by a Reef. You leave them on your starboard side; and on your larboard side, you leave a Sand Boor that has breakers all round it, and no bushes on it. And about two cable's length to the N.W. of this Sand Boor there is a small spot of Rocks, which breaks when it blows fresh. And to the eastwards of that Sand Boor there is another Boor. There is a channel between them of 2 1-half, and 3 fathom water" (1766, p.24). This would suggest the identity of Cohune's Kay with the present Tom Owen's West Cay, and that in the eighteenth century the present Tom Owen's East Cay was one of the sandbores joined to Cohune by a reef. In this case the "very remarkable small Kay" with palmettoes was probably old Tom Owen's Cay, now disappeared. Jefferys marks Cohune Kay on his 1775 chart, and immediately north of it, across a main channel, "Halls Key". Thus Hall's may also be tentatively identified with old Tom Owen's. We have no information on when, after 1835, this island disappeared; there is certainly no trace of it now.

Tom Owen's East Cay (16°11½'N, 88°13½'W) Figure 22, Plates 39, 43, 46 and 47

Tom Owen's East Cay is the smaller of the two. When mapped in 1960 it was triangular in shape, with sides 35-45 m long. It abuts on its north side on the reef-crest rubble zone, and the northwest and northeast shores were built of shingle. Most of the cay was built of sand, however, rising up to 1 m above sea level. There were four

tall coconuts on the island, and a number of smaller ones, together with a scrub of *Tournefortia* and *Coccoloba* and extensive *Hymenocallis* and *Sesuvium*. The island had changed considerably by 1972. The old island had been eroded and then extended southwards by a new sand spit. The area had increased from 0.10 to 0.12 ha. The area of *Coccoloba* had greatly increased, and there was also a patch of *Conocarpus*. Otherwise the vegetation resembled that in 1960. No beachrock was seen in either survey. In 1972 the area of rubble along the north shore was much more extensive than in 1960, and probably represented a hurricane event.

Ten plant species were recorded in 1960 and 11 in 1972, giving a total of 15. The following are recorded:

Paspalum distichum 72C
Sporobolus virginicus 72C
Cyperus planifolius 72C
Cyperus sp. 60S
**Cocos nucifera* 60S 72S
Hymenocallis littoralis 60S 72S
Coccoloba uvifera 60S 72C
Philoxerus vermicularis 72C
Portulaca oleracea 72C
Portulaca sp. 60S
Sesuvium portulacastrum 60S 72C
Bursera simaruba 60S
Euphorbia mesembrianthemifolia 72C
Euphorbia sp. 60S
Conocarpus erectus 72C
Tournefortia gnaphalodes 60S
Erithalis fruticosa 60S
Wedelia trilobata 60S

Tom Owen's West Cay (16°11½'N, 88°14'W) Figure 23, Plates 45, 46 and 48

In 1960 Tom Owen's West Cay was about 90 m long and 35 m wide; it had an area of 0.26 ha. It was fringed along its northern side by a zone of coral rubble, and both north and south shores were formed of shingle. The interior was sandy with occasional blocks of coral rubble, and there were sand beaches at both east and west ends. The general surface stood about 1 m above sea level. The island was covered with coconut woodland, especially dense at the western end, with an undercover of *Wedelia, Cakile, Ambrosia, Sesuvium, Euphorbia*, sedges and grasses. There was some marginal *Coccoloba, Conocarpus* and *Tournefortia*. No beachrock was seen. The island remained very much the same in 1972, with rather minor changes in outline; the area had decreased to 0.24 ha. It was still covered with coconut woodland, but *Conocarpus* and *Caesalpinia* appeared much more extensive. *Cordia* survived from 1960 on the south shore. *Portulaca* was extensive on the windward beach crests. Fifteen species of plants were recorded in 1960 and 17 in 1972, giving a total of 22:

Paspalum distichum 72C
Paspalum sp. 60S
Sporobolus virginicus 72C
Sporobolus sp. 60S
Cyperus planifolius 72C
Cyperus sp. 60S
**Cocos nucifera* 60S 72S
Coccoloba uvifera 60S 72C
Iresine diffusa 72C
Rivina humilis 72C
Portulaca oleracea 72C
Portulaca sp. 60S

Sesuvium portulacastrum 60S 72C
Cakile lanceolata 60S
Caesalpinia bonduc 72C
Canavalia rosea 60S
Thespesia populnea 72C
Rhizophora mangle 60S 72C
Conocarpus erectus 60S 72C
Ipomoea macrantha 72C
Ipomoea pes-caprae 72C
Tournefortia gnaphalodes 60S 72C
Lippia nodiflora 72C
Erithalis fruticosa 60S
Ambrosia hispida 60S
Wedelia trilobata 60S

One of the present Tom Owen's Cays was visited by the Marshall Field Expedition in 1923, when K.P. Schmidt and L.L. Walters collected two lizards (*Aristelliger georgeensis* and *Anolis sagrei*) (Schmidt 1941).

Cays between Tom Owens Cays and Northeast Sapodilla Cay Figures 20 and 21

Owen in 1835 (Admiralty MS L45) charted two small islands lying respectively 3.2 and 4 km southsouthwest of the present Tom Owen's Cays. The northern island had "dry sand, one Cocoa N. Tree and Shrubs"; the other "Dry Sand, 2 Cocoa N. Trees, Shrubs & bushes". They were situated on the south side of the main channel between Tom Owen's and Northeast Sapodilla Cays, and are probably the "Sand Boors" referred to by Speer (1766, p.24; quoted above). Both islands have now disappeared, though still marked on charts; when they were destroyed is not known.

The Sapodilla Cays Figures 20 and 21, Plate 49

The southern six kilometres of the barrier reef consists of a series of large shoal patches intersected by deep channels. The six islands now existing on these patches are termed the Sapodilla Cays (Admiralty MS L45, 1835) or Zapotilla Cays (Chart 1573), and there is some informal suggestion of a territorial claim to them by the Republic of Honduras (Aguilar Paz 1954). The main islands are here referred to as Northeast Sapodilla, Frank's, Nicolas, Hunting, Lime and Ragged Cays. Speer (1766, 24) refers to them as "six large Champaign Kays" [champaign: "an expanse of level, open country. Unenclosed or common land" (*Shorter Oxford English Dictionary*, I (1933), p.289)].

Northeast Sapodilla Cay (16°08'N, 88°15'W) Figure 24, Plates 50, 52 and 53

Northeast Sapodilla Cay, the most northerly, is a rectangular island with greatest north-south and east-west dimensions of 300 m. In 1960 its area was 4.79 ha. The seaward shore was formed by a shingle ridge rising 2 m above sea level, highest near the northeast point and declining southwards. The northwest and southwest beaches are formed by low sand ridges. The centre of the cay is low-lying and poorly drained. The main dry land areas were to leeward of the seaward

shingle ridge and at the west end of the cay. In the southeast bay there are 8, possibly 9, lines of relict beachrock, standing up to 30 m from the present beach; the outer lines carry up to 1 m of water. In 1960 there was a further patch of beachrock, 15 m long, poorly cemented, on the southwest shore. The low-lying centre of the island was occupied by hundreds of young coconut palms, surrounded by *Acrostichum aureum*. The sandy areas were occupied by taller coconut woodland. *Coccoloba* and *Thrinax* grew along the seaward beach crest. A large patch of rubble at the eastern point was colonised by *Sesuvium*. Little morphological change had occurred by July 1972 except for erosion along the northwest bay. This averaged 10 m and reached 20 m at one point, leaving a cliffed shore with fallen coconut trees. The southwest sandy shore had been covered with shingle for its entire length and the small beachrock exposure hidden. On the northeast shore the beach itself was formed of sand overlying the face of the high shingle ridge, and low beachrock was exposed for part of its length. The vegetation was observed in greater detail than in 1960. In the low-lying coconut woodland with *Acrostichum*, the dominant woody species beneath the coconuts was *Erithalis*. *Chrysobalanus* was common round the margins of the area on slightly higher ground, and individuals were scattered through the woodland itself. *Coccoloba, Conocarpus* and *Suriana* formed a littoral hedge on the beach crest round much of the windward side of the cay, but *Tournefortia* was surprisingly absent. Trees in the coconut woodland included *Ficus, Terminalia, Hibiscus tiliaceus,* and *Citharexylum caudatum*, this last forming trees 3-6 m tall near the south point. The island was inhabited in 1960 but had been abandoned by 1972, when the main house was in ruins and the jetty broken.

26 plant species were recorded in 1972, which with the six noted in 1960 brings the total recorded to 28:

Acrostichum aureum 60S 72C
Eragrostis prolifera 72C
Eustachys petraea 72C
Paspalum blodgettii 72C
Paspalum distichum 72C
Sporobolus jacquemontii 72C
Stenotaphrum secundatum 72C
Cyperus planifolius 72C
**Cocos nucifera* 60S 72S
Thrinax radiata 60S 72C
**Musa sapientum* 72C
Ficus sp. 72C
Coccoloba uvifera 60S 72C
Sesuvium portulacastrum 60S
Cakile lanceolata 60C
Chrysobalanus icaco 72C
Sophora tomentosa 72C
Suriana maritima 72C
Euphorbia blodgettii 72C
Hippocratea volubilis 72C
Hibiscus tiliaceus 72C
Passiflora suberosa 72C
Conocarpus erectus 72C
**Terminalia catappa* 72C
Citharexylum caudatum 72C
Stachytarpheta jamaicensis 72C
Erithalis fruticosa 72C
Wedelia trilobata 72C

Frank's Cays (16°08'N, 88°15'W) Figure 25, Plate 54

Owen in 1835 charted a single island 0.5 km south of Northeast Sapodilla Cay, named "Grass Cay", and this is marked on Admiralty Chart

1573. Three islands now exist at this point and are known as Frank's Cays: a main island (Frank's Cay) and two smaller ones (Frank's Cay East, Frank's Cay West). Whether these have formed by fragmentation of the earlier island or whether the small cays have formed since 1835 is not known.

Frank's Cay in 1960 was 230 m long and up to 100 m wide. It was low and formed entirely of a dark sand. The beaches were low and uneroded. At the eastern end of the cay there was a dense belt of mangroves (*Rhizophora, Conocarpus, Laguncularia, Avicennia*). The rest of the island was covered with a dense coconut woodland with herbs and grasses. *Conocarpus, Coccoloba* and *Thrinax* were found around the shores. There were two patches of poorly cemented beachrock at the eastern end of the south shore. By 1972 much of the north shore was cliffed and a substantial area of mangroves at the northeast point had been destroyed. The area of the cay had declined from 1.94 ha to 1.76 ha. The eastern mangrove fringe was much narrower and consisted mainly of *Conocarpus* and *Laguncularia*. *Chrysobalanus, Pithecellobium* and *Thrinax* were common round the shores. The south shore beachrock was still exposed.

Frank's Cay East is separated from the main cay by a shallow channel 25 m wide. In 1960 it was an arcuate island 120 m long, but by 1970 the western embayment had been infilled and the shape of the island was more regular; the area had increased from 0.5 to 0.57 ha. None of the shores were undercut in 1960, but the northeast and southeast shores were cliffed in 1972. Mangroves fringe the west side of the cay. The rest is covered with coconut woodland, with much *Conocarpus, Laguncularia* and *Thrinax*. A continuous belt of *Coccoloba* along the northeast shore in 1960 had been reduced to two clumps in 1972, presumably by shore erosion.

Frank's Cay West lies 75 m southwest of the main cay, and in 1960 was a lens-shaped sandy island 70 m long with an area of 0.11 ha. It was covered with a thicket of *Conocarpus* and coconut; a single *Avicennia* was prominent on the northwest shore. This tree still existed in 1972 but the northwest shore was cliffed; the southeast shore had been colonised by *Rhizophora* immediately offshore. *Thrinax, Ficus* and *Laguncularia* were noted in addition to *Cocos* and *Conocarpus*.

31 plant species have been recorded from the main island (13 in 1960, 30 in 1972). In addition the moss *Calymperes richardii* C. Müll. was collected (Spellman and Stoddart 129a). Plants recorded are:

Andropogon glomeratus 72C
Eragrostis prolifera 72C
Eustachys petraea 60C 72C
Paspalum blodgettii 72C
Paspalum sp. 60S
Spartina patens 72C
Sporobolus virginicus 72C
Sporobolus sp. 60S
Stenotaphrum secundatum 72C
Cyperus peruvianus 60C 72C
Cyperus planifolius 72C
Fimbristylis cymosa 72C
**Cocos nucifera* 60S 72S
Thrinax radiata 60S 72C
Ficus sp. 72C
Coccoloba uvifera 60S 72C

Cakile lanceolata 60S
Chrysobalanus icaco 72C
Gliricidia sepium 72C
Pithecellobium keyense 72S
Sophora tomentosa 72C
Euphorbia blodgettii 72C
Euphorbia mesembrianthemifolia 72C
Euphorbia sp. 60S
Passiflora suberosa 72C
Rhizophora mangle 60S 72C
Conocarpus erectus 60S 72C
Laguncularia racemosa 60S 72C
* *Terminalia catappa* 72C
Avicennia germinans 72C
Lippia nodiflora 72C
Stachytarpheta jamaicensis 72C
Erithalis fruticosa 72C
Wedelia trilobata 60S 72C

Seventeen species are recorded from Frank's Cay East (12 in 1960, 11 in 1972). They include the uncommon orchid *Brassavola nodosa* from the *Rhizophora* at the easternmost point. Species recorded are:

Acrostichum aureum 72C
Andropogon sp. 60S
Eustachys petraea 60S
Paspalum sp. 60S
* *Cocos nucifera* 60S 72S
Thrinax radiata 60S 72S
Brassavola nodosa 72C
Coccoloba uvifera 60S 72S
Cakile lanceolata 60S
Pithecellobium keyense 72S
Euphorbia sp. 60S
Rhizophora mangle 60S 72S
Conocarpus erectus 60S 72S
Laguncularia racemosa 60S 72S
Avicennia germinans 60S
Erithalis fruticosa 72S

Twelve species are recorded from Frank's Cay West (9 in 1960 and 6 in 1972). They are:

Andropogon sp. 60S
Paspalum sp. 60S
Sporobolus sp. 60S
* *Cocos nucifera* 60S 72S
Thrinax radiata 72S
Ficus sp. 72S
Canavalia rosea 60S
Euphorbia sp. 60S
Rhizophora mangle 60S 72S
Conocarpus erectus 60S 72S
Laguncularia racemosa 72S
Avicennia germinans 60S

Nicolas Cay (16°07'N, 88°16'W) Figure 26, Plates 51 and 57

Nicolas Cay lies 2 km southsoutheast of Frank's Cays, on the northern side of a channel carrying 11 m of water. It is oval-shaped, and in 1960 had maximum dimensions of 310 x 190 m. There was some beach erosion at the north and southwest ends of the cay, but most of the shore is formed by a broad sand beach. No beachrock was exposed. By 1972 there had been considerable erosion, averaging 10-15 m, on all sides of the cay except the south and southeast. Shores were cliffed on the west and northeast sides, and a soft root filled lithified material ('root rock') was exposed on the west shore. The area had declined from 4.53 to 3.86 ha. The cay is densely vegetated with coconut woodland, with an understorey of *Psychotria nervosa*. On the seaward side of the cay the beach crest is lined by *Coccoloba*, *Conocarpus*, *Cordia* and *Sophora*, with *Erithalis* and *Chrysobalanus*,

partly fronted by a strip of herbs and grasses with germinating drift coconuts. A patch of *Tournefortia* growing at the east point in 1960 had disappeared as a result of beach retreat by 1972, and this removed the species from the island. The littoral hedge on the west shore is largely formed by *Erithalis* and *Conocarpus*. Other species noted include *Terminalia* and a large *Ficus*. There are temporary fishing huts on the cay, but it is uninhabited. Sherds of red Maya pottery were eroding from superficial midden deposits in the area of root rock exposure on the west shore in 1972 (Stoddart 1980, p.162). When mapped by Owen in 1835 the island was inhabited and had fresh water.

32 species have been recorded from the cay (4 in 1960, 31 in 1972). In addition four mosses were collected in 1972: *Taxithelium planum* (Brid.) Mitt. (Spellman and Stoddart 125b), *Callicostella depressa* (Hedw.) Jaeg. (Spellman and Stoddart 125c), *Calymperes erosum* C. Müll. (Spellman and Stoddart 126BO), and *Calymperes richardii* C. Müll. (Spellman and Stoddart 127a). The plant species recorded are:

Nephrolepis multiflora 72C
Polypodium lycopodioides 72C
Polypodium polypodioides 72C
Andropogon glomeratus 72C
Eragrostis prolifera 72C
Eustachys petraea 72C
Paspalum blodgettii 72C
Paspalum distichum 72C
Sporobolus virginicus 72C
Cyperus peruvianus 72C
Cyperus planifolius 72C
Fimbristylis cymosa 72C
**Cocos nucifera* 60S 72S
Thrinax radiata 72C
Ficus sp. 72C
Coccoloba uvifera 60S 72C
Chrysobalanus icaco 72C
Pithecellobium keyense 72C
Sophora tomentosa 72C
**Citrus aurantiifolia* 72C
Euphorbia mesembrianthemifolia 72C
Passiflora suberosa 72C
Conocarpus erectus 60S 72C
**Terminalia catappa* 72C
Pouteria campechiana 72C
**Nerium oleander* 72C
Tournefortia gnaphalodes 60S
Lippia nodiflora 72C
Diodia serrulata 72C
Erithalis fruticosa 72C
Ernodea littoralis 72C
Psychotria nervosa 72C

Hunting Cay (16°07'N, 88°16'W) Figure 27, Plates 55, 56 and 58

Hunting Cay lies 0.6 km south of Nicolas Cay, on the south side of the channel which divides the barrier platform at this point. When mapped in 1960 it had a maximum north-south length of 440 m and was up to 220 m wide; its area was 5.79 ha. The west and south coasts were formed by broad sand beaches. The east coast was more complex, with two projections separated by a wide sandy bay facing a gap in the reef. The northeast shore was built of shingle but the other seaward shores of sand. Both in the bay and on the southern headland beachrock indicated beach retreat. There was some undercutting near the north-west point. By 1972 there had been erosion on the west and south shores as well as in the east bay. The west shore was cliffed, with fallen coconuts, for much of its length. More beachrock had been exposed on the eastern side.

The island is covered with a dense coconut woodland. *Coccoloba* formed an extensive littoral hedge along the east shores in 1960 and again in 1972. Grasses and juvenile *Casuarina* were colonising the fresh sand accumulations in the south in 1960 and 1972. Beach retreat in the east bay had destroyed the only colony of beach-crest *Tournefortia* between the two surveys, and this species was not found in 1972. *Hymenocallis* is particularly common in the southeast part of the island. Vermeer (1959, p.90) mentions *Manilkara zapota* in the coconut woodland, but this record has not been confirmed. The cay is inhabited and has a lighthouse. Craig (1966) mentions it as one of the islands with Maya remains, but these were not seen during our surveys.

58 species of plants have been recorded, 7 in 1960 and 57 in 1972. They are:

Acrostichum aureum 72C
**Eleusine indica* 72C
Eragrostis ciliaris 72C
Eragrostis prolifera 72C
Eustachys petraea 72C
Paspalum blodgettii 72C
Paspalum distichum 72C
Sporobolus virginicus 72C
Sporobolus sp. 60S
Cyperus ligularis 72C
Cyperus peruvianus 72C
Cyperus planifolius 72C
Fimbristylis cymosa 72C
**Cocos nucifera* 60S 72S
Thrinax radiata 72C
Hymenocallis littoralis 60S 72C
Brassavola nodosa 72C
**Casuarina equisetifolia* 60S 72C
Ficus sp. 72C
Coccoloba uvifera 60S 72C
Portulaca oleracea 72C (seedling)
Cakile lanceolata 72C
**Kalanchoe pinnata* 72C
Chrysobalanus icaco 72C
Canavalia rosea 72C
Gliricidia sepium 72C
Pithecellobium keyense 72C
Sophora tomentosa 72C
Vigna luteola 72C
**Citrus aurantiifolia* 72C
**Codiaeum variegatum* 72C
Euphorbia blodgettii 72C
Euphorbia mesembrianthemifolia 72C
Phyllanthus amarus 72C
Hippocratea volubilis 72C
Hibiscus tiliaceus 72C
Passiflora suberosa 72C
**Cucumis melo* 72C
Conocarpus erectus 60S 72C
**Terminalia catappa* 72C
Eugenia sp. 72C
[*Manilkara zapota* Vermeer (1959, p.90)]
**Nerium oleander* 72C
**Plumeria rubra* 72C
Rhabdadenia biflora 72C
Tournefortia gnaphalodes 60S
Citharexylum caudatum 72C
Lippia nodiflora 72C
Stachytarpheta jamaicensis 72C
**Russelia equisetiformis* 72C
Enallagma latifolia 72C
Diodia serrulata 72C
Erithalis fruticosa 72C
Ernodea littoralis 72C
**Ixora coccinea* 72C
Spermacoce assurgens 72C
Spermacoce prostrata 72C
Ageratum littorale 72C
Bidens pilosa 72C
Conyza canadensis 72C

Lime Cay (16°06'N, 88°16½'W) Figure 28, Plates 59-61

Lime Cay, the "Low Cay" of charts, lies nearly 1 km south of Hunting Cay. In 1960 the island was 300 m long and up to 110 m wide; it had an area of 1.83 ha. The northeastern point was built of shingle and abutted on a semicircular reef-crest rubble zone; the other shores were sandy. Much of the northwest-facing shore was cliffed, and beachrock offshore indicated past beach retreat. The shingle hook at the northeast point was apparently a recently formed and perhaps still mobile feature. In 1972 the hook had disappeared and the northeastern and northwestern shores were cliffed and eroding. The width of the island in this sector had decreased from 75 to as little as 35 m. Conversely there was a great deal of fresh sand forming two large spits at the southwest end (in July 1972), and as a result the island had increased in length to nearly 330 m and in area to 2.07 ha.

The island is covered with a coconut woodland, which is most dense in the southwest. In the centre, on low-lying poorly-drained ground, there is an area of *Hymenocallis, Thrinax* and *Acoelorrhaphe*. Beach-crest vegetation consists of discontinuous *Erithalis, Coccoloba, Conocarpus* and *Sophora*; in particular the small patch of *Conocarpus* noted on the shingle hook in 1960 had greatly expanded by 1970. In 1970 there was also a small patch of *Sesuvium* on the seaward rubble.

Thirty species of plants have been recorded from Lime Cay, 5 in 1960 and 28 in 1972. The *Rhizophora* seedlings colonising inside the shingle hook in 1960 had disappeared by the later survey. Species recorded are:

Nephrolepis multiflora 72C
Andropogon glomeratus 72C
Anthephora hermaphrodita 72C
Cenchrus incertus 72C
Eragrostis prolifera 72C
Eustachys petraea 72C
Panicum pilosum 72C
Paspalum blodgettii 72C
Sporobolus virginicus 72C
Stenotaphrum secundatum 72C
Cyperus peruvianus 72C
Cyperus planifolius 72C
Fimbristylis cymosa 72C
Acoelorraphe wrightii 72C
**Cocos nucifera* 60S 72S
Thrinax radiata 72C
Hymenocallis littoralis 72C
Coccoloba uvifera 60S 72C
Sesuvium portulacastrum 60S 72S
Pithecellobium keyense 72C
Sophora tomentosa 72C
Euphorbia mesembrianthemifolia 72C
Passiflora suberosa 72C
Rhizophora mangle 60S (seedlings)
Conocarpus erectus 60S 72C
**Terminalia catappa* 72C
Lippia nodiflora 72C
Stachytarpheta jamaicensis 72C
Diodia serrulata 72C
Erithalis fruticosa 72C

In addition the moss *Calymperes richardii* C. Müll. was also collected (Spellman and Stoddart 128a).

Ragged Cay (16°05'N, 88°17½'W) Figure 29, Plates 62-63

Ragged Cay, the southernmost on the barrier reef, appears on charts as "South Cay" and "Zapotilla Cay". It stands on a small reef patch with deep channels to east and west. In 1960 it was triangular, with sides 40-70 m long, and with an area of 0.24 ha. It was built entirely of concentric ridges of coarse shingle, reaching about 1 m above sea level. By 1972 it had changed considerably, and was an oval island, orientated north-south, 75 m long and 35 m wide, with an area of 0.22 ha. It was still built of shingle, with a small southern sand spit. Owen in 1835 noted a "Small cluster of cocoanut trees, grasses and bushes". In 1960 there were five *Casuarina* trees, one a mature specimen 15 m tall, together with 10 coconuts. The ground surface was covered with a thick mat of *Sesuvium* with bushes of *Conocarpus* and *Rivina*. In 1972 the vegetation remained dominated by the *Casuarina* and the coconuts, with *Sesuvium* and *Rivina*. A feature of this island is the great number of coenobitid hermit crabs inhabiting it. Only seven plant species have been recorded from Ragged Cay (5 in 1960 and 5 in 1972); they are:

Cyperus planifolius 72C
**Cocos nucifera* 1835S 60S 72S
**Casuarina equisetifolia* 60S 72C
Rivina humilis 60C
Portulaca oleracea 72C
Sesuvium portulacastrum 60C 72C
Conocarpus erectus 60S

Seal Cays (16°10½'N, 88°20'W) Figure 30, Plates 64-65

At Ragged Cay the barrier reef trends westwards for 3.7 km and northwards for 9 km, forming a narrow hook. Where not occupied by surface reefs this carries 4-5 m of water over it; inside the hook the water depths are 29-33 m, and outside it 55 m. The reef is uninterrupted by channels in its north-south limb. Admiralty Chart 1573 shows Seal Cays on this reef at 16°08'N: these are the "Observation Seal" Cays mapped by Owen in 1835. They then comprised two islands on an arcuate reef, one with a "cluster of cocoa-nut trees", the other with a "grove of cocoa-nut trees, huts". Only an unvegetated sandbore occupies this site now; the cays are said to have been destroyed in the 1945 hurricane. At the northern end of the reef there are two large reef patches. The southernmost possessed a cay in 1835, with "one bushy tree"; this, too, is now an unvegetated sandbore. The other forms a perfect faro or circular reef enclosing a lagoon, about 150 m in diameter, at the end of the barrier reef. It has a cay at its northeast point, and Owen noted a "small cluster of cocoa-nut trees" in 1835. This is the present Seal Cay. A group of small sandbores lies north of the cay, bearing 335°, 003°, 013° and 021° from its north point.

Seal Cay is a small sandy island sheltering in the lee of a rubble ridge which occupies the reef top on the windward side of the faro. It is arcuate in shape, about 65 m long and only 15-20 m wide, with an

area when mapped in 1972 of 0.14 ha. Its main vegetation is *Rhizophora*, with single trees of *Cordia, Coccoloba, Avicennia* and *Cocos*. There are shrubs of *Concarpus* at the west point. The ground cover consists of *Hymenocallis, Ipomoea, Sesuvium* and *Rivina*. The island is uninhabited but is used as a fishing station: the leeward beach has been modified by conch shells to form small boat harbours. Seal Cay was approached but not visited in 1960; there is a note on it in Vermeer (1959, p.90). Sixteen species of plants are recorded:

Paspalum distichum 72C
Cyperus planifolius 72C
Cocos nucifera 1835S 57S 60S 72S
Hymenocallis littoralis 72C
Coccoloba uvifera 72C
Philoxerus vermicularis 72C
Rivina humilis 72C
Portulaca oleracea 72C
Thespesia populnea 72C
Rhizophora mangle 72C
Conocarpus erectus 72C
Laguncularia racemosa 72C
Ipomoea macrantha 72C
Cordia sebestena 72C
Avicennia germinans 72C
Lippia nodiflora 72C

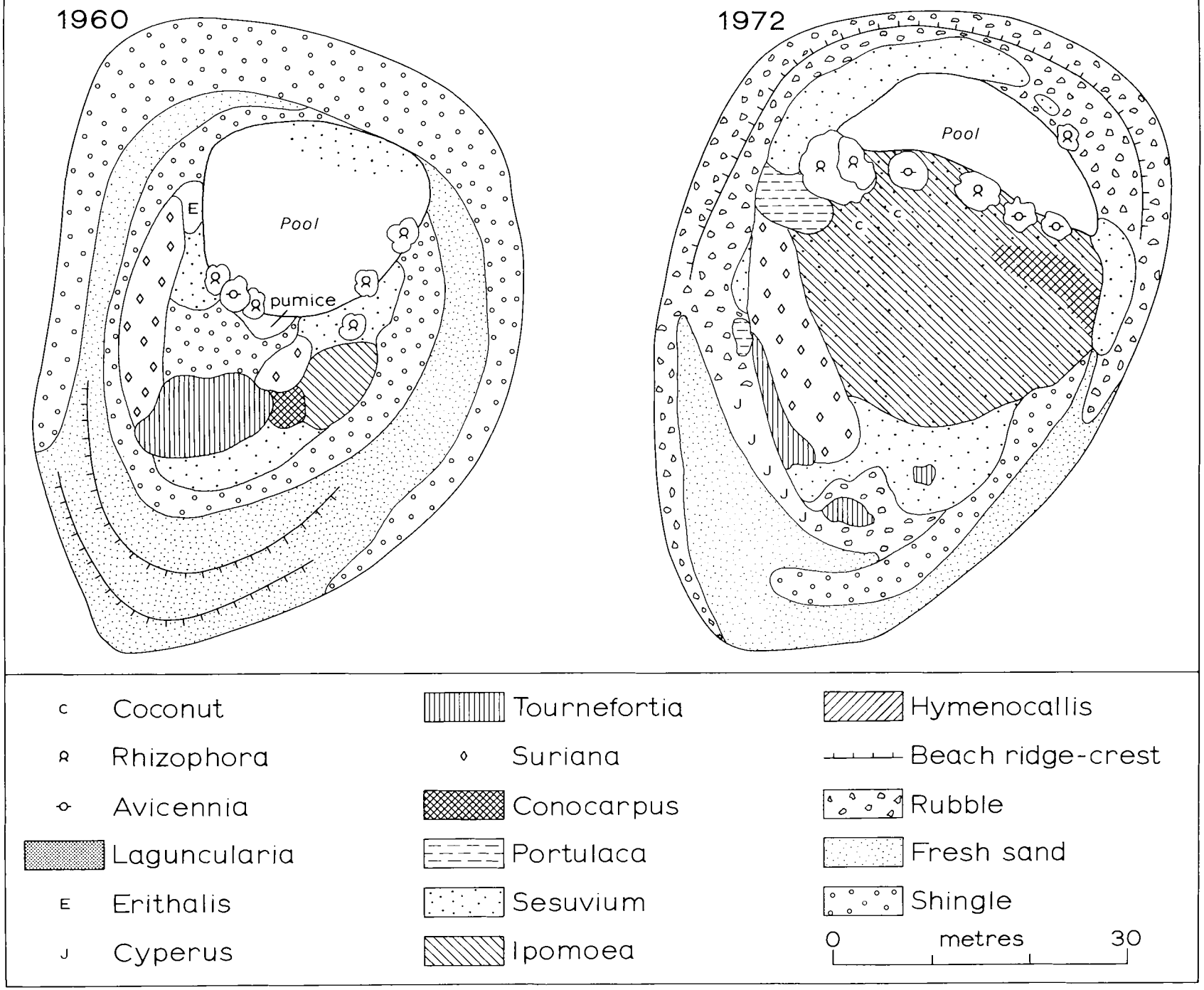


Figure 12. North Silk Cay 1961 and 1972

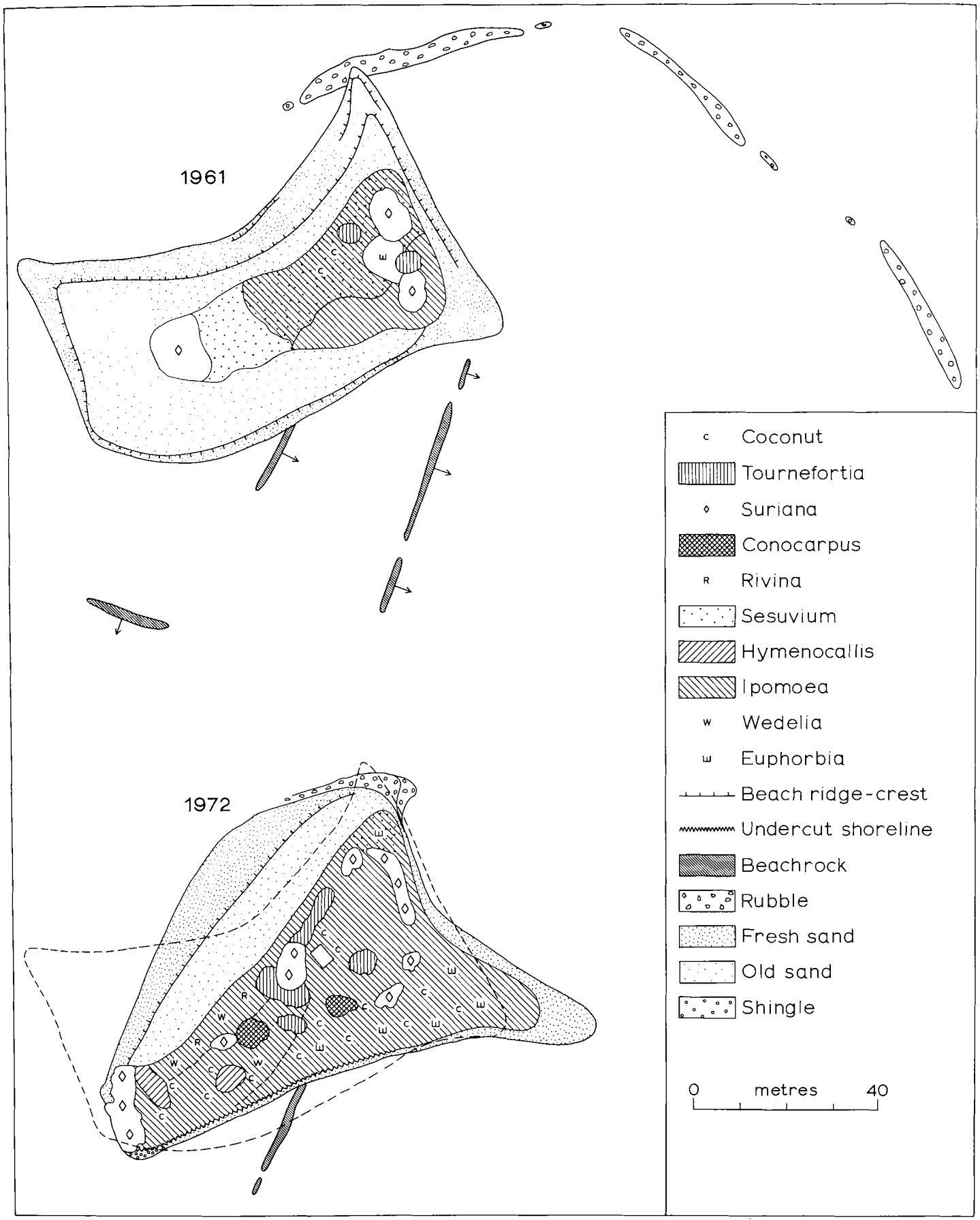


Figure 13. Middle Silk Cay 1961 and 1972

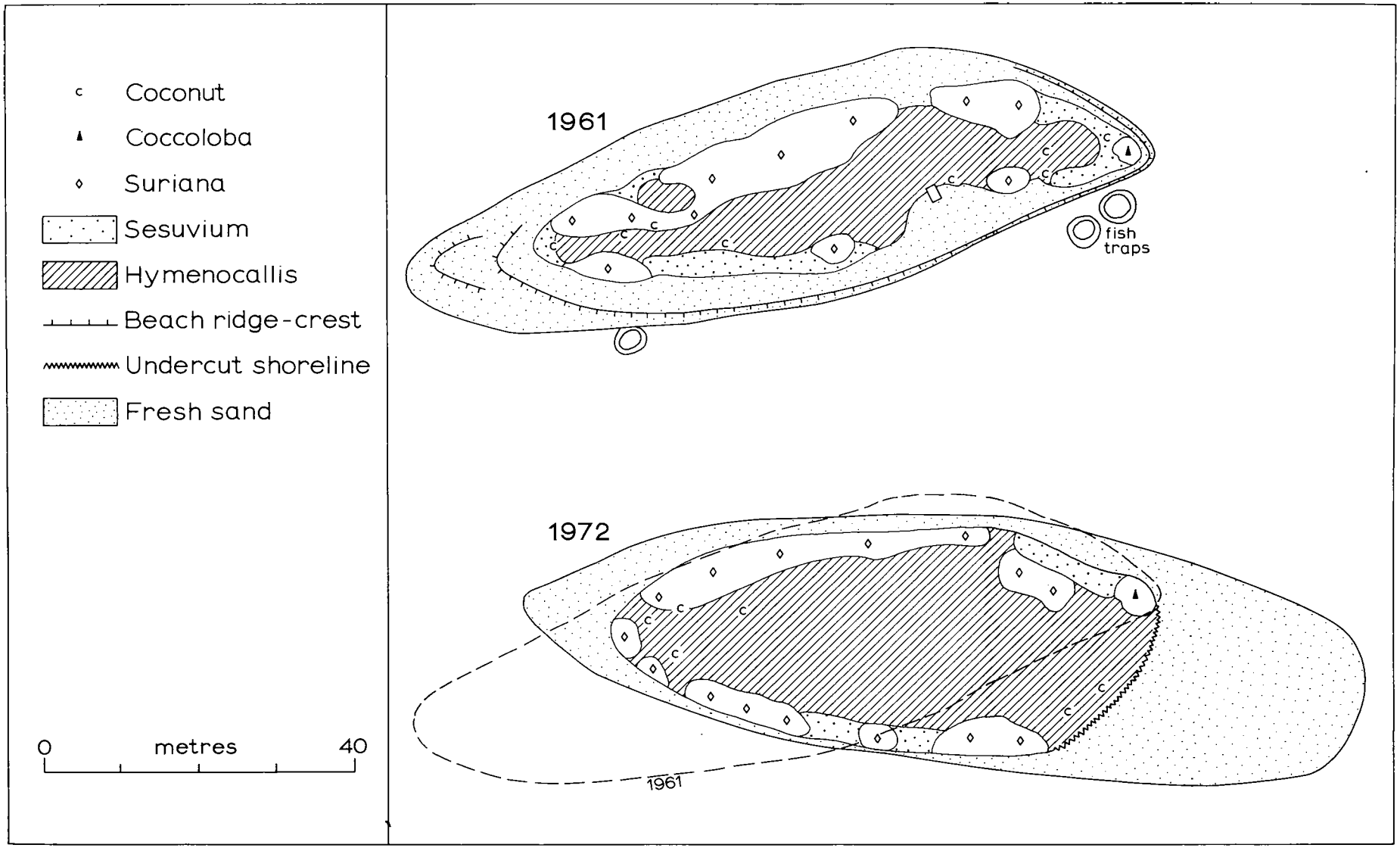


Figure 14. South Silk Cay 1961 and 1972

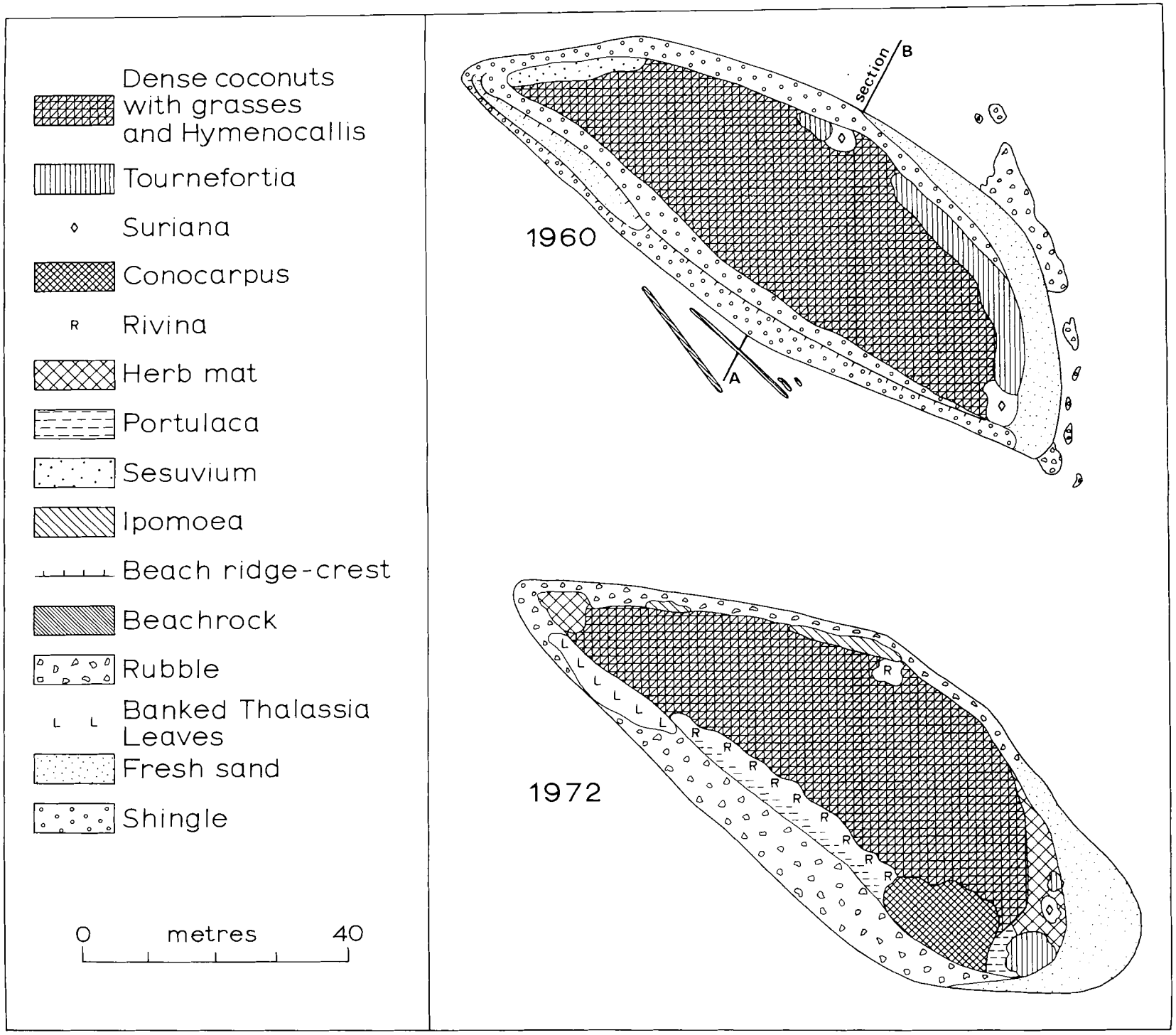


Figure 15. Round Cay 1960 and 1972

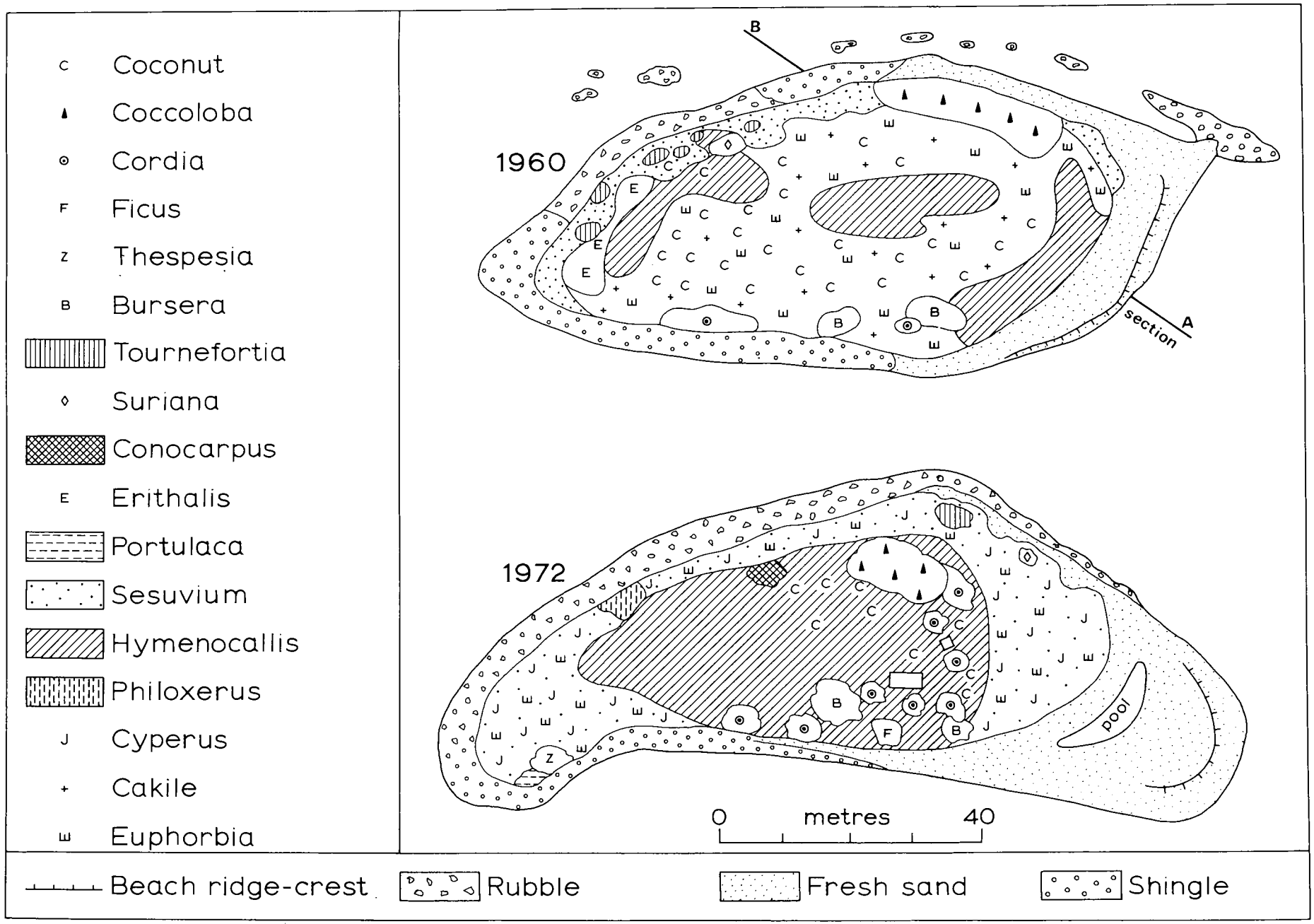


Figure 16. Pompion Cay 1960 and 1972

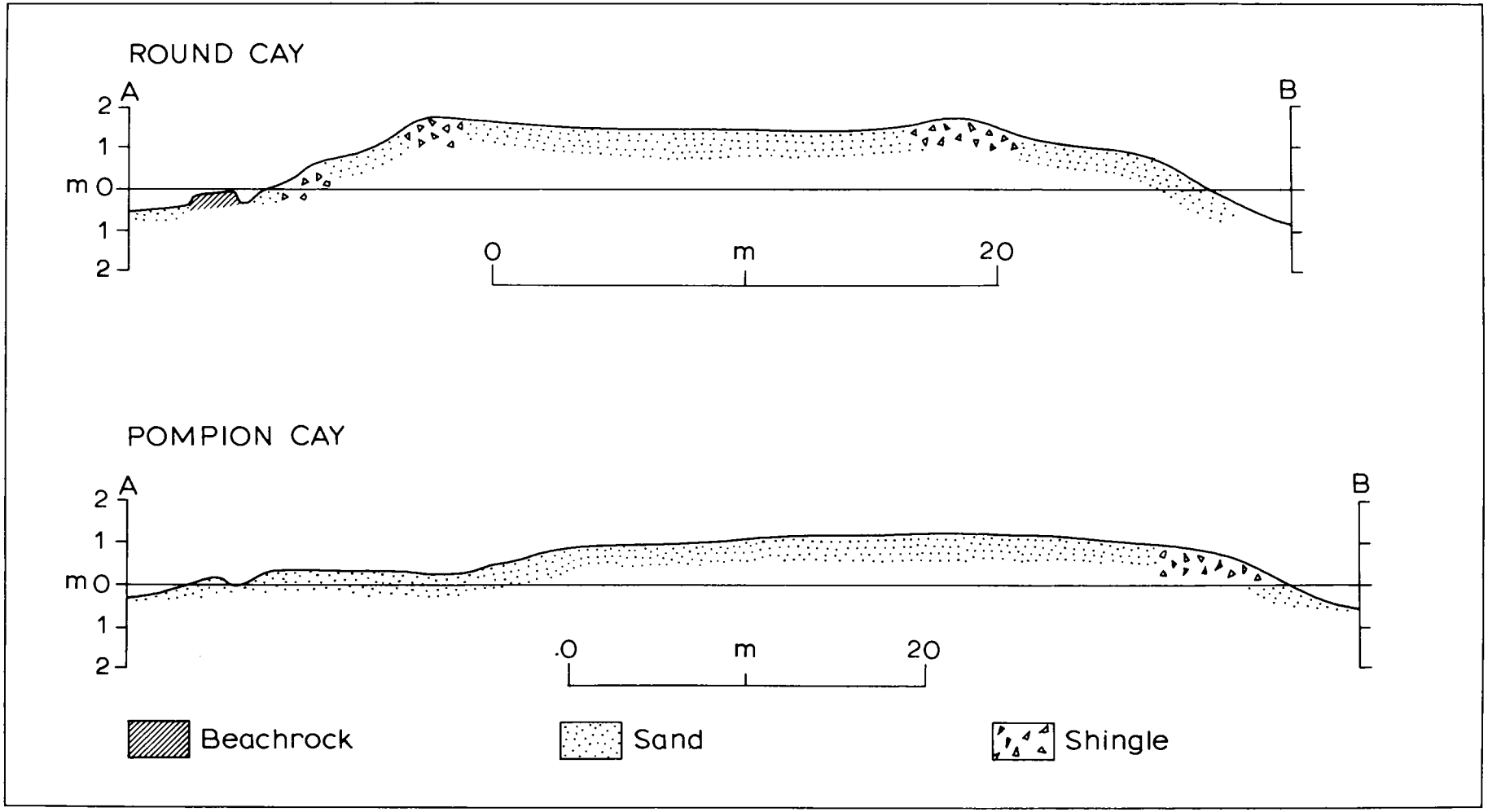


Figure 17. Profiles of Round and Pompion Cays 1960. For locations see Figures 14 and 15

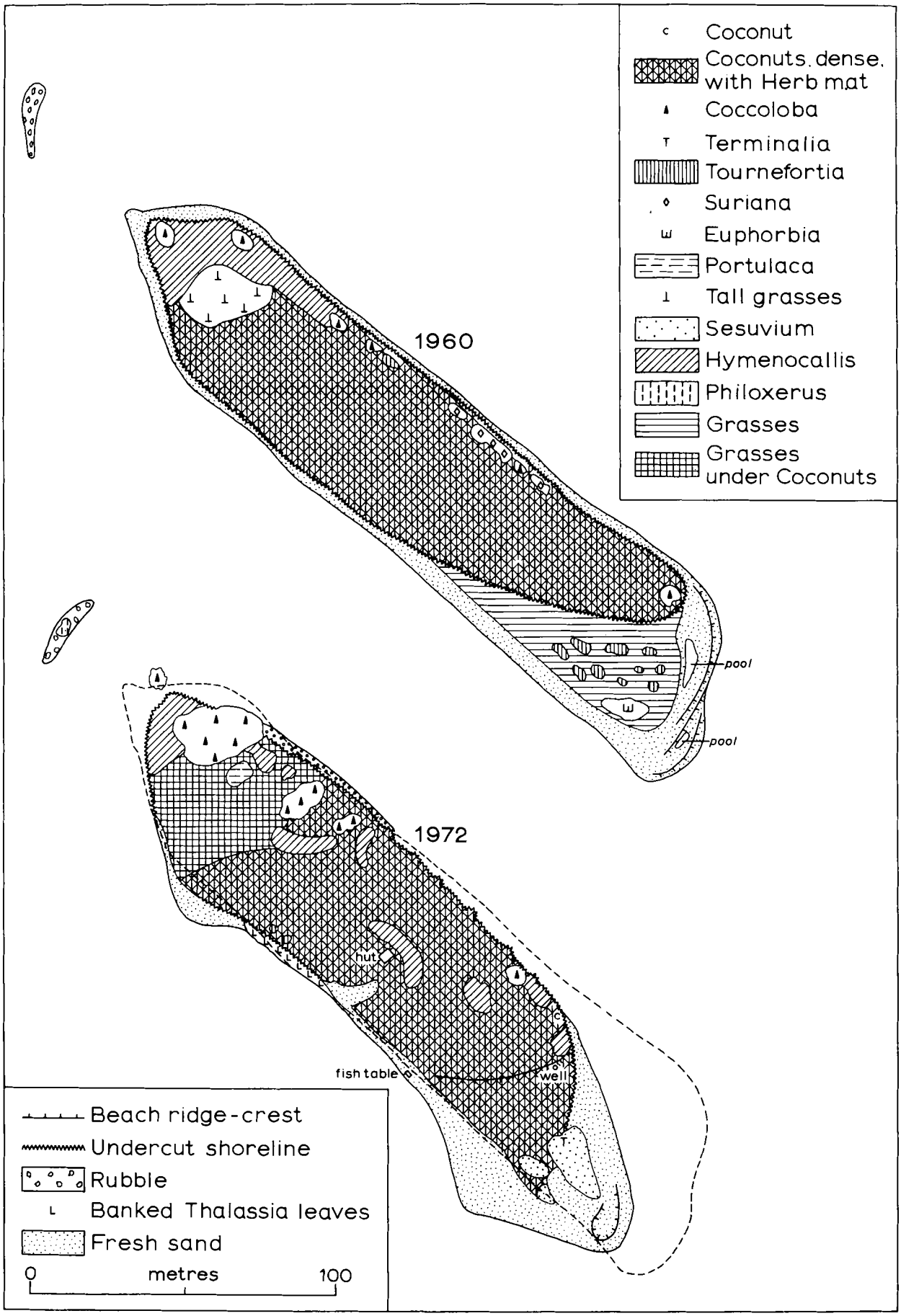


Figure 18. Ranguana Cay 1960 and 1972

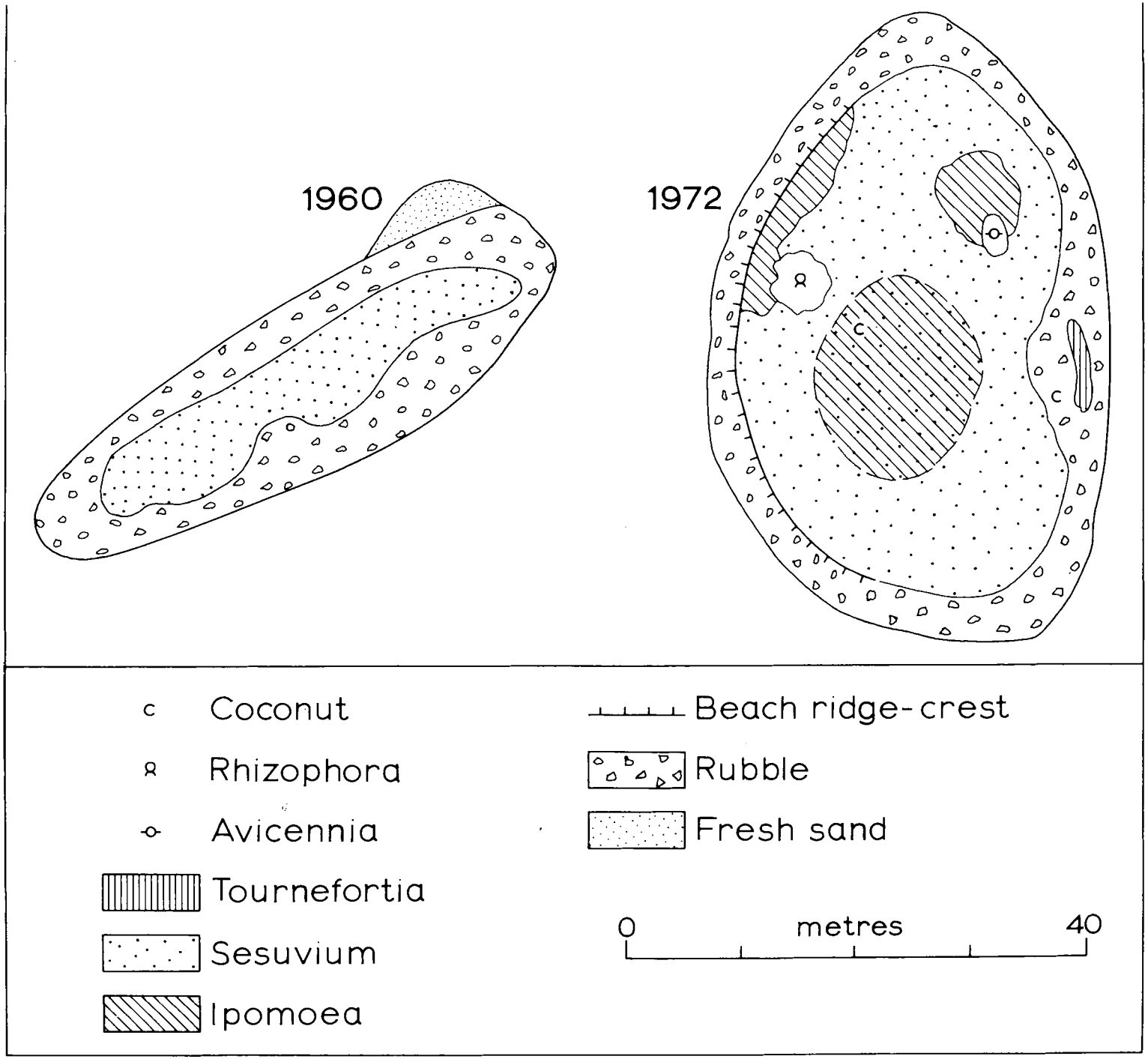


Figure 19. North Spot 1960 and 1972

Figure 20. Reefs and cays of the southernmost barrier reef. Based on original plots by R. Owen, 1835

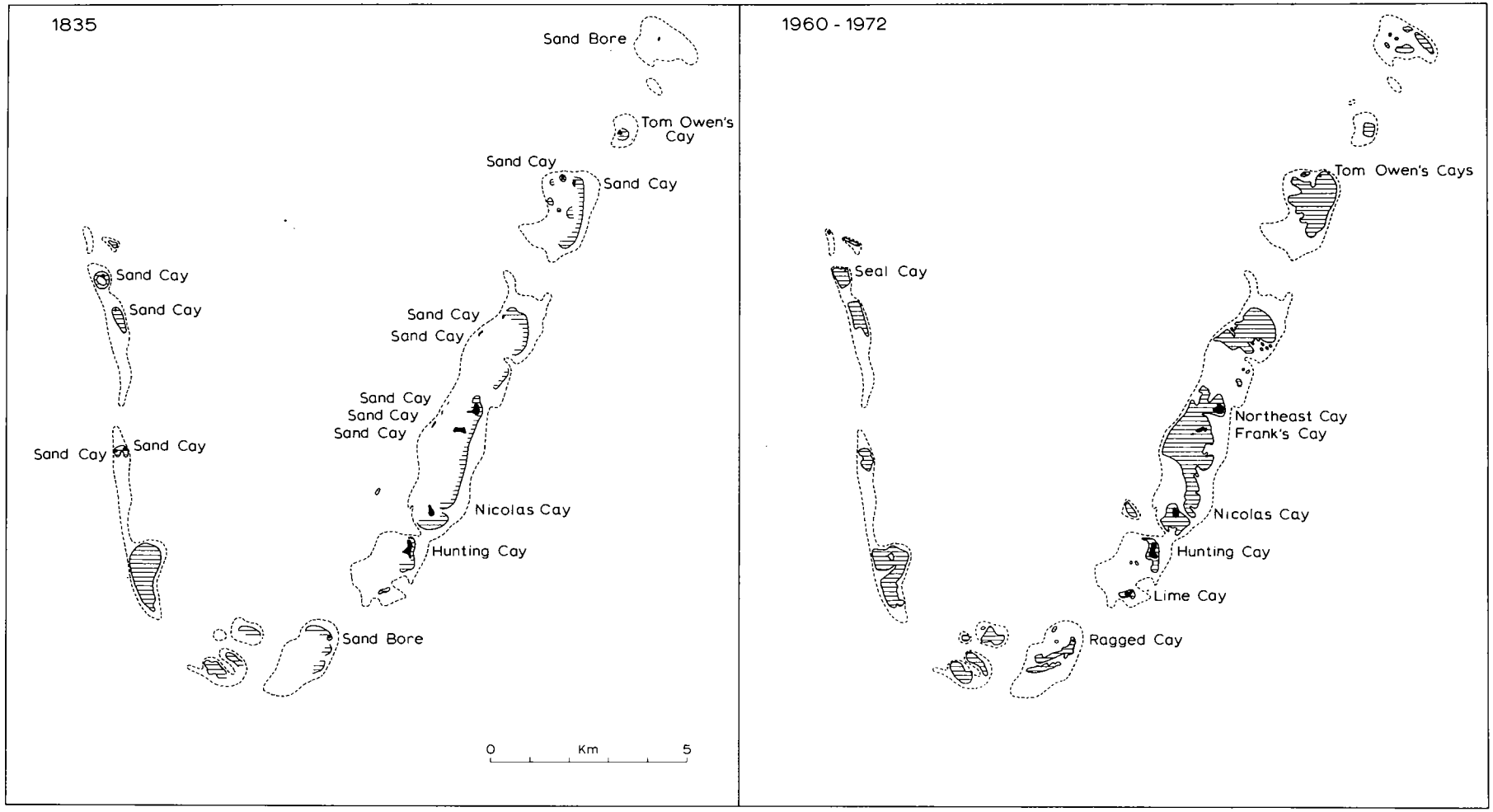


Figure 21. Topographic change on the southernmost barrier reef, between the surveys of Owen (1830) and those of 1960-1972

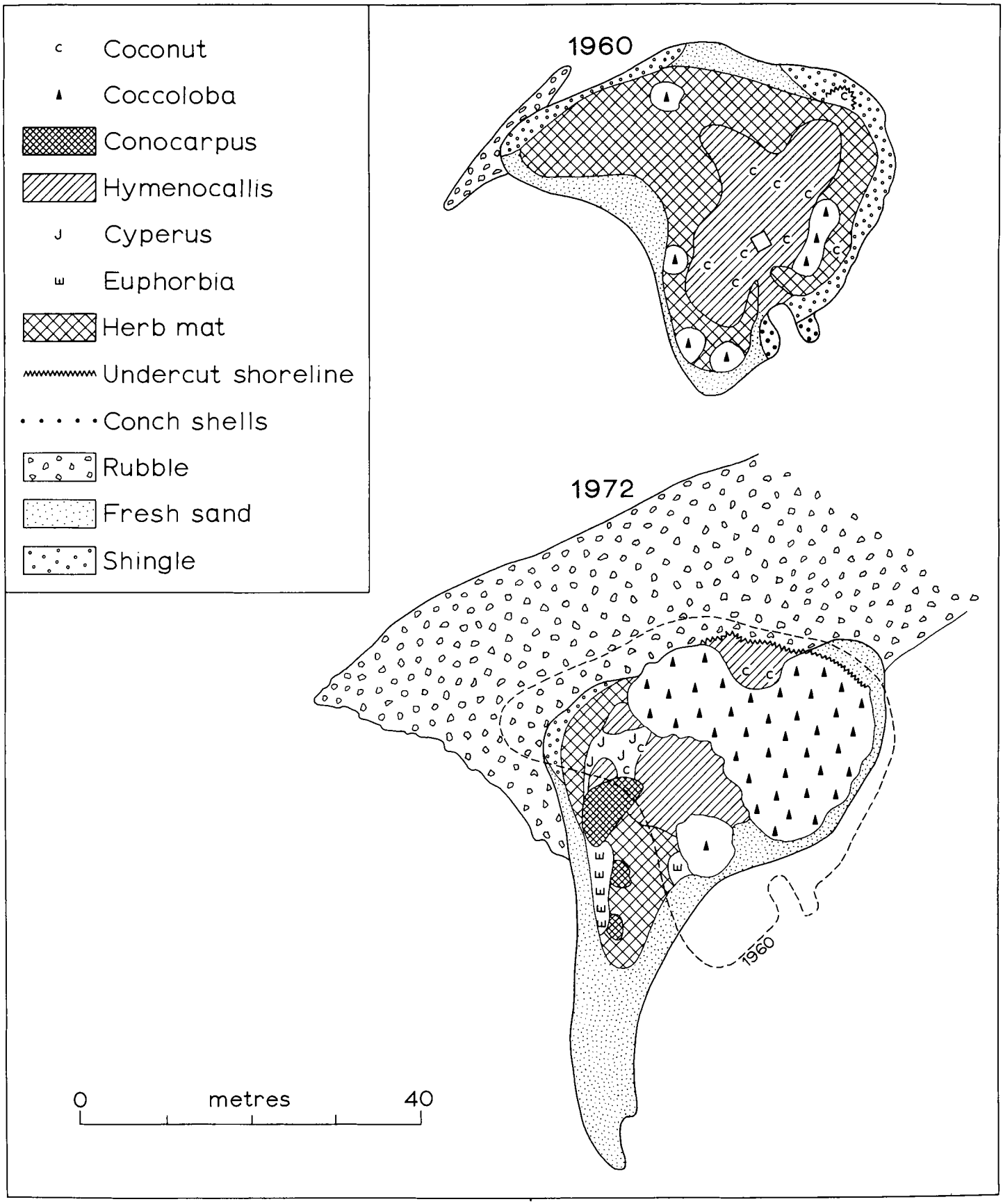


Figure 22. Tom Owen's East Cay 1960 and 1972

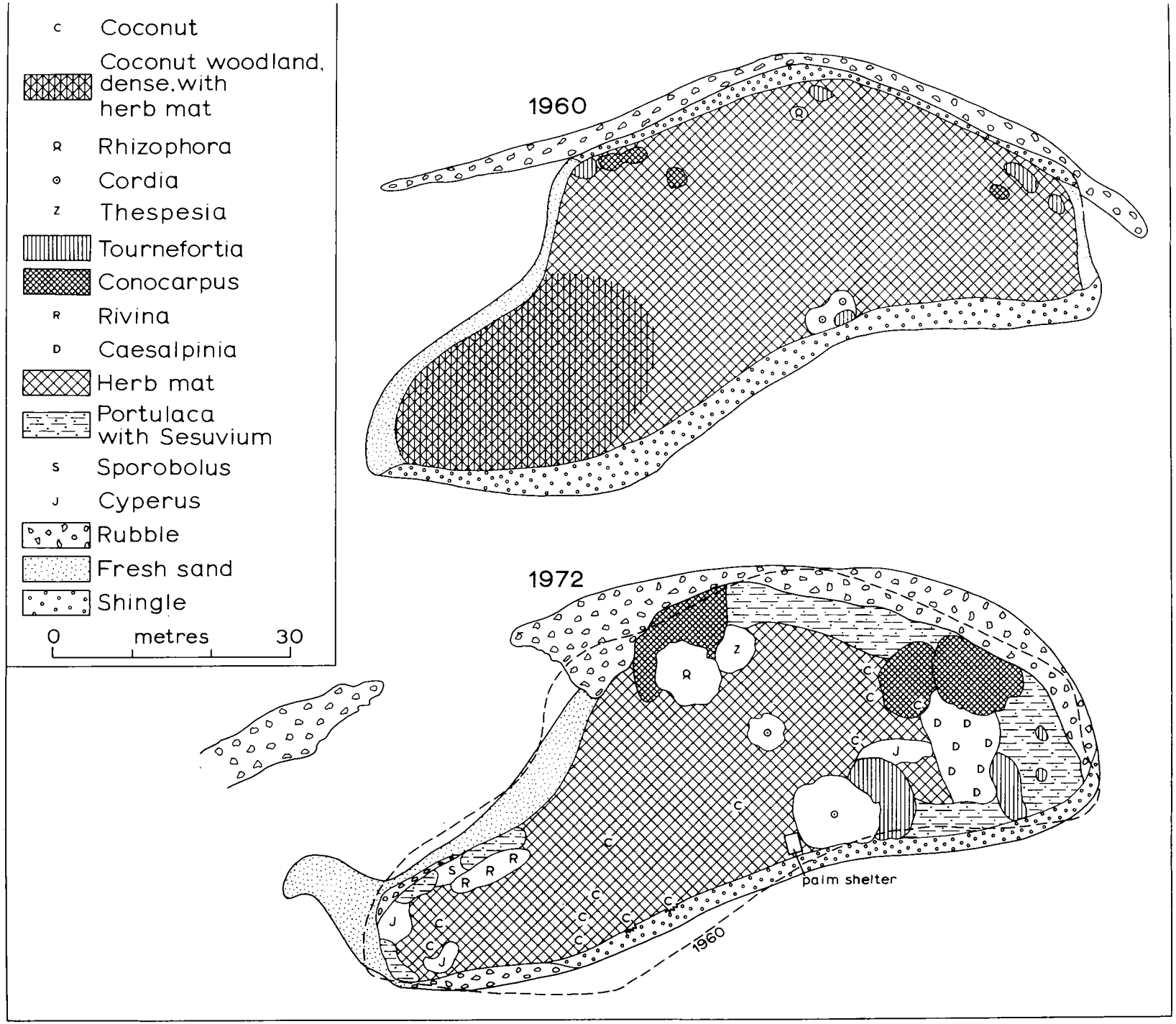


Figure 23. Tom Owen's West Cay 1960 and 1972

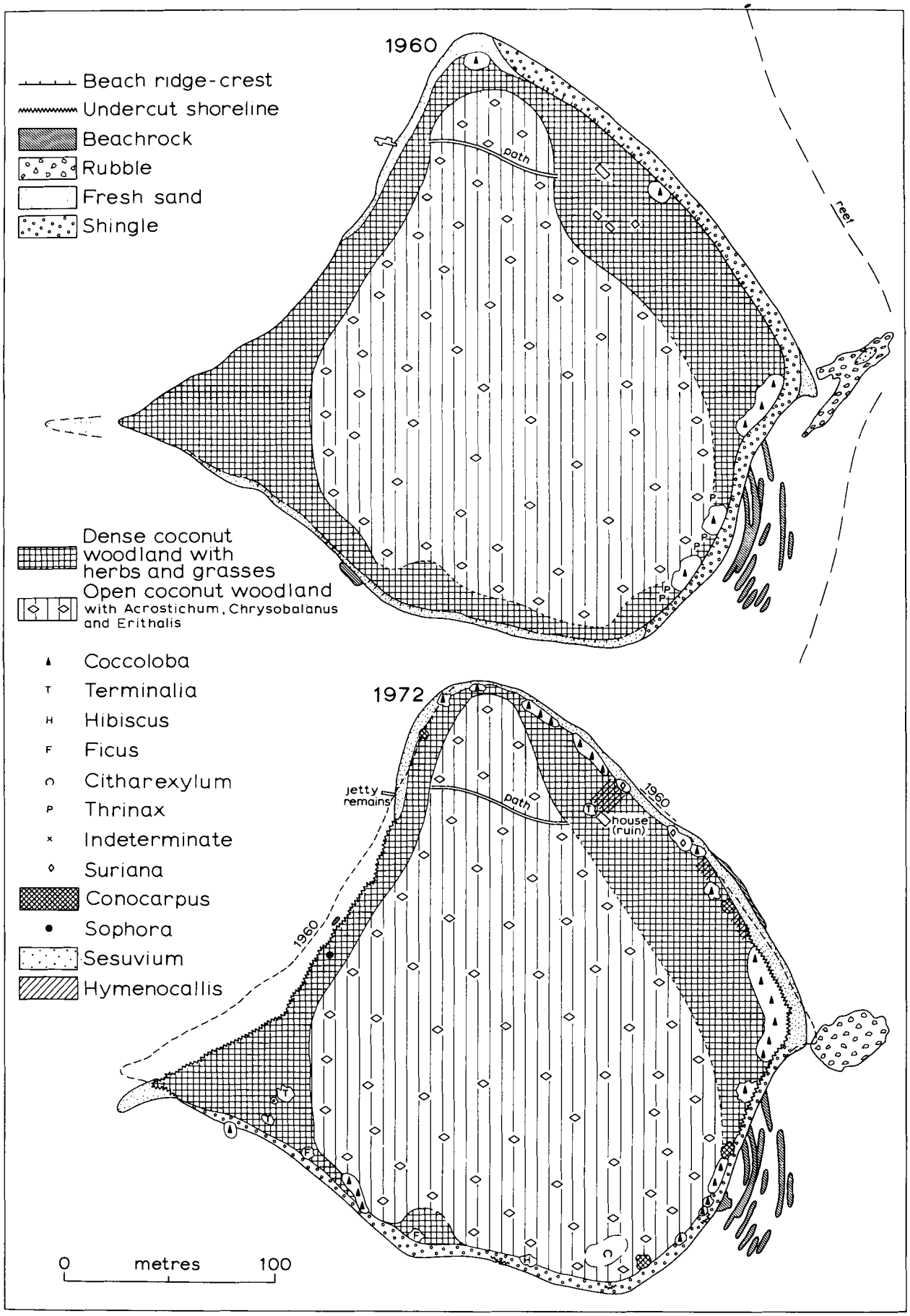


Figure 24. Northeast Sapodilla Cay 1960 and 1972

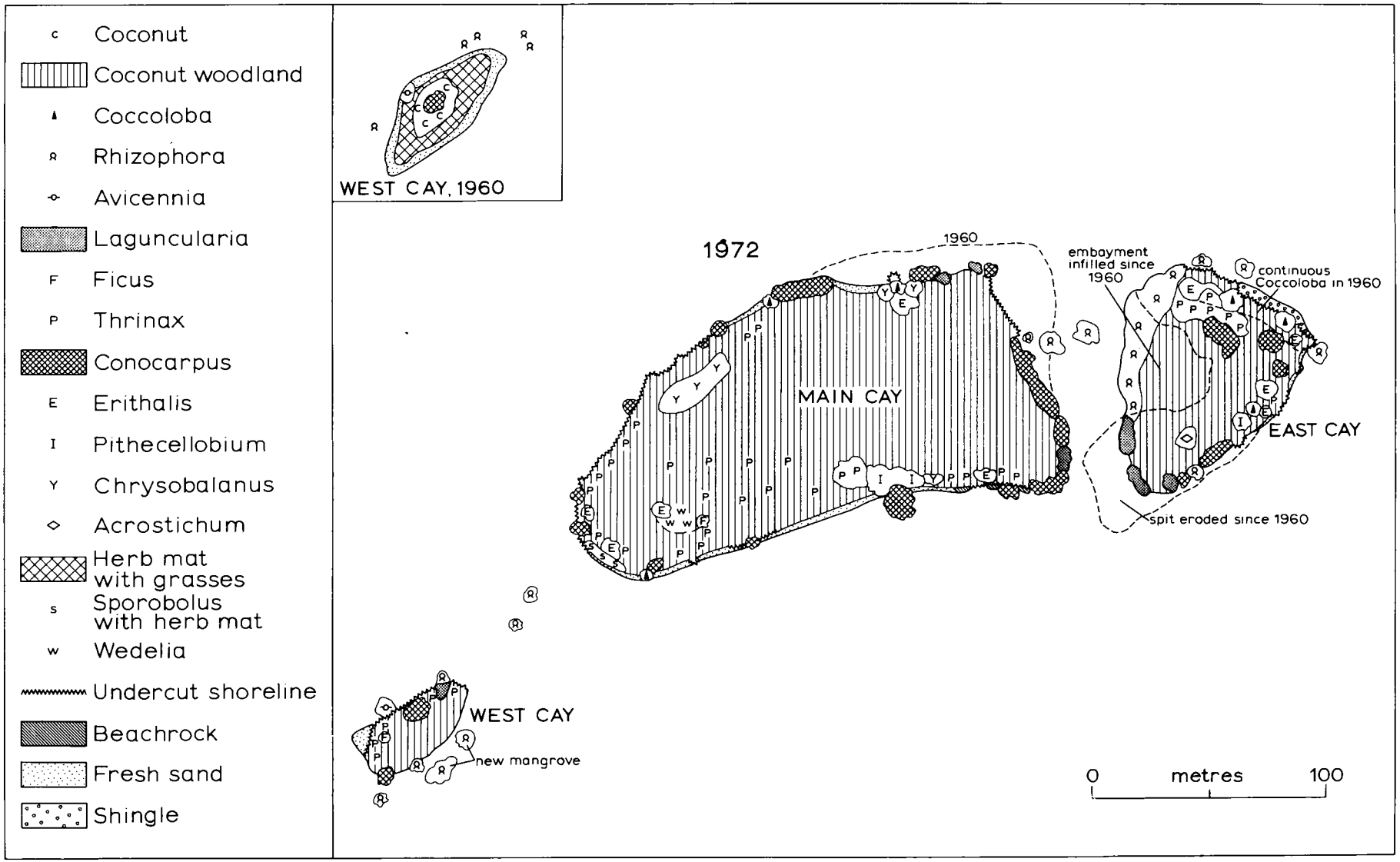


Figure 25. Frank's Cays 1972

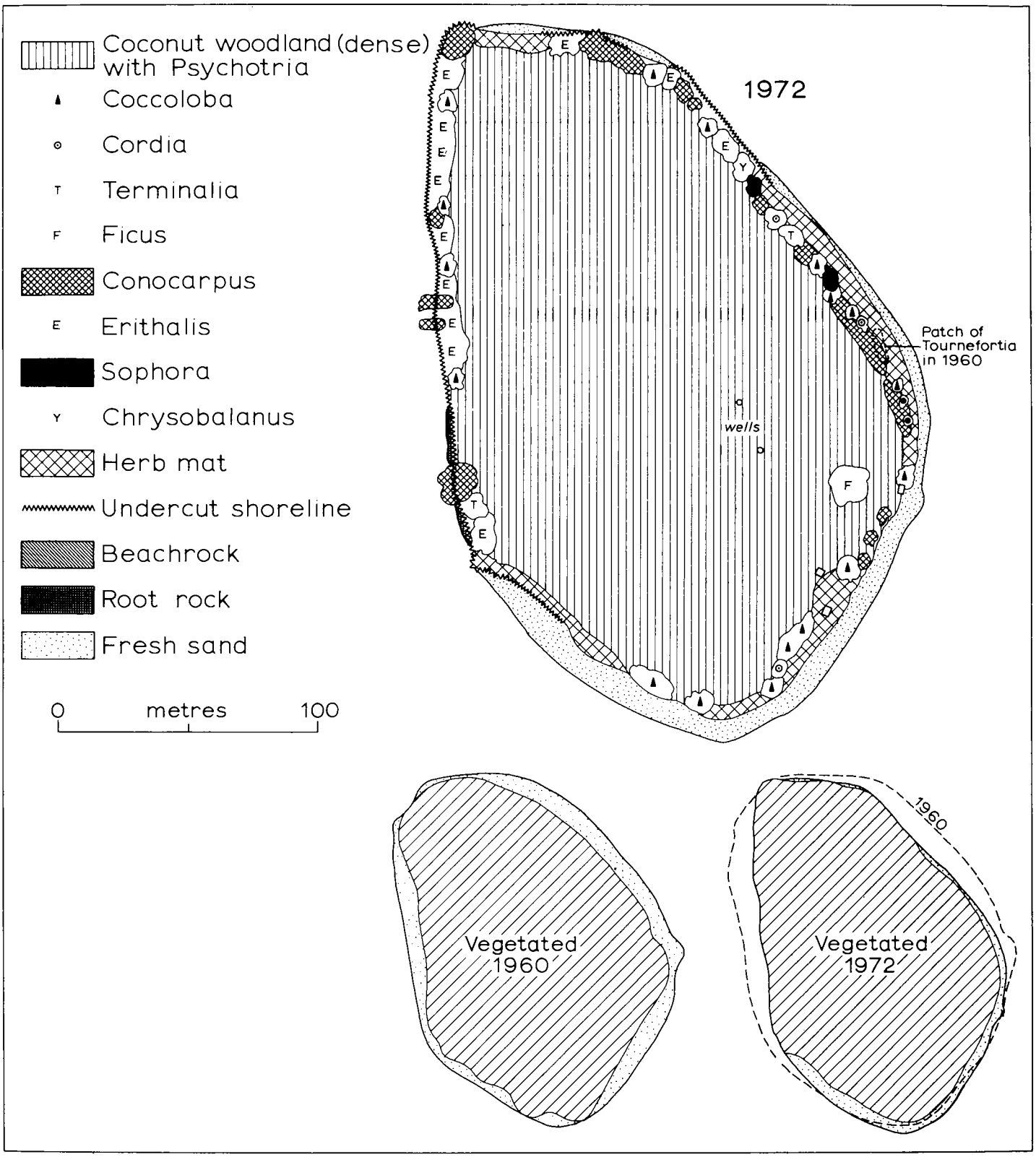


Figure 26. Nicolas Cay 1960 and 1972

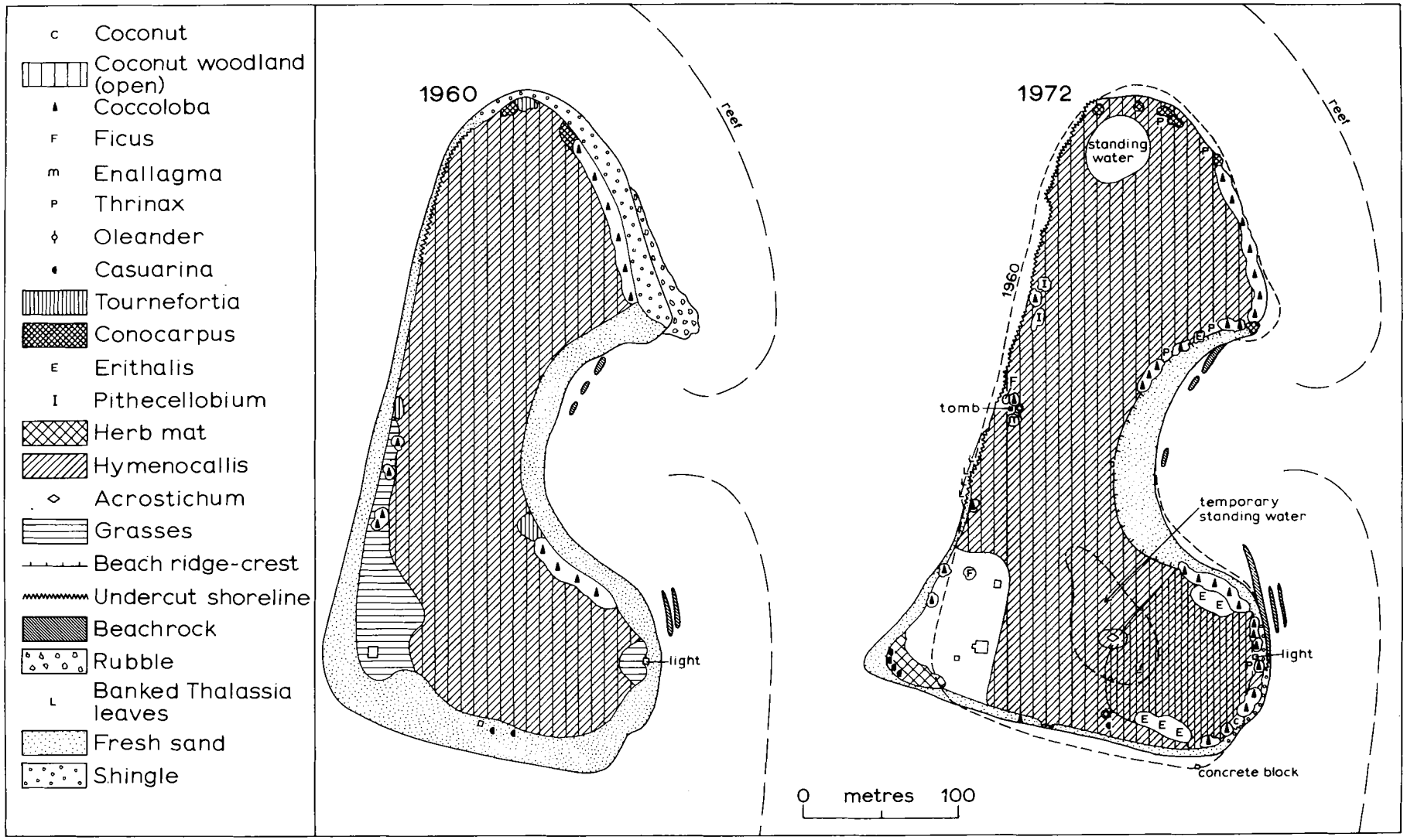


Figure 27. Hunting Cay 1960 and 1972

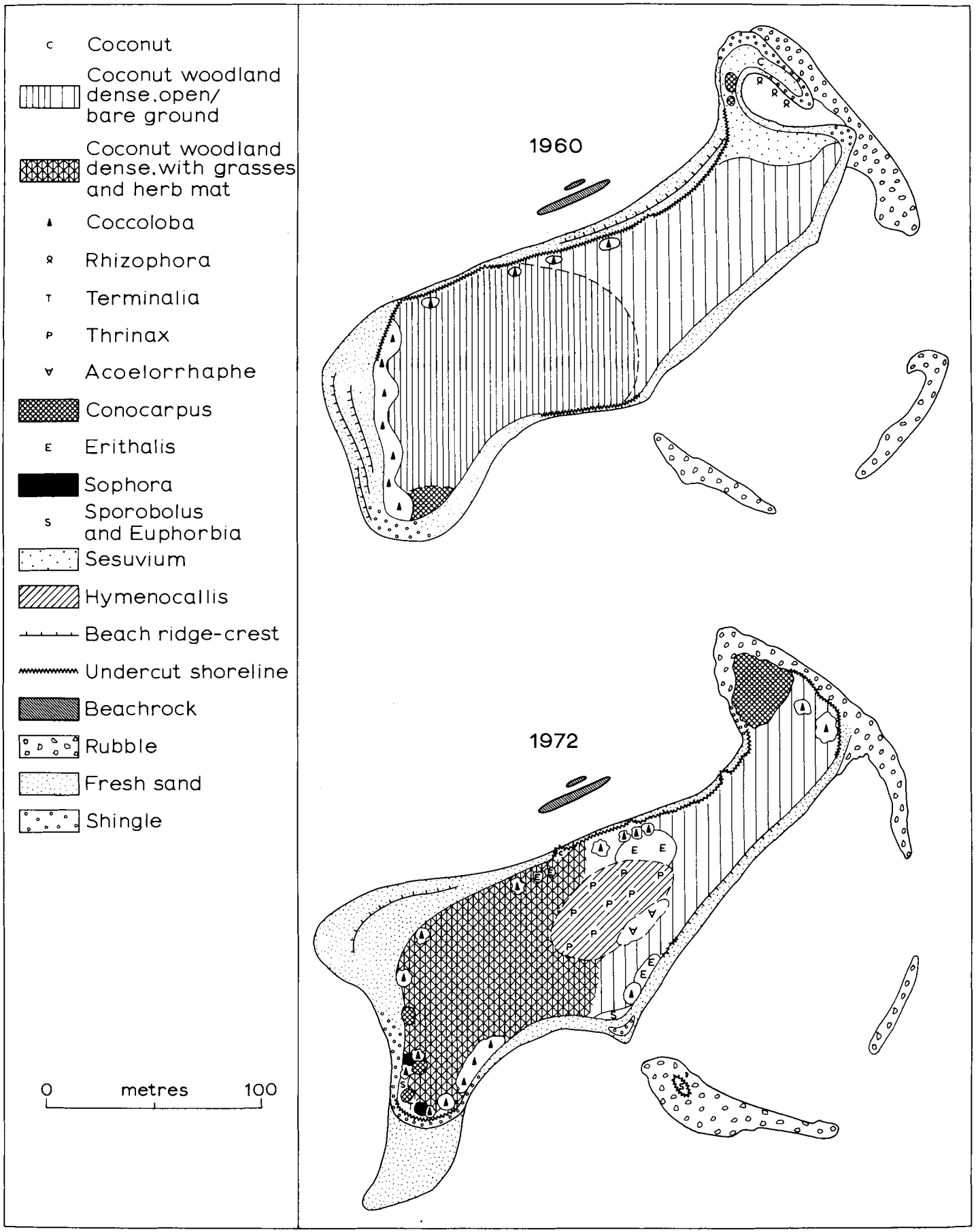


Figure 28. Lime Cay 1960 and 1972

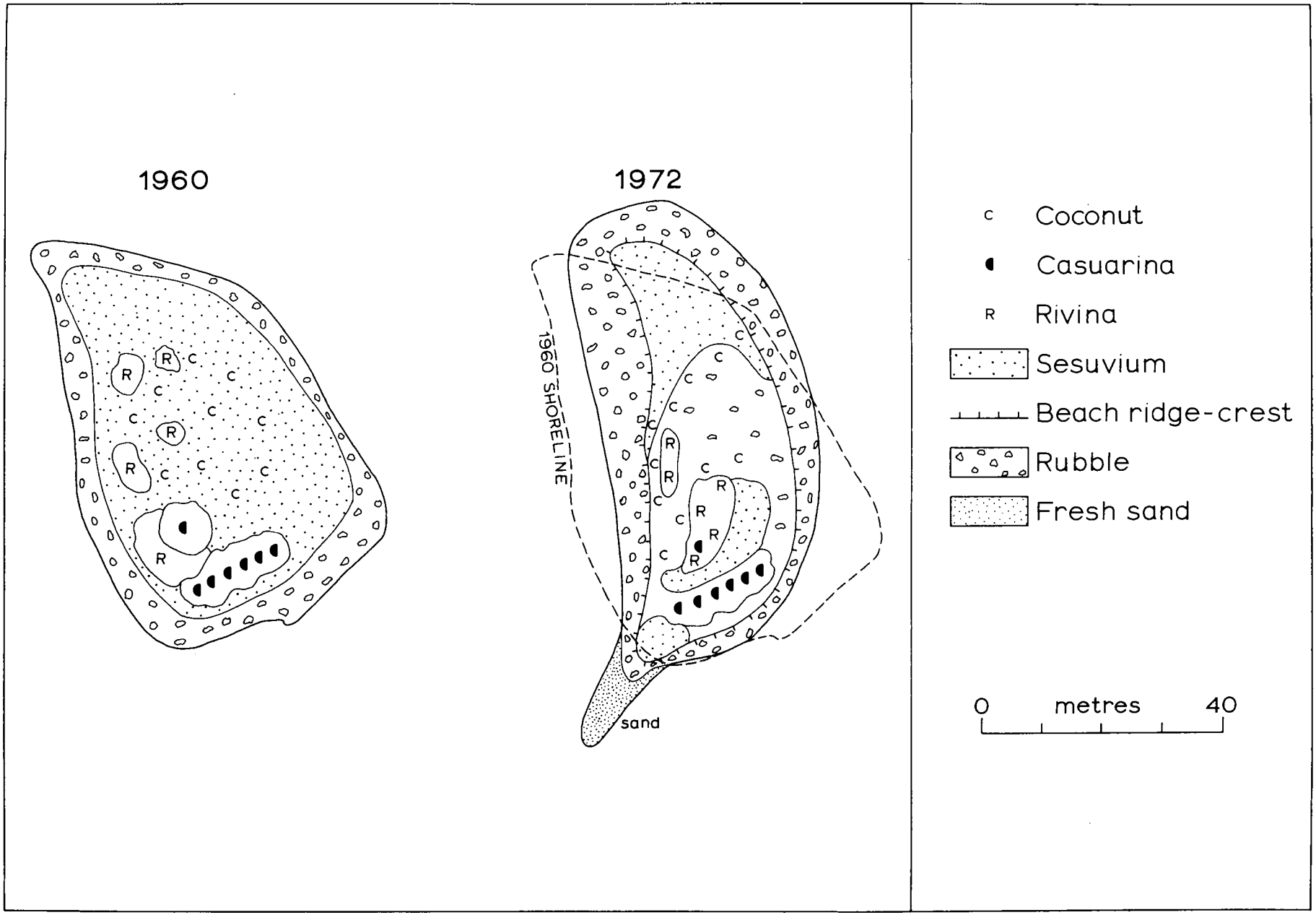


Figure 29. Ragged Cay 1960 and 1972

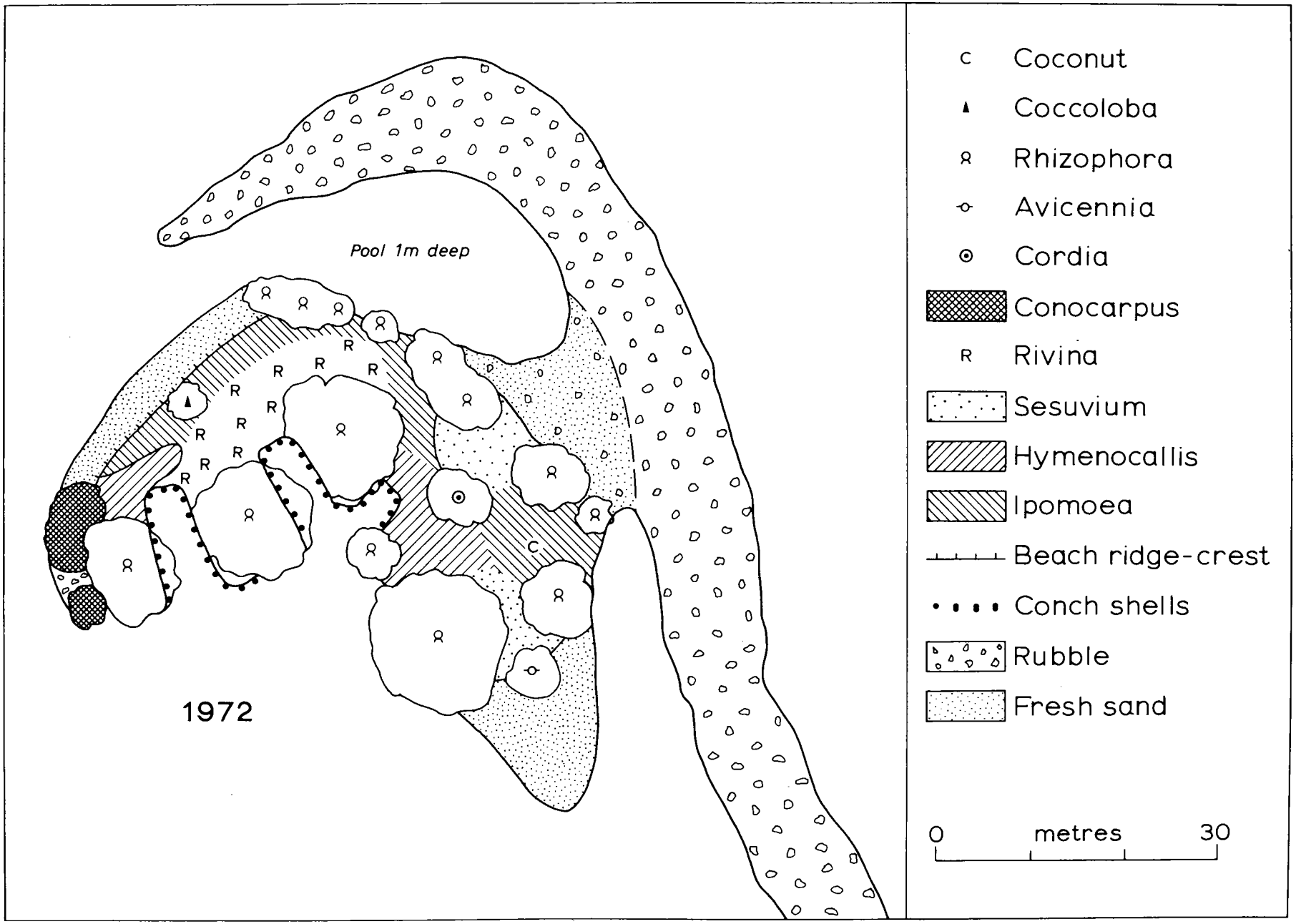
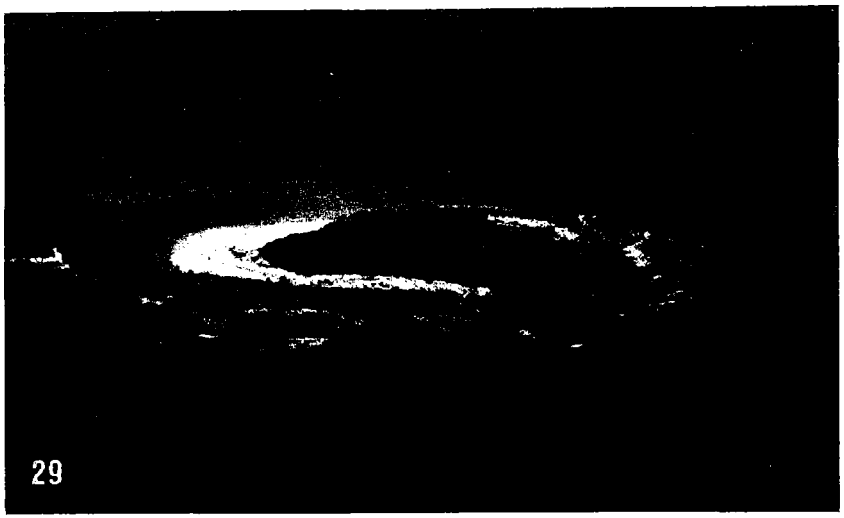


Figure 30. Seal Cay 1972



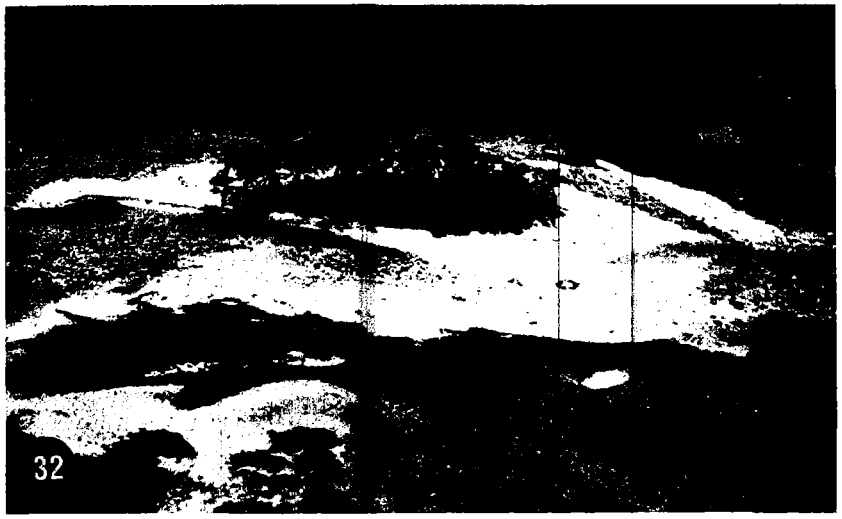
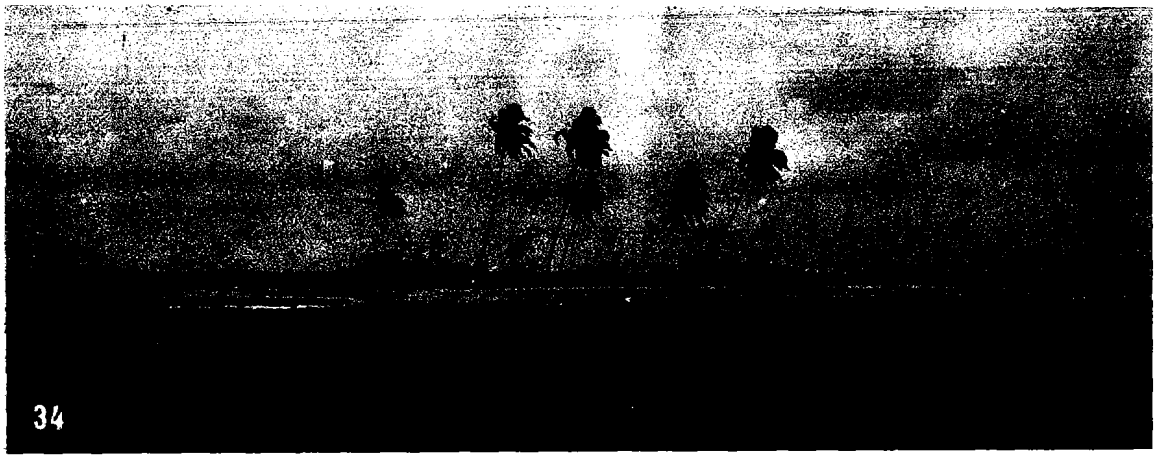


Plate 29. North Silk Cay: aerial view from the east 1962
Plate 30. South Silk Cay: aerial view from the south 1962
Plate 31. Round Cay: aerial view from the southeast 1962
Plate 32. Pompion Cay: aerial view from the southeast 1962



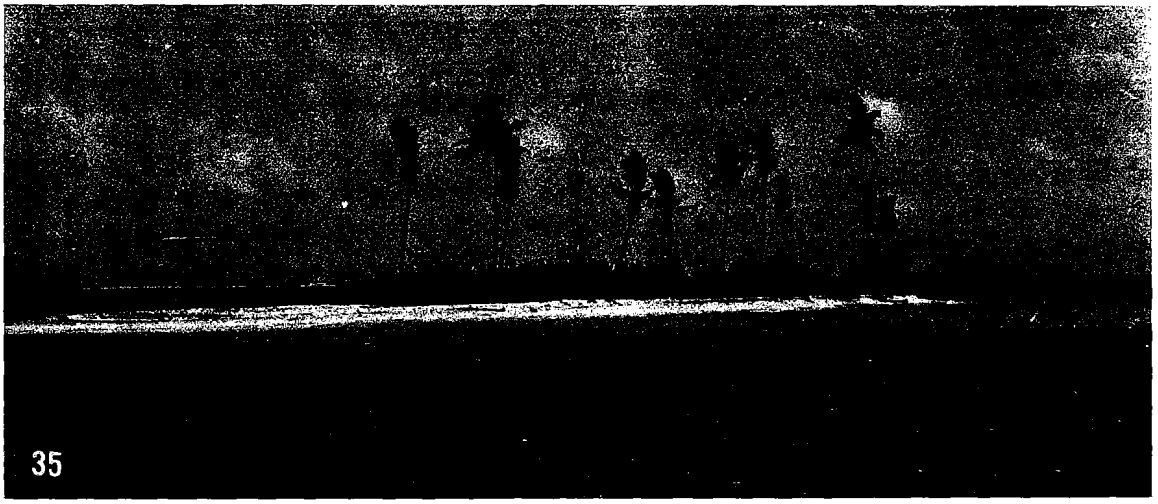
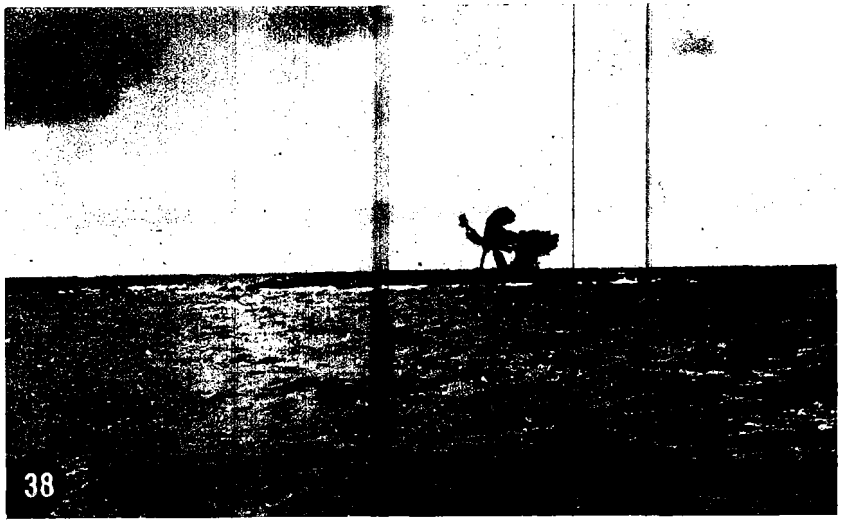


Plate 33. Pool on North Silk Cay 1961
Plate 34. Middle Silk Cay 1961
Plate 35. South Silk Cay 1961



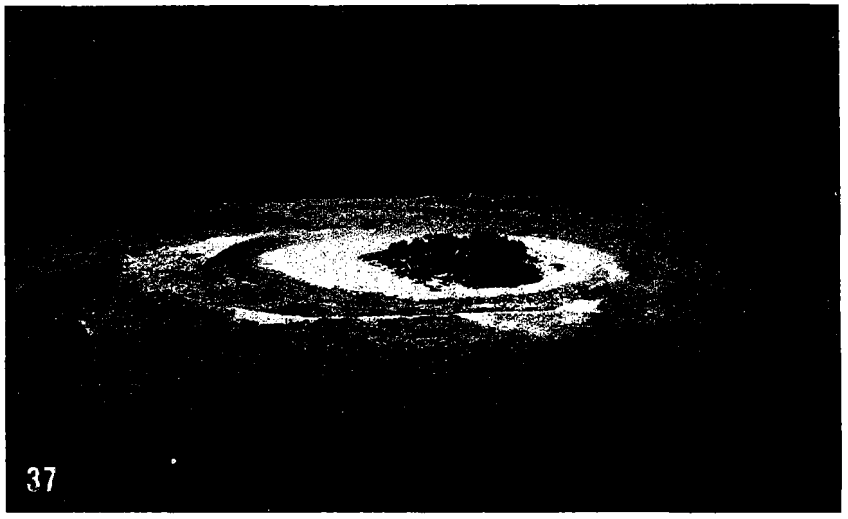


Plate 36. Ranguana Cay: aerial view from the northeast 1962
Plate 37. North Spot: aerial view from the southeast 1962
Plate 38. North Spot from the south 1972
Plate 39. Tom Owen's Cays: aerial view from the northeast 1961

Plate 40. *Hymenocallis littoralis* under coconuts at Pompion Cay 1972

Plate 41. Ranguana Cay: erosion on the north shore 1972

Plate 42. Ranguana Cay seen from the shingle islet at the west end 1972

Plate 43. Tom Owen's East Cay from the southwest 1972

Plate 44. North Spot 1972

Plate 45. Tom Owen's West Cay: north shore 1972

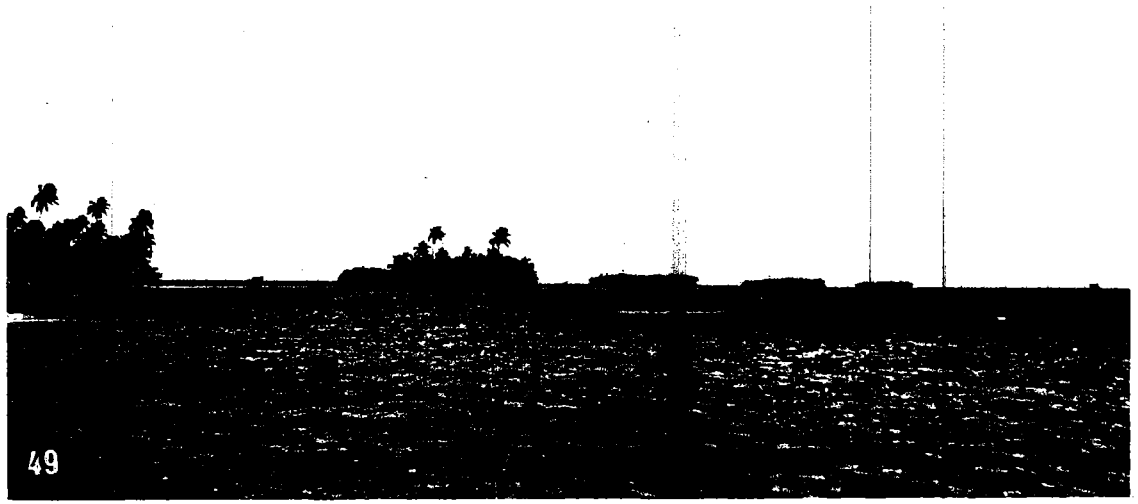


Plate 46. Tom Owen's Cays from the west 1972
Plate 47. Tom Owen's East Cay: aerial view from the south 1962
Plate 48. Tom Owen's West Cay: aerial view from the southwest 1962
Plate 49. The Sapodilla Cays 1972: left-right Frank's Cay, Frank's Cay West, Nicolas Cay, Hunting Cay, Lime Cay, Ragged Cay

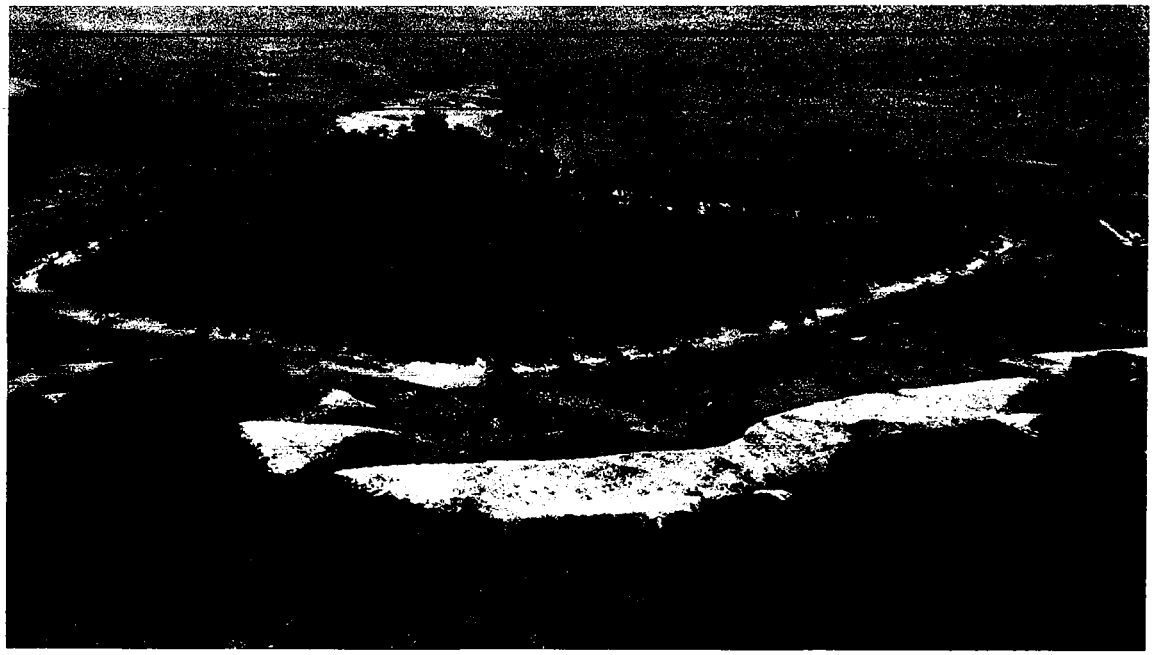


Plate 50. Northeast Sapodilla Cay: aerial view from the east 1962

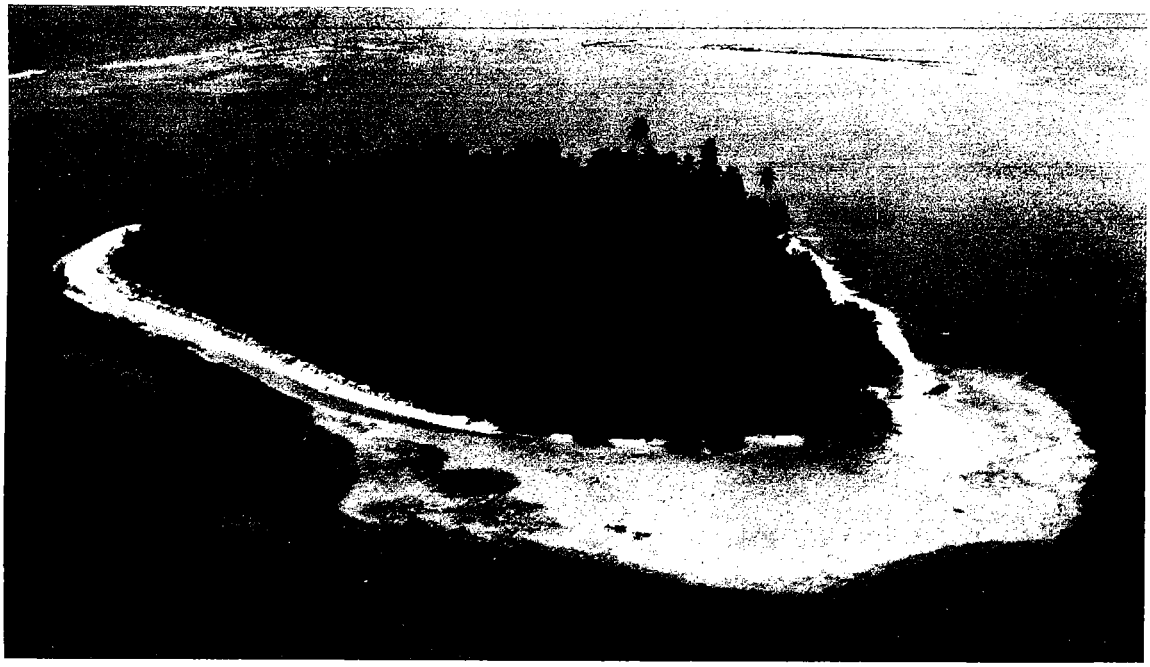


Plate 51. Nicolas Cay: aerial view from the northeast 1962

Plate 52. Northeast Sapodilla Cay: northeast shingle ridge 1972

Plate 53. Northeast Sapodilla Cay: eroding northwest shore 1972

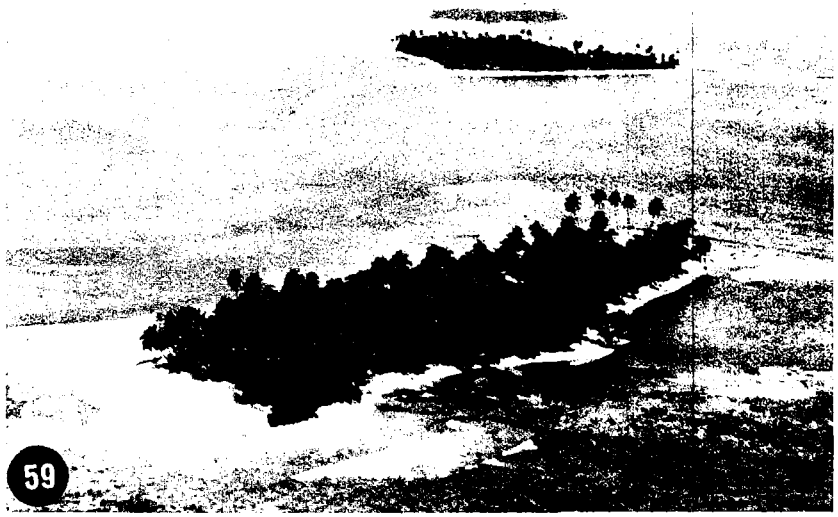
Plate 54. Frank's Cays: aerial view from the south 1961

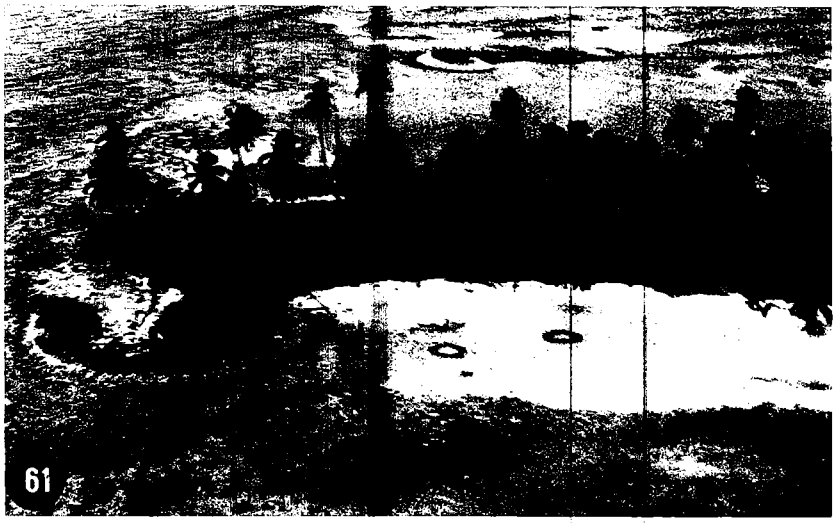
Plate 55. Hunting Cay: aerial view from the north 1961

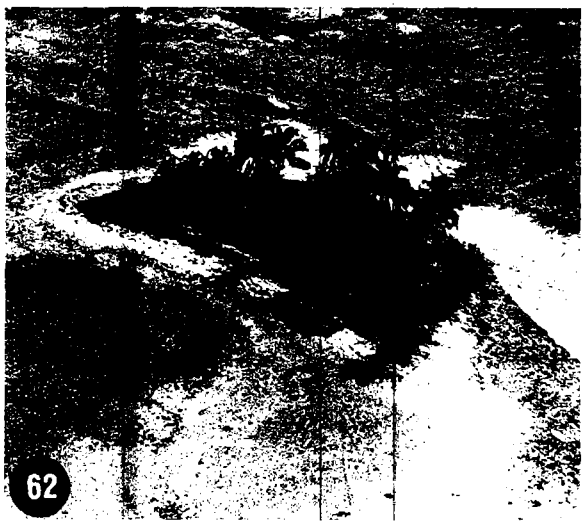
Plate 56. Hunting Cay: aerial view from the southeast 1962

Plate 57. Nicolas Cay: 'rootrock' exposed on the eroding west shore 1972

Plate 58. Hunting Cay east bay from the north 1972







Plates 59-61. Lime Cay: aerial views in 1962 from the south; of the west end from the north; of the east end from the north
Plate 62. Ragged Cay: aerial view from the south 1962

Plate 63. Ragged Cay from the west 1972
Plate 64. Seal Cay: aerial view of the cay and faro from the east 1962
Plate 65. Seal Cay: east rampart and moat 1972

5. CAYS OF THE BARRIER REEF LAGOON

The barrier reef lagoon contains islands of many different types and widely differing sizes. The great majority are mangrove islands, and these have been very little studied. Others are of more complex form and vegetation, but only a few of these have been studied in the same detail as the barrier reef cays. The lagoon cays fall into several distinct groups, and these are described from north to south.

A. The northern lagoon

North of latitude 17°30'N the coastal shelf has an average width of 24 km, and between Belize and the Bulkhead Reef (which extends as a shallow bar from the mainland to Ambergris Cay) is 2.5-4.5 m deep. The Bulkhead itself carries only 0.5-1.4 m, and encloses the 90 km long Bahia de Chetumal, a shallow embayment with depths of 2-6 m. The cays of the northern lagoon consist mainly of a series of linear mangrove-sand cays (mangrove islands with a sand ridge on their windward sides) and mangrove cays located 3.5-4 km landward of the barrier reef and separated from it by a depression termed the "reef lagoon" by Ebanks (1975, p.238) and less than 4.5 m deep. In the southern part of the area, large mangrove cays (Hicks Cays, Hen and Chickens, Peter's Bluff, North Drowned Cay, the Drowned Cays) extend across the shelf towards the mainland.

Ambergris Cay

This is the largest island of the Belize coastal shelf, extending for 40 km southwards from the largely artificial cut Boca Bacalar Chico which forms the Belize-Mexico boundary. It varies in width from 6.5 km to less than 90 m. Jefferys noted in his 1775 chart that there were "plenty of deer in it and Ambergrease often found on its Beach". Henderson (1811, p.24) described it as "of considerable size, abounding with extensive fresh water lakes, and at most seasons ... plentifully stocked with many kinds of game. This Key is likewise said to produce Logwood, and the more valuable kind of Dye-wood, named Brasiletto." Allen (1841, p.80) also stated that the cay was named "from the produce of its shores". It was visited by Stoddart in 1960, 1962 and 1965 and briefly described (1963, pp. 31-33, fig. 16; 1969, pp. 5-6), and by H. Pelzl in 1972. Sediments and geology have been studied in detail by Ebanks (1975) and Tebbutt (1975). Stoddart's vegetation map (1963, fig. 16) may be compared with Ebanks's geological

map (1975, fig. 3): there is a broad correspondence between vegetated supratidal flat of Ebanks and mangrove swamp of Stoddart; between Pleistocene limestone and high and low woodland; and between coconut woodland and windward beach ridge. Ebanks distinguishes four main components to the island:

(a) Windward beach ridge, a linear sand body along the east side of the island, about 3 m thick above bedrock, reaching 1.2-2.4 m above sea level (with a maximum of 6.6 m at San Pedro), and 90-460 m wide. Sediment analyses of 19 samples showed that 90.8% of the sediments on average are of skeletal origin (*Halimeda* 35.5%, molluscs, 18.0%, coralline algae 14.8%, corals 8.6%) (Ebanks 1975, p.247). Most of our floristic information about Ambergris Cay comes from this unit.

(b) Supratidal flats, formed of fine sediments with dolomitic crusts and extreme environmental conditions (mean salinity 76.3°/oo, range 41.5-123.8°/oo; maximum water temperature 42°C). This unit is vegetated by *Rhizophora* and *Avicennia* on the flats, with some shelly windward sand ridges carrying a palmetto-salt grass-mangrove assemblage (Ebanks 1975, p.253); these ridges reach 0.3-1.3 m above sea level.

(c) Intra-island lagoons: oval-shaped ponds, often with arcuate and smooth lee shores and irregular windward shores, the bigger ones 1.3-2 m deep, the shoaler areas less than 0.6 m deep, occupying about one-third the total area of the cay (Ebanks 1975, p.265).

(d) Limestone surface. This is of uncertain age: north of Boca Bacalar Chico Butterlin and Bonet (1960a, 1960b) map the limestones in the Xcalak area as belonging to the Carrillo Puerto Formation of Upper Miocene-Pliocene age; Sapper (1896) mapped those on Ambergris Cay as Quaternary; and Flores 1952, p.409) by implication states that they are Miocene to Pliocene. Tebbutt (1975, p.300) believes them to be Pleistocene, and broadly correlative with the Key Largo Limestone of Florida, of Last Interglacial Age. Reef facies in this limestone outcrop at Reef Point on Ambergris Cay in a manner comparable to that of the widespread "ironshore" of other Caribbean localities, but no absolute dates are available. The existence of Last Interglacial reef limestones further north along the Yucatan coast has already been noted (Szabo *et al.* 1978). The deep well drilled by Gulf-Shell at Basil Jones revealed 425 m of Tertiary rocks (post-Eocene) and 1790 m of Lower Cretaceous. The vegetation of the Ambergris limestone area is clearly an extension of that of neighbouring Quintana Roo. Wagner (1964, p.223) simply and misleadingly maps this as Tropical Rain Forest, but from casual observation it is more realistically classed in Beard's (1955; 1949, p.82) categories of Dry Evergreen Woodland, Dry Evergreen Thicket, and Evergreen Bushland (cf. Stoddart 1980, pp. 55-58). This is the view taken by Romney *et al.* (1959, p.28). No collections have been made on the surface limestone on Ambergris Cay and the flora is thus unknown.

The windward sand ridge is vegetated by a coconut woodland with a mainly weedy ground vegetation, and a beach-crest vegetation of shrubs

and pioneer grasses and herbs. On the leeward side the ridge is abutted by mangroves. At the small village of San Pedro there are introduced trees, shrubs and herbs. It is worth noting that the vegetation of Ambergris Cay has been influenced by man since pre-European times (Stoddart 1980, pp. 160-161). It has several Maya sites, two of which were located by Romney *et al.* (1959, fig. 10) and Hammond (1977, p.48). Several were excavated by Gann (1926, p.59). He found them to be "for the most part kitchen middens, composed of enormous numbers of conch, cockle, whelk and oyster shells, turtle carapaces, crab and crayfish shells, and vast quantities of such fish as inhabit the surrounding waters. Amongst these were numerous potsherds, all of the coarse, red and gray, domestic varieties, broken flint spear-heads in great numbers, with a few broken obsidian knives, and greenstone celts, many stone and pottery net sinkers, and a few broken hand corn mills of Esquipulas stone. There were also found the bones of a few small mammals, including the gibnut and armadillo, but none of deer or wild hog, such as are usually found at most Maya sites on the mainland." Later Gann mentioned "innumerable burial and kitchen-midden mounds along the coast" (1927, p.95).

Only 22 species of plants have been recorded from Ambergris Cay so far; undoubtedly a complete list would be very much larger. Those recorded are:

Distichlis spicata West(1977)
Sporobolus sp. 62S 65S
Cyperus sp. 62S
**Cocos nucifera* 57S 60S 62S 65S
Thrinax radiata 62S
Hymenocallis littoralis 65S
Sesuvium portulacastrum 62S
Sophora tomentosa 65S
Suriana maritima 65S
Euphorbia sp. 65S
Rhizophora mangle 60S
Bucida spinosa 72C
Terminalia catappa 62S 65S
Ipomoea macrantha 65S
Ipomoea sp. 65S
Cordia sebestena 65S
Tournefortia gnaphalodes 65S
Avicennia germinans 60S
Solanum blodgettii 65C
Hamelia patens 72C
Ambrosia hispida 65S
Borrichia arborescens 65C
Flaveria linearis 65C

Mangrove cays in the lee of Ambergris Cay (Deer Cay, Swab Cay, Blackadore Cay, Mosquito Cay) have only been observed from the air. There are small mangrove islands at the southern tip of Ambergris Cay, and also Cay Cangrejo (17°50½'N, 88°03'W), a mangrove island.

Cay Caulker

Cay Caulker (the Cay Corker of Jefferys (1775) and Owen (1830)) is a large mangrove-sand cay 8 km south of Ambergris Cay and 1.5-2.4 km from the edge of the coastal shelf. It has been described briefly by Vermeer (1959, pp. 55-58), Stoddart (1963, pp. 33-35, fig. 17) and Stoddart (1969, p.6). It is 7.2 km long and 60 m to 1.2 km wide. Its windward side is formed by a sand ridge generally less than 1 m

high, but rising at the village site to over 2 m. In places there are clumps of mangroves on the seaward side of the ridge. On the western side there are extensive mangroves, with in places a low leeward sand ridge. Palm thicket occupies the interior areas not cleared for coconut woodland. During Hurricane Hattie there was much marginal erosion and surface sand-stripping and scouring on the seaward side of the windward sand ridge. Some coconuts and other trees were felled near the seaward shore, and exposed mangroves were defoliated. But in general, away from the cleared area of the village, physiographic effects were negligible and vegetation damage moderate. 34 species of plants have been recorded (30 of them in 1965), and this is undoubtedly a partial list. They are:

Eragrostis prolifera 65C
Eustachys petraea 65C
Cyperus ligularis 65C
Fimbristylis cymosa 65C
**Cocos nucifera* 57S 60S 61S 62S 65S
**Musa paradisiaca* 57S
**Casuarina equisetifolia* 62S 65C
Coccoloba uvifera 62S 65C
Philoxerus vermicularis 65C
Crotalaria verrucosa 65C
Pithecellobium keyense 65C
Vigna luteola 65C
Suriana maritima 65C
Euphorbia blodgettii 65C
Euphorbia mesembrianthemifolia 65C
**Mangifera indica* 57S 60S
Hibiscus tiliaceus 65C
Sida acuta 65C
Turnera ulmifolia 65C
Rhizophora mangle 60S
Bucida spinosa 65C
**Terminalia catappa* 61S 65S
**Catharanthus roseus* 65C
Ipomoea sp. 62S
Cordia sebestena 65C
Tournefortia gnaphalodes 65C
Lantana involucrata 65C
Stachytarpheta mutabilis 65C
Solanum blodgettii 65C
Ernodea littoralis 65C
Spermacoce suaveolens 65C
Ageratum littorale 65C
Borrichia arborescens 65C
Wedelia trilobata 65C

Cay Chapel (17°41'N, 88°02'W)

Cay Chapel lies 1.6 km south of Cay Caulker and 2.5 km from the shelf edge. It is 3.6 km long and up to 460 m wide, and built of parallel sand ridges rising to 2 m above sea level. The leeward mangrove is not well developed, and most of the sand ridges are covered by coconut woodland: mechanical clearing has destroyed not only the original vegetation but also the surface topography. This clearing has taken place since 1775 when Jefferys noted a single "large cocoa tree"; the greater part, however, took place in 1960-61. During Hurricane Hattie it is said that some 60% of the coconuts were felled, and there was much marginal erosion and surface sand stripping. For details see Stoddart (1963, pp. 35-36, fig. 17). By 1965 the windward shore had been extensively colonised by *Conocarpus*, *Borrichia*, *Suriana* and *Tournefortia*, with herbs and grasses beneath the coconut woodland. For an account of recovery from Hurricane Hattie see Stoddart (1969, pp. 6-7). Eighteen species of plants have been recorded, and many more must be present. The list is:

Cenchrus incertus 62S 65S
Cyperus sp. 62S
**Cocos nucifera* 1775S 62S 65S
Thrinax radiata 62S
Coccoloba uvifera 62S 65S
Rivina humilis 65C
Cassytha filiformis 65S
Cakile lanceolata 65S
Suriana maritima 62S 65S
Euphorbia sp. 62S 65S
Rhizophora mangle 62S 65S
Conocarpus erectus 65S
Merremia dissecta 65C
Tournefortia gnaphalodes 62C 65S
Ernodea littoralis 65S
Ageratum sp. 65S
Conyza canadensis 65S
Wedelia trilobata 65C

Craig (1966, p.21) describes a mound faced with shaped stone blocks, with broken pottery and conch shells, on this island.

St. George's Cay (17°33½'N, 88°04'W) Plates 66-68

St. George's Cay is an arcuate mangrove-sand cay standing 2.5 km from the shelf edge. The western part is about 1.6 km long and 90-180 m wide, and consists entirely of mangrove. At the northeast end is a low sandy ridge 1.2 km long and 40-90 m wide, with some mangrove on its lee side. The sandy area was cleared and settled at the end of the eighteenth century and was entirely devoted to residential use at the time of Hurricane Hattie. It was overtopped by the storm surge during the hurricane and five channels were cut through the ridge. Most coconuts were felled and mangroves defoliated, though ground vegetation survived in patches. By 1965 two of the scoured channels had been blocked, some of the mangrove was still living, and there was a luxuriant growth of herbs and grasses. Detailed accounts of the island before and immediately after Hurricane Hattie, and in 1965, are given by Stoddart (1963, pp. 37-40, figs. 18 and 19; 1969, pp. 7-8, fig. 3). Romney *et al.* (1959, fig. 10) describe the cay as a shell midden site. 30 plant species are recorded (16 during the earlier surveys and 21 by Spellman in 1972). They are:

Eustachys petraea 72C
Paspalum sp. 62S
Sporobolus sp. 65S
Cyperus sp. 62S 65S
**Cocos nucifera* 60S 62S 65S 72S
Hymenocallis littoralis 62S 65S
Coccoloba uvifera 62S 65S
Batis maritima 65S 72C
Philoxerus vermicularis 72C
Portulaca oleracea 72C
Sesuvium portulacastrum 60S 65S 72C
Cakile lanceolata 62S
Canavalia rosea 72C
Euphorbia mesembrianthemifolia 72C
Euphorbia sp. 62S 65S
Rhizophora mangle 62S 65S
Conocarpus erectus 65S 72C
Eustoma exaltatum 72C
Echites umbellata 72C
Ipomoea pes-caprae 62S
Ipomoea stolonifera 72C
Ipomoea sp. 65S
Cordia sebestena 72C
Tournefortia gnaphalodes 72C
Stachytarpheta jamaicensis 65S 72C
Erithalis fruticosa 72C
Ernodea littoralis 72C
Spermacoce verticillata 72C
Ageratum sp. 62S 65S
Melanthera nivea 72C
Synedrella nodiflora 72C
Wedelia trilobata 62S 65S 72C

Cays between Cay Chapel and Belize

There are numerous large mangrove islands on the coastal shelf between 17°30'N and 17°45'N. They include Long Cay (the northernmost of that name), Hicks Cays, Montego and Frenchman's Cays, Hen and Chicken Cays, Rider's Cays, and the northernmost Drowned Cays. Apart from a narrow seaward sand ridge with coconut woodland on Long Cay and on the Drowned Cays north of Gallows Point, these islands consist wholly of mangrove. Thus the Hicks Cays consist of a dozen islands, four of them large, separated by deep meandering channels through which tidal currents set with great rapidity. The Drowned Cays too are intersected by a number of east-west tidal channels or 'bogues', namely Shag Cay Bogue, Bannister Bogue, Farls Bogue and Goring Bogue, most of which carry 5-7.5 m of water. For further details on these islands, none of which have been studied in detail, see Vermeer (1959, pp. 58-59) and Stoddart (1963, pp. 36-37).

Moho Cay (17°31½'N, 88°12'W)

Moho Cay is a small island immediately north of the Belize delta. Gann (1925, p.19) mentions "innumerable flint spear-heads ... with thousands of circular pottery rings, probably used as net sinkers." He suggested that the island had been used as a Maya fishing station: "Many tons of manatee bones have been washed out from the northern end of the cay." Craig (1966, p.20) found habitation sites exposed by wave erosion for 125 m along the shore, with "numerous pottery sherds, abundant chert cores, flakes, and stone artifacts, including jadeite celts, and large (25 cm) fine-wrought projectile points." In addition to manatee bones, Craig also found oyster and conch shells, and two human burial sites. The island was not visited during our own surveys.

Stake Bank (17°28'N, 88°07½'W)

This is a mangrove island approximately 400 m long and 120 m wide, standing on a shoal area 2.3 km long and 1.4 km wide. There is a widespread tradition that the shoal was built with ballast deposited by ships in the harbour (Anderson 1958, p.95), though this could only account for a small part of the shoal volume. In the survey of Belize harbour by Anthony de Mayne in 1828 the Bank had only one or two mangrove seedlings. The bank was described as "dry in some parts" by Speer in 1765, and was marked by Jefferys in 1775.

Spanish Lookout Cay (17°24'N, 88°04'W)

This very small island at the southern end of the Drowned Cays was visited briefly in 1965. It is largely artificial, built of conch shells collected by fishermen, and surrounded by a coral block wall. It has no natural vegetation.

Water Cay (17°23'N, 88°03½'W)

This large mangrove island is immediately south of the Drowned Cays; it has a sand ridge along its windward side. J. Dwyer collected *Euphorbia mesembrianthemifolia*, *Lantana involucrata* and *Conocarpus erectus* there in 1967. It was not visited by us.

B. The Southern Triangles

Though this name no longer appears on charts it is convenient to use it for the groups of islands at the inner end of the Belize Deepwater Channel: it was used on the charts of Speer (1765, 1771) and Jefferys (1775) and also in the Anglo-Spanish Treaties of 1753 and 1783. Altogether there are some two dozen islands standing on the flat tops of steep-sided shoals. On the north side of the channel Robinson Point and Robinson Island both have dry-land vegetation in addition to mangroves, but the other islands (Grennels Cay, Ramseys Cay, One Man Cay) are entirely of mangrove. On the south side Spanish Cay is a sand cay and the others (Long, Crayfish, Simmonds and other unnamed cays) are mangrove.

Robinson Point Cay (17°22'N, 88°11½'W)

This island, totalling about 29 ha, has the largest dry land area in the Southern Triangles. It is described by Vermeer (1959, pp. 75-79, fig. 16) and Stoddart (1963, pp. 46-47, fig. 26). There is a low narrow sand ridge along the east and southwest sides of the cay; it is nowhere more than 50 m wide and about 900 m long. Before Hurricane Hattie it was covered with a dense thicket of coconuts, *Thrinax* and other strand species, except at the small settlement near the lighthouse, built at the western point in 1939. During the storm most of the dry-land vegetation was destroyed and the mangroves defoliated, and in 1962 the island had been abandoned by its inhabitants. The following plant species were noted in 1961 before the storm:

Cyperus sp. 61S
**Cocos nucifera* 57S 61S
Thrinax radiata 61S
Hymenocallis littoralis 61S
Coccoloba uvifera 61S
Suriana maritima 61S

Euphorbia sp. 61S
Rhizophora mangle 61S
Conocarpus erectus 61S
Cordia sebestena 61S
Avicennia germinans 61S
Stachytarpheta jamaicensis 61S

Robinson Island (17°22½'N, 88°10½'W)

There is a less well-developed sand ridge along the south side of Robinson Island. The palm thicket here was badly damaged during Hurricane Hattie, and the mangroves defoliated (Stoddart 1963, p.47). Only two species were noted in passing in 1961:

**Cocos nucifera* 61S
Rhizophora mangle 61S

Spanish Cay (17°21'N, 88°09½'W)

Spanish Cay when mapped in 1961 was a low-lying sandy island 100 m long and 10-18 m wide. The southern end of the cay was fringed with *Rhizophora*, and there were several tall *Avicennia* trees. It appeared that mangroves had previously been more extensive but had been cleared. There were several coconuts and a ground cover of sedges, grasses and ornamental plants. Much of the vegetation disappeared during Hurricane Hattie; the island has not been revisited since (see Stoddart 1963, p.47, fig. 27). Its total area in 1961 was 1260 sq m. The following plant species were recorded, but the list is certainly partial:

**Cocos nucifera* 61S 62S
Euphorbia sp. 61S
Rhizophora mangle 61S 62S
Conocarpus erectus 61S 62S
Avicennia germinans 61S 62S

C. Cays of the Central Lagoon

For 60 km southwards from the Southern Triangles to the latitude of South Water Cay the coastal shelf has an extremely simple topography. The floor shelves gradually eastwards from the mainland coast to depths of 20-24 m, and the shelf is edged by a barrier platform 5-8 km wide and 4-6 m deep. There are no patch reefs or cays within the lagoon. Near the inner edge of the barrier platform there is a series of linear mangrove islands, aligned north-south, and generally about 1.8 km from the lagoon edge and 3.4 km from the seaward edge of the platform. These islands include Middle Long Cay, Bluefield Range, Alligator Cay and Colson Cays. Others, such as Southern Long Cay, Columbus Cay and Cross Cay, are less regular islands closer to the seaward margin of the platform. All are mangrove islands; none has been investigated in detail. The linear islands occupy the same relative position as do the mangrove-sand cays of the northern barrier reef (Cay Caulker, Cay

Chapel), but they lack the windward sand ridge and strand flora. South of 17°N the mangrove islands near the inner edge of the barrier platform become more complex. Instead of simple linear cays they are complexes of smaller mangrove islands, often arranged in an ellipse, and known as "ranges". These include Fly Range, Tobacco Range, South Water Range and Blue Ground Range. Some of these have been visited and will be described below. For further brief notes on this sector of the reef, see Vermeer (1959, pp. 59-71 and 79) and Stoddart (1963, pp. 51-52).

South of South Water Cay the barrier reef swings southeastwards in a broad continuous arc to Gladden Spit and then turns sharply southwestwards. There are no sand cays on the southeast-trending sector, and only small patch reefs with small cays (already described) to the south of it. At Gladden Spit the coastal shelf reaches its maximum width of nearly 40 km, and the greatest lagoon depths reach 35 m. The barrier platform on the edge of the shelf becomes narrower and less regular in this sector, and lacks mangrove islands. Within the lagoon the topography is extremely intricate, with either long arcuate ridges or elongate elliptical ring-like structures with deep central depressions, the largest being up to 13 km long. These ridges rise to within 5 m of the surface; they are interrupted by deep gaps; and their upper surfaces are often pitted with deep holes; active coral reefs reaching the surface are comparatively rare. The inference from morphology that these structures resulted from karst erosion of older reef limestones (Stoddart 1963, p.60) has been amply confirmed by Purdy (1974a, 1974b), who terms them "shelf atolls". This intricate topography provides a wide range of substrates and exposure conditions for island development: all types of island from true sand cay to mangrove island are found.

The islands of this central lagoon area are described from north to south, beginning with the Ranges of the northern area.

Tobacco Range (16°53'N, 88°05'W) Plates 69-70

Tobacco Range is an elliptical array of mangrove islands with a shallow central lagoon, standing near the middle of the barrier platform at Tobacco Entrance; it is roughly 4.8 km long north-south and 1.8 km wide. The largest northeastern island was visited in 1972 at its northern and southern ends. At its northern end there is a seaward sand ridge 0.6 m high and 18 m wide; a zone 60 m wide of low boggy ground with coconuts and no other ground vegetation; and a zone 90 m wide of *Batis maritima*, open pools, and standing dead mangrove trunks. These are 4-4.5 m tall and date from Hurricane Hattie's effects in 1961. The mangrove zone in the lee is low and presumably regenerated since that time. Beach shrubs include *Tournefortia, Sophora, Suriana, Borrichia* and *Laguncularia*, with some *Rhizophora* on the seaward shore. The ground cover includes *Spartina, Ageratum, Cyperus* and *Euphorbia*, with carpets of *Sesuvium*. *Pithecellobium* takes

the place of *Conocarpus*, and *Pluchea symphytifolia* and *Echites umbellata* are also unusual additions to the flora. Both north and south from the point of survey the coconut zone narrows until it is only 2 m wide, separating the *Batis* zone from coastal *Sesuvium*. At the southern end of the island the seaward sand ridge is 20 m wide, with *Rhizophora* and *Avicennia* clumps on its seaward side. Inland there is a zone of mangroves 20-30 m wide and then open standing water. The sand ridge itself supports a dense scrub of *Thrinax, Conocarpus* and coconuts, with *Cyperus, Batis, Spartina, Sesuvium* and *Borrichia*. Coconut boles 3-4 m offshore and outcropping lightly-cemented root rock on the shore indicate beach retreat. At both of the sites visited the effects of Hurricane Hattie are still very apparent. Before the storm tall mangrove presumably extended to the beach ridge. The death of a zone of mangrove up to 100 m wide, indicated by the standing dead trees, has allowed colonisation by *Batis maritima*, and because of the high level of the substrate, apparently rarely flooded, there is no opportunity for recolonisation by mangroves. One might expect colonisation in due course by sedges, grasses, and shrubs such as *Conocarpus* and *Pithecellobium*.

Thirty species of plants were recorded in 1972:

Eragrostis prolifera 72C
Eustachys petraea 72C
Paspalum distichum 72C
Phragmites cf. *australis* 72C
Spartina spartinae 72C
Cyperus planifolius 72C
**Cocos nucifera* 72S
Thrinax radiata 72C
Crinum amabile 72C
Batis maritima 72C
Salicornia perennis 72C
Sesuvium portulacastrum 72C
Pithecellobium keyense 72C
Sophora tomentosa 72C
Suriana maritima 72C
Euphorbia blodgettii 72C
Euphorbia mesembrianthemifolia 72C
Passiflora suberosa 72C
Rhizophora mangle 72C
Conocarpus erectus 72C
Laguncularia racemosa 72C
Bumelia retusa 72C
Echites umbellata 72C
Tournefortia gnaphalodes 72C
Avicennia germinans 72C
Erithalis fruticosa 72C
Ernodea littoralis 72C
Ageratum littorale 72C
Borrichia arborescens 72C
Pluchea symphytifolia 72C

Coco Plum Cay (16°53'N, 88°07'W)

Coco Plum Cay is a linear mangrove island near the inner edge of the barrier platform, immediately west of Tobacco Range. Like Tobacco Range it has a low beach-ridge area with similar vegetation. Seventeen plant species are recorded:

Paspalum distichum 72C
Spartina spartinae 72C
Sporobolus virginicus 72C
Cyperus planifolius 72C
Fimbristylis spadicea 72C
Thrinax radiata 72C
Batis maritima 72C
Suriana maritima 72C

Euphorbia mesembrianthemifolia 72C
Rhizophora mangle 72C
Conocarpus erectus 72C
Laguncularia racemosa 72C
Tournefortia gnaphalodes 72C
Avicennia germinans 72C
Erithalis fruticosa 72C
Pluchea symphytifolia 72C
Wedelia trilobata 72C

Phillips Petroleum drilled a hole 91.5 m deep through Coco Plum Cay; the sub-Holocene unconformity was reached at 9.2 m depth (Purdy 1974b, pp. 841, 853).

Man-o'-War Cay (16°52½'N, 88°07'W)

This island, one of several of the same name on this coast (e.g. at 16°39'N, 88°12'W) lies at the southern end of Coco Plum Cay. It is a small mangrove island, with *spartina* and succulents. Six plant species are recorded:

Spartina spartinae 72C
Batis maritima 72C
Sesuvium portulacastrum 72C
Rhizophora mangle 72C
Laguncularia racemosa 72C
Avicennia germinans 72C

Water Range (16°50'N, 88°06'W)

This is the group of mangrove islands (the Twin Cays of charts and Figure 1) 2.2 km northwest of South Water Cay. There is a small sand patch measuring 100 x 18 m at the south end on the seaward side, and another of shell sand on the lee side. Both support a scrub of *Thrinax, Conocarpus, Laguncularia, Suriana, Erithalis* and *Borrichia,* with grasses, sedges and succulents. On their inner sides they pass into *Rhizophora* swamp through *Laguncularia* and *Avicennia.* Twenty plant species are recorded:

Eustachys petraea 72C
Paspalum distichum 72C
Sporobolus virginicus 72C
Cladium jamaicense 72C
Cyperus planifolius 72C
**Cocos nucifera* 72S (juvenile)
Thrinax radiata 72C
**Casuarina equisetifolia* 72C
Batis maritima 72C
Salicornia perennis 72C
Suriana maritima 72C
Euphorbia mesembrianthemifolia 72C
Rhizophora mangle 72C
Conocarpus erectus 72C
Laguncularia racemosa 72C
Avicennia germinans 72C
Erithalis fruticosa 72C
Ageratum littorale 72C
Borrichia arborescens 72C
Wedelia trilobata 72C

Weewee Cay (16°46'N, 88°08½'W)

Weewee Cay stands on an isolated patch reef 6.5 km southwest of South Water Cay. It is a small triangular island with sides 90-140 m long, surrounded by dense *Rhizophora*, with a low-lying central sandy area about 70 m in diameter. The dry-land vegetation is limited to coconuts with an undercover of grasses and sedges. It is used as a fishing station. Hurricane Hattie in 1961 killed some *Rhizophora* at the south end and felled many coconuts; the island has not been visited since 1962. For a brief account of it at that time see Stoddart (1963, p.61). Six species of plants are recorded:

Eustachys petraea 62C
Cyperus peruvianus 62C
Fimbristylis cymosa 62C
**Cocos nucifera* 62S
Batis maritima 62C
Rhizophora mangle 62S

Cat Cay (16°40'N, 88°12'W)

This is one of the small constituent islands of the Pelican Cays, the northernmost shelf atoll of the central lagoon. It was visited in 1962 (Stoddart 1963, p.62). It has a narrow fringe of *Rhizophora* on its north and east shores and much of the west shore. The centre of the island is low-lying and sandy, with a woodland of coconuts, *Thrinax* and *Thespesia*. Ospreys were nesting here in 1962. Eight plant species are recorded:

Cyperus sp. 62S
**Cocos nucifera* 62S
Thrinax radiata 62S
Euphorbia sp. 62S
Thespesia populnea 62C
Conocarpus erectus 62S
Avicennia germinans 62S
Wedelia trilobata 62S

Lagoon Cays between Stewart Cay (16°46'N, 88°10'W) and Baker's Rendezvous (16°34'N, 88°12'W)

These are briefly noted by Stoddart (1963, pp. 61-62). They are mainly mangrove islands and have not been studied in detail. Peter Douglas Cay (16°43'N, 88°10'W) and the adjacent Little Peter Cay both have an area of palm thicket with *Sophora tomentosa*. There are coconuts on Peter Douglas Cay and Baker's Rendezvous.

Jack's Cay (16°33'N, 88°04'W)

Jack's Cay is a mangrove island on an isolated reef patch in the lee of the Gladden Spit reef, 5.5 km from the reef edge. It is dominated by mature *Rhizophora* trees. Seven plant species are recorded:

Sporobolus virginicus 72C
Brassavola nodosa 72C
Batis maritima 72C
Sesuvium portulacastrum 72C
Rhizophoramangle 72C
Laguncularia racemosa 72C
Avicennia germinans 72C

Buttonwood Cay (16°32½'N, 88°03'W) Figure 31

Buttonwood Cay lies 1 km southeast of Jack's Cay. It was mapped in 1961 (Stoddart 1963, p.64, fig. 39) and again in 1972. It is surrounded on its eastern side by *Rhizophora*, with a low-lying central sand area measuring 95 x 75 m. The sand area is covered with a coconut woodland with a ground cover of grasses and herbs; there is a discontinuous fringe of *Conocarpus*, *Laguncularia* and *Coccoloba* between the coconut woodland and the *Rhizophora*. The island was mapped in 1961 before both Hurricane Anna and Hurricane Hattie: the northeastern mangrove area has since decreased in area, and the sand area has accreted to leeward. The island is a fishing station with accumulations of conch shells along the shores. Its area in 1972 was 0.72 ha. 26 species of plants have been recorded:

Andropogon glomeratus 72C
Eragrostis prolifera 61C 72C
Eustachys petraea 61C 72C
Spartina spartinae 72C
Cyperus ligularis 61C 72C
Cyperus planifolius 72C
Fimbristylis cymosa 72C
**Cocos nucifera* 61S 72S
Coccoloba uvifera 61S 72C
Batis maritima 72C
Protulaca oleracea 72C
Sesuvium portulacastrum 72C
Vigna luteola 61C 72C
Euphorbia blodgettii 61C 72C
Euphorbia mesembrianthemifolia 72C
Euphorbia sp. 61S
Hibiscus tiliaceus 72C
Rhizophora mangle 61S 72C
Conocarpus erectus 61S 72C
Laguncularia racemosa 72C
Avicennia germinans 61S 72C
Lantana involucrata 72C
Hedyotis corymbosa 72C
Eclipta alba 72C
Melanthera nivea 72C
Pluchea symphytifolia 72C
Wedelia trilobata 72C

Trapp's Cay (16°30½'N, 88°10'W)

Trapp's Cay (the Moho Cay of charts) stands on an isolated patch reef in the deepest part of the lagoon. It was mapped after Hurricane Hattie in 1962 (Stoddart 1963, pp. 63-64, fig. 38). It is a sandy island with maximum dimensions of 240 x 190 m, and an area of 4.54 ha. The north and east sides of the cay were blanketed with fresh shingle up to 0.6 m thick and 9-23 m wide during Hurricane Hattie. The island is covered with a woodland of coconuts and *Thrinax*, with *Coccoloba* and *Thespesia*. The vegetation was not studied in detail and only 10 species are recorded:

Cyperus sp. 62S
**Cocos nucifera* 62S
Thrinax radiata 62S
Hymenocallis littoralis 62S
Coccoloba uvifera 62S
Sesuvium portulacastrum 62S
Phyllanthus amarus 62C
Thespesia populnea 62S
Rhizophora mangle 62S
Conocarpus erectus 62S

Cary Cay (16°31½'N, 88°12'W) Plate 71

Cary Cay stands on one of the longest reef ridges in the central lagoon: it is 460 m long and has a total area of 4.29 ha. In the north there is an extensive mangrove swamp up to 180 m wide; in the south there is a narrow tapering sand and shingle ridge. In the centre of the island there is an *Acrostichum* marsh with standing water. The dry sand area has a palm thicket with *Cocos, Thrinax, Coccoloba* and *Cordia*. Much fresh shingle was deposited along the east and southeast sides of the island during Hurricane Hattie, but vegetation damage was minor. For details see Stoddart (1963, pp. 62-63, fig. 37); the island has not been visited since. Only 11 plant species are recorded:

Acrostichum aureum 62S
**Cocos nucifera* 62S
Thrinax radiata 62S
Hymenocallis littoralis 62S
Coccoloba uvifera 62S
Rhizophora mangle 62S
Cordia sebestena 62S
Avicennia germinans 62S
Stachytarpheta jamaicensis 62S
Ageratum sp. 62S
Wedelia trilobata 62S

Bugle Cay (16°29½'N, 88°19'W)

Bugle Cay is a mangrove island only 5.5 km from the mainland coast at Placentia Point. The western end of the island is an arcuate strip of low sand 150 m long and 15-45 m wide. The island is a lighthouse station, and the sand area is planted to coconuts. The island was much damaged by marginal erosion and surface sand-stripping during Hurricane Hattie, and many coconuts were destroyed. In 1965 new coconuts had been planted, and the ground surface was being colonised by herbs and grasses. The sand sector had an area of 0.5 ha in 1962. Only seven plant species have been recorded:

Cyperus sp. 65S
**Cocos nucifera* 62S 65S
Batis maritima 65S
Sesuvium portulacastrum 65S
Euphorbia sp. 65S
Rhizophora mangle 62S 65S
Avicennia germinans 62S

For further details, see Stoddart (1963, pp. 67-68, fig. 43; 1969, p.11).

Owen Cay (16°29½'N, 88°15½'W)

Owen Cay, 6.5 km east of Bugle Cay, is a sand and shingle island 165 m long and up to 35 m wide, with an area of 0.49 ha. In the centre of the island there are clumps of *Rhizophora* and *Avicennia*, with a ground cover of *Batis*. The sand areas are covered with coconuts, *Thrinax*, *Cordia* and *Hymenocallis*. Fresh shingle was deposited round the whole margin of the cay in 1961, forming ridges up to 1.5 m high. For details see Stoddart, 1963, pp. 65-66, fig. 41). Only seven plant species are recorded:

**Cocos nucifera* 62S
Thrinax radiata 62S
Hymenocallis littoralis 62S
Batis maritima 62S
Rhizophora mangle 62S
Cordia sebestena 62S
Avicennia germinans 62S

Scipio Cay (16°28½'N, 88°18'W) Plate 72

Scipio Cay resembles Owen Cay 4 km to the eastnortheast. It is 250 m long and up to 90 m wide, with an area of 1.67 ha. It is covered by coconut woodland, with a central *Avicennia* swamp, and with stands of *Thrinax* on the beach ridges. During Hurricane Hattie fresh shingle was deposited round almost the entire periphery of the cay. By 1965 these ridges had moved inland and been colonised by *Sesuvium*, *Sporobolus* and *Euphorbia*. For details see Stoddart (1963, pp. 66-67, fig. 42; 1969, pp. 11-12, fig. 9). Only 11 plant species have been recorded:

Sporobolus virginicus 65S
**Cocus nucifera* 62S 65S
Thrinax radiata 62S 65S
Sesuvium portulacastrum 65S
Sophora tomentosa 65S
Euphorbia sp. 65S
Rhizophora mangle 62S 65S
Ipomoea sp. 62S
Cordia sebestena 62S
Tournefortia gnaphalodes 65S
Avicennia germinans 62S 65S

Colson Cay (16°28'N, 88°19'W) Plate 73

Colson Cay closely resembles Scipio Cay, only 1.6 km away. It is triangular, with sides of 140-175 m and an area of 2.03 ha. It is low and sandy, with a dense vegetation of coconuts and *Thrinax*, and with a central *Avicennia* swamp. Fresh shingle was deposited all round the cay during Hurricane Hattie in 1961. These ridges had eroded and moved landward by 1965, and had been colonised by *Sesuvium*, *Euphorbia*, *Sporobolus*, *Cassytha* and two small *Tournefortia* bushes. For details see Stoddart (1963, p.67, fig. 42; 1969, p.12, fig. 10). 11 plant species have been recorded:

Sporobolus sp. 65S
**Cocos nucifera* 62C 65C
Thrinax radiata 62S 65S
Sesuvium portulacastrum 65S
Cassytha filiformis 65S
Sophora tomentosa 65S
Euphorbia sp. 65S
Rhizophora mangle 62S 65S
Cordia sebestena 62S 65S
Tournefortia gnaphalodes 65S
Avicennia germinans 62S 65S

Purdy (1974b, pp. 841, 853) drilled a 19.2 m hole through Colson Cay. The entire section was in Holocene material. A date of 5550±140 yr from a sample at 6.4-7.3 m indicated a Holocene reef growth rate of 1.2 m/1000 yr.

Hatchet Cay (16°28'N, 88°04½'W) Figure 32

Hatchet Cay lies 3.3 km lagoonward of the Silk Cays, close to the edge of the coastal shelf south of Gladden Spit. It is a low-lying sandy island 240 m long and 45-85 m wide, with an area when mapped in 1972 of 1.30 ha. It is almost completely surrounded by a zone of *Rhizophora* woodland from 5 to 40 m wide. The interior of the cay is occupied by coconut woodland. It thus closely resembles Weewee, Buttonwood and Trapp's Cays. Hatchet is inhabited, and has two wells. 38 species of plants have been recorded, and this more accurately reflects the floras of this type of island than the collections made on the other three islands mentioned. The species are:

**Cymbopogon citratus* 72C
Eragrostis ciliaris 72C
Eragrostis prolifera 72C
Eustachys petraea 72C
Paspalum laxum 72C
Spartina spartinae 72C
Sporobolus jacquemontii 72C
Cyperus peruvianus 72C
Cyperus planifolius 72C
Fimbristylis cymosa 72C
Fimbristylis spadicea 72C
**Cocos nucifera* 72S
Thrinax radiata 72C
Hymenocallis littoralis 72C
Batis maritima 72C
Philoxerus vermicularis 72C
Portulaca oleracea 72C
Sesuvium portulacastrum 72C
Cakile lanceolata 72C
Vigna luteola 72C
**Citrus aurantiifolia* 72C
Euphorbia blodgettii 72C
Euphorbia mesembrianthemifolia 72C
Hibiscus tiliaceus 72C
Rhizophora mangle 72C
Conocarpus erectus 72C
Laguncularia racemosa 72C
**Terminalia catappa* 72C
**Psidium guajava* 72C
**Nerium oleander* 72C
Ipomoea pes-caprae 72C
Avicennia germinans 72C
Lantana involucrata 72C
Lippia strigulosa 72C
Ageratum littorale 72C
Melanthera nivea 72C
**Vernonia cinerea* 72C
Wedelia trilobata 72C

A discontinuous ridge of rubble extending along the reef crest to the southwest of the cay, about 35 m offshore, may date from Hurricane Hattie in 1961.

Little Water Cay (16°27½'N, 88°06'W) Figure 33, Plate 75

Little Water Cay lies 3.7 km southwest of Hatchet Cay. It is a triangular island 255 m long and up to 170 m wide, with an area in 1972 of 2.07 ha. Most of the island is covered with a dense coconut woodland, with an interior area of sedge marsh and narrow fringes of *Rhizophora* at the west end and along the east shore. There are some patches of *Conocarpus* along the shore, especially on the north side, but generally the coconut woodland extends to the beach. The whole of the south shore is cliffed and eroding, with fallen coconuts. There is an extensive zone of rubble on the reef crest at the east end of the cay, which may date from Hurricane Hattie. The island is uninhabited. 29 plant species are recorded:

Eragrostis prolifera 72C
Eustachys petraea 72C
Paspalum blodgettii 72C
Paspalum distichum 72C
Spartina spartinae 72C
Sporobolus virginicus 72C
Stenotaphrum secundatum 72C
Cyperus ligularis 72C
Cyperus planifolius 72C
Fimbristylis cymosa 72C
**Cocos nucifera* 72S
Batis maritima 72C
Philoxerus vermicularis 72C
Portulaca oleracea 72C
Sesuvium portulacastrum 72C
Vigna luteola 72C
Suriana maritima 72C
Euphorbia blodgettii 72C
Euphorbia mesembrianthemifolia 72C
Hibiscus tiliaceus 72C
Rhizophora mangle 72C
Conocarpus erectus 72C
Laguncularia racemosa 72C
**Terminalia catappa* 72C
Avicennia germinans 72C
Lippia strigulosa 72C
Eclipta alba 72C
Melanthera nivea 72C
Wedelia trilobata 72C

Laughing Bird Cay (16°27'N, 88°12'W)

Laughing Bird Cay is the southernmost of the islands in the central lagoon. It stands on an elongate reef ridge 23 km from the coast and 14 km from the shelf edge: water depths to the southeast reach 45 m, but Purdy has shown that the Holocene sequence beneath this island is 18.3 m thick, giving a pre-Holocene relief above the present lagoon floor of about 20 m (Purdy 1974b, p.841). The island itself is an elongate sand ridge about 460 m long and 9-40 m wide. During Hurricane Hattie rubble and shingle were deposited at the northeast and southwest ends of the cay, and along the southeast shore. When mapped in 1962 the area of the cay was 1.36 ha; it has not been visited since (Stoddart 1963, p.65, fig. 40). The island is covered with coconut woodland, with scattered coastal mangroves. Only seven plant species have been recorded:

**Cocos nucifera* 62S
Hymenocallis littoralis 62S
Sesuvium portulacastrum 62S
Euphorbia sp. 62S
Rhizophora mangle 62S
Ipomoea sp. 62S
Avicennia germinans 62S

Placentia Cay (16°31'N, 88°21½'W)

This is a mangrove island with a small area of strand vegetation and coconuts located 1 km east of Placentia Point on the mainland coast. It was mapped as True Point Patience Kay of Speer (1966, p.23) and as Patience Brother Island of Jefferys (1775). Jefferys also mapped the small mangrove islets at the mouth of Placentia Lagoon as The Virgins, and Speer commented on these "several small Kays ... at the mouth of a large lagoon, where there is plenty of Turtle passes morning and evening" (1766, p.23). No plant collections have been made on these islands, which are part of the coastal quartz and carbonate sand accretional sequences.

Harvest Cay (16°29'N, 88°24'W)

Harvest Cay, 5.5 km to the southwest, is the "Hobbe's Kay" of Speer (1766, p.23). This and other nearshore islands to the south, such as Palmetto Cay, are properly barrier beaches built of terrigenous quartz sand, backed by mangrove swamp, rather than true coral cays. Harvest Cay has a dense vegetation of coconuts, *Thrinax* and mangroves, with a tall undergrowth of *Cladium*, together with succulents and grasses. The island was briefly visited in 1962. Four species were noted:

Cladium jamaicense 62C
**Cocos nucifera* 62S
Thrinax radiata 62S
Batis maritima 62S

D. The Punta Gorda Cays

The cays of the Port Honduras Bight between Punta Gorda and Punta Ycacos, in the southern part of the barrier reef lagoon, stand on numerous steep-sided knolls, rising from a shelving lagoon floor in from 8-24 m of water. The innermost cays, from Stuart Cay at the mouth of the Rio Grande to Bedford Cays at the mouth of the Ycacos Lagoon, all surrounded by water less than 10 m deep, are wholly mangrove. Further lagoonward there are some islands with dry land in addition to mangrove, notably Frenchman's Cay and Wild Cane Cay, but most of the islands are un-named and wholly of mangrove. On many of them the mangrove in 1961 was less than 2 m tall, suggesting recent growth following hurricane damage. The Moho Cays are all mangrove, except for the outer one, which is a sand cay. The outermost islands, the Snake Keys, stand on patches rising from a lagoon floor 20-30 m deep; they are sand cays with shingle ridges; only these patches have significant amounts of coral on them. All of these islands come under the influence of freshwater discharge from the Deep River and the Rio Grande; the rainfall in this area (4239 mm at Punta Gorda) is much higher than elsewhere on the coastal cays. The published chart of the Gulf of Honduras dates from surveys in 1835-1841 and is rather generalised, and

the islands are known only through a brief reconnaissance visit in 1961. They would repay further investigation.

East Snake Cay (16°12½'N, 88°30½'W) Figure 34, Plates 76 and 79

East Snake Cay consists of a densely vegetated sand cay wholly surrounded by shingle ridges which enclose a shallow moat containing mangroves. The total area is 1.94 ha, of which the main core, excluding the moat and rampart, comprises 1.04 ha. The whole complex is 260 m long and up to 110 m wide, and the reef patch on which it stands is only slightly larger. Vegetation on the shingle rampart is limited to patches of *Ipomoea* and *Rhizophora*. On the sand cay there is a dense woodland of coconuts, *Thrinax, Cordia, Coccoloba, Terminalia* and *Ficus*. There is an automatic lighthouse on the island. For a brief account, see Stoddart (1965, p.138, fig. 4). 20 species of plants have been recorded:

Cyperus sp. 61S
**Cocos nucifera* 57S 61S
Thrinax radiata 61S
Hymenocallis littoralis 61S
Brassavola nodosa 61C
Ficus sp. 61C
Coccoloba uvifera 61S
Erythrina sp. 61C
Sophora tomentosa 61C
Euphorbia sp. 61S
Rhizophora mangle 61S
Conocarpus erectus 61S
**Terminalia catappa* 61C
Ipomoea sp. 61S
Cordia sebestena 61S
Tournefortia gnaphalodes 61S
Avicennia germinans 61S
Stachytarpheta jamaicensis 61S
Erithalis fruticosa 61S
Wedelia trilobata 61S

Purdy (1974b. p.841) drilled a hole 39.7 m deep through East Snake Cay. Recent reef material gave way to pre-Recent terrestrial sediments at a depth of 25.9 m.

Middle Snake Cay (16°12'N, 88°33'W) Figure 35

Middle or Ragged Snake Cay comprises two islands built of shingle, each having an area of 0.66 ha. The northeastern island is about 275 m long but is everywhere less than 40 m wide. It is built of two linear shingle ridges with an intervening partly water-filled depression. The outer ridges, presumably hurricane-formed, include coral blocks 1 m in diameter. The vegetation is limited to succulents and grasses, with low shrubs of *Coccoloba, Suriana, Tournefortia* and mangroves. 7 plant species were noted in 1961:

Coccoloba uvifera 61S
Sesuvium portulacastrum 61S
Suriana maritima 61S
Rhizophora mangle 61S
Conocarpus erectus 61S
Ipomoea sp. 61S
Avicennia germinans 61S

The southern island is also built of shingle ridges, but is triangular, with sides of 75-110 m. The interior is more sandy, and the concentric ridges enclose linear pools. There is a dense growth of *Avicennia* and *Rhizophora* along the north side, with a woodland of coconuts, *Thrinax* and *Coccoloba* on the rest of the cay. 15 species of plants were noted in 1961:

Cyperus sp. 61S
**Cocos nucifera* 61S
Thrinax radiata 61S
Hymenocallis littoralis 61S
Brassavola nodosa 61S
Coccoloba uvifera 61S
Sesuvium portulacastrum 61S
Cakile lanceolata 61S
Sophora tomentosa 61S
Suriana maritima 61S
Euphorbia sp. 61S
Conocarpus erectus 61S
Ipomoea sp. 61S
Tournefortia gnaphalodes 61S
Wedelia trilobata 61S

West Snake Cay (16°11½'N, 88°34'W) Figures 36 and 37, Plates 77 and 80

West Snake Cay is a complex island with a leeward sand area, a central mangrove swamp, a moat, and a windward shingle ridge, with a total area of 5.35 ha. It has been described briefly by Stoddart (1965, p.137, fig. 4), and recalls the features of low wooded islands of the northern Great Barrier Reef and of Djakarta Bay. The shingle rampart follows the eastern edge of the reef patch for about 370 m, rising to 1 m above sea level. The moat enclosed by the shingle ridge is about 200 m long and up to 100 m wide: it is less than 0.6 m deep; and with its enclosing shingle ridges has an area of 2.5 ha. There are many *Rhizophora* seedlings in the moat and along the inner margin of the ridge, and the shingle ridge itself is patchily covered with *Sesuvium, Tournefortia, Coccoloba*, mangroves and grasses. The most extensive vegetation unit is the mangrove swamp, consisting of *Rhizophora, Avicennia* and *Acrostichum*, but much of it is open standing water. The leeward dry sand area is 15-30 m wide and rises to 1 m above sea level. It is under coconut woodland with *Coccoloba* and *Tournefortia* and a diverse ground cover. 13 species of plants were recorded in 1961:

Acrostichum aureum 61C
Sporobolus virginicus 61C
Cyperus sp. 61S
**Cocos nucifera* 61S
Coccoloba uvifera 61S
Sesuvium portulacastrum 61S
Cakile lanceolata 61C
Euphorbia sp. 61S
Rhizophora mangle 61S
Ipomoea macrantha 61C
Ipomoea pes-caprae 61C
Tournefortia gnaphalodes 61S
Avicennia germinans 61S

150 m northwest of the main island is a small shingle island, West Island. It is 140 m long, up to 23 m wide, has an area of 800 sq m, and rises 1 m above sea level. Most of the islet is covered with *Sesuvium* and *Ipomoea*, with some shrubby *Coccoloba, Suriana* and *Conocarpus*. Six species were recorded in 1961:

Sporobolus sp. 61S
Coccoloba uvifera 61S
Sesuvium portulacastrum 61S
Suriana maritima 61S
Conocarpus erectus 61S
Ipomoea sp. 61S

South Snake Cay (16°11'N, 88°34'W) Figure 38, Plate 78

South Snake Cay is very similar to West Snake Cay, but the eastern shingle rampart is uninterrupted and adjoins the main cay at each end. The mangrove area is smaller and the leeward sand area forms the largest part of the complex (Stoddart 1965, pp. 137-138, fig. 4). The shingle rampart is 20 m wide and 1.5 m high at its southeast end; it becomes narrower and lower northwards. The moat is shallow and completely enclosed, and contains much stranded pumice; the area of the moat and enclosing rampart is 1.05 ha. The rampart itself is not vegetated and there are no *Rhizophora* seedlings in the moat. The dry sand area has maximum dimensions of 180 x 90 m, has an area of 1.7 ha, and is strongly undercut along its southwest shore, where the surface stands at 1 m above sea level. Poorly cemented beachrock outcrops along this shoreline between the small bluffs formed by the boles of coconut trees. The sand area is covered with a dense thicket of coconuts and *Thrinax*. 11 species of plants were noted in 1961:

Andropogon sp. 61S
Cyperus sp. 61S
**Cocos nucifera* 61S
Thrinax radiata 61S
Hymenocallis littoralis 61S
Dalbergia ecastophyllum 61C
Sophora tomentosa 61S
Suriana maritima 61S
Rhizophora mangle 61S
Conocarpus erectus 61S
Wedelia trilobata 61S

Wild Cane Cay (16°12½'N, 88°38'W) Figure 39

This is a mangrove island 7.5 km southwest of Punta Ycacos. The whole island is about 1 km long. At its southern end there is a rectangular dry area measuring 300 x 100 m, with an area of 2.0 ha. Mangroves are growing at several points along its shores. The dry area is only about 0.6 m above sea level; the soil is dark and humic and parts are boggy. The vegetation consists of coconut woodland with marginal *Conocarpus*. The island is inhabited and there are several introduced food and ornamental plants. The most striking feature of the cay, however, is the presence of large stone-faced Maya burial mounds. One of these constituted Mound 39 in Gann's excavations (1918, pp. 135-136). This was a mound 3 m high consisting of sand and blocks of reef limestone covering a surface burial. Gann found pottery, obsidian knives, the femur of a deer with an incised design, and copper ornaments (rings, gorgets, studs) which he suggested showed Spanish influence. In another account (1927, p.238) Gann speaks of "great numbers of interments in four large mounds."

When mapped in 1961 the four mounds still existed, the largest being 65 m long. They have, however, been much disturbed. In 1918 Gann noted that they were used as a source of stone, and in 1927 (p.238) he stated that "when the Cabral family needs a little ready money, they excavate a small area and sell the beads, pottery, spear-heads, etc., which invariably turn up." In 1961 the ground surface was littered with obsidian flakes up to 4 cm long, and with fragments of coarse red pottery. A drilled jade bead and a projectile point 16 cm long were also found. Other remains included grey pottery net sinkers and small animal figures. The most remarkable object from Wild Cane Cay, however, is an animal-shaped jar 13.7 cm high of Plumbate Ware. It is described by Bray (1970, p.32, plate 27): "The head is frog-like, but the feet and stumpy tail belong to a different kind of animal. The creature wears a necklace, each end of which terminates in a disc ornamented with six pits. The body of the pot is further decorated with broad line designs incised through the greenish-brown slip." Plumbate Ware was manufactured in Guatemala and widely traded: the use of zoomorphic shapes began about 1000 A.D. and this serves as a time-marker for the early Postclassic period. Bray dates this particular object between 1000 and 1200 A.D.

Fifteen plant species were noted in 1961; undoubtedly more are present.

Pityrogramma calomelanos 61C
Sporobolus jacquemontii 61C
Fimbristylis spadicea 61C
**Cocos nucifera* 61S
Laelia tibicinis 61C
Coccoloba uvifera 61S
**Citrus* sp. 61S
**Pedilanthus tithymaloides* 61C
**Mangifera indica* 61S
Sida acuta 61C
Opuntia sp. 61S
Rhizophora mangle 61S
Conocarpus erectus 61S
**Psidium guajava* 61C
Stachytarpheta jamaicensis 61C

Frenchman's Cay (16°11½'N, 88°38'W)

Frenchman's Cay is very similar to Wild Cane Cay, though almost the whole shoreline is lined by mangroves. The sandy interior is covered with coconut woodland, and the centre is low-lying and swampy. There is a freshwater well, several huts, and an area of cultivated plants. There are several burial mounds faced with limestone blocks, seen in 1961. Gann (1927) reported the excavation of gold ornaments and other artefacts from these sites. Only five species of plants were noted in 1961; many must remain to be recorded. They are:

**Saccharum officinarum* 61S
**Cocos nucifera* 61S
**Musa paradisiaca* 61S
**Mangifera indica* 61S
Rhizophora mangle 61S

Moho Cay (16°30½'N, 88°10'W) Figure 40

Apart from coastal mangrove islets, Moho Cay is the southernmost cay in the Punta Gorda group, and the only sand cay. It is a narrow island 160 m long, with an average width of 18-35 m, and an area of 0.54 ha. Owen in 1835 noted a solitary coconut at its northern end, but since then the vegetation has been cleared and the island is now covered with coconut woodland, except for an area of dense woodland at the south end. There is a varied ground cover of herbs, grasses and sedges beneath the coconuts. The dense woodland includes coconuts, *Thrinax* and some mangroves. The whole island is sandy and low-lying, and the south and southeast shores are undercut and eroding. There is a freshwater well and a small hut. Twenty species of plants were recorded in 1961:

Eragrostis prolifera 61C
Eustachys petraea 61C
Paspalum paniculatum 61C
Sporobolus virginicus 61C
Stenotaphrum secundatum 61C
Cyperus ligularis 61C
Cyperus peruvianus 61C
Fimbristylis cymosa 61C
Fimbristylis spadicea 61C
**Cocos nucifera* 61S
Thrinax radiata 61S
Hymenocallis littoralis 61S
Coccoloba uvifera 61S
Sophora tomentosa 61C
Vigna luteola 61C
Euphorbia blodgettii 61C
Bidens cynapiifolia 61C
Conyza canadensis 61C
Melanthera nivea 61C
Wedelia trilobata 61C

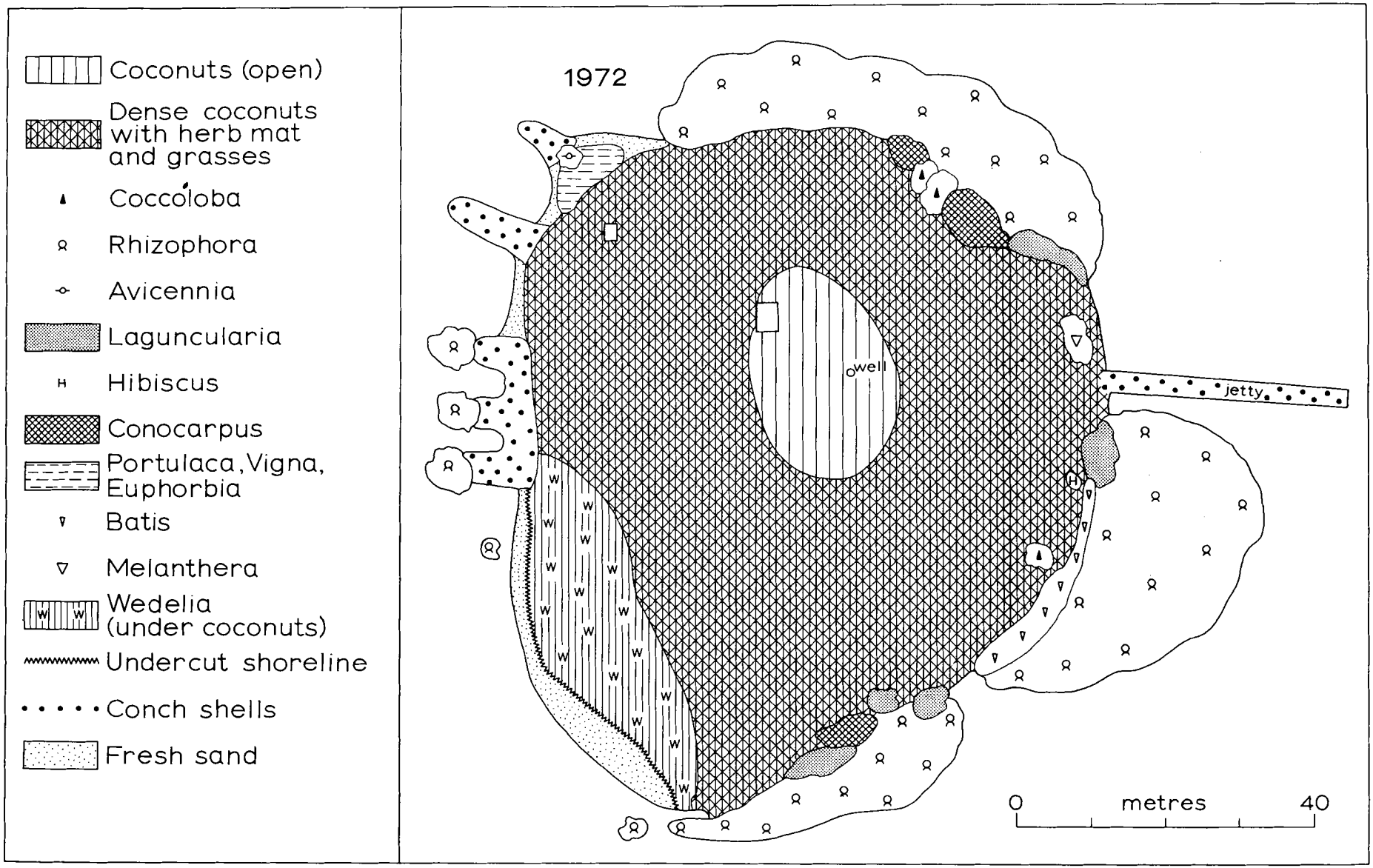


Figure 31. Buttonwood Cay 1972

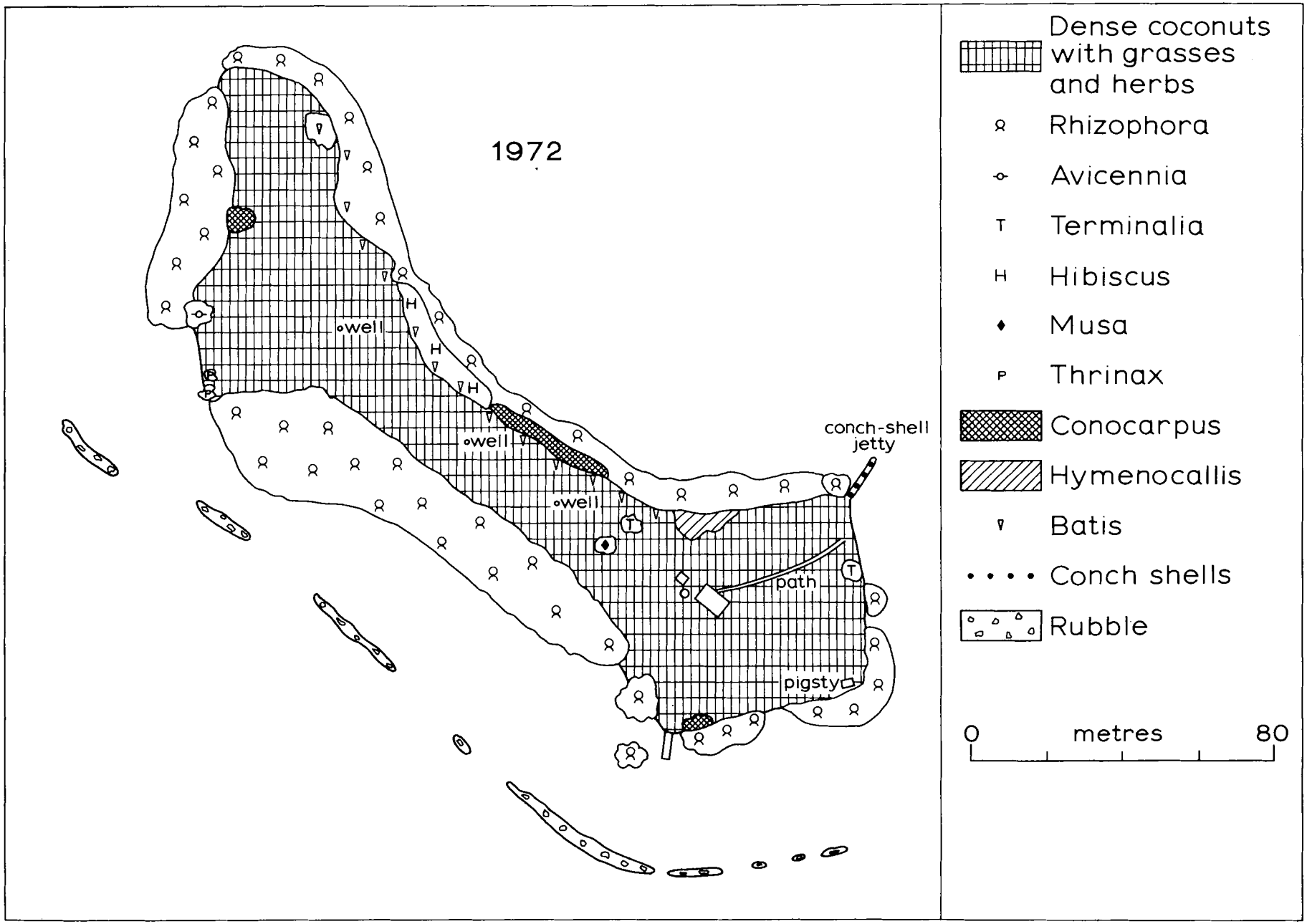


Figure 32. Hatchet Cay 1972

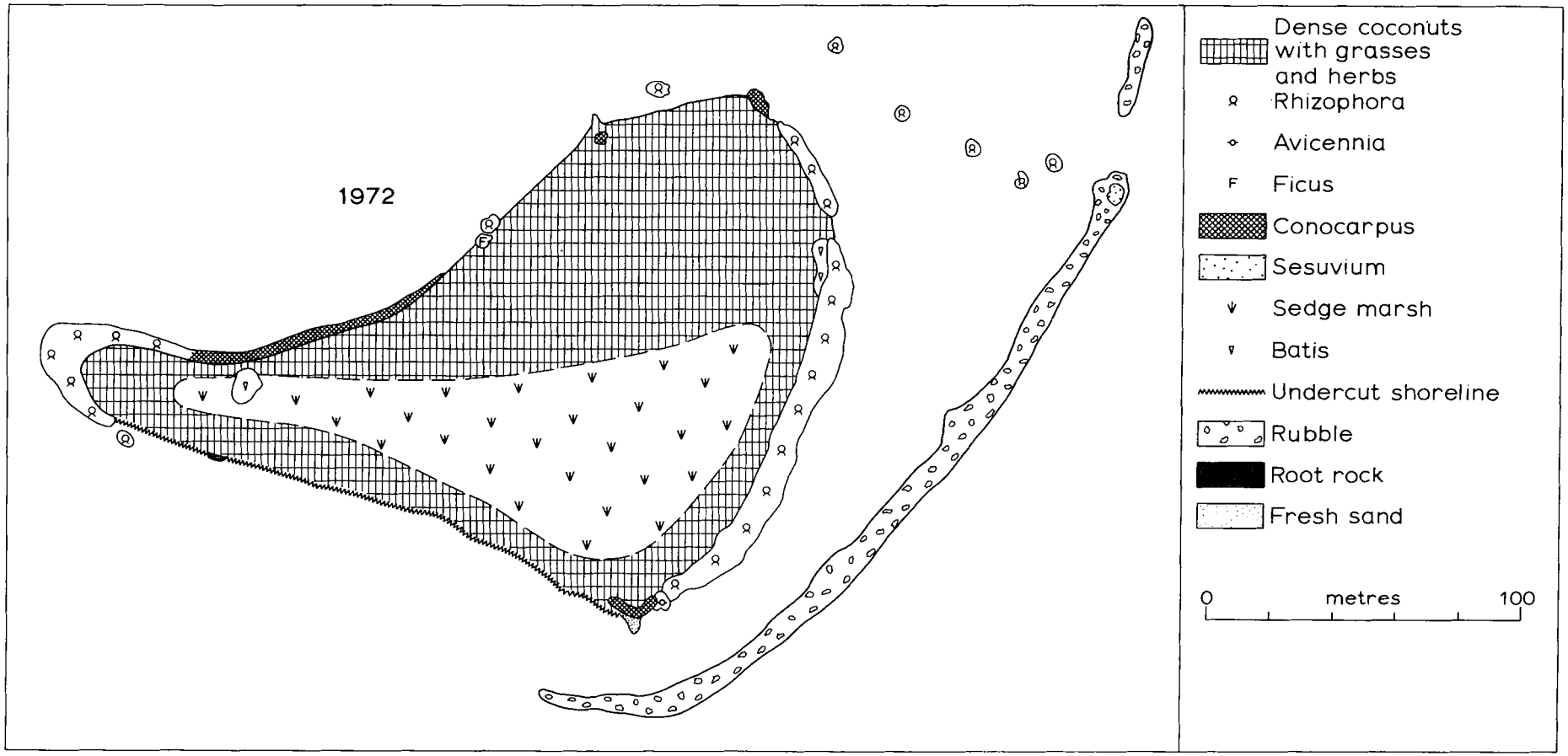


Figure 33. Little Water Cay 1972

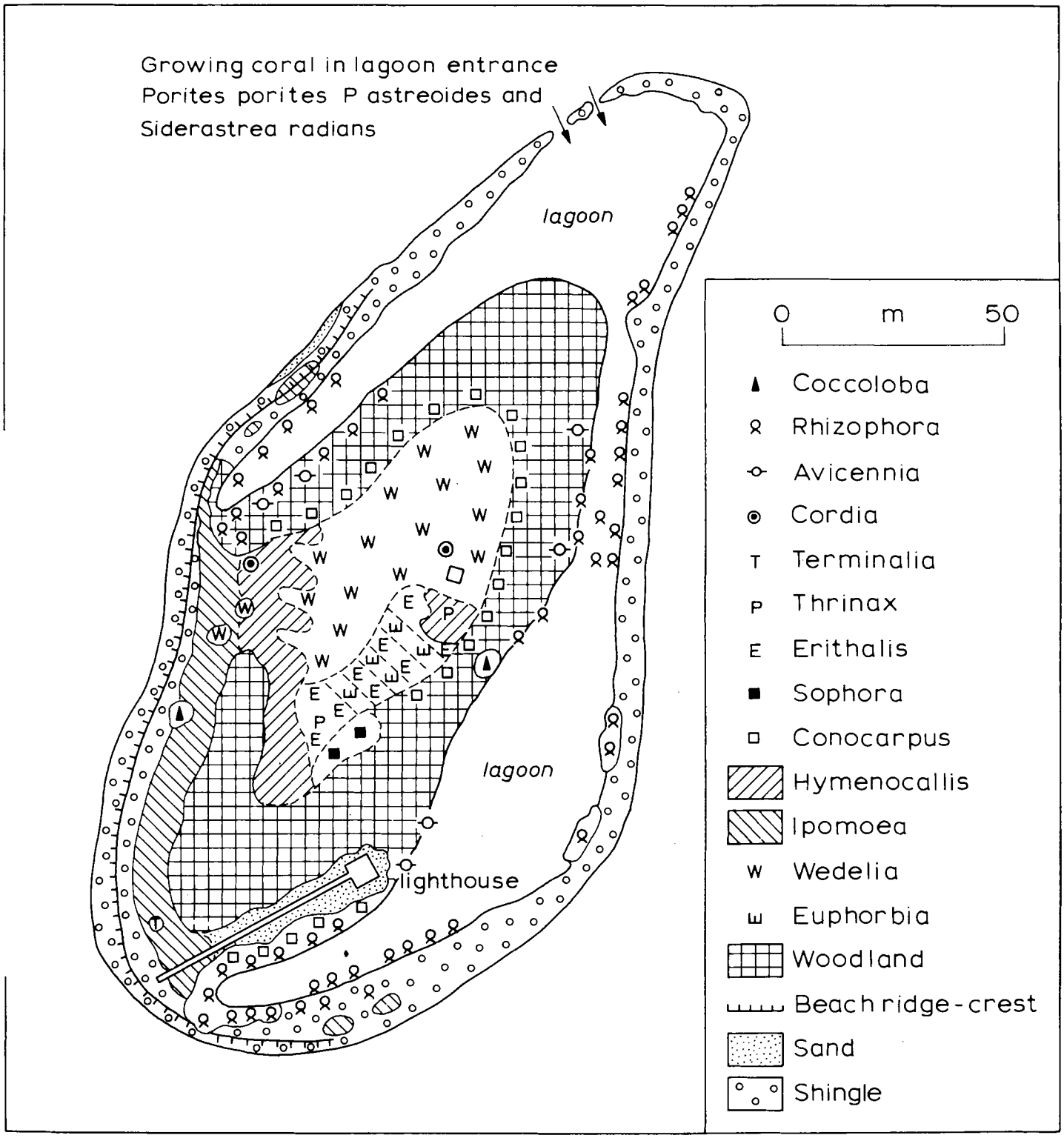


Figure 34. East Snake Cay 1961

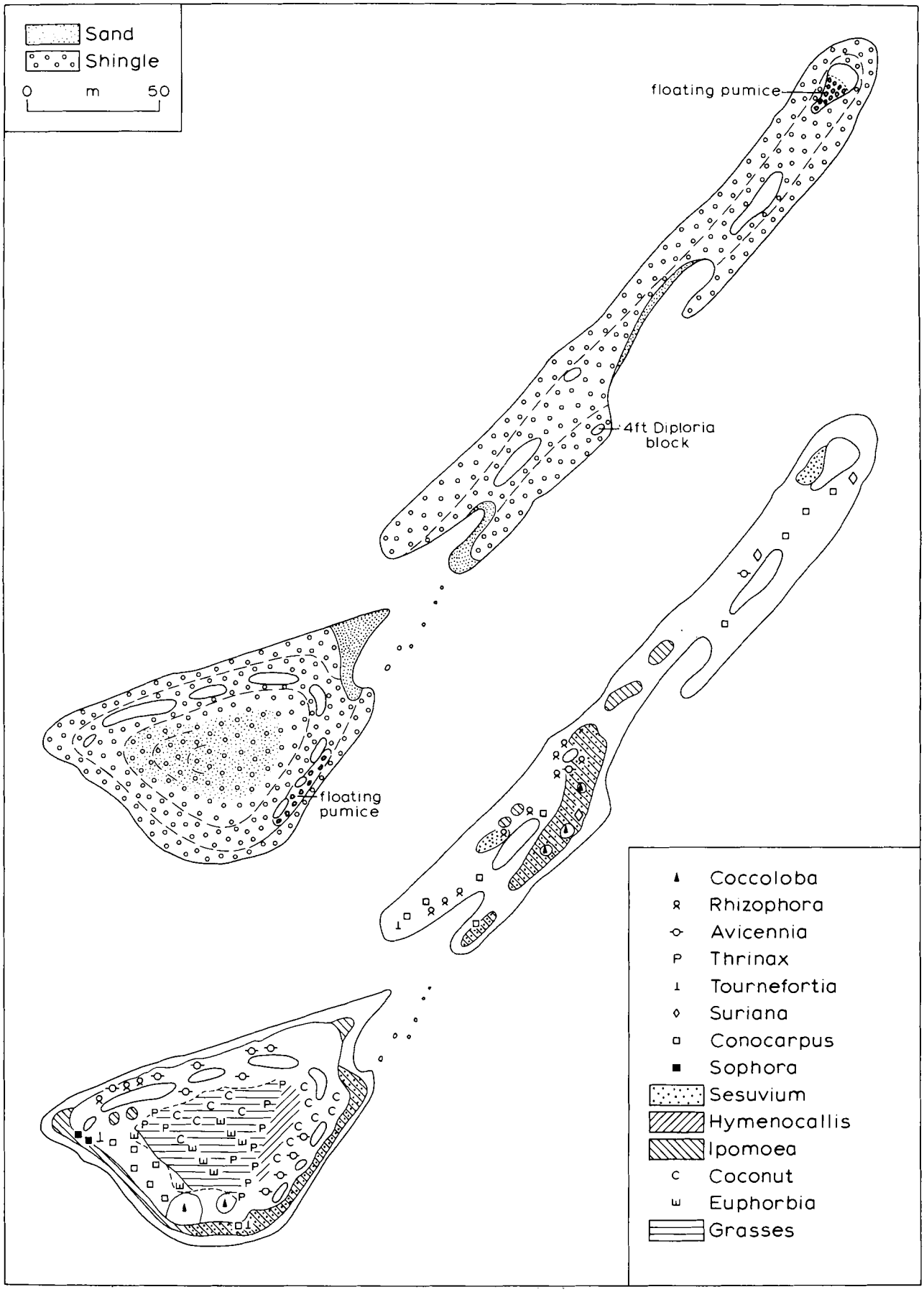


Figure 35. Middle Snake Cay 1961

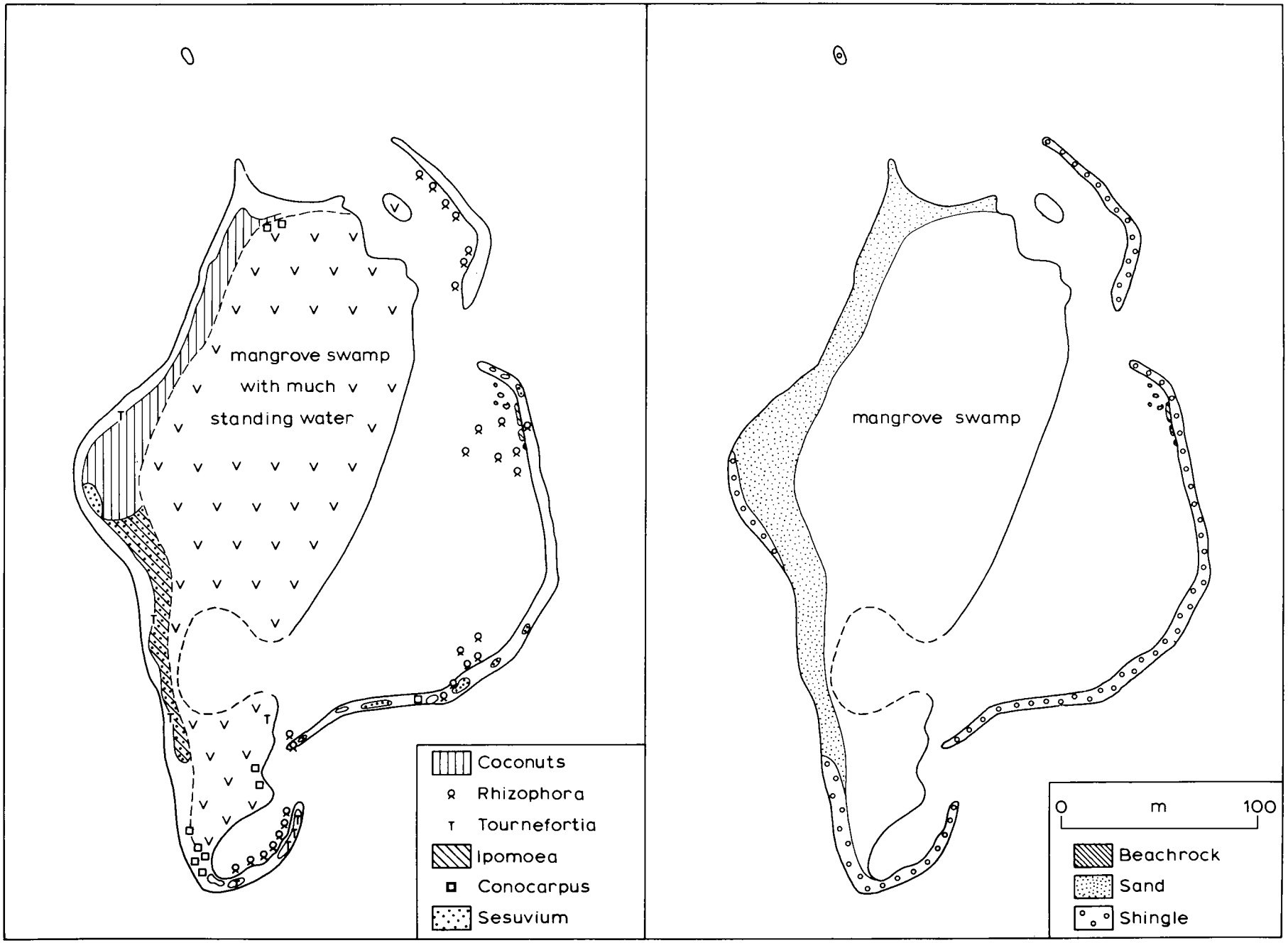


Figure 36. West Snake Cay 1961

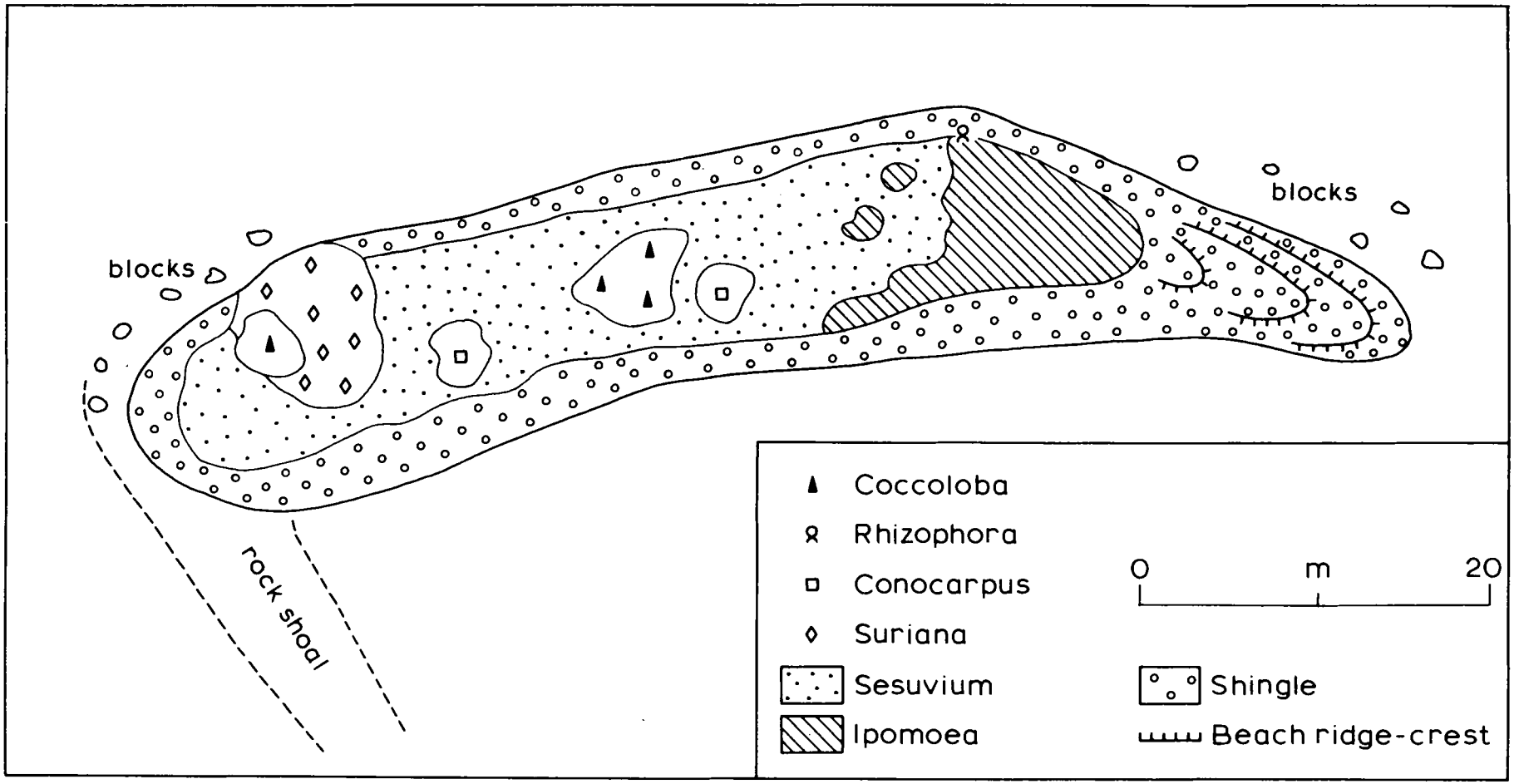


Figure 37. West Island West Snake Cay 1961

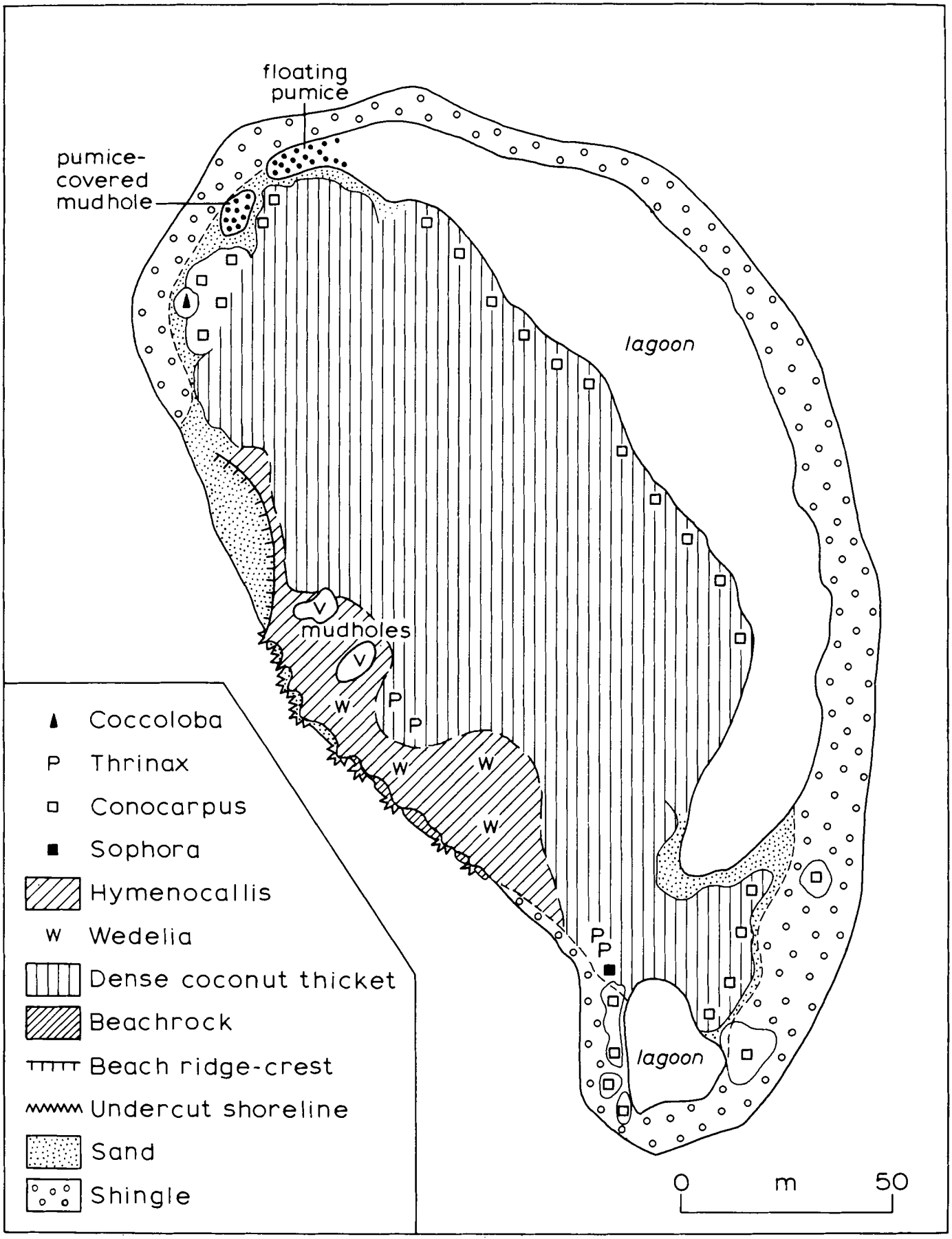


Figure 38. South Snake Cay 1961

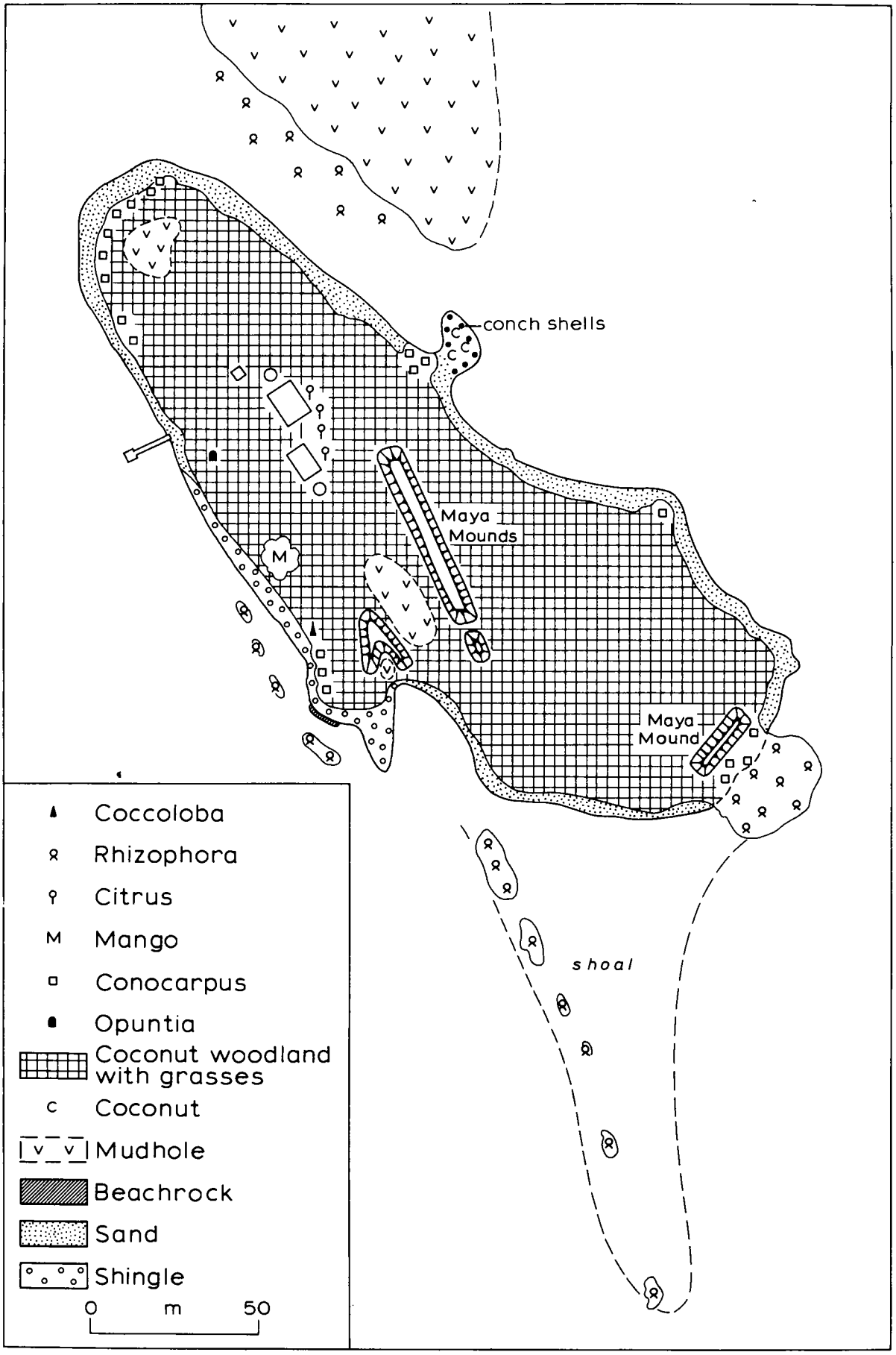


Figure 39. Wild Cane Cay 1961

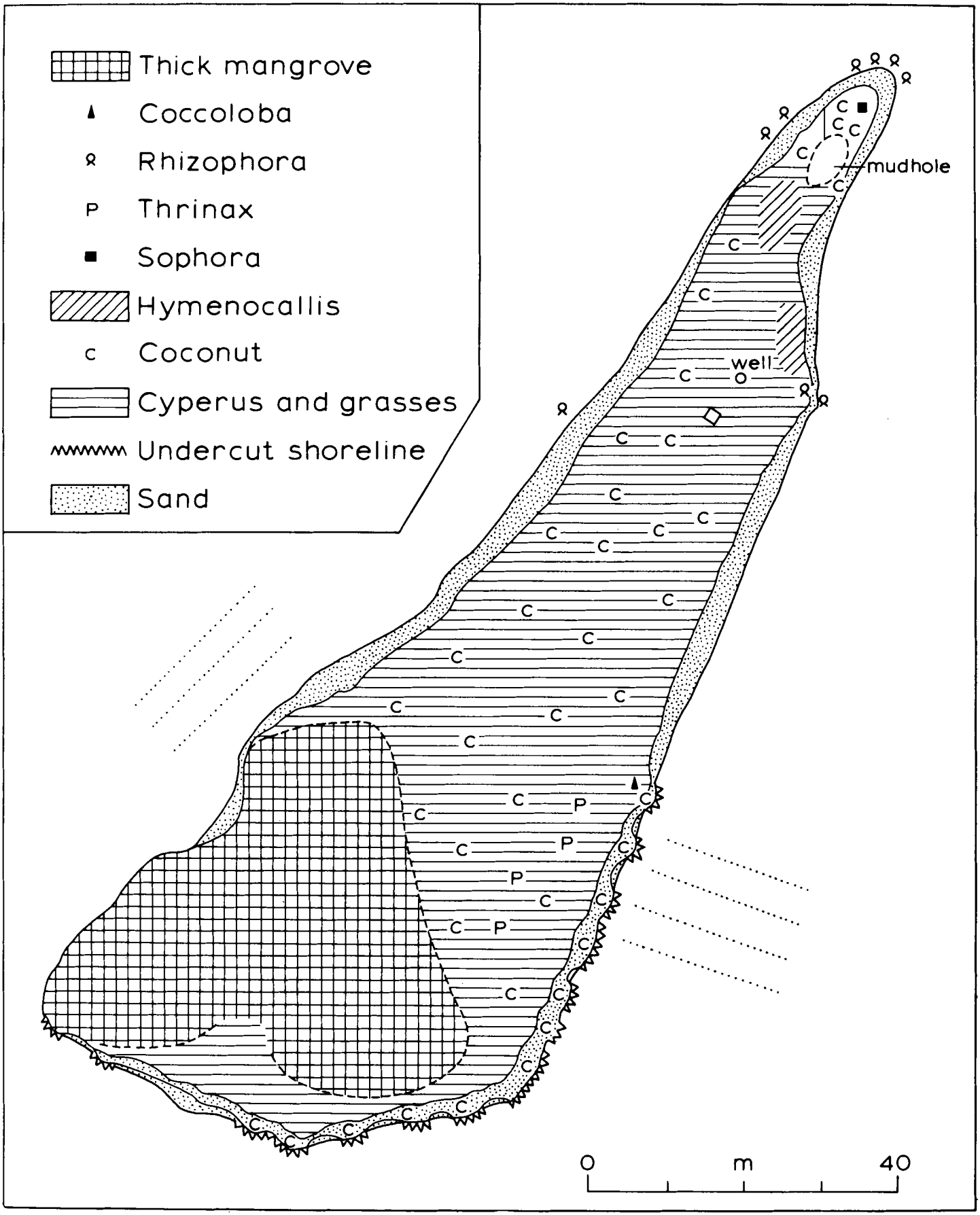
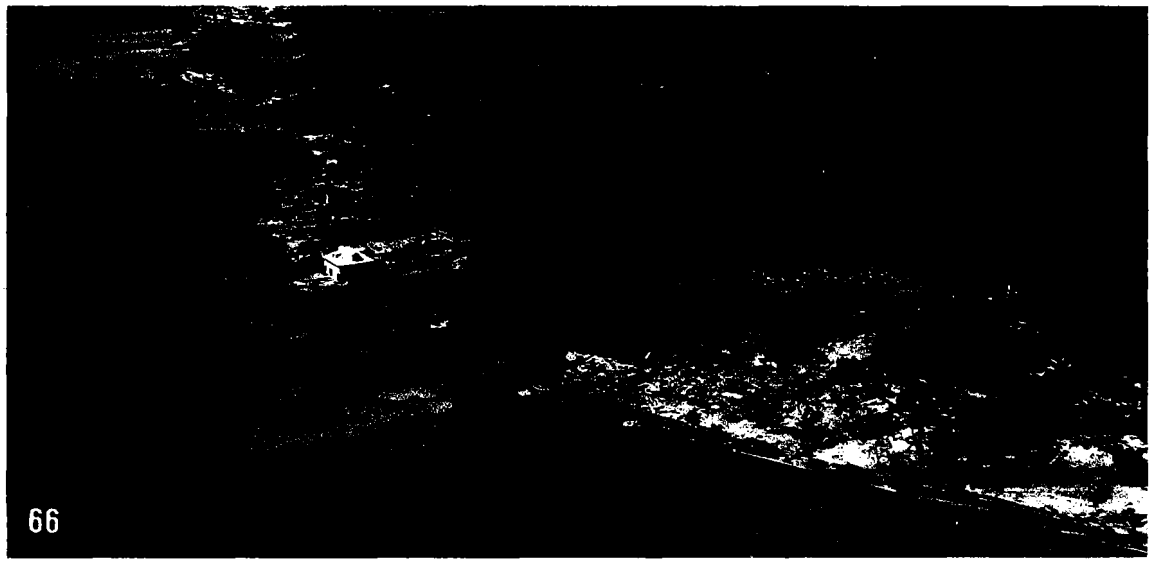


Figure 40. Moho Cay 1961



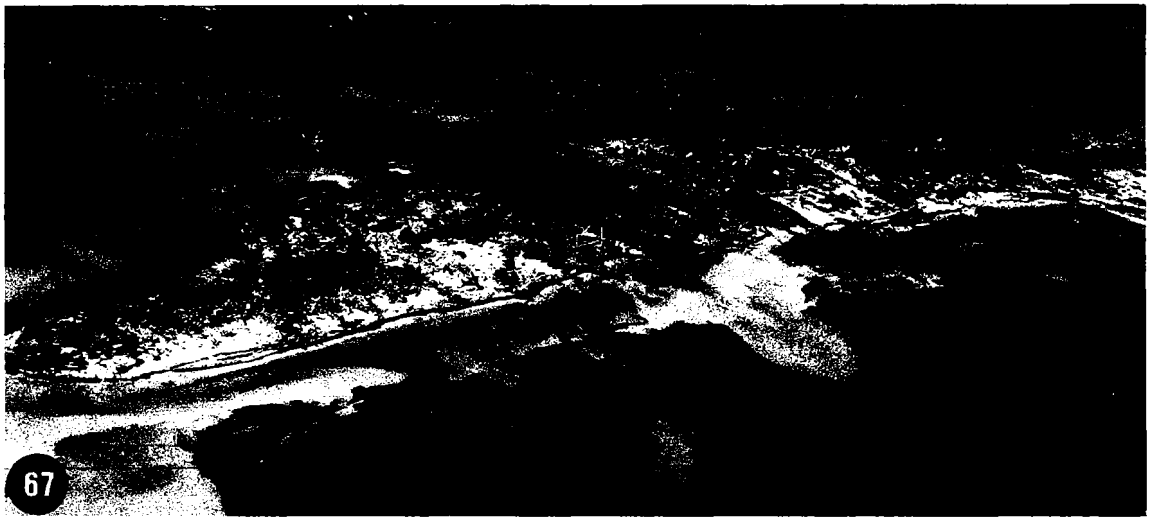


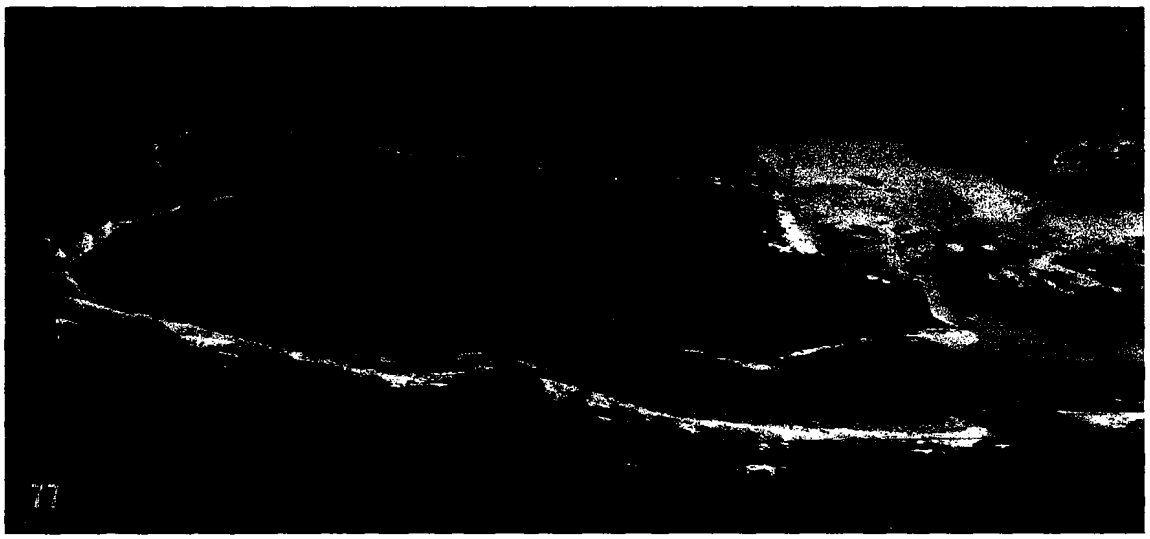
Plate 66. St. George's Cay: aerial view from the north 1962 (channel A)
Plate 67. St. George's Cay: aerial view from the north 1962 (channel C)
Plate 68. St. George's Cay: aerial view from the east 1962 (channels D and E)
(For the location of these channels see Stoddart 1963, fig. 19)

Plate 69. Tobacco Range 1972: view inland from the northeast sand ridge
Plate 70. Tobacco Range 1972: *Rhizophora* killed by Hurricane Hattie in 1961, invaded by *Batis*, at the northeast point

Plate 71. Cary Cay: hurricane-deposited shingle on the east side 1962
Plate 72. Scipio Cay: hurricane-deposited shingle ridge 1962
Plate 73. Colson Cay: hurricane-deposited shingle on the southeast shore 1962

Plate 74. Water Range (Twin Cays): *Thrinax* thicket, south shore 1972

Plate 75. Little Water Cay: shingle rampart on the southeast shore 1972



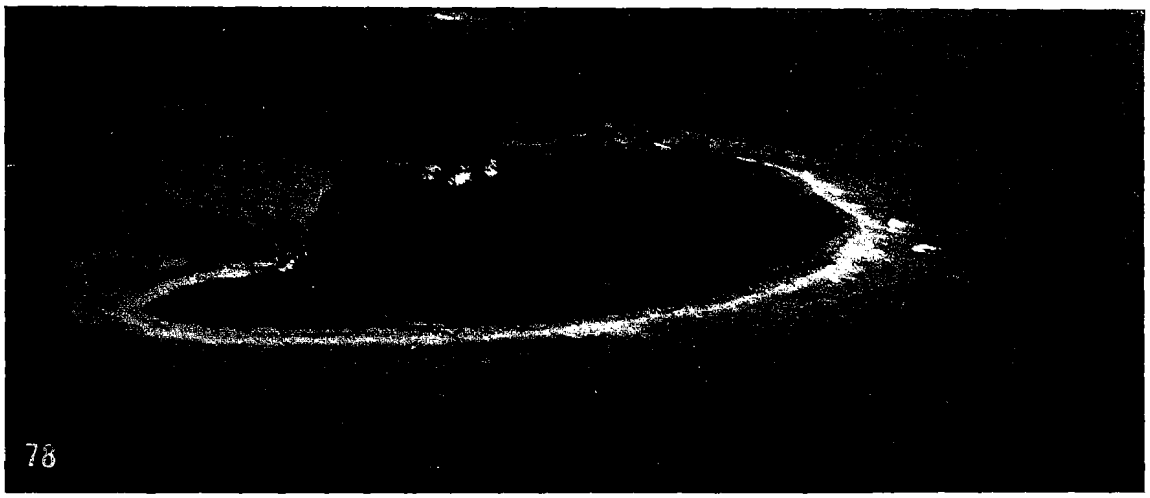


Plate 76. East Snake Cay: aerial view from the southeast 1961
Plate 77. West Snake Cay: aerial view from the northeast 1961
Plate 78. South Snake Cay: aerial view from the southeast 1961

Plate 79. East Snake Cay rampart and moat from the north 1961

Plate 80. West Snake Cay rampart and moat from the south 1961

6. SUMMARY AND CONCLUSIONS

A. Types of islands

This consideration of the cays of the Belize barrier and shelf has indicated the variability of reef island types in such an extensive province. In a previous paper (Stoddart 1965, pp. 134-142), nine types of island were distinguished on the Belize reefs as a whole and their distribution mapped. This classification can now be extended and the following types recognised:

1. Unvegetated sand cay. These are ephemeral islands, usually less than 50 m long and often overtopped by swash, and lacking contemporary beachrock. Many on the Belize reefs are second-generation features which have re-formed following the destruction of an earlier larger island by hurricane damage; the location and extent of the former island can be recognised by relict beachrock. Examples are Paunch Cay and Curlew Cay.

2. Vegetated sand cay. These are larger islands with a vegetation of strand scrub and strand woodland, though in most cases the woodland has been removed for coconut plantations. Examples are Nicolas and Tobacco Cays. Smaller vegetated sand cays with maximum dimensions of about 100 m are still subject to major modification or even destruction during hurricanes. Most vegetated islands, however, persist or rapidly re-form in the same locations (e.g. Sergeant's, Goff's, English and Rendezvous Cays). The largest vegetated islands to disappear completely in the 1961 hurricane were St. George's East Cay (110 m long, 0.3 ha) and Cay Glory (105 m long, 0.13 ha).

3. Unvegetated shingle cay. These are small, ephemeral, and located in exposed situations. Often they may be reef-top ridges adjacent to a larger cay. They may from time to time be colonised by patches of *Philoxerus* or *Sesuvium* and mangrove seedlings.

4. Vegetated shingle cay. These are also small, located in exposed situations, often on small patch reefs, and are topographically mobile. Good examples showing substantial changes during 1960 and 1972 are North Spot and Ragged Cays.

5. Sand and shingle cays. These are larger and more stable islands, in more exposed situations than simple sand cays, and consist of islands with a windward shingle ridge and leeward sand area, with or without an intervening depression. Such islands are lacking on the barrier reef in the lee of the offshore atolls, where only simple sand

cays are found. Because of their size and stability these islands are always vegetated. Strand woodland survives on Nicolas Cay, but elsewhere has been replaced by coconuts. Examples are Lime, Hunting and Northeast Sapodilla Cays, the latter with a large interior depression. This type is also typical of the windward sides of the atolls. Most such islands have both modern and relict beachrock, the latter indicating beach retreat on their windward shores.

6. Mangrove cays. On the Belize shelf these are dominated by *Rhizophora mangle*; Jack's Cay is an example. Ebanks (1975, p.278) describes them as "little more than mud mounds colonised by vegetation". They are found only within the lagoon and not on the barrier reef itself.

7. Shelf islands. This term is introduced by Ebanks (1975, pp. 277-278) for islands which "form by sediment accretion on a partly submerged topographic prominence" on a wide shallow shelf. These islands are located on the shallow shelf north of Belize, 3.5-5 km back from the reef edge. They are elongate islands, parallel to the shelf edge, with a windward sand ridge of variable height and width, generally less than 2 m above sea level but exceptionally reaching 6 m. Their leeward sides are formed by mangroves, bays and intertidal flats. Examples include Ambergris Cay, Cay Chapel and Cay Caulker, and Ebanks draws attention to similar shelf islands in the Bahamas and Florida. Previously they had been included in the general category of mangrove-sand cay by Vermeer (1959, pp. 35-39) and Stoddart (1965, p.139).

8. Mangrove cay with dry sand areas. Many mangrove islands have low-lying sand areas, often but not exclusively on the windward side, and usually flat and featureless. These cays are found in fairly protected situations, and may be a late stage in the evolution of ordinary mangrove cays. Frequently the dry-land areas have been cleared and planted to coconuts. Examples are Weewee, Buttonwood, Hatchet, Wild Cane and Frenchman's Cays.

9. Mangrove range. These are extensive and complex arrays of mangrove islands, often with intermittent low sand ridges on their windward sides. They probably owe their location and arrangement to pre-existing topographic variations in the substrate. The islands are separated by partly enclosed bays and lagoons, rather than by intertidal flats, and also by sinuous, deep, narrow tidal channels known as 'bogues'. Tobacco Range and Water Range are typical mangrove ranges; bogues are particularly well seen in the Drowned Cays, as well as in the extensive mangroves of Turneffe.

10. Moat islands. This term has been applied to characteristic associations of leeward sand area, interior mangrove swamp, reef-top shallow lagoon or moat, and windward-reef-edge shingle ridge formed on small patch reefs in the southern shelf lagoon (Stoddart 1965). East and West Snake Cays are good examples. Topographically these islands have features in common with reef islands on the Queensland coast (Steers 1937) and in Djakarta Bay (Umbgrove 1928). The Snake Cays owe

their distinctiveness to their relatively exposed situation in deep water facing the open southern shelf, which allows the formation of shingle ridges on the windward reef edges; the other features have formed in the lee of these ridges.

11. Coastal barrier islands. On the Belize coast the term 'cay' is applied to any island, not only those of reef origin. Many islands near the mainland coast are barrier beaches or detached cuspate headlands, formed of terrigenous sediments (High 1975). Harvest Cay is an example.

B. Topographic change

These surveys have shown considerable topographic change on almost all islands of the coastal shelf and barrier reef for which we have comparative data. Of 24 islands mapped in 1960-61 and again in 1972, 11 decreased in area and 13 increased. The greatest percentage loss was 31 per cent at Rendezvous Cay, and the greatest percentage increase was 160 per cent at North Spot. Aggregating all these islands together, the total area decreased from 35.7 to 33.3 ha, a decrease of 6.6 per cent (cf. the changes on the islands of Glover's Reef, where the total area of six islands declined from 33.6 to 31.8 ha, a decrease of 5.4 per cent: Stoddart *et al.*, 1981). As might be expected, the percentage changes are most marked on the smallest cays. Four modes of topographic change may be distinguished:

1. Catastrophic change caused by a single event, in this case Hurricane Hattie of October 1961, which affected barrier reef islands in northern Belize. Small vegetated sand cays were spectacularly eroded and two (Cay Glory and Paunch Cay) disappeared. Recovery took place over the ensuing decade, so that comparative figures between 1961 and 1972 give a very conservative indication of change: Goff's Cay gained 10 per cent, and Sergeant's, English and Rendezvous Cays lost 54, 25 and 31 per cent respectively.

2. Severe marginal erosion by an unknown event, but probably by a specific hurricane. This is widespread on the cays of the southern barrier reef, e.g. Frank's, Lime and Nicolas Cays. This must be a fairly common consequence of hurricanes of lesser severity than Hattie.

3. The re-working of small islets, notably of shingle islands in exposed situations. This may be accomplished by ordinary storms over periods of years, or it may result from single hurricanes. A moderate example is given by North Silk Cay, and more extreme examples by North Spot and Ragged Cay.

4. The accumulation, probably mainly on a seasonal basis, of sand in the form of spits, lobes and bars during ordinary non-catastrophic conditions. This mostly results in ephemeral topographic features, but some become vegetated and stabilized.

There is some suggestion in the number of cays which have disappeared since Owen's surveys in 1830, as well as in the widespread erosion during 1960-1972, that reef islands in the Belize province may be undergoing a period of diminution. It is not possible to say whether this relates to the results of fluctuating sea levels, increased frequency of catastrophic storms, or both, but it has been argued (Stoddart 1964) that an important factor in the present disequilibrium is the destabilising effect of the replacement of natural strand woodland by coconut woodland during the past century.

C. Flora and Vegetation

A total of 178 species of vascular plants has been recorded from the Belize cays, including 32 non-native species (18 per cent) (Fosberg *et al.* 1981). Of these, 90 species are found only on the barrier reef and shelf islands, and not on the atolls; these include 28 non-native species or 31 per cent; 15 are found only on the atolls and not on the barrier reef and shelf (no non-native species); and 73 are common to the barrier and shelf cays and to the atolls (3 non-native species, or 4 per cent).

The total flora of the barrier reef and lagoon islands comprises 164 species, including 31 non-native species (19 per cent). Of these, 61 are found only on the barrier reef islands (17 of them non-native, or 11 per cent), and 22 only on the shelf islands (4 non-native, or 7 per cent). 37 species are extremely widespread, and include strand grasses and sedges, strand shrubs, common weedy species of coconut woodland, and mangroves. They are:

Acrostichum aureum
Eragrostis prolifera
Paspalum distichum
Spartina patens
Sporobolus virginicus
Cyperus ligularis
Cyperus planifolius
Fimbristylis cymosa
Cocos nucifera
Thrinax radiata
Hymenocallis littoralis
Coccoloba uvifera
Batis maritima
Philoxerus vermicularis
Portulaca oleracea
Sesuvium portulacastrum
Canavalia rosea
Sophora tomentosa
Vigna luteola
Euphorbia mesembrianthemifolia
Rhizophora mangle
Conocarpus erectus
Laguncularia racemosa
Terminalia catappa
Ipomoea macrantha
Ipomoea pes-caprae
Ipomoea stolonifera
Cordia sebestena
Tournefortia gnaphalodes
Avicennia germinans
Stachytarpheta jamaicensis
Erithalis fruticosa
Ernodea littoralis
Ageratum littorale
Borrichia arborescens
Eclipta alba
Wedelia trilobata

It is clear that the native woodland of the cays has been greatly disturbed by planting of coconuts, and on most islands has entirely disappeared. Its main components probably included *Thrinax radiata, Coccoloba uvifera, Ficus* sp., *Neea choriophylla*, and *Bursera simaruba*. Strand shrubs are represented mainly by *Tournefortia gnaphalodes, Suriana maritima, Conocarpus erectus* and *Borrichia arborescens*. The complete absence of *Scaevola plumieri* from these islands is remarkable (it occurs on the north coast of Yucatan, on Alacran and Cayo Arcas, and in the Cayman Islands to windward), as is the rarity of *Chrysobalanus icaco*.

The plants of the dry mangrove cays and the mangrove ranges are quite distinctive, with many more grasses, sedges and succulents than the sand cays of the reef edge. Species which are characteristic of the dry mangrove cays (but most of which are very widespread) are *Eragrostis prolifera, Eustachys petraea, Paspalum distichum, Spartina spartinae, Fimbristylis cymosa, Fimbristylis spadicea, Thrinax radiata, Batis maritima* and *Pluchea symphytifolia*. Two species (*Salicornia perennis, Lippia strigulosa*) are found only on these islands. Conversely, some species which are common on the reef-edge sand cays are absent from the dry mangrove cays. These include *Cakile lanceolata, Canavalia rosea, Bursera simaruba, Pouteria rivicoa, Morinda citrifolia* and *Ambrosia hispida*.

It is also instructive to compare the plants recorded on the two mangrove ranges visited, Tobacco Range and Water Range. 33 species are recorded in total, with 15 in common. Apart from the mangroves, these are *Eustachys petraea, Paspalum distichum, Cyperus planifolius, Thrinax radiata, Batis maritima, Salicornia perennis, Suriana martima, Euphorbia mesembrianthemifolia, Erithalis fruticosa* and *Borrichia arborescens*. A larger sample would undoubtedly include as characteristic plants of these islands *Eragrostis prolifera, Phragmites* cf. *australis, Spartina spartinae, Cladium jamaicense, Sesuvium portulacastrum, Pithecellobium keyense, Ernodea littoralis*, and others. It is particularly interesting to observe the long term effects of hurricane damage on Tobacco Range, where mortality of mangroves in 1961 has led to their replacement by *Batis maritima*, even though the dead tree trunks still stand.

We have already noted the existence of a fairly steep rainfall gradient from north to south along the Belize coast. The effects of this appear in the distribution of ferns and orchids. Ferns other than *Acrostichum aureum* occur only on Nicolas Cay (3 species), Lime and Wild Cane Cays. Orchids have been recorded only on Frank's, Hunting, Jack's, East Snake and Middle Snake Cays (as well as on Northeast Cay, Glover's Reef). The climbing vine *Rhabdadenia biflora* is only recorded from the southern shelf (Hunting Cay) and Glover's Reef (Southwest Cay).

Finally, the catastrophic damage caused to some of the northern sand cays by Hurricane Hattie has allowed the observation of successional processes over the ensuing decade. The primary coloniser on

bare sand after the storm was *Portulaca oleracea*, together with *Sesuvium portulacastrum* and *Euphorbia mesembrianthemifolia*; these were well established as scattered colonies within five months of the storm. By 1965 *Portulaca* had greatly declined in importance, and the main species present were *Sesuvium, Euphorbia* and *Ipomoea pes-caprae*. By 1972 many more species were present, including shrub species such as *Tournefortia, Conocarpus* and *Suriana*. The following table gives the number of species recorded on the most damaged islands following Hurricane Hattie:

Island	1962	1965	1972
Sergeant's Cay	4	12	14
Goff's Cay	2	4	10
English Cay	2	5	18
Rendezvous Cay	16	16	17

The opportunity clearly exists to monitor vegetational changes on these islands in the future, as well as topographic change in general, to establish the long-term response of islands to normal as well as to extreme events.

We do not wish in this paper to consider the floristic biogeography of the cays in greater detail. A preliminary paper has been prepared (Stoddart and Fosberg, in press), and a more detailed treatment is in preparation. We can, however, note that there is a very close association between island area and number of species of vascular plants present, and that area appears to be the major control of floristic diversity on islands of the Belize barrier reef and shelf.

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