OVER AND UNDER:

Geography and Archaeology of the Palm Islands

and

Adjacent Continental Shelf of North Queensland

Thesis submitted by

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for the Research Degree of Master of Arts in

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ABSTRACT

A preliminary investigation into the Aboriginal archaeology of the Herbert / Burdekin region of the continental shelf, northeastern Queensland, is approached (a) from the beginning of the Holocene transgression when sea level first overtopped the edge of the shelf at c. 13,000 BP; and (b) from the time of the apparent stabilisation of sea level at c. 6,500 years BP.

A possible episodic rise in Holocene sea level, as evidenced by relic shorelines, is related to the palaeochannels of the Herbert and Burdekin Rivers to reconstruct the palaeogeography of the shelf during the low sea level of the last glacial period and subsequent Holocene transgression. Potential archaeological sites for future investigation are identified on the emergent landmasses of the Palm Islands. Antecedent platforms of modern reefs, sheltered sites around island land masses which existed at earlier shorelines and areas adjacent to former estuaries are suggested as potential underwater archaeological sites.

While the patterning of late Holocene Aboriginal settlement on Orpheus Island, in the Palm Islands, is offered as a possibe recent analogue for earlier settlement on the continental shelf, it suggested that isolation by rising sea level at c. 7,500 BP created drastic environmental changes and triggered a divergence from modern mainland lifeways for the Palm Islanders. Evidence is drawn from preliminary habitat reconstruction, radiocarbon dating and small excavations of shell midden deposits on Orpheus Island.

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CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF PLATES

STATEMENT ON SOURCES

DECLARATION

I declare that this thesis is my own work and has not been submitted in any form for another degree or diploma at any university or other institution of tertiary education. Information derived from the published or unpublished work of others has been acknowledged in the text and a list of references is given.

15 July 1991

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... the Barrier Reef was the original coastline of the country. Goonyah was the first man in that country. One day with his two wives, he went to the coast to catch fish. In some way he offended the Great Spirit Balore. It is said, that he caught and ate a certain kind of fish that was forbidden. Balore in anger caused the sea to rise in order to drown Goonyah and his women, but they fled to the mountains. The waters rose rapidly as the fugitives climbed to the height of the Murray Prior Range. This range is called by the Aboriginals Wambilari.

The two women became very tired, and stopped running. Goonyah, well ahead of them, stopped on a huge boulder of granite, and called upon them to hurry----the footprint of Goonyah----a patch of very dark stone in the granite----was left by Goonyah's muddy foot.

They succeeded in reaching the top of the highest peak in the range, and there they made a fire, and heating large stones rolled them down the mountain side, and succeeded in checking the flood. The sea however, never returned to its original limits.

A legend of the Cape Grafton Aborigines (recorded by Gribble 1932:56)

CHAPTER 1

INTRODUCTION

1.1 Study area and aims

The study area encompasses both the submerged Herbert / Burdekin region of the North Queensland continental shelf and the exposed highs known today as the Palm Islands. The edge of the continental shelf in the Central Province of the Great Barrier Reef is at a depth of about -70 m at about 125 km from the coast. Opposite Ingham on the mainland the shelf is about 106 km wide. The Palm Islands lie between 145° 27" and 145°45" East and 18° 30" and 18° 50" South, centered approximately 15 km east from the mainland coast near Ingham (see Fig. 1.1). The four largest of the eleven islands of the group are Great Palm, Orpheus, Fantome and Curacoa. As the exposed heights of two parallel mountain ranges rising steeply from the drowned inner continental shelf, they represent the most southerly exposure of the late Carboniferous / early Permian intrusive granites and volcanics of the Hodgkinson Basin. The islands rise to their highest point at Mt. Bentley (547 m) on Great Palm Island as shown in Fig. 1.2 (see also Fig. 4.1,fold-out inside back cover).

Preliminary archaeological research in the Palm Islands has

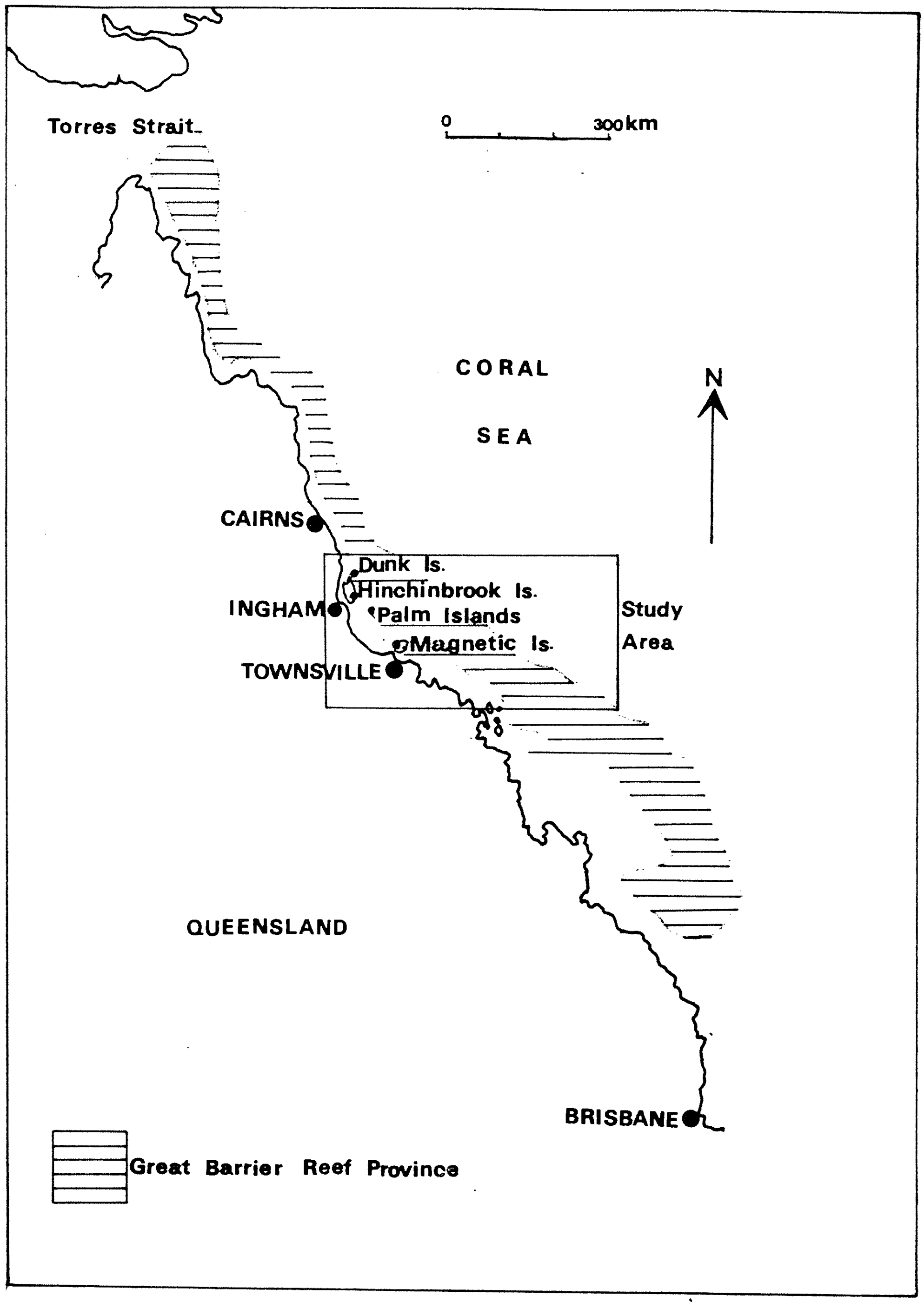


Fig. 1.1 Location map with the study area outlined

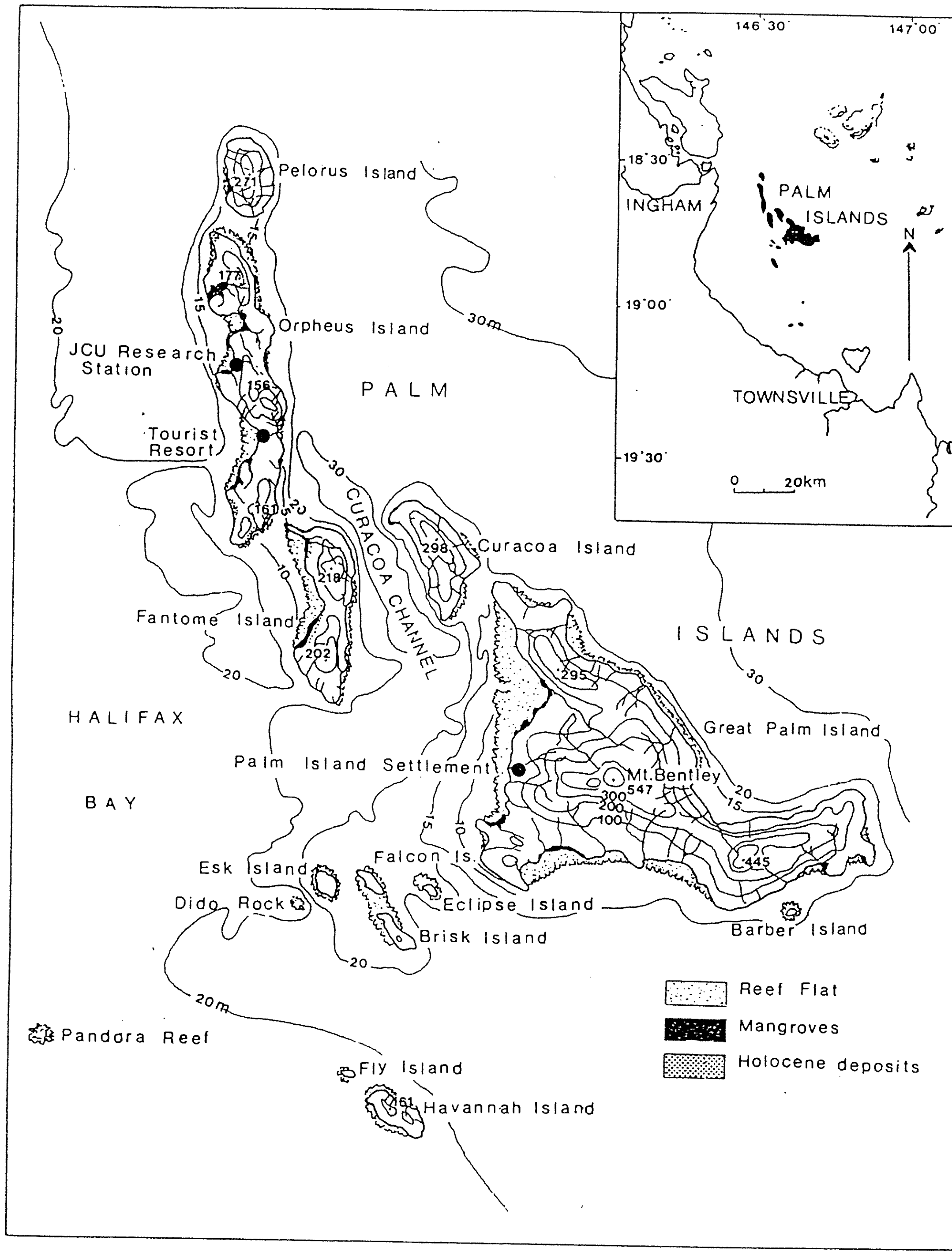


Fig. 1.2 Physical map of the Palm Islands

produced evidence of late Holocene settlement patterns of Aboriginal peoples on offshore islands in North Queensland. This research (O'Keeffe 1988) has begun to fill the physical gap between archaeological research on Hinchinbrook Island (Stephens 1945, 1946; Brayshaw 1977, 1990; Campbell 1979, 1982) and Magnetic Island (e.g. Greer 1981; Gorecki and Greer 1988; Mardaga-Campbell *et al.* 1989). As bedrock islands similar to the Palm Islands, both have in the main remained exposed above fluctuating sea-levels of the last glaciation. No definite Pleistocene archaeological sites have yet been identified on these islands, although there is certainly the likelihood that they could exist. People have been present on the Greater Australian or Sahulian continent since at least 45,000 years BP (Nanson *et al.* 1987; Groube *et al.* 1986) and possibly since 60,000 years BP or more (Wright 1986; Roberts *et al.* 1990), though the evidence for the latter is far from conclusive.

A considerable amount of work has been carried out on the Quaternary history of the Australian continental shelf, and the Townsville region in particular has been the focus for a number of studies which provide some clues to the Pleistocene and Holocene environments of the shelf in the vicinity of the Palm Islands (Belperio 1979; Hopley 1971, 1982, 1983, 1984; Searle *et al.* 1981; Johnson *et al.* 1982; Searle and Harvey 1982; Harvey and Searle 1983; Marshall and Davies 1984; Symonds *et al.* 1983; Searle 1983; Johnson and Searle 1984; Davidson and Johnson 1986; Carter and Johnson 1986; see Chapter 2 Review of the Literature below). Data contained in these studies present interesting implications for archaeological research (see also O'Keeffe 1988).

This thesis attempts to fulfill four main aims:

(1) To reconstruct the palaeogeography of the Palm Islands and the continental shelf in the Herbert / Burdekin region in order to identify areas within this zone where archaeological sites might be located;

(2) To identify environmental resources on the Palm Islands which may have served to support a human population prior to European contact;

(3) To record the Holocene archaeology on selected parts of the Palm Islands and to assess the potential archaeology of the immediately adjacent continental shelf;

(4) To determine if a divergence from mainland lifeways occurred with the isolation of the Palm Islands by the rising Holocene sea level at c. 7,5000 BP.

To achieve the first aim, a review of the geophysical literature provides current local evidence for fluctuating sea-levels and changing climates during the Quaternary which is relevant to the Herbert / Burdekin region. This evidence allows the construction of a hypothetical palaeogeography that demonstrates the existence on the continental shelf of a highly attractive habitat for gatherer-hunter peoples of the late Pleistocene.
Surveys of those areas of the Palm Islands, identified from the palaeogeography as possible late Pleistocene archaeological sites, were not undertaken during the present study due to limits of time,

finance and difficulty of access. Most of the Palm Islands are included in the Palm Island Aboriginal Land Trust and permission to enter this area must be obtained from the Community Council. A full approach to the Council was not made at this preliminary stage as recording the late Holocene archaeology of Orpheus Island , which is a National Park and a James Cook University Research Station, was considered a more urgent project. It is intended that full Aboriginal consultation will take place in any future extension of this research.

To fulfill the second aim interpretation of aerial photography followed by ground truthing was used to define the geomorphology and vegetation patterns of the island group to identify resource areas. Surveying was carried out over Orpheus Island to identify archaeological sites, and two small soundings were made in Pioneer Bay South to give some indication of late Holocene settlement patterns and food exploitation strategies. Aspects of the Holocene geomorphology of Pioneer Bay South were examined as a step towards determining further spatial and temporal dimensions present in Holocene settlement patterns. Vegetation (see also Appendix 1), water resources and fauna are discussed as part of the reconstruction of the local habitat. Analyses of the stone-walled fish traps found on the reef flats of Orpheus were conducted to determine if they were constructed in specific locations which were possibly perceived as optimum by the Aboriginal fishers. The possibility that a predictive model might be designed to locate other traps on unsurveyed parts of the Palm Islands, Magnetic Island and the mainland, was also investigated. A basal age for the conditions necessary for construction of these traps is suggested. To fulfull the fourth aim it is argued that the drastically altered environmental conditions following the isolation from the mainland approximately 1,000 years before sea level reached the present coast would have necessitated a correspondingly acute change in resource exploitation by gatherers and hunters.

1.2 Island ethnohistory

Although as Brayshaw (1977, 1990) notes there is a considerable body of ethnohistorical literature for the Herbert / Burdekin district from which to reconstruct the traditional Aboriginal culture at the time of European contact, there is little specific information on the Palm Islands and almost none on Orpheus Island.

Cook (1771) saw people and canoes on one of the Palm Islands and Banks, Hicks and Solander went ashore to collect 'Cocoa Nuts', not seeing any people but hearing shouting from one man as they left (Banks 1768-1771). The Great Palm Island people have a story of Cook's visit to that island (Palm Island 1975), although it has been suggested from the navigational information contained in Cook's Log that the island in question was Orpheus Island (Porter 1983). This view is supported by Gribble (1932:147) who claims that Lieutenant Hicks, Dr Solander and Sir Joseph Banks went ashore on the western extremity of one the group now known as Orpheus Island.

Flinders (1814), more concerned with finding a passage through the Barrier Reef, passed well to the east of the Palm Islands. On 17th 6

June, 1819 King (1827) and Cunningham (1816-1831) in the *Mermaid*, charting the inner route along the coast, sailed from Cape Cleveland around the northern end of Magnetic Island and across Halifax Bay to an island at latitude 18° 50'15". This latitude corresponds to Havannah Island to the south-west of Great Palm Island. That this is the island referred to by King (1827: 198) is supported by a further comment in his Journal regarding palm trees: 'Few palm-trees were seen, but at the large islands, according to Captain Cook's account they are probably abundant'. This remark suggests that the island where landfall was made was a small one. Of their landing on this island (Havannah) on 18th June, 1819, King (1827: 197) wrote:

> Near our landing-place were some natives' huts and two canoes; the former appeared to have been recently occupied, and were very snug habitations. They were of a circular shape, and very ingeniously constructed by twigs stuck in the ground and arched over, the ends being artfully entwined so as to give support to each other; the whole was covered with a thatch of dried grass and reeds; they were not larger than two people could conveniently occupy. In one of the huts, which was of a more elliptical shape and of larger dimensions then the other, was a bunch of hair that had been recently clipped from either the head or beard. This proves that these operations are not done solely by fire, as Captain Cook supposed, but by means of a sharp-edged shell, which must be both tedious and painful to endure; and we have often witnessed the delight shewn by the native at the speedy effect a pair of scissors has produced upon the beard or hair. The canoes were not longer than eight feet,

> and would not safely carry more than two people; the ends were stitched together by strips of the stem of the *flagellaria indica* (sic).

In 1839 Stokes in the *Beagle* passed about 8 km to the east of the Palms as did King with Blackwood in the *Fly* in 1843 (Jukes 1847). By 1864 European settlers had arrived in the Halifax Bay region and population numbers of the Aborigines began to decline drastically. Cassady (1886) estimated a total population of about 500 persons for an area around the Herbert River, extending 80 km along the coast and 24 km inland in 1865. By 1880 this number was reduced by disease and abuse to about 200. Similarly in the lower Halifax Bay area Johnstone (1886) noted a rapid decline in Aboriginal numbers.

Records of early European contact through the Palms are sparse, but *bêche-de-mer* and pearling boats were operating in the area, and Aborigines from the Palm Islands were press-ganged onto such boats in 1872. Later women were kidnapped by the crew of a sugar vessel (Johnstone 1904). When he visited Great Palm Island in 1909 to check on Japanese pearling crews, the Chief Protector found only a small camp of Aborigines composed of eight men, five women and three small children (Howard 1910). Before European contact 'a couple of hundred' people in 'three camps of 50-60' and living in huts were in permanent residence (Palm Island 1975).

Gribble (1932:147) devotes a brief chapter to the few surviving members of the *Mun-bar-ra* , i.e. the *Manbarra,* Brayshaw 1977,

1990) living on Great Palm Island when the mission was established there in 1918 after the settlement at Hull River, just north of the Tully River and near the southern end of Mission Beach, was destroyed by a cyclone. His list of words (see Table 1.1) and Brayshaw's research (1977, 1990) provide some clues to the original material culture of Great Palm Island, only a few examples of which exist; e.g. a set of firesticks made from two long like pieces of wood (catalogue item 6531, Museum of Mankind, London); a 9 to12 m brown vegetable fibre strung with 1.7 - 2.5 cm long yellow reeds (6532, Museum of Mankind); a 'bent-pin' turtle shell fishhook described by Massola (1956:11; see also Roth 1904: 33); a boomerang reported by Huxley (1935:139). Although he was sympathetic, in common with most early European settlers Gribble had no formal training in recording the traditional culture of the people under his care. A valuable opportunity to obtain a comprehensive ethnohistory of the Palm Islands was lost. For Orpheus Island no records have been found from before 1884, when the Hayes family began running sheep there (Beddoe 1910).

Banfield (1908, 1909) describes many of the subsistence strategies used by the people of Dunk Island to the north of Hinchinbrook Island which might be applicable to the Palm Islands. He comments briefly on the efficiency of the stone-walled fish traps in Missionary Bay on Hinchinbrook Island (Banfield 1909). There are extensive complexes of such traps at nearby Goold and Hinchinbrook Islands (Campbell 1979, 1982; Campbell and Mardaga-Campbell 1990). On the south-eastern side of Great Palm Island there is now a record of an extensive stone-walled tidal fish trap system in Horseshoe Bay

Table 1.1 A list of words obtained from the oldest of the few surviving members of the *Manbarra* who originally inhabited the Palm Islands (Gribble (1932:148).

Ah-ba-ree	Sister	*Dan-oo*	Fire
Bah-de-go	Cry	*Darn-doo*	Baby
Bah-ge-ra	Body	*Del-berra*	Shoulder
Bah-ree	Rock	*Dig-e-go*	Sit down
Bal-ee	Wallaby	*Doo-lah*	Sun
Billie	Run	*Dul-burra*	Chin
Binna	Ear	*Dun-doo*	Boy
Binna	Leaf	*Dun-goo-ra*	Stranger
Boo-ga-moo	Forearm	*Ga-gah*	Sick
Boon-de-mah	Hit	*Gah-ba-roo*	Three
Boor-roo-roo	Shark	*Gil-e-bah*	Wommera
Bub-in-mulla	Kill	*Gnoo-rool*	Sky
Bul-gil-ah	'Tomahawk'	*Gnoom-ba-ra*	Man
Bur-ga-la	White	*Gneem-ba-roo*	Husband
By-yal-goo	Sing	*Gnoora*	Camp
Cum-ee	Aunt	*Gnur-joo*	Fish
Cum-oo	Water	*Go-ah*	Rain
Dah-loon	Dilly-bag	*Go-gah*	Neck
Dah-lun	Tongue	*Go-wah*	Uncle
Dah-rah	Thigh	*Goin-ba-roo*	Eyebrow
Daln-boo or *Gud-da*	Brother	*Goo-ba-ra*	To-morrow
Gul-ba-ra	River	*Re-rah*	Teeth
Gul-barrie	Moon	*Re-we-rin*	Toe
Gum-ba-da-la	Shield	*Roo-lah*	Tree
Gun-ba-ra	Spear	*Rool-gun*	Small shark
Gun-dun-oo	Thunder	*Run-dal*	Gunyah (hut)
Jinga-jinga	Black	*Wah-dee*	Laugh
Jinna	Feet	*Wah-kah*	Leg
Mah-goor	Cloud	*Wah-loo*	Head
Mal-lah	Hand	*Wah-roo*	Nose
Marl-gun	Lightning	*Wah-roon*	Ground
Marn-go	Arm	*We-aj-loo*	Grass
Me-el	Eye	*We-ra*	Wind
Mer-roo	Elbow	*Wirra-ca-go*	Swim
Moo-koo	Knee	*Wool-i*	Dead
Moo-lin	Mouth	*Woom-ba-la-roo*	Morning star
Moo-lun	Hair	*Wung-ul*	Boomerang
Mood-ja	Wife	*Yane-go*	Walk
Moodja-moodja	Woman	*Yergan-go*	Two
Mudda	Sea	*Yoon-gool*	One
Mun-goo	Upper arm	*Yun-gool-murra*	Four
Murrah	Morning	*Goo-bun-ju-la*	Star
Nah-dan-gee	Glad	*Goo-ray*	Alive
Noo-roo	Bark canoe	*Goo-ree*	Cousin
Nuddie	Night	*Goon-billie*	Yellow
Nun-jee-ya-go	Dance	*Goon-dee*	Fight
Nunnie-nunnie	Buried	*Goorie-goorie*	Red

(E. Bunn pers. comm.; see Plate 7.5).

1.3 People of the Palms

As far as is known to the author no fully traditional original Great Palm Island people (i.e. the *Manbarra* ; see Brayshaw 1977, 1990) are alive today, although some descendents still live on Great Palm Island and elsewhere on the mainland, and in that sense there are still some traditional owners in the district. Most of the present inhabitants of Great Palm Island are from many different Queensland Aboriginal and Islander communities.

Tindale (1974) includes the Palm Group in the territory of the so-called *Wulguru*, of which the *Manbarra* would possibly have been a sub-division. Through recent research (N. Heijm pers. comm.) it has come to be known that the name *Wulguru* means 'canoe' and is not the name of the Townsville Aboriginal people but is the language name for the area designated by Tindale (1974). The *Wulguru* language area extends from the Herveys Range in the west to Magnetic Island in the east, and from Cape Cleveland in the south to the southern end of Halifax Bay in the north. This would seem to be supported by oral history of the Palm Islands (Palm Island 1975), as well as by Meston (1895:10), who observed a party of fifty men and ten boys from Great Palm Island who travelled to the mainland at Halifax Bay for initiation purposes. Table 1.2 gives the *Manbarra* names for the islands from Gribbles's list, plus the Aboriginal names given under the dual naming system on the Topograhic Series

Table. 1.2

Conflicting nomenclature of the Palm Islands from Gribble (1932:148) and the Topographic Series (Lucinda, Palm Islands and Havanna Island). The source of the Aboriginal names used in the dual naming system on the Topographic Series is unknown. (Both lists incomplete)

European Names	"Manbarra" names from Gribble (1932)	Aboriginal names from Topographic Series
Pelorus	*Guy-roo-garrie*	*Yandboa*
Orpheus	*Mow-yere*	*Goolboddi*
Fantome	*Guy-roo-loo*	*Eumilli*
Curacoa	*U-millie*	*Noogoo*
Palm	*Doe-bun*	
Eclipse	*Gno-goo*	*Garoogubbee*
Falcon	*Yan-o-wah*	*Carbooroo*
Brisk	*Boor-gah-mun*	*Culgarool*
Esk	*Booral-booral*	*Soopun*
Dido Rock		
Fly		
Havanna	*Goy-u-loo*	
Acheron		
Rattlesnake		
Magnetic		

for the Palm Islands. The source of these names is obscured by time, but they could have been used on early charts, and may be names given to the islands by Aboriginal people other than the *Manbarra*. The two most conservative of the dialects of the Wulguru language were spoken in the Palm Islands, *Mulgu* and *Buluguyban*. These dialects split from the main language early in its evolution (M. Donohue pers.comm.). Unfortunately the words collected from the Palm Islands do not include the names of the islands.

In terms of the physical landscape it would appear at first to Europeans as a strange extension of territory from the core region. There is less distance between the Palms and the mainland to the west than the largest gap between islands to the south, and this might suggest that social contacts would have been more likely in that direction. The total distance from Great Palm, the most southerly of the larger islands of the group, to Magnetic by island hopping is about 43 km (the largest distance between individual islands is 20 km from Rattlesnake to Magnetic; see also Table 1.3). Rattlesnake to the mainland is half the distance from Rattlesnake to Magnetic and this may have been the preferred route considering the report from Meston (1899:10) regarding the Palm Islanders visiting Halifax Bay.

1.4 Approaches to the study

In order to understand the broad archaeological picture of the Herbert / Burdekin region of the continental shelf, and to determine what changes have occurred to settlement patterns through time, it is considered necessary to look at the environment as it was pre-Holocene sea rise, and as it is today. Looking at what sites are actually present today on the Palm Islands and working backwards in time and outwards underwater to the shelf edge as time and money permit would appear to be the logical approach.

Table 1.3 Shortest distances between the Palms and Magnetic Island, as well as to the Mainland.

Place to place	km
Mainland to Pelorus	16.0
Mainland to Orpheus	15.0
Pelorus to Orpheus	1.0
Orpheus to Fantome	0.3
Fantone to Curacoa	1.6
Curacoa to Great Palm	1.75
Great Palm to Eclipse	1.75
Eclipse to Falcon and Brisk	1.5
Falcon to Esk	1.0
Esk to Dido Rock	1.0
Brisk to Fly and Havanna	5.0
Havanna to Acheron and Herald	8.5
Acheron and Herald to Rattlesnake	5.0
Rattlesnake to Magnetic	20.0
Rattlesnake to the Mainland	10.0
Magnetic to Mainland	2.5

CHAPTER 2

GEOPHYSICAL LITERATURE REVIEW AND SEA LEVELS

2.1 Review of the literature

For the greater part of the 40,000 or more years of human history in Australia about one third of the North Queensland continental shelf was in a zone of fluctuating sea levels. During the last glacial maximum about 25,000 years BP to 18,000 years BP the sea withdrew to about 130 m below present levels (Chappell 1983). Hopley (1982), however, suggests that for most of the Pleistocene, sea level did not fall below -60 m, which would have placed the coastline during these periods approximately 50 to 60 km east of the Palm Islands. Seismic profiling in the Townsville region has identified the Pleistocene / Holocene disconformity (Harvey and Searle 1983; Johnson *et al.* 1982; Searle and Harvey 1982) underlying the thin sediments laid down on the shelf during the Holocene transgression. The infilled channels of rivers and streams which downcut through the shelf to the lower base level during the glacial low sea level have also been identified by seismic profiling (Johnson and Searle 1984). The Herbert palaeochannel runs between Fantome and Curacoa Islands, effectively dividing the old range into north and south. It has been traced from the mainland south of Ingham across the shelf to the reef tract (Johnson *et al.*

1982; Johnson and Searle 1984; Searle 1983; see also Fig. 2.1). Other palaeochannels of the Herbert and Burdekin have been identified as fluvial and / or estuarine fill deposited during transgression or channel abandonment. Between the Palm Islands and the mainland the shelf depth is generally less than 20 m, but deepens to 40 m along the western edge of the Palm Islands where wide channels of 0.7 to 2 km exist (Davidson and Johnson 1986). Reefs which developed on the outer shelf during an earlier high sea level remained as limestone hillocks (Marshall and Davies 1984; Johnson and Searle 1984) on the relict alluvial plain (see also Searle et al.1981; Symonds *et al.* 1983).

Possible changes in climate in northeastern Queensland are inferred from the various features of spits on offshore islands (Hopley 1971, 1982, 1984). The orientation of some of the older beachrock differs from the present day formation, and the height of boulder spits is up to 4.3 m above postulated high water mark at their time of formation. The evidence provided by these features implies a stronger wave activity when they were emplaced, i.e. during rising sea levels between 8,500 and 6,000 years BP, when no physical barrier existed to lessen wave action on the coastline. This is thought to have occurred due to a time lag in growth of the outer reef. Modern reef height acts to restrict fetch and decrease wave strength. Increased summer cyclone activity or greater wind strength generally, separately or in combination, may have operated during this period (Hopley 1971, 1982, 1984). If that were so, then it would have had implications for preservation of earlier archaeological sites (see also references to work by Bird 1987, In

Press, on Upstart Bay).

Bowler *et al.* (1976) review the literature on Quaternary climatic change and indicate that the climate of eastern Australia was significantly drier during much of the last glacial, with mean annual temperatures lowered by between 6°and 10° C. During the glacial maximum precipitation was lowered to at least 50% below present records (Webster and Streton 1978). Lowered sea temperatures, the exposure of large areas of continental shelf and the changes in land and sea configuration, such as the closing of the Gulf of Carpentaria and the consequent diversion of ocean currents, would have resulted in a significant reduction in the development of cyclones (Webster and Streten 1978; Oliver 1978). In addition Van Andel *et al.* (1967) and Oliver (1978) suggest that the southward movement of the Intertropical Convergence Zone during the summer months was lessened during glacial periods with a consequencial reduction in the potential for monsoonal influences. Precisely what effect the large freshwater lake, Lake Carpentaria, had on the climate of North Queensland during the last glacial maximum is not yet clear (Torgersen *et al.* 1983, 1988), though it certainly would have influenced the distribution of human groups in the northwestern regions of North Queensland.

Evidence for climatic change in North Queensland from Kershaw's (1970, 1971, 1973, 1974, 1975 a, 1975b, 1976, 1978, 1983, 1986, 1989; see also Coventry *et al.* 1980) palynological work on the Atherton Tablelands provides a continuous record of vegetation and implied climatic changes for the last 200,000 years. This is complemented by evidence from soils and geomorphology of the Townsville region for the last 125,000 years. Hopley (1973a) and Hopley and Murtha (1975) suggest that conditions in this latter area differed from the general pattern. The climate was dry or drier than present during the warmer interglacial period and following regression phase with probably highly seasonal rainfall. It then became wetter than present during the lowered sea level of the last glacial maximum from about 25,000 years BP. Conditions became drier again by 15,000 years BP (Hopley 1973a) until the mid-Holocene sea level was reached about 7,500 years BP, returning to the more humid conditions of the present time (Hopley 1973a, 1982).

Sea temperatures were lowered by only 2° C during the last full glacial at 18,000 BP (CLIMAP1976; Skackleton 1978), while temperatures in some parts of the New Guinea highlands were reduced by up to 11° C (Walker 1978; Hope 1983; Gorecki 1986) due to cold air incursions from higher latitudes (Webster and Streten 1978). However, for most of the last 120,000 years sea level stood higher than that of the full glacial at 18,000 BP when it reached approximately -130m locally (Chappel 1983), as pointed out above. Shallow seas covering much of the continental shelf may have ameliorated the climate in nearshore areas such as the ranges which have become the present-day Palm Islands.

Carter and Johnson (1986) suggest that rising seas overtopped the shelf at about 13,000 years BP and rose episodically to a level slightly higher than present at c. 6,500 years BP (see Fig. 2.1).

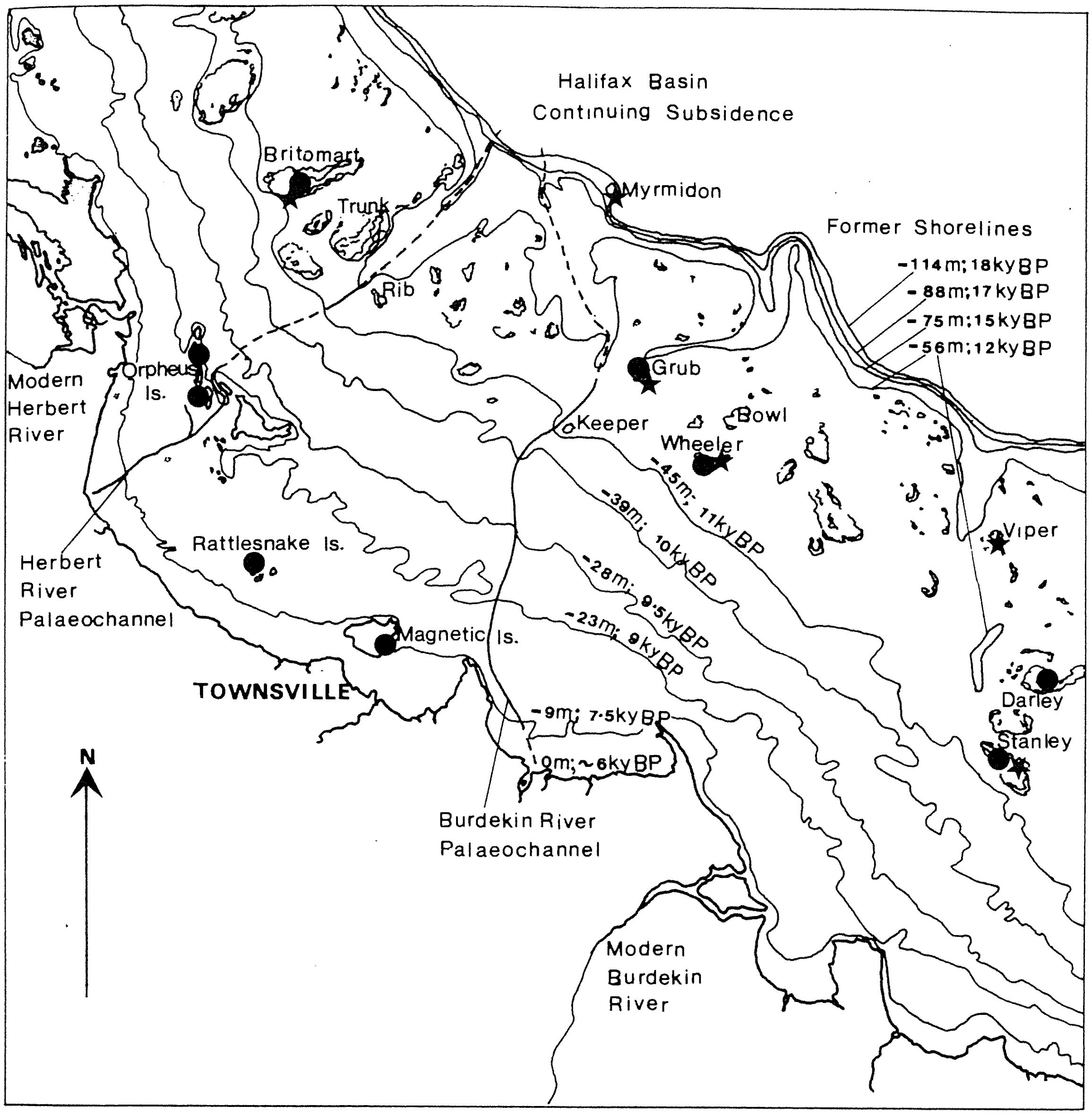


Fig. 2.1 Past shorelines along the Herbert / Burdekin region of the continental shelf.

Pre-Holocene surface determined by drilling (●) and seismic profiling (✶) from Johnson *et al.* (1984), Johnson *et al.* (1986), Harvey (1978, 1980).
* Antecedent limestone platform\

Grub Reef	~ 24 m	Bowl Reef	- 30 m
*Britomart Reef	- 19 to -8 m	Keeper Reef	- 25 to -17.5 m
*Wheeler Reef	- 20 m	*Viper Reef	- 22 m
Myrmidon Reef	- 24 m	*Stanley Reef	- 15 to -22 m
*Darley Reef	- 13 m		

Dates and depths of former shorelines from Carter and Johnson (1986), Carter *et al.* (1986).
Contours from Admiralty Chart (Palm Island, Brook Islands and Palm Passage, 1987) and Johnson and Searle (1984).

From this level it fell smoothly to modern sea level by c. 6,000 years BP (Chappell 1983).

In reviewing global models of the last post-glacial sea-level rise Carter *et al.* (1986) argue that such models based primarily on radiocarbon dating with all its inherent problems fail to detect episodic features which may be present. Such models frequently result in a smooth curve of sea-level rise. However, Carter *et al.* (1986) and Carter and Johnson (1986) argue for an episodic rise in sea level from c.18,000 to 6,500 BP, which was related to pauses in ice sheet melting. Their work follows an earlier inference by Fairbridge (1961) for an episodic transgression. Drowned shoreline features at depths comparable to those found in the recent studies were proposed by Maxwell (1973) as reef precursors.

Carter and Johnson (1986) and Carter *et al.* (1986) have produced a model with global implications based primarily on stratigraphic evidence from analysis of shallow seismic profiles obtained locally in North Queensland and compared to almost identical New Zealand shelf data. This they supplemented by radiocarbon dating where possible to identify former shorelines. These shorelines are marked by submerged reefal features including wavecut shorelines, clastic sediment wedges and / or drowned reefs. Pulses of sea-level rise separated by periods of stillstand or slight regressions characterise this model.

Rates of sea-level rise as high as 12 m ky^{-1} or higher between stillstands outstripped the typical coral reef building rate of 5 m

ky^{-1} (Smith 1983). From about 25,000 to 18,000 years BP, which is universally recognised as the last glacial maximum, low sea level reached at least -120 m depth locally. The level progressed upward to -114 m by 18,000 years BP and to the shelf edge at -70 m by 13,000 years BP (Carter and Johnson 1986). This represents a vertical rise of 44 m in 5,000 years with two periods of stillstand. Over a period of about 6,500 years (13,000 to 6,500 years BP) from the shelf edge depth of -70 m, seven shorelines have been identified, including the present one (see Fig.2.1). Apart from the episodic nature of the rise, the overall time curve produced by Carter and Johnson (1986) for the Central Province of the Great Barrier Reef is similar to that of Belperio (1979), Hopley (1983), Chappell (1983) and Grindrod and Rhodes (1984).

Chappell (1982) emphasises the importance of local research into environmental changes and the dangers of using studies from other areas as analogies. In particular the sea-level history of coasts and islands can vary markedly over relatively small distances, and each region must be studied separately (see also Belperio 1989 on misinterpretations and potential errors in so-called Greenhouse Effect modelling). Coastal features are altered not only from the effects of glacio-eustatically induced sea-level fluctuations and vertical tectonic movements, but from rifting and stretching and passive subsidence on continental margins. Deposition of sediment can exceed the transgressive rise of sea level and subsidence within a basin and result in a regressive shoreline such as presently found in active deltas, perhaps better termed as a prograding shoreline (Kraft 1978; Chappell 1982). Conversely, erosion can exceed the rate of deposition and a transgressive coastline can develop during a regression. The situation is further complicated by the hydro-isostatic effects of water loading on continental shelves with resultant flexing (Bloom 1967; Walcott 1972; Mörner 1972; Chappell 1974; Clark *et al.* 1978). Interpretation of coastal sedimentary environmental sequences is therefore fraught with difficulties, and it is within such a complex region that the core area of the present research, the Palm Islands, lie. Their geomorphological history is part of the history of the continental shelf and the Great Barrier Reef. Before the Holocene rise in sea level after the last glacial period, the Palm Islands were a range of hills in a relatively flat plain, and similar to the coastal ranges along the North Queensland coast today. Two major rivers and numerous channels dissected the plain. Some of these channels have been found to be only 2 m deep but 100 m across and are possibly related to the ancestral Herbert and Burdekin Rivers (Johnson and Searle 1984).

The long period of comparative sea-level stability for most of the time that Australia is thought to have had a human population implies from modern analogues that stability in settlement patterns could also have been the norm during much of the last glacial. As no specific archaeological literature exists for the immediate study area, archaeological references which may be pertinent to the discussion will be cited later within the text of this thesis.

2.2 Palaeogeography

The recent investigations (cited above) into continental shelf morphology in the Central Province of the Great Barrier Reef allow a model to be suggested which has relevance to the Palm Islands. This also makes it possible to present a hypothetical reconstruction of the palaeogeography of the continental shelf from the period before and during the most recent post glacial sea-level rise. By applying the data from these studies to the modern bathymetry from Admiralty Charts, maps have been produced (see Fig. 2.1 to Fig. 2.6) showing the postulated environments available for human exploitation during the different time periods and shoreline orientations.

Assuming that groups of people lived on the continental shelf around the 'Palm Range' during the last glacial maximum when sea level was at approximately -120 m, we might logically assume that some people exploited the coastal resources along the lowered shelf edge. Here the coastline may have been similar to that existing today along the coast to the north of Cairns where the Macalister Range drops sharply into the ocean. Along this steep rocky coast small embayments with narrow coastal plains, creeks emptying into the sea and rocky beaches support varied but frequently rich littoral and marine resources. Such human groups would have been forced back on to the upper surface of the shelf over the 5,000 years from 18,000 to 13,000 years BP when sea level overtopped the shelf. A retreat of the population would have had to occur with each episodic advance of sea level, but rates of

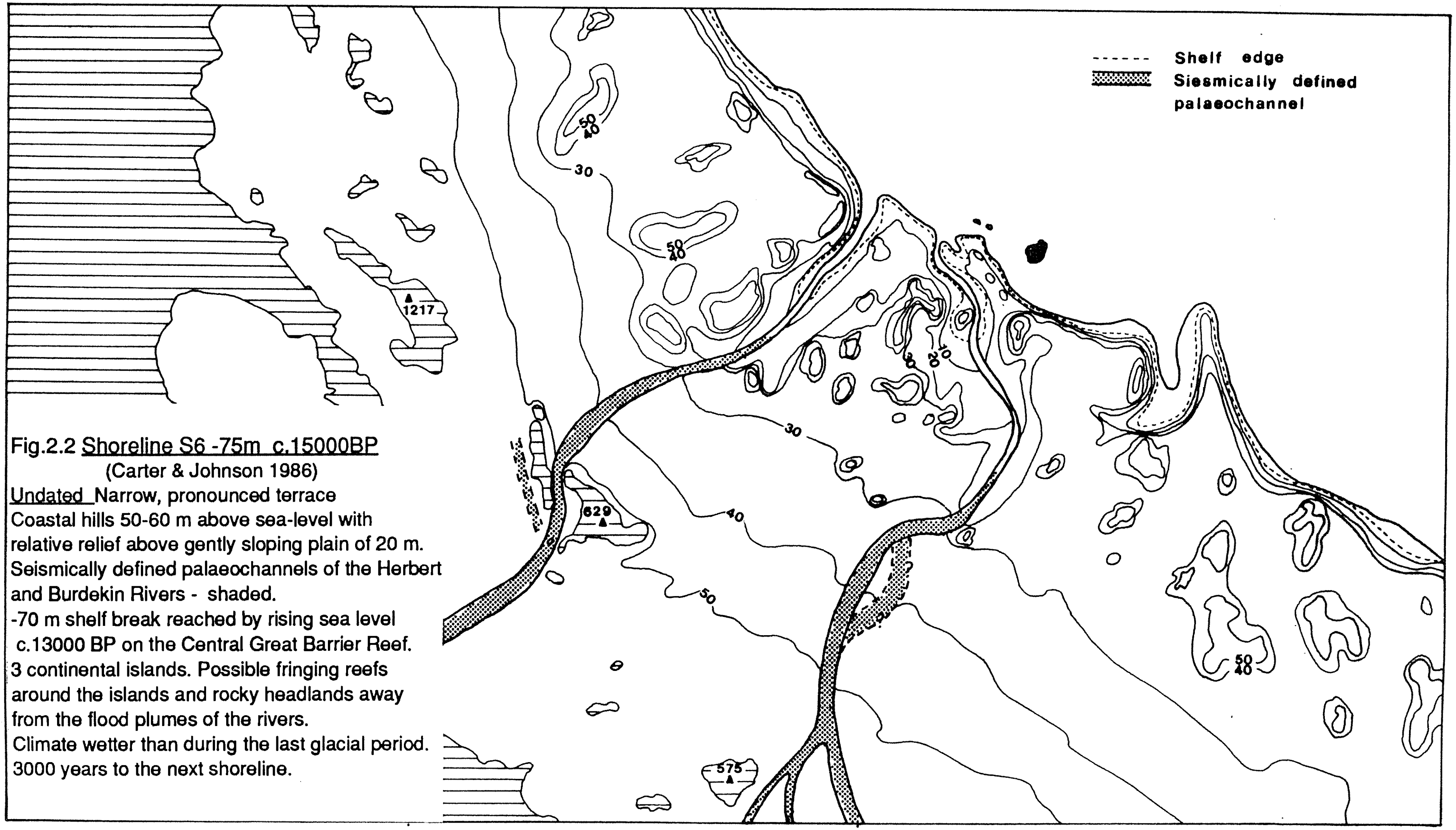


Fig.2.2 <u>Shoreline S6 -75m c.15000BP</u>
(Carter & Johnson 1986)
<u>Undated</u> Narrow, pronounced terrace
Coastal hills 50-60 m above sea-level with relative relief above gently sloping plain of 20 m.
Seismically defined palaeochannels of the Herbert and Burdekin Rivers - shaded.
-70 m shelf break reached by rising sea level c.13000 BP on the Central Great Barrier Reef.
3 continental islands. Possible fringing reefs around the islands and rocky headlands away from the flood plumes of the rivers.
Climate wetter than during the last glacial period.
3000 years to the next shoreline.

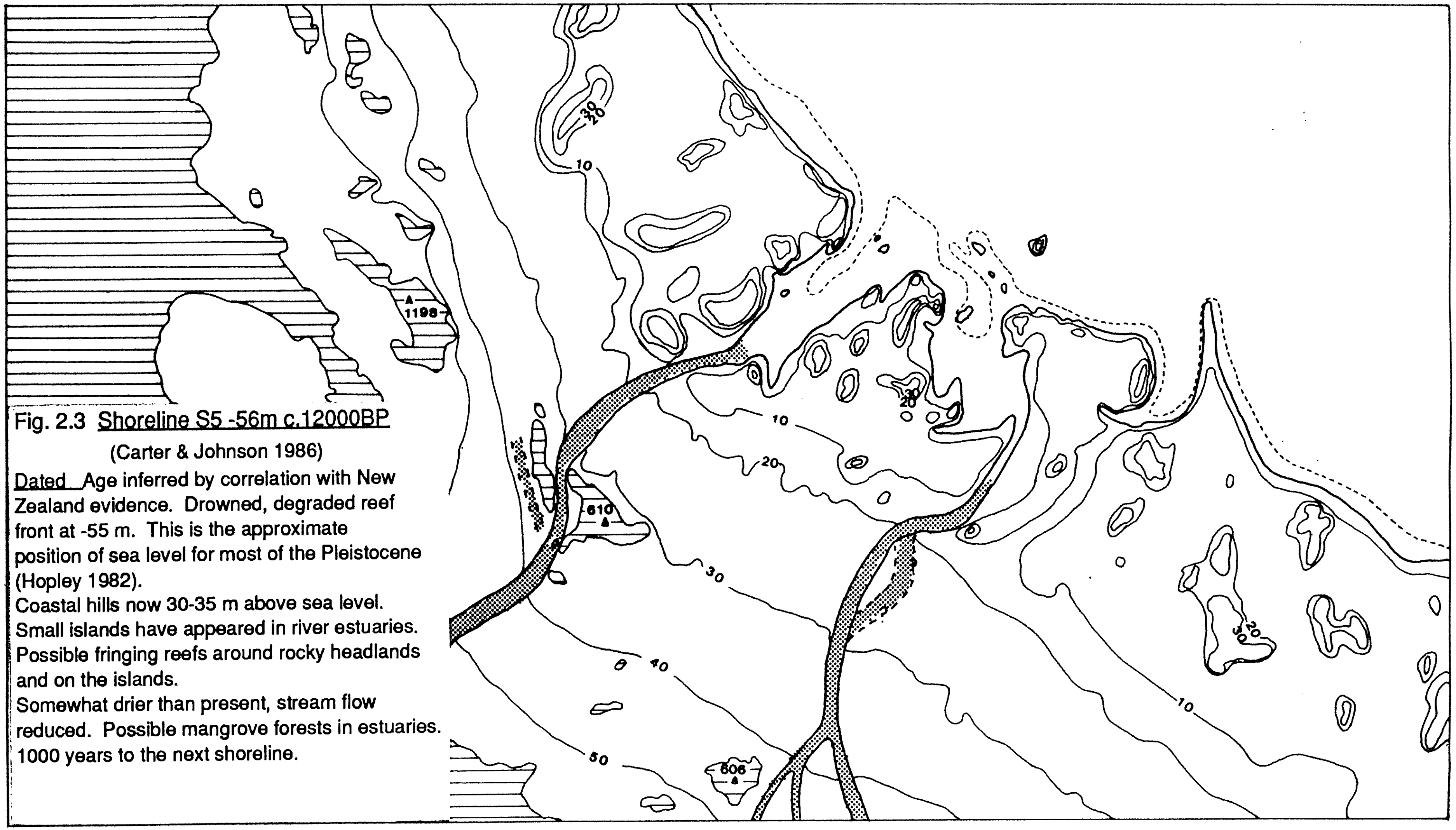


Fig. 2.3 Shoreline S5 -56m c.12000BP

(Carter & Johnson 1986)

Dated Age inferred by correlation with New Zealand evidence. Drowned, degraded reef front at -55 m. This is the approximate position of sea level for most of the Pleistocene (Hopley 1982).
Coastal hills now 30-35 m above sea level.
Small islands have appeared in river estuaries.
Possible fringing reefs around rocky headlands and on the islands.
Somewhat drier than present, stream flow reduced. Possible mangrove forests in estuaries.
1000 years to the next shoreline.

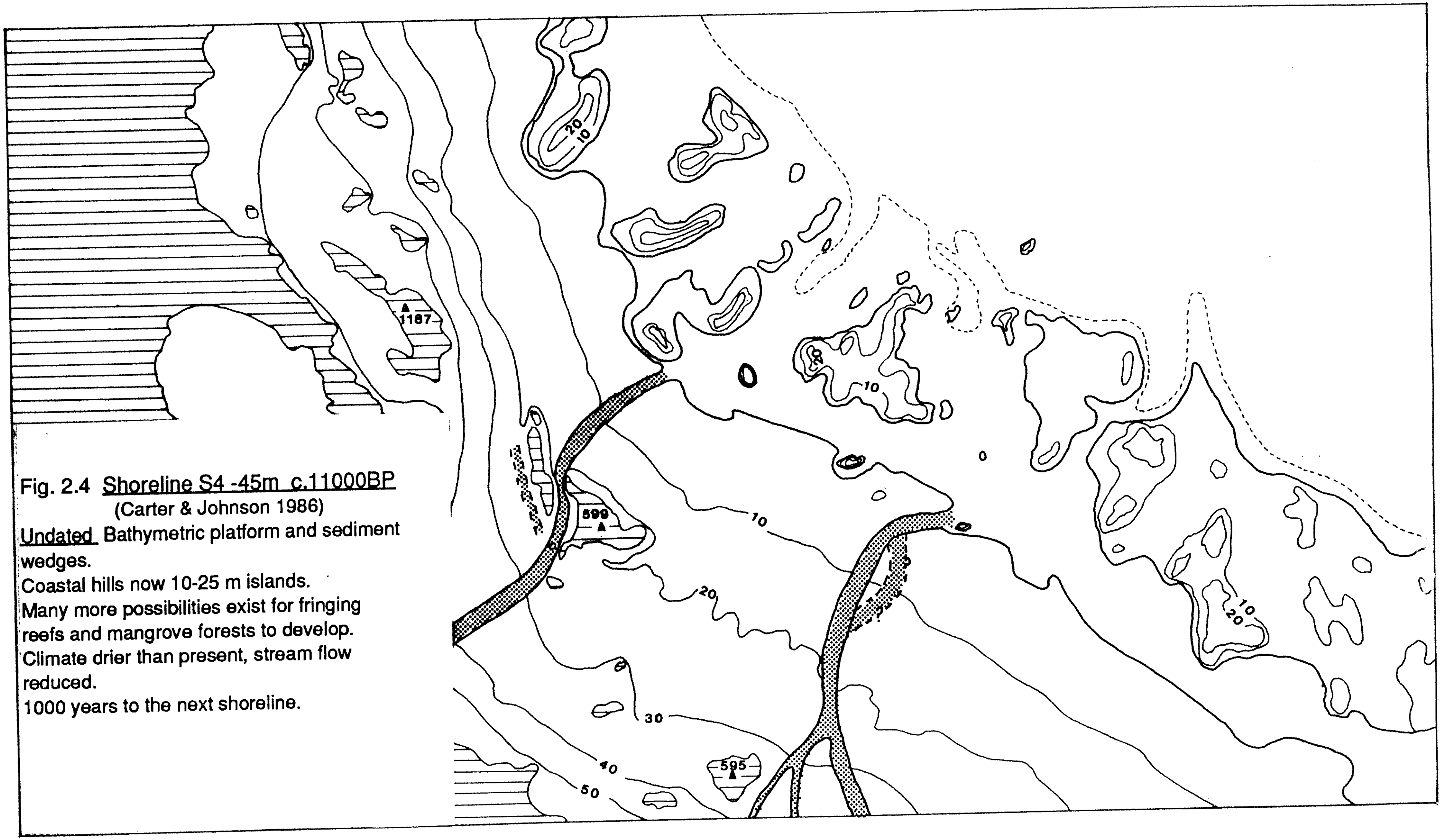


Fig. 2.4 <u>Shoreline S4 -45m c.11000BP</u>
(Carter & Johnson 1986)

<u>Undated</u> Bathymetric platform and sediment wedges.
Coastal hills now 10-25 m islands.
Many more possibilities exist for fringing reefs and mangrove forests to develop.
Climate drier than present, stream flow reduced.
1000 years to the next shoreline.

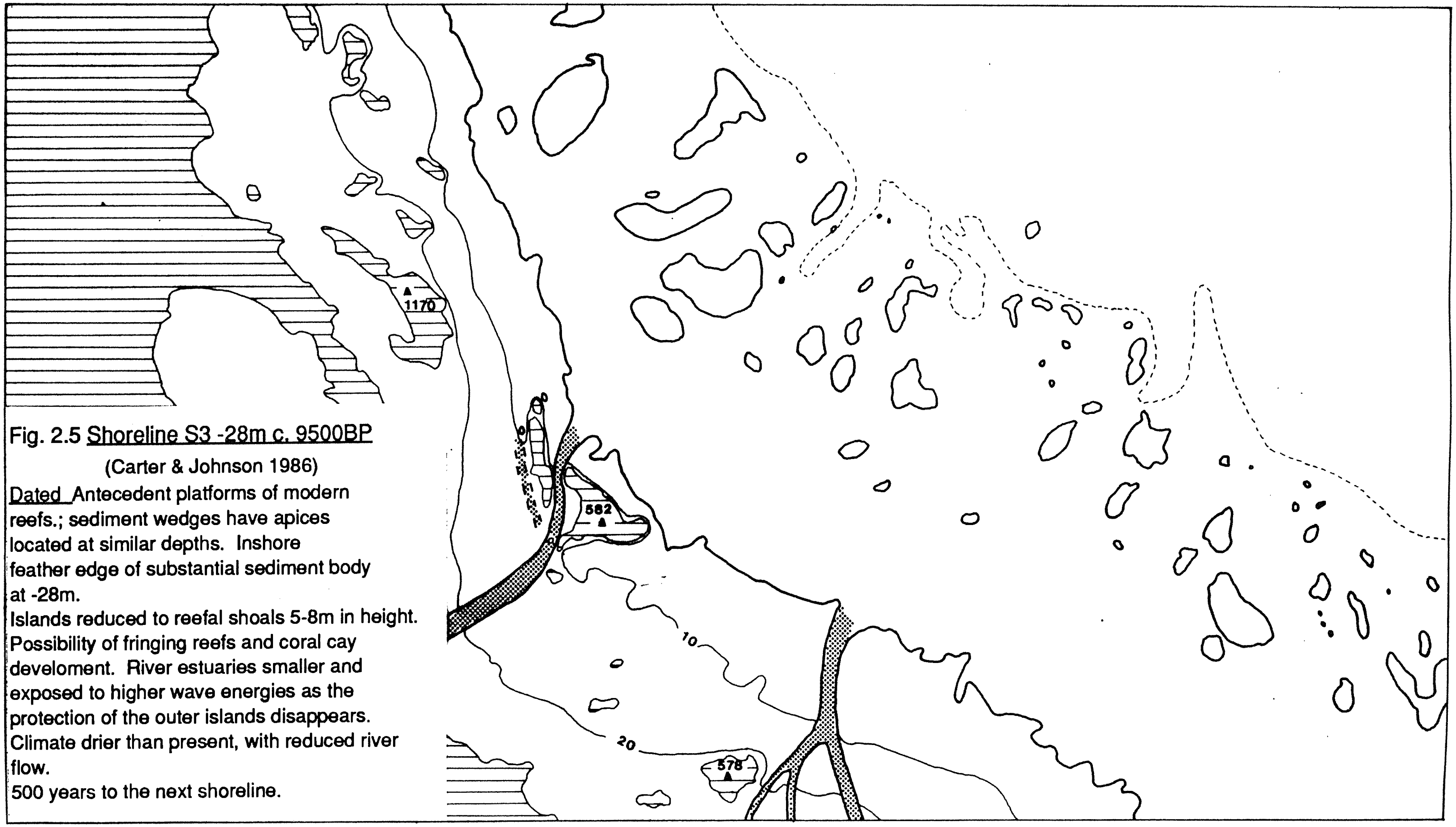


Fig. 2.5 <u>Shoreline S3 -28m c. 9500BP</u>

(Carter & Johnson 1986)

<u>Dated</u> Antecedent platforms of modern reefs.; sediment wedges have apices located at similar depths. Inshore feather edge of substantial sediment body at -28m.

Islands reduced to reefal shoals 5-8m in height. Possibility of fringing reefs and coral cay develoment. River estuaries smaller and exposed to higher wave energies as the protection of the outer islands disappears.

Climate drier than present, with reduced river flow.

500 years to the next shoreline.

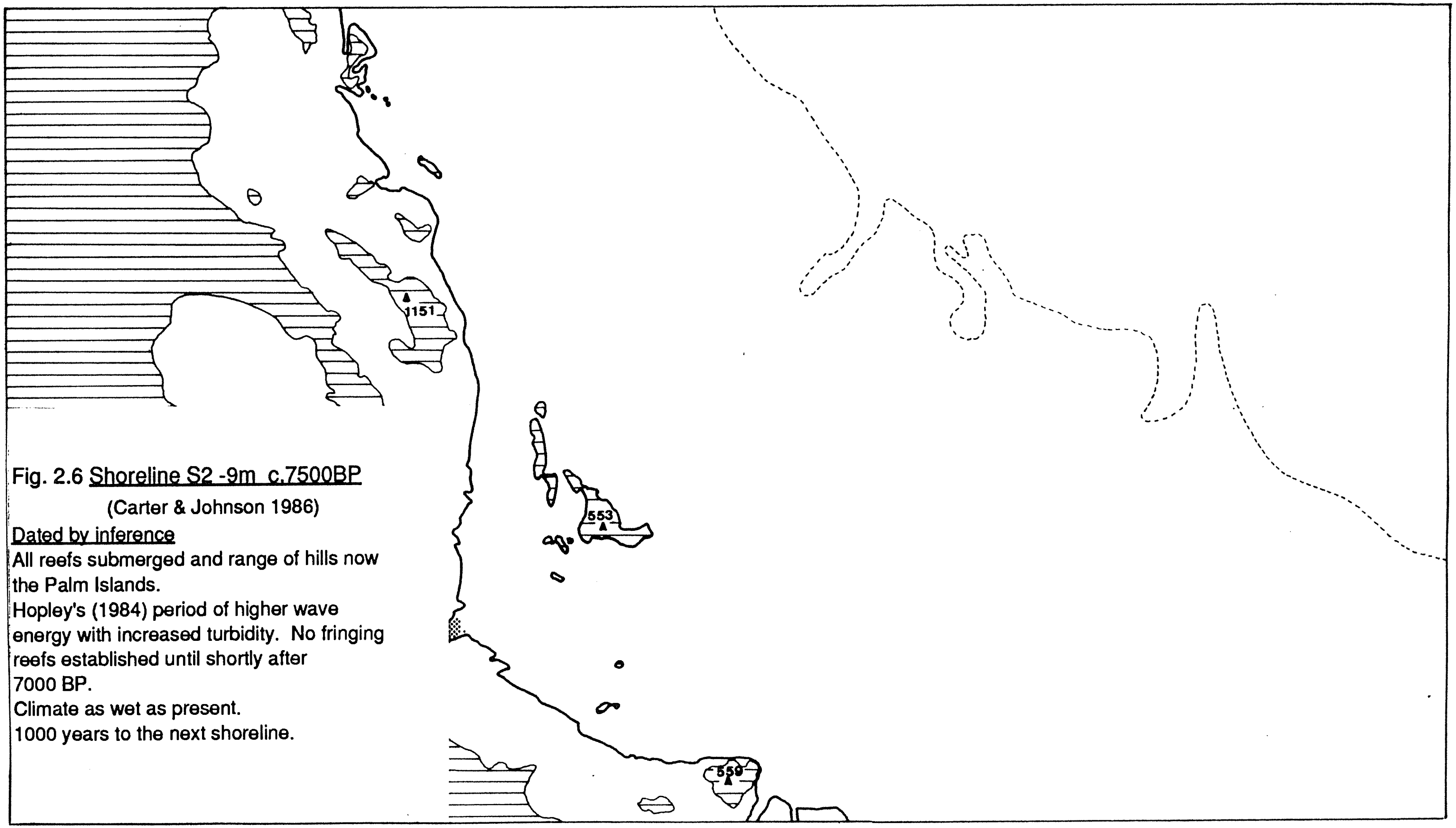


Fig. 2.6 Shoreline S2 -9m c.7500BP

(Carter & Johnson 1986)

Dated by inference

All reefs submerged and range of hills now the Palm Islands.

Hopley's (1984) period of higher wave energy with increased turbidity. No fringing reefs established until shortly after 7000 BP.

Climate as wet as present.

1000 years to the next shoreline.

advance (see Table 2.1) suggest that these periodic retreats might have been gradual migrations. Small reversals of the transgressing sea would have seen a corresponding relocation of the human population but the net movement probably would have been towards the present mainland.

Fig. 2.1 gives a general overview of the full Herbert / Burdekin region of the continental shelf, showing the hypothetical contours of the identified shorelines in relation to the mainland and present-day coral reefs. Figs. 2.2 to 2.6 show Carter and Johnson's (1986) shorelines [-75 m at c.15,000 BP (S6), -56 m at c.12,000 BP (S5), -45 m at c.11,000 BP (S4), -28 m at c.9,500 BP (S3) and -9 m at c.7,500 BP (S2)] with estimated contours in increments of 10 m related to each change of sea-level base. Only those shorelines which are relatively firmly dated either by radiocarbon dating or by correlation with similar features identified elsewhere have been mapped. Table 2.1 and Figs. 2.2 to 2.6 show the lateral movement of sea level along the palaeochannel of the Herbert River towards Orpheus Island compared to the time elapsed between each successive shoreline.

Fig. 2.2 of shoreline S6 at -75 m, reached by sea level at c.15,000 BP, is marked by a narrow wave-planed terrace on the steep upper slope of the continental shelf and is tentatively correlated with the -75 m terrace of the New Zealand sequence (Carter and Johnson 1986.. The shelf edge at -70 m is marked by a dotted line which subsequently appears on the following maps as a control. This map shows the coastline during a period when it rose steeply

Table 2.1 Horizontal displacement of shorelines along the palaeochannel of the Herbert River towards Orpheus Island as estimated from present bathymetry. Dates and depths from Carter and Johnson (1986) and Carter *et al.* (1986). Contours from Admiralty Chart (Palm Isles and Brook Islands and Palm Passage, 1987), Johnson and Searle (1984) and Carter and Johnson (1986).

Shoreline	Depth	Date	Increment Vertical	Increment Horizontal	Distance from Orpheus	Period between shorelines
S8	-114 m	18ky BP		80 km		
S7	-88 m	17ky BP	26 m	2 km	78 km	1,000 yrs
S6	-75 m	15ky BP	13 m	18 km	60 km	2,000 yrs
S.edge	-70 m	13ky BP	5 m	6 km	54 km	---
S5	-56 m	12ky BP	14 m	18 km	36 km	3,000 yrs
S4	-45 m	11ky BP	11 m	9 km	27 km	1,000 yrs
S4a	-39m	10ky BP	6 m	9 km	19 km	1,000 yrs
S3	-28 m	9.5ky BP	11 m	10.5 km	9 km	500 yrs
S3a	-23 m	9 ky BP	5m	9 km	0 km	500 yrs
S2	-9 m	7.5ky BP	14 m	21 km	Isolation from mainland	1,500 yrs
S1 c	0 m	6.5ky BP		9 m	6 km	1,000 yrs
S1b	+2-3 m	6 ky BP -	-	-		500 yrs
S1 a	0 m	0 yr BP -	-	-	---	

Shorelines S1a, b and c represent the small vertical rise (+2.3m) above the present sea level at c.6,500 years BP followed by the drop to present level. These shorelines have been identified from various depositional features on the modern coastline (e.g. Hopley 1982; Chappell 1982).

from the sea, river mouths were incised into steep valleys and the coast was open to the full force of the Pacific Ocean. As rising sea levels approached the shelf edge the first noticable effects for people living in the vicinity of the 'Palm Range' would have been the inundation of flood plains and backfilling of the ancestral Herbert and Burdekin River channels as base levels were raised. Estuaries would have formed at the mouths of the Herbert and Burdekin Rivers, effectively increasing the length of the coastline, and hence the resource base. Fringing reefs probably became established along rocky cliffed shores of the shelf edge and wetlands would have filled the lower sections of the coastal plains.

Some of the modern reefs in relatively close proximity to the estuarine areas have antecedent platforms of limestone (see Fig 2.1). Others not yet investigated may also prove to have limestone underlying the modern reef veneer. These remains of earlier coral reefs would have stood as isolated hills of approximately 20 m relative relief within the gently sloping coastal plain during most of the late Pleistocene (Searle 1983). If these limestone hills possessed karstic features (Purdy 1974; Marshall and Davies 1984), including caves, they may have been desirable shelters for gatherer-hunter groups (Campbell 1979; Coventry *et al.* 1980; Campbell and Mardaga - Campbell 1990). A period of approximately 3,000 years elapsed between this shoreline and the next at -56 m.

Fig. 2.3 shows shoreline S5 at -56 m which was reached by sea-level rise at c.12,000 BP. The age of this shoreline is inferred by correlation with New Zealand evidence (Carter and Johnson

1986). Very large estuarine areas related to the ancestral river channels of the Herbert and Burdekin Rivers are the dominant features of this shoreline. The drowned coastline during this period was similar to that existing today in the ria coast of the Hawksbury River and Sydney Harbour of New South Wales. Rich estuarine resources would have provided for human exploitation in sheltered environments away from the storms and rough weather of the open ocean. Relict delta deposits have been found between Trunk and Rib Reefs at the inner extremity of the estuarine area and to the north of Keeper Reef (Johnson and Searle 1984). These deposits are probably related to this shoreline. Approximately two-thirds of the continental shelf was exposed above sea level at this time, as it was for most of the Pleistocene (i.e. the -60 m average level of Hopley 1982).

The presence of two large rivers in close proximity on the Herbert / Burdekin region of the shelf would have been a great attraction for gatherer -hunter groups, particularly if the climate was wetter than suggested for other areas of Northern Australia for much of the late Pleistocene (Kershaw 1970, 1971, 1973, 1974, 1975a, 1975b, 1976, 1978, 1983,1986, 1989; Coventry *et al.* 1980; Hopley 1973a; Hopley and Murtha 1975).

There is a suggestion that the local climate was drier from 15,000 to about 7,500 years BP (Hopley 1973a). Under these circumstances estuarine and riverine environments would have been optimal areas for settlement. Wetland and mangrove forest development would have been most likely within and adjacent to the estuaries. Higher land formed small islands in the estuaries. Fringing reefs may have remained around the continental islands and along the rocky coastline away from flood plumes from the rivers. Changes in estuary size, shelf width and river channels through time probably would have been slow enough to allow readjustments in territory, causing minimal social and ecological disruption to people living on the shelf. If people occupied caves in the limestone hills adjacent to the estuaries during periods when sea level was at this approximate position or lower, then there is a possibility of a long sequence of archaeological deposits dating back to within the Pleistocene. A time gap of approximately 1,000 years occurred between this shoreline and the next at -45 m.

Fig. 2.4 shows shoreline S4 at -45 m and is an undated bathymetric platform with associated sediment wedges. There is a possibility that this shoreline may date from before 18,000 BP, but the more recent stillstand associated with it was probably at c.11,000 BP (Carter & Johnson 1986). No barrier existed against the full force of the Pacific Ocean until the sea level rose across the continental shelf to beyond the coastal hills at this shoreline. Estuarine areas related to the ancestral river channels became reduced in size and the coastline became straighter. The coastal hills formed 10 to 25 m high islands providing protection for the mainand coast and many more suitable locations existed for the development of fringing reefs and mangrove forests. Some land which remained as islands at the earlier shoreline would have been inundated. Those islands very close to the coast may have been rapidly reconnected to the mainland by mudflats as sedimentation processes operated to prograde the coastline. Exploitation of offshore islands further removed from the coast would have depended on the presence of some type of watercraft. The climate was drier than at present with reduced stream flow.

The next shoreline which possibly formed approximately 1000 years later at -39 m is not mapped (except see Fig. 2.1), as there is strong doubt as to whether it dates from before the Holocene sea-level rise or from an earlier period, i.e. interstadial (Carter and Johnson 1986). If indeed a stillstand did occur at this time then the coastline would have been very similar to the S4 shoreline with a reduction in the size of the offshore islands to reefal shoals about 10 m high. In both cases the coastline would have been under the influence of tidal currents created by the configuration of islands, and fluvial processes from the rivers. Terrigenous material from fluvial discharge would have worked to prograde the coastline, possibly in the form of deltas. Wave action and tidal currents would have reformed sediments into bars and spits.

Fig. 2.5 shows the shoreline at -28 m at c. 9,500 BP (S3), which is radiocarbon dated by material from antecedent platforms underlying modern reefs. Sediment wedges have apices located at similar depths and the inshore feather edge of a substantial sediment body is located at -28 m (Carter and Johnson 1986). The offshore islands were now reduced to reefal shoals 5 to 8 m in height with the possibility of fringing reefs. River estuaries were smaller and exposed to higher wave energies due to the reduced protection as the islands were inundated. The coastline remained relatively straight. The climate continued to be drier than present with reduced river flow. The next possible shoreline at -23 m formed approximately 500 years later and is not mapped (except see Fig 2.1). It must be borne in mind that Carter and Johnson (1986) have reservations regarding the proposed - 23 m shoreline, as the evidence for it comes from a single geomorphic site.

Sea level would have reached almost to the eastern coast of Orpheus Island by about 9, 000 years BP at the -23 m shoreline. As can been seen on Fig. 2.1 a shoreline at the -23 m level would have dramatically altered the configuration of the mainland coast, half-enclosing the two sections of the island group as a large promontory, with the steep sided channel of the ancestral Herbert running between. Fluvial and deltaic deposits to a depth of 18 m have been identified in the Herbert palaeochannel between Fantome and Curacoa Islands (Johnson and Searle 1984). Numerous indentations in the coastline at this time probably represent minor palaeochannel outlets to the coast. Reefs established on the shoals offshore had not reached their modern height but provided protection for the mainland coast.

The next shoreline at -9 m formed approximately 1,500 years later. Fig. 2.6 shows this shoreline (S2). It is dated by inference to 7,500 BP from several studies made in the Herbert / Burdekin region (Searle *et al.* 1981; Belperio 1979; Grindrod and Rhodes 1984; Pye and Rhodes 1985; Davidson 1984; Hopley *et al.* 1983; Davies and Hopley 1983; Hopley 1983; Johnson *et al.* 1984; Johnson and Risk 1984). The depth and age correlate with New Zealand evidence

(Carter and Johnson 1986). All reefs were now submerged and modern reef growth had not reached the surface. The former coastal range was now the Palm Islands. The combined three northern islands, Pelorus, Orpheus and Fantome, were now one landmass. Curacoa, Great Palm and the minor islands similarly were combined in the south. A period of higher wave energy and increased turbidity due to the absence of protection from barrier reefs prevented the formation of fringing reefs until shortly after 7,000 BP (Hopley 1984). The climate was as wet as at present. Magnetic Island, the Brook Islands, some of the Family Group of islands, Dunk Island and Hinchinbrook Island were connected to the mainland until about 1,000 years later (i.e., c. 6,500 BP).

Various lines of evidence have emerged from the studies cited above which support the existence of a stillstand at -9 m and which allow the description of some elements of the physical environment prevailing c. 9 - 6.5 ky BP . Radiocarbon dates of 8.6 ky BP for brackish swamp facies at a depth of -11 m, from Missionary Bay, Hinchinbrook Island, (Grindrod and Rhodes 1984), and 7.7 - 8.5 ky BP for relict peat and mangrove muds at a depth of -11 m in Cleveland Bay (Belperio 1979) are apparently related to the -9 m shoreline. Barrier sands which extend to more than -30 m from the Ramsay Bay Dune sand body on Hinchinbrook Island are considered by Pye (1982) to be of Holocene age. The barrier was in existence by at least 8700 C-14 yrs BP. Sediments deposited since the attainment of modern sea level are prograding across a terrigenoclastic terrace at c. 10 m depth off the northeastern side of Magnetic Island (Davidson 1984). The reef flats on Orpheus (Hopley *et al.* 1983) and

Fantome (Johnson and Risk 1984) Islands are built on terrigenoclastic terraces at c. 10 m depths. Archaeological sites such as shell middens and rock-walled fish traps which may have existed on beaches and reefs around the islands at the -9 m level would most probably now be buried under present-day fringing reef.

2.3 Rates of sea-level advances

Figs. 2.1 and 2.7 demonstrates from the comparative distance between isobaths that advances of sea level varied considerably over relatively small distances along this section of the coast. Where two isobaths are drawn close together, the vertical difference between the two implies a steeper gradient from one to the other. Where two isobaths are at some distance from each other, the gradient is less steep over a longer distance. Therefore the horizontal distance covered by rising sea level would vary according to the gradient of the continental shelf at that particular point.

The shelf edge is steep below the -70 m isobath, except where it is indented by the former channels of the Herbert and Burdekin Rivers. Above this level a greater rate of lateral movement per vertical accretion would be expected on the gentler gradient. The shelf gradient is 0.67 m / km^{-1} between the coast near Ingham and the reef tract, 0.34 m / km^{-1} off Townsville and 0.42 m / km^{-1} off Bowen (Johnson and Searle 1984). Stillstands of unspecified lengths allowed the formation of the relict shorelines within each time zone. The modern bathymetry may in places reflect deposits

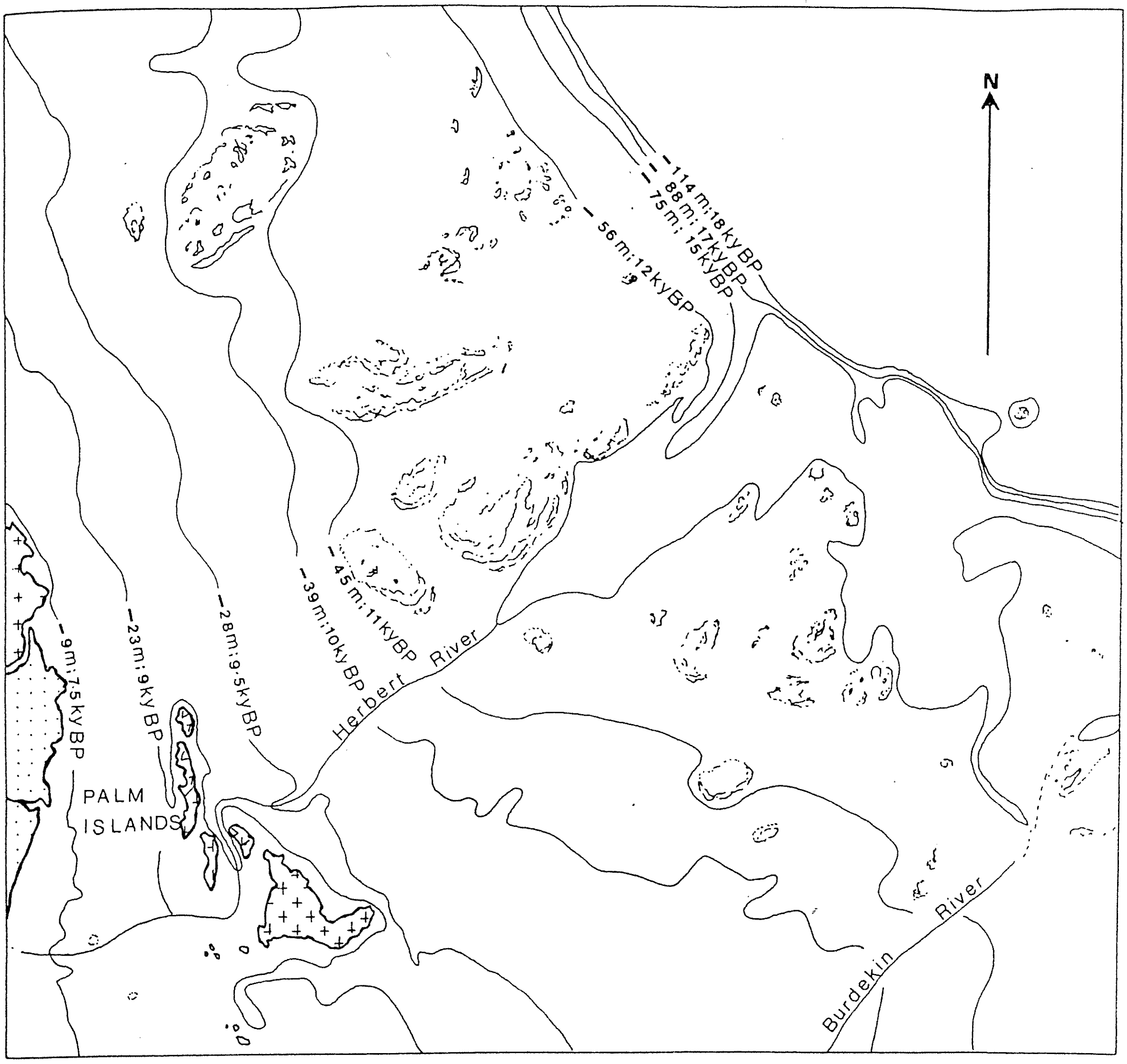


Fig. 2.7 Horizontal displacement of shorelines along the palaeochannel of the Herbert River towards Orpheus Island as estimated from present bathymetry. Dates and depths from Carter and Johnson (1986), Carter *et al.* (1986). Contours from Admiralty Cahrt (Palm Island, and Brook Islands and Palm Passage 1987), Johnson and Searle (1984).

of sediments from both late last glacial and Holocene periods, rather than the true morphology of the exposed glacial continental shelf, thus causing potential problems in palaeogeographical interpretation.

In human terms seven periods of sea-level rise over 6,500 years at the estimated rate of 12 m / ky^{-1}, perhaps higher (Carter et al.1986; Carter and Johnson 1986), could hardly be perceived as a sudden catastrophe, but rather as perfectly natural, i.e. as a statement of fact that things do change. Even at the highest rate postulated for the northern hemisphere of 35 m / ky^{-1} or 3.5 cm per year (Cronin 1983) perception of the vertical rise would probably have been minimal, considering that 1000 years would represent about 35 to 45 generations of human beings. In some areas the horizontal movement of sea level may have been very rapid, in others it may have been almost stationary for long time periods.

As there is no evidence that reef growth kept pace with sea-level rise between the -56 m and -28 m shorelines, it is inferred that the rate of rise across this zone was relatively rapid, i.e. a 28 m vertical and a 28.5 km horizontal increment over 2,500 years. Large volumes of sediment were deposited along both of these shorelines, suggesting that stillstands lasted perhaps for up to several thousand years (Carter et al.1986). If this means that the actual rise of sea level occurred over only a few hundred years, then this presents a picture closer to the often accepted view of a *visibly* rising sea level during the Holocene transgression; i.e. that of a rapid change of shorelines. A slower rate of movement between the

-39 m and the -28 m shorelines is suggested by the presence of small drowned reefs in succession between the two shorelines (Carter and Johnson 1986).

Regardless of the rate of advance, the successive shorelines since c.15,000 years BP would correspond to the contours of the shelf surface, which is largely a relict alluvial plain (Searle *et al.* 1981; Symonds *et al.* 1983; Johnson and Searle 1984) through which palaeochannels have been downcut. Stillstands of several hundred to several thousands of years would allow enough time for memories of the last transgression to have, to a great extent, faded from the minds of people, and for sedimentation to form coastal features. The combination of major environmental change and a strong tradition of oral history could lead to Aboriginal legends which were then handed down literally for thousands of years (e.g. see legend quoted in frontispiece of this thesis; see also Coventry *et al.* 1980).

The Carter and Johnson (1986) model has not been fully proven or tested, but nevertheless it provides a very useful starting point for finding underwater Aboriginal archaeological sites. Evidence for the prehistoric habitation of old shoreline areas during the Holocene transgression would in turn confirm the episodic sea-level rise theory.

CHAPTER 3

UNDERWATER PREHISTORIC ARCHAEOLOGY AND ISLAND ARCHAEOLOGY

3.1 Underwater prehistoric archaeology

The identification of shorelines associated with stillstands is the logical first step towards finding sites of human activitiy on the continental shelf (Inman 1983). Stillstands in sea level allow the formation of coastal features of wave-cut terraces, lagoons and littoral ecological zones to become established and stabilised, supplying resources for exploitation by human populations and consequently the chance for formation of cultural sites. Although all such underwater sites have been exposed at least to one episode of wave attack as sea levels rose (Inman 1983), there is strong potential for preservation of various sorts of underwater archaeological sites (Masters and Fleming 1983; Flemming 1983; Andersen 1987), even including caves with last glacial archaeological deposits as was proved virtually 20 years ago off the south coast of France (Bonifay 1970). The survival potential of stratigraphically undisturbed cultural sites on relict coastal features after inundation by rising sea level is proportional to the degree of protection provided from wind and wave action by topographical and geomorphological characteristics of the shoreline (Flemming 1983; Inman 1983). Underwater sites can be destroyed or hidden by wave erosion, current erosion and burial by coral reef development or rapid sedimentation. A combination of low fetch, low wave energy, sheltered bays and indentations, nearshore islands and submerged reefs or rock provide the highest potential for site preservation. The most favourable geomorphological conditions for preservation of sites include:

(a) ria, lagoon or estuary;

(b) sheltered alluvial coast;

(c) an exposed beach which is accumulating or in equilibrium;

(d) sea caves;

(e) karstic cave or sink-hole;

(f) lee of coastal island or within an archipelago;

(g) coral reefs.

Archaeological sites found worldwide in such situations are discussed by Flemming (1983) and Coles and Lawson (1987).

Examples of the sorts of environments which Flemming (1983) lists can be found amongst the known terrestrial and littoral archaeological sites of North Queensland. Some of these may provide clues to the sorts of settings and sites which could eventually be located underwater and which may have had a high potential for preservation. Using lagoons and estuaries as an example, one can cite the large shell middens at Weipa, Cape York Peninsula, which were found in sheltered positions behind an estuary (Bailey 1977, 1983), or the cheniers with cultural deposits which were found on the plains behind the shallow and sheltered Princess Charlotte Bay (Beaton 1985).

In the case of islands and archipelagoes, one can cite the stone walled fish traps which were built in sheltered positions within bays and channels on Hinchinbrook, Gould, Great Palm, Orpheus and other offshore islands, and in similar sheltered mainland positions, for instance behind headlands (Brayshaw 1977, 1990; Campbell 1982; Bird 1987; O'Keeffe 1988; see also Chapter 7). Shell middens are found on most beaches on the leeward side of Orpheus Island (see Chapter 5), and they are often found on the sheltered parts of Great Palm, Hinchinbrook, Gould etc. (see references just cited). Sites such as these might by analogy be found in similar locations on submerged shorelines.

Karstic caves containing stratified cultural remains are found throughout the Chillagoe / Palmer limestone system inland from the Northeastern Queensland coast with dates ranging from the recent past to more than 20,000 BP (Campbell 1982, In Press; Campbell and Mardaga-Campbell 1990; David 1990). It is therefore possible to suggest that contemporary people living further east along the lowered coastline were also inhabiting or otherwise utilising karstic caves in the old limestone hills bordering the Herbert and Burdekin estuaries of the time (i.e. 25,000 to 15,000 years BP). Within the restricted fetch inside estuaries the wave energy of trangressing seas could be expected to have been moderate to low. Caves on the lee side of hills might not have been exposed to high wave energies, experiencing only a gentle inundation from back flow as the water rose. It is possible that cultural deposits could remain stratigraphically intact within such caves (e.g. again see Bonifay 1971).

Subsequent growth of a veneer of coral reef marks the position of the former coastal hills, although the existence of definite karstic caves within those local hills has not yet been determined. However, karstic features are known in the Whitsunday underwater district (Hopley 1982; Marshall and Davies 1984). It seems possible that caves could be found in the Palm district, although their entrances might be partially or wholly blocked by modern reef debris. The most promising areas in the Herbert / Burdekin region of the Great Barrier Reef are at a depth of more than -50 m, while on a more global basis most submarine archaeological sites found to date have been at depths of -10 to -20 m and no deeper (Flemming 1983). Conditions for diving in the outer Great Barrier Reef waters depend on seasonal factors of wind and tide, though submersibles could be used to explore for sites at depths greater than -30 m. Although the use of submersibles would be very expensive, the practice is not unknown in marine archaeology.

Open alluvial coasts in North Queensland have sites which are subject in varying degrees to disturbance from cyclonic storms (Lorensz 1977; Stoddart 1971). Storm surge can cause inundation of sites, with breaching of beaches from over-topping and increased fluvial runoff. Open alluvial coasts where the fetch is greater than 30 km have the most dynamic beach processes and the lowest potential for preservation of sites. A graphic example of rapid site loss has been documented by Bird (In Preparation) at Beachmount, Upstart Bay, south of Townsville, where a beach approximately 12 km in length fronts a prograding alluvial coastline. At the beginning of the study shell middens extended the full length of the beach.

Winds in a cyclonic disturbance approaching this section of the coast from the Coral Sea in the northeast have a fetch in the order of 120 km within the Great Barrier Reef. Two cyclonic storms have influenced this coast during the course of a three-year study, totally removing a section of the beach with its associated shell middens, and damaging a considerable section of the remainder. The potential for preservation of undisturbed sites under conditions of rising sea levels in such a coastal situation is almost nil, considering the dramatic loss due to normal climatic conditions of random storm attack. However, a curvature of the coastline could cause refraction and dissipate wave energy, so that shell middens on some sections of such a beach might survive relatively undisturbed through repeated storms and even a rising sea level.

Archaeological remains imbedded in peat beds or mud and covered with 1 to 2 m of sand can withstand rising seas, even where the fetch is thousands of kilometres. An example cited by Flemming (1983) is of human and animal remains found in terrestrial peat with a sand cover off Cape Canaveral in Florida. The recognition of similar coastline configurations and geomorphology on relict shorelines now inundated might provide a starting point for site identification.

Some sites with a high potential for preservation must first be searched for on a gross scale of about 10 to 100 km to identify the most probable settings for human habitation, and then on a local scale of 1 km or less within smaller former coastal indentations or curvatures. These would probably be related to submerged stream channels. Although the geophysical work done to date has identified gross features of channel systems and estuaries, no small scale underwater mapping investigations with archaeology in mind have been undertaken. Sediment wedges related to modern coastal progradation on the inner section of the continental shelf would pose problems by obscuring former coastal features of the -9 m shoreline. Similarly, fringing reefs established at modern sea level over earlier reefs of the islands and mainland would cover former possible coastal sites. Shorelines located further from the mainland coast and to the east of the Palm Islands would offer better chances of underwater site identification in this region. If stillstands occurred at -23, -28, -39 and -45 m the coastlines at these times would have been more-or-less straight and sheltered behind islands or reefs situated on the outer shelf. It is possible that modification of sediments during stillstands might have resulted in bars and barriers forming along this coast.

Preservation of Pleistocene sites which may be related to earlier shorelines off the eastern coastline of Orpheus and other Palm Islands would depend on the amount of erosion and shoreline retreat which has occurred since modern sea level has been achieved. Less coastal erosion appears to have occurred along the Herbert palaeochannel between the east coast of Fantome Island and the west coast of Curacoa Island, suggesting a survey in this area might prove fruitful archaeologically.

It has been a long held view that rising seas rework coastal deposits during transgression. This view states that as sea level rises barriers migrate through a process of 'shoreface retreat' where the breaker zone attacks the entire area which is submerged. Rampino and Sanders (1980) present the alternative view regarding the preservation of backbarrier sediment on the inner shelf along the barrier coast of the Atlantic continental shelf of the United States. A transgressive sequence of sediments up to 8 m in thickness and dated to between 7 and 8 k yr BP was deposited across the Long Island shelf during the Holocene sea-level rise. The sequence contains brackish-water to salt-marsh peats, lagoonal silty clays, backbarrier sands and barrier-island sands, representing the movement of successive environments of deposition landward and upward with the transgression. Rampino and Sanders (1980) argue that preservation of transgressive backbarrier deposits such as these may be due to the surf zone moving landward spasmodically during periods of rapid sea-level rise (Sanders and Kumar 1975). This is known as stepwise retreat where the barrier may remain in place as the sea rises while the lagoon behind the barrier widens and deepens. Eventually the breaker zone overtops the barrier and a new barrier shoreline forms along the landward edge of the former lagoon. When the former barrier is drowned it remains essentially unaffected by wave action because it is below the surf zone. An entire transgressive sequence complete with archaeological sites might be preserved in this way. Although the studies from which these theories have been drawn refer to the open barrier coast of the Atlantic shelf of the United States, they may have some relevance for the north Queensland coast at earlier shorelines.

3.2 Island archaeology

Brayshaw (1977:312) postulated three foci of pre-European occupation (inland riverine, coastal and rainforest) in the Herbert-Burdekin region of which the Palm and other offshore islands form part. She did not distinguish the islands as environments requiring a separate adaptation. Greer (1981), on the other hand, argued for the approaches of Darlington (1957), McLean (1980), Jones (1968) and Bowdler (1974), seeing islands as specialised environments.

Continental islands such as the Palms form a special case requiring a separate category. This is not only because they are islands as such, but because they are essentially part of the Australian continent separated only recently from the mainland, in the geological sense, by the very last steps of the transgressing Holocene seas. Their prehistory involves the geomorphic history of Quaternary sea levels, both during the latter part of the Pleistocene and during most of the Holocene. It cannot be seen as separate from mainland prehistory until rising seas isolated the range as islands. Since the last interglacial high sea level at c.125,000 BP, sea levels remained below that which would isolate the old coastal range as islands. If the Palm Islands were isolated from the mainland by the transgressing sea for some time before Magnetic, Hinchinbrook, Dunk and other offshore islands, as postulated by the Carter and Johnson (1986) model of episodic sea-level rise, then their Holocene prehistory may prove to be somewhat different.

Small islands are defined by Fairbridge (1968) as those less than

10,000 sq km in area. Although extensive research has been done on the sea-level history of islands of the Great Barrier Reef, little geomorphological research has been attempted on small islands as such because of the consequences of the development of the science. Yet because they are circumscribed areas on a scale where geological and geomorphological characteristics are relatively simplified, they present unique opportunities for such research. Landform and processes are much more complex then formerly thought to be and the opportunity presented by a simplified situation allows a greater potential for interpretation. Similarly, smallness of scale can help to simplify the interpretation of archaeological deposits. Interrelationships between climate, geomorphic processes and human manipulation of environment can be more readily discerned and more easily interpreted where a geographical boundary such as the sea allows a relatively closed system.

Climate at a macro scale on small islands, even close inshore islands, is usually dominated by oceanic influences which ameliorate seasonality. Where rainfall and temperature vary only slightly a more uniform process operation could be expected. Adverse effects of climate are often of greater consequence on small islands, because the entire land surface can be affected and the resource base for human inhabitants destroyed. Natural disasters from tropical cyclones, for example, also can be more readily assessed on small islands. Soil and vegetation again reflect climatic influences, and the smaller scale and circumscribed area allow the impact of human populations on these features to be more readily assessed.

Arguably all islands are subject to some form of earth movement. Continental islands and coral atolls situated on continental shelves are subject not only to tectonic movements associated with the continental landmass, but to hydro-isostatic downwarping due to loading of water across the shelf due to rising sea levels, passive subsidence of shelf edges due to sedimentary loading or as a result of sea-floor spreading. The geomorphological and archaeological history of small islands is closely allied to the history of sea-level fluctuations. Geomorphic disequilibrium following the Holocene rise in sea level is reflected in the development of coastal features and interpretation of these features is crucial to the understanding of the archaeological deposits within them. Balance between possible decreasing terrestrial resources over time is often maintained by deposition around an island which creates a greater land surface either as tidal flats, reef flats or beach ridge sequences as sites for new resources.

Islands as circumscribed areas vary in the degree to which they are able to support a resident population. This ability, or 'carrying capacity', depends on size, climate and resource availability. The Palm Islands are continental islands on the edge of the humid tropics, richly endowed with marine resources from well developed fringing reefs, and each of the larger islands was probably capable of supporting a permanent population, though Aboriginal people may well not have opted to stay permanently on all of the larger islands. Brayshaw (1977:312) apparently included islands of the Herbert /

Burdekin region in the coastal category, but it must be argued that all three broad environmental zones (i.e. inland, coastal and rainforest) exist on a microscale on the larger of the islands, particularly Hinchinbrook, Magnetic and Great Palm. Orpheus Island as the second largest in the Palm Group possesses all three zones on an even smaller scale. The spatial patterning of archaeological sites found during fieldwork on Orpheus Island reveals that all three environments were exploited by Aboriginal people.

After the islands were isolated there may have been a period of harder times for any people remaining, as wave energy would have been unimpeded by barrier reefs and turbidity would have been higher (Hopley 1984). Although fringing reefs probably established themselves soon after 7,000 years BP around the rocky headlands (Hopley *et al.*1983), it was not until the cessation of turbidity due to the reworking of sediments by rising seas that fringing reefs of sufficient size to support a more marine-oriented resource became available for exploitation. The earliest date determined by Hopley *et al.* (1983) for the reef flat surface at Pioneer Bay South is c. 5,000 years BP. Under these circumstances the economy would have had an initially heavy dependence on a diminished area of land for terrestrial food resources, supplemented with some shellfish, fish, dugong and turtle, etc.

3.3 Approaches to the Holocene archaeology

Without firm evidence to the contrary it could be assumed that similar types of archaeological sites exist along coastlines today as those which might be found on submerged shorelines. For example, shell species found in middens today may not be the same as those found from earlier periods when environmental factors may have been different, but it could nevertheless be expected that shell middens as such were formed during previous time periods, indeed especially during sea-level stillstands. The spatial patterning of the Holocene middens will by analogy provide clues to underwater sites.

The three northern islands of the Palms must be regarded as one entity as present bathymetry shows that even with modern sea level the depth between Orpheus and Fantome Islands is only around -5 m in a narrow 0.5 km passage and between Pelorus and Orpheus approximately -14 m in a 1 km wide passage (see Fig. 1.1). Scouring by modern currents related to the present land / sea configuration has probably deepened these channels (Johnson and Searle 1984). Spring tidal streams exceed 3 knots (5.55 km per hour) in the narrower parts of the channels between the Palm Isles (Admiralty Chart, Palm Isles to Brook Islands and Palm Passage, 1:150 000, 1987), and scouring has probably removed some infilling sediments from the Herbert palaeochannel between Fantome and Curacoa Islands.

Changes in land / sea relationships can be reflected in changes in subsistence resources, which in turn may require adaptation in the form of new or modified gathering and hunting techniques. It might be assumed again that people moved to higher ground to escape the rising Holocene waters as they approached the eastern coast, and that a population remained on the Palm Isles. Each time a stillstand occurred the memory of earlier transgressions would have faded somewhat to the status of a myth (again such as that presented in the frontispiece) only to be reinforced as the sea once more began to rise. As the eventual isolation of the highland areas with the sea-level rise to the -9 m level at 7,500 years BP became apparent, any people remaining in the area around the former ranges would have had to make a decision based on their oral history and the evidence of their own eyes as to whether they should stay or leave for the mainland.

An examination of the geography and archaeology of Orpheus Island as a case study in the following chapters forms an attempt to answer partly whether a human population remained on the islands and if any marked cultural divergence from lifeways of the mainland people occurred from this time.

CHAPTER 4

THE PRESENT PHYSICAL SETTING

4.1 The Palm Islands

What remained after the final isolation of the 'Palm Range' as the Palm Islands was a number of rocky highlands surrounded by sea and devoid of fringing reefs until turbidity ceased after the sea-level rise to -9 m at 7.5 ky BP. With the attainment of approximately modern sea level at 6,5000 BP the islands took on their present configuration without the additions of fringing reefs and recurving spits. Although the rise of sea from the -9 m level reduced the land area of the islands, sedimentation with a relatively stable sea level since 6,000 BP has infilled some flats between ridges on all of the islands to differing degrees (see Fig. 4.1, fold-out inside back cover).

Vegetation on the islands ranges from rainforest over much of the mountainous area of Great Palm Island, through *Eucalyptus* woodland to open grasslands. The northern islands are in the influence of the rainshadow of Great Palm and are consequently drier with rainforest only in drainage lines and on the moister slopes (see Fig. 4.2, fold-out inside back cover).

Backbeach lagoons existed during the formation of beach sequences on the islands, filling and emptying with tidal flow and overtopping during storms. Today many old lagoons are isolated from the sea as depressions behind the beaches. They abut the small coastal plains, but there is little or no retention of fresh water within them except during the wet season, although some seepage occurs through the sediments to the beach. Most old backbeach lagoons are now vegetated with *Melaleuca* spp. or with vine forest species and lack the water plants which provided the tubers, rhizomes and corms which formed staples in much of northern Australia. That changes in the vegetation patterns on Orpheus Island have occurred since European contact is demonstrated by the growth of vine forest over the shell middens on the beach ridge systems on at least two separate beaches and a new area of *Eucalyptus tessalaris* encroaching on the grassland. What changes have occurred throughout the other islands has not been assessed, but it would appear that similar patterns are present. It is known that one midden on Great Palm Island at least is vegetated (Eric Bunn Pers. Comm.) At what point in time the fruit / use plants found around headlands and the beach foreshores became established is not able to be determined, but this probably occurred soon after the stabilisation of present sea level. Although at present there are few tubers, corms or rhizomes available for use as a staple, there is fruit available most seasons of the year.

4.2 Geomorphic equilibrium

Humanly induced changes to the environment must have had some effect on the landforms (Davies 1965, 1967; Goede 1973; Hughes and Sullivan 1981), although much of the evidence for geomorphic disequilibrium on the island may reflect a period of readjustment following the last sea level fluctuations. One natural result of rising sea levels would be a disruption of geomorphic equilibrium as base levels were raised, with an undetermined time-lag between the event and restoration of dynamic equilibrium. Geomorphic disequilibrium could alter landforms, and this in turn would affect habitat distribution and niche availability and therefore species diversity and number.

The dynamic equilibrium theory of island biogeography was developed as a model to explain biogeographical distributions on isolated oceanic islands (MacArthur and Wilson 1967), and it is not necessarily applicable to continental islands located close to the mainland. The basic tenet of this theory is that species numbers will increase with island size and habitat diversity, but will decrease with island isolation as defined by distance from the nearest major island or the mainland. Buckley (1981) argues from studies of vegetated small reef islands off the northern coast of Cape York Peninsula that this theory does not hold. He emphasises three points:

(1) That dymanic equilibrium is dependent on the scale of the spatial and temporal elements involved;

(2) That the heterogeneous nature of the islands studied suggested that discrete elements would be better examined separately rather than as part of a complex whole;

(3) That environmental change must not be discounted.

Although much controversy has arisen since the formulation of the theory of island equilibrium (Diamond 1975, 1977; Simberloff and Abele 1976; Connor and Simberloff 1978; Gilbert 1980; Williamson 1981), some aspects of this theory may apply to vegetational and faunal elements of an islands's biota. When manipulative human beings are involved, however, the picture becomes very complicated (Fosberg 1963; Vayda and Rappaport 1963; Rappaport 1963).

Rowland (1980) points out that small islands are useful for modelling human adaptation, although the term is better restriced to biological theories of population dynamics. In order to provide the basic necessities of survival in a sometimes hostile environment, prehistoric human beings manipulated their environment in such ways as the building or finding of shelter, the management of plant resources to provide basic food, the digging of wells to obtain water, and the construction of fish and eel traps. As manipultors of their environment they can't be seen as passive units of an ecological system, but as dymanic interactors with their environment. Islands do however, as Rowland (1980) emphasises, present the opportunity to study the degree of externally versus internally directed change, group selection in a small population and other more environmentally determined cultural and resources strategies.

4.3 Orpheus Island

Orpheus Island is the second largest in the Palm Group with an area of 1,300 hectares, but not including the extensive reef flats in a number of indented bays on the western coast (see Fig. 4.3, fold-out inside back cover). It is situated approximately 60 km north-west of Townsville and 15 km from the mainland near Ingham. It is 11 km long and 2 km wide at its widest point, but less than 1 km at the two narrowest points. The highest elevations are 177 m in the north and 161 m in the south. The northern section is composed of mid- to late Carboniferous porphyritic rhyolite with numerous dolerite dykes. The southern section is mostly Permo - Carboniferous granitoids (de Keyser *et al.* 1965).

Cliffs, boulder beaches and narrow discontinuous fringing reefs characterise the eastern side of the island, while fringing reefs, small depositional plains, beaches and mangrove forests fill the lee or western embayments. Areas of flat to flattish land occur only where small plains have formed from alluvium and colluvium around the lower reaches of creeks. They also occur as small tablelands along ridge tops. Much of the plain behind a poorly sorted boulder beach (Hopley 1982) at the northern end of South Beach is a lagoon, approximately 50 by 100 m in area, during the wet season and after heavy rains. Water flows through the boulder wall and across the beach when the lagoon is full. There has been water in this lagoon several times during this study. Photographs show the lagoon during heavy rains in March 1989 and at a dry period (see Plates 4.1 to 4. 3).

What the landscape looked like at the time of European contact is unknown, but probably it was somewhat different from the present day. Destruction caused by overgrazing of grassland by goats since the last century (K. Bryson pers. comm.), sheep for the latter part of

Plate 4.1 Lagoon at South Beach at the shallowest end during the dry season

Plate 4.2 Lagoon at South Beach showing the main ponding area during the dry season

Plate 4.3 Lagoon at South Beach at shallowest end during the wet season

the last century (Beddoe 1910) and cattle in this century (G. Morris pers. comm.), and soil compaction by hooves of these animals, has not been evaluated, but probably it is quite considerable. Rabbits introduced to the island several years ago by persons unknown, began to cause damage in a number of areas but are now controlled.

Under the open forest canopy the downslope movement of weathered material is less obvious because of the presence of litter, but on slopes where vegetation is sparse slides of blocky debris occur. Small debris slides and incipient slides and slumps are apparent in many areas of the open grasslands, particularly where marine undercutting on the cliffed eastern coast is causing slope instability. Absence of soil-binding vegetation with protective canopies, roots and litter layers aggravates this erosion. In combination a number of factors such as these can cause changes to the plant resource base by creating a simplified secondary vegetation, which Butzer (1982) calls a 'cultural steppe'.

In many parts of mainland and island Australia, 'fire-stick farming' practices of the Aborigines involved a deliberate and careful use of this principle to clear the ground and create areas of grassland to attract and support wallabies so that they were easily accessible as a food resource (Jones 1969; Hughes and Sullivan 1981; Beaton 1982; Horton 1982; Hughes and Lampert 1982). The open grasslands on Orpheus Island may have been maintained by this method. Brennan (1986), however, concluded that similar grasslands on continental islands in the southern section of the Great Barrier Reef are not the result of humanly induced modification but are natural features. Evidence for regular burning comes from Thomson (1939) on Cape York Peninsula, and Herbert (1929,1930, 1932) who noted that the *Eucalyptus* forest on Great Palm Island was fired regularly with the result that modification occurred, and light-loving grasses replaced herbs and small shrubs. Modern-day children on Great Palm Island are known to light uncontrolled fires around the town (Eric Bunn pers. comm.) and extensive fires have been noted on Curacoa and Fantome Islands.

No land clearing was carried out by the Morris family during their ownership of Orpheus from 1928 to1950 (G. Morris pers.comm.), and it is not known if clearing was done by the earlier shepherds. Yards existed adjacent to the shepherd's hut in Pioneer Bay North (see Plate 4.4), and the surrounding vegetation, consisting in the main of *Acacia* and *Melaleuca* species, is atypical and simplified compared to other forested areas of the island. This area possibly represents a regrowth of colonising species.

Native fauna noted on Orpheus Island by the Queensland National Parks and Wildlife Service includes bandicoots, echidnas, snakes, lizards and birds including *Megapodius freycinet* (jungle-fowl). No macropods are presently found on Orpheus Island, although wallabies are found today on Magnetic, Great Palm and Hinchinbrook Islands. Banfield (1908) documented the last wallaby drive on Timana Island near Dunk Island. Assuming a population of macropods remained on Orpheus Island following the last transgression of sea level, along with a human population, a number of alternatives can be suggested. A viable population of macropods

Plate 4.4 Ruins of the shepherd's hut on the ridge above Pioneer Bay North beach

may have been rapidly hunted out during the period between sea rise and the development of fringing reefs, when greater dependence was presumably placed on terrestrial food resources. On the other hand, a viable population of macropods may have remained on Orpheus Island well into the Holocene, only gradually being hunted out. A third alternative is that an original wallaby population may not have been viable and not augmented by immigration of new members or by restocking by the Aborigines, so eventually it would have become extinct. Competition from goats and sheep also might have led to the disappearance of the macropods. Orpheus Island archaeology and palaeontology may eventually show that they also existed on that island.

Vegetation varies with aspect, exposure to prevailing winds and rock type and is generally thicker everywhere along stream lines. Vine forest often occurs in gullies, where the basically skeletal soils are somewhat deeper and moister (see Fig. 4.4, fold-out inside back cover). In the northern section the most exposed high areas on the eastern side of the island are covered by grasses, sedges and occasional shrubs grading into low *Melaleuca / Acacia* regrowth on the western downslope areas and into sclerophyll forest on the ridges further west (Plates 4.5 and 4.6). Vine forest is found on the more protected western slopes and coastal strips, on the northernmost tip of the island and as gallery forests along streams. The vegetation on the southern section of the island is typically sparser due to the granitic nature of the rock. It consists of open grassland and tropical woodland dominated by *Eucalyptus* species with vine forest along watercourses. The vine forest merges into

Plate 4.5 East coast looking towards Palm Island to the south in foul weather, December 1989. Note the regrowth or new growth of *Eucalyptus tessalaris* in mid picture

Plate 4.6 Pioneer Bay North looking across the grassland to the regrowth area and the mangrove-filled embayment. This plate joins Plate 4.6. A heavy swell is evident in the passage beyond the bay

littoral species along the headlands. Many littoral species are known use plants of the Aborigines.

A fuller description of the vegetation is given in Appendix 1 along with a plant list, which is by no means fully representative of the flora of the island. This partial list gives some of the plants which may have formed part of the economy of the Aborigines.

An association of Burdekin Plum (*Pleiogynium timorense*) with shell middens and other archaeological sites has been noted and might suggest the possibility of domiculture, as postulated for Cape York Peninsula by Hynes and Chase (1982). At or adjacent to all sites found during the survey are single trees or groups of trees and other plants known to have been used by Aborigines. From the location of most of these plants it would certainly seem possible that they are the result of semi-domesticating processes, where serendipituous germination of discarded seeds from favoured food plants on midden verges was subsequently afforded protection from damage (Hynes and Chase 1982). This practice would not only increase the number of trees and plants around naturally occurring fruit groves, but also new trees or groves would eventuate from the discarded seeds of fruits transported some distance away. Probably the best fruits would be chosen for eating, thereby insuring that the bearing quality of the plants would also improve.

Hynes and Chase (1982) also describe the practice of using some plant species as markers or boundaries between named site areas, and between neighbouring estates. *Ficus* spp., for example, are said to have been planted as 'shade trees'. The remains of two dead fig trees, each adjacent to shell middens in Pioneer Bay South (sites PBS 3 and PBS 5), suggest that these two may have been such 'shade trees' before the present vine forest species became established over the beach ridge sequence.

Other known food plants such as *Ficus* spp., *Terminalia* spp., and *Cycas media* are found in association with the Burdekin Plums in some instances on Orpheus. Further research could determine if these plants can be regarded as artefacts of the former Aboriginal inhabitants.

The island is rugged throughout and difficult to traverse on foot, except along ridge tops where downslope movement of rocky debris has cleared the surface of most loose rock. On the northern section of the island the direction of movement is dictated to a large degree by steep and rocky streamlines and steeply sloping, debris-strewn north-west to south-east trending ridges. The southern granitic section of the island is less difficult for walking, but slopes remain steep and the terrain rugged. Movement on foot is much easier along the beaches, around the headlands and across reef flats at low tide, but by far the simplest and easiest means of access to different areas of the island is by boat around the coast. Even when heavy weather, which is typical of the dominant south-east to southerly winds, prevents small craft movement in open waters, it is possible to go by boat from bay to bay on the western side of the island. The leeward side of the island group as a whole provides excellent shelter from the dominant south-east

Table 4.1 Rainfall records for Lucinda, Pioneer Bay, Townsville and Cardwell.

	Lucinda		Pioneer Bay			
	Average rainfall (mm)		1982	1983	1984	1985
January	**369**	**158.5**	205.0	83.5	272.5	73.0
February	**484**	**319.75**	324.5	36.0	571.5	347.0
March	**417**	**388.6**	254.5	510.5	123.5	666.0
April	**195**	**200.9**	437.0	136.5	24.0	206.0
May	**112**	**105.5**	48.5	174.5	4.0	195.0
June	**73**	**43.4**	36.5	80.5	38.5	18.0
July	**51**	**15.0**	9.0	7.5	28.5	NR
August	**47**	**3.0**	1.5	7.5	-	NR
September	**33**	**23.6**	43.5	16.0	11.5	NR
October	**37**	**13.0**	0.5	19.5	19.2	NR
November	**90**	**50.5**	14.5	129.5	37.5	NR
December	**166**	**29.1**	28.5	33.0	16.0	NR
Annual	**2074**	**1351.6**	1406.5	1234.0	1446.6	

(NR = No record)

Townsville mean precipitation (mm):	Annual Average	**1098**
	January	305
	July	15
Cardwell mean precipitation (mm):	Annual Average	**2129**
	January	451
	July	32

(Data from Bureau of Meteorology 1988)

winds, and on the leeside of Orpheus Island, Pioneer Bay South in particular is well protected.

The climate is similar to that of Townsville, but the Palms are on the edge of the humid tropical region extending from Ingham to Cooktown where rainfall is less seasonal and intensities are very high. Mt. Bowen (547 m) on Great Great Palm Island and the higher peaks on Curacoa (298 m), Fantome (218 m) and Pelorus (271 m) have sufficient height to induce some orographic rainfall. Orpheus Island with 177 m as its highest point may possibly experience lower rainfalls than these higher islands, but this would need to be tested. Table 4.1 compares the rainfall records from Lucinda, Cardwell and Townsville with records kept throughout a three and a half year study period by Parnell (1987) for Pioneer Bay South.

Along the North Queensland coast winds are dominantly south-east with occasional north or north-east winds during the summer (see Plates 4.7 and 4.8). For approximately 6% of the time winds have a western component (Oliver 1978). Pioneer Bay on the western side of the island is very sheltered from all but westerly winds. A former lease holder in Pioneer Bay has known cyclonic force winds approaching from a westerly direction to blow for four to five days (K. Bryson pers. comm.). G. Morris (pers. comm.), son of a former owner of Orpheus Island, witnessed a back surge of turbid water into Hazard Bay from a cyclone located outside the islands. Evidence for storm surges in the past can seen in the coral shingle ramparts and boulder beach along the southern headland of Pioneer Bay South (Hopley 1982; see also Plates 4.9 and 4.10). Twenty-two

Plate 4.7 Pioneer Bay South, calm during foul weather December 1989, looking towards Hinchinbrook Island.

Plate 4.8 The east coast of Orpheus Island looking north to Pelorus island on the same day as Plate 4.8. Note the contrast between east and west coasts during heavy weather

Plate 4.9 Terracing of coral shingle beach deposits by Cyclone Aivu, March 1989. Photograph taken December 1989 on the northern lee-side of Orpheus Island

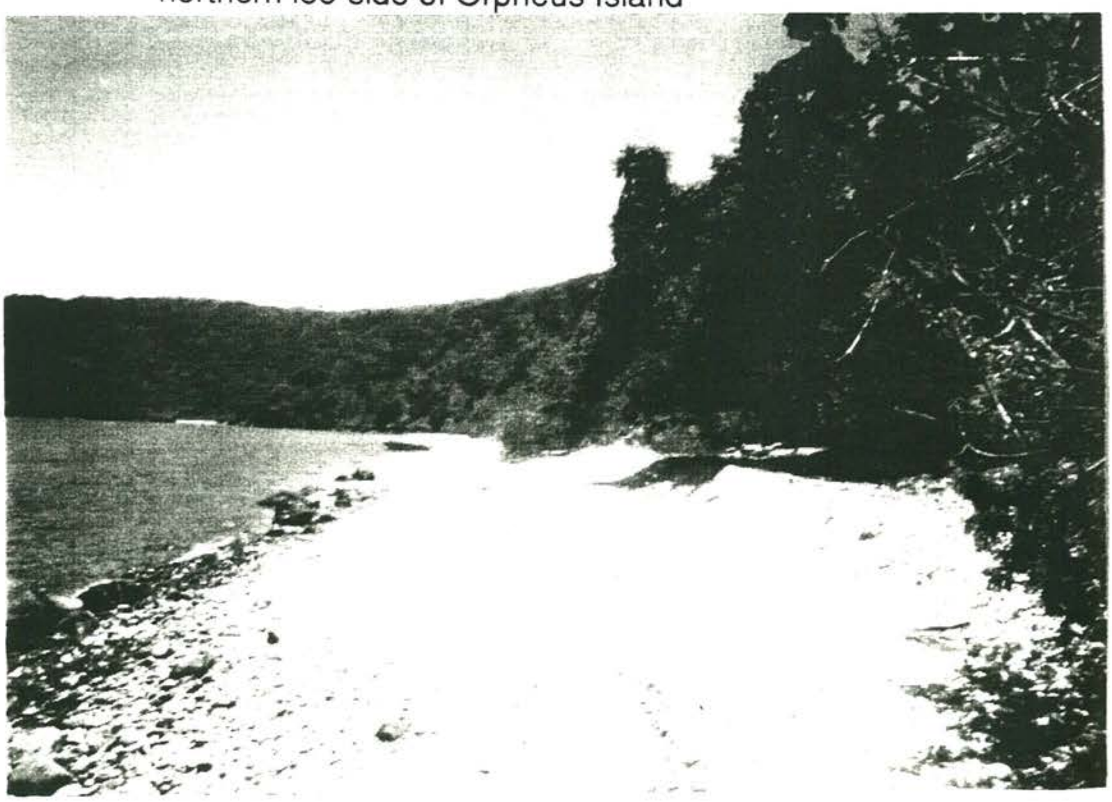


Plate 4.10 Oblique view of terraced beach deposits onthe northern leeside of Orpheus Island. Cobble to sand sized deposits from mixed calcareous and terrigenous sources

cyclones passed within 167 km of Townsville within a thirty year period from 1940-69 (Oliver 1978). In coastal areas catastrophic events such as cyclones can totally remove the dunes containing shell middens, so that the opportunity to record them can be lost, unless it has been done beforehand (see Bird In Prep.; this is also discussed in Chapter 3, q.v.).

Most watercourses are steep and rocky with ephemeral streamflow and as most are dry or have only small isolated pools in rocky holes at the height of the wet season, it is considered that running water is only present actually during and immediately after heavy rainfall. This was evident in the catchment of Pioneer Bay South during the period 1982-1985 (Parnell 1987). It would seem that although a channel system is well developed on Orpheus Island, in general the streams have little or no baseflow at the present time, except occasionally during very heavy wet seasons.

The only permanent or semi-permanent water on the island is a soakage behind Hazard Bay and a creek rising in a spring in a higher granite area and running to the east coast through the open grassland of the mid section of the island (see Plate 4.11). Several bores are situated around the boundary of the tourist lease in Hazard Bay, and a dam has been built there in recent years. European settlement on the island depends on rainwater and bores for present freshwater supplies. Two circular depressions have been noted, one on the slopes of the northern section of the island, and one in the floor of the lagoon at South Beach. Whether these depressions are the remains of wells and whether they are of

Plate 4.11 Headwaters of the permanent stream on the east coast of Orpheus Island lookng north to Pelorus Island. *Pandanus* sp. line the creek and groves of *Ficus microcarpa* can be seen in the left mid picture

Aboriginal or European origin is unknown.

Soil compaction and erosion are particularly evident on the open grassland along northeastern side of the island where the soil is laid bare along numerous goat tracks. Soil compaction may have reduced the ability of the soil to absorb water, causing accelerated water runoff and leading to a reduction in the percolation of rainwater down to the groundwater. Groundwater supply to stream baseflow may have been reduced over time by this means.

Permanent water sources on Orpheus Island may have been more numerous in the period before European contact. They were probably sufficient not only to support a small resident human population throughout the Holocene but also the food chain on which they were dependent (Watts 1971). Some sites may have been occupied only during the wetter summer months from December to March, with a shift closer to permanent water sources during the drier months. Heavy rainfalls can eventuate in any month of the year.

Hinchinbrook Island was large enough to support in the main the entire *Banjin* or *Biyaygiri* tribe (Campbell 1979, 1982; Campbell and Mardaga- Campbell 1990). The Palm Group as a whole is smaller than Hinchinbrook, but when the combined length of coastline and extent of marine resource areas are compared, the difference is greatly lessened. During the late Holocene each of the eleven Palm Islands may have separately supported part of the *Manbarra* people (Brayshaw 1977). As discussed earlier the human population on Orpheus Island during the period before European contact may have only been resident on a part-time basis and not overly dependent on the plant resources of the island. The paucity of terrestrial animal and plant staples before European contact would have thrown the emphasis on to marine resources, in the first instance on fishing and shellfish gathering from the rocky coastline, and extending gradually outwards with the growth of reef flats.

Since the stabilisation of sea level c. 6,000 years BP sedimentation has become the dominant geomorphic process operating along the eastern Australian coast (Chappell 1982), providing many areas of rich littoral resources for exploitation. The reef flat of Pioneer Bay South provides an example of a changing marine environment during this period, from the development of a fringing reef across the bay mouth to the present-day infilled reef flat, although such changes are not yet evident in the archaeological record.

Beach ridge sequences have developed in some embayments. Shell middens (PBS 3 and PBS 5) within the beach deposits in Pioneer Bay South have been dated but the results are ambiguous (see Chapter 6). The 34 cm depth dated on PBS 5 is not the bottom of the archaeological deposit at this site and the shell material dated was obtained by the unreliable method of augering. More controlled excavation would have to be done and more dates obtained before any opinion could be formed regarding the age of the midden and hence the beach ridge. It would appear that an age younger than 1,000 years is most likely for all of the midden deposits, and that beach ridge formation is slow. Without a detailed study of sedimentary deposits in which archaeological deposts are incorporated, the environmental history of an area is incomplete. Such detailed research is unfortunately beyond the scope of the present study.

Beaches around Orpheus Island show effects of erosion as do a number of shell middens close to the high water mark. It has not been empirically determined how much sediment is totally lost to the system over the reef rim or how sediments are deposited and redistributed. The majority of high islands between Bowen and Cairns have spits on their northern or western sides (Steers 1929,1937; Hopley 1968,1971). These are complex structures composed variously of boulders, coral shingle, beach rock, sand, raised beach rock and raised reef depending on geology and climate throughout the zone (Hopley 1971). Some sand-sized sediments are moved north alongshore to these spits and presumably some is lost from the system in the deep waters offshore.

In Hazard Bay a channel has been cut through the reef flat and some of the sand which formerly might have been shifted backwards onto the reef flat and alongshore again further north onto the beach appears to be moving into the channel and then to the base of the reef front. As a consequence this sand is lost to the island's sediment budget. What affect this removal of sediment has on the beaches alongshore on the western side of the island is not known. The observed loss of sand from the beaches in Pioneer Bay and further north may in fact be due to lack of replenishment from areas further south due in part to the loss of sediments into the boat channel in Hazard Bay.

The evidence from Orpheus Island suggests from the extent of the shell middens and the presence of stone-walled fish traps, that the human population at the time of European contact was probably quite dependent on marine resources, supplemented by terrestrial resources. Shell middens are plentiful and obvious features of the coastline and inland areas of the island (see Fig. 5.1). Brayshaw (1977, 1990) concluded from her surveys of the Herbert / Burdekin region that shell middens were rarely present and were normally small, recent and superficial. She saw these as transient sites rather than base camps and the role of shellfish in the diet as comparatively small. However, the greater importance of shellfish along at least some parts of the Herbert / Burdekin coastline is highlighted by the extent of the middens which were found for 12 km along the dunes at Beachmount, Upstart Bay, near the mouth of the Burdekin River to the south of Townsville (Campbell 1983; Bird 1987, In Prep.).

Some have argued for a late Holocene intensification of coastal adaptations which may have been due to a number of causes: telescoping territorial boundaries, a real increase in population numbers, social factors, an increase in number, diversity and availability of marine resources, or a combination of any or all of these factors (cf. Bowdler 1977; Beaton 1985; Lourandos 1984,1985; Cribb 1986). In terms of demographic density it might be argued that modern urban patterns in Australia are little different from the distribution map of tribal territories (cf. Tindale

1974), roughly paralleling the availability of adequate water resources and maximum ecological diversity. The recent and obvious shell middens on Orpheus Island may not indicate an overall increase in human population numbers. They may only reflect the relative abundance of marine resources compared to possibly depleted terrestrial resources in the latter part of the Holocene. As most are found on beach and near-beach sites, they only represent shellfish collected sometime since the formation of the beaches themseves, i.e. since sea level attained its modern height and sedimentation processes produced enough terrigenous and biogenic sands to form beaches.

People are geological agents (Jennings 1965) and the archaeological remains of their activities, such as the open shell middens found on Orpheus Island and other coastal and island areas throughout the world, are incorporated in natural sedimentary deposits. They might remain relatively undisturbed for many years, their stratigraphy providing valuable temporal and spatial clues for determining both their geomorphological and cultural history. Conversely, natural and humanly induced processes might rework and redeposit, or totally destroy them. Archaeological remains on coastal dunes are particularly prone to destruction by natural forces of wind and water. It is reasonable, therefore, to expect that any long extant archaeological deposits in such situations, will be due to fortuitous survival.

CHAPTER 5

ARCHAEOLOGY OF ORPHEUS ISLAND OTHER THAN PIONEER BAY SOUTH

5.1 Archaeology of Orpheus Island

Earlier archaeological work on Orpheus Island (O'Keeffe 1988) addressed the following questions:

1. where are archaeological sites known to exist on Orpheus Island, and what type of sites are they?

2. what types of sites might be expected in the physical landscape as suggested from analogies with similar areas?

3. when were these sites formed and what processes have operated on them since their formation?

4. what do the archaeological remains tell us?

5. and how are the various site types, if present, inter-related physically and culturally?

From the literature a number of different site types can be expected on continental islands off the eastern coast of Australia (e.g. Banfield 1908; Bowdler 1974, 1981; Palm Island 1975; Brayshaw 1977, 1990; Jones and Lampert 1978; Campbell 1979, 1982; Greer 1981; Rowland 1980, 1981, 1982a, 1982b,1984, 1986; Morwood

1982; Sullivan 1982; Hall 1982, 1984; Robins 1984a, 1984b; Gorecki and Greer 1988; Mardaga-Campbell *et al.* 1989; Campbell and Mardaga-Campbell 1990). The site types include shell middens, fish-traps, stone artefact scatters, quarries, shelter deposits, burials and rock art. It would probably be reasonable to expect that most sites will be related to coastal exploitation strategies of gatherer-hunter societies and of no great time depth (i.e the latter part of the post glacial period). This follows from the development of existing coastal features only since sea level reached its present position at c. 6,000 years BP. Consequently, the value of coastal archaeological sites as sources of information for changes through time is limited to this geologically short time-span. Nevertheless, it is still of definite value for testing for either contrasts or similarities with contemporaneous adjacent site areas.

At the beginning of this study it was known to Brayshaw (1977), the Queensland National Parks and Wildlife Service (QNPWS) and to the staff of the Sir George Fisher Centre for Tropical Marine Studies, James Cook University of North Queensland, that on Orpheus Island there were two rock-walled fish-traps, one in Pioneer Bay South and one in Pioneer Bay North, and one open shell midden on the northern end of the coastal dunes just outside the University's Research Station lease in Pioneer Bay South.

When possible during the study periods, opportunistic reconnaissances were undertaken across the island using what appeared to be the most logical routes along ridges and creeks. These brief surveys located a number of interesting sites for further investigation, and these are shown in Fig. 5.1 and listed in Appendix 2.

Geology, climate and time influence the development of landforms, and constraints of the physical landscape dictate largely the presence, absence or visibility of particular site types. In the northern volcanic section of Orpheus Island weathering processes have produced a fractured and blocky regolith covering steep slopes where there is little likelihood of any caverns forming, while in the southern granitic section large boulder residuals have tumbled in many places forming small potential shelters. Coastal plains, mangrove swamps, reef flats, small streams and lagoons all provide potential food sources, and it is to be expected that archaeological remains would be found adjacent to these resources.

Coastal shell middens are not difficult to find particularly in areas where the visibly dominant shell species exploited are the relatively large burrowing clams (*Tridacna crocea.*), as on Orpheus Island, and particularly where such middens are obviously on deposits related to modern sea levels (Hopley 1982). Problems arise in the identification of major midden concentrations where vegetation is dense or where fauna and European settlement have disturbed the ground surface. The inland middens, possibly of the same age as the coastal middens, are not so easy to find as they have become covered in many cases by *Lantana camara* and other colonising plant species. However, on coloured aerial photographs patches of lantana do tend to show up as a lighter green than the surrounding vegetation. Ground-truthing is necessary to confirm

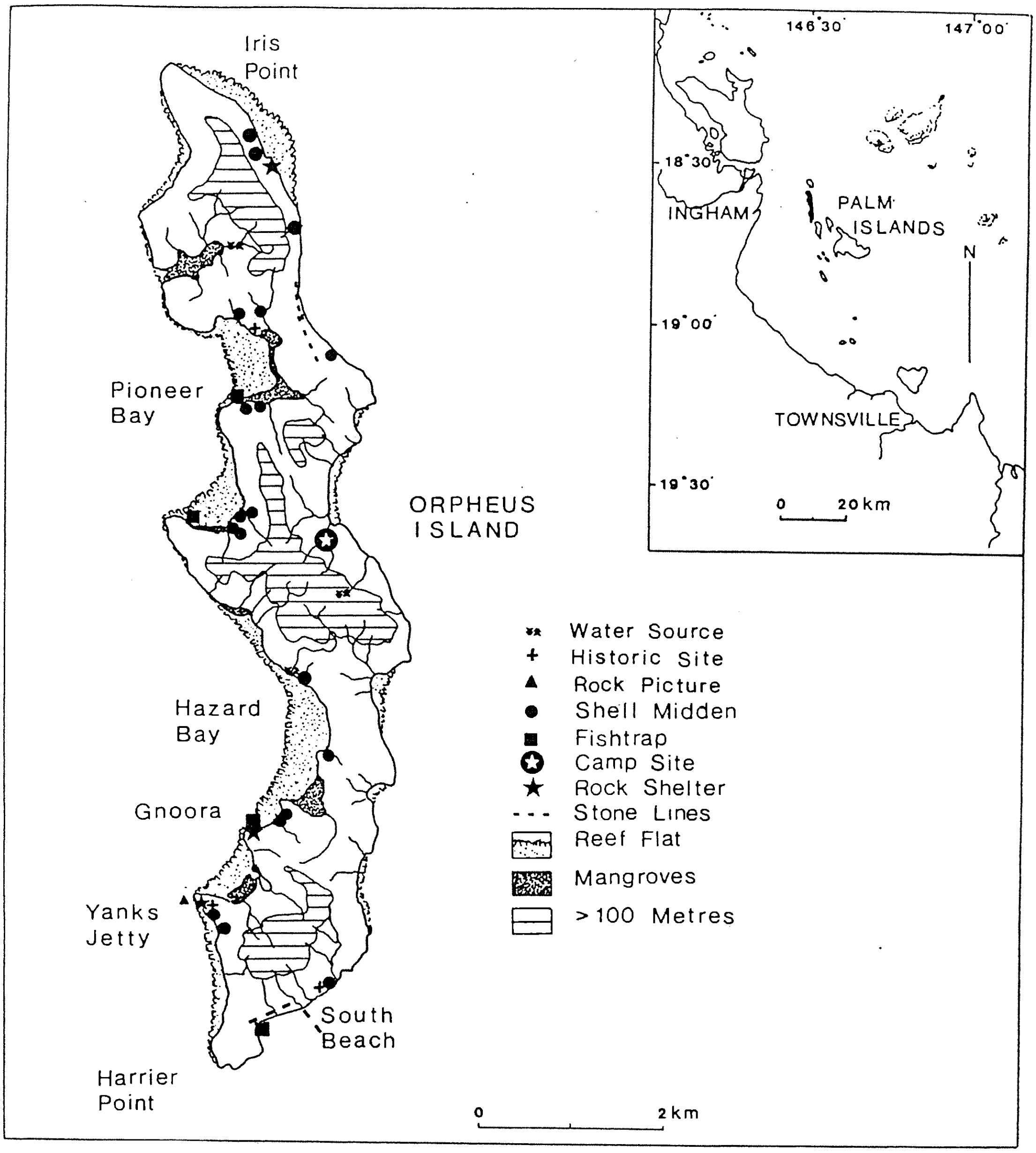


Fig. 5.1 Archaeological sites on Orpheus Island

that these lighter green patches are really lantana, and if so, that it is established on a midden. The implication is not that lantana equals a midden, but that a likelihood exists that where an open space rich in organic remains occurs, such as a midden, lantana will establish before native species. This is probably only useful for late post glacial sites which were most recently used. A natural succession of plant species could be expected to have partly obscured other sites as in Pioneer Bay.

One shell midden is sited high on the cliff above the eastern coast. When such an anomaly occurs then a natural origin for the deposit, such as apparent shell middens formed by birds (Jones and Allen 1978; Dwyer *et al.* 1985) must be considered. Large shells such as *Tridacna crocea* would be too heavy for birds to transport making it extremely unlikely that this could be the origin of the midden. If natural causes are eliminated, then cultural explanations such as camp sites for the particular purpose of ceremony, for example, must be sought.

Overall a variety of midden locations have been found ranging from coastal middens on beach deposits and bedrock sites behind mangroves on reef flats, to those occurring beside inland creeks and the cliff top. Other more ambiguous sites such as lines of stones and odd scatters of reef flat shells in inland areas add interest to the archaeological puzzle. A brief description and Grid References of the prehistoric and historic sites, actually found on the island to date, are listed in the Gazetteer. Sites in Pioneer Bay North, the adjacent east coast, and other areas surveyed, will be described in this Chapter. Pioneer Bay South and the sites within that bay will be dealt with in Chapter 6.

5.2 Pioneer Bay North

The coastal plain of Pioneer Bay North is very narrow and confined to the northern end of the bay (see Fig. 5.2). It widens to approximately 50 m at the extreme northen end. Mangrove forests fill the minor embayments in the middle and southern end of the bay and fringe the northern headland.

A much disturbed midden is located at the northern edge of this small vine forest covered coastal plain. Jungle-fowl have scratched surface material from the flat into an incubating mound approximately 2 m high and several metres in diameter. The margin of the midden is being reworked by wave action, concentrated in this region by the configuration of mangroves on the reef flat in front. Much midden material (noticeably *Tridacna crocea* valves) is washed out onto the nearby reef flat (see Plate 5.1).

A back beach depression runs almost the entire length of the narrow beach, which extends only to the mid point of the bayhead. A mangrove filled embayment marks where two small creeks enter the bay, and a ridge runs northwest parallel to the beach from this embayment. During March 1988 the spring tides covered the beach to the inner margin of the back beach depression.

Two shell middens were found behind the mangroves on the southern

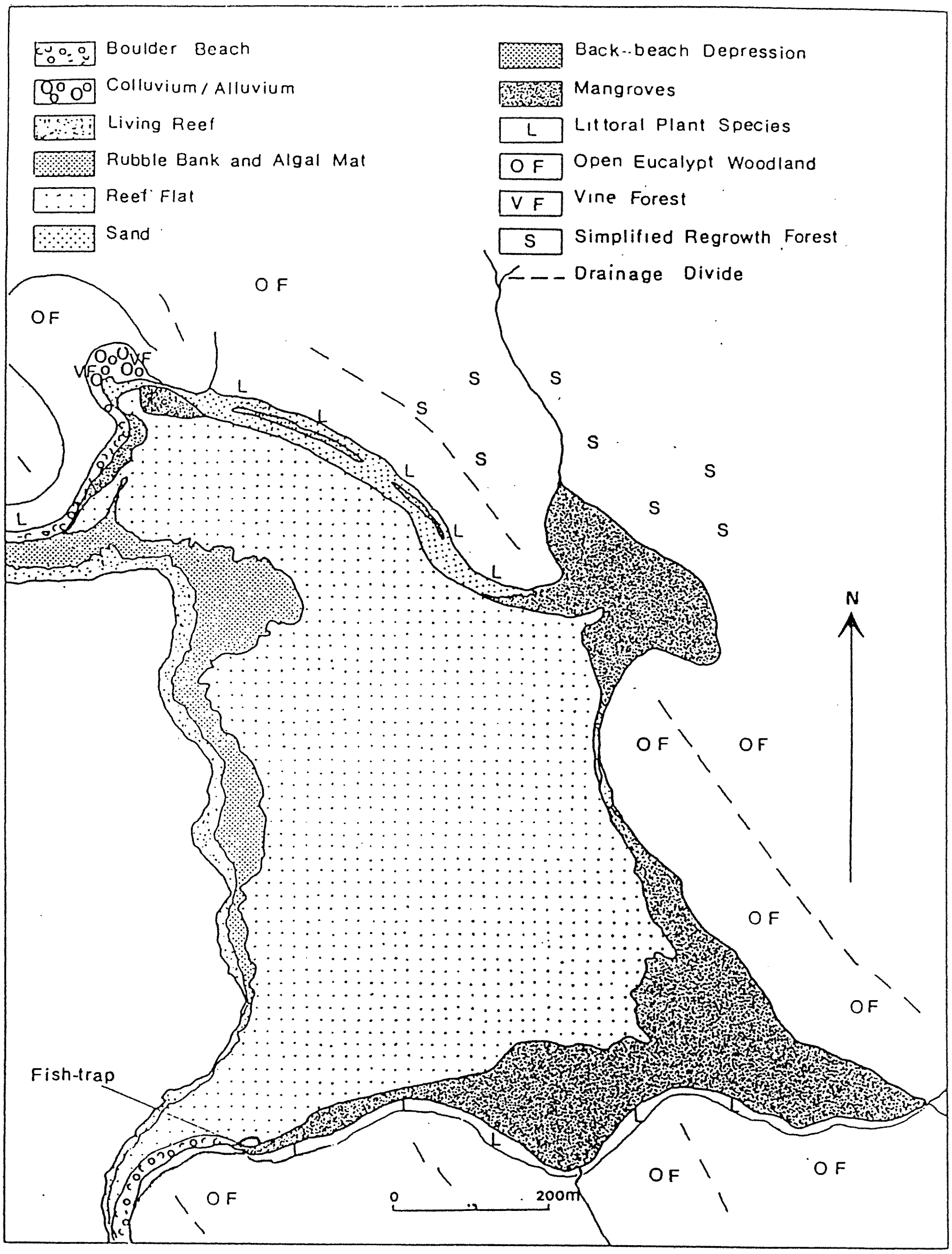


Fig. 5.2 Geomorphology of Pioneer Bay North

Plate 5.1 Shell washed onto the beach from eroding midden PBN 1, Pioneer Bay North

end of Pioneer Bay North (PBN 2 and PBN 3) about 150 -200 m from the fish trap on the southern headland of this bay (see Fig.5.3). Both of these were very close to high water mark and were being reworked by the higher spring tides. Despite the extensive damage done by the tide, jungle fowl and other fauna, there were some sections where stratified deposits appeared to be undisturbed (see Plates 5.2 and 5.3).

A rock-walled fish trap is located on the reef flat near the southern headland. It is of simple rounded, rectangular shape with no raceways, and walls which are better preserved than the trap in Pioneer Bay South. A full description is given in Chapter 7.

As noted above a small shell midden is situated adjacent to a group of fruit / shade trees including Burdekin Plum (*Pleiogynium timorense*), White Almond *(Terminalia* sp.), and Sandpaper Fig (*Ficus* sp.) at the top of the cliff on the eastern side of the island opposite Pioneer Bay North. This site is called "Cliff Top" (CT 1). The group of trees forms a patch of vine forest within the surrounding grassland and woodland (see Fig. 5.3).

It was suggested by Reg Palm Island and others present at an interview carried out by Brayshaw on Palm Island in 1975, that the presence of shells in the hills of Great Palm Island was due to people hiding when others came to raid them. The high eastern cliff on Orpheus Island where a shell midden is sited, commands a view in every direction except the south, and may represent a lookout either for spotting turtles and other marine resources or to guard

Plate 5.2 Midden PBN 2 located behind the mangroves on the southern end of Pioneer Bay North

Plate 5.3 Midden PBN 3 located behind the mangroves near PBN 2 at the southern end of Pioneer Bay North

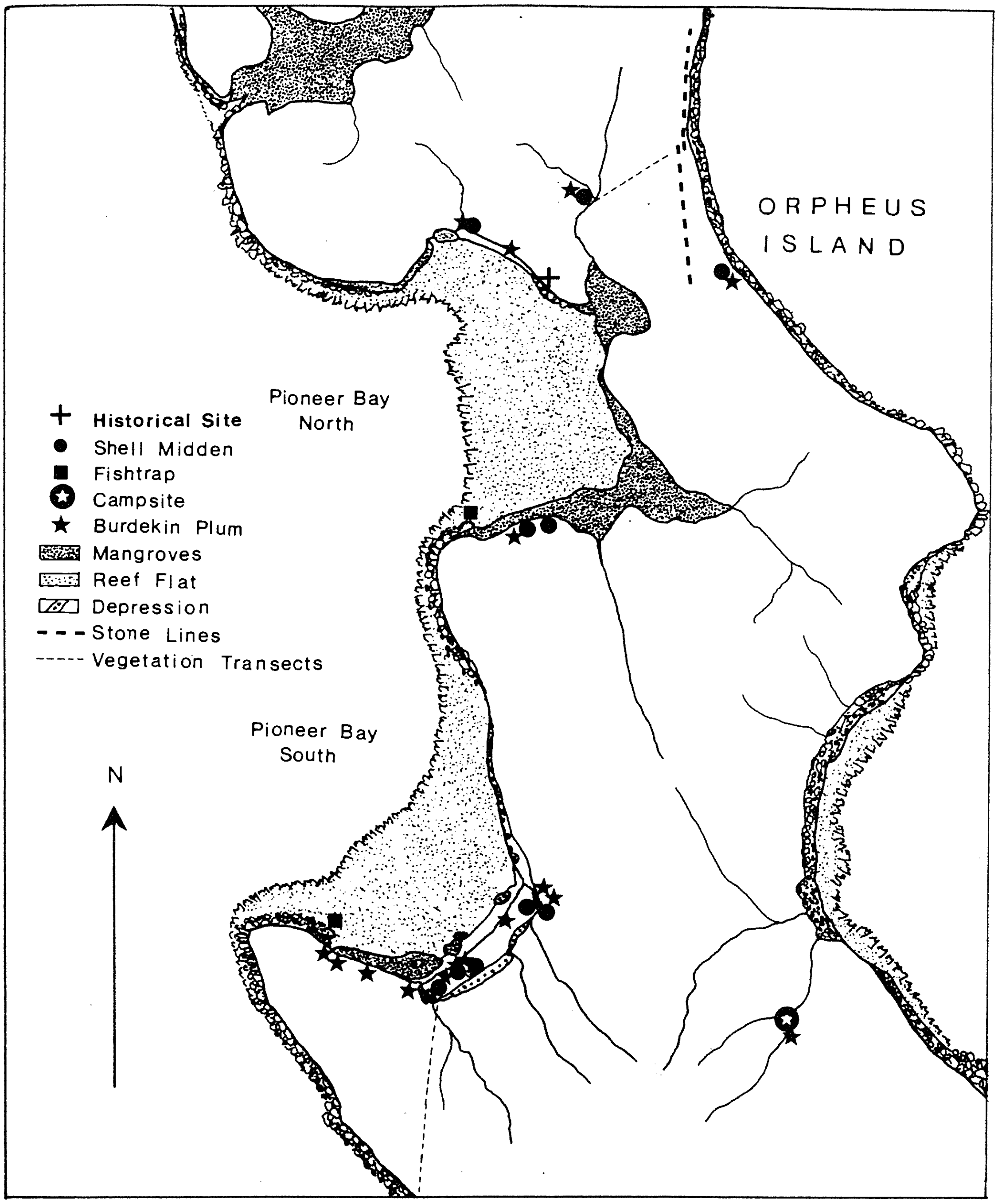


Fig. 5.3 Archaeological sites of Pioneer Bay North and Pioneer Bay South

against unexpected visitors.

An approximately 50 m long line of single stones with gaps between each stone runs along the top of the cliff in the saddle to the north of CT 1 (see Fig.5.3 and Plate 5.4). A second line of rocks runs from the southern end of the first at an angle of 60-75 °, for approximately 70 m towards a point below the group of trees containing the midden (see Plate 5.5). These two lines of stones, whose function is unknown, may be associated with the midden site. It could be a religious or ceremonial site. Palm Island (1975) spoke of stones on Great Palm Island which were not to be touched because they were invaders who had been magically turned to stone.

The lines of stones along the eastern cliff were in place when the Morris family bought Orpheus island (G. Morris pers.comm.). It is possible that this could be an Aboriginal stone arrangement, but at the same time it might also be the remains of a fence. Shepherds in the last century built a stone hut on the ridge above the beach in Pioneer Bay North, and may also have constructed some type of fence along the cliff verge with the rocks as part of the base. It is difficult, however, to reconcile the size and placement of the stones with any concept of bracing or support in relation to a fence.

A shell midden, (UC 1 or unnamed creek), covered with lantana is located at the junction of a small dry creek with a smaller tributary. This small creek runs from the northwest, parallel to the ridge behind the beach at the northern end of the bay, and into the small mangrove filled embayment in the mid section of the

Plate 5.4 Line of stones (arrowed) on the east coast cliff top looking north

Plate 5.5 Line of stones looking south. This line connects at an angle to the cliff top line of stones

beach (see Figs. 5.2 and 5.3). At the second visit (March 1988) the rock hole in the creek below the midden had a pool of water. A Burdekin Plum tree overhangs the midden. The presence of Burdekin Plum and other known fruit / use trees adjacent to CT 1, UC 1 and the Pioneer Bay South and North middens strongly suggests the possibility of regular association between indigenous fruit trees and shell middens on the island (cf. Hynes and Chase 1982). A survey was made from UC 1 along the creek banks to the open grassland upstream, and back to its mouth at the mangrove filled embayment in the middle of the bay. No other sites were found.

5.3 Other surveyed areas

Hazard Bay

From the extent of scattered shells in Hazard Bay (see Fig. 5.1) middens apparently existed throughout the coastal deposts as they do in Pioneer Bay South, but little remains due to the activities of European settlers since before the end of last century. The choice of such settlement is obvious; the bay is sheltered, the topography is the least rugged of the island and permanent water is available from a soak behind the bay.

A small natural dam up from the beach at the northern end of the bay also held water in 1989. One shell midden is situated on the next small creek to the south of this dam, and another is about mid-way along the beach. There is a small tidal creek at the southern end of the beach with one very disturbed midden on the inland bank.

Yanks' Jetty

A small rock shelter is situated just above the high water mark at Yanks' Jetty to the south of Hazard Bay (see Fig.5.1). No evidence of human occupation was noted and water penetrates through the roof and as surface flow during rainy periods (see Plate 5.6). The QNPWS have dug a pit toilet on one midden on the small flat to the south of the headland (see Plate 5.7). Gullying has dissected another midden deposit to a depth of about 30+ cm. The entire flat in this area seems to have been one continuous midden. Historical remains of the United States Military Forces, who were stationed here during World War II, are scattered around the crest of the headland between the large granite boulders. An open concrete water reservoir of about 2 m diameter on top of the headland still retains water (see Plate 5.8 and 5.9). One faded rock picture has been reported on a granite boulder near the headland at Yanks' Jetty but is as yet unconfirmed (S. Sutton pers. comm.).

Gnoora

Gnoora (*Manbarra* for camp, Gribble 1932; see Fig. 1.1) is a small beach to the north of Yanks' Jetty. The United States Military Forces were camped on this beach during World War II. Midden deposits have little surface expression due to this concentrated occupation but appear to have existed throughout the coastal plain. One very large Burdekin Plum tree and several cycads could be the

Plate 5.6 Rock shelter at Yanks' Jetty, Orpheus Island

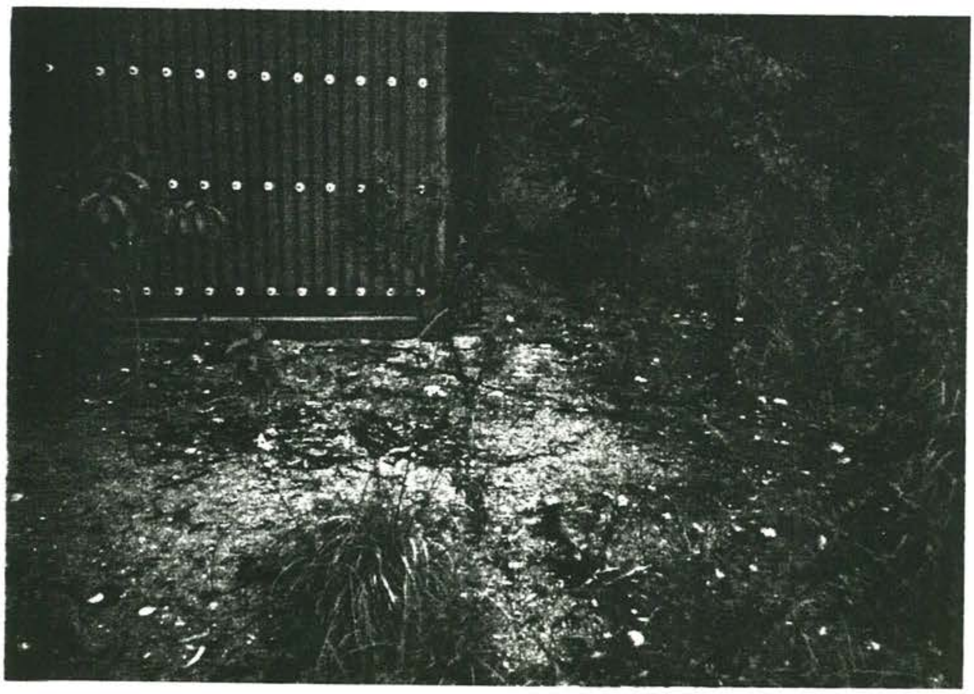


Plate 5.7 Pit toilet built on the shell midden at Yanks' Jetty, Orpheus Island, by the Queensland National Parks and Wildlife Service

Plate 5.8 Water reservoir built bythe United States Armed Forces during World War II at Yanks' Jetty

Plate 5.9 Reservoir retains water even though breached on one side

remains of the possible domiculture (cf. Hynes and Chase 1982) of this beach.

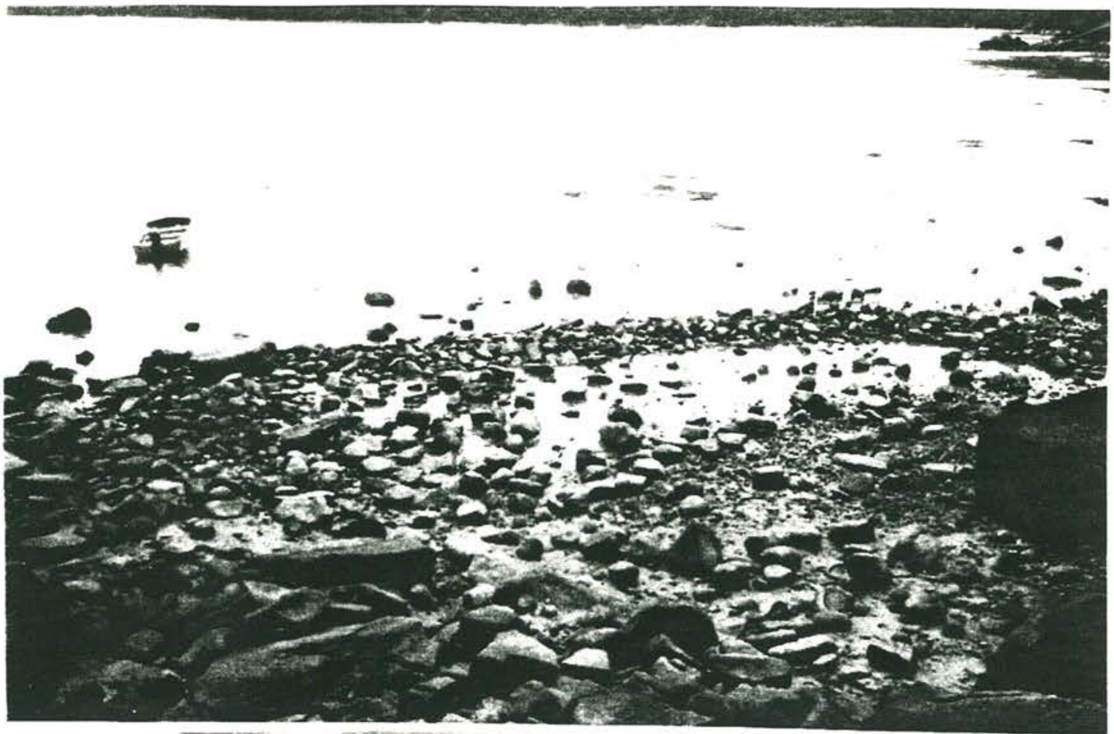
A fish trap similar to the horseshoe shaped one in Pioneer Bay North is situated on the northern side of the southern headland of this bay (see Plate 5.10 and 5.11). The walls are relatively well preserved but probably have decreased in height due to lack of maintenance. No detailed study of this fish trap has been undertaken. A rock shelter is located under the high water mark behind this fish trap (see Plate 5.12).

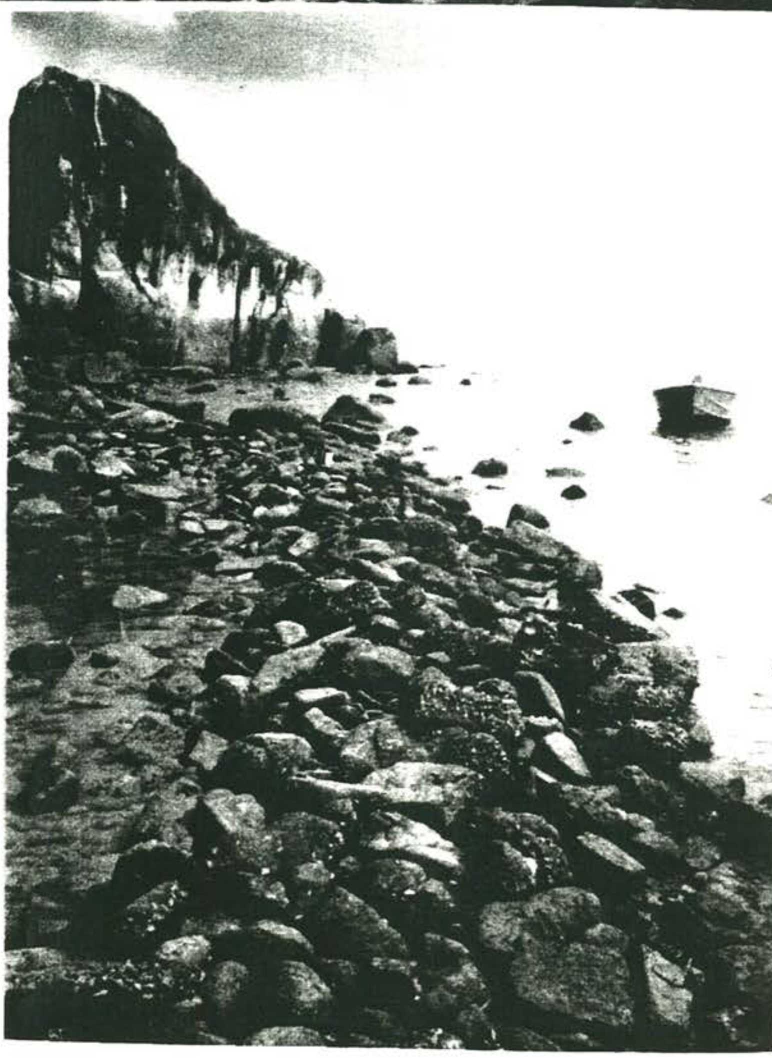
Small bay between Gnoora and Yanks Jetty

A wide dune ridge sequence backs the mangrove forest on the reef flat. Shell middens extend along the banks of both the northern and southern creeks which run into this bay. A small shell scatter is evident in the old vegetated back beach lagoon and a grove of large *Buchanania arborescens* (a known fruit tree) is situated on the seaward side of the lagoon.

South Beach

South Beach (see Fig. 5.1) has a badly disturbed midden beside an area enclosed by walls constructed from rocks. This stone wall may represent the remains of either a hut or yard of European origin and is said to be the ruins of a second shepherd's hut (S. Mostachetti QPNWS pers.comm., see Plate 5.13). Large fruit and other vine forest trees are established along the upper and inner sections of





Plates 5.10 and 5.11 Rock-walled fish trap at Gnoora, Orpheus Island, at low tide. Photograph by K. Bartlett

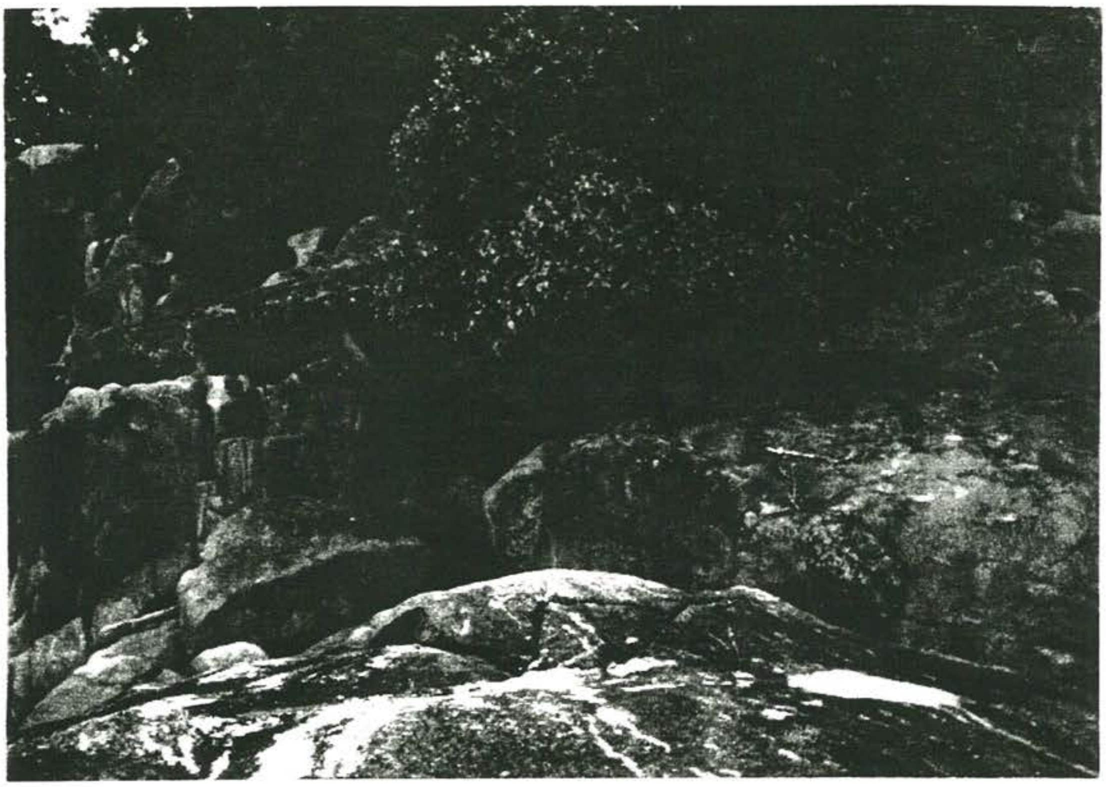


Plate 5.12 Rock shelter at Gnoora situated just below the high water mark. Photograph by K. Bartlett

Plate 5.13 Ruins of the stone fence or wall at South Beach which is probably contemporary with the shepherd's hut

the boulder barrier beside the dry lagoon. The midden on the frontal dune near the lagoon was the only one found. A large lagoon eroded from the cemented conglomerate platform which forms the coastline at the northern end of the beach could have easily been blocked off to become a fish trap (see Plate 5.14 and 5.15; also see Chapter 7).

A line of stones running across the mouth of a tidal inlet at the southern end of South Beach was recorded on an early survey. After heavy cyclonic weather had changed the distribution of sand along the beach, the line of stones proved to be the upper portion of a fish trap (see Plate 5.16 and 5.17) . This trap has not been studied in detail. Another line of stones runs seawards across part of the reef flat from a large rock located about mid-way along the beach opposite the mouth of a small ephemeral creek (see Plate 5.18 and 5.19). The purpose of this line of stones is open to question. It may be a different type of fish trap or it may be designed to make a calm landing place for canoes.

A line of stones similar to those found on the east coast cliff top runs along the bottom of the now vegetated back beach lagoon at the southern end of South Beach. It is very hard to locate under the vine forest but when found it is quite distinct .

East coast opposite Pioneer Bay South

A large grove of food / use trees are growing around a large basin in the main creek, at the junction of two creeks on the eastern slope

Plate 5.14 Cemented conglomerate platform at the northern end of South Beach, Orpheus Island

Plate 5.15 Cemented conglomerate platform eroded to form a natural lagoon at the northern end of South Beach

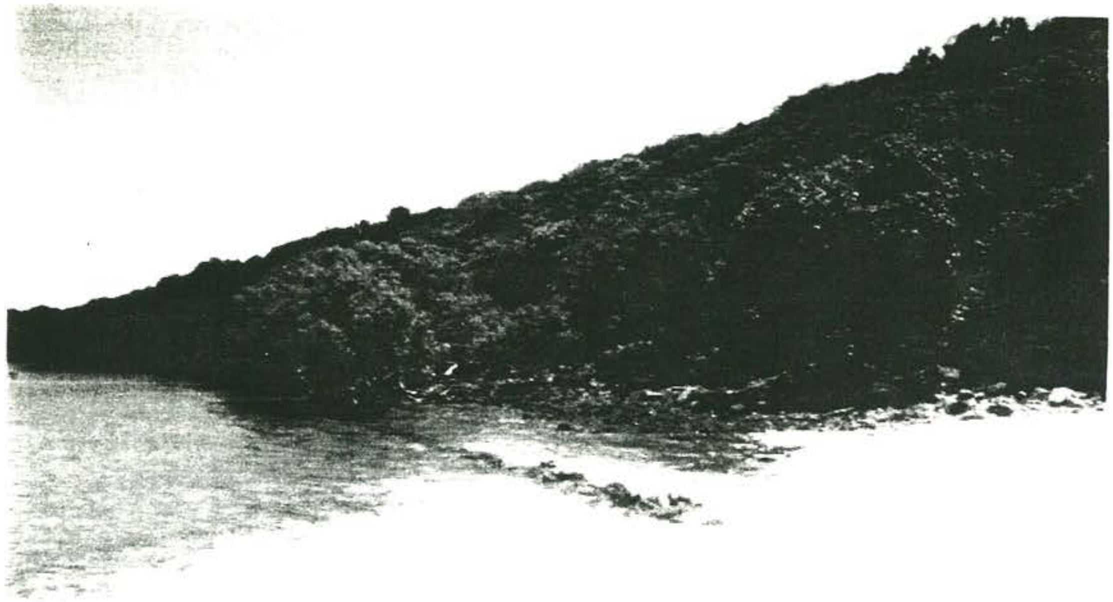


Plate 5.16 Fish trap at the southern end of South Beach, Orpheus Island at ebb tide

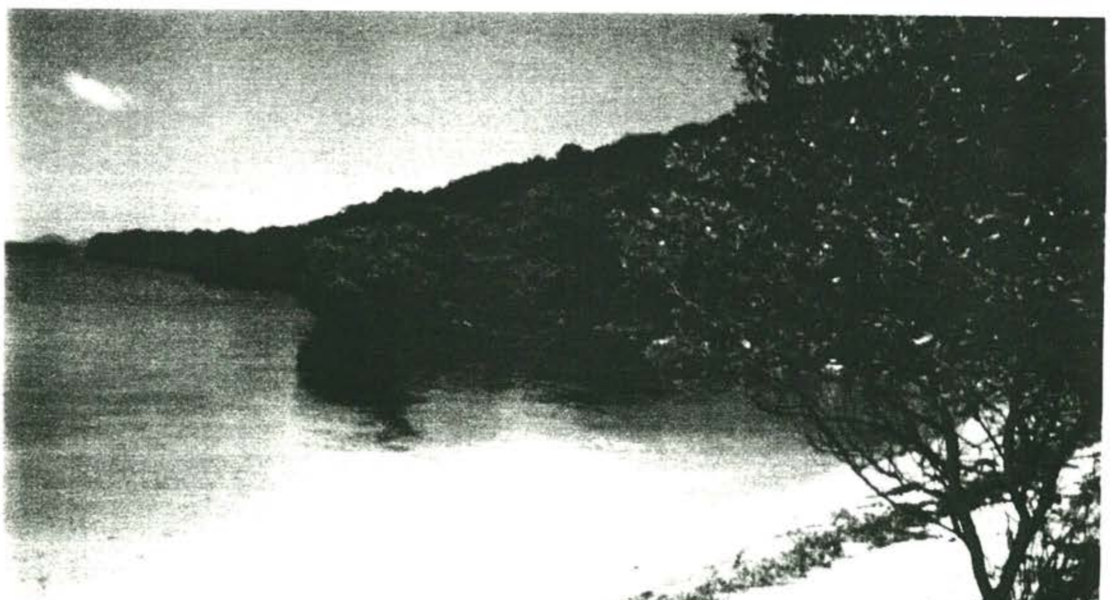


Plate 5.17 Fish trap at the southern end of South Beach at near high tide

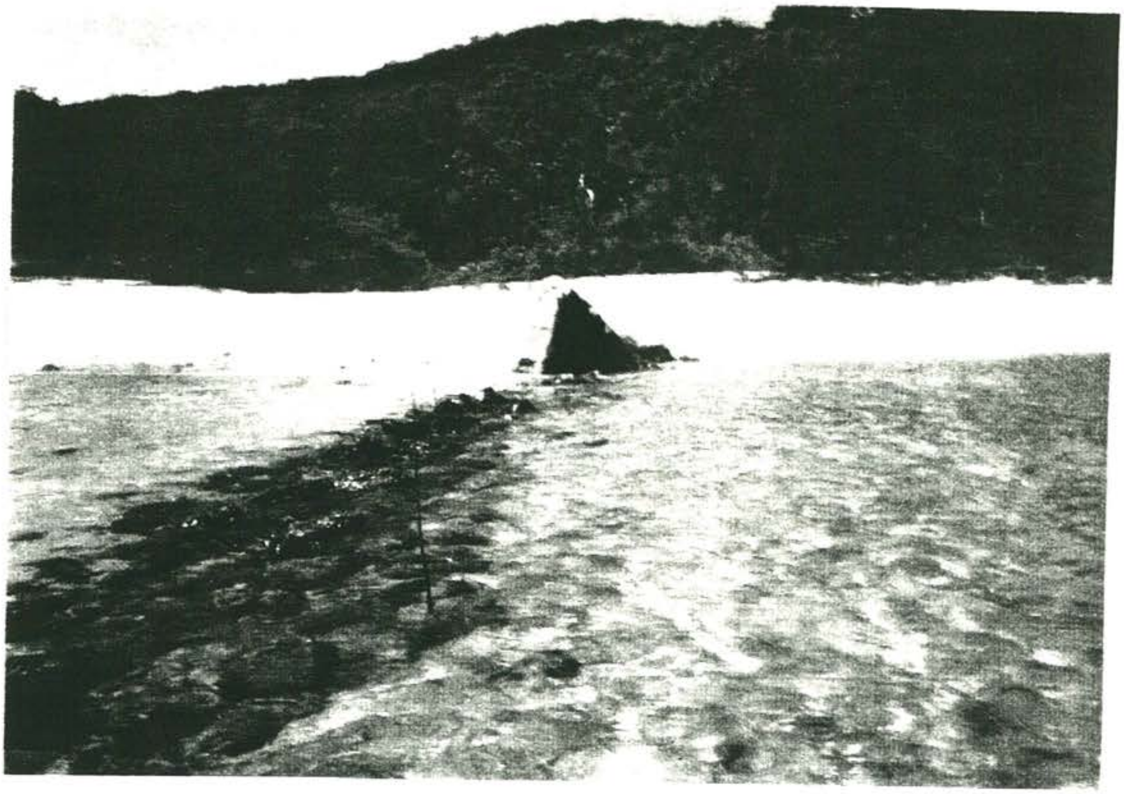


Plate 5.18 Line of stones mid-way along South Beach, Orpheus Island.

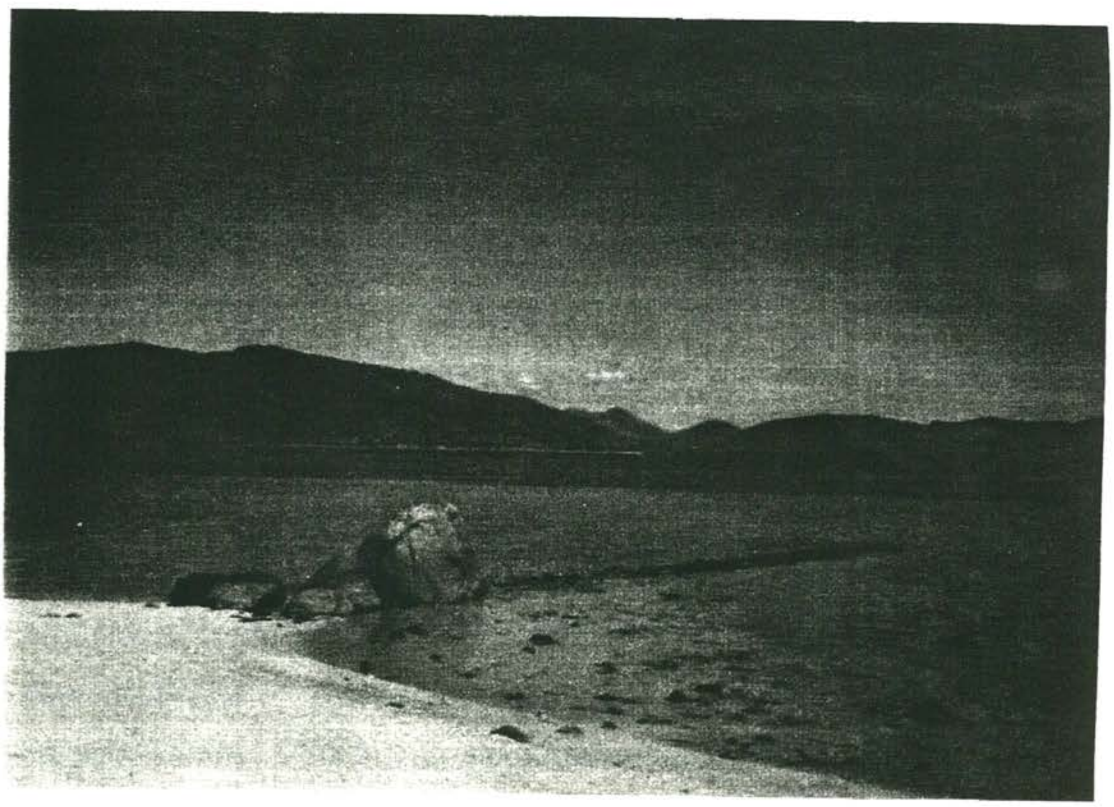


Plate 5.19 Line of stones mid-way along South Beach looking across the saddle of Fantome Island to Great Palm Island

of the island opposite Pioneer Bay South (see Fig. 5.1 and Plate 5.20). This has been designated as a possible camp site. This site is below the open grassland area and the prevailing south-east winds, and not far from the permanent stream on the eastern side of the island. A small scatter of *Tridacna crocea* valves, possibly representing one meal for one person, was found at this site. It may represent a camp used seasonally (Thomson 1939), for example, when fruit was ripe.

Iris Point

Three shell middens have been found along the beach on the seaward side of Iris Point behind the reef flat. A rock shelter with smoke marks on the wall is situated in the cliff behind the beach (K. Bartlett pers.comm.). This is the only rock shelter found as yet in the volcanic rocks of the northern part of the island (see Plate 5.21). A number of features along the beach suggest the shape of stone-walled fish traps. It is possible that they were constructed traps, now almost destroyed by the high wave action on the weather side of the island, or that they are natural features of shoaling. One is known to be the work of Europeans within the last few years (G. Richards pers. comm.)

These brief descriptions of archaeological sites on Orpehus Island serve to illustrate the variety and spatial patterning found at this stage of survey. With further investigation even greater diversity may become obvious. To date no quarry sites have been found but these could be present.

Plate 5.20 The east coast of Orpheus Island looking south to Curocoa and Great Palm Island, with the campsite on the creek junction in the mid-right

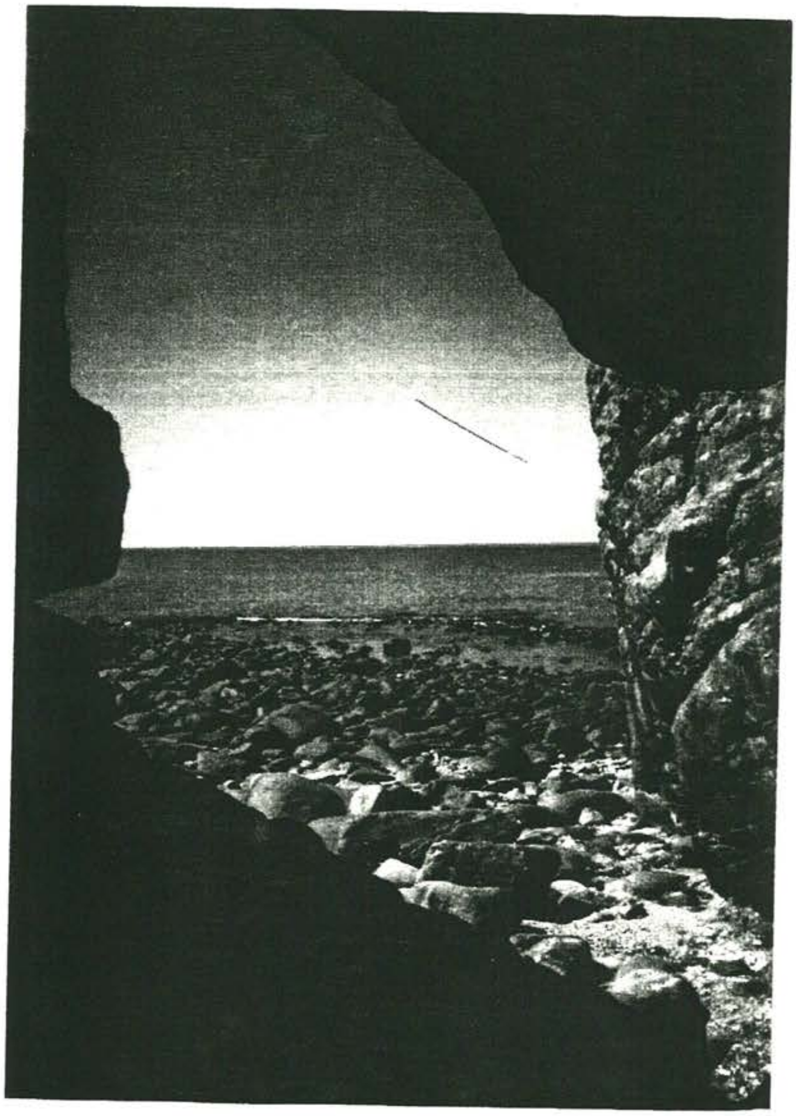


Plate 5.21 Rock shelter with fish trap-like structure in the background at Iris Point, Orpheus Island. Photograph by K. Bartlett

CHAPTER 6

ARCHAEOLOGY OF PIONEER BAY SOUTH

6.1 The physical setting of Pioneer Bay South

Aspects of the physical characteristics of Pioneer Bay South and the results obtained from exploratory archaeological soundings are examined in this chapter in an attempt to reconstruct the late Holocene settlement pattern for one area of Orpheus Island at about one phase in time. Pioneer Bay South is separated from Pioneer Bay North by a rocky headland (see Fig.5.2). The reef flat in this bay is approximately 400 m wide in front of narrow coastal plain (see Fig. 6.1).

The beach ridge sequence in Pioneer Bay South is approximately 150 m wide and consists of a series of coalesced quartoze and biogenic sand and shingle terraces, the highest to the landward side and decreasing in height towards the reef flat (Hopley 1982). The modern beach rises steeply at a 9° angle from the surface of the reef flat (Parnell 1987). Cemented beach deposits underlying the beach ridge sequence rise to 2 m above Mean High Water Spring tide, an indication of higher water tables (Hopley 1971) and therefore the hypothetical higher sea level at c. 6,500 BP (Hopley 1983; Grindrod and Rhodes 1984; Johnson *et al* 1986). Geomorphological studies to investigate reef development through time (Hopley et al 1983), and hydrological studies (Parnell 1986, 1987) to determine water movement around the bay, have been carried out in Pioneer Bay South.

Trees and shrubs which are known Aboriginal use plants fringe the shores of the bay within easy walking distance of an old base camp on the beach ridge system (see Appendix 1). Fruit plants include *Pleiogynium timorense* (Burdekin Plum), *Ficus platypoda* (Fig), *Mimusops elengi* (Tanjong Tree), *Pouteria sericea* (Mongo), *Pandanus* sp., *Eugenia reinwardtiana* (Coast Lilly-pilly), *Myoporum montanum, Clerodendron inerme, Cycas media* and *Ipomoea pes-caprae* ssp. *brasiliensis.* Fish poison can be obtained from *Pongamia pinnata*, a tree which grows along the shore. *Hibiscus tillaceus, Macaranga tanarius* and *Casuarina equisetifolia* have been used for the manufacture of artefacts. At least six different mangroves are found within the bay and tidal creeks. Of these *Avicennia marina, Bruguiera gymnorrhiza* and *Ceriops tagal* provided fruits. All mangrove habitats provided niches for gastropods, bivalves and other marine food organisms.
Steep rocky ridges rising to 156 m form the catchment for a number of drainage lines which converge to empty as three small ephemeral streams into a depression behind the beach ridge sequence. This depression in turn empties into the reef flat from both ends of the beach (see Fig 6.1). Widening of the back beach depression to 20 - 25 m in the middle section suggests the existence at one time of a lagoon. Following heavy rain fresh water flows out of the beach (Parnell 1987) at a point opposite an enclosed depression in the

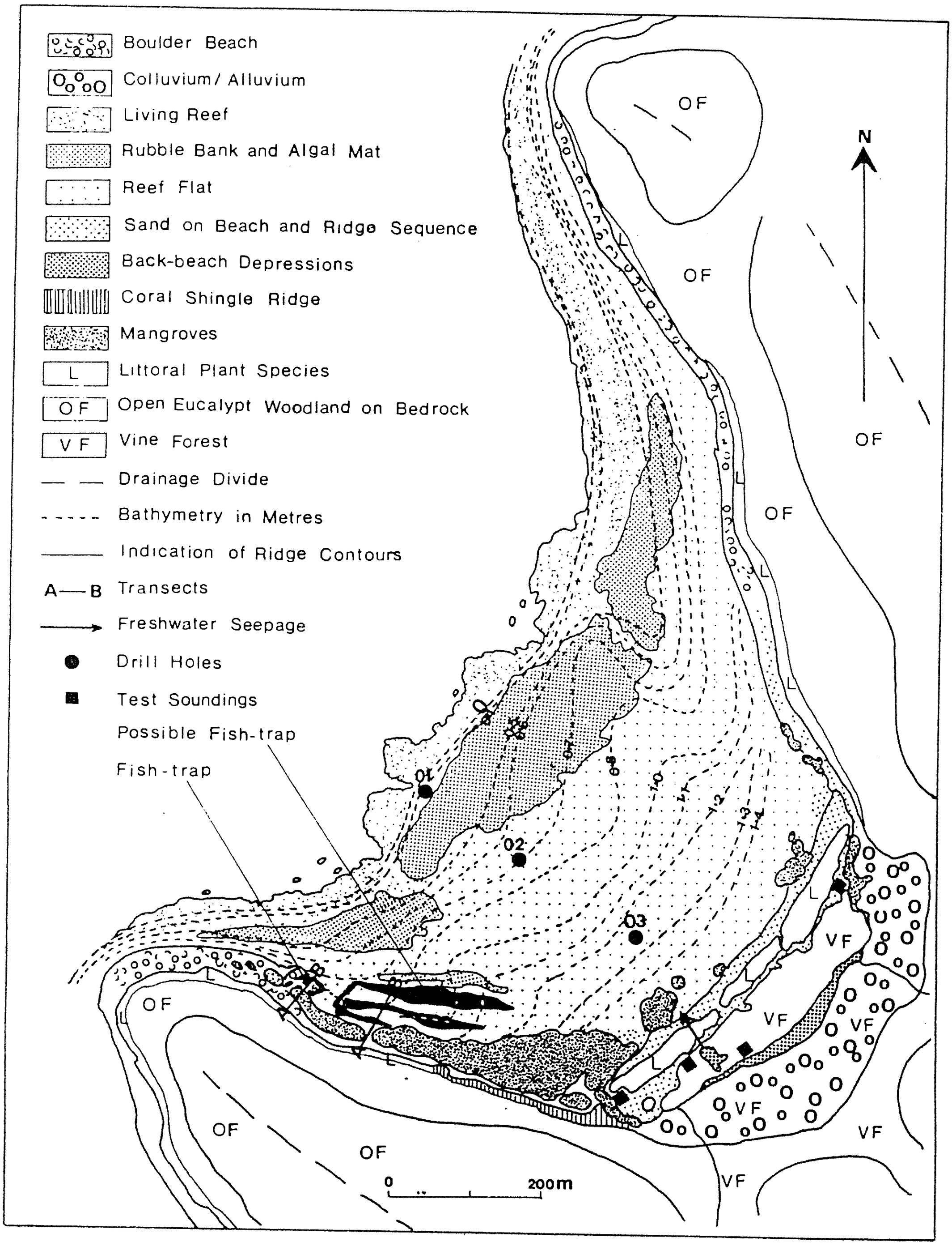


Fig. 6.1 Geomorphology of Pioneer Bay South with bathymetry from Parnell (1987) and drill holes from Hopley *et al.*(1983)

beach ridge sequence.

It is possible that a fissure in the cemented material (Parnell 1987) follows a former tidal channel, which is now fully blocked from both the beach side and from the back beach depression side. The beach and that area of the coastal dunes on the reef flat side of the depression are relatively lower than the areas to either side perhaps suggesting a former discontinuity across the length of the ridge sequence. In addition, a small grove of mangroves is established on the reef flat to either side of this depression, suggesting deposition from a former creek mouth (see Fig.6.1). An auger hole into the floor of the depression recorded 0. 83 m of black organic sandy soil which appears to be consistent throughout and contains no archaeological material or coral shingle. The black organic soil lies directly above the underlying cemented material. This may represent the infilling of a former stream channel after the original blocking of the channel on both the beach and lagoon sides.

6.2 Pioneer Bay South archaeological sites

The small scale distributional pattern of past Aboriginal settlement along the Pioneer Bay beach ridge sequence has been largely obscured by vine forest and European development. However, it was possible to distinguish six more or less discrete concentrations of midden material (see Fig. 6.2). PBS 1 was mapped and contoured to define the extent and main surface concentrations of shell and to obtain a representative sample of species present on

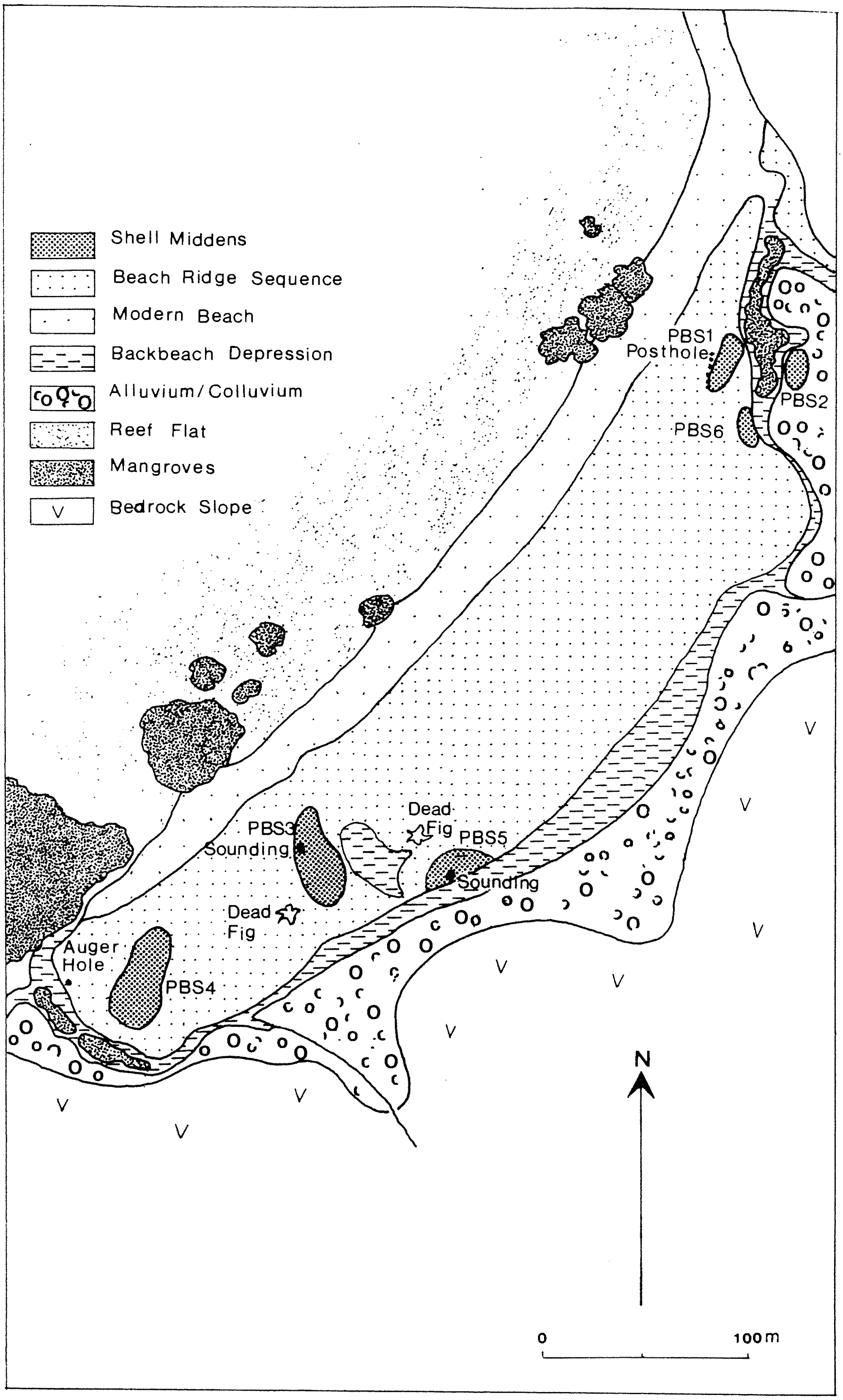


Fig. 6.2 Geomorphology of beach ridge sequence in Pioneer Bay South with sites and soundings indicated

the midden surface (see Fig.6.3). Grid squares were assigned a number and plotted on the graph, pegged, sampled and mapped. Each shell species present was assigned a number and one of each species collected for identification (see Table 6.1). The installation of the QNPWS boardwalk subsequent to this time caused a degree of disturbance as shown in Plates 6.1 and 6.2.

All shell species found on the midden are presently found on and adjacent to the fish trap in Pioneer Bay South. Two discrete groups of fire-affected stones on the midden surface are considered to represent disturbed remains of hearths (see Fig. 6.3).

Unfortunately, no excavation was permitted on PBS 1. However, post holes to a depth of 40 cm were dug for the guide fence flanking both sides of the boardwalk during its installation on midden PBS 1. Seven holes were augered using a posthole digger, and the stratigraphy of five of these holes is shown in Fig. 6.4. The evidence from these holes confirms the subsurface lateral extent of shell material and represents the edge of the midden deposit in this direction. The apparent juxtaposition of layers suggests some type of disturbance to the stratigraphy. This could be consistent with the known history of this midden, which has suffered from a number of disturbances since European settlement on the island. For example, sand has been removed from an area adjacent to the midden leaving a depression in the dune. The two holes not shown contained medium coarse sand characteristic of the ridge as a whole.

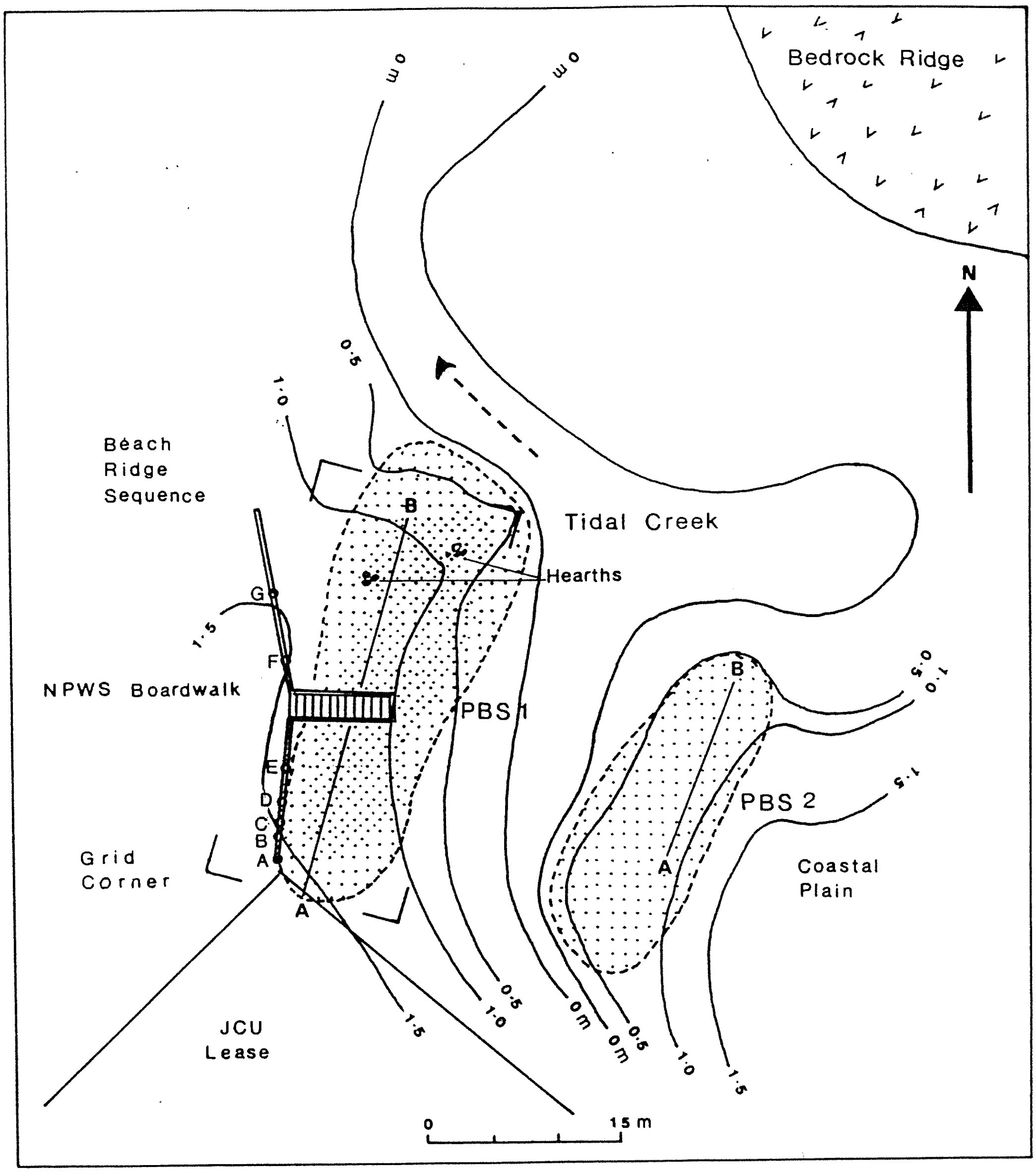


Fig. 6.3 Site plan of middens PBS 1 and PBS 2

Table 6.1

Mollucs species present in surface collection of Midden PBS 1. Genus present on Hinchinbrook Island* (Brayshaw 1977; Campbell 1979,1982) and Magnetic Island ˙ (Greer 1981). The mud welk *Telescopium* sp. common to both Hinchinbrook Island and Magnetic Island middens has not been found to date on or in middens PBS 1. PBS 3 or PBS 5 in Pioneer Bay South, Orpheus Island.

Class BIVALVA

*°	Arcidae	*Anadara* sp.
*˙	Ostreidae	*Saccpstrea* spp.
	Cardiidae	*Acrosterigma flava*
˙	Tricadnidae	*Tridacna maxima*
		Tridacna crocea
		Hippopus hippopus

Class GASTROPODA

	Fissurellidae	*Diodora jukesii*
	Trochidae	*Trochus pyramis*
	Turbinidae	*Turbo* sp.
*˙	Neritidae	*Neritsa* sp.
	Strombidae	*Strombus luhaenus*
		Lambis lambis
		Polinices sp.
	Naticidae	*Chicoreus* sp.
	Muricidae	*Melo amphora*
	Volutidae	*Melo amphora*

Land snail	*Xanthomelon* sp.

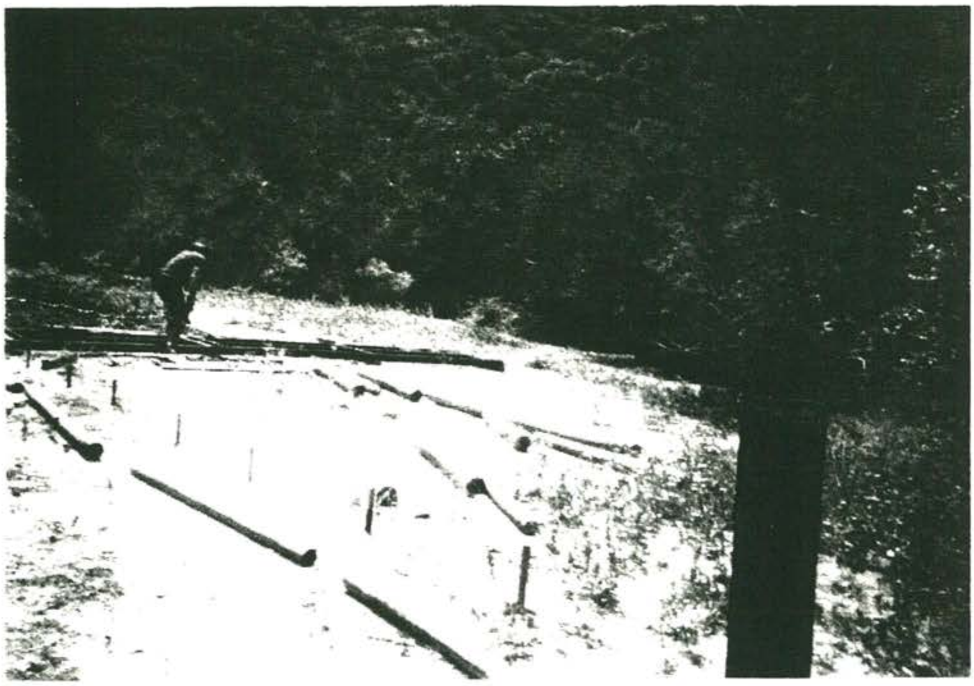


Plate 6.1 Queensland National Parks and Wildlife Service boardwalk being erected on Midden PBS 1. Stakes mark the postholes excavated

Plate 6.2 Surface damage to Midden PBS 1 by erection of the boardwalk

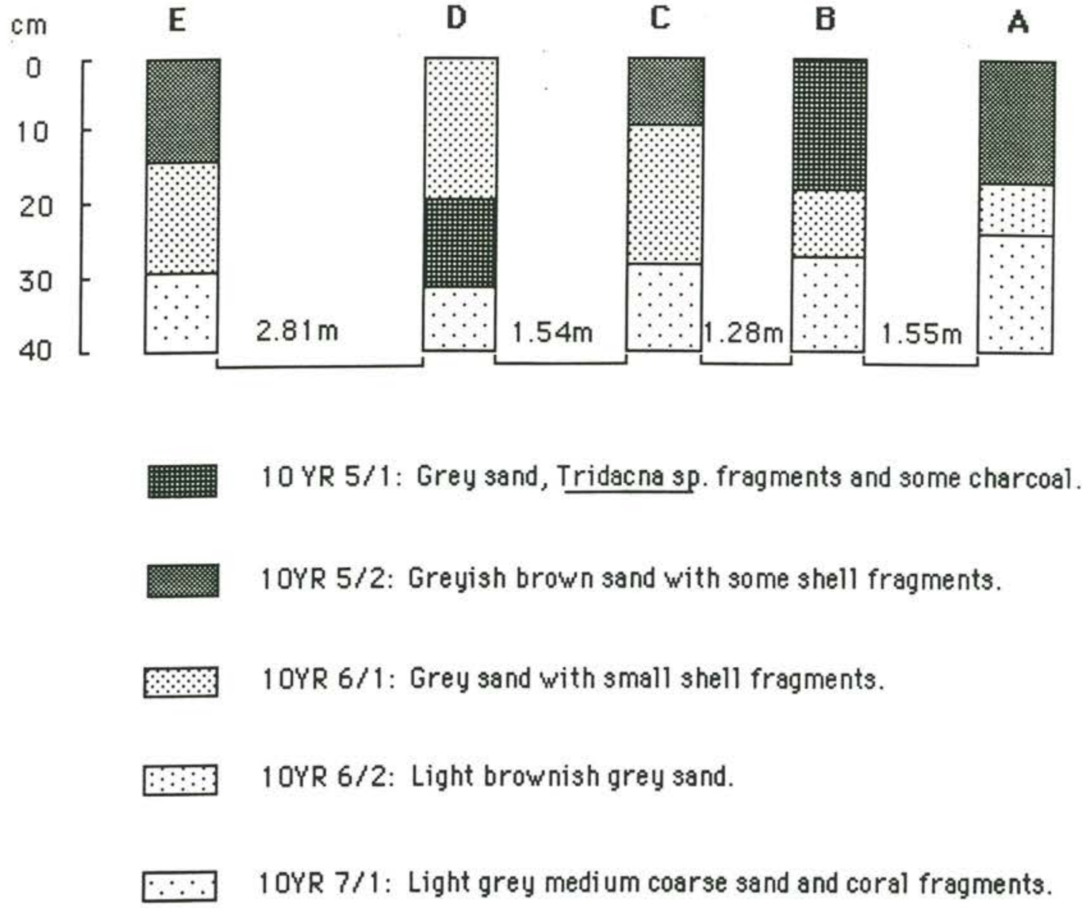


Fig. 6.4 Stratigraphy of guide rail postholes at PBS 1. Guide rail flanks a Queensland National Parks and Wildlife Service boardwalk.

PBS 2 is on the lower colluvial / alluvial plain on the other side of the tidal creek, which drains from the back beach depression between PBS 1 and PBS 2 (see Figs. 6.2 and 6.3). This midden is overgrown by lantana and other scramblers. The same shell species appear to be present as on PBS 1, but the vegetation made clear sampling impossible. The midden was mapped and contoured and tied to PBS 1. *Pleiogynium timorense*, *Pandanus* sp. and *Cycas media* were found on the bank of a dry drainage line which runs into the tidal creek from the northern ridge behind the bay. No excavation was permitted on this midden.

The creek bed between the middens PBS 1 and PBS 2 is scattered with weathered shells eroding out of the deposits. Some erosion is evident near the north-east corner of PBS 1 and the roots of a *Casuarina equisetifolia* appear to be retarding erosion at this point.

Two small scatters of shell were also found on lower sandy ridges behind PBS 1. The height of these lower ridges was not mapped but they appeared to be only slightly higher than the floor of the depression, and may have been dunes within the outlet mouth at an earlier stage of development of the beach ridge sequence. No augering was carried out to determine if midden material extended below the surface. Research into the sedimentary history of this area was not possible within the limits of the present study.

PBS 4 is located at the southern end of the University's Research Station lease (see Fig. 6.2). It has been disturbed and flattened during the construction of buildings, but it appears to have discrete edges. This was mapped for the record, and one auger hole was dug at the far southern edge of the deposit adjacent to the tidal creek. The stratigraphy shows a layer of slightly humic sand with some *Tridacna* sp. shell over interbedded coarse to fine beach sands (see Fig. 6.5).

No midden material except for PBS 2 has been found to date on the landward side of the back-beach depression. The vegetation which covers the greater part of the coastal strip has a tendency to obscure the morphology and mask the surface scatters of shell. Other middens could be present but not detected.

A rock-walled fish trap (PBS FT), constructed of rocks from the adjacent boulder beach and taking advantage of natural features of the reef flat such as ponding and gravel banks, is located towards the southern headland of the bay. It has race type features and is largely destroyed and non - functioning (see Fig. 6.1. See Chapter 7 for full descripiton).

PBS 3 and BPS 5 will be used as a case study of a possible former settlement pattern for one area of the bay.

6.3 Site description and analysis of PBS 3 and PBS 5

PBS3 is located approximately mid-way across the coastal ridge sequence in Pioneer Bay South and towards the southern end (see Fig. 6.2). The midden is situated under medium height vine forest species. The surface expression of the midden is one of *Tridacna*

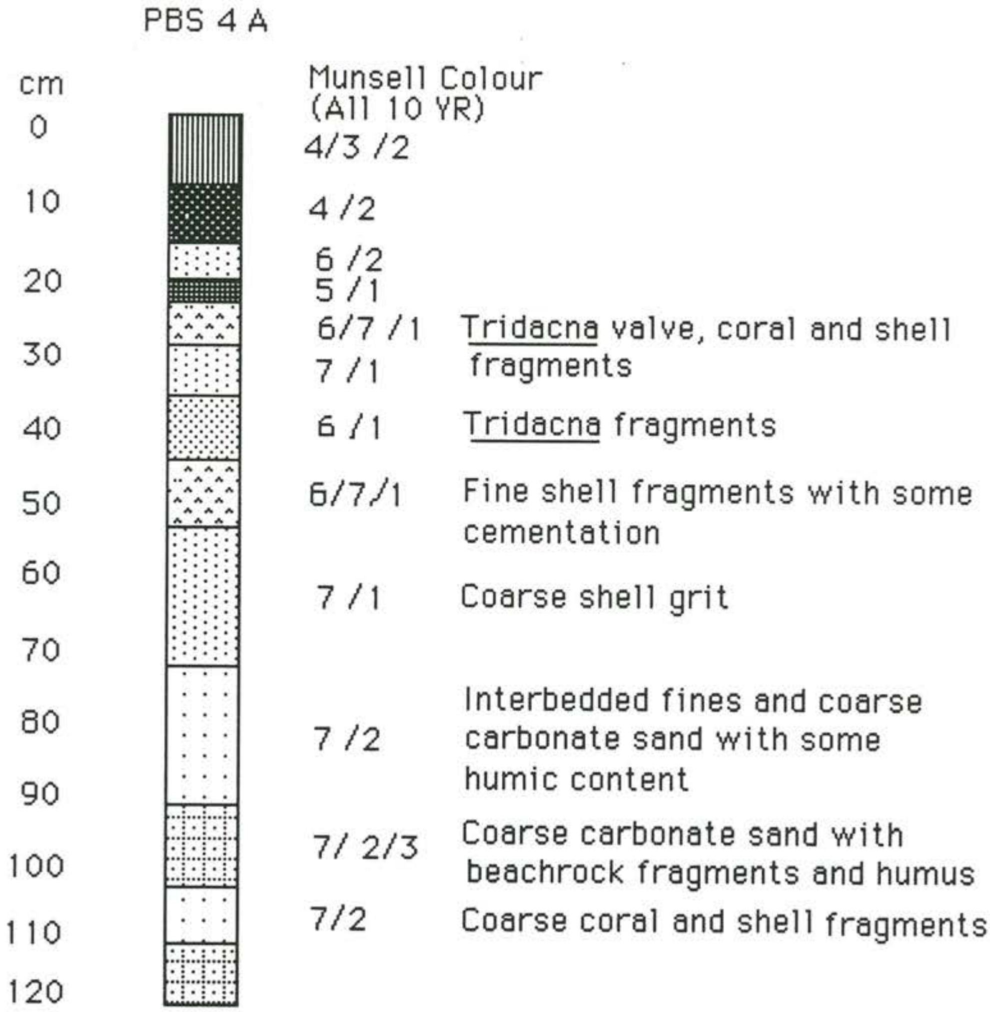


Fig. 6.5 Stratigraphy of PBS 4 obtained by augering

valves (commonly *Tridacna crocea* with an average size of 7.5 cm from the edge to the umbo) and other shells scattered through the litter layer. A 50 by 100 cm sounding was excavated to a depth of 40 cm at point (A9 - A10) on a base line established across a narrow clearing. The clearing was originally an access track to the James Cook Research Station radio aerial. The midden appears to represent a continuous deposition of shell with density decreasing with depth. The surface of what appears to be archaeologically sterile dune sand underlies the 40 cm depth (see Fig. 6.6).

The large size and number of *Tridacna crocea* valves packed in the upper layers presented great difficulty in three-dimensional recording so a decision was made to remove all material in arbitrary 5 cm spits. All material recovered from the sounding was sieved in the field (6 mm and 2 mm) and sorted into categories of shell, bone, plant material, charcoal and stone. Shell species where readily identifiable were further divided. For Spits 1, 2 and 3 the entire *Tridacna crocea* valves were weighed, measured, examined by eye for damage or obvious working, and backfilled with discarded matrix.

The upper stratum contained closely packed shells in a black humic sand. A number of small charred rocks of the local bedrock were recorded in groups in ash lenses. Fragmented charcoal, fish vertebra and other bones, a small amount of unidentified small mammal bone (see Table 6.2) and plant material were found throughout. One broken crescent-shaped shell fish hook and a fragment of a larger fish hook were found in Spit 2 (5-10 cm depth;

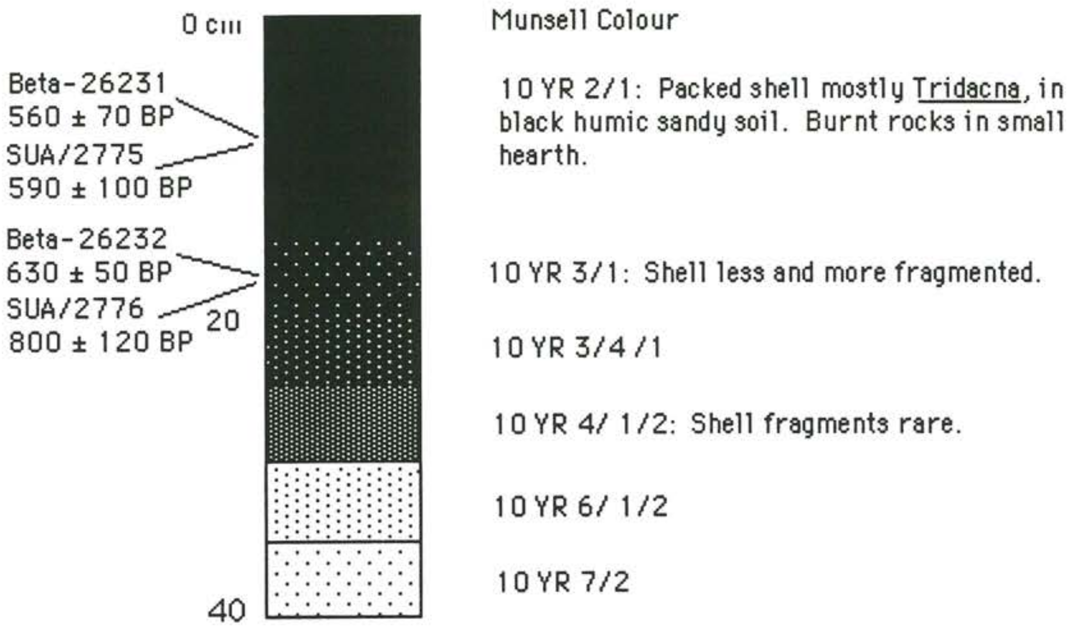


Fig. 6.6 Stratigraphy of the sounding on Midden PBS 3, Pioneer Bay South, Orpheus Island. Radiocarbon dates are from Tridacna crocea shell (Beta - 26231:560 ± 70 BP corrected to 110 ± 80 BP, and Beta - 26232:630 ± 50 BP corrected to 180 ± 60 BP using the formula of Gillespie and Polach (1979), and charcoal (SUA - 2775:590 ± 100 BP and SUA - 2776:800 ± 120 BP).

Table 6.2 Weight of bone in grams per spit from PBS 3

Spit No.	Fish		Mammal		Unidentified	
Grams	>2mm	>6mm	>2 mm	>6mm	>2mm	>6mm
1	-	9.67	-	-	-	0.38
2	9.67	-			12.70	-
3	8.63	38.57			11.52	-
4	0.21	-	1.18	-		7.00
-						
5	-	-	0.82	-		1.57
-						
6	No bone					
7	No bone					
8	No bone					

see Plate 6.3). A small fragment of another fish hook was also found in Spit 4 (15-20 cm depth). Radiocarbon dates were obtained for paired samples of *Tridacna* sp. shell and charcoal from Spits 2 and 4 (5-10 and 15-20 cm depths, respectively; see Table 6.3).

There is a marked difference between the dates obtained for the charcoal and the corrected dates obtained for the shell, approximately 480 years in the first case and 620 years in the second. The charcoal from both spits is older than the shell, which is the reverse of what one would normally expect, given the usual influence of the 'ocean reservoir effect' on marine shell (cf. Gillespie and Polach 1979; Head *et al.* 1983). It might be suggested that higher inputs of freshwater from the Herbert River flood plume could have affected the littoral environment in which these shells were growing. If the difference had been more marked for Spit 2 than Spit 4, then it might have suggested disturbance of the upper layers, but this is not so.

As just suggested, the problem may lie with the shell. Ocean water in the inner barrier reef area may show a difference in the surface ocean water bicarbonate ^{14}C activity from more open water areas. Conversely, the charcoal could have come from old heart wood, or the humic acids from the soil could have differentially affected the shell due to some property of their crystalline structure. The only other date obtained for the bay is from PBS 5 and is on shell only, as no charcoal of suitable size was found at that site. Further dates from this and other middens on the island might show a different pattern.

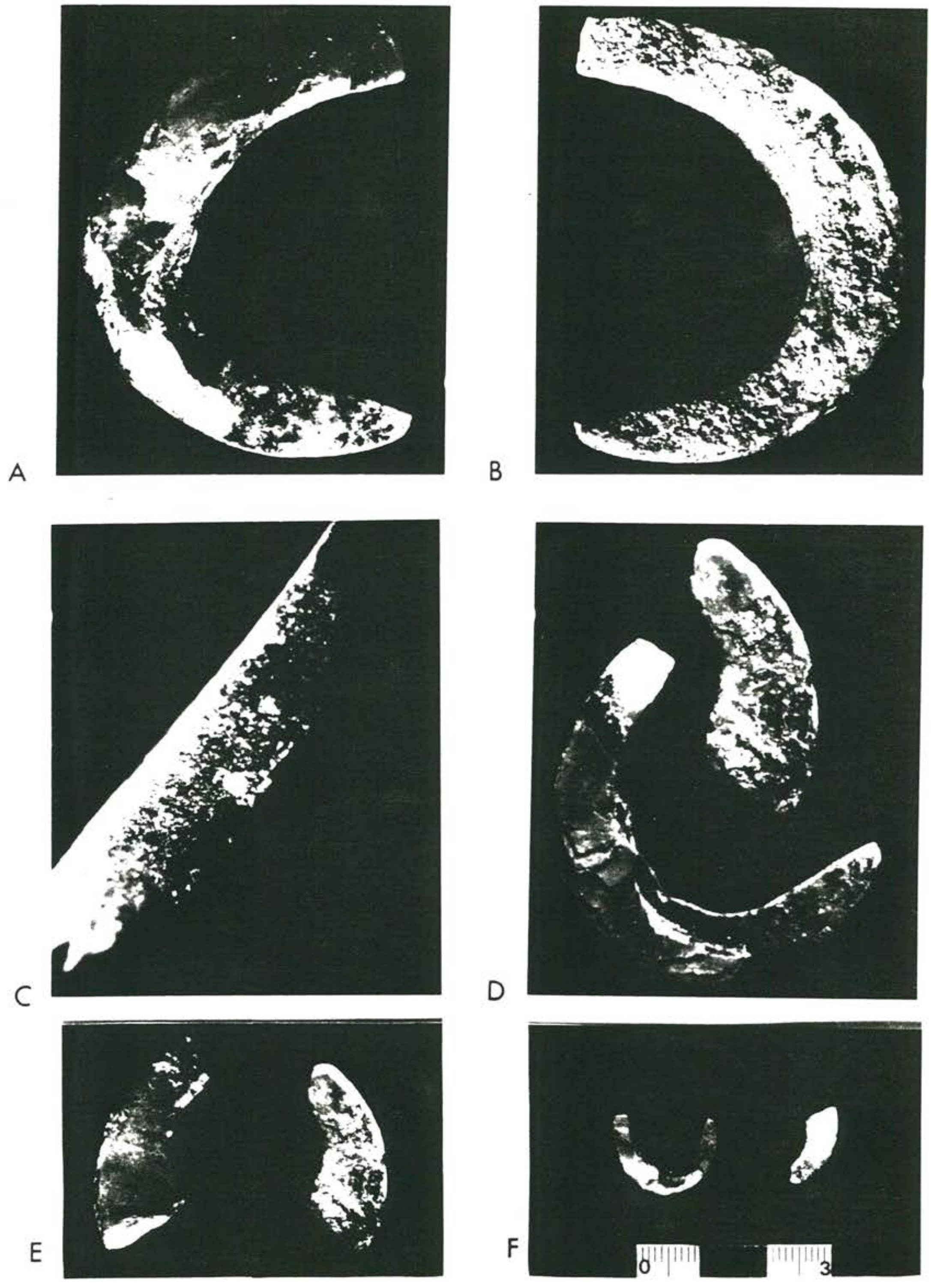


Plate **6.3** Shell fishhook recovered from Spit 2 (5-10 cm) of PBS 3, Pioneer Bay South, Orpheus Island.

(A and B) Enlarged view of each side of the fishhook.
(C) Enlarged view of the inner curve of the fishhook. No file or other marks due to manufacturing techniques can be seen.
(D) Enlarged view of the fishhook, and fragment of a larger hook also recovered from Spit 2 of PBS 3. (E) Enlarged views of each side of the shell fishhook fragment. (F) Fishhook and fragment with scale in centemetres for comparison.

Table 6.3 Radiocarbon dates for archaeological sites on Orpheus Island.

Site No.	Depth (cm)	Lab. No.	Date (BP)	Material
PBS 3	5 - 10	Beta-26231	560 ± 70 110 ± 80*	*Tridacna* sp. shell
PBS 3	5 - 10	SUA-2775	590± 100	Charcoal
PBS 3	15 - 20	Beta-26231	630 ± 50 180 ± 60*	*Tridacna* sp. shell
PBS 3	15 - 20	SUA-2776	800 ± 120	Charcoal
PBS 5	34	Beta-26233	540 ± 80 90 ± 90*	*Tridacna* sp. shell

* Radiocarbon dates corrected for ocean reservoir effect following the formula of Gillespie and Polach (1979).

The deposit gradually decreases both in humic staining and shell content until the sterile layer is reached at approximately 40 cm. A further occupation stratum may be below the sterile layer, but as this excavation was in the nature of an experimental sounding under restricted time limits, it was decided to proceed no further. Percentages of shell by weight from PBS 3 are listed in Table 6.4 and shown diagrammatically in Fig. 6.7.

Nineteen shell species are represented in PBS 3. This includes the land snail (*Xanthomelon* sp.) and small pipis (*Donax* sp.), which appear to be introduced to the midden deposit from the surrounding beach ridge as their numbers increase in the lower layers. The greatest percentage of the total shell is represented by the larger and heavier *Tridacna* valves. *Nerita* sp. are not as immediately visible as *Tridacna crocea*, but numerically they are the most important at a ratio of about eleven *Nerita* individuals to one *Tridacna* valve throughout the upper spits of the PBS 3 deposit.

Of the gastropods *Strombus* sp., *Trochus* sp., *Turbo* sp. and *Lambis lambis* have comparatively heavy shells and so possibly assume a disproportionate importance when species are listed by weight. *Trochus* sp., *Turbo* sp. and *Lambis lambis* appear in the top five spits, and *Strombus* sp. in the top six spits. These gastropods might be also present in the lower spits where much of the shell is unidentifiable. A steady increase in the percentage of fragmented and weathered shell with depth is obvious in Table 6.4.

Acanthopleura sp. (chiton) segments occur in the top seven spits as 1.25 - 5.5% of the total shell. They appear to be more resistant to

Table 6.4 Percentage of shell by weight per spit from Midden PBS 3 sounding.

Spit	1	2	3	4	5	6	7	8
Total Sample Sizes in kilograms	14.9	6.5	5.6	2.8	1.31	1.1	1.3	1.4
Class POLYPLACOPHORA								
Chitonidae								
Acanthopleura sp.	1.25	2.55	4.05	2.45	1.68	5.44	3.85	-
Class BIVALVA								
Arcidae								
Anadara sp.	1.21	2.20	8.19	7.68	8.49	-	-	0.73
Pteridae								
Pinctada sp.	0.13	0.19	0.5	1.51	-	-	-	-
Ostreidae								
Saccostrea sp.	0.06	0.14	0.21	0.80	0.48	-	-	-
Tridacnidae								
Tridacna crocea	67.71	41.3	41.73	38.11	14.37	39.7	14.47	10.28
Hippopus hippopus	-	3.37	-	-	-	-	-	-
Mytilidae	-	-	0.15	0.48	1.93	-	-	-
Veneridae								
Antigona sp.	-	0.48	0.18	1.05	-	-	-	-
Donacidae								
Donax sp.	0.01	0.03	0.06	0.13	0.85	1.91	15.57	10.49
Class GASTROPODA								
Trochidae								
Trochus pyramis	1.32	0.9	2.18	2.24	21.03	-	-	-
Turbinidae								
Turbo sp.	0.7	2	0.20	1.45	2.08	1.66	-	1.65
Neritidae								
Nerita sp.	7.01	20.74	15.54	12.08	9.24	8.50	1.65	0.43
Strombidae								
Strombus sp.	6.11	12.41	7.41	9.56	14.66	15.41	-	-
Lambis lambis	33.92	5.74	8.13	3.97	3.99	-	-	-
Naticidae								
Polinicies sp.	0.34	0.07	-	-	-	-	-	-
Muricidae	0.43	1.64	0.34	0.72	1.31	-	-	-
Volutidae								
Melo amphora	0.53	0.85	0.35	0.48	-	-	-	-
Conidae								
Conus sp.	0.36	-	0.70	2.39	-	-	-	-
Land Snail								
Xanthomelon sp.	0.01	0.08	0.14	0.19	-	-	-	-
Unidentified gastropod	0.12	0.74	1.12	1.07	0.1	-	-	-
Unidentified fragments	8.78	7.82	7.85	9.20	16.01	24.37	64.47	67.67

Fig. 6.7

A. Percentage of dominant archaeological remains in the sounding on Midden PBS 3

— Shell species retained by 6 mm sieve
— Shell species retained by 2 mm sieve
--- Matrix

B. ▦ Stone manuports and plant residue

C. Archaeological remains as a percentage of the total sediment from the sounding on Midden PBS 3 weathering than the other shell, which is generally very fragmented and weathered in the lower spits. Operculums of different sizes were plentiful throughout the deposit, and two *Anadara* sp. valves were refitted; both occurrences being evidence that entire organisms were transported to the midden site. The shell species present in the both PBS 3 and PBS 5 are more fully described and illustrated in Appendix 3.

Although unconfirmed reports of stone axes on middens in Pioneer Bay South have been received, only two small, worked fragments of quartz and several fire-marked stones of the local bedrock were found in association with a fine charcoal and ashy lens in Spit 1 (1-5 cm depth) of PBS 3. These latter stone artefacts have been drawn for the author by James Knight (see Fig. 6.8). No source of quartz has yet been found on the island, but it may be present. Whether the use of stone for tools was minimal when compared to the amount of shell possibly utilised unfortunately cannot be answered from the data obtained from the auger holes or the sounding. Indeed, whether shell was used at all for tools at this site is still uncertain, as there is no direct evidence for this.

6.4 Site description and analysis of PBS 5

PBS 5 is located on the beach ridge sequence, adjacent to the back-beach depression (see Fig. 6.2). There is little surface expression due to the activities of the jungle-fowl in this area, but some shell on the floor of the depression suggested that a midden might be near-by. A test auger hole then revealed the existence of

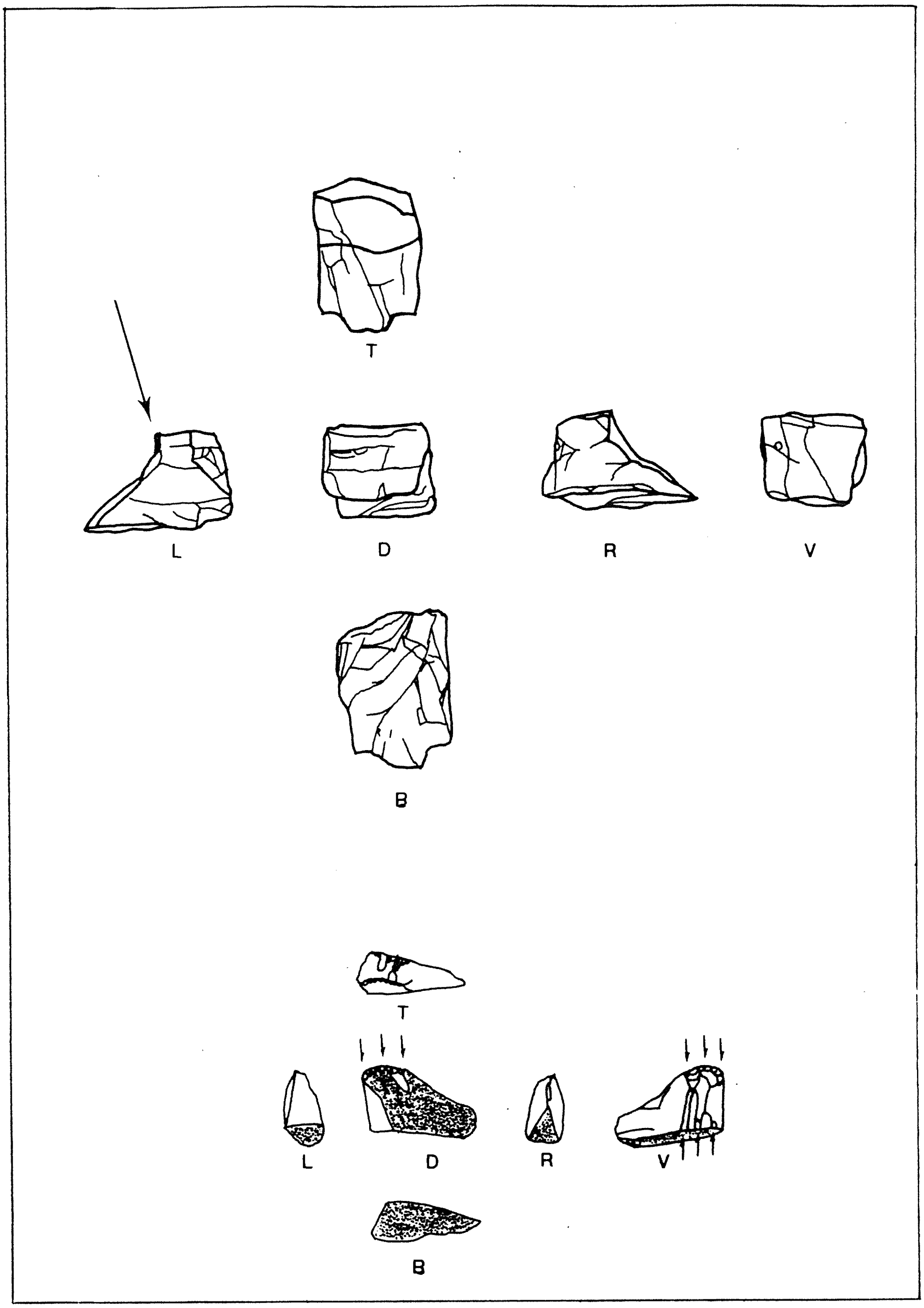


Fig. 6.8 Quartz artefacts from PBS 3 illustrated by James Knight

T - to of flake
L - left of flake
D - dorsal
R - right of flake
B - bottom
V - ventral
\ direction of blow which removed flake
\\\ area of repeated bashing

subsurface midden deposit (see Fig. 6.9). Its stratigraphy has much similarity to that of PBS 3, but the small samples obtained give only a slight indication of what would be the true nature of the deposit. A radiocarbon date was obtained for *Tridacna* sp. shell from a depth of 34 cm (see Table 6.3). No charcoal of sufficient size for radiocarbon dating was present in these auger samples. No definite stone artefacts were recovered, although some fire affected stone occurred.

The auger hole was abandoned at a depth of approximately 50 cm due to the great difficulty of retaining the unconsolidated sandy samples in the posthole digger. Shell fragments were still being recovered at this level, but the humic material was lessening. The deposit appears to continue below the level sampled. The lateral extent of this midden has not been determined.

In this midden *Tridacna* sp. occurs in all sampling levels except the second and the ninth, and is dominant in the third (13-18 cm) and the seventh (31-34 cm; see also Table 6.5, Fig. 6.10). As for PBS 3, *Nerita* sp., *Turbo* sp., *Strombus* sp. and *Lambis lambis* are also present. *Acanthopleura* sp. is present in all levels except the sixth. The unreliability of sampling with a posthole digger means that the results shown in Table 6.5 and Fig. 6.10 should be looked on with caution. This makes comparison between the stratigraphy of PBS 3 and PBS 5 of dubious value at this stage of the investigation. Superficially, there appears to be a broad similarity between the two middens, but nothing conclusive can be stated. PBS 5 is located on the beach ridge sequence, adjacent to the back beach depression

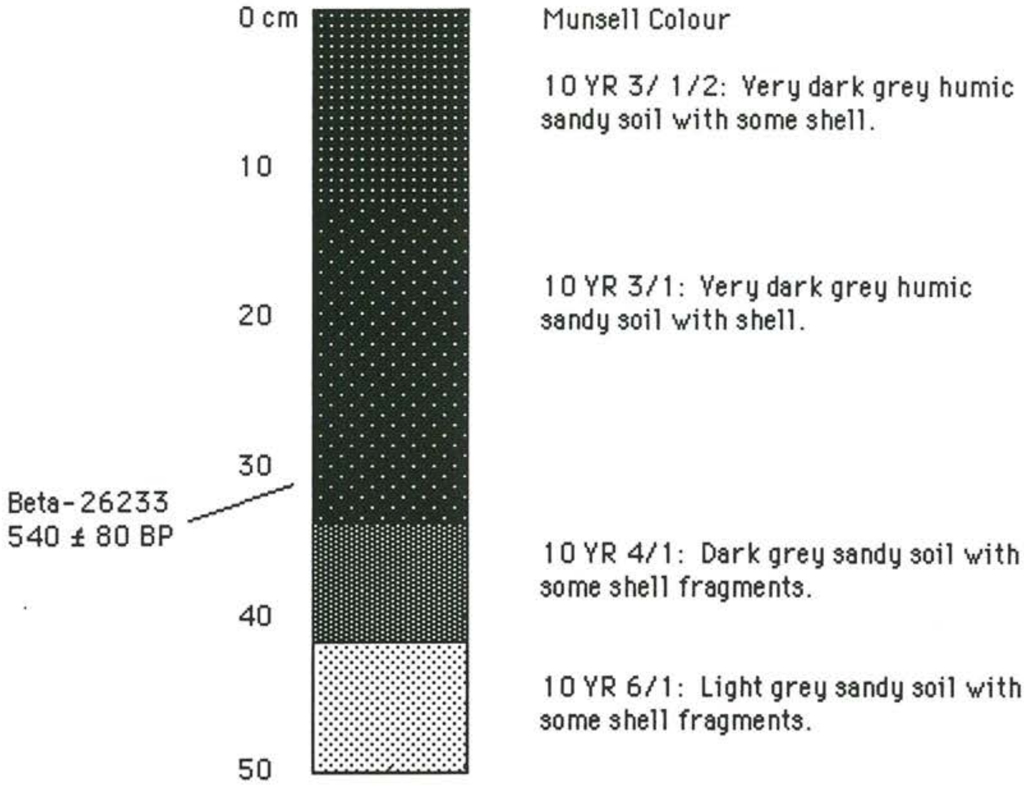


Fig. 6.9 Stratigraphgy of the auger hole on Midden PBS 5, Pioneer Bay South, Orpheus Island. Radiocarbon date from Tridacna crocea shell (Beta - 26233:540 ± 80 BP corrected to 90 ± 90 using the formula of Gillesie and Polach (1979).

Table 6.5 Percentage of shell by weight per spit (unevenly spaced) from Midden PBS 5 auger hole

Spit	1	2	3	4	5	6	7	8	9
Total Sample Size in kilograms	0.15	0.59	0.39	0.12	0.13	0.16	0.24	0.23	0.17
Class POLYPLACOPHORA									
Chitonidae									
Acanthopleura sp.	3.85	9.4	3.8	4.23	3.65	-	1.08	0.70	1.2
Class BIVALVA									
Arcidae									
Anadara sp.	-	-	-	-	-	-	-	-	-
Pteridae									
Pinctada sp.	-	-	-	-	-	-	-	-	-
Ostreidae									
Saccostrea sp.	0.06	0.14	0.21	0.80	0.48	-	-	-	
Tridacnidae									
Tridacna crocea	48.6	-	62.47	29.8	21.60	14.40	89.22	1.14	-
Hippopus hippopus	-	-	-	-	-	-	-	-	
Mytilidae	-	-	-	-	-	-	-	-	-
Veneridae									
Antigona sp.	-	0.48	0.18	1.05	-	-	-	-	
Donacidae									
Donax sp.	0.01	0.03	0.06	0.13	0.85	1.91	15.6	10.49	
Class GASTROPODA									
Trochidae									
Trochus pyramis	-	-	-	-	-	-	-	-	-
Turbinidae									
Turbo sp.	2.4	-	1.12	0.18	-	-	-	-	-
Neritidae									
Nerita sp.	4.38	-	2.91	4.23	3.73	1.26	1.01	0.92	2.0
Strombidae									
Strombus sp.	-	-	1.81	6.02	-	-	-	-	-
Lambis lambis	-	-	-	-	14.07	-	-	-	
Naticidae									
Polinicies sp.	-	-	-	-	-	-	-	-	
Muricidae	-	-	-	-	0.46	-	-	-	
Volutidae									
Melo amphora	-	-	-	-	-	-	-	-	
Conidae									
Conus sp.	-	-	-	-	-	-	-	-	
Land Snail									
Xanthomelon sp.	-	-	2.99	-	-	-	-	-	
Unidentified gastropod	-	-	-	-	-	-	-	-	
Unidentified fragments	13.21	-	6.0	7.87	7.68	6.6	8.41	9.59	4.9

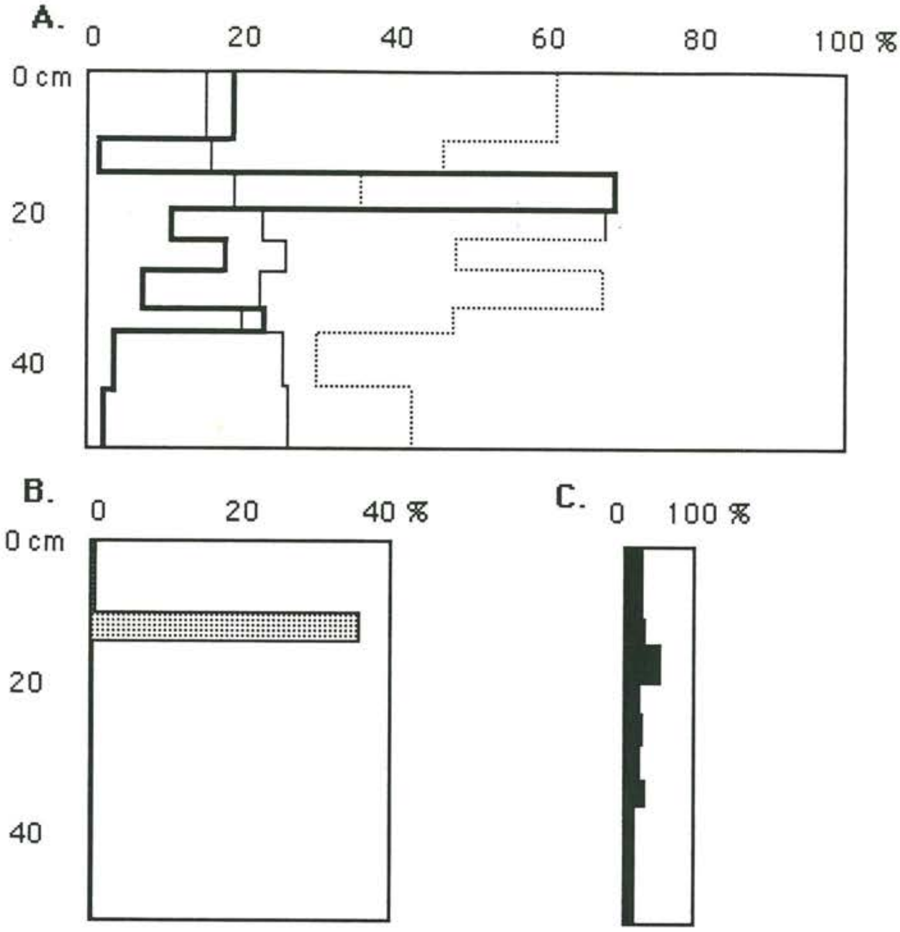


Fig. 6.10

A. Percentage of dominant rchaeolgical remains in auger hole on MIdden PBS 5

— Shell species retained by 5 mm sieve
— Shell species retained by 2 mm sieve
--- Matrix

B. ▦ Stone manuports, coral fragments and plant residue

C. Archaeological remains as a percentage of the total sediment from auger hole on Midden PBS 5 (see Fig. 6.2).

Given the limited extent of the test excavation, no attempt has been made to calculate the actual meat content of the different shells or to determine the exact role shellfish and fish played in the diet of the population of Orpheus Island (see discussion below).

6.5 Late post-glacial settlement pattern of Pioneer Bay South

The above geomorphological information, as well as discussion on the theory of domiculture (Hynes and Chase 1982) in the previous chapter, and the results from the soundings at PBS 3 and PBS 5, allow a tentative reconstruction of the late Holocene settlement pattern in this area of the bay. It would not be unreasonable to suggest that Aboriginal groups (possibly families) lived in huts in camps under the shade of fig trees on either side of a tidal creek at this bay. The shell midden deposits remaining and the dead fig trees within the vine forest are the possible remnants of these hypothetical camps. The middens appear to be the result of comparatively continuous occupation of these places by a small group of people, perhaps on a permanent or semi-permanent basis.

Part of their diet consisted of shellfish collected from the neighbouring reef flat and mangroves. Fish were caught either by line with cresent-shaped shell fish hooks or in the tidal fish trap on the reef flat. As some small mammal bones were found in the midden deposits, it might be assumed that these could also have been the result of meals. Fruits, roots and nuts were probably gathered from the surrounding vine forest and littoral zones. The existing Burdekin Plum trees might have formed part of the *domus* (Hynes and Chase 1982) or physical and cultural environment in which they operated as a society. These two hypothetical camp sites perhaps formed only part of a wider complex of camp sites, middens and associated domicultural plants which covered the beach ridge sequence and inner coastal plains during the period before European contact.

Water was obtained either from creeks during the wet season, or from soaks within the upper reaches of the creek beds during the dry season. Bark canoes, and possibly outriggers, were used to move around Orpheus and the other Palm Islands, and to cross to the mainland and other offshore islands.

Given the limited extent of the auger holes and excavations, no attempt has been made to calculate the actual meat content of the different shells or to determine the exact role shellfish and fish played in the diet of the population of Orpheus Island.

6.6 Seasonality

It has been demonstrated that the economy, movement of people and holding of ceremonies in the moonsoonal tropics is determined by the onset of several marked seasons throughout the year (Thomson 1939 ; Meehan 1977, 1982). Lack of ethnographic and archaeological detail for the Palm Islands prohibits any definite claims for seasonality. It is known from the ethnography (Jukes 1847:86; Carron 1849:9,16) that fishing was carried out during both the wet and dry seasons, and that shellfish were gathered throughout the year. Cunningham saw freshly burnt shells discarded on Palm Island in June, 1819. Whether the shells gathered were of the same genus in each case was not noted. There may have been a particular physical condition which made each genus and specie desirable at a certain time of the year or social restrictions on diet and gathering may have regulated their collection.

Determination of seasonality from archaeological remains where reef flat resources are available on a year-long basis presents difficulties, although recent work on the seasonal gathering of the pipi (*Donax deltoides*), as determined by oxygen isotope analysis (Godfrey 1988), may also be applicable to the relatively unchanging environmental conditions which exist on tropical reef flats. The efficacy of the technique is based on the continuous uptake of two oxygen isotopes (^{16}O and ^{18}O) by the shell as it grows, and is dependent on certain environmental parameters of water temperature and chemistry and the rate at which the molluscs grow. Seasonal changes in water chemistry need to be very small relative to water temperature, and molluscs which grow rapidly throughout the year are those most suitable for sampling (Godfrey 1988). If this technique is applicable to shell species commonly found in the Orpheus Island middens, it should be possible to determine if there was any preferential collection according to seasonal factors. For example, Meehan (1977:366; 1982) noted the *Anabara* preference for shellfish collected at the time when their 'fat' content seasonally attains a maximum level. The selective use of shellfish with a high fat content has been cited by Noli and Avery (1988) as a means of offsetting, to some extent, the problems of protein poisoning which come from an overuse of lean meat in the diet. The subsistence strategies of the Orpheus Island population might have been shaped by such a need to avoid overdependence on the high protein molluscs.

Environmental factors, such as the catastropic destruction of reef resources, may be reflected in a sudden species change within a shell midden. Reef flat organisms are subject to destruction from a number of sources: freshwater influxes from fluvial outflow or intense rainfalls can reduce salinity, breaching of moats by storms can result in lowered water levels and higher water temperatures, disease can cause mortality, and cyclonic surges and flood plumes from mainland river runoff can increase turbidity. Mass mortalities of giant clams (Tridacnidae) during the winter months of July and August are recorded from Lizard Island and Thetford Reef where the mortality rate was 25% for *Tridacna* spp. within 4 weeks (Alder and Braley 1988). Possible contributing factors in mass mortality rates amongst *Tridacna* spp. include toxins, predators, environmental conditions, pathogens and old age. Of these, pathogens and the combination of low temperatures and low tides during the winter months, appear to be the major cause of mass mortality. Hopley (1973b) earlier noted that on the leeside of the Palm Islands coral growth, normally subject to lower wave energies than those on windward reefs, suffered far more damage during Cyclone Althea in 1971 due probably to the influx of fresh water. All these factors can cause ecosystem impoverishment by the death of reef flat organisms, and this may be reflected in the archaeological record as changes in the frequences of shellfish. If environmental changes of any magnitude occurred during the period of Holocene occupation of Pioneer Bay, it is not evident from such small archaeological samples as those obtained to date. The sounding on PBS 3 would appear to represent a continuing deposition without any marked change in the composition of the deposits apart from increased fragmentation of shells with depth.

CHAPTER 7

FISH TRAPS OF ORPHEUS ISLAND

7.1 General description of rock-walled fish traps

Fish traps with walls constructed of stones are reported throughout Australia from riverine and coastal areas (King 1837; Enright 1935; McCarthy 1970). Tidal rock-walled fish traps in the Eastern Islands of Torres Strait are described by Sweatman (1847:558-9), and some at Moa were recorded by Vanderwal (1973) to be still functioning in 1972. In North Queensland Johnstone (1903) described tidal fish traps constructed of stones and generally laid out in a semicircular shape as weirs.

The best examples he saw were those of the Scraggy Point complex on Hinchinbrook Island (which lies to the near north-west of Orpheus Island) with some walls about 5 ft. (1.5 m) high, built of rocks firmly cemented together by rock oysters (Johnstone 1903; see also Stephens 1945, 1946; Campbell 1982). A complex on Goold Island, just north of Hinchinbrook Island, is about 20% of the size of the Scraggy Point one, similarly located at the mouth of a freshwater creek and almost covered by sand and mud (Campbell 1979). Bird (1987) also reports on the existence of a fish trap near RM Creek in Upstart Bay to the south of the Burdekin delta.

The fish traps in Pioneer Bay, Orpheus Island are simple horseshoe-shaped structures with low walls in differential states of repair and no significant infilling by sediments. Runoff from the streams in the two bays has little influence on the fish traps which are situated away from their outlets. Both traps are close to mangroves as are those at Scraggy Point. Little sediment is deposited from longshore drift along the coastline, and only a thin coating of biogenic mud is present within the traps.

The Pioneer Bay South fish trap is situated on the southern side of the reef flat at the eastern extremity of the boulder and rubble bank. It has been largely destroyed and is difficult to distinguish at ground level (see Fig. 7.1; Plates 7.1 and 7.2). This fish trap is roughly rectangular in plan and covers an area of 1,125 m^2. It has a race inlet on the reef flat side towards the rubble bank. Between the two groups of mangroves growing on the landward side of the trap is what appears to be another race-like structure. Only a few oysters cling to the rocks around the trap and no cementing together of the rocks in the walls is evident.

Natural moating on the reef flat may have been utilised in the construction of the Pioneer Bay South fish trap, as water remains in an area of approximately 60 m^2 even at low water spring tides. Muddy sediments cover all of the trap apart from the higher parts of the stone walls and other minor topographic highs. The walls are constructed of weathered terrestrial rock from the boulder beach lining the headland. A marked area of oxidised terriginous sediments of large angular gravel to cobble- sized stones

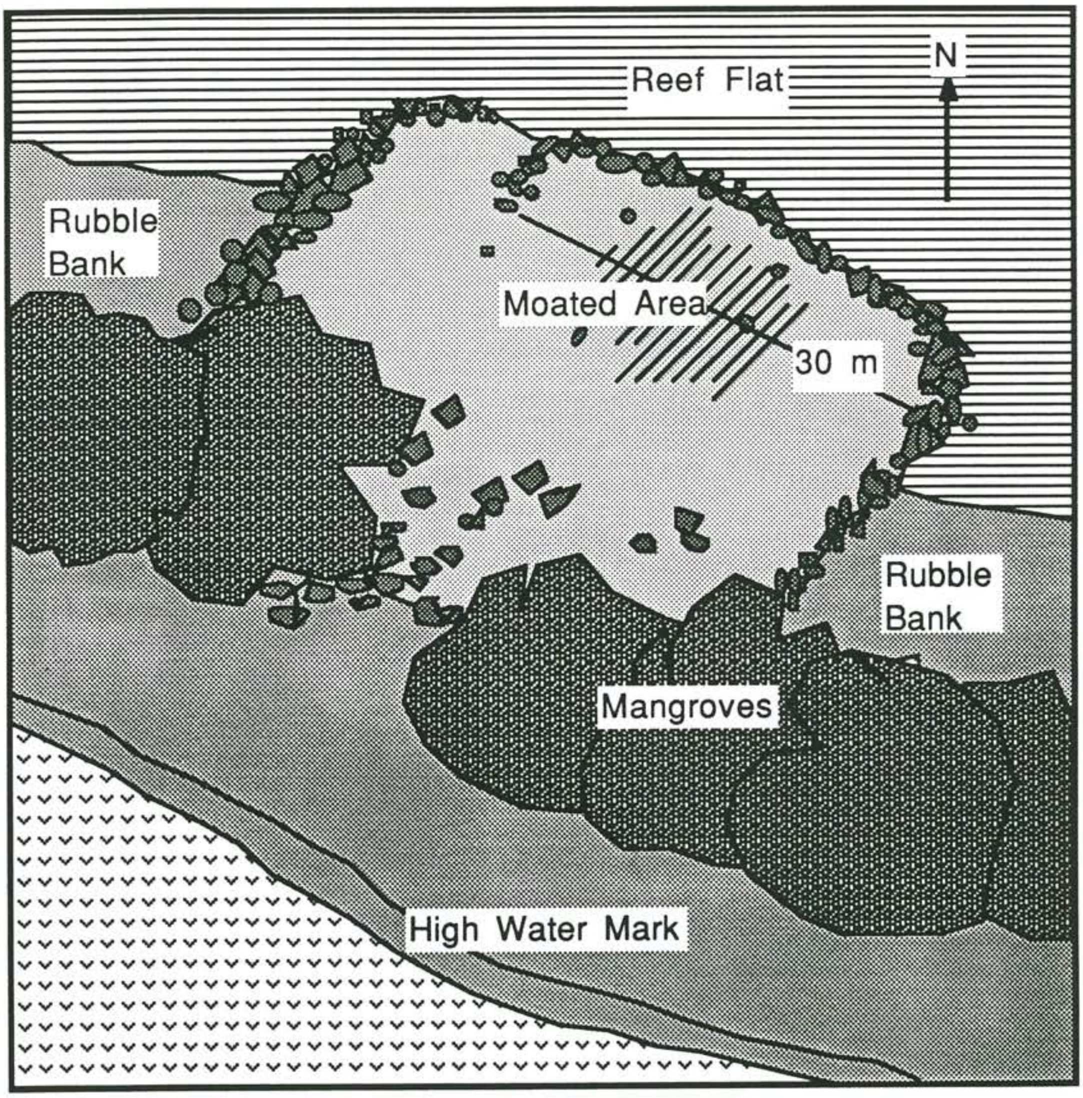


Fig. 7.1 Fish trap on the southern side of the reef flat in Pioneer Bay South, Orpheus Island.

Plate 7.1 Pioneer Bay South fish trap looking towards the mainland

Plate 7.2 Pioneer Bay South fish trap looking back to the beach and surrounding drainage basin

characterises the eastern section of the wall.

The fish trap in Pioneer Bay North is situated on the southern side of the bay and within the rubble bank (see Fig. 7.2; Plates 7.3 and 7.4). It is much more coherent in form than the Pioneer Bay South fish trap. It has a simple rounded rectangular shape with no raceway structures and covers only 600 m^2. As found in the Pioneer Bay South fish trap, no cementation of rocks in the walls is present. The floor of this trap is covered with sediment and rock debris of large angular gravel size, the individual stones being approximately 16 cm^3 in volume. This shattered rock may represent residual material remaining after the larger rocks had been moved to the perimeter of the trap to form the walls, or they may have been deposited within the trap by storm surge after its construction.

Nearly all shell species found on the middens are found at the present time on and adjacent to the fish traps. The one exception is *Trochus sp.*, which must be dived for off the coast of the Island (Richard Brayley pers. comm.). This suggests that gathering of shellfish and collection of fish from the trap could be companion activities, as noted by Campbell (1982) for the Scraggy Point complex.

7.2 Wall heights

An exploratory sounding beside the walls of both traps to determine if rocks extended below the present surface failed to

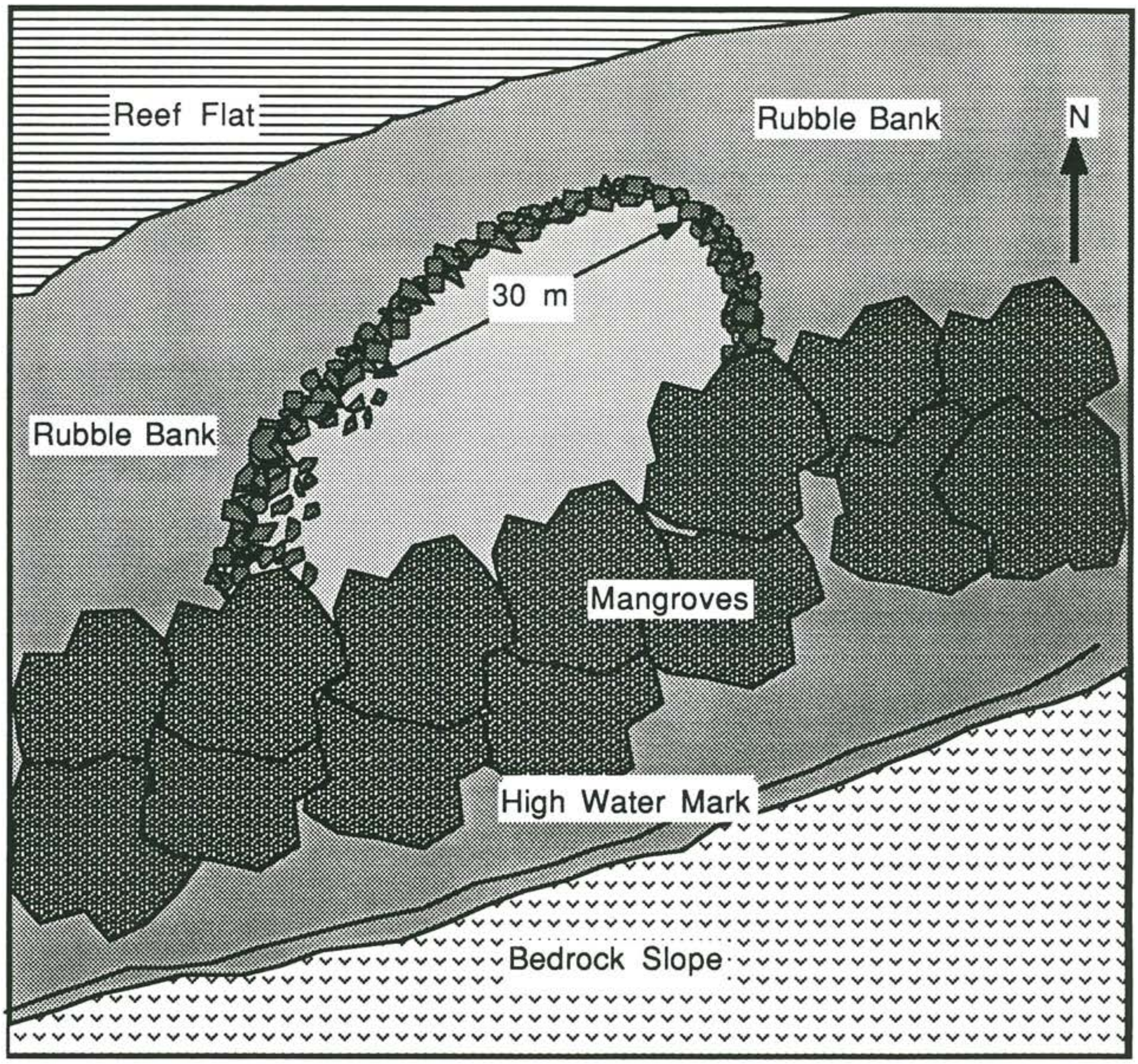


Fig. 7.2 Fish trap on the southern side of the reef flat in Pioneer Bay North, Orpheus Island.

Plate 7.3 Pioneer Bay North fish trap looking towards the mainland

find any evidence of this. The height of the wall can only be measured from the present surface of the reef flat. Dead microatolls lie immediately beneath the lower rocks with the intervening gaps infilled with reefal sediments (see also Hopley 1982).

An attempt was made to calculate the height of the walls of both traps from the rock material at present in and around the walls. Rocks were measured and counted around the perimeter of the trap from the southern corner of Pioneer Bay South fish trap, until a frequency was determined for four size categories which seemed to be representative of the rocks forming the wall. Rocks of the smallest category were small enough to have been carried by a child of say 4-10 years of age, while the largest rocks would have needed to have been rolled or levered into position. This might help to explain why the number of large rocks increased towards the boulder beach end of the trap. Counting continued for one hour for a total distance of 37.5 m around the perimeter of the wall and included all scattered rocks within the confines of the trap area which this wall section enclosed. The results are shown in Table 7.1. The height of the walls was calculated using the total volume of rocks counted, the distance measured around the wall for one hour's counting and an average for wall width of 38 cm measured at twenty-two points ranging from 25 to 50 cm in width around the perimeter of the wall, from the southern corner to the end at the race mouth. The upper limit (**A**) and median (**B**) of each rock size category was used in the calculation. Assuming the original wall width was at least 50 cm, i.e. for increased stability, the

Table 7.1 Volumes of rocks from the wall of Pioneer Bay South fish trap;
A. estimated from the upper limit of each of four size categories;
B. estimated from the median of each size category.

A

Size Category	Number	% of all rocks counted	Volume in cm^3
1,000 - 5,500 cm^3	509	71.1%	2,799,500
6,000 - 14,500 cm^3	152	21.2%	2,204,000
15,000 - 19,500 cm^3	30	4.2%	585,000
20,000 - 25,000 cm^3	25	3.5%	625,000
		Total	6,213,500

Length Measured 3750 cm x assumed width 50 cm = 187,500 cm^2

Giving a wall height of 33.13 cm.

B

Median of each size category	Number	% of all rocks counted	Volume in cm^3
3,000	509	71.1%	1,527,000
11,500	152	22.2%	1,748,000
17,500	30	4.2%	525.000
22,500	25	3.5%	562,500
		Total	4,363,500

Length measured 3,750 cm x assumed width 50 cm = 187,500 cm 2

Giving a wall height of 23.2 cm.

reconstructed height of the wall for case **A** was 33 cm and for case **B** 23 cm. The observed height of the wall in 1928 was in fact about 60 to 75 cm (G. Morris pers.comm.).

Actual removal of rocks to collect oysters (G. Morris pers. comm.) and mechanical destruction of the walls by storms since 1928 probably accounts for the descrepancy between the recorded 1928 height and the reconstructed height obtained by this study. Rocks located well beyond the immediate surrounds of the trap were not included in the count.

At the Pioneer Bay North fish trap the same size ratio for the rocks forming the walls and an average wall width of 50 cm were again found to be the likely case. Rocks around the perimeter of the wall were counted for one hour using the same categories (see Table 7.2). Assuming an original average wall width of 50 cm and measured length of 14.15 m, and again using the upper limit of each size category (**A**) and the median of each size category (**B**), the reconstructed height of the wall was calculated to have been 99.2 cm for **A** and 72.2 cm for **B**.

Both Pioneer Bay traps are in comparable positions on the reef flat in each bay and are subject to comparable wave and tidal influences, as well as to rarer catastrophic cyclonic events. Cyclones usually approach the north Queensland coastline from the general direction of the Coral Sea to the north and north-east. When in the direct path of a cyclone, an area will suffer from winds mainly from these directions owing to the wide geographical

Table 7.2 Volumes of rocks from the wall of Pioneer Bay North fish trap;
A. estimated from the upper limit of each of four size categories;
B. estimated from the median of each size category.

A

Size Category	Number	% of all rocks counted	Volume in cm^3
1,000 - 5,500 cm^3	495	66.0%	2,722,500
6,000 -14,500 cm^3	156	21.0%	2,262,000
15,000 - 19,500 cm^3	89	12.0%	1,735,500
20,000 - 25,000 cm^3	12	1.0%	300,000
		Total	7,020,000

Length Measured 1,415 cm x assumed width 50 cm = 70,750 cm 2

Giving a wall height of 99.2 cm.

B

Median of each size Category	Number	% of all rocks counted	Volume in cm3
3,000	495	66%	1,527,000
11,500	152	21%	1,748,000
17,500	30	12%	525,000
22,500	12	1%	562,500
		Total	4,362,500

Length measured 1,415 cm x asumed width 50 cm = 70,750 cm^2

Giving a wall height of 72.2 cm.

extent and clockwise movement of the cyclonic formation. Therefore, the west and south-west sides of high continental islands on the east coast of North Queensland are relatively sheltered. However, when a cyclone remains almost stationary on the seaward side of the islands, and depending on its lateral extent, the backswing of the formation can bring strong winds with a westerly component. This creates windwaves much higher than normal for sheltered reef flats. When these winds coincide with low tides which expose the flat to the full influence of the waves, much structural damage to the reef fabric can occur.

Both fish traps are on the southern shore of rocky headlands of leeside bays, backed by mangroves, but away from creek mouths. Pioneer Bay North fish trap is in better condition than Pioneer Bay South fish trap, and its reconstructed walls are approximately three times higher than the reconstructed walls of Pioneer Bay South fish trap. In plan they differ, as the Pioneer Bay South fish trap has a more intricate design. As pointed out above, neither trap has any great degree of cementation by oysters, so this appears not to have been an important factor in differential preservation, say like on Hinchinbrook Island (see Campbell 1982). However, the collection of oysters from the Pioneer Bay South fish trap as part of an oyster lease may have affected that trap. These variations in structural detail, height of walls and state of preservation between the two traps could also suggest a time difference in their construction.

The complex at Scraggy Point on Hinchinbrook Island involves a series of traps from older to youngest, the youngest in places being built over older structures (Campbell 1982; Campbell and Mardaga-Campbell 1990), implying a difference in sea level or mean tide level, in relation to the wall height through time. Prograding shorelines of the Hinchinbrook Passage since the Holocene transgression may have altered the tidal regime of the mudflats, and subsequently the height of sea level in relation to the traps, or destruction by mechanical action of waves or subsidence of the walls into the muddy substrate may have occurred. Whatever the case actually was, some replacement by new structures was clearly necessary to maintain the resource base. This could help to explain the complexity of this Hinchinbrook site.

The Scraggy Point traps are more intricate in design compared to the simpler shapes of the Pioneer Bay fish traps (Fig. 7.3) and the height of the walls of the Scraggy Point traps is, and has been in historical times, higher than the Pioneer Bay walls. Today the best preserved walls at the Scraggy Point complex, which covers about 21,600 m^2 on Hinchinbrook Island, are of the order of 0.5-0.8 m and cemented by heavy oyster growth (Campbell 1982). These heights were measured and mapped in 1980. Early in the century Johnstone (1903) recorded the height of the walls as 1.5 m. At the end of the World War II Stephens (1945, 1946) recorded some walls from 0.4-0.6 m high for the complex. These heights must be regarded as estimates only as they are lower than the averages recorded by Campbell (1982) thirty-six years later. A

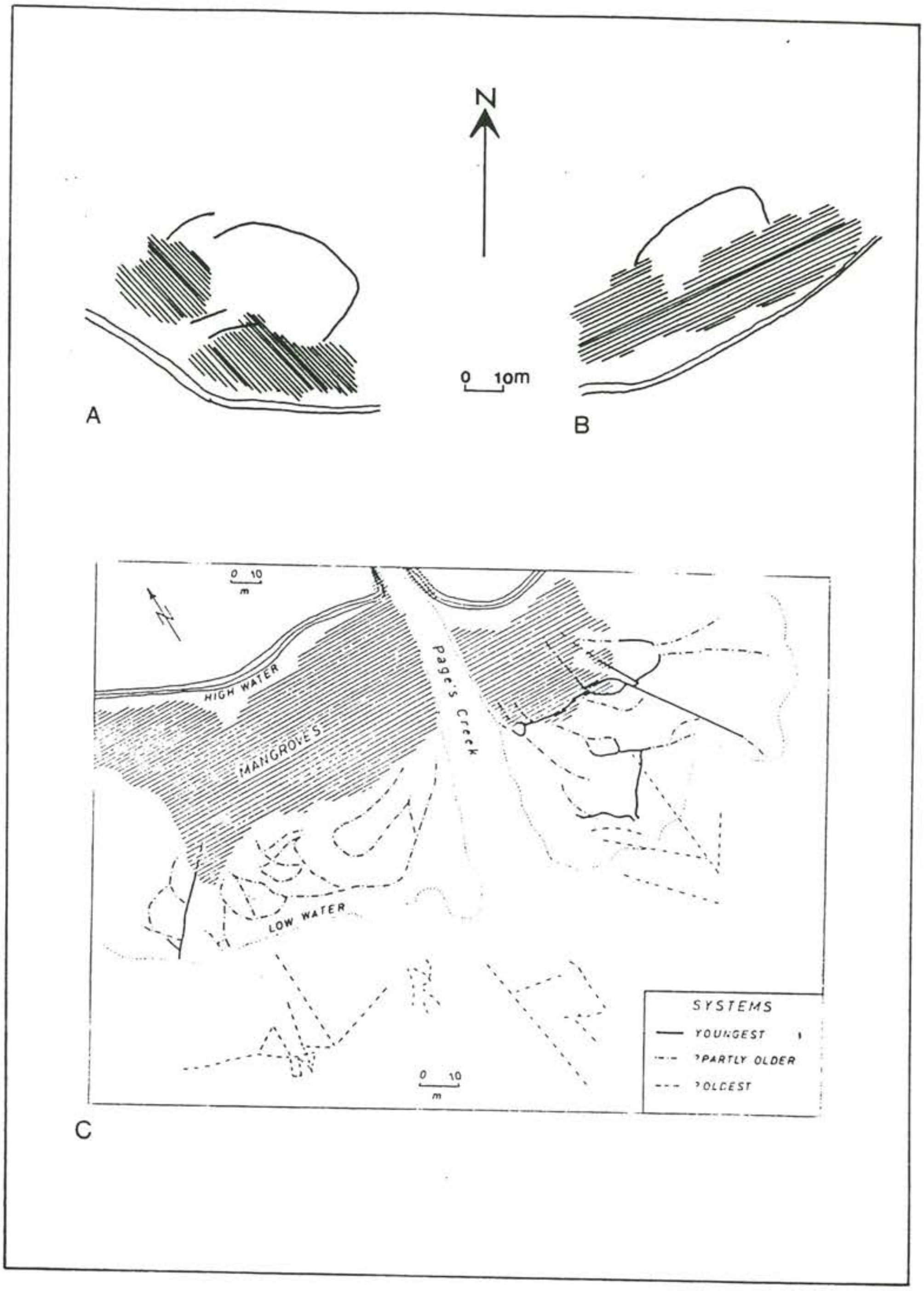


Fig. 7.3 Comparison of Pioneer Bay fish traps with Scraggy Point, Hinchinbrook Island, fish trap complex.

reduction of up to approximately 1 m has occurred from 1903 to 1980. Bird's current PhD research on Hinchinbrook Island may reveal further changes in the heights of these fish trap walls (Michele Bird pers. comm.).

The estimated volume for the oldest system is 1,220 m^3 (Campbell 1982). The volume of the Pioneer Bay South trap with an area of 1,125 m^2 and a height of 60 cm in 1928 would have been 675 m^3, and today with an estimated wall height of 28 cm the volume would be 315 m^3. The Pioneer Bay North trap with an area of 600 m^2 and an estimated wall height today of 99 cm would be approximately 600 m^3. At no time would the Pioneer Bay fish traps have approximated in size those of Scraggy Point.

The unconsolidated sediments of the mangrove lined mudflats of Scraggy Point on Hinchinbrook Island and the firm cemented reef flats in Pioneer Bay North and South, Orpheus Island, present contrasting substrates for the construction of rock walls. On the reef flats mechanical destruction by wave action would be the major natural factor involved in wall breakdown. Sedimentation and subsidence would presumably have played the major role in the destruction of rock walls at Scraggy Point. As pointed out above, these factors might in part account for the complexity of Scraggy Point compared to the simplicity of the traps on the reef flats of Pioneer Bay.

Mechanical destruction by wave action or removal of rocks by people collecting oysters may have contributed to the reduction in wall height of the Scraggy Point complex since the cessation of maintenance by the Aboriginal builders. No detailed investigation of the Goold Island trap has yet been carried out, although Bird (pers. comm.) will be undertaking that.

There is not only a difference in substrate between the two sites, but a difference in environmental conditions for marine organisms also. The tidal waters of the Hinchinbrook Passage close to the mainland would contain, in general, different fish species from the reef flats of the offshore islands of the Palm Group and different strategies would be required in their capture. Higher walls may have been necessary to retain fish in the Hinchinbrook Passage. For example, Kowanyama ('Mitchell River') Aboriginals built weirs of bushes and grass across the river to a height of almost 2 m above the water to prevent leaping fish from escaping (Done 1926-29).

7.3 Date of construction

The earliest date possible for the construction of both traps in Pioneer Bay would be the date at which the lateral extension of the fringing reef, i.e. from the perimeter of the bays towards the middle, reached the width on which the traps would fit. Hopley *et al.* (1983) suggest that corals would have become established around the rocky shores shortly after 7,000 BP. Fringing reef extension over unconsolidated sediment banks, which accumulated during the Holocene transgression, is considered to have commenced at that time. Turbidity, due to the reworking of sediments by rising sea levels, retarded the rate of horizontal accretion across the reef flat. As turbidity decreased the rate of accretion increased (Hopley *et al.* 1983).

The Pioneer Bay South reef flat developed at a higher sea level at c. 5,000 years BP, a pattern common to many fringing reefs between Bowen and Cardwell (Hopley *et al.* 1983). It is now completely devoid of living corals except for the 100 m of the reef rim. Three holes drilled across the Pioneer Bay South reef flat from the reef rim towards the beach provide dates for vertical and horizontal accretion (Hopley *et al.* 1983).

From dates of coral samples from the drill holes (Hopley *et al.* 1983; see also Fig. 6.1), it is possible to suggest the time when the Pioneer Bay South reef flat may have reached a width which could have accommodated the fish trap structure. At the calculated rate of 5-10 cm per year for horizontal accretion it would take somewhere between 500 and 1,000 years to build a 50 m wide shelf. This is of course assuming that growth occurred everywhere evenly and towards the centre of the bay. The bathymetry, as measured by Parnell (1987; see again Fig. 6.1), would suggest that this was not so and that on the margins of the bay growth was slower than in the middle. Over time, the outflow of freshwater from the small streams at both ends of the beach may have affected the growth rates of corals within the influence of their plumes. This might account for the marked indentations towards both ends of the reef front, which are clearly visible in aerial photographs.

Parnell's (1987) 0.5 m contour line corresponds roughly to Drill Hole No. 2 of Hopley *et al.* (1983) where coral found *in situ* at a depth of -0.70 m was dated to 2,620 ± 90 BP [corrected age 2,160 ± 270 BP; this includes an ocean reservoir correction of -450 ± 35 years as per Gillespie and Polach (1979), correction for past variations in atmosphere ^{14}C concentration using the calibration curve of Clark (1975) to 6,500 years BP, and Barbetti's (1980) estimate for ages prior to 6,500 years BP]. A time later than this may be calculated for the actual reef flat surface from the vertical accretion rate (using the corrected age) determined by Hopley *et al.* (1983) of 3.15 mm/year for Hole 2 for an estimated height of 0.7 m. This gives a period of 2,000 years of vertical accretion for an estimated surface date between approximately 400 years BP and about the time of European contact.

Both fish traps in Pioneer Bay appear to have been built on the eroded surface of dead microatolls which form the framework of the reef veneer (Hopley *et al.* 1983). However, they may have been built on living microatolls which have since died and eroded, while the rock walls of the trap settled gradually, requiring occasional maintenance. If they were built on an eroded surface, a time period would have to be allowed for such erosion to occur.

Many studies have been carried out into the weathering of emerged reefs and limestone zones, and into individual species of reef flat organisms such as bioeroders and grazers (e.g. see Hamner and Jones 1976), but to my knowledge no studies have been done into the overall weathering rates of reef flats subject to tidal inundation.

Precise dating of either trap is not possible within the limits of the present study, but it is likely that all other things being equal 'better preserved could equal a younger structure'. If so, the Pioneer Bay North fish trap is probably younger than the Pioneer Bay South fish trap.

7.4 Location for other fish traps

In low level aerial photographs of the reef flat of Pioneer Bay South (e.g. see Plate 7.4) a faint outline of stones roughly echoing the shape of the known fish trap can be seen to the east of that trap. The impression received is of an earlier and similar structure. A transect was run from high water mark across this feature for 70 m (see Figs. 6.1 and 7.4) and compared to the two known fish traps.

This faint outline on the reef flat in Pioneer Bay South would appear on closer examination to be a natural shoaling feature of the reef flat. While some larger stones do appear to be widely spaced along a line for some small part of the structure, these stones are closest to the bayhead wall of Pioneer Bay South fish trap and may have been rolled from their position in that wall by storm surge. The major part of the feature is made up of gravel banks of angular to sub-angular terrestrial material covered in part with algal growth and separated by shallow ponding. As suggested above, the bayhead side wall of Pioneer Bay South fish

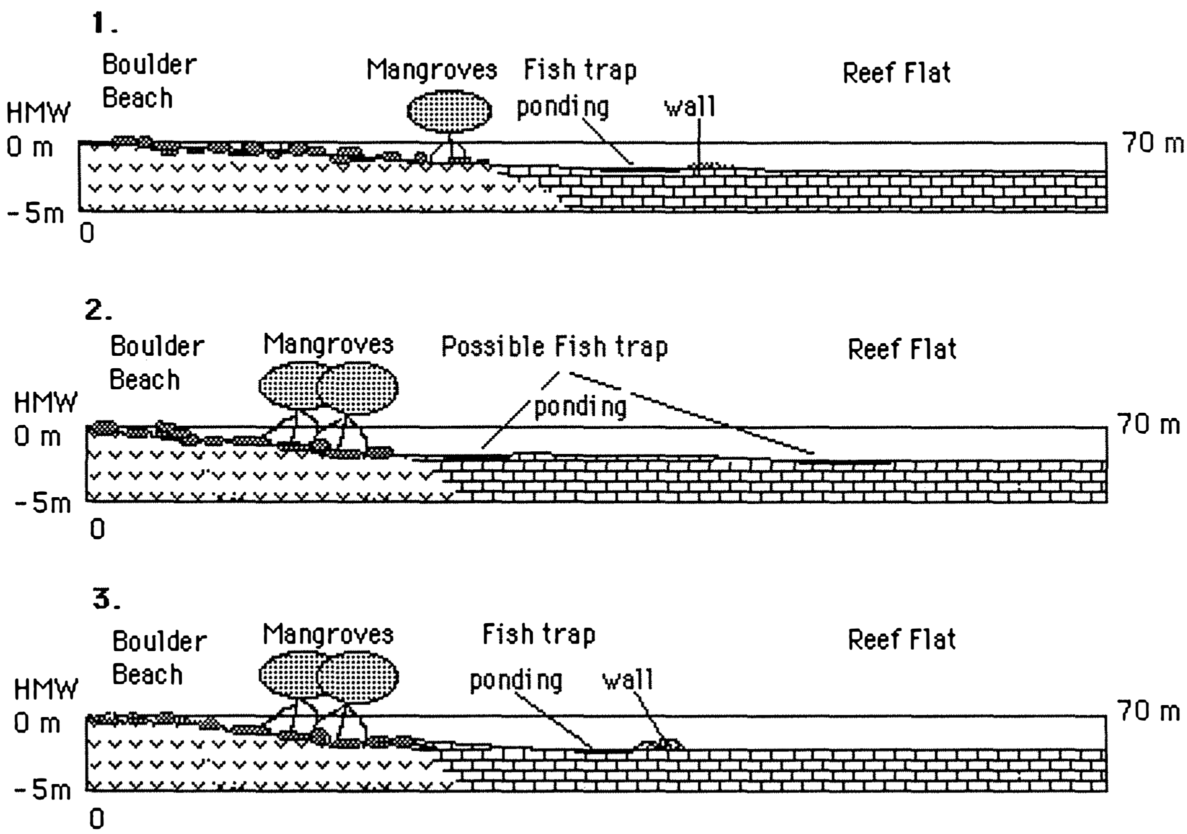


Fig. 7.4 Transects across fish traps from high water mark.
1. Pioneer Bay South fish trap
2. Possible fish trap in Pioneer Bay South
3. Pioner Bay North fish trap

Plate 7.4 Low level aerial photograph of Pioneer Bay South, Orpheus Island, showing the fish trap (arrowed)

trap may also have been constructed on just such a gravel bank.

It would appear from the similarity in the location of the two fish traps in Pioneer Bay that it might be possible to predict the siting of rock-walled fish traps around Orpheus and other islands of the Palm Group. This possibility seems even more probable as two more traps have been found on Orpheus Island in likely spots. One at the north-western side of the rocky headland at the southern end of Gnoora Beach. This is sited where it would have been predicted that a fish trap might be found. The second was uncovered by Cyclone 'Aivu' at the south-eastern end of South Beach in a relatively sheltered position near the headland. What appeared on a first visit to be a line of small stones across the mouth of the creek was revealed as a low (~30 cm) rock-walled fish trap (see Plates 5.16 and 5.17).

A platform of cemented conglomerate is located on the north-eastern side of the submerged ridge connecting Orpheus Island with Fantome Island (Fig. 4.1). Superficially it appears to have a similar structure to the Pioneer Bay South fish trap. An arm of the cemented material surrounds a lagoon-like area on the seaward side (see Plates 5.14 and 5.15). After rain fresh water pours freely out of the beach from the lagoon behind the boulder wall on the landward side of the platform. This may contribute to the erosion of the platform resulting in the present formation. This lagoon could be easily blocked and could have been used for spearing and netting of fish, as presumably were the constructed fish traps.

The factors in common between the known fish trap sites on Orpheus Island are the presence of a platform on which to build, a relatively sheltered position and boulder beaches with a ready supply of stones suitable for the construction of fish trap walls. Sections of the coastlines of the other Palm Islands with these attributes may therefore be potential sites for fish traps. One large fish trap complex is sited in Horseshoe Bay, Great Palm Island (Eric Bunn pers. comm.; see also Plate 7.5), and its relatively large size possibly reflects a larger human population in its vicinity.

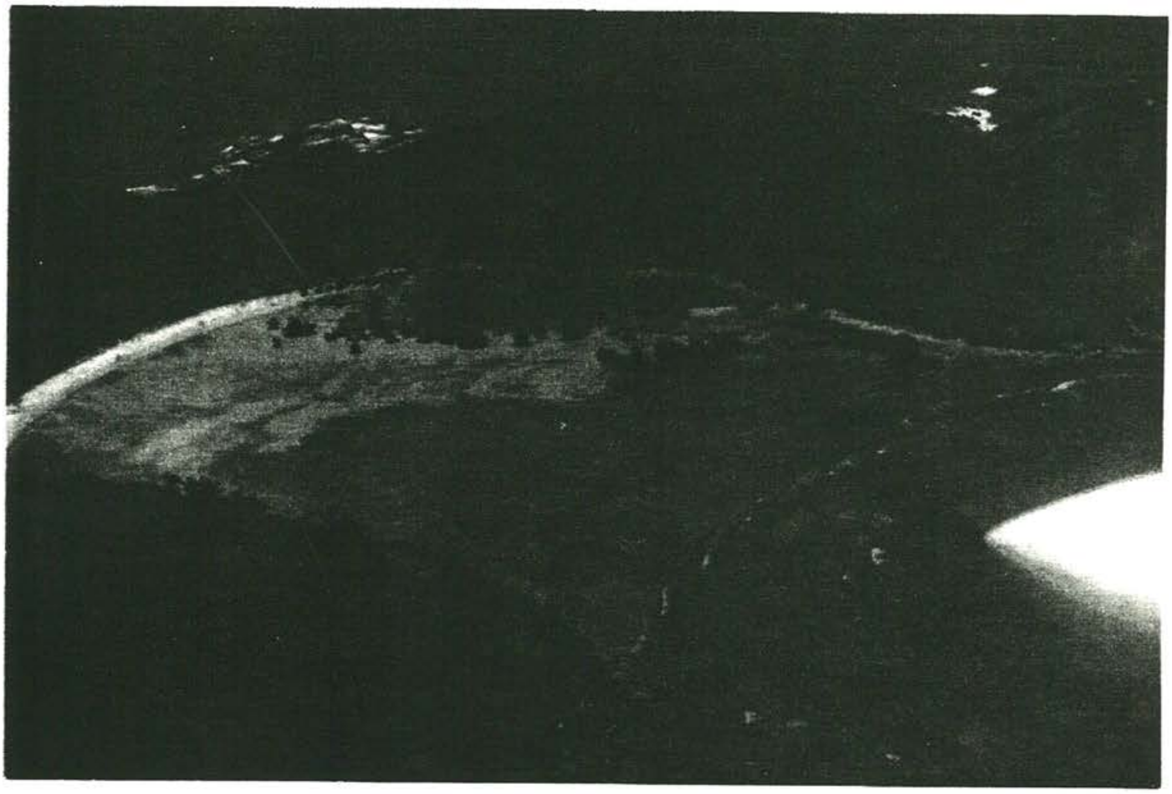


Plate 7.5 Fish trap complex in Horseshoe Bay, Great Palm Island

CHAPTER 8

DISCUSSION AND CONCLUSIONS

8.1 Pleistocene sites

The episodic sea level rise model of Carter and Johnson (1986) has been suggested as a starting point for potential underwater archaeological research which, if successful, could confirm both the validity of the model and the presence of people on the continental shelf in the vicinity of the Palm Islands during the period under scrutiny. Possible places for underwater archaeology have been identified from the reconstruction of the palaeogeography of the continental shelf in the Herbert / Burdekin region, and potential for analogous underwater sites defined by the Holocene archaeological remains on Orpheus Island. For example, shell middens similar to those found today in sheltered leeside bays and covered by vegetation might survive a sea level rise relatively undisturbed. Rock- walled fish traps which daily undergo attack by wave action in these same bays might also survive, if the sea level rise quickly outstripped the growth of coral which otherwise might obscure them, or if they were covered by sand before the sea level rise. Small scale underwater surveys in areas which have been defined by the maps of former coastlines as island masses during the Holocene sea level rise (see Chapter 3) might disclose the presence of preserved sites similar to those found on Orpheus Island.

The present study has not located any archaeological sites on the emergent landmasses which appear to have any great age depth, but earlier sites situated closer to the 9,000 year BP (-23 m), and earlier, shorelines might be found on island sites near the palaeochannels of the Herbert and Burdekin Rivers. The plains between the topographic highs on Great Palm Island and the environs of the swamps and lagoons bordering these plains, present the best chance for finding older sites within the Palm Island group. Shell middens of probable recent Holocene age have been already been located around the beaches adjacent to the settlement areas on Great Palm Island. One shelter with rock pictures and a fish trap complex have been recorded (Eric Bunn pers. comm.).

8.2 Environmental changes

Since the presumed arrival time (c. 40,000+ years BP) of human beings in Sahul,the 'Greater Australian' continent, there were two periods when drastic changes occurred to the environment: the first when sea level receded to about -130 m at c. 25,000 BP, and the second when the Holocene sea level rise inundated the shelf to the present level. Admittedly, the changes were slow on a human scale, and assumptions about the actual environmental conditions are but sparsely backed up by modern evidence. Nevertheless, an inevitable change to less optimal conditions occurred if optimal conditions for gatherer / hunters are those described by Hallam (1987) as coastal and riverine plains. On the continental shelf in the Herbert / Burdekin region of North Queensland what this meant in essence is that at both periods of time a change to a more marine-based economy was necessary to off-set the loss of wetlands with their abundant resources. The topography of the shelf below -70 m is steep and would have provided few if any places where wetlands could become established. The riverine environments of the Herbert and Burdekin Rivers, downcut into the edge of the continental shelf, would have borne the burden of human exploitation at this time of lowest sea level during first occupation of the Australian continent. Any wetlands existing would have been on a very reduced basis compared to the major periods of the Pleistocene, when sea level remained at the -60 m level (Hopley 1982) and large estuarine and freshwater wetlands were most probably associated with the two rivers. Similarly when the Holocene sea level rise isolated the Palm Islands, the greatest loss to the human economy was the loss of wetlands on the coastal plains surrounding the 'Palm Range', as well as in this case the riverine environment of the Herbert River.

Present day freshwater wetlands such as the Townsville Town Common bear a great diversity of plant and animal life. At least seven different edible plants grow on the Common today (Rowlatt 1981): *Triglochin procera* (Arrow Grass), *Eleocharis dulcis* (Bulkuru), *Typha* sp. (Bulrush), *Nymphaea gigantea* (Blue or Giant Water Lily), *Aponogeton queenslandica* (Water Hawthorn), *Marsilea drummondii* and *M. mutica* (Nardoo) and *Nelumbo nucifera* (Pink Lotus). Many species of waterbirds breed on the Common and feed on the plants and animals supported by the wetlands. The loss of such rich resources would have triggered a readjustment in the economy of the early Palm Islanders.

If the sea did in fact rise episodically and the proposed stillstands of Carter and Johnson (1986) did occur, then during each phase of major environmental change biogeographic and geomorphic processes must have operated to produce minor changes. One such small environmental change in recent times is demonstrated by the growth of the *Eucalyptus tessalaris* forest onto the grasslands of Orpheus Island. From a comparison of modern distribution of this species and 1978 aerial photography, it can been seen that over a period of about 10 years considerable expansion to the forest has occurred. Adaptation to small changes in environmental conditions over time must of necessity have caused some modification to human behavioural responses (cf. Schrire 1984).

8.3 Holocene sites

This survey has revealed the existence of a number of previously unrecorded archaeological sites in the inland of Orpheus Island, as well as on its beaches. The spatial pattering of sites found during fieldwork shows that all three environments of coast, riverine and inland were exploited by Aboriginal people. The archaeological sites identified as having been extant after the stabilisation of sea levels may appear at first glance as a new colonisation, but in reality they may be only the indirect evidence of increasing abundance of coastal resources and more extensive use of them (cf. Beaton 1985; but see also Cribb 1986).

Islands as circumscribed areas vary in the degree to which they are able to support a resident population. This ability, or 'carrying capacity', depends on size, climate and resource avilability. The Palm Islands today are continental islands on the edge of the humid tropics, richly endowed with marine resources from well developed fringing reefs. Each of the larger islands was probably capable of supporting a permanent population before European settlement, yet after the islands were isolated there may have been a period of harder times for any people remaining. Wave energy would have been unimpeded by barrier reefs and tudbidity would have been higher (Hopley 1984), and although barrier reefs probably established themselves soon after 7,000 years BP around the rocky headlands (Hopley *et al.* 1983), it was not until the cesssation of turbidity due to the reworking of sediments by rising seas that fringing reefs of sufficient size to support a more marine-oriented resource became available for exploitation.

The numerous middens and the fish traps attest to the fact that much dependence was placed on marine resources. The results of the two small excavations may reflect this, but they unfortunately do not provide a sufficiently large enough sample to prove it indisputably. Plant remains within the middens have not been analysed, but the few seeds found could have been incorporated into the deposits from the covering vine forest. The present-day plant resource is poor in roots and tubers but relatively rich in fruits, although as discussed above small scale changes no doubt have occurred since European contact. Further, roots and tubers might have been more plentiful before goats were released on the islands.

8.4 Orpheus Island settlement patterns

For the period immediately before European contact, the population on Orpheus Island may have been heavily dependent on marine resources, but it has not been proven archaeologically that larger native land animals (e.g. macropods) than presently living on the islands did not formerly exist there. Neither has it been proven archaeologically if a human population existed permanently on the Island, or islands, throughout the prehistory of northern Australia, or if the Island was only inhabited periodically and by different peoples. What has been determined is that the more recent inhabitants lived and ate meals across much of Orpheus Island whilst using a variety of sites, with an apparent dependence on the modern reef flat and marine resources. The presence of a shell midden high on the eastern cliff top, the small scatter of clam shells at the creek on the eastern side of the Island and other reported but still unconfirmed inland middens, show that movement around the Island carrying at least some food supplies occurred, for at least the period that these sites were being formed. Settlement appears to have been more intense on the leeside of the Island, a conclusion reached also by Greer (1981) for Magnetic Island and Campbell (1982) for Hinchinbrook Island.

No clear exploitive patterns have as yet been determined from the preliminary sampling, other than spatial distribution and type, and the possible evidence for domiculture as defined by Hynes and

Chase (1982). However, from the site distribution it is possible to suggest a pattern of usage.

At least one or more semi-permanent groups of people possibly had major camp sites on at least five beaches around the southern and western sides of the Island. People might have moved from site to site according to the abundance of water and other resources in each particular area or each beach might have had a particular group as owner / custodians.

For example, if the burrowing clams were proving too great an effort to obtain on one reef flat because those close to the shore had been harvested, under the first scenerio, a shift to another beach with fringing reef may have ensued under a rotation pattern of usage, perhaps adopted to ensure that each resource area had a recovery period. Moves may have been made from camp to camp according to the availability of plant foods to supply essential carbohydrates, or to social factors which dictated how and when resources were exploited. More protected inland sites such as the midden on Unnamed Creek, which has a very small and reasonably level area above the midden, may have been suitable only to accommodate a few huts or shelters. The Unnamed Creek site may have been a favoured retreat for a small group from strong south-east winds, which affect the northern section of the Pioneer Bay North beach where PBN 1 is situated.

The fish traps in both Pioneer Bays, Gnoora and South Beach suggest that these bays were more likely to represent base camps.

Fish traps appear to have been constructed close to a camp, when a suitable platform of sufficient width and a plentiful supply of suitable stones were present.

The well protected camp site on the creek on the eastern side of the Island has areas nearby large enough to accommodate a number of shelters. A large number of trees which might have provided fruit and material for artefact manufacture form the gallery forest along the creek. Seasonal use of these trees and other plant resources may have been the primary purpose for camping in this spot. Only a small surface scatter of clam valves, possibly representing one meal for one person, were found at this site. The earliest radiocarbon date so far obtained establishes the late Holocene nature of two middens on the coastal dune sequence at Pioneer Bay South. These two middens, however, only represent a small sample of the extensive midden remains on the Island.

8.5 Evidence from the language

The evidence assembled during this preliminary study of the geographical and archaeological history of Orpheus Island raises more questions than it provides answers. Very little is known about the original Palm Islanders except for the remnants of material culture which have been preserved and the word lists which have been compiled. In 1884, about twenty years before settlement of the Herbert River district, two Belgian researchers (Houze and Jacques) visited Hinchinbrook Island and carried out a comparison between the language spoken there and that of two

Palm Island men also on Hinchinbrook at that time. The language spoken by the Palm Islanders was very different from that of the Hinchinbrook Islanders. It has since been established that two dialects of the *Wulguru* language were spoken, *Buluguyban* and *Mulgu*. Donohue (pers. comm.) considers that these represent twomigrations. In the evolution of the *Wulguru* language the *Buluguyban* dialect is the most conservative and therefore the oldest. The next split from the mainstream language was the *Mulgu* dialect. The dialect of Magnetic Island is next in the evolutionary line towards the more recent *Wulguru* language of the Townsville region.

Does the existence of two dialects within the Palm Islands represent two separate migrations to the islands from the outer shelf region? Or does it mean that a group of people speaking one dialect migrated to the islands where the second dialect was already spoken? Apart from the undeniable physical fact that the Palm Islands were isolated from the mainland by rising sea levels about 7,000 to 7,500 years ago, the evidence of the antiquity of the two dialects strongly suggests that little or only intermittent contact was maintained with the mainland for some considerable time. It is conceivable that such isolation would result in a stultifying of the language and lifeways on the islands and hence a diversification from mainland culture, where contacts with other groups were physically more likely. Why the two dialects were not assimilated into one should be left to the linguists to resolve, but it possibly says that one group occupied one part of the islands and the second another. The old channel of the Herbert River divided the 'Palm Range' into two sections when the sea level was directly to the east, and this might have been the boundary between the two language groups.

Rowland (1980, 1982) cites isolation and adaptation to an island environment as the explantation for the cultural differences between the Keppel people and the mainlanders in a somewhat similar situation on the Keppel Islands offshore from Rockhampton. Roth (1898) reported that the Keppel Islanders spoke a language which was unintelligible to the mainlanders and lacked the weapons commonly found on the mainland. Rowland (1982) suggests that cultural divergence from the mainland could be the pattern for many islands off the Queensland coast. Further research might reveal that those groups on islands isolated earlier by rising seas, such as the Palms, might have been further removed from mainland lifeways than people on islands closer inshore where contact was easier to maintain.

Several options exist to explain Holocene settlement patterns throughout the islands:

(1) The islands might have been continually occupied throughout the entire period of sea level fluctuations, augmented by new arrivals of people from the outer shelf as the coastline receeded;

(2) A population might have survived on the islands with a later migration from the mainland;

(3) The islands might have had a population which did not survive long after the almost total isolation by rising seas; or

(4) If a relict population did not long survive, the islands might have been recolonised at a later date from the mainland by two groups of people speaking different dialects.

With isolation caused by the rise in sea level, what might have been the previously far-ranging physical freedom of any human inhabitants remaining would have been curtailed, unless some type of watercraft was in use at this time. This former 'freedom' of movement assumes that people were not unduly restricted by small tribal / clan etc. territories during the late glacial, something which we cannot know. Given the recent discovery of what appears to have been much earlier regular navigation between the northern Melanesian islands of the last glacial off the northern coast of Sahul or 'Greater Australia' by c. 30,000 BP (e.g. see Wickler and Spriggs 1988; Allen *et al.* 1989), such a suggestion regarding watercraft is not unreasonable. The distance from Orpheus Island, for example, to the mainland at the -9 m shoreline would have been about 12 km. If a population remaining on the island had sea-going canoes, this would have presented no problem, and social contact with mainland peoples could have been maintained. However, if they did not have sea-going canoes for some or most of the initial millennia of isolation, then some divergence from mainland cultural patterns might have occurred.

8.6 Communication with other islands and the mainland

During the last century and the early part of this century, travel between offshore islands and to the mainland was comparatively commonplace. For example, people from Dunk and other Family Islands travelled by bark canoe down the length of Hinchinbrook Island to its southern end, although they had less contact with the mainland (Banfield 1908). People from the mainland visited Orpheus Island, and Great Palm Island people travelled to other islands of the group (Cunningham 1816-1831), to Rowes Bay on the mainland at what is now Townsville, to Magnetic Island (Palm Island 1975), to Hinchinbrook Island (Houze and Jacques 1884) and to the mainland at Halifax Bay (Meston 1895).

Outrigger canoes were seen by Johnstone (1904) coming in from the Great Barrier Reef to the Johnstone River mouth. These were dugouts of cedar logs which were capable of carrying twenty people. The Aboriginals in this area also had rafts which were used for fording the rivers. They sometimes used their large buoyant shields as aids for transporting gear or babies across estuaries or rivers. Outriggers are reported to have been in use as far south as the Whitsunday Islands (Rowland 1987). Cook (1771) noted canoes on the Palms, but he unfortunately did not distinguish between bark canoes and outriggers. MacGillivray (1852) noted reports of outriggers at Great Palm Island. Distances between islands (see again Table 1.3 and the mainland appear to have been less of a barrier to movement than territorial boundaries (Brayshaw 1977, 1990; Lumholtz 1890; Dixon 1976; N. Heijm pers. comm.).

In an interview with Brayshaw one of the last traditional Palm Islanders, Reg Palm Island (1975), spoke of visits to Orpheus

Island by mainland people who crossed from Taylors Beach near Ingham. They remained on the island for a few days and then sneaked in to Great Palm with raiding in mind. It is not clear from his remarks whether Orpheus Island was uninhabited or whether people were in permanent residence when the mainlanders visited on their way to Great Palm. These mainlanders may have been from the *Wargamay*, a group who spoke a language related to that of the Hinchinbrook Islanders (Dixon 1972, 1976, 1980). Fear of these neighbours may have been a factor in the continued alliance of the *Manbarra* with people of the Townsville area.

Weather also could have been a big factor in restricting movement from and to the islands, considering that the south-east winds blow for the greater part of the dry season, and the fetch is sufficient for 3 to 4 m waves to be generated in the passage. The need for relatively good weather for canoe travel might have worked to decrease the number of social and trade contacts with other groups of people. The old men of the Flinders Islands in Princess Charlotte Bay on the east coast of Cape York Peninsula, by lighting fires and 'singing', ensured fine winds for a safe passage for their canoes to the mainland (Hale and Tindale 1933). There is no ethnographic evidence that a similar procedure was carried out on the Palm Islands, but it is not beyond the realms of possibility.

However, considering the widespread use of canoes and other watercraft at the time of initial European contact, it is doubtful whether physical isolation was the major factor influencing the economy of the Palm Islands during the period immediately before

European contact. Social constraints of territorial boundaries most probably would have been the dominant factor in restricting movement. To what extent this situation prevailed back in time has not been determined, but it might have been only for a relatively short period of the late Holocene.

This study has described the present-day physical characteristics of the Palm Islands in general and Orpheus Island in particular. It has attempted to reconstruct the palaeoenvironment of the adjacent continental shelf during the latter part of the Pleistocene as well as the Holocene up to the present time. It has also attempted to show that cultural divergence from mainland lifeways was a inevitable outcome of isolation by rising sea levels.

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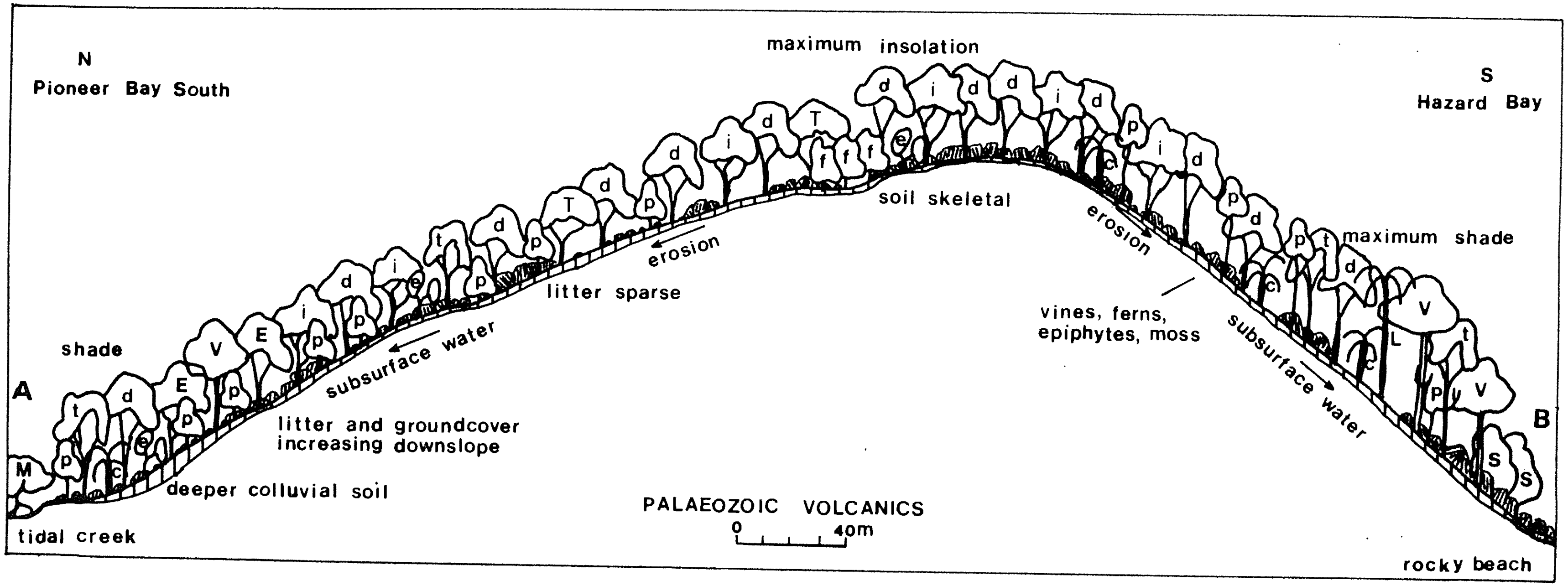
APPENDIX 1

Vegetation of the Palm Islands with an emphasis on Orpheus Island.

The vegetation of the Palm Islands has been interpreted from aerial photographs taken in 1978 and may not reflect the present patterns exactly. Goundtruthing was carried out during surveys of Orpheus Island from 1986 to 1989, and Great Palm Island in 1990. Observations during these surveys have been applied to patterns throughout the island group. A marked change since the 1978 photography has been noted in one area on Orpheus Island (Fig. App. 1.1, **A - B;** see aso Fig. 4.4, fold-out inside back cover) and is discussed below.

The vegetation of the Palm Islands consists of a mosaic of medium to low open forests and woodlands, open grass and shrub lands, and closed forest which includes mangroves and vineforests. The vegetation patterns (Fig. 4.2, fold-out inside back cover) overprint the geology and strongly reflect the influence of the topography and the dominant southeasterly winds. The highest section of the islands lies across the southern part of Great Palm Island, effectively trapping much of the moisture from the dominant southeasterly winds. Under the influence of the southeasterly winds the northwestern side of Great Palm Island, and other islands of the group further north, are affected to some degree by a rainshadow. The topography of the smaller islands to the west of Great Palm Island



D *Eucalyptus drepanophylla*
d *Eucalyptus intermedia*
t *Eucalyptus tessalaris*
E *Eucalyptus polycarpa*
Boulders and rocks

p *Acacia polystacha*
f Acacia flavescens
e *Ervatamia orientalia*
V Vineforest species
M Mangroves

C *Cycas media*
T *Lothostemon suaveolens*
L *Livistona drudei*
P *Pandanus* sp.
S Strand species

Fig. App. 1.1 Vegetation transect of the ridge forming the southern boundary of the drainage basin, Pioneer Bay South, Orpheus Island, showing the distribution of dominant vegetation on north and south slopes (**A - B;** see also Fig. 4.4, fold-out inside back cover). The asymmetry of the ridge is typical of those formed on the volcanics of the northern section of the island.

lacks height for the development of orographic rainfall and these islands are also dry by comparison to Great Palm Island.

Vineforest covers most of Great Palm Island, with areas of *Eucalypt* woodland, open grassland, shrub communities and swamps. A number of large clearings have resulted from the activities of the Palm Island Aboriginal Community. These clearings are mainly on coastal plains where the settlement and its infrastructure are located, and on a plateau between the main heights to the south and the spur running northwest. A pine plantation forms part of the clearing on the plateau. The southern and eastern sections of the island remain essentially unaltered except for the possible effects of fire. Herbert (1929) reported the regular firing of *Eucalypt* forest which also affected the vineforest margins.

Vineforest covers the higher areas and moister slopes and extends down streams and gullies. A higher species diversity could be expected in this more extensive vineforest than in the smaller areas on the drier islands. The drier ridges and slopes support *Eucalypt* woodland, and shrub communities which tend to be located on rocky exposed sections of the islands.

Open grassland is found mainly on the eastern windswept sides of the islands within the rainshadow of Palm Island, suggesting a natural origin for these grassed areas. What role fire has played in the existence and maintenance of the grass and vineforest areas has not been assessed. Fires were observed on Curacoa Island in June 1989 and it is common knowledge that *Eucalypt* seeds need soil free of surface vegetative matter for germination and that fire thus favours the spread of this group of trees. Swamp communities fill old lagoonal basins behind some beach ridge systems.

The vegetation patterns of Orpheus Island are similar to other islands of the group, having all the same elements present but to different degrees (Fig.4.4, fold out inside back cover).

Closed Forests

The vineforests of Orpheus Island have their best development behind the James Cook University Research Station in Pioneer Bay South, and at the northwestern end of the island. They are confined to the moister and more protected slopes, form gallery forests along steep, rocky, intermittent watercourses and extend onto coastal flats and into old ridge and swale systems behind reef flats. They grade into open *Eucalypt / Acacia* woodland on ridges and into typical strand vegetation towards the beach. Strand vegetation includes *Caesalpinia bonduc, Mimusops elengi, Sterculia quadrifida, Pleiogynium timorense, Clerodendron inerme, Ochrosia elliptica, Carissa ovata, Cycas media, Eugenia reinwardtiana, Hibiscus tiliaceus* and *Thespesia populnea.* The nearshore vegetation is often dense and luxuriant along the mainland side of the island and forms a closed canopy on the boulder barrier confining the lagoon at the eastern end of South Beach (Plates 4.2 an 4.3).

Some of the species in the vineforest have been positively identified: for example *Myristica insipida, Buchanania arborescens, Scolopia* *braunii, Syzygium cormiflora, Terminalia sericocarpa.* Small groves of *Livistona drudei* are found within the vineforest where moist soil conditions exist at the head of small creeks, along streamlines where drainage is impeded and in the swales behind beach ridges. *Pandanus* sp. replaces *Livistona drudei* where the gallery forest is less dense along creek lines and on the open creek on the east side of the island. Large lianas are locally prominent, as in Mosquito Creek which flows northwest into the mangrove filled embayment on the southern end of Pioneer Bay North.

Vineforest species intermix with *Eucalypt* spp. and *Acacia* spp. on the downslope of ridges and extend to the steep and rocky shoreline. Fig. App. 1.1, **A - B** shows the distribution of dominant vegetation across asymmetric ridge typical of those formed on the volcanics of the northern section of the island.

Vineforest today extends across the beach ridge sequence on which the James Cook University Research Station is located. It covers an extensive shell midden complex and appears to have developed to its present state only since the departure of the Aborigines from the bay. It also covers the midden complex at the northern end of Pioneer Bay North. Some fruit and shade trees probably existed in these areas before European contact, as evidenced by the remains of two large fig trees (see Chapter 6).

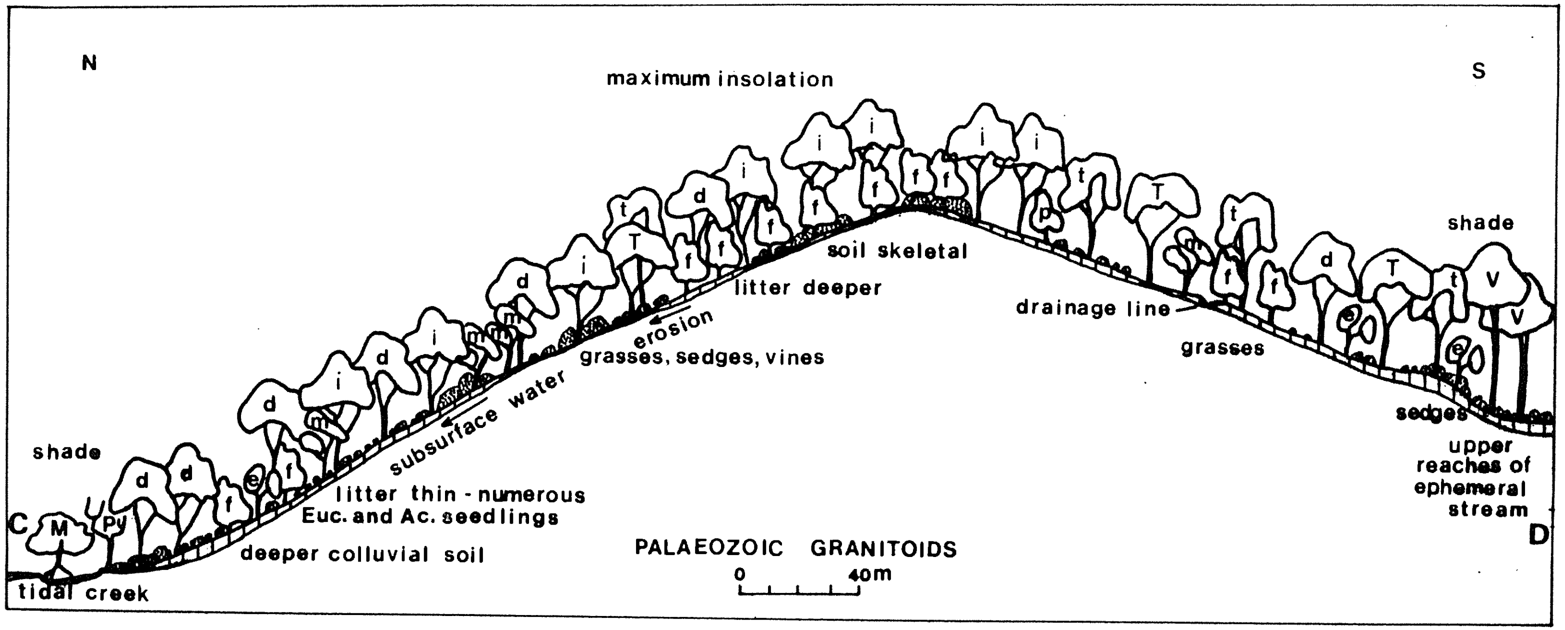
Mangroves fill the embayments and line parts of the coast in protected areas where intermittent streams deposit alluvium. Cattle Bay, a constricted embayment on the northern inland side of the island

and the embayment immediately to the south of the Resort beach in Hazard Bay are totally filled with mangroves. They also fill the minor embayments within the larger Pioneer Bay North and Hazard Bay. Cattle Bay is reputed to have been navigable for small craft at high tide for a short distance within the last thirty to forty years.

Eight mangrove species were keyed from Lear and Turner (1977), and there may be others not identified: *Acanthus illicifolius, Avicennia eucalyptifolia, Avicennia marina* var. *australasica, Bruguiera gymnorrhiza, Ceriops tagal, Osbornea octodonta., Rhyzophora stylosa, Sonneratia alba.* They show zonation with *Rhyzophora stylosa* the dominant species in less sheltered areas.

Medium Eucalypt Forest

Eucalypt forest with a canopy at approximately 10 meters covers most of Orpheus Island. Four species have been identified; *Eucalyptus drepanophylla, Eucalyptus intermedia, Eucalyptus polycarpa* and *Eucalyptus tessalaris.* A shrub layer sparse in places and quite dense in others is dominated by *Acacia* sp. seedlings, *Ervatamia orientalis* , *Cycas media, Xanthorrhorea johnsonii,* and *Lantana camara.* The *Eucalypt* forest on the southern granites has a somewhat more open appearance than that on the volcanics, with less understory shrubs on a gentler more rounded gradient. Fig. App.1.2, **C - D** shows as a comparison the distribution of dominant vegetation on a ridge on the granitoids of the southern section of the island, oriented north to south as on the northern volcanic section.



d *Eucalyptus drepanophylla*
i *Eucalyptus intermedia*
t *Eucalyptus tessalaris*
Boulders and rocks
p *Acacia polystacha*
f *Acacia flavescens*
V Vineforest species
e *Ervatamia orientalis*
m *Melaleuca viridiflora*
T *Lothostemon suaveolens*
M Mangroves

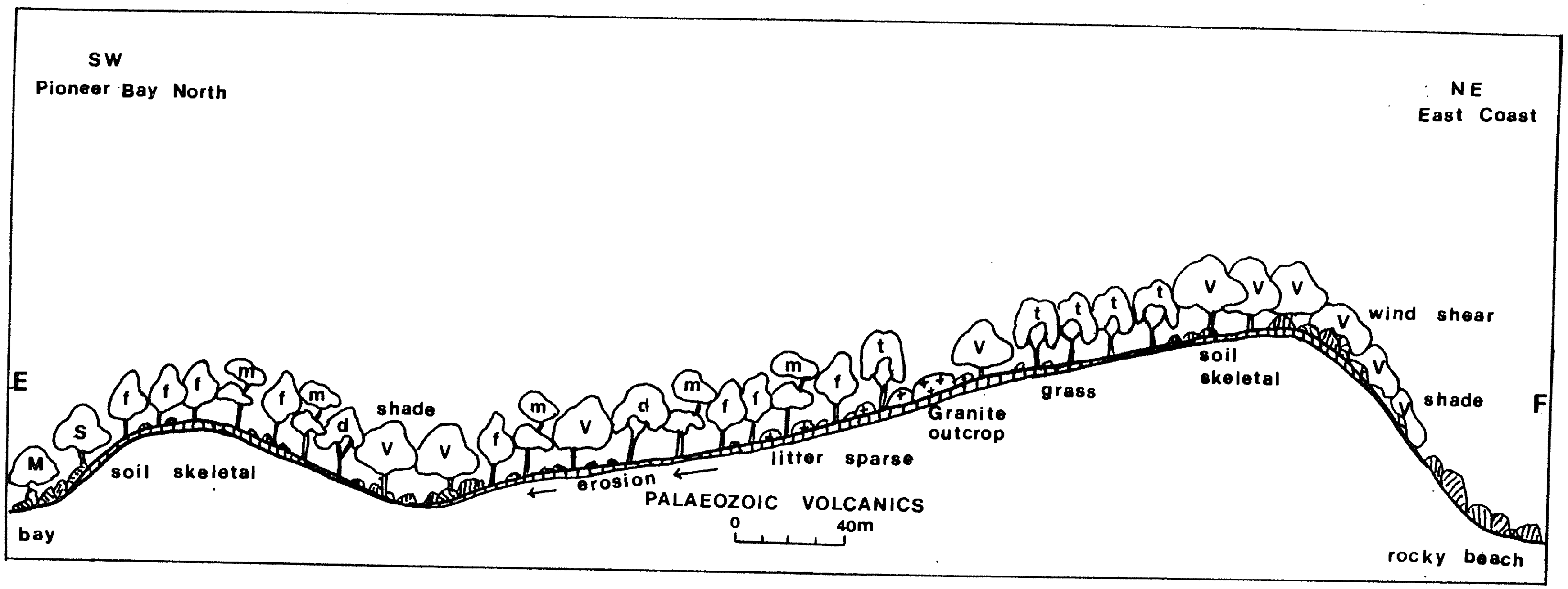
Fig. App. 1.2 Vegetation transect on a line from north to south of the ridge from the bay north of Yanks' Jetty, Orpheus Island, to the upper reaches of an ephemeral creek running onto the southern end of Yanks' Jetty beach (**C - D**; see also Fig.4.4, fold-out inside back cover).

Grasslands

The open grass and shrub lands extend in a discontinuous strip along the middle portion of the eastern side of the island. On the southern end of its extent it is within the windshear zone, but this is not true of the slope below the eastern cliff edge behind Pioneer Bay North and the grassland on this less exposed slope appears to be shrinking in area. It is here that an almost pure stand of juvenile *Eucalyptus tessalaris* has grown since the aerial photography in1978 (Fig. App.1.3, **E - F**; see also Fig. 4.4, fold out inside back cover). This could be due to the grazing by goats or to fire, either of which may have cleared areas of the soil leaving a suitable substrate for the germination of *Eucalypt* seeds.

The *Acacia / Melaleuca* forest is referred to on the map (see Fig. 4.4, fold out inside back cover) as Simplified Forest and appears to be regrowth. No clearing was carried out by the Morris family (G. Morris pers.comm.) while they owned the island in the 1920s, but nothing is known about the earlier settlers who ran sheep here before the turn of the century.

Eight grass species and three sedges have been identified across the open grassland from the eastern cliff edge to the tree line behind Pioneer Bay North. Towards the cliff edge are thickets of *Myoporum montanum* , some exposed to wind shear and others sheltered by the cliff rim (Fig. App. 1.4, **G - H**).

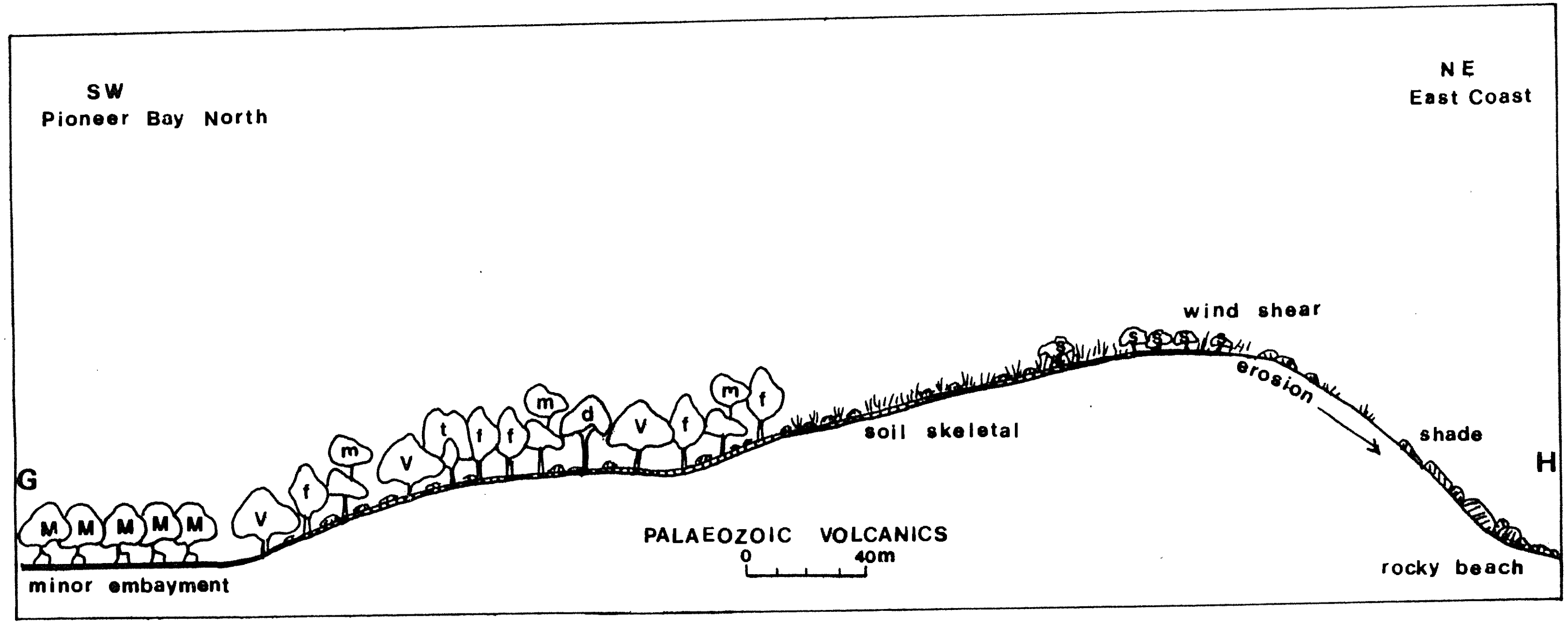


d *Eucalyptus drepanophylla*
t *Eucalyptus tessalaris*
Boulders and rocks

f *Acacia flavescens*
V Vineforest species
Granite outcrop

m *Melaleuca viridiflora*
M Mangroves
S Strand species

Fig. App. 1.3 Vegetation transect across Orpheus Island at the narrowestpoint from the small embayment in Pioneer Bay North to the east coast on a line from southwest to northeast (**E - F**; see also Fig. 4.4., fold-out inside back cover). Regrowth areas of dominant *Eucalyptus tessalaris* and mixed *Melaleuca* and *Acacia* forest, and dominant vine forest are marked features across this transect.



d *Eucalyptus drepanophylla*
t *Eucalyptus tessalaris*
Boulders and rocks
f *Acacia flavescens*
V Vineforest species
Grass and sedges
m *Melaleuca nervosa*
M Mangroves
S *Myoporum montanum*

Fig. App. 1.4 Vegetation transect from the east coast clifftop across the open grassland to the mangrove-filled embayment in Pioneer Bay North, Orpheus Island (**G - H**; see also Fig. 4.4, fold-out inside back cover).

Swamp

Swamp communities are represented on Orpheus Island by the *Melaleuca* forest within and around the basin of the lagoon behind South Beach. It is not a true swamp as it is seasonally dry but fills for a time during the wet season and after heavy rains. The seaward verge of this swamp is formed by a boulder wall which confines the water. Vineforest species have established on this wall. Behind the swamp area *Ervatamia orientalis* is again dominant in the understory layer with juveniles of the vineforest species also present. The flowering fern *Helminthostachus zeylandica* and small unidentified herbaceous plants form a carpet on the floor of the lagoon as the water dries out of the basin (Plates 4 and 4.2).

A partial list of plant species of Orpheus Island has been prepared from specimens lodged with the Queensland Herbarium and from reference to several authors (Hyland 1983; Jackes 1987; Jones and Clemensha 1976; Jones and Gray 1977; Jones and Gray 1984). Those plants which may have formed part of the economy of Aboriginal people on Orpheus Island are appropriately keyed and references to their usage are included in the Reference list.

VEGETATION OF ORPHEUS ISLAND
PARTIAL LIST

Those specimens collected for taxomonic identification have been lodged with the Queensland State Herbarium.

Key to location

Open forest and clearings	O
Vine forest	V
Strand	S
Mangrove	M
Grassland	G

Key to Aboriginal Usage

Food	f
Artifacts	a
Ornamentation	o
Medicinal	m
Fish poison	p
Shade	s

Key to References on Aboriginal Plant Usage

Banks (1768-1771)	1
Leichardt (1846:150)	2
Thozet (1868:46)	3
Lumholtz (1890)	4
Roth (1901 Bull.1)	5
Kennedy (1902:73)	6
Johnstone (1904:51)	7
Hale & Tindale (1933:114)	8
Thomson (1933:507)	9
Golson (1971)	10
Cribb and Cribb (1974)	11
Meehan (1977:501)	12
Levitt (1981:147)	13
Hiddens (1980)	14
Cribb and Cribb (1985)	15
Isaacs (1987)	16
Brock (1988)	17
Barr *et al* (1988)	18
Low (1989)	19

	Location	Usage	Reference
ACANTHACEAE			
Acanthus illicifolius	M		
Pseuderanthemum variable	O		
ANACARDIACEAE			
Buchanania arborescens	V	f	2,16,17,19
Pleiogynium timorense	V, S	f	1,5,11,19
APOCYNACEAE			
Carissa ovata	V	f	3,10,11
Catharanthus roseus	S		
Ervatamia orientalis	V, O		
Ochrosia elliptica	V		
Parsonsia velutina	V		
ARACEA			
Rhaphidophora pinnata	V	f	5,17
ARALIACEAE			
Schefflera actinophylla	V		
ARECACEAE			
Cocos nucifera	S	f	
Livistona drudei	V	f, a,o	5,7,11,13
ASCLEPIADACEAE			
Hoya australis	S	a	17
ASTERACEA			
Tridax procumbens	O		
AVICENNIACEAE			
Avicennia eucalyptifolia	M		
Avicennia marina var. *australasica*	M	f,a,m	3,5,10,11,12
BALANOPHORACEAE			
Balanophora fungosa	V		
BARRINGTONIACEAE			
Planchonia careya	O	f,a,m	11,16
BURSERACEAE			
Canarium australianum	V	f,a,m	11,13,17

CACTACEAE			
Opuntia sp.	O		
CAESALPINICEAE			
Caesalpinia bonduc	S	m	17
Cassia retusa	S		
CAMPANULACEAE			
Wahlenbergia sp.	O	f	11
CAPPARACEAE			
Capparis sepiaria	V		
CASSINE			
Cassine melanocarpa			
CASUARINACEAE			
Casuarina equisetifolia	S	a,m, s	13,16,17
CHENOPODIACEAE			
Sarcocornia quinqueflora	S		
CLUSIACEAE (GUTTIFERAE))			
Calophyllum inophyllum	S	m	17
COMBRETACEAE			
Terminalia catappa	V	f,a	5,11,13
Terminalia meulleri	V	f,a	5,11,13
COMMELINACEAE			
Commelina cyanea	O	f	11,15,19
CONVULVULACEAE			
Ipomoea pes-caprae			
brasiliensis	S	f,m	5,10,11,13,16
CYCADACEAE			
Cycas media	O	f	3,4,5,10,11
CYPERACEAE			
Cyperus tetracarpus	G		
Gahnia aspera	O	f	11
Scleria brownii	G		
Scleria mackaviensis	G		
EBENACEAE			
Diospyros maritima	O	a,m	13,17
EUPHORBIACEAE			
Alchornea ilicifolia	V		

Baurella simplicifolia	V		
Bridelia leichardtii	V		
Breynia oblongifolia	V		
Euphorbia cyathophora	S		
Macaranga tanarius	V, S	a	5,13,16
Mallotus philippensis	V	a	17
FABACEAE			
Abrus precatorius	V, O, S	a,m	13,16,17,19
Castanospernum australe	V	f	11,16
Pongamia pinnata	S	p,m	5,17
FLACOURIACEAE			
Scolopia braunii	V		
FLAGELLARIACEAE			
Flagellaria indica	V	f,a,m	17,195
LAURACEAE			
Neolitsea australiensis	V		
LECYTHIDACEAE			
Planchonia careya	O	f,a,m,p	11,13,17,18
LILIACEAE			
Dianella caerulea sens. lat.	O	f	16,19
Lomandra longifolia	O	f	11,13,16,19
LOGANIACEAE			
Strychnos axillaris	V		
LORANTHACEAE			
Amyema sp.	O	f	17,18,19
MALVACEAE			
Hibiscus tiliaceus	S	a,m	5,11,13,18
Sida sp.	S		
Thespesia populnea	S	f,a	11,13
MELIACEAE			
Melia azedarach var. *australasica*	V, O		
MENISPERMACEAE			
Stephania japonica var. *timorensis.*	V		
Tinospora smilacina	V	m	13,18,16,

MIMOSACEAE			
Acacia flavescens	O	a	5
Acacia polystachya	O		
Acacia solandri	O		
Albizia procera	V		
Entada phaseoloides	V, S	f,p	3,5,8,9,11,16,19
MORACEAE			
Ficus opposita	V	f, a,m	5,10,16,18,19
Ficus platypoda	V	f	5,10,16,18
Ficus microcarpa	G	f	10,16
MYOPORACEAE			
Myoporum montanum	G, S	f,m,p	10,11,13,14,15,18
MYRSINACEAE			
Rapanena porosa	V	f	11
MYRTACEAE			
Austromyrtus sp.	V		
Eucalyptus drepanophylla	O	a,m	18
Eucalyptus intermedia	O	a,m	18
Eucalyptus polycarpa	O	a,m	13
Eucalyptus tessalaris	O, V, G		
Eugenia reinwardtiana	L	f	5,16
Lothostemon suaveolens	V, O		
Melaleuca dealbata	O	f,a,m	2,5,13,16,17,18
Melaleuca leucandendra	S	f,a,m	2,513,16,17,18
Melaleuca viridiflora	O	f,a,m	2,5,13,16,17,18
Osbornea octodonta	M		
Syzygium sp.	V	f	5,16,17
Syzygium cormiflorum	V	f	5,16,17
OLEACEAE			
Chionanthus ramiflora	V		
Jasminum didymum	V, O		
ORCHIDACEAE			
Dendrobium discolor	O, S	f,a	3,15,19
Calanthe triplicata	O, S	f,a	3,15,19
PANDANACEAE			
Pandanus sp.	V	f, a	1,2,5,8,10,11,13,16,18

PASSIFLORACEAE			
Passiflora suberosa	V	f	14,15
POACEAE			
Aristida queenslandica			
var. *dissimilis*	G		
Aristida spuria	G	f	10
Arundinilla setosa	O		
Cynodon dactylon	G		
Imperata cylindrica	G	m	13,16
Oplismenus aemulus	S		
Paspaliduim sp.	G		
Rhynchelytrum repens	O		
Sporolobus virginicus	S		
Themeda sp.	O		
RHAMNACEAE			
Alphitonia excelsa	V	a,m,p	11,13,16,17, 18
Colubrina asiatica	S	p, m	14
RHIZOPHORACEAE			
Bruguiera gymnorrhiza	M	f,a	5,10,11,13,17
Ceriops tagal	M	m	13,16,17
Rhizophora stylosa	M		
RUBIACEAE			
Gardenia ochreata	S	m	16
Guettarda speciosa	S	a,m	13,15,17
RUTACEAE			
Acronychia laevis	V	f	11
Geijera salicifolia			
var *latifolia*	V		
SAPINDACEAE			
Alectryon connatus	V		
Alectryon tomentosus	V	f	11,19
Cupaniopsis anacardioides	V	f	
Jagera pseudorhus	V		
SAPOTACEAE			
Mimusops elengi	S	f	5,10,11,13 ,17
Planchonella obovata	V	f	13,16,17

Pouteria sericia	S	f,a	10,11,14,17
SMILACACEAE			
Smilax australis	O	f, a	13,16,17
SONNERATICEAE			
Sonneratia alba	M		
STERCULIACEAE			
Sterculia quadrifida	V,S	f,a,m	5,6,11,13,16 ,17,18
TACCACEAE			
Tacca leontopetaloides	V,S	f,m	5,11,13,16, 17,19
URTICACEAE			
Dendrocnide moroides	V	f	11
VERBENACEAE			
Avicennia marina var. *australasica*	M	f,m	3, 5,10,11,13,17,18
Avicennia eucalyptifolia	M		
Clerodendron inerme	V, S	f,a,m	5,11,14,16
Lantana camara	V, O		
Stachytarpheta jamaicensis	S, G		
Vitex trifolia	S		
VITACEAE			
Cissus reniformis	O	f	11
XANTHORRHOEACEAE			
Xanthorrhoea johnsonii	O	f,m	11,16

FERNS

Adiantum hispidulum	V		
Cheilenthes tenuifolia	O		
Davallia sp.	O		
Drynaria rigida	O		
Helminthostachys zeylanica	O	f,m	15
Platycerium sp.	O		

Vegetation of Orpheus Island Alphabetically by Genus

Abrus precatorius - Fabaceae	V, O, S	a,m	13,16,17,19
Acacia flavescens- Mimosaceae	O	a	5
Acacia polystachya - Mimosaceae	O		
Acacia solandri - Mimosaceae	O		
Acanthus illicifolius - Acanthaceae	M		
Acronychia laevis - Rutaceae	V		
Albizia procera - Mimosaceae	V		
Alchornea ilicifolia - Euphorbiaceae	V		
Alectryon connatus - Sapindaceae	V		
Alectryon tomentosus - Sapindaceae	V	f	11,19
Alphitonia excelsa	V	a.m.p	11,13,16,17, 18
Aristida queenslandica var. *dissimilis* - Poaceae	G		
Aristida spuria - Poaceae	G	f	10
Arundinilla setosa - Poaceae	O		
Austromyrtus bidwillii - Myrtaceae	V		
Avicennia eucalyptifolia - Avicenniaceae	M		
Avicennia marina var.*australasica* - Avicenniaceae	M	f	3, 5,10,11,12
Balanophora sp. - Balanophoraceae	V		
Baurella simplicifolia - Euphorbiaceae	V		
Breynia oblongifolia - Euphorbiaceae	V		
Bridelia leichardtii - Euphorbiaceae	V		
Bruguiera gymnorrhiza - Rhizophoraceae	M	f	5,10,11
Buchanania arborescens - Anacardiaceae	V	f	2,16,17,19
Caesalpinia bonduc - Caesalpiniaceae	S	m	17
Calanthe triplicata - Orchidaceae	O,S	f,a	3,15,19
Calophyllum inophyllum - Clusiaceae (Guttiferae)	S	m	17
Canarium australianum - Burseraceae	V	f,a,m	11,13,17

Capparis sepiaria - Capparaceae	V	f	3,5,10,11
Carissa ovata - Apocynaceae	V	f	3,10,11
Cassia retusa - Caesalpinaceae	S		
Cassine melanocarpa - ?			
Casuarina equisetifolia - Casuarinaceae	S	m,a,s	13,16,17
Catharanthus roseus - Apocynaceae	S		
Ceriops tagal - Rhizophoraceae	M	m	13,16,17
Chionanthus ramiflora - Oleaceae	V		
Cissus reniformis - Vitaceae	V	f,m	2,16
Clerodendron inerme - Verbenaceae	V, S	f,a,m	5,11,14,16
Cocos nucifera - Arecaceae	S	f,a	
Colubrina asiatica - Rhamnaceae	S	m, p	14
Commelina cyanea - Commelinaceae	O	f	11,15,19
Cupaniopsis anacardioides - Sapindaceae	V	f	?
Cycas media - Cycadaceae	S	f	3,4,5,10,11
Cynodon dactylon - Poaceae	G		
Cyperus tetracarpus - Cyperaceae	G	f	10
Dendrobium discolor - Orchidaceae	O, S	f	3,15,19
Dendrocnide moroides - Urticaceae	V	f	11
Dianella caerulea sens. lat. - Liliaceace	O	f	16,19
Diosporus maritima - Ebenaceae	V	a	13,17
Entada phaseoloides - Mimosaceae	V, S	f,p	3,5,8,9,11, 16,19
Ervatamia orientalis - Apocynaceae	V, O		
Eucalyptus drepanophylla - Myrtaceae	O	a,m	18
Eucalyptus intermedia - Myrtaceae	O	a,m	18
Eucalyptus tessalaris - Myrtaceae	O,V,G		
Eugenia reinwardtiana - Myrtaceae	S	f	5,16
Euphorbia cyathophora - Euphorbiaceae	S		
Ficus opposita - Moraceae	V	f, a,m	5,10,16,18, 19
Ficus platypoda - Moraceae	V	f	5,11
Gardenia ochreata - Rubiaceae	S	m	16
Geijera salicifolia var *latifolia* - Rutaceae	V		
Guettarda speciosa - Rubiaceae	S	a,m	13,15,17

Hibiscus tiliaceus - Malvaceae	S	a,m	5,11,13,18
Hoya australis - Asclepiadaceae	S	a	17
Imperata cylindrica - Poaceae	G	m	13,16
Ipomoea pes-caprae ssp. *brasiliensis* - Convulvulaceae	S	f,m	3,5,10,11,13
Jagera pseudorhus - Sapindaceae	V		
Jasminum didymum - Oleaceae	V, O		
Lantana camara - Verbenaceae	V, O		
Livistona drudei - Arecaceae	V	f,a,o	5,7,11,13
Lomandra longifolia - Liliaceae	O	f	11,13 ,16,19
Lothostemon suaveolens - Myrtaceae	V, O		
Macaranga tanarius - Euphorbiaceae	V, S	a	5,13,16
Mallotus philippensis - Euphorbiaceae	V	a	17
Melaleuca dealbata - Myrtaceae	O	f,a,m	2,5,13,16,17, 18
Melaleuca leucandendra - Myrtaceae	S	f,a,m	2,5,13,16,17, 18
Melaleuca viridiflora - Myrtaceae	O	f,a,m	2,5,13,16,17, 18
Melia azedarach var. *australasica* - Meliaceae	V, O		
Mimusops elengi - Sapotaceae	S	f	5,10,11,13, 17
Myoporum montanum - Myporaceae	G, V	f,m,p	10,11,13,14 ,15,18
Neolitsea australiensis - Lauraceae	V		
Ochrosia elliptica - Apocynaceae	V		
Oplismenus aemulus - Poaceae	S		
Opuntia sp. - Cactaceae	O, S		
Osbornea octodonta - Myrtaceae	M		
Pandanus sp. - Pandanaceae	V	f, a	1,2,5,8,10, 11, 13,16,18
Parsonsia velutina - Apocynaceae	V		
Paspalidium sp. - Poaceae	G		
Passiflora suberosa - Passifloraceae	V	f	14,15
Planchonella obovata - Sapotaceae	V, S	f	13,16,17

Planchonia careya - Barringtoniaceae	O	f,a,m	5,11,16
Pleiogynium timorense - Anacardiaaceae	V, S	f	1,5,11,19
Pongamia pinnata - Fabaceae	S	m,p	5 ,17
Pouteria sericia - Sapotaceae	S	f,a	10,11,14,17
Pseuderanthemum variable - Acanthaceae	O		
Rapanena porosa - Myrsinaceae	V	f	11
Rhaphidophora ? pinnata - Araceae	V	f	5
Rhizophora stylosa - Rhizophoracea	M		
Rhynchelytrum repens - Poaceae	S		
Salrcocornia quinqueflora - Chenopodiaceae	S		
Schifflera actinophylla - Araliaceae	V , S		
Scleria brownii - Cyperaceae	G		
Scleria mackaviensis - Cyperaceae	G		
Scolopia braunii - Flacouriaceae	V		
Sida sp. - Malvaceae	O		
Smilax australis- Smilacaceae	V	f, a	13,16
Sonneratia alba - Sonneratiaceae	M		
Sporolobus virginicus - Poaceae	S		
Stachytarpheta jamaicensis - Verbenaceae	S, G		
Stephania japonica var. *timorensis.* - Menispermaceae	V		
Sterculia quadrifida - Sterculiaceae	V	f,a,m	5,6,11,13,16, 17,18
Strychnos axillaris- Loganiaceae	V		
Syzygium cormiflorum - Myrtaceae	V	f	5,16,17
Syzygium sp.- Myrtaceae	V	f	5,16,17
Tacca leontapetaloides - Taccaceae	V	f,m	5,11,13,16, 17,19
Terminalia catappa -Combretaceae	V	f,a	5,11,13
Terminalia muelleri - Combretaceae	S	f	5,11,13
Tinospora smilacina - Menispermaceae	V		
Tridax procumbens - Asteraceae	O		
Vitex trifolia - Verbenaceae	S		
Xanthorrhoea johnsonii - Xanthorrhoeaceae	O	f,m	11,16

FERNS

Adiantum hispidulum	V		
? *Cheilenthes tenuifolia*	O		
Davallia sp.	O		
Drynaria sp.	O		
Helminthostachys zeylanica	O	f,m	15
Platycerium sp.	O		

APPENDIX 2

GAZETTEER

Location of archaeological sites on Orpheus Island, with Grid References and a general description of the site. All Grid References are taken from the Australian 1:50,000 Topographic Survey Series 733, Lucinda Sheet 8160.

PREHISTORIC SITES

Pioneer Bay south

Shell middens: PBS 4 - 460417 PBS 3 - 461418 PBS 5 - 461417 PBS 1 - 462419 PBS 2 - 462419	Shell middens on beach deposits extend along most of the frontal dune ridge sequence under heavy vegetation. Much of the surface integrity of the deposits is disturbed by the activities of fauna and European settlement. One midden is sited on the landward side of the back beach depression and a scatter of shells is situated on low sand ridges within the depression. A number of known Aboriginal food plants including Burdekin Plum trees (*Pleiogynium timorense*) are found adjacent to the most concentrated midden deposits.
Fish trap: 456417	A fish trap constructed of rocks from the adjacent boulder beach and taking

advantage of natural features of the reef flat, such as ponding and gravel banks, is located towards the southern headland of the bay. It has a race type feature and is largely destroyed and non-functioning. Several Burdekin Plum trees and *Cycas media* are growing along the coast between the traps and the beach.

Pioneer Bay North

Shell middens: 460440	One shell midden on the heavily PBN 1 - vegetated small coastal plain at the northen end of the beach is badly eroded by wave and tidal processes. The surface is also reworked by jungle fowl and other fauna. A Burdekin Plum is growing on the beach side of the midden. An extension of PBN 1 is under vegetation immediately to the south of the mapped area and has not been mapped.
Unnamed Creek - 464433	Behind the ridge paralleling the beach, there is a midden above a rock pool at the junction of the main creek with a tributary. Downstream is a small indented bay infilled with mangroves. A Burdekin Plum is growing above the midden.

PBN 2 - 463431 PBN 3 - 463431	Behind the mangroves on the slope of the southern headland just above high water mark are two shell middens. King tides and fauna are reworking these deposits. These appear to have a higher concentration of *Saccostrea spp.* present. A Burdekin Plum is nearby.
<u>Fish trap</u>: 460430	A fish trap of smaller size, simpler shape and in a state of better preservation than the trap in Pioneer Bay South is sited on the reef flat near the southern headland
<u>East Coast</u>	
<u>Shell midden:</u> 469438	A small midden is located just below wind shear level on the cliff top beside a group of fruit/shade trees including Burdekin Plum.
<u>Stone arrangement</u>: 468439	Along the cliff top is a 50 m line of stones intersected at an angle at the southern end by another 70m line. This second line runs towards a point below the grove of trees containing the small midden.
<u>Creek camp:</u> 471416	At the junction of two creeks above the eastern coastal plain is a small scatter

of *Tridacna sp.* (Clam) shells. Burdekin Plum tree and other fruit/use trees are growing in a grove around a large basin in the creek, presently dry.

South Beach

Shell midden: SB 1 - 472367	A midden is sited on the frontal dune deposits adjacent to a boulder barrier beach. A stone wall of European construction beside the midden suggests probable disturbance to the deposit.
Lagoon: 472368	Behind a boulder barrier is a large shallow depression, usually a lagoon as in 1989, but dry in 1988. A circular pit is dug into floor of the lagoon possibly as a well during dry periods. It may be a European artifact related to the stone walls. Large fruit/use trees are established along the boulder wall and around the lagoon. Burdekin Plum is again present.
Fish Trap: 464359	A fish trap was uncovered across the mouth of the small tidal inlet at the southern end of South Beach by Cyclone Aivu. The wall is not curved but runs directly across the creek mouth.

Stone Arrangement: 464360	A line of smaller stones extends seawards from a group of boulders on the beach. A small creek empties through the beach behind the boulder. Possibly the line represents the remains of a fish trap although there seems that there is not enough stones scattered across the reef flat to have formed a trap wall.
Stone Arrangement: 463360	A line of stones runs for approximately 55 m along the floor of an old lagoon at the southern end of South Beach. As the depression is vegetated the line is often obscured. The size and placement of the stones is similar to the arrangement along the Eastern Cliff. A similar ambiguity exists for this stone line as with the Eastern Cliff lines.

Yanks' Jetty

Shell middens: 458374 459373 459374	Scatters of shell along most of the coastal deposits are obviously the surface expression of deeper layers evident where erosion has gullied the deposits. One midden has a 2m deep pit toilet constructed on it by the Queensland National Parks and Wildlife Service.

Rock shelter:
458375

On the beach above high water mark is a small shelter under large granite boulders. No signs of human occupation are obvious but the shelter is of sufficient size to warrant further investigation. During the wet season water penetrates both from the roof rocks and as slope wash.

Rock pictures:

A faded rock picture has been reported beneath a boulder overhang but has not as yet been sighted.

Hazard Bay

Shell middens:
471392

All that remains of the extensive middens on the coastal deposits in this bay is one very disturbed midden beside the small creek on the southern end of the bayhead. Homestead and tourist resort development since late in the 19th century has resulted in almost total destruction. Some shell has been removed from the remaining midden to decorate or delineate the walking path near the midden.

Gnoora

Shell middens:
465384

There are three small embayments in the southern section of Hazard Bay. Gnoora is the middle embayment. Several concentrations of shell were noted. This beach was a camp site for American forces during WW II and much disturbance is to be expected. A number of well documented Aboriginal food plants e.g. Burdekin Plum and *Cycas sp.* of mature age are growing on the frontal dune. One cycad has been removed recently and an attempt to remove another was noted.

Fish Trap:
465385

A fish trap is located on the northern side of the Yanks' Jetty headland i.e. in Gnoora embayment. It is a simple wide U-shaped structure similar to the trap in Pioneer Bay North.

Most Southerly Hazard Bay Embayment

Shell Middens:
464377
464375

The major concentration in this bay is on the beach ridge sequence or southerly side of the northern tidal creek. This midden appears relatively undisturbed and extends for about 50 metres along the creek bank, but may not have much depth. A scatter of shells was also found in the old lagoon behind the beach ridge sequence and along the northern bank of the southern tidal creek. This last deposit is being eroded by the creek and the exposure in the creek bank appears to be only about 20-25 cm in depth, but may have greater depth further from the edge. A large grove of *Buchanania arborescens* , a known fruit tree, extends along the beach ridge side of the old lagoon.

Iris Point

Shell Middens:
463477
464478
467467

Three shell middens have been reported at Iris Point (K. Bartlett), but have not been surveyed by the author.

Rock Shelter:
465463

Rock shelter with smoke staining reported from Iris Point (K. Bartlett).

HISTORICAL SITES;

Pioneer Bay North

Ruins:
463438

On the ridge above the beach is a ruined shepherd's hut constructed of stones possibly in the last century.

South Beach

Ruins:

454418

On the frontal dune is a low stone walled enclosure of European construction probably related to the shephers's hut on the northern end of the island.

Yanks' Jetty

Reservoir:

457376

On the ridge top above the headland is an open, round cemented water reservoir used by American armed forces during World War 11. Various remains of structures sited on small terraces are visible.

APPENDIX 3

SHELL SPECIES RECOVERED FROM THE SOUNDINGS ON MIDDENS PBS 3 AND PBS 5, PIONEER BAY SOUTH

Brayshaw (1977:295) reviews the ethnohistorical literature relating to the use of shells in the Herbert / Burdekin area where shells were used to scrape smooth strands of lawyer vine (*Calamus australis)* used in basket making (Herbert River, Lumholtz 1890:193-4), (Great Palm Island, Palm Island 1975), and for cutting cicatrices in the skin near Townsville (Meston 1899:11) and on the Herbert River (Lumholtz 1890:135). King (1827) noted that hair clippings found in a hut were apparently cut with shell and not burnt as Cook had recorded in 1788. A spearthrower from Palm Island (476, Townsville Museum of Music) has two pieces of melo shell fixed together by gum to form a handle. Roth (1910 14:7) also noted the use of shell scrapers throughout the northeast coast and gulf areas. Shell was utilised in northern Australia and Timor. There is no proof, however, from the excavation in Pioneer Bay South that shell was used for artefact manufacture other than for shell fish hooks.

One damaged crescent-shaped shell fish hook and a segment of another hook were found in Spit 2 (5-10 cm) in Midden PBS 3 (Plate 6.3). Under the microscope no obvious marks due to manufacturing processes are visible. Another very small segment of a shell hook was found in Spit 4 (15-20 cm) (Not illustrated). No manufacturing material such as anvil stones, quartz drills, coral files, blanks or shell chips (Roth 1897; Banfield 1908; Bowdler 1970; Dyall 1982) were recognised within the 50 cm X 100 cm X 45 cm sounding, although two small pieces of quartz and several pieces of coral of suitable size for use as files were found.

Shell fish hooks are known in Queensland from the Endeavour River (Cook 1770), Barron River (Roth 1904), Cape Grafton (Roth 1904), Rockingham Bay (Brough-Smyth R. 1878; Edge-Partington 1890), Dunk Island (crescent, Banfield 1908), Tully (Roth 1901), Halifax Bay (Cassady and Johnstone in Curr 1886; Johnstone 1903), and the Keppels (crescent, Roth 1901; Rowland 1980,1981, 1983). Crescent- shaped fish hooks have been found as far south as Sydney (Wooley 1966; Lampert and Turnbull 1970; Mulvaney 1975).

Massola (1956) suggested that fish hooks were moving down the coast, probably from Melanesia, at the time of European contact, in direct contradiction to the fish hooks found in archaeological deposits in southern New South Wales, dated to approximately 2,000 years BP (Lampert and Hughes 1974).

A crescent-shaped fishhook from the Keppels is thought by Rowland (1981, 1983) to be a little more than a thousand years old and possibly not more than 200 years, but no firm date was obtained due to sampling problems. Some implications of the distribution and use of fish hooks is discussed by Bowdler (1976) and Walters (1988).

The Orpheus Island crescent-shaped fish hook is similar in shape to those described from Melanesia by Reinman (1970) and from the Palaun Islands of Micronesia by Johannes (1981) which are used for jagging fish. This is a shallow water fishing technique depending on speed to apply continual pressure on the line, in order to hold the hook firm in the fish's mouth while swiftly landing it. The opalescent inner shell acted as a lure, so bait was unnecessary (Mulvaney 1975:100).

The hooks found by Banfield (1908) on Dunk Island were interpreted by him to represent aborted attempts to complete manufacture, as blanks, manufacturing tools and debris were also present. The Orpheus Island hook and fragment have both been broken in approximately the same place i.e. close to one tip of the crescent. There may have been a tendency for hooks to break in a particular place during the process of manufacture because of pressure exerted along planes of weakness.

By 1909 (Banfield) the Dunk Island Aboriginals had no knowledge of the use of shell fish hooks as European hooks had entirely replaced them. The method of manufacture on the adjacent mainland as demonstrated to Banfield (1908, 1909) by an Aboriginal elder who could remember their use as a boy, is as follows:

The method of manufacture was to reduce by chipping with a sharp-edged piece of quartz a portion of a black-lip mother-of-pearl shell to a disc. A central hole was then chipped - not bored or drilled - with another tool of quartz. The hole was gradually enlarged by the use of a terminal of one of the staghorn corals (*Madepora laxa*) until a ring had been formed. Then a segment was cut away, leaving a rough crescent, which was ground down with coral files, and the ends sharpened by rubbing on smooth slate.

This method is the same as described by Roth (1904) for Cape Grafton. The most valued shell for the manufactury of hooks on Dunk Island was gold-lip mother-of-pearl, the most commonly used the black-lip, and when no other shell was available the hammer oyster (Banfield 1908). However the fishhook in Massola's own collection (1956) from Dunk Island is similar to the Orpheus Island hook and made from Trochus shell. The Orpheus Island fish hooks appear to have been made from Trochus shell.

Coconut and turtle shell fish hooks are reported from Palm Island, the Keppel Islands (Roth 1897:24, 1904 (7):33; Jardine 1936; Rowland 1980) but not from the adjacent mainland (Roth 1897:24). Coconut shell, wood with bone barbs, catfish spines and dried tendril of *Hugonia jenkensii* were all used around the Tully River (Roth 19). Torres Strait islanders used baited (Haddon 1912) barbless turtleshell hooks (Macgillivray 1852; Haddon 1912; Massola 1956). Thomson (1936) described bone and wood fish hooks from the west coast of Cape York Peninsula.

The most obvious shell on the Orpheus Island middens is the clam, *Tridacna crocea*, a deep burrower in coral, which has a narrow range similar to the larger species *T. gigas, T. derasa* and *Hippopus hippopus* through the western Pacific and Micronesia. Its habitat is reef flats and coral heads in water from several centimetres to about 30 metres in depth (see Plate App. 3.1). To remove *Tridacna crocea* from the coral in which it is embedded the coral must be broken away and the stout byssus by which it attaches itself to the substrate must be undercut. Projecting sculpture on the valve surface of *Tridacna crocea* is completely lacking in specimens entirely encased in coral pockets (Rosewater 1965).

Tridacna species are exploited throughout the Indo-Pacific region for their food value and for the valves which are used for such diverse purposes as washbasins, for tool making, as money and as personal adornments (Rosewater 1965). No worked Tridacna valves were found in the small sounding on midden PBS 3 in Pioneer Bay South.

Shell types present on the middens on Orpheus and other islands of the Palm Group are mainly reef species and the associations found here differ from those of the mainland, Magnetic Island and the Hinchinbrook Channel (see Table 6.1). It is considered to be a useful exercise to illustrate and describe both the entire shells of the more dominant species, along with fragments found in excavations from PBS 3 and PBS 5 on Orpheus Island, to assist later researchers to recognise these shells. Other shell species of which only relatively insignificant samples were obtained are not illustrated, but are described. The descriptions have been taken from Coleman (1988) and Wells and Bryce (1988).

Plate App. 3.1 *Tridacna crocea* or borrowing clam in eroded microatoll on the reef flat of Pioneer Bay South, Orpheus Island

Class **POLYPLACOPHORA**

Family CHITONIDAE

Fig. 1 (a) *Acanthopleura spinosa* (Bruguiere 1792)

Spiny Chiton

Many specialized chitons are included in the family but all are united by the pectination of the insertion plates. Chitons are made up of eight articulated plates which are very thick and robust. They are very common on rocky shore reefs throughout the range, and shelter from the heat during the day in cracks and crevices. Chitons feed by scraping algae off the rocks.

Range: Queensland to northern Western Australia. Size: to 100 mm. Common.

(i) Entire animal; actual size fragments from PBS 3 Spit 3, (ii) inner side of body segment; (iii) upper side of body segment; (iv) inner side of mouth segment with rasping teeth; (v) upper side of mouth segment.

CLASS **GASTROPODA**

Family TROCHIDAE

Fig. 1 (b) *Trocus* sp.

Top Shells

Top shells form a large family of primitive gastropods and are widely collected as jewelery and items such as buttons. They are herbivores which feed on short fine algae growing on coral and rocky reefs intertidally.

Range: Queensland to Western Australia. Size: to 75 mm. Common.

(i) Entire shell; (ii and iii) actual size fragments found in PBS 3

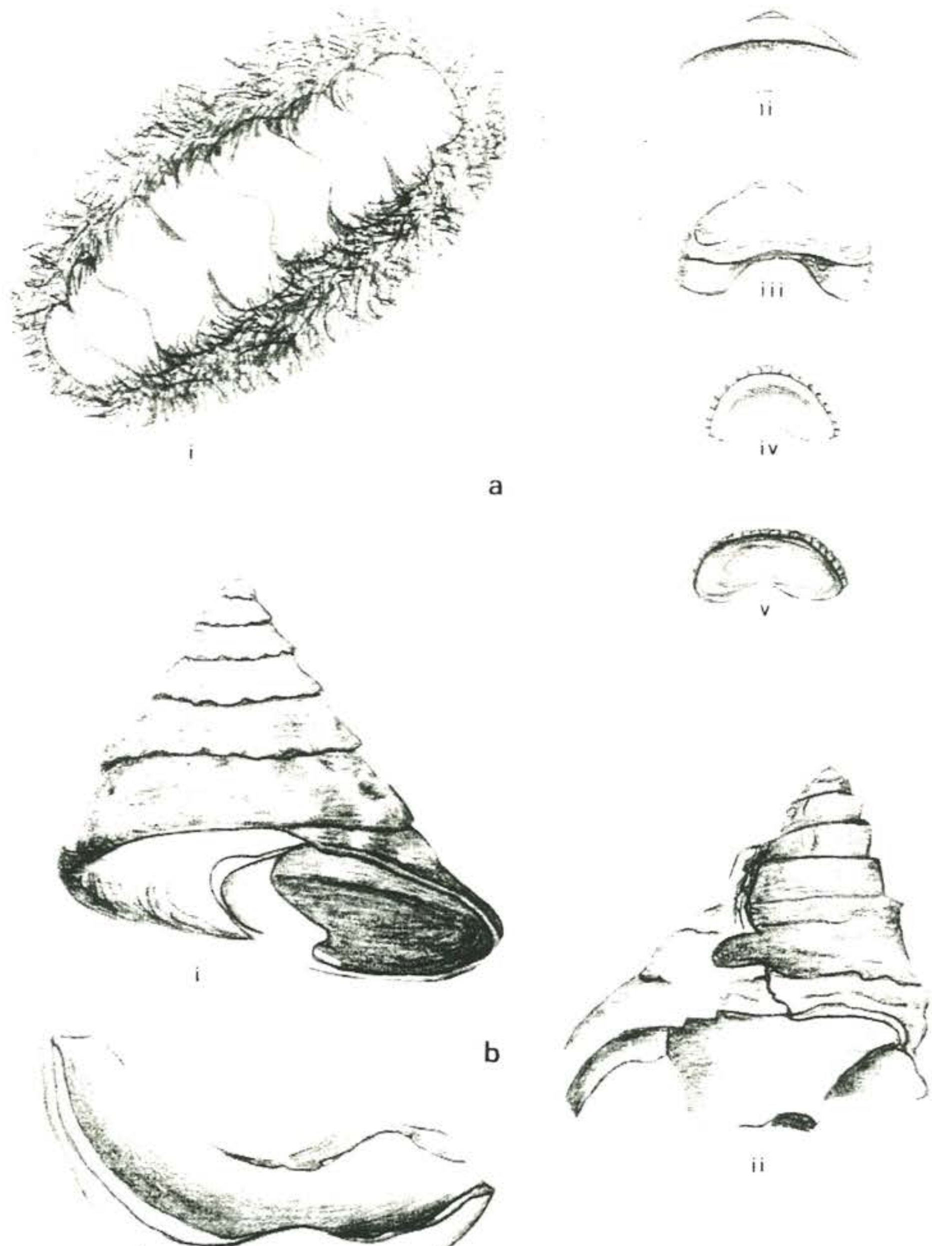


Fig. 1 (a) *Acanthopleura spinosa* (Bruguiere 1792) - Spiny Chiton.
(i) Entire animal; actual size fragments from PBS 3 Spit 3, (ii) inner side of body segment; (iii) upper side of body segment; (iv) inner side of mouth segment with rasping teeth; (v) upper side of mouth segment.

1 (b) *Trocus* sp. - Top Shells. (i) Entire shell; (ii and iii) actual size fragments found in PBS 3 Spit 3.

Spit 3.

Family TURBINIDAE

Fig. 2 (a) *Turbo* sp. probably *Turbo cinereus* (Born 1778)

Squat Turban

Turban shells are generally heavy, globose and medium to large in size. Some species are similar to trochids but they can always be separated by the operculum. The operculum of a turban shell, known as a cat's eye is round, calcified and white or coloured to match the inside of the shell aperture. In top shells the operculum is horny and a drab brown. Turban shells are herbivores found on intertidal rocks.

Range: Queensland to Western Australia. Size: to 30 mm. Common.

(i) Entire shell; (ii) actual size fragment found in PBS 3 Spit 3.

Family NERITIDAE

Fig. 2 (b) ; *Nerita* sp. probably *Nerita lineata* (Gmelin 1791)

Lined Nerite

Lined Nerite inhabits the roots of tropical mangroves close to and above high tide. Empty shells are favoured by hermit crabs. Nerites are numerically the most dominant shell found in the middens excavated on Orpheus Island, but their small size compared to that of the much larger (100 - 140 mm) *Tridacna crocea* or burrowing clam makes them less obvious in the surface expression of the middens.

Range: Queensland to Western Australia. Size: to 38mm. Common.

(i and ii) Entire shell; (iii and iv) actual size fragments found in

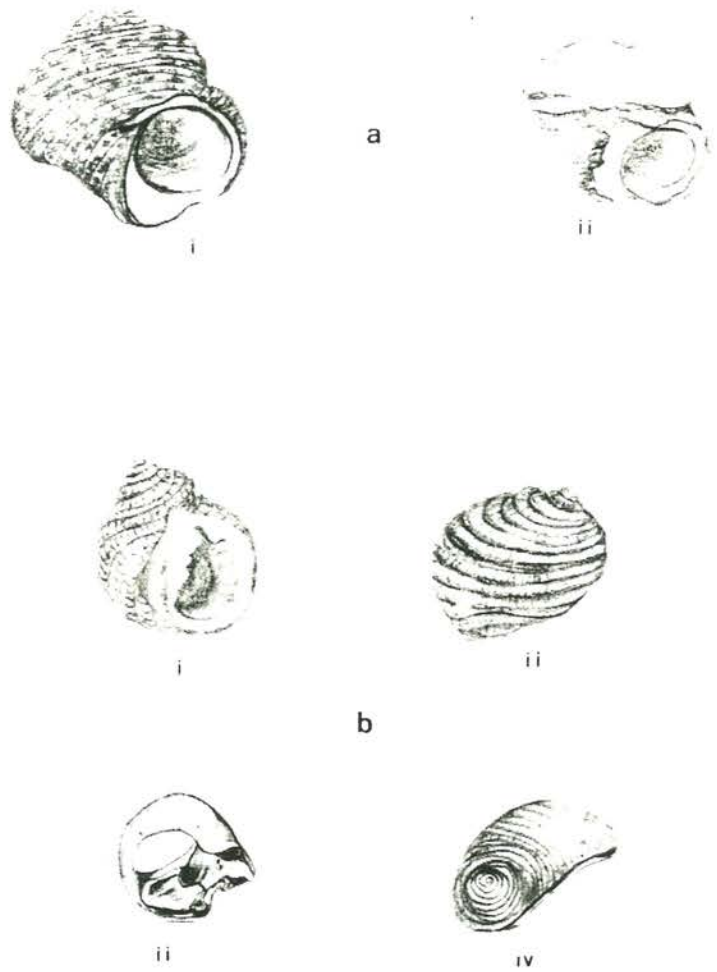


Fig. 2 (a) *Turbo* sp. probably *Turbo cinereus* (Born 1778) - Squat Turban (i) Entire shell; (ii) actual size fragment found in PBS 3 Spit 3.

(b) ; *Nerita* sp. probably *Nerita lineata* (Gmelin 1791) - Lined Nerite. (i and ii) Entire shell; (iii and iv) actual size fragments found in PBS 3 Spit. 3.

PBS 3 Spit 3.

Family STROMBIDAE

Fig. 3 *Lambis lambis* (Linneaus 1758)

Common Spider Shell

Strombs, wing, spider or scorpion shells are tropical shells. They are solid, porcelanous, often brightly coloured shells with the outer lip flared and sometimes extended into pointed projections. Very common on reef flats and rubble patches at low tide down to 10 metres. They feed exclusively on short fine algae growing on dead coral and rocks.

Range: Queensland to northern Western Australia. Size: to 270 mm. Common.

(i and ii) Entire shell of *Lambis lambis* ; (iii and iv) actual size fragments found in PBS 3 Spit 3.

Family STROMBIDAE

Fig. 4 (a) *Stromb* sp. probably *Strombus luhuanus* (Linneaus 1758)

Strombs, wing, spider or scorpion shells

Strombs are solid, porcelanous, often brightly coloured shells with the outer lip flared and sometimes extended into pointed projections. They inhabit areas of intertidal coral rubble to 10 metres.

Range: New South Wales, Queensland to Western Australia. Size: to 76 mm. Common.

(i) Entire shell of *Strombus luhuanus* ; (ii) actual size shell with characteristic breakage found in PBS 3 Spit 3.

Fig. 3 *Lambis lambis* (Linneaus 1758) - Common Spider Shell (i and ii) Entire shell of *Lambis lambis* ; (iii and iv) actual size fragments found in PBS 3 Spit 3.

Family NATICIDAE

Not figured: *Polinices* sp. Possibly *Polinices aurantuis* (Roeding 1798)

Moon snails

Moonsnails are among the commonest molluscan predators of the intertidal sandflats. They emerge at night to feed on other mlluscs, especially bivalves. The shells of moon snails are small to medium in size, smooth, olften coloured with elaborate patterns, and globose with a low spire. The operculum may be either horny or clacified. Fragments found in PBS 3 are not figured.

Range: New South Wales to Northern Territory. Size: to 40 mm. Common.

Family MURICIDAE

Fig. 4 (b) *Chicoreus cornucervi* (Roeding 1798) (figured)

Murex or rock shell

The shells of murex are often complex. The whorls are always interrupted by rib-like varices, but these may be produced into all sorts of complex decoration. The aperture is circuclar to ellipitcal. The body whorl is expanded and produced anteriorally to enclose a narrow canal. The operculum is horny. Rock shells are carnivorous, feeding mainly on bivalves.

Range: Queensland to Western Australia. Size: to 120 mm. Common.

(i) Entire shell of *Chicoreus cornucervi;* (ii, iii, and iv) actual size fragments found in PBS 3 Spit 3.

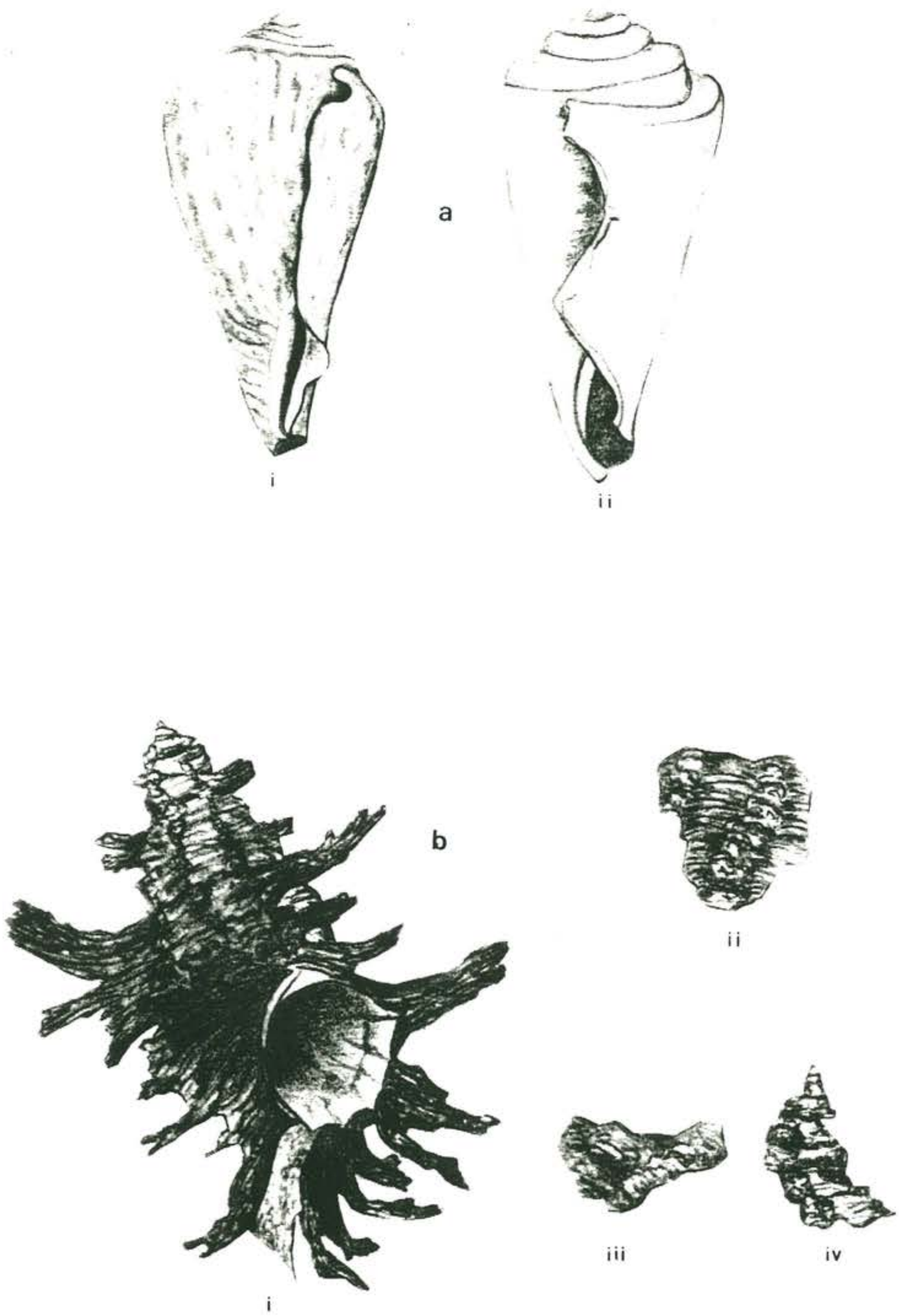


Fig. 4 (a) *Stromb* sp. probably *Strombus luhuanus* (Linneaus 1758) Strombs, wing, spider or scorpion shells. (i) Entire shell of *Strombus luhuanus* ; (ii) actual size shell with characteristic breakage found in PBS 3 Spit 3.

(b) *Chicoreus cornucervi* (Roeding 1798) (figured) - Murex or rock shell. (i) Entire shell of *Chicoreus cornucervi;* (ii, iii, and iv) actual size fragments found in PBS 3 Spit 3.

Family VOLUTIDAE

Fig. 5 *Melo amphora* (Solander 1786)

Baler shell

Volutes are carnivorous, feeding on other molluscs, or are scavengers. They inhabit coastal mud flats and are trawled in deep water on the continental shelf. They are variable in shape, ranging from small to large. The spire is short to high, the aperture is wide, the columella calloused and with or without plaits. Only a few species have an operculum.

Range: Southern Queensland to northern Western Australia. Size: to 560 mm. Common.

(i and ii) Entire shell of *Lambis lambis* ; (iii and iv) actual size fragments found in PBS 3 Spit 3.

Family CONIDAE

Fig. 6 *Conus marmoreus* (Linneaus 1758)

Marbled cone

Cone shells are beautifully coloured often smooth shells with the spire depressed but pointed. The long body whorl is shouldered and narrows towards the base as an inverted cone. The aperture is long and narrow. Cone shells are carnivores with dart-like teeth in the proboscis which is assocaiated with poison apparatus. Handle with care. *Conus marmoreus* inhabits sandy areas where it lives under dead coral or in sand around coral heads or soft corals.

Range: Queensland. Size: to 76 mm. Common.

(i) Entire shell of *Conus marmoreus* ; (ii) actual size fragment found in PBS 3 Spit3.

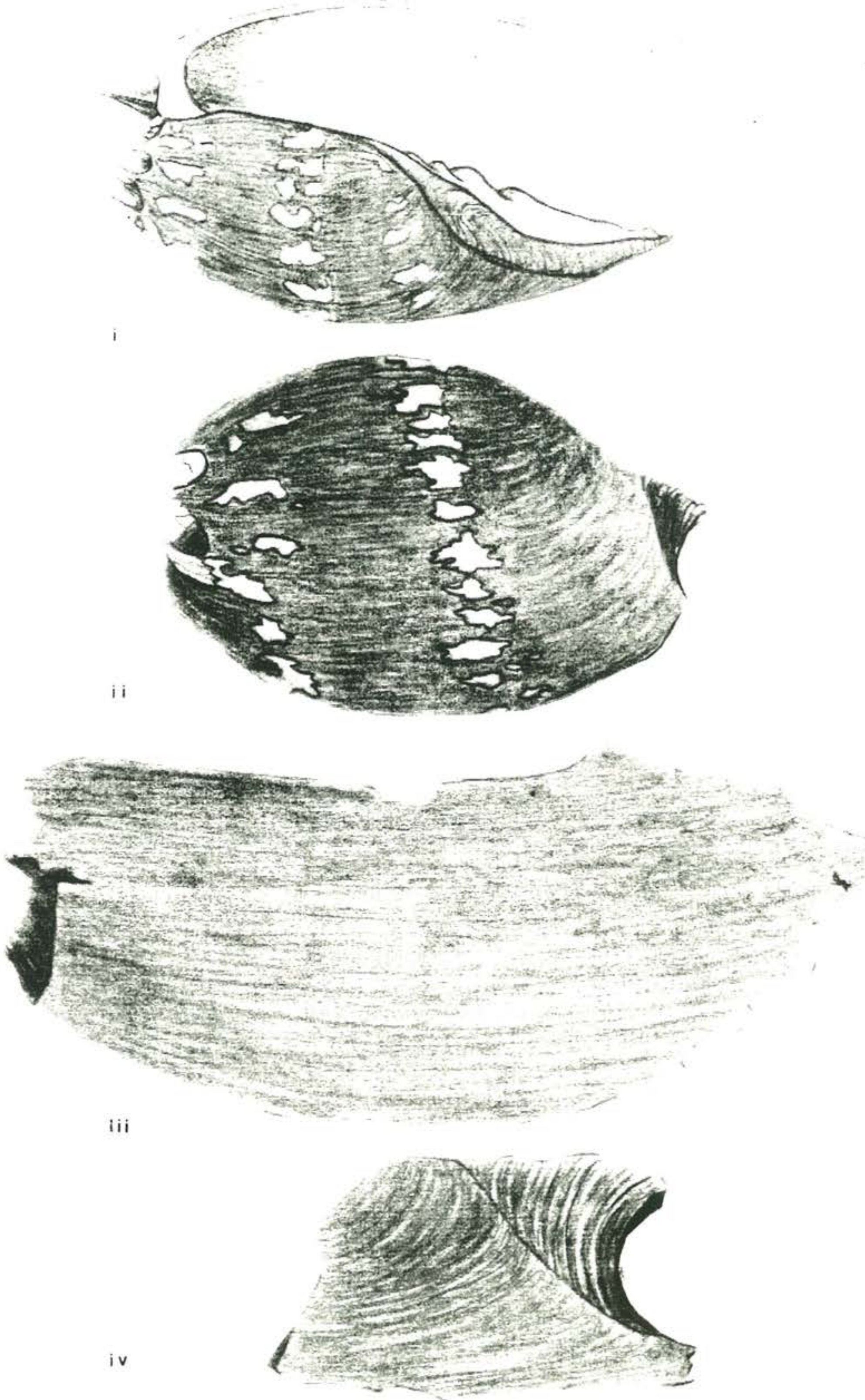


Fig. 5 *Melo amphora* (Solander 1786) - Baler shell. (i and ii) Entire shell of *Lambis lambis* ; (iii and iv) actual size fragments found in PBS 3 Spit 3.

i

ii

Fig. 6 *Conus marmoreus* (Linneaus 1758) - Marbled cone. (i) Entire shell of *Conus marmoreus* ; (ii) actual size fragment found in PBS 3 Spit3.

CLASS **BIVALVA**

Family ARCIDAE

Fig. 7 (a) *Anadara* sp. possibly *Anadara trapezia* (Deshayes 1840)

Ark shells

Ark shells are well-known edible species. They are commonly collected amongst mud and weed on intertidal flats in estuaries, where they are usually are located below the surface of the mud.
Range: New South Wales, Queensland to southern Western Australia. Size: to 70 mm. Common.
(i and ii) Both valves of an entire shell found in PBS 3 Spit3.

Family MYTILIIDAE

Not figured: Mussel or coquina shell

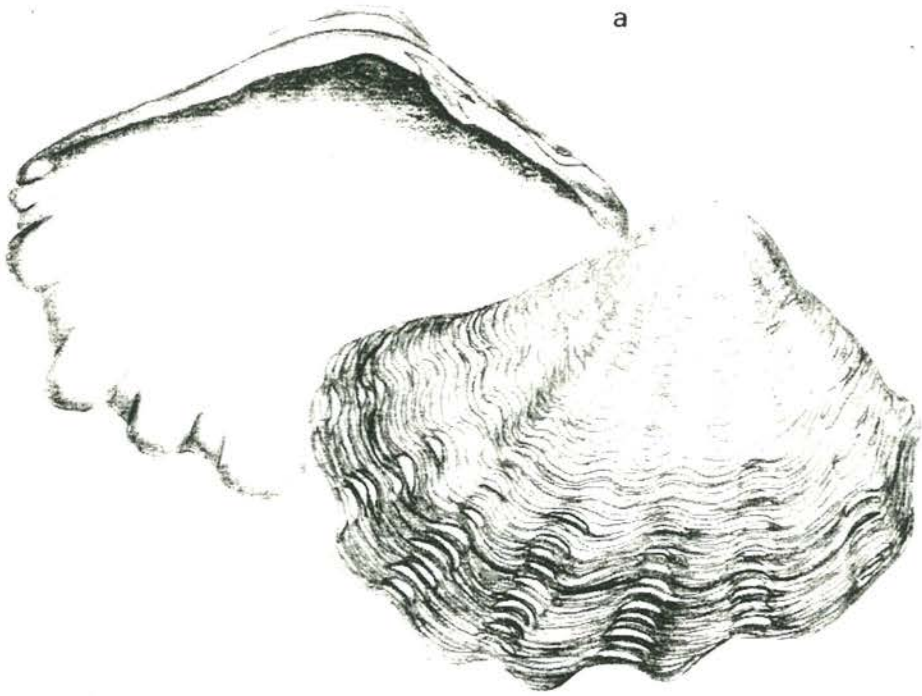
Mytilus edulis planultus (Lamarck 1819) and *Trichomya hirsuta* (Lamarck 1819) are edible mussels which occur in clumps on mudflats, muddy bottoms or on rocky reefs usually in silty areas.
A fragment of a mussel species was found in PBS 3.
Range: New South Wales to Western Australia. Size: 50-120 mm. Common.

Family PTERIIDAE

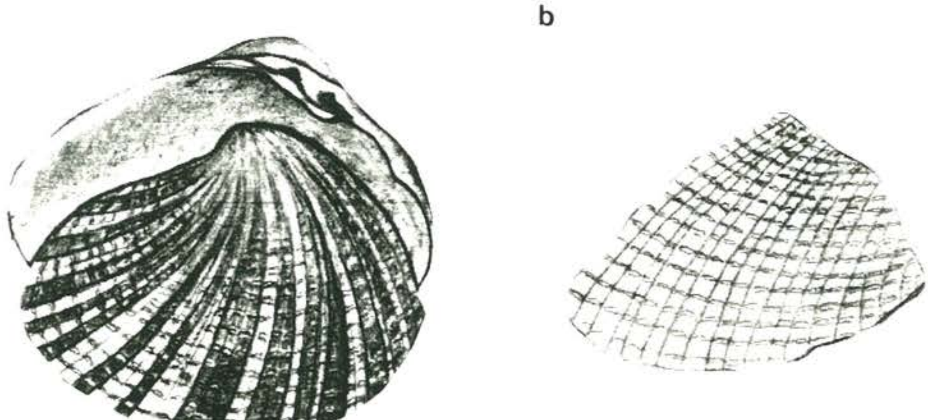
Fig. 7 (b) Pearl and winged pearl shells

Pearl oysters are small to large in size, flattened, have a straight hinge line and a notch on the right valve through which the byssus emerges. There may be wings on the side of the hinge. The anterior adductor muscle scar is small or absent. Pearl oysters are filter feeders, sifting plankton from the surrounding water. They live from low tide level down to and beyond 40 metres.

a



b



i ii

Fig. 8 (a) *Tridacna crocea* (Lamarck 1819) - Burrowing clam. (i) Both valves of an entire *Tridacna crocea* usually found as entire valves in the upper levels of Orpheus Island middens and commonly as fragments of every shape (not figured) throughout the midden deposit.

8 (b) *Antigona* sp. - Venus or tapestry shells. (i) Both valves of entire bivalve; (ii) actual size fragment found in PBS 3 Spit 3.

Range: Queensland, Northern Territory to northern Western Australia. Size: to 230 mm. Common.

(i) Both valves of an entire *Pinctada margaritifera* (Linneaus 1758); (ii, ii and iv) actual size fragments found in PBS 3 Spit 3.

Family OSTREIDAE

Not figured: *Saccostrea* sp.

Oyster

Oysters normally live in a variety of habitats but seems to favour areas of mangroves, mud flats and rocky reefs. Medium to large in size, the shape varies to fit the living space available. The left valve is cemented to the substrate and often rounded to fit the body of the animal. There is a single adductor muscle scar. Fragments were found in PBS 3 but these bivalves appear to be more numerous on the surface of PBN 2 and 3.

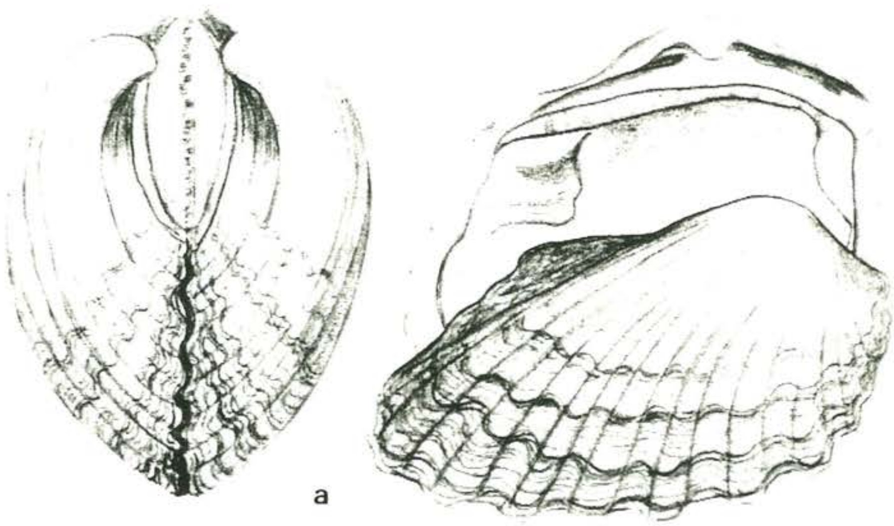
Range: Victoria to Queensland. Size: to 80 mm. Common.

Family TRIDACNIDAE

Fig. 8 (a) *Tridacna crocea* (Lamarck 1819)

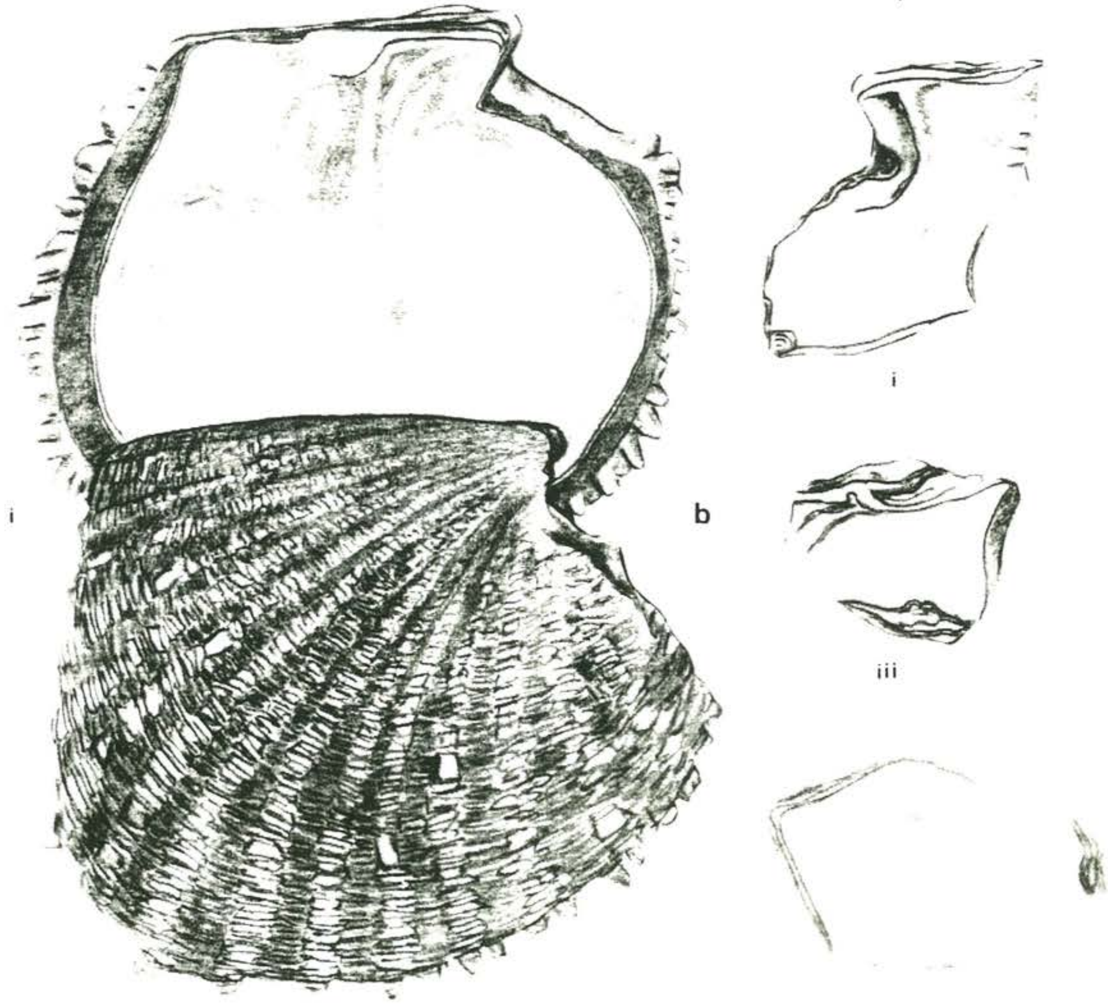
Burrowing clam

The most obvious shell on the Orpheus Island middens is the burrowing clam, *Tridacna crocea*. A deep burrower in coral, it has a narrow range similar to the larger species *T. gigas, T. derasa* and *Hippopus hippopus* through the western Pacific and Micronesia. Its habitat is reef flats and coral heads in water from several centimetres to about 30 metres in depth. To remove *Tridacna crocea* from the coral in which it is embedded the coral must be broken away and the stout byssus by which it attaches itself to the



i ii

Fig. 7 (a) *Anadara* sp. possibly *Anadara trapezia* (Deshayes 1840) Ark shells. (i and ii) Both valves of an entire shell found in PBS 3 Spit3.



7 (b) *Pinctada margaritifera* (Linneaus 1758) - Pearl and winged pearl shells. (i) Both valves of an entire *Pinctada margaritifera* (Linneaus 1758); (ii, ii and iv) actual size fragments found in PBS 3 Spit 3.

substrate must be undercut. Projecting sculpture on the valve surface of *Tridacna crocea* is completely lacking in specimens entirely encased in coral pockets .

Tridacna species are exploited throughout the Indo-Pacific region for their food value and for the valves which are used for such diverse purposes as washbasins, for tool making, as money and as personal adornments. No worked Tridacna valves were found in the small sounding on midden PBS 3.

Range: Ind-West Pacific; Queensland to Western Australia. Size: 100-140 mm. Common.

(i) Both valves of an entire *Tridacna crocea* usually found as entire valves in the upper levels of Orpheus Island middens and commonly as fragments of every shape (not figured) throughout the midden deposit.

Family TRIDACNIDAE

Not figured: *Hippopus hippopus* (Linneaus 1758)

Horse's Hoof Clam

One of the free-living clams of the Great Barrier Reef. A fragment of one valve was found in PBS 3 Spit 3.

Range: Queensland ro northern Western Australia. Size: to 300 mm. Common.

Family DONACIDAE

Not figured: *Donax* sp.

One species *Donax deltoides* (Lamarck 1818), or pipi, inhabits areas of coarse sandy surf beaches where it lives at low tide to several fathoms in large gregarious colonies. *Donax* species found

in PBS 3 appear to be naturally occurring small shells increasing in numbers with increasing depth of the midden deposit.
Range: Queensland, New South Wales, Victoria and South Australia.
Size: to 60 mm. Common.

Family VENERIDAE
Fig. 8 (b) *Antigona* sp.
Venus or tapestry shells
The family is united by a number of shell characteristics, most notably that the shells are oval or circular, the valves are equal and often inequilateral, the ligament is external, there are two or three strong cardinal teeth and other strong laterals and two adductor muscle scars. Venerids are most common in shallow, sandy or muddy areas of protected bays and at the mouth of estuaries. The animals burrow into the sediment, leaving the siphons and often the upper surface of the shell exposed.
Range: Queensland to Northern Territory. Size: 60-80 mm.
Common.
(i) Both valves of entire bivalve; (ii) actual size fragment found in PBS 3 Spit 3.