

## MOUND OVER MATTER

Origins of shell and earth mounds of northern Australia:  
an evaluation of mounds on Channel Island and Middle Arm  
mainland, Darwin Harbour.

by

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Except where otherwise acknowledged, all the work presented here is my own. The research undertaken here has not been presented as part of the requirements for any other degree.

*I.R.*

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## ABSTRACT

Issues addressed in this thesis stem from the current debate concerning a possible megapode rather than human origin of the large shell and earth mounds of northern Australia. Shell mounds attributed by archaeologists to human agency, are claimed by Stone (1989) to be identical to scrubfowl mounds, apparently requiring a reassessment of the criteria used to define the archaeological significance of shell mounds.

This thesis examines Stone's hypothesis,<sup>3</sup> by differentiating the content of the argument put forward, from the approach used in its presentation. It is argued that not only are the conditions necessary for a theory to be considered scientific not met by Stone's methodology, but that elements of cult archaeology are exhibited in his style of argument.

Comparative field data is provided in this thesis, on shell mounds on Channel Island, interpreted by Stone (1989) as built by scrubfowl, and on shell mounds on nearby Middle Arm mainland, interpreted by archaeologists as built by humans. Significant differences are observed between the composition of shell mounds on Channel Island and those on Middle Arm, which are not explained by Stone's hypothesis of the same formation processes for both types of mounds. It is concluded that archaeological criteria for differentiating agencies of formation provide a more coherent explanation for these differences.

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## CHAPTER 1

### INTRODUCTION

#### 1.1 Stone's Hypothesis

Based on the literature on shell and earth mounds and field experience in the Northern Territory, Stone (1989) posits an hypothesis of a megapode rather than human origin for the large shell and earth mounds of northern Australia. These mounds are deemed not primary archaeological features, but merely repositories for Aboriginal artefacts scraped up by generations of the nesting scrub fowl Megapodius reinwardt. This theory is proposed not only for mounds in the area Stone (1987) studied in the Northern Territory, but in the whole of northern Australia, and perhaps the rest of Australia as well. Mounds attributed by archaeologists to human agency are claimed to be identical to scrub fowl mounds described by ornithologists and palaeoecologists. Later Stone (1992:158) argued that even low mounds (<1m thick) are not middens of human origin, but are small shell cheniers or coarse shell berms deposited by wave action.

Posited as being of avian origin are the large shell mounds at Weipa, Aurukun and Princess Charlotte Bay on Cape York Peninsula, and the mounds on Milingimbi Island in the Northern Territory. Stone (1989:60) describes the Kwamter mound near Weipa, which is composed almost entirely of Anadara granosa shell "with little surrounding soil matrix"

(Bailey 1977:133), as atypical of recorded mounds. Mounds described near Aurukun (Cribb 1986), at Macassar Well in Milingimbi (McCarthy & Setzler 1960) and the South Mound site near Princess Charlotte Bay (Beaton 1985), are cited as typical, with higher proportions of soil. From a review of the literature, and his own field experience in the Northern Territory, Stone (1989:60) claims that the north Australian mounds vary considerably in composition, with respect to their proportions of shell and earth.

Most of the evidence Stone provides to support the argument for a megapode origin of northern shell mounds is environmental and ethnographic data. Presented as support is the distribution of shell mounds recorded by archaeologists, in a similar latitude and local environment as scrub-fowl mounds recorded by ecologists. As an explanation for the locations and distributions of the large shell mounds, Stone (1989:62) cites palaeoenvironmental reconstructions by Stocker (1971) and Russell-Smith (1985). Since the scrub fowl's habitat is restricted to closed forest vegetation, the presence of abandoned scrub fowl mounds in open woodland is used to infer that more extensive areas of Monsoon Vine Forest (MVF) once existed in northern Australia. It is argued that mounds recorded by archaeologists are distributed in these proposed past (MVF) Scrub-fowl habitat areas. Russell-Smith's theory of an expansion in the numbers of scrub-fowl in the wetter conditions around 1600 years B.P., as proposed by Lees and Clements (1987), is also provided as supporting evidence.

Ethnographic data consists of an extract from historical

records and an oral account. The taxidermist Gilbert recorded in the 1840's that some mounds on Coburg Peninsula were built by the megapode, as Aboriginal people claimed, and were not the "tumuli of aborigines" as some European locals believed. The latter oral account is one senior Aboriginal man's interpretation of a photo of the Garrki shell mounds at Milingimbi as "bird's nests" (Stone 1989:63).

Radiocarbon dates and the stratigraphic sections of the Kwamter mound are interpreted as more consistent with scrub-fowl agency than human agency (Stone 1989:61; 1992:142-4). Some non-sequential dates from the South mound site are interpreted by Stone (1989:61-2) as indicating reworking of the mound by scrub fowl. In addition, a cluster of dates between 1100 and 1800 years BP for five mounds in northern Australia are said to be consistent with wetter conditions and expansion of the scrub fowl habitat (Stone 1989:62-3).

## **1.2 Mounds In Northern Australia**

Numerous shell mounds along the coasts of northern Australia have been recorded by archaeologists (eg. Bailey 1975; Beaton 1985; Cribb et al 1988; Woodroffe et al 1985). Research on shell mounds has generally been concentrated around Cape York Peninsula in north Queensland and in north eastern Arnhem Land in the Northern Territory.

### **1.2.1 Cape York Peninsula**

Shell mounds in Cape York Peninsula which have been recorded as of human origin by archaeologists include over

300 mounds at Weipa, 28 mounds in the Aurukun region and 38 shell mounds at Princess Charlotte Bay. Of the Weipa mounds, one large mound, the Kwamter mound, has been excavated and analyzed by Wright (1963; 1971) and subsequently Bailey (1977; 1983). At Princess Charlotte Bay 13 mounds were excavated or sectioned for samples by Beaton (1985). Beaton presented the results of the excavation of the South Mound site because it typified the "internal structure" of all the mounds sampled.

### 1.2.2 The Northern Territory

In the Northern Territory 15 shell mounds were recorded by McCarthy and Setzler (1960) on Milingimbi Island. They recovered numerous artefacts and human bones from the mounds, described as "of a compact mass of bivalve and other shell deposits". Four shell mounds were recorded by Peterson (1973) near the mouth of the Glyde River on the mainland south of Milingimbi. In the same area, two shell mounds were sampled by Meehan (1982:168) near the Blyth River. McCarthy and Setzler (1960:230-250) excavated three of the shell mounds at Milingimbi, one of which, Macassar Well mound, was previously excavated by Warner (1958:455). Smaller shell mounds have been recorded at Chambers Bay on Van Diemen Gulf (Baker 1981), on Croker Island (Mitchell 1993), and the Alligator Rivers region (Woodroffe et al 1988) of Arnhem Land. One of the shell mounds on Croker Island, "Maramamay", was excavated and analyzed by Mitchell (1993).

Recently, numerous shell mounds have been recorded in Darwin Harbour by Hiscock & Hughes (n.d.) and by the author

during research for this thesis. A review of literature on shell mounds suggests a general uniformity of character and composition of recorded mounds in the Northern Territory, such as Bailey (1991:22) observed for the Weipa mounds.

### 1.3 Review Of Literature on Shell Mounds

Stone joins those eighteenth century European scholars who believed that the numerous shell deposits featured in the landscape all over the world were natural formations. At that time the few dissenting voices to this view were explorers such as botanists Peter Kalm and Joseph Banks, who were able to observe the process of shell midden accumulation by humans. In the 1830's and 1840's it was American geologists who first argued in favour of a human origin for most shell deposits. This was followed in the late 1840's by "problem-oriented scientific excavations" of "kitchen middens" by Danish scholars. From these excavations criteria were developed to distinguish cultural from natural shell deposits. Shell middens were found to consist of adult individuals of species, often from different habitats, and also contained artefacts, charcoal and animal bones. Natural shell beds were found to contain juvenile through to adult individuals of species belonging to a similar habitat. These were also sorted and stratified according to volume and weight, through wave-action (Waselkov 1987:139).

When Bailey, the "Cambridge archaeologist" (Stone: 1993:25) visited the Weipa shell mounds in the 1960's and 1970's, he did indeed have traditions of research into the origins of shell deposits behind him. The work of those

early Danish scholars was corroborated by the findings of nineteenth century archaeologists through excavations in Europe, England and America (see Waselkov 1987:140). In Australia methods of identification, and problems with criteria for distinguishing between human and natural origins of shell deposits have been thoroughly researched and discussed since the late nineteenth century (Statham 1892; Gill 1954; Coutts 1966; Ambrose 1967; Hughes & Sullivan 1974; Bailey 1977; Hughes & Lampert 1977; Jones & Allen 1978; Horton 1978; Bowdler 1983).

More recent analyses dealing with this specific question have been carried out by Attenbrow (1992) and Mitchell (1993). Criteria developed by previous researchers were re-examined by Attenbrow and additional factors which need to be taken into account were identified. Criteria used to analyze the status of shell deposits include the range and number of species of mollusc present, the proportion of each species, and the size of shells within each species. The source or habitat of each species in the deposit is also seen as pertinent. These are all criteria which indicate whether a "degree of selection" exists which does not occur in natural shell deposits (Attenbrow 1992:9).

Other criteria determined as relevant are the presence or absence of "non-economic" species (ie. those species considered too small to provide a reasonable amount of flesh), and in what proportion these occur. The shells are inspected with regard to their condition; whether still articulated (in the case of bivalves), or water worn, broken or burnt. Also considered is the presence or absence of

materials other than shell. These include non-molluscan fauna, Aboriginal artefacts, charcoal, pumice and shell grit, and pitted stones deposited by birds. Another factor regarded as relevant is the presence of forms of life not recorded ethnographically as being used by Aboriginal people, such as coral and worm tubes. Stratigraphy and location of the shell deposit within the soil profile and in the landscape, and post-depositional factors are also taken into account (Attenbrow 1992:9-20).

In response to Stone's hypothesis, a number of researchers have addressed the specific question of determining which criteria are useful in the particular case of distinguishing megapode mounds from human mounds. Criteria suggested by Bailey (1991:22) include mound shape, stratigraphy, rate of accumulation, proportion of sediment to shell, source of sediment, degree of shell fragmentation, and number of artefacts present. Cribb (1991:24) suggests four criteria on which shell mounds may be assessed: composition, structure, location and role within contemporary Aboriginal culture. The most relevant criteria as determined by Mitchell (1993:12) are composition, internal structure, and environmental context.

Mound size and shape is ruled out as useful distinguishing criteria by Mitchell (1993:4) because of the large variability of these features in recorded mounds. The importance of artefact density as a determinate, suggested by Bailey (1991) and Roberts (1991), may also be problematic. As observations by Attenbrow (1992:17) and Bowdler (1983:137) show, the absence of defining features



such as artefacts need not necessarily indicate a non-human origin for mounds. Artefact density appears to be a highly variable component in shell mounds. This is most probably a reflection of the poor preservation of the types of tools (perishable implements made from wood, bone and shell) used to obtain resources in coastal areas (Bailey 1977:136; Baker 1981:81; McCarthy and Setzler 1960:250).

Literature in Australia concerning techniques of midden analysis include works by Bailey (1975) and Bowdler (1983). Examinations of Australian shell mounds and deliberations on their formation processes have been carried out by Baker (1981), Bailey (1977; 1983), Beaton (1985), Brockwell (1989), Hiscock and Kershaw (1992), McCarthy & Setzler (1960), Meehan et.al. (1985), Mulvaney (1975), Peterson (1973), Roberts (1991), Waselkov (1987), and Wright (1971). Ethnographic data on the collection, cooking methods, and patterns of disposal of shellfish by the Anbarra people of Arnhem Land by Meehan (1982; 1988) also provides ideas on possible past processes of mound formation:

Cultural processes that influence the deposit directly begin with cultures forming the site. On Australian Aboriginal home bases, for example, clean-ups dispersed fresh deposits and occasionally older debris to the peripheries of hearths where banks formed (and were rummaged by dogs); on one site a house post was dug into a "dead man's" ..deposit (Meehan 1982:114,166).

Physical and biological processes of mound formation by megapodes, termites, ants, crocodiles and mice as outlined by Stone (1992), are recognised by archaeologists. Research has shown that different species may make use of available mounds, whatever their origin. Archaeological research by

Brockwell (1989) on the South Alligator mound sites found that the evidence shows that Aborigines camped on existing mounds during the wet season, whether they were abandoned scrub-fowl mounds or some other type of mound. Brockwell points out that artefacts were only present on the mounds and not on the ground surface around the sites. This observation contradicts Stone's (1989:61) idea that artefacts were incorporated into mounds by scrub-fowl (Brockwell 1989:209-210).

Archaeological knowledge is not confined to formation processes. Bioturbation of shell mounds by birds, goannas, dogs (Meehan et.al. 1985), turtles, rodents (Ceci 1984:64), pigs, and crabs (Specht 1985) has been explored. Other recognised post-depositional disturbances include chemical processes, tree root growth, tides and storms, as well as human trampling (Hughes & Lampert 1977), or removal of shells by birds for nest-building (Dwyer et.al 1985). Information gained from ethnographic studies such as Meehan's (1982), and experimental work on the dating of shells from middens (Head et.al.1983) indicate that coastal sites are unlikely to display stratigraphic integrity, due to the complexities of midden formation.

Archaeologists are aware of the importance of recognising the role of natural physical processes in mound formation as discussed by Stone (1993:30-45). Geomorphologic reports are frequently employed in interpretations of archaeological features of the landscape, and Australian archaeologists have worked with geomorphologists since the

1960's. Indeed, a number of Australian archaeologists are trained geomorphologists (see Hughes and Sullivan 1982). In Europe, the Middle East and America studies involving geomorphology and sedimentology in archaeology (geoarchaeology), mostly engaged in reconstructing palaeoenvironments, have been numerous (Hughes 1980:3-4; see also Hughes 1983 and Stein 1992). An Archaeological consultancy which began investigating sites, including shell middens, in Kakadu in the early 1980's included archaeologists, geomorphologists, and a botanist (Jones 1985). Baker's (1981) thesis on the Aboriginal and Environmental History of the Chambers Bay Coastal Plains is an example of combining the information and concepts of geography with those of prehistory. A more recent thesis by Roberts (1991), proposes a combination of geomorphological processes, Aboriginal discard behaviour, and bioturbation as contributing to mound formation.

Evidence is available that humans are one of the most destructive biological agents to affect shell deposits, mining the mounds extensively for industrial, gardening, and other uses. (Waselkov 1987:146-150; Ceci 1984; Hiscock & Hughes n.d). Yet the only biological agent (Hiscock & Hughes n.d.) that Stone seems to have problems accepting as having any input into processes of mound formation is humans.

#### 1.4 Choice Of Study Area

Large mounds built by the scrub-fowl Megapodius reinwardt on Channel Island in the Northern Territory, have been presented by Stone (1989:61;1991a:26;1992:28) as evidence demonstrating that scrub-fowl build mounds "almost entirely from shell". Nearby on Middle Arm peninsula a scrub-fowl mound built on the edge of an Anadara midden is claimed by Stone (1989:61) to resemble a shell mound at Princess Charlotte Bay described by Beaton (1985). Like their counterparts elsewhere in northern Australia, recently located Anadara mounds on Middle Arm peninsula can be attributed, according to Stone's (1989;1992) hypothesis, to megapode or natural agencies rather than human agency. Channel Island and Middle Arm peninsula are the areas where Stone (1989) carried out the fieldwork on which his hypothesis is founded, and are therefore relevant to the topic of this thesis. Thus Channel Island in Port Darwin harbour and the nearby Middle Arm mainland are the areas chosen for this study.

#### 1.5 Aims Of Thesis

The aims of this thesis are to:

1. Review the debate sparked by Stone's (1989) hypothesis, with reference to scientific methods of testing.
2. Examine Stone's hypothesis as a scientific theory.
3. Provide further field data on mounds, to further inform the current debate.
4. Address theoretical questions raised by the debate.

## CHAPTER 2

### THE DEBATE

#### 2.1 Introduction

In order to adequately deal with the controversy the epistemological issue of "ways of knowing" cannot be ignored. It is important to examine the form of the debate in order to differentiate between the actual content of the argument put forward and the manner of approach used in its promulgation. To this end the nature of "scientific theory" and methods of testing proposed in the debate are explored.

#### 2.2 The Nature Of Scientific Theory

Many claims to scientific method in western society are actually based on a popularly held premise, of a "universal scientific method", through which science produces "proven knowledge" (Chalmers 1979:1). Chalmers (1979:1; 141) argues that this is a false premise, and that due to this "ideology of science" the public can have difficulty in distinguishing between scientific and un-scientific practices. Popper (1959; 1976) saw all knowledge as hypothetical, in that theories can only be improved by continual testing, but not proven absolutely. His philosophy was that all scientific

hypotheses must be empirically falsifiable through testing, to "merit consideration", but that even if an hypothesis was not falsified, it could never be more than probable (Samuel 1985:254; Champion 1986:113-4; Watson 1991:277). The testing of an individual hypothesis is limited in practice because every hypothesis is part of a broader framework of hypotheses, termed a "paradigm" by Thomas Kuhn (1970).

Since Popper's (1959) The logic of Scientific Discovery, philosophers of the twentieth century have debated the nature of scientific theory and methodology of science (eg. Feyerabend 1978; Kuhn 1970; Lakatos 1970). Today, although some such as Chalmers (1979) have argued that there is no "universal scientific method", scientists generally agree on the conditions necessary for a theory to be considered scientific. Scientists aim to construct theories or explanations, which are "well grounded in empirical observations others can replicate (that are) free from... inexplicable contradictions" (Kehoe 1987:13). Acceptable theories are those constructed from tested hypotheses which are presented so that possible tests to refute the hypothesis are easily identified (Kehoe 1987:13; Fletcher 1991:62). Theories such as Freudian or Marxist theories, either of which can explain everything with the same empirical data, are not scientific as they cannot be tested.

Salmon (1982:180) defines Archaeology as scientific if the methods used in "knowing" are well founded, systematic and testable. Scientific archaeologists, like other scientists, realize that their theories can never be absolutely certain, but can only be considered most probable, if they are adequately corroborated by the available evidence at that time. Archaeologists study contemporary data generated by observing the archaeological record. Inherent in the production of this data are ambiguities and inaccuracies in ideas (or theories), which can be revealed by empirical research (Binford 1987:392). Therefore, as Binford (1987:403) argues, proponents of new ideas have the responsibility of exploring as wide experiences as possible to check the accuracy and usefulness of their ideas.

Since before the end of World War Two, scientists have acknowledged that science is not value free, but that scientist's (and archaeologist's) interpretations and analytical practices are always subjective. Knowledge of prehistory is created by people in the present about people in the past, within the context of their ways of knowing in the present. This is always constrained by their own values, as well as the political climate and social values of the wider society in which they live. Thus it is important that science, and scientific archaeology, in both theory and

practice, make clear its own values and objectives within those of the wider society (Patterson 1989:562)<sup>1</sup>.

I follow the moderate scientific empiricist position as outlined by Huchet (1991:3), that despite the subjective nature of all research, "since all observations are theory-laden", it is possible to rationally assess scientific hypotheses. This is achieved by applying the hypothetico-deductive method which is the legacy of the positivists, to evaluate the merit of hypotheses (Huchet 1991:3). Instead of verification and falsification however, which express an hypothesis as absolutely true or false, the terms corroboration and refutation are used, to indicate that scientific hypotheses are always open to further testing.

### 2.3 Methods Of Testing

Science may not operate ideally in practice (Cole 1980:18), but Bailey (1991;1993), Cribb (1991) and Mitchell (1993) generally adhere to the conditions considered acceptable in the construction and testing of their hypotheses. They look for empirical data derived from analyses of mound composition to provide criteria against which hypotheses may be validly tested. The presence or absence of these observations is considered evidence to refute or corroborate their hypothesis. In determining criteria to distinguish between mounds of human and natural origin, they build upon past work in this area (see above).

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<sup>1</sup>See Patterson (1989:562) for a range of literature on the nature of science and scientific archaeology, dealt with in the post-processual debate.



Bailey (1977) compares the composition, stratigraphy and environmental context of the posited human Kwamter mound with that of a posited natural beach ridge. His explanations are based on empirical observations others can replicate. The pattern of the Kwamter dates, Bailey (1977:135) suggests, is "not inconsistent with a natural process of deposition". Although the data are "not adequate to confirm it,.. they do not exclude the possibility that the rate of accumulation of the shells in the Kwamter mound varied widely during...its formation". Thus a test to refute the hypothesis is offered, while Bailey interprets the results in view of knowledge of ethnographic data on practical aspects of human discard of shell. With reference to composition, Bailey (1977:137) again offers a test to refute the hypothesis of a human origin for the Kwamter mound; "If the same agent had been responsible for the deposition of shell at both sites, we would expect a similar list of species to be present". The data with respect to this aspect of the analysis supports Bailey's explanation.

Whilst Stone (1989;1992) professes to use the scientific method of testing formulated hypotheses against empirical data, "scientific" archaeologists would object to his hypothesis on the grounds that they are untestable (Watson et.al 1971:27-29). A tendency to simply explain away inconsistencies in the evidence for his theory, makes it difficult to determine under what criteria Stone is prepared to concede that his hypothesis is refuted.

For example, Stone (1989:61) states that the radiocarbon dates and stratigraphic sections of the Kwamter mound

demonstrate a gradual accumulation which is "as consistent with scrub-fowl agencies as with human agencies". Later Stone (1991a:27) claims that the Kwamter dates place 2.5 metres of the 3 metres deposit at roughly the same age, which is not "gradual accumulation through human agency" but rather, "is consistent with scrub-fowl rapidly reworking one old midden". Meanwhile, the "erratic dating sequence" at South Mound site is also "more consistent with scrub fowl agencies". Inconsistencies such as this make it difficult to challenge Stone's hypothesis in the usual scientific manner, since as Bailey (1993:10) points out, "all possibilities are consistent with scrub fowl accumulation".

In fact Bailey (1977:134) says that the Kwamter dates "suggest marked irregularities in rate of accumulation" but that because there are so few dates it is difficult to determine any pattern. Bailey (1977:135) argues that given practical aspects of processes of discard, including use of different campsites at different times, a shell mound would be expected to demonstrate a wide variation in rate of accumulation. This would occur even though the mound's development was part of a "stable, long-term pattern of resource exploitation" over a region. Stone (1992:142) persists in either a misrepresentation or a misunderstanding of Bailey's argument, claiming that "Gradual accumulation is the fundamental tenet of the hypothesis of human origin".

Perhaps Stone's (1991a:27) misunderstanding of human discard processes as "neat occupation events" is due in part to archaeological interpretations which emphasised chronological gradation in shell mounds as showing how long

the site was occupied. Nonetheless, gradual accumulation is not the fundamental tenet of archaeologist's hypothesis of human origin for some shell mounds as Stone (1992:142) claims. As discussed below, ethnographic evidence of patterns of shell disposal suggests that large shell deposits can form over relatively short time spans (eg.200 years), complicated by abandonment and reoccupation periods. Radiocarbon dates from shell mounds, which are non-sequential or span only a couple of hundred years, are consistent with what is known of human accumulation of shell deposits (Meehan 1982; Waselkov 1987:143-5).

Stone (1992) claims to test the hypothesis that the Weipa shell mounds accumulated due to repeated Aboriginal shellfishing and occupation, by dating a sequence of ten shells from various depths of the Kwamter mound. The results of "roughly" the same radiocarbon age (dates ranging from  $830_{\pm 80}$  to  $1030_{\pm 40}$ ) for most of the shells are alleged to "cast(s) serious doubt on the hypothesis of human origin" (Stone 1992:ii-iii). Yet observations quoted by Stone (1992:53) of a rate of growth of 1.3m in diameter and 60cm in height over one year for a scrubfowl mound would seem to be a much faster growth rate than the dates indicate for the Kwamter mound. Healey (in prep) has observed during fieldwork over a four year period since 1990, that scrub fowl mounds can reach a height of one metre in 12 months. A rate of growth of 3m in four to five years was also reported for a mound at Yepoon (Wolstenholme 1925).

Stone's hypothetico-deductive logic is seriously flawed simply because the dates for the Kwamter mound are not

inconsistent with a humanly deposited shell mound. The test is not a valid one, since Stone has not refuted the proposition that people deposited these shells. The radiocarbon ages are not inconsistent with the hypothesis of human origin of a shell mound built up at intervals over a period of two hundred years; quite a long time in terms of human lifetimes. Archaeologists have long noted, as Waselkov (1987:143) says, that "The single most important effect of large-scale molluscan consumption and shell disposal is a rapid rate of midden accumulation".

Similarly, Stone (1989:61-2; 1991a:27) interprets non-sequential dates of the South Mound site as an indication of periodic reworking, and therefore "more consistent with scrub fowl agencies than neat Aboriginal occupation events". Information on formation processes of shell mounds are derived from ethnographic observations (eg. Jones 1980:157-61; Meehan 1982:112-18) of contemporary mollusc gatherers. These observations reveal that a mound may represent the accumulation of a number of small heaps of shell through "discrete depositional events" separated in time (Waselkov 1987:143). Constant reworking of cultural shell deposits occurs through activities by humans, such as clearing areas being reoccupied by piling the rubbish (shells) on the side, and digging holes at camp sites for ovens or sleeping hollows. Thus dates which do not follow a sequence are not inconsistent with Aboriginal occupation (Head et al. 1983).

The high proportion of shell relative to soil in the Kwamter mound contradicts Stone's idea that this mound is a scrub fowl mound. A scrub fowl mound, Bailey (1991:22)

points out, would require a large proportion of soil to fulfil its function as a nest. To explain this problem Stone (1989:62) suggests a "supplementary hypothesis" that earth may have been leached out of the mound by rainfall. Popper (1963:37) tells us that "ad hoc supplementary hypotheses" may be introduced as auxiliary assumptions to rescue a theory when it is falsified by testing through empirical observation. When Bailey (1991:22) replied that the presence of lenses of ash in the Kwamter mound rebuts this suggestion, Stone moved away from his original argument. He then claimed that if the Kwamter mound composition reflects the materials on the ground surrounding the mound (which is not established), then "there is no real need to invoke any soil leaching process" (Stone 1991a:27). Furthermore Stone (1991a:26) asserts that the existence of scrub fowl mounds built "almost entirely from shell" on Channel Island, demonstrates that shell "presents scrub fowl with no logistical difficulties".

A further test of the hypothesis of human origin, by microscopic examination of the interior surface of shell valves is put forward by Stone (1992:107). The theory is that the interior surfaces of shells collected live from their intertidal habitat and taken to dry land for consumption "should show no signs of encrustation, boring or any other activity associated exclusively with sea water". In this instance Stone's logic appears sound and the conditions necessary for a theory to be considered scientific are followed. Empirical observations are presented that can be replicated and the results presented in such a manner that a test to disprove the hypothesis is

offered. Stone (1992:145-6) discusses the problems and limitations of this test and acknowledges that the results were ambiguous and did not corroborate his hypothesis.

Questions left unanswered by Stone's (1989) hypothesis, on the characteristics of scrub fowl mounds, are addressed in part by Mitchell (1993), who seeks to determine criteria to distinguish between mounds built by megapodes and humans. Observations in Northern Australia on scrub fowl mounds and mounding behaviour are collated by Mitchell (1993:3) into a consistent set of data which provide a basis for identifying useful criteria. Most of the observations described scrub fowl mounds as composed of a mixture of soil, vegetable matter, leaf litter/mould (eg. Beruldsen 1980; Cayley 1991:41; Crome & Brown 1979; and Frith 1956) and/or sand and shells (eg. Gilbert [in Gould 1865:172]; Frith & Hitchcock 1974:129-130; Mathews & Iredale 1921:219). The focus in Mitchell's paper is on the availability of quantitative data. Mitchell (1993:4) points out that Stone (1989:61) gives no details of the dimensions or locations of very large scrub fowl mounds (up to 10m height) that he claimed to have observed.

Criteria determined by Mitchell (1991:5-7) as diagnostic in distinguishing between mounds built by scrub fowl or humans include the composition and internal structure of the mound, and environmental context. Mitchell tests his theory that the Mari-maramay mound can be distinguished from scrub fowl mounds, by applying criteria determined from the data base available on the composition of scrub fowl mounds, to excavated data from a mound on Croker Island. He also

examines the ground surface around the mound to test whether the mound composition reflects the surroundings, as it should if it were a scrub fowl mound.

As Bailey (1991:22) comments, it is up to Stone in positing a new hypothesis, to provide "objective criteria" to distinguish between mounds built by scrub-fowl or human agency. The criticism which Stone (1991a:26) levels at Cribb (1986, 1991) for making distinctions between scrub fowl and "allegedly" human mounds without excavated data can be applied to Stone himself. Stone (1989,1991a) provided no detailed excavated data on the composition of mounds he discussed.

In his Masters thesis, Stone (1992:65-84) dismisses archaeological interpretations of a human origin for many of the world's shell mounds, in favour of a natural or megapode origin. Rowland (1994:155) points out that there are a few problems with Stone's (1992) reasoning, one of which is that shell mounds around the world are common outside the range of megapode distribution. They also continue over time spans which are not invariably related to coastal changes, and are not always close to sea level, so can not always be explained as natural features resulting from wave-action.

The only mounds which Stone (1992:59) allows as having "strong claims to human origin" are those mounds with "architectural features and other cultural remains". If we try to determine exactly which features convince Stone of the anthropogenic status of shell mounds, we can list the features of the shell mounds of Honshu in Japan, the only

sites in the world that Stone recognises as "unequivocally human". Stone (1992:61) identifies as distinguishing features of these mounds:

location on plateaus 25-40m above sea level;  
structural features and cultural remains  
associated with the mounds, eg. "pit dwellings  
and postholes often sunk into the underlying  
volcanic soil"; and numerous "firepits,  
ceramics, stone and bone artefacts and burials".

Excavation of Californian shell mounds revealed prehistoric artefacts and burials, and the presence of ash and charcoal layers throughout the mounds. But according to Stone (1992:72), "this is hardly proof that the deposits accumulated through human agencies". Flint, bone and ceramic artefacts, charcoal, burnt shell and clay "interpreted as hearths or firepits" in the Ertebolle midden of the Baltic coast are not criteria accepted by Stone (1992:74-5) as indicating human agency. The remaining features left to convince Stone of the "unequivocally human status" of the Honshu shell mounds are:

location on plateaus 25-40m above sea level;  
structural features "associated with" the  
mounds, eg. "pit dwellings and postholes often  
sunk into the underlying volcanic soil"

However, the features accepted by Stone as indicating human origin, may only mean that people built on a mound, not that they built the mound itself (pers. comm. P. Hiscock). Also, Stone's requisite features for recognition of a shell mound as human appear to be overly restrictive, given that "architectural features" are not known to have been prominent in prehistoric hunter-gatherer societies.



## 2.4 Ethnography And Its Uses

In this debate a contemporary oral account by a senior Aboriginal man interpreting the Garrki shell mounds of Milingimbi as "bird's nests" is used by Stone (1989:63) as support for his hypothesis. However, there are many oral accounts and historical records which demonstrate Aboriginal recognition of mounds as human or as part of Aboriginal mythology (eg. Cribb 1986:143;153; McCarthy & Setzler 1960:249; McConnell 1957 cited in Cribb et.al 1988:68; Meehan 1982; Peterson 1973:187). There is also ethnographic data on the contemporary practice of mollusc gathering and patterns of disposal of shell by the Anbarra people of Arnhem Land by Meehan (1982;1988), which provides ideas on possible past processes of mound formation.

Ethnographic information to support archaeological explanations is often obtained from historical sources (ethnohistory), or from contemporary oral accounts by Aboriginal people. Observations of practices in contemporary communities where some cultural continuity is said to exist are also used to support archaeological interpretations. However, it is recognised by prehistorians, as Mitchell (1993:6) points out, that care must be taken in the way ethnographic data are used in analyses of archaeological material. The problems of using ethnography or ethnohistory

to interpret archaeological events are well discussed in the literature (eg. McBryde 1979:140-4; Murray 1988; Davidson 1988). One of the problems lies in inherent assumptions of a continuity between people's past and present behaviour, when the kinds of scale involved span thousands of years since the formation of these mounds.

Ethnographic analogies derived from such information are useful if they are regarded simply as hypotheses which must be tested against independent archaeological data. In scientific theory the source of an hypothesis is not important; what counts is that it is adequately corroborated by testing (Watson et al 1971:50-51; Watson 1991:278).

## 2.5 Conclusion

Archaeologists have developed a number of criteria which are considered useful for differentiating between shell mounds deposited by natural, megapode or human agencies. Hypotheses which postulate a particular origin for shell mounds are tested by applying these criteria. Refutation or corroboration of an hypothesis is based on the presence or absence of these criteria, considered together, within the context of the particular circumstances and location in which a shell deposit is found. Criteria which have been found to be diagnostic by archaeologists such as Bailey (1991;1993), Cribb (1991) and Mitchell (1993) are briefly outlined below:

Table 1. Criteria used for distinguishing megapode from human mounds.

Criteria	Megapode	Human
Mound shape	Usually conical (may be a long ridge)	Variety of forms
Mound size	0.5m to 5m (Stone claims up to 10m)	0.3m to 13m
Stratigraphy	None	Usually Some
Composition	High sediment content reflects surroundings	High shell content discrete
Environmental context	Closed monsoon forest may be near mangroves	Open areas bordering mangroves/saltpans

With respect to the presence of shell in some scrub fowl mounds as noted by Stone, archaeological criteria developed in the debate on origins of shell mounds are considered relevant. Characteristics of the shell in each type of deposit are examined and differences explained as due to the different origins and formation processes of the deposits:

Table 2. Distinguishing characteristics of shell in scrubfowl and human mounds.

Characteristics	Scrubfowl	Human
Shell size	small + variable	large + uniform
Shell condition	water worn + bleached	weathered + dark
No. of species	many	few
Mollusc development	juvenile to mature	mostly mature
Range of habitats	wide	restricted
Proportion of shell	small	large

These criteria developed by archaeologists, Stone (1992:160) claims, are met by natural and megapode shell deposits, and are therefore invalid criteria. However, no new criteria are proposed by Stone. Stone's argument is not presented like that of a scientist who wants to "maximise the empirical content of the views (s)he holds and who wants to understand them as clearly as ..possible". (Feyerabend 1978:30).

Where Stone's mode of argument falls down is in the department of Popper's recipe for "intellectual honesty". For Popper, the focus should not be on trying to entrench one's position by "proving" a theory, but on "specifying precisely the conditions under which one is willing to give up one's position" (Lakatos 1970:92). There does not appear to be any conditions under which Stone is prepared to admit that his hypothesis fails to provide the most coherent explanation for the shell mounds of northern Australia. In fact as we shall see below, his methods can be described as more than just "unscientific".

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## CHAPTER 3

### STONE'S HYPOTHESIS AND CULT ARCHAEOLOGY

#### 3.1 Introduction

The inconsistencies in Stone's argument and his lack of critical evaluation of the evidence which is available are examples of poor science. The flawed hypothetico-deductive logic in Stone's method of testing the hypothesis that the Weipa shell mounds are of human origin, means that his theory is not corroborated. However, Stone's theory is not only poor science because of poorly designed methods of testing, but his mode of argument also exhibits elements of cult archaeology as defined by Cole (1980:5).

#### 3.2 Cult Archaeology

Cult Archaeology is a term used to describe the social phenomena of popular movements or followings of a type of speculative theorising, which are underpinned by public misconceptions of the nature of scientific theory and method (Cole 1980:3). Characteristically, cult archaeology is sensational, demonstrates misunderstanding of scientific methodology and use of evidence, and tends to provide simple answers to complex issues. Arguments used by proponents of this type of theorising often reveal internal contradictions and misuse of logic and evidence (Cole 1980:2; Stiebing 1987:2). A typical, well known example of these types of works

is Erich von Daniken's Chariots of the gods?. Similar characteristics are apparent in creationist critiques of archaeological and palaeontological interpretations (eg. Lubenow 1992). Common traits of cult archaeology as defined by Cole (1980:6-8) are:

Atheoretical particularism, where the distinction between assertion and theory is ignored and particular, narrow interest claims are made out of context, ignoring related data, and with little regard for implications.

Oversimplification, where arguments portray science in absolute terms, as black or white, right or wrong

Appeals to belief and new authorities, while old authorities are criticised as static and dogmatic, and personal attacks made on "big names" of the establishment rather than replacing their ideas with better explanations

Ambivalent antielitism, where arguments are won by citing endorsements as much as evidence and majority opinion is rebuked while votes are acclaimed as proof, and scientific caution is construed as inability to disprove a claim.

Some of the specific devices used in arguments, which follow from the above characteristics include the misuse of references through selective quotation, and ignoring prior work on a subject to create the illusion of being revolutionary. Cult archaeology type arguments may display an ethnocentrism which contains implications that contribute to their popularity, and often allege a discord amongst one's opponents on the subject which doesn't exist (Cole 1980:8-9)

Although some of the traits of cult archaeology do emerge occasionally in "normal" science, most scientists are aware of such pitfalls and attempt to avoid them (Cole 1980:5).

However, the style of a purported scientific argument may exhibit parallels to cult archaeology in that its persuasiveness may be more in language used to present the argument, than on the evidence presented (Cole 1980:13-14).

### 2.3 Stone's Hypothesis As Cult Archaeology

Elements of "Cult Archaeology" as discussed above appear frequently in the techniques used in Stone's (1989; 1991a; 1992) mode of argument. The style with which Stone presents his argument depends as much on the language used as it does on any evidence presented. For example, Stone (1989:59) claims that the large shell mounds of Cape York "are accepted uncritically" as of Aboriginal origin by prehistorians, who proposed "complicated theories" to explain the mounds. Prehistorians are said to make "dubious assumptions" and to argue for a cultural origin of mounds "rather than attempt to explain" the variability seen in the sedimentary structures of mounds (Stone 1989:60).

In Stone's (1992) Masters thesis, this mode of argument continues. Those who agree with him, such as Stanner "an accomplished anthropologist" "argues cogently" or "sagely wrote" (Stone 1992:16;18), like Stone's (1992:27) own "sensible arguments". Those who disagree however, "assume", perform "limited excavations", have a "dogmatic view", and "rarely question their beliefs" (Stone 1992:11;24;30). Similarly, Stone (1992:101) casts doubt on Bailey's (1977) evidence that the Kwamter mound differed significantly from a natural shell deposit on Kokato Island, through the language he uses, rather than any analysis of the evidence provided.

Bailey only "thought" that the ways in which the two deposits differed was relevant, and his analysis of the contrast between the properties of the shells in the two deposits is reduced to an "apparent" difference. These subtle mechanisms cast aspersions on the observational ability of the writer, and gloss over the finer details of analysis to push one's own point of view.

Ethnographic or historical observations which contradict Stone's view are "wishful thinking", or "ramblings" of early explorers (Stone 1992:20;80). While Stanner (1961) "set the example for future scientific inquiry by excavating a shell mound", Wright (1963) and Bailey (1975) are only "Guided by their archaeological training" when they interpret their own excavations differently (Stone 1992:96). Here Stone employs the strategy of claiming legitimacy for his views according to their scientific status, while withdrawing this authority from the views of his opponents<sup>2</sup>. Archaeologists are portrayed as rigid thinkers of the old school - "Cambridge (archaeologists) in the bush" (Stone 1992:96). Meanwhile Stone (1992:29) claims his own ideas are a "departure from orthodox thinking". While this may be the case, such a claim is an example of proclaiming virtue in new ideas for the sake of being a nonconformist and pioneer, rather than providing theories with more explanatory power than "orthodox" explanations (Cole 1980:18).

Previous work on the subject of mollusc gathering is ignored by Stone (1992:65) when he states that "There is an

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<sup>2</sup>see Gellner (1985:106) for discussion on the importance of having claim to being scientific.



idea amongst prehistorians that at one time in prehistory coastal people subsisted almost entirely on shellfish". Archaeological researchers have realised since the 1960's that prehistoric societies did not rely primarily on molluscan resources for subsistence (eg Osborne 1977, Waselkov 1987:109). As noted above, the ignoring of prior work on a subject is a cult archaeology trait used in order to create the illusion of being revolutionary.

Oversimplification of the criteria developed by archaeologists for identification of human shell mounds forms the nucleus of Stone's argument. Stone (1989:60; 1992:29;74) asserts that a cultural origin of shell mounds has been assumed by archaeologists largely on the basis of the presence of artefacts in some mounds. In fact a number of criteria are employed on which archaeologists base their interpretations, including selectivity of shell species and shell size, as well as the context and location of the mound (Bailey 1993:9). This cult characteristic is also evident in Stone's (1991a:26) dismissal of the differentiation in kinds of mounds found in the wetlands of the Aurukun area, as described by Cribb (1991:23-4).

Another cult characteristic displayed by Stone is the misuse of references, through selective quotation. References are cited by Stone (1989) to create an illusion of support for his claim which is not upheld when the actual reference is read. For example, Stone argues that Chappell observed that chenier ridges at Princess Charlotte Bay, which includes Beaton's (1985) South Mound site, are covered extensively with Anadara shell of Aboriginal origin. Therefore, Stone (1991a:26) says

"..it is ..reasonable to assume that scrub-fowl made exclusive use of this abundant cultural material in mound construction". Not mentioned is that Chappell, a Professor of Geomorphology at Australian National University, declares his recognition of middens and mounds on chenier ridges as human. Chappell (1984:203) states that these shell deposits are "easily distinguished from chenier shell gravels, being built of food species of shellfish (usually more than 98% of Anadara), and have dark grey or black interstitial soil".

Another misleading use of quotation is apparent in Stone's (1989:61) claim that the South Mound site is a good example of scrub fowl processes because of its "sediment rich" Anadara layers as described by Beaton (1985:8). However, Beaton (1985:8) explains that he uses the term "sediment-rich" in a special sense, only to describe the contrast between Anadara layers with a minor amount of sediment, and Anadara layers with no sediment. It does not mean that the South Mound is composed of large amounts of sediment, as Stone (1989:61) intimates.

Other examples of partial citation are available. Ceci (1984) may have stressed, as Stone (1992:83) claims, how little is known about the specific behaviours and processes responsible for the formation of shell middens. What Stone neglects to mention is that she also states that this gap in knowledge of formation processes "is addressed in part by Meehan's recent ethno-archaeological study of Australian Aboriginal shellfishing" (Ceci 1984:63). Stone's (1989:61) reference to Peterson (1973:186) as an example of "prehistorian's indifference to local Aborigines' opinion"

that shell mounds are of natural origin is also subtly misleading. Peterson (1973:186-191), a social anthropologist, provides ethnographic evidence of the important contemporary use of shell mounds as a living area in Castlereagh Bay and on Milingimbi Island. He also reports an Aboriginal myth related to him which explains the large shell mounds as due to the activities of an ancestral hero. Peterson's main point is that the low shell incipient mounds used in daily outings are pointed out by Aborigines as being left by themselves. Large mounds however, are said to be the work of ancestors despite the fact that there is virtually no difference in composition between the mounds" (Peterson 1973:186) (my emphasis).

Although Stone is happy to use ethnographic data in support of his hypothesis (eg Stone 1992:16), he rejects ethnographic data which contradicts his claim. For example, Stone (1989:59-60) simply dismisses any connection between "ample evidence" as he himself admits, that Aborigines camped on tops of mounds, and the process of accumulation of these mounds. Stone (1989:59-61; 1992:10-11) acknowledges the accounts of Roth (1984) and others (eg. Peterson 1973:187) who observed people camping on mounds. But prehistorians, claims Stone (1989:60), make the "dubious assumption" that this is "proof" that the mounds are due to the activities of humans.

Roth's (1984:7) account states, "On the tops of certain of them (the shell mounds) may be seen remains of fires and huts, the shells, after cooking, having been thrown down the sides". Such historical accounts are not looked upon as "proof" by archaeologists, but it is considered that they may provide some insight into past Aboriginal practices of shell

discard. Another such record is Warner's (1958:462) description of the Macassar Well Mound in Milingimbi, which he excavated during 1927-8. Warner reports that "The Murngin women were still adding shells to the heap by bringing to the water hole for opening baskets full of bivalves dug out of the mud flats along the coast or pried from the rocks of the oyster beds".

Stone alleges a discord amongst his opponents which doesn't exist. There is no "major controversy" on the origins of shell and earth mounds in northern Australian archaeology, contra Stone (1992:29), other than his own claims. Stone also exhibits the cult archaeology trait of ambivalent anti-elitism, where "Arguments are won by citing endorsements as much as evidence" (Cole 1980:7). The opinions of the majority of archaeologists are dismissed. Yet votes for Stone's ideas from "one of the most authoritative senior Aboriginal men in the Northern Territory" (Stone 1989:63), and a banana grower from Innisfail (Stone 1993:26), are acclaimed as confirmation. Misunderstanding of the nature of scientific theory ensues from this mode of argument. This is apparent when Stone (1991a:26) takes as support for his hypothesis, Cribb's "scientific caution" in accepting that scrub-fowl mounds may be mistaken for archaeological mounds (Cole 1980:7).

Finally, Stone (1992:16) suggests that an Aboriginal myth of the early 1960's which seems to provide support for his theory "may represent one of the last untainted Aboriginal accounts of the Weipa shell mounds". This account is said to have been told before "teams of archaeologists" came and told the Aboriginal people a different story which corrupted their

beliefs. Such notions of the existence of a pristine, traditional Aboriginal mind, have been shown by anthropological critique to be simplistic and inadequate (eg. Merlan 1991). Under this criteria, ethnographic information given to McCarthy & Setzler at Milingimbi in 1948 by a senior Aboriginal man would surely take precedence as an "untainted" account. Mahkarolla told them "that these shell mounds were present before he was born, and that he had heard that the natives who built them were much more orderly than his people because they gathered up the shells from around the fires and piled them on the mounds" (McCarthy & Setzler 1960:249).

#### 2.4 Conclusion

Knowledge may be structured by the way it is presented (Vasicek 1991:288), and one's image of the past, as their understanding and image of the world, affects this presentation. In any scientific theory a selection of certain aspects of reality are represented while other aspects are omitted (Samuel 1985:254). And since descriptions of the past can become the basis for executive actions in the future, people who make claims about the past have an obligation to other people in the manner in which they justify their knowledge claims (Fletcher 1991:60-2). Since it is generally recognised that there is no such thing as value-free knowledge, those who propose new theories should be conscious of the value-systems implied by their theories, and their possible implications. It is unfortunate that Stone (1991a:27) finds it ludicrous, that Cribb (1991:25) should raise the issue of the implications of Stone's (1989) hypothesis, for contemporary Aboriginal people in conflict with mining and

development interests.

A distinction can be made between poor science because the method of testing an hypothesis is poorly designed, and cult archaeology (Cole 1980:5). However, Stone's uncorroborated hypothesis was submitted in an oversimplified form to a popular magazine and an ornithological journal (Stone 1993; 1991b). In typical cult archaeology style, this suggests a tendency to capitalize on general ignorance of the way science works, in order to push a particular point of view. This is achieved by providing the public with simple, authoritative, black and white alternatives, to the probabilistic arguments put forward by archaeologists in academic journals (Cole 1980:26).

Thus it is argued that the manner of approach used in Stone's proposition is not only "unscientific", but also leans too heavily on devices used in argument by proponents of "cult archaeology". Part of the actual content of the argument put forward by Stone is examined in the next Chapter, by a comparative analysis of shell mounds on Channel Island, and mounds on Middle Arm peninsula.

## CHAPTER 4

### CHANNEL ISLAND AND MIDDLE ARM PENINSULA

#### 4.1 Introduction

During a geomorphological survey of Channel Island, near Darwin, Stone (1987:132) recorded mounds of earth and shell around four metres high as nests built by the scrub fowl "Megapodes freycinet". Stone (1989:61; 1992:28) presented these mounds as demonstrating that scrub fowl can build their nests almost entirely from shell. This "evidence" is claimed as support for Stone's (1989) hypothesis that large shell and earth mounds in northern Australia were built by scrub fowl and not by humans. The "shelly Scrubfowl mounds" on Channel Island are said to resemble the "allegedly Aboriginal shell mounds" of Cape York (Stone 1991b:255).

Nearby, on the mainland of Middle Arm peninsula, is a conical mound which Stone (1989:61) describes as a shell and earth mound "which had clearly been raked up by scrub-fowl from the edge of an extensive Anadara midden". It is claimed that this mound provides an explanation for the presence of artefacts in shell mounds, and indicates that scrub fowl may prefer shell discarded by Aborigines as building material (Stone 1991b). This mound is claimed by Stone (1989:61) to resemble the "sediment rich Anadara layers" of the South Mound site described by Beaton (1985:8).

As advanced by Bailey (1991:22), detailed quantified comparisons of accepted scrub fowl mounds and human shell mounds is required to address the question of origins of the mounds. Accordingly, this study provides comparative field data on mounds accepted by ornithologists as of scrub fowl origin, on Channel Island, and on mounds accepted by archaeologists as of human origin, on Middle Arm. Samples from these mounds are analyzed with respect to their composition, especially relative proportions of shell to sediment. The environmental context of the mounds is also examined.

#### 4.2 Location

Channel Island in Port Darwin harbour, and nearby Middle Arm Peninsula are approximately 12 kilometres south of Darwin (Figure 1). Present day Channel Island consists of around 70 hectares, incorporating two land masses which become separated at very high tides. A ridge 21 to 28m in elevation traverses the centre of the southern body of the island, while the northern body rises to a 10m elevation. The island is connected to the nearby Middle Arm mainland by a rock causeway only exposed at low tides. Both the island and the peninsula are fringed by expansive mangrove areas merging into estuarine mudflats which extend into the harbour. Several islets on the peninsula to the east across from Channel Island are isolated by mangroves from the rest of the mainland. The topography of Middle Arm peninsula is described as an undulating low ridge 15 to 40 metres high, with some ephemeral wet season creeks cutting through it (Anon 1983:44-5).



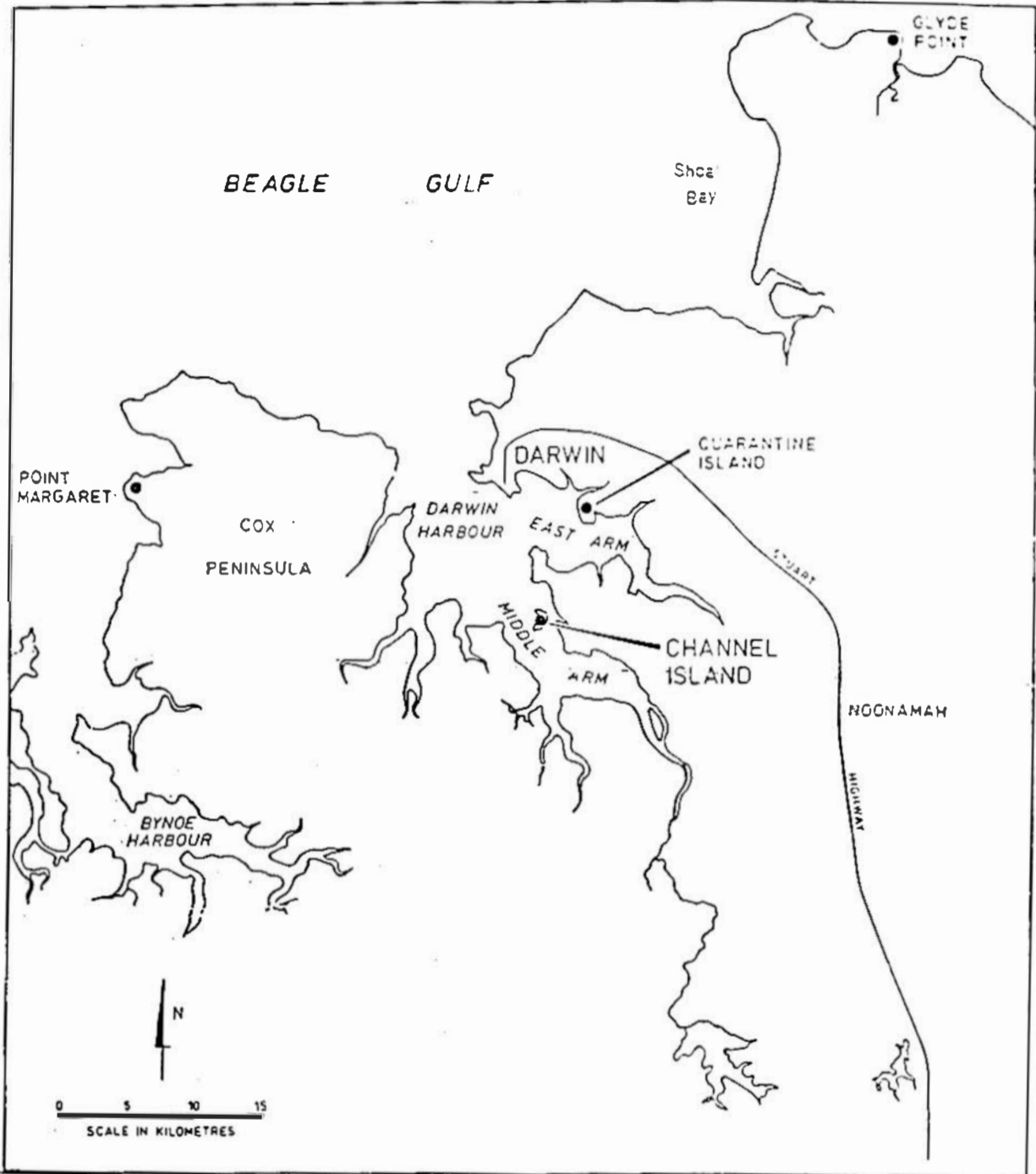


Figure 1. Location of Channel Island and Middle Arm Peninsula

### **4.3 Climate**

Typically, the climate of this area is described as tropical monsoonal, with two major seasons; a wet season from November to March and a dry season from May to September. In the Dry season, the temperatures and humidity are generally lower, and evaporation rates are high. In the Wet, tropical cyclones, characterised by destructive winds, substantial rainfall, and storm surges, periodically encroach upon the coast of Port Darwin. These extremes in climate have a marked effect on the social, biological and physical environments of the area (Anon 1983; Semeniuk 1985).

### **4.4 Environment**

Geomorphic features of Channel Island include a shelly beach and shelly sandy vegetated beach ridges on the northwestern tip, and extensive chenier ridges on the northeastern and western shores (Stone 1987:132). Cheniers are landforms commonly found on tropical coasts. Sullivan and O'Connor (1993) describe cheniers as ridges of shell, often with sand and gravel sediments, sitting on coastal mudflats or wetlands called "chenier plains". Studies on the nature and formation of cheniers on Australian coasts are summarised by Chappell and Grindrod (1984) and Short (1989). On these chenier ridges are mounds described by Stone (1987:132) as scrub fowl nests, two of which are examined in detail in this thesis.

On Channel Island the vegetation has been extensively modified by human activity, with the removal of all timber

for firewood whilst the leprosarium was in place. Revegetation with shrubby woodland took place following the abandonment of the leprosarium in 1955. At present there are some areas of monsoon vine forest on the island, which provide a habitat for scrub-fowl and other birds, insects and reptiles.

Vegetation on Middle Arm peninsula consists of mainly open eucalypt woodland typical of the northern monsoonal coast, the type of vegetation influenced by poor soils, monsoonal climate and burning by fires. The frequency of fires is thought to have increased following Aboriginal, and later European, occupation of the land. Thicker vegetation and Monsoon vine forest (MVF) occurs in tracts on the peninsula, and in the islet areas protected from the fires by their isolation. The peninsula is bordered by mangroves which extend inland along the tidal sections of the Elizabeth and Blackmore rivers (Anon 1983:44-9).

#### **4.5 Coastal Geomorphology**

In northern Australia, studies have demonstrated that sea levels stabilised following a rise to their present levels at around 6,000 years BP (Chappell & Grindrod 1984; Woodroffe et al. 1988). During this period of post-glacial transgression, the process of marine flooding formed Darwin Harbour, isolating hills in the original Port Darwin valley, to form islands such as Channel Island (Semeniuk 1985). The prograding shoreline of Middle Arm peninsula projects between the East and Middle Arms of the Port Darwin embayment. Post-glacial marine flooding, of Elizabeth River which developed East Arm, and of the Darwin and Berry Rivers which developed Haycock

Reach, shaped Middle Arm peninsula (Semeniuk 1985:85). Since this Late Holocene transgression vast tidal sandy mudflats have built up in the embayment and riverine zones of Darwin Harbour (Michie 1987:38)

A reconstruction of the geomorphological history of Channel Island during the Holocene is provided by Stone (1987), who describes the major landform units and dominant processes of shoreline progradation and change in sedimentation through time. From an analysis of shoreline deposits Stone (1987:133) found indications of a change in the geomorphology, from quartz sand and shingle sedimentation, to more recent shell sedimentation. Prior to this the shoreline gradient of Channel Island was thought to be steeper with slow clay accumulation. A decrease in gradient through progradation of the clays, and expansion of the mangroves, led to the creation of conditions conducive to the establishment of substantial numbers of shellfish. This provided a supply of shell debris for chenier construction through reworking of inter-tidal shells and sand during storm-surges and deposition by wave action.

Availability of shell from source areas has been identified as a factor contributing to the episodic construction of cheniers (Chappell and Grindrod 1984:222). Other factors outlined by Sullivan and O'Connor (1993) include the presence of a mangrove fringe which focuses sedimentation of shells and mud, and the mode of progradation resulting from the geometry of the embayment. In northern Australia research has shown that cheniers and mudflats are formed by a complex interaction of storms, the mangrove fringe, embayment geometry

and mud deposition (Chappell and Grindrod 1984; Sullivan and O'Connor 1993). Evidence supporting the correlation of drier climatic conditions with chenier formation has also been demonstrated. (Lees 1987; 1992; Lees and Clements 1987; Lees et al 1990). Using dates from chenier ridges at Point Stuart (Clarke et.al. 1979) and Shoal Bay (Hickey 1981) for comparison, Stone (1987:133-7) estimates that the shelly chenier ridges on Channel Island formed during a "shell period" in the last 2,000 years.

#### **4.6 Ethnographic and Historical Background**

According to available historical records, at the time of European settlement in the early 1800's, the Port Darwin area was inhabited by Aboriginal people called the "Larrakeah" (Foelsche 1881:7), or "Larrakia" (Parkhouse 1881:1). Port Darwin and its surrounding areas, including Channel Island and Middle Arm peninsula, have borne the full force of European settlement, with substantial changes to the landscape, and extensive disruption of the socio-economic system of the local Aboriginal inhabitants (Anon. 1987:68-9).

There is a dearth of information on the past environmental relationship between the Aboriginal people and the land in this particular area. A postulated ethnographic scenario was constructed by Anon. (1987) through communication with Davis (1984). This describes the possible annual movements of the Larrakia people around Darwin Harbour, including Channel Island, and inland around past lagoons and rainforest pockets (Figure 2; Appendix 1).

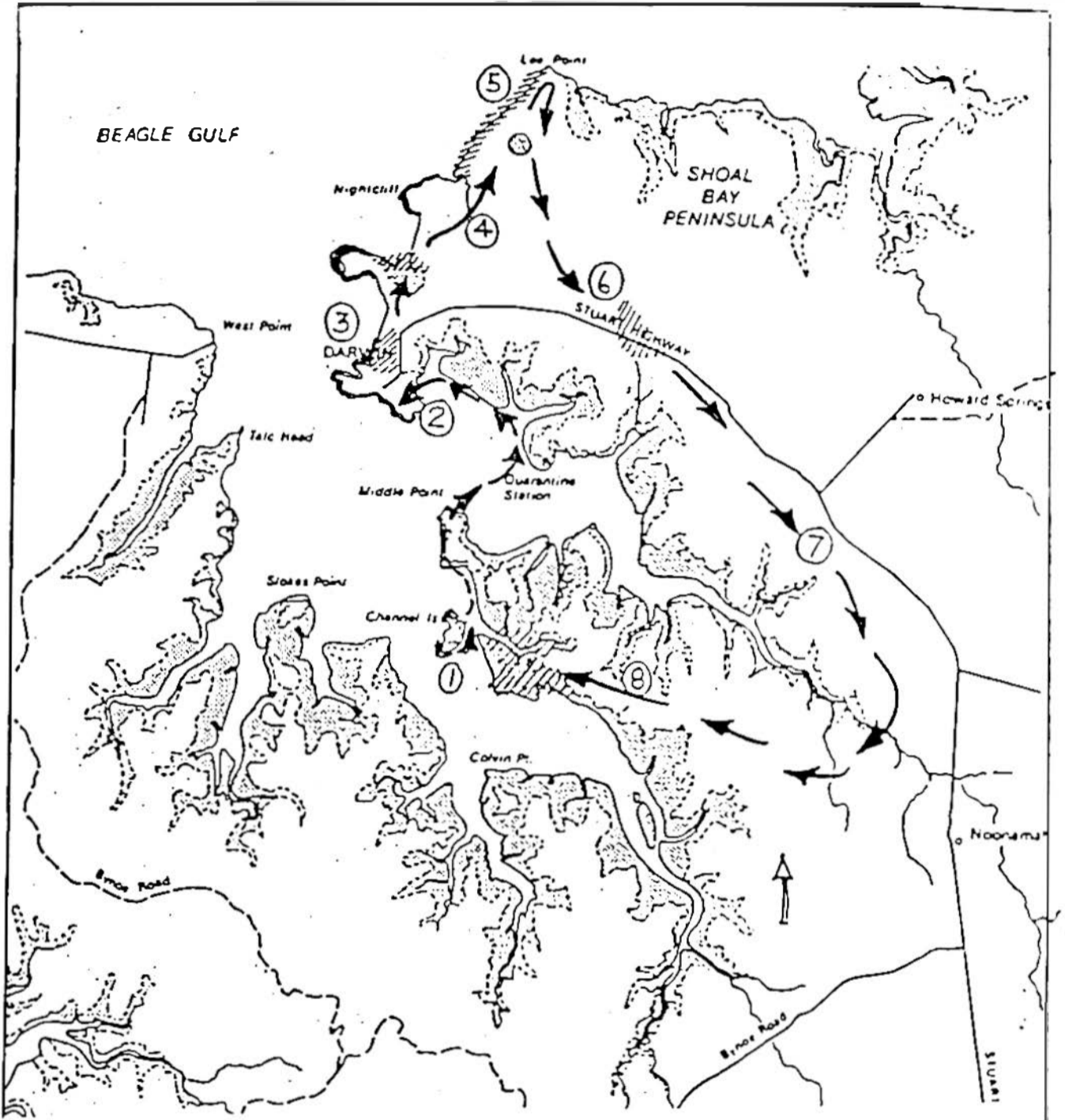


Figure 2. Postulated movements of the Larrakiya people prior to European occupation (from Anon 1987:65) (see Appendix 1 for explanation of numbers)

It is reasonable to assume that prior to European occupation, the vegetation and wildlife resources on Channel Island were similar to that on the mainland. Access to the island would have been easily achieved by walking from the Middle Arm mainland across the reef causeway exposed at low tides. The kinds of subsistence relationships which the Larrakia may have had with the land may be inferred from ethnographic data on people living in similar habitats at Milingimbi, Bathurst and Melville Islands. This ethnographic evidence attests to the importance of mollusca as a food resource for Aboriginal people, especially in the "Growth Season" of December to January (Anon. 1987).

Historically, Channel Island was first recorded by Stokes in 1839 while surveying on the H.M.S. Beagle, and named by Goyder in 1869. In 1884 Channel Island was proclaimed as a Quarantine Station and used as an isolation centre. From 1931 to 1955, Channel Island became the site of a leprosarium, an isolated, forsaken place of despair and death for its mostly Aboriginal patients (Mulvaney 1989). There are over 140 gravesites on the island, many on the cheniers ridges which have since been disturbed by the activities of scrub fowl (Anon 1987). After the closure of the leprosarium, Channel Island remained abandoned for 27 years with little significant use by humans, its landscape modified only by the tropical climate, faunal activity, and vegetation regrowth.

As a result of the N.T. government's decision in 1982 to build a power station on the island, an Environmental Impact Statement for the proposed Channel Island Power Station was prepared by Caldwell Connell Engineers (1983). Investigations

entailed a study of the historical and archaeological significance of Channel Island and nearby Middle Arm Peninsula, and the impact of the project on relics of past occupation. These relics included "prehistoric midden sites" on Middle Arm peninsula, and the historical burial and building sites on Channel Island. No prehistoric sites were found on Channel Island. However, mounds of "earth and shell" around four metres high situated on chenier ridges, were recorded by Stone (1987:132) as scrub fowl mounds during a geomorphological survey of the Island. Six abandoned scrub fowl mounds and one occupied scrub fowl nest are recorded in the Environmental Impact Statement, and the bird itself, Megapodius freycinet, was observed on the island during the study (Anon 1983:50-51).

During the survey on Middle Arm Peninsula four mounds of shell, described as "middens" were found. The mounds are reported as ranging from 8 metres to 20 metres in diameter, and composed predominantly of Anadara shells, with a small percentage of Telescopium shells. Several quartz artefacts were found on the surface of one of the mounds (Caldwell 1983:107). The survey found indications that three of the mounds had been quarried for shells for constructions of military camps and roads (Anon 1983:108).

It is known that in the 1940's the Australian army maintained a base on the East Arm of Darwin harbour (Powell 1988), and a string of searchlight and battery sites were established around the harbour (Anon 1992). Hiscock and Hughes (n.d.) have recorded the war-time use of prehistoric mounded shell deposits on Haycock Reach, for the construction of



historic structures such as anti-aircraft posts. Thus there is evidence that during World War Two considerable use was made by humans, of shell mounds on Middle Arm peninsula.

#### **4.7 Conclusion**

Mounds of earth and shell described as scrub fowl nests were recorded on Channel Island, while mounds of shell described as "middens" were recorded on the nearby mainland. Descriptions such as these do little to distinguish between the two types of mounds, which may appear similar at a superficial level, in that they are both mounded deposits containing sediment and shell. The shell mounds on Channel Island and on Middle Arm peninsula are examined in more detail in Chapter 5.

## CHAPTER 5

### MOUNDS ON CHANNEL ISLAND

#### 5.1 Introduction.

Stone (1989; 1991a; 1992) provides no detailed information on the environmental context, or composition of the mounds that he depicts as demonstrating that scrub fowl can build their nests almost entirely from shell. In this study shell mounds on Channel Island are examined in detail, especially with regard to their composition, to determine the proportion of shell, sediment and other materials in the mounds.

#### 5.2 Location And Environmental Context.

As noted by Stone (1987:132), these mounds are located along the coastline of the island, at the interface between the shore-parallel chenier ridges and stony slope. The location of mounds on Channel Island, recorded as scrub fowl mounds, are shown in Figure 3 (Anon 1983:44). Vegetation on the mounds consists of moderately dense monsoon vine thicket. The land surrounding the mound and chenier ridges on which the mounds are built, are similarly vegetated with dense monsoon vine thicket. In the lower lying area near the mounds, and running roughly parallel to the chenier ridge, is the mangrove zone extending to the coast. A thin sandy, shelly strip intersects the two vegetation zones. Two of the recorded mounds from the northern and western sides of the island were

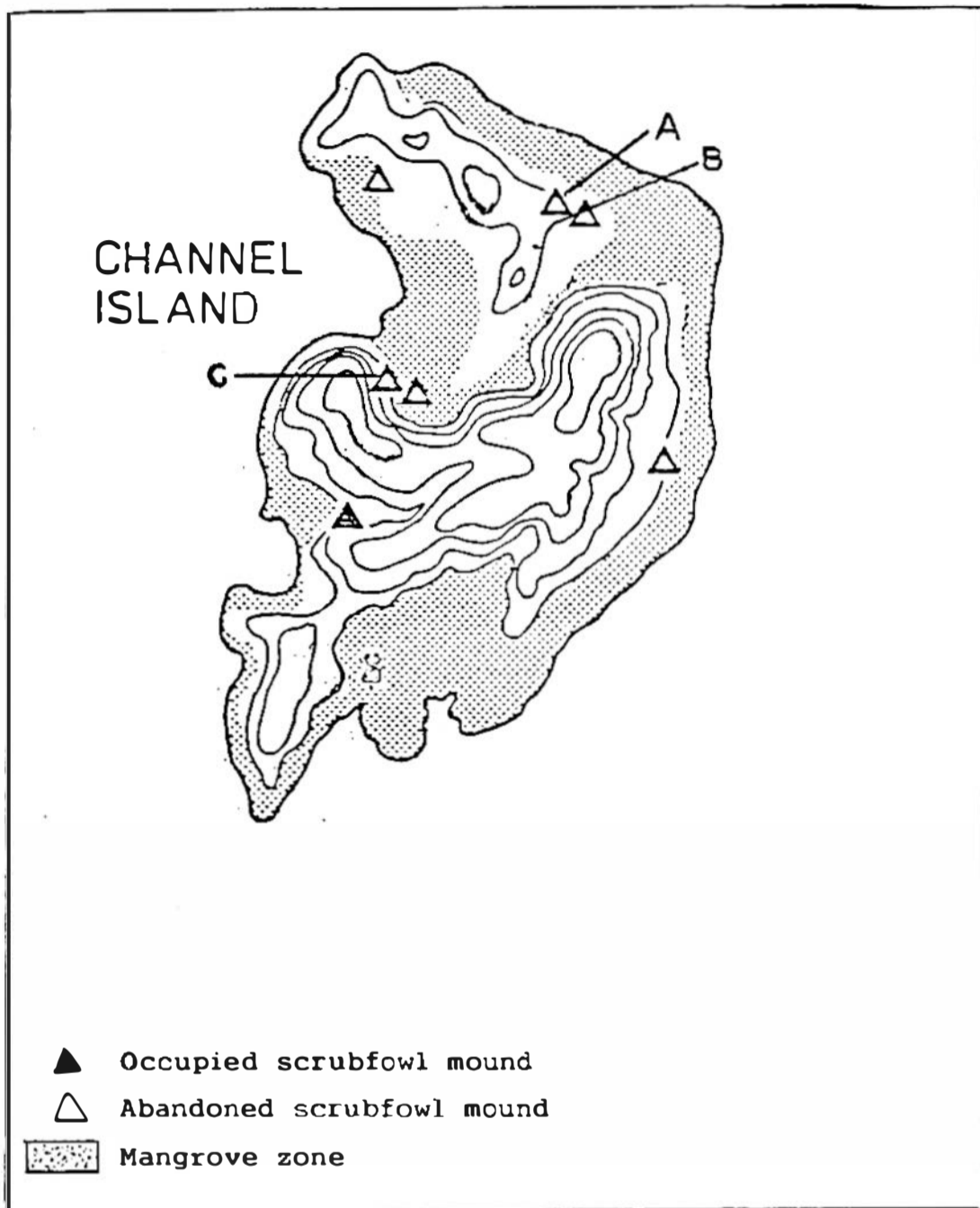


Figure 3. Location of mounds on Channel Island  
(from Anon 1983:44)

selected for detailed investigation.

### 5.3 Mound Analysis

Three bulk samples were taken from two of the mounds and a chenier ridge on Channel Island, in order to analyze their composition.

#### 5.3.1 Description Of Mounds

The locations selected for investigation from which the samples were collected, designated locations A, B and C, are shown in Figure 1. The dimensions of the mounds at locations A and C are given in Table 3. The mound and chenier ridge, at Locations A and B respectively, are positioned on the northern end of the island. The first sample (0.5m x 0.5m x 0.11m) at location A, was taken from a mound which is accepted by the Conservation Commission of the Northern Territory (CCNT) as well as Stone (1987), as being a megapode mound.

The second sample (0.5m x 0.5m x 0.12m) at location B, was taken from the chenier ridge on which the first mound was situated, less than 20m from the mound in a south-easterly direction. This sample was obtained to investigate whether the mound composition reflects the composition of the surface material around the mound, as it would if it was built by scrub fowl (Cribb 1991:24; Mitchell 1993:183; Stone 1989:62; 1991a:26). Observations over a three year period by Crome and Brown (1979:112-114) noted that mound composition depended on locality, with scrub fowl raking up material for mound construction from a maximum radius of 25m.

For comparison, a third sample (0.5m x 0.5m x 0.12m) at location C was taken from a mound also considered by CCNT and Stone (1987) to be a megapode mound. This mound was one of several mounds situated on a chenier ridge on the western side of the island.

All the mounds on Channel Island, including mounds at locations A and C, appear similar in size, shape and composition. The mound at location A, situated on a chenier ridge, is conical with a flattened summit. Approximately thirty metres southeast of this mound, closer to the mangrove zone, is another mound of similar size and shape, which was not analyzed. The mound at location C, one of several along a large chenier ridge, is also conical and slightly smaller than the mound at location A.

Table 3. Dimensions of mounds at locations A and C on Channel Island

Location	Length	Width	Height
A	20m	19m	2.4m
C	8.5m	9m	2.5m

On first inspection the mounds, like the chenier ridges on which they are situated, appear to be composed of a mixture of sand and shelly debris. Examination of the surface of the mounds at locations A and C, and of the surface of the chenier ridge at location B, found as well as sand, small rocks and pieces of quartz, sticks and leaves. Also noted were several species of shell including Saccostrea echinata (oyster), Cerithidae sp., Corbula sp., Anadara granosa, Placamen sp.,

and pieces of Telescopium sp.. Most of the shells on the surface were small (<5mm in size). For more detailed examination of the composition of these mounds, laboratory analysis of the samples collected was required.

### 5.3.2 Laboratory Methods

The samples were taken back to the laboratory, weighed and dried, then sieved through a nest of sieves of mesh sizes 5mm, 2mm, 1mm, and 0.5mm. For component analysis, material over 2mm was selected, as the bulk of the shell species were between 2mm and 5mm in size. Material over 2mm from spit 1 of each location was washed, dried and sorted by hand into the different components, which were then weighed.

Sieve residue sizes 1-2mm, 0.5-1mm, and <0.5mm were separated and each size category weighed and stored. The colour of the deposit retained as residue in the 0.5mm sieve was checked against a Munsell colour chart. It was observed that many small, whole shells were retained in the 2mm sieve residue. Therefore, after sorting of all other components, shells above 2mm in size were identified, grouped into species, weighed, and the minimum numbers (MNI) of each species counted.

Shell species and their habitats were identified with the help of Dr. Richard Willan, and through comparison with collections in the N.T. Museum of Arts and Sciences. The most prevalent feature of each species was used as the diagnostic feature for calculating MNI. Thus MNI was calculated on spires for most gastropods such as Cerithium coralium, on flanges for

Nerita, and on the largest number of left or right hinges for bivalves. For oysters, the "lids" with more than half the adductor muscle scar visible were used as diagnostic features.

Procedures for the analysis of small samples as developed by previous researchers were generally followed (Bowdler 1983:139). Each taxa was weighed and the minimum numbers of individuals (MNI) within each species counted. Percentages of the total sample, for each of the components and shell taxa, were then calculated for both weight and MNI. The combination of these two methods of analysis provides a more accurate description of the proportions of shell in a site than only one method, as demonstrated by previous researchers in mollusc analysis.

The use of minimum numbers alone as a method of analysis disguises the significant differences of size of species, and of individuals. Employing the "weight method" alone provides less precise information than the "individual method" (Bowdler 1983:140). By using both methods, information required for this study, such as the differences in the size of separate taxa of mollusca, as well as of individuals within each taxa, are revealed.

### 5.3.3 Marine Shell

All shell species identified in spit 1 of each the samples from locations A, B and C, are listed in descending order of frequency (Tables 4, 5 and 6), together with the minimum numbers (MNI) and weight of each species. Wt/MNI is included as this gives an indication of the shell sizes. Over 40

Table 4. Shell species identified in spit 1, location A.

SPECIES	MNI	MNI%	Wt(g)	Wt%	Wt/MNI
<i>Cerithium coralium</i>	4510	73.66%	453.4	29.45%	0.10
<i>Saccostrea echinata</i>	933	15.24%	836.4	54.32%	0.90
<i>Corbula</i> sp.	142	2.32%	44.1	2.86%	0.31
<i>Thalotia aruensis</i>	94	1.54%	7.3	0.47%	0.08
<i>Anadara granosa</i>	73	1.19%	162.2	10.53%	2.22
<i>Cosa</i> sp.	72	1.18%	2.1	0.14%	0.03
<i>Cerithidae</i> sp.	52	0.85%	2.4	0.16%	0.05
<i>Nassarius</i> sp.	41	0.67%	3.8	0.25%	0.09
<i>Acar</i> sp.	24	0.39%	2.7	0.18%	0.11
<i>Clypeomorus bifasciata</i>	23	0.38%	2.4	0.16%	0.10
<i>Nerita</i> sp.	17	0.28%	3.7	0.24%	0.22
<i>Placamen</i> sp.	16	0.26%	7.2	0.47%	0.45
<i>Littoraria articulata</i>	13	0.21%	0.5	0.03%	0.04
<i>Turricula nelliae</i>	12	0.20%	1.0	0.06%	0.08
<i>Mitra rosacea</i>	11	0.18%	1.1	0.07%	0.10
<i>Monodonta labio</i>	10	0.16%	1.4	0.09%	0.14
<i>Emarginula rosea</i>	9	0.15%	0.3	0.02%	0.03
<i>Nassarius celebensis</i>	7	0.11%	0.6	0.04%	0.09
<i>Circe australis</i>	6	0.10%	0.4	0.03%	0.07
<i>Fragum hemicardium</i>	6	0.10%	1.4	0.09%	0.23
<i>Thais trigonus</i>	6	0.10%	0.6	0.04%	0.10
<i>Truncatella guerini</i>	6	0.10%	0.1	0.01%	0.02
<i>Dentalium</i> sp.	5	0.08%	0.2	0.01%	0.04
<i>Turbo cinereus</i>	5	0.08%	0.9	0.06%	0.18
<i>Iravadia australis</i>	4	0.07%	0.1	0.01%	0.03
<i>Laemodonta octanfracta</i>	3	0.05%	0.1	0.01%	0.03
<i>Vexillum vulpecula</i>	3	0.05%	0.8	0.05%	0.27
<i>Cardita muricata</i>	2	0.03%	0.2	0.01%	0.10
<i>Etrema</i> sp.	2	0.03%	0.1	0.01%	0.05
<i>Notoacmea</i> sp.	2	0.03%	0.1	0.01%	0.05
<i>Philbertia</i> sp.	2	0.03%	0.1	0.01%	0.05
<i>Pyrene essingtonensis</i>	2	0.03%	0.1	0.01%	0.05
<i>Trapezium sublaevigatum</i>	2	0.03%	0.4	0.03%	0.20
<i>Acar avellana</i>	1	0.02%	0.3	0.02%	0.30
<i>Bedeва blosvillei</i>	1	0.02%	0.6	0.04%	0.60
<i>Brachidontes ustulatus</i>	1	0.02%	0.1	0.01%	0.10
<i>Marginella</i> sp.	1	0.02%	0.1	0.01%	0.10
<i>Petricola divergens</i>	1	0.02%	0.1	0.01%	0.10
<i>Pupa alveolata</i>	1	0.02%	0.1	0.01%	0.10
<i>Salinator</i> sp.	1	0.02%	0.1	0.01%	0.10
<i>Seila</i> sp.	1	0.02%	0.1	0.01%	0.10
<b>TOTAL</b>	<b>6123</b>	<b>100%</b>	<b>1539.7</b>	<b>100%</b>	



Table 5. Shell species identified in spit 1, location B

SPECIES	MNI	MNI%	Wt(g)	Wt%	Wt/MNI
<i>Cerithium coralium</i>	5100	66.54%	594.6	21.82%	0.12
<i>Saccostrea echinata</i>	1672	21.82%	1695.1	62.19%	1.01
<i>Corbula</i> sp.	228	2.97%	78.2	2.87%	0.34
<i>Cosa</i> sp.	120	1.57%	3.1	0.11%	0.03
<i>Anadara granosa</i>	88	1.15%	290.8	10.67%	3.30
<i>Thalotia aruensis</i>	74	0.97%	8.8	0.32%	0.12
<i>Cerithidae</i> sp.	38	0.50%	1.5	0.06%	0.04
<i>Monodonta labio</i>	38	0.50%	2.8	0.10%	0.07
<i>Nerita</i> sp.	36	0.47%	5.7	0.21%	0.16
<i>Acar</i> sp.	27	0.35%	3.3	0.12%	0.12
<i>Truncatella guerini</i>	25	0.33%	0.1	0.00%	0.00
<i>Circe australis</i>	21	0.27%	0.9	0.03%	0.04
<i>Placamen</i> sp.	21	0.27%	11.4	0.42%	0.54
<i>Mitra rosacea</i>	20	0.26%	1.8	0.07%	0.09
<i>Littoraria articulata</i>	17	0.22%	0.6	0.02%	0.04
<i>Fragum hemicardium</i>	15	0.20%	3.0	0.11%	0.20
<i>Emarginula rosea</i>	14	0.18%	0.4	0.01%	0.03
<i>Nassarius</i> sp.	14	0.18%	3.6	0.13%	0.26
<i>Turbo cinereus</i>	10	0.13%	3.6	0.13%	0.36
<i>Turricula nelliae</i>	10	0.13%	0.6	0.02%	0.06
<i>Clypeomorus bifasciata</i>	7	0.09%	1.0	0.04%	0.14
<i>Nassarius celebensis</i>	7	0.09%	0.1	0.00%	0.01
<i>Turbonilla</i> sp.	7	0.09%	0.1	0.00%	0.01
<i>Acar avellana</i>	5	0.07%	1.8	0.07%	0.36
<i>Laemodonta octanfracta</i>	5	0.07%	0.1	0.00%	0.02
<i>Thais trigonus</i>	5	0.07%	0.5	0.02%	0.10
<i>Dentalium</i> sp.	4	0.05%	0.3	0.01%	0.08
<i>Merelina</i> sp.	4	0.05%	0.1	0.00%	0.03
<i>Pseudoliota</i> sp.	4	0.05%	0.1	0.00%	0.03
<i>Vexillum vulpecula</i>	4	0.05%	1.9	0.07%	0.48
<i>Brachidontes ustulatus</i>	3	0.04%	0.3	0.01%	0.10
<i>Marcia hiantina</i>	3	0.04%	0.1	0.00%	0.03
<i>Cardita muricata</i>	2	0.03%	0.3	0.01%	0.15
<i>Gafrarium tumidum</i>	2	0.03%	0.2	0.01%	0.10
<i>Montfortula</i> sp.	2	0.03%	0.1	0.00%	0.05
<i>Aspella anceps</i>	1	0.01%	0.1	0.00%	0.10
<i>Etrema</i> sp.	1	0.01%	0.1	0.00%	0.10
<i>Eucithara arenivaga</i>	1	0.01%	0.2	0.01%	0.20
<i>Iravadia australis</i>	1	0.01%	0.1	0.00%	0.10
<i>Littoraria filosa</i>	1	0.01%	0.6	0.02%	0.60
<i>Nuculana</i> sp.	1	0.01%	0.1	0.00%	0.10
<i>Petricola divergens</i>	1	0.01%	0.1	0.00%	0.10
<i>Pyrene essingtonensis</i>	1	0.01%	0.1	0.00%	0.10
<i>Telescopium telescopium</i>	1	0.01%	0.1	0.00%	0.10
<i>Terebralia</i> sp.	1	0.01%	1.6	0.06%	1.60
<i>Trapezium sublaevigatum</i>	1	0.01%	0.2	0.01%	0.20
<i>Volema cochlidium</i>	1	0.01%	5.4	0.20%	5.40
<b>TOTAL</b>	<b>7664</b>	<b>100%</b>	<b>2725.6</b>	<b>100%</b>	

Table 6. Shell species identified in spit 1, location C

SPECIES	MNI	MNI%	Wt(g)	Wt%	Wt/MNI
<i>Saccostrea echinata</i>	5114	68.43%	4723.3	95.03%	0.92
<i>Cerithium coralium</i>	666	8.91%	37.7	0.76%	0.06
<i>Cosa</i> sp.	262	3.51%	5.6	0.11%	0.02
<i>Corbula</i> sp.	190	2.54%	19.4	0.39%	0.10
<i>Acar</i> sp.	126	1.69%	13.3	0.27%	0.11
<i>Notoacmea</i> sp.	112	1.50%	2.1	0.04%	0.02
<i>Anadara granosa</i>	110	1.47%	44.1	0.89%	0.40
<i>Circe australis</i>	78	1.04%	4.2	0.08%	0.05
<i>Placamen</i> sp.	71	0.95%	21.4	0.43%	0.30
<i>Monodonta labio</i>	56	0.75%	18.0	0.36%	0.32
<i>Dentalium</i> sp.	53	0.71%	1.7	0.03%	0.03
<i>Truncatella guerini</i>	53	0.71%	0.5	0.01%	0.01
<i>Littoraria articulata</i>	50	0.67%	1.5	0.03%	0.03
<i>Nerita</i> sp.	47	0.63%	8.0	0.16%	0.17
<i>Nuculana</i> sp.	46	0.62%	0.5	0.01%	0.01
<i>Turricula nelliae</i>	36	0.48%	1.3	0.03%	0.04
<i>Emarginula rosea</i>	36	0.48%	1.1	0.02%	0.03
<i>Siphonaria</i> sp.	36	0.48%	0.6	0.01%	0.02
<i>Marcia hiantina</i>	32	0.43%	0.6	0.01%	0.02
<i>Cerithidae</i> sp.	28	0.37%	1.9	0.04%	0.07
<i>Nassarius</i> sp.	25	0.33%	4.5	0.09%	0.18
<i>Pyrene essingtonensis</i>	24	0.32%	0.8	0.02%	0.03
<i>Clypeomorus bifasciata</i>	23	0.31%	11.5	0.23%	0.50
<i>Turbo cinereus</i>	21	0.28%	12.8	0.26%	0.61
<i>Nassarius celebensis</i>	18	0.24%	0.4	0.01%	0.02
<i>Diodora jukesii</i>	16	0.21%	0.5	0.01%	0.03
<i>Brachidontes ustulatus</i>	15	0.20%	2.2	0.04%	0.15
<i>Cardita muricata</i>	11	0.15%	3.3	0.07%	0.30
<i>Mitra rosacea</i>	11	0.15%	1.2	0.02%	0.11
<i>Chama fibula</i>	9	0.12%	8.5	0.17%	0.94
<i>Acar avellana</i>	8	0.11%	1.5	0.03%	0.19
<i>Etrema</i> sp.	8	0.11%	0.2	0.00%	0.03
<i>Laemodonta octanfracta</i>	8	0.11%	0.2	0.00%	0.03
<i>Trapezium sublaevigatum</i>	7	0.09%	3.4	0.07%	0.49
<i>Marginella</i> sp.	7	0.09%	0.1	0.00%	0.01
<i>Thalotia aruensis</i>	6	0.08%	2.0	0.04%	0.33
<i>Thais trigonus</i>	6	0.08%	1.9	0.04%	0.32
<i>Merelina</i> sp.	6	0.08%	0.2	0.00%	0.03
<i>Salinator</i> sp.	6	0.08%	0.1	0.00%	0.02
<i>Fragum hemicardium</i>	4	0.05%	0.2	0.00%	0.05
<i>Montfortula</i> sp.	4	0.05%	0.2	0.00%	0.05
<i>Terebralia</i> sp.	3	0.04%	0.9	0.02%	0.30
<i>Turbonilla</i> sp.	3	0.04%	0.1	0.00%	0.03
<i>Morula margariticola</i>	2	0.03%	1.5	0.03%	0.75
<i>Gafrarium tumidum</i>	2	0.03%	1.0	0.02%	0.50
<i>Iravada australis</i>	2	0.03%	0.1	0.00%	0.05
<i>Pseudoliota</i> sp.	2	0.03%	0.1	0.00%	0.05
<i>Rissoina</i> sp.	2	0.03%	0.1	0.00%	0.05
<i>Seila</i> sp.	2	0.03%	0.1	0.00%	0.05
<i>Cassidula angulata</i>	1	0.01%	2.2	0.04%	2.20
<i>Patelloida saccharina</i>	1	0.01%	0.4	0.01%	0.40
<i>Chlamys</i> sp.	1	0.01%	0.3	0.01%	0.30
<i>Clementia papyracea</i>	1	0.01%	0.2	0.00%	0.20
<i>Meropesta nicobarica</i>	1	0.01%	0.2	0.00%	0.20
<i>Eucithara arenivaga</i>	1	0.01%	0.1	0.00%	0.10
<i>Philbertia</i> sp.	1	0.01%	0.1	0.00%	0.10
<i>Pupa alveolata</i>	1	0.01%	0.1	0.00%	0.10
<i>Ringicula</i> sp.	1	0.01%	0.1	0.00%	0.10
<i>Vexillum vulpecula</i>	1	0.01%	0.1	0.00%	0.10
<b>TOTAL</b>	<b>7473</b>	<b>100%</b>	<b>4970.2</b>	<b>100%</b>	

species of mollusc were identified from locations A and B, and approximately 60 species in the sample from location C.

Both location A, an accepted scrub fowl mound, and location B, the chenier ridge on which this mound rests, are very similar in composition. The dominant species by MNI for both these locations is Cerithium coralium, a gastropod between 2mm and 5mm in size, followed by Saccostrea echinata (oyster), which is generally larger than 5mm. The proportion by MNI of Cerithium coralium for locations A and B is 74% and 67% respectively. For the species Saccostrea echinata, the proportion by MNI comprises 15% for location A, and 22% for location B. These two species together make up over 85% of minimum numbers of shell in each of locations A and B. The remaining 15% of shell comprises over 38 different species.

The relative abundance of these two species are reversed for the percentage frequency by weight, simply because Saccostrea echinata is a larger and heavier species than Cerithium coralium. Location A comprises 54%, and location B 62% by weight of Saccostrea echinata, while the percentage frequency by weight of Cerithium coralium is 29% for location A and 22% for location B. The remaining proportion of shell (17%) is comprised of 39 species for location A, while the remaining 16% for location B contains 45 species.

On examination, the proportion of marine shell of the total weight of all excavated material larger than 2mm, was found to comprise 22% in location A, and 35% in location B. Material larger than 5mm constituted only 9% marine shell in location A, and 18% in location B. Rocks were excluded from

the calculation of the proportion of marine shell in the samples. The non-shell component is discussed below.

The mound at location C on Channel Island is dominated by Saccostrea echinata for both MNI (69%) and weight (95%). The second most common species, Cerithium coralium, makes up 9% of the minimum numbers and 1% of the weight. The remaining 22% of minimum numbers, and 4% of the total weight, comprises 58 species, the vast majority of which are between 2mm and 5mm in size. Marine shell constitutes 55% of the total weight of material over 2mm in location C. Material larger than 5mm in size comprises 40% marine shell in location C, the bulk of which consists of oyster shell.

#### 5.3.4 Components Other Than Marine Shell

Analysis of sieve residue material over 2mm from spit 1 of each of the locations A, B, and C, found a variety of components besides marine shell (Tables 7, 8 and 9). Locations A and B contained large numbers of rocks, some coral, small amounts of vegetation, land snails and the tubes of annelid worms. In addition to these components, location C also contained a small amount of charcoal, barnacle plates, internal casts of small invertebrates and small pieces of crab carapace.

#### 5.3.5 Sediment And Component Sizes

In order to ascertain the proportion of sediment and component sizes in the samples, material was sieved through each of the sieve residues sizes: 0.5mm, 1mm, 2mm and 5mm.

Table 7. Non-shell component of spit 1, location A.

Component	Wt(g)	% of Total Wt
Rocks	2126.9	13.84%
Coral	34.4	0.22%
Vegetation	6.2	0.04%
Annelid worms	1.2	0.01%
Internal casts	0.3	0.00%
Total wt. of spit 1	15371	

Table 8. Non-shell component of spit 1, location B.

Component	Wt(g)	% of Total Wt
Rocks	595.7	5.49%
Coral	47.9	0.44%
Vegetation	8.5	0.08%
Land snails	2.8	0.03%
Annelid worms	0.9	0.01%
Total wt. of spit 1	10852.3	

Table 9. Non-shell component of spit 1, location C

Component	Wt(g)	% of Total Wt
Rocks	1023.5	8.81%
Vegetation	83.7	0.72%
Coral	47.3	0.41%
Annelid worms	3.7	0.03%
Barnacle plates	1.8	0.02%
Crab carapace	0.8	0.01%
Charcoal	0.7	0.01%
Internal casts	0.7	0.01%
Land snail	0.1	0.00%
Total wt. of spit 1	11612.9	

The proportion of material in each sieve residue size category: <0.5mm, 0.5-1mm, 1-2mm, 2-5mm and >5mm in all the locations was calculated per spit (Table 10). Material retained in the 2mm, 1mm and 0.5mm sieves is termed sediment rather than sand (following Anon 1979). Sediment less than 0.5mm in size makes up almost half the material by weight from locations A and B. This consists of dark yellowish brown sediment (10YR 4/4) with specks of shell grit.

Sediment less than 2mm constitutes a significant component of the total weight of the samples in locations A and B. Approximately 68% of material from location A, and 64% from location B, is less than 2mm. Around 20% of material from locations A and B is larger than 5mm, comprising the components listed above, as well as shell. Location C contained approximately 22% by weight of sieve residue sediment less than 0.5mm, and about 38% sediment less than 2mm. A higher proportion of material (43%) in location C is over 5mm in size.

#### 5.3.6 Conclusion

The sample from location C differs slightly in composition from that of locations A and B. Saccostrea echinata is the dominant species at location C for both minimum numbers (69%) and weight (95%). For locations A and B, Cerithium corallium is the dominant species by MNI (74% and 67% respectively), and Saccostrea echinata dominant by weight (54% and 62% respectively). Cerithium corallium accounts for 29% by weight of location A and 22% of location B. Thus two species of mollusc make up the bulk of shell in locations A and B,

Table 10. Proportion of sediment and component sizes (by weight) in locations A, B and C. Because of rounding, not all totals equal 100.

LOCATION		SIEVE RESIDUE SIZE									
		<0.5mm		0.5-1mm		1-2mm		2-5mm		>5mm	
		Wt(g)	%Total	Wt(g)	%Total	Wt(g)	%Total	Wt(g)	%Total	Wt(g)	%Total
A	Spit 1	7334		2339		634		1897		3101	
	+ Spit 2	+ 7554		+ 3505		+ 813		+ 2132		+ 3059	
		<u>14888</u>	46%	<u>5844</u>	18%	<u>1447</u>	4%	<u>4029</u>	12%	<u>6160</u>	19%
B	Spit 1	4534		1444		594		1869		2405	
	+ Spit 2	+ 4788		+ 1852		+ 686		+ 1571		+ 2051	
		<u>9322</u>	43%	<u>3296</u>	15%	<u>1280</u>	6%	<u>3440</u>	16%	<u>4456</u>	20%
C	Spit 1	2159		1123		728		2095		5509	
	+ Spit 2	+ 2934		+ 1268		+ 774		+ 2267		+ 4453	
		<u>5093</u>	22%	<u>2391</u>	10%	<u>1502</u>	6%	<u>4362</u>	19%	<u>9962</u>	43%

while only one of the species dominates in location C.

After removal of the dominant species, the remainder of shell in all three locations on Channel Island is made up of a large number of species from a wide range of habitats. This phenomena is more pronounced in location C, where 5% (by weight) of shell is made up of 58 different species. In location A 17% of shell consists of 39 species, while the remaining 16% of shell in location B comprises 45 species. One characteristic common to all three locations is that the vast majority of the numbers of shell species identified are between 2mm and 5mm in size.

The sample from the mound at location A reflects the composition of the sample from location B, obtained 20m away, from the chenier ridge on which the mound is situated. The number and range of shell taxa present in the samples are similar, and proportion by weight of marine shell larger than 2mm is comparable. Location A has a slightly higher proportion by weight of sediment less than 2mm in size than location B.

Observations on the composition of scrub fowl mounds in Northern Australia consistently describe the mounds as consisting of high proportions of sand or soil (Mitchell 1993:3). These mounds are also observed to reflect the surrounding surface material (see above). The features noted in this analysis are consistent with the identification of the mound at location A as a megapode mound, built by scrub fowl from the chenier ridge material on which the mound rests. The environmental context, of closed (MVF) vegetation in which this mound is found, is also consistent with this.



At first inspection the mounds at location A and location C on Channel Island also appear similar in composition and environmental context. Differences in the composition of these two mounds was found with more detailed analysis. The sample from the mound at location C contains a larger number of shell taxa than at location A, as well as additional non-shell components such as charcoal, barnacle plates and crab carapace,

One noticeable difference between the samples from the mounds at location A and location C, is in the proportions by weight, of the size categories of sieve residue material. Unlike location A, which is composed predominantly of sediment <2mm in size, location C contains only 38% sediment <2mm. The bulk of the material in location C is >2mm, and more than 40% of the material is >5mm in size. Marine shell constitutes more than half the total weight of material >2mm at location C, but only 22% at location A. Thus, detailed analysis demonstrates that these mounds differ somewhat in terms of composition, though both are found in a similar environment.

Analysis shows that the mound at location C is more similar in composition to the chenier ridge at location B, than it is to the mound at location A. The proportion of oyster shell (which makes up the bulk of material >5mm) in the sample from location C, comprises 95%, which is closer to that of 62% for location B, than to that of 54% for location A. Locations B and C contain a larger number of species and more components than location A. The composition of the sample from the mound at location C is consistent with the accumulation of large quantities of oyster shell and other material from the local environment to form a chenier ridge.

## CHAPTER 6

### MOUNDS ON MIDDLE ARM PENINSULA

#### 6.1 Introduction

According to Stone's (1989; 1992) interpretation, large shell and earth mounds in northern Australia were built by megapodes, while low shell mounds (<1m depth) are natural features such as "small shell cheniers or coarse shell berms" (Stone 1992:158). Following this hypothesis, low mounded deposits of Anadara shell on Middle Arm peninsula are evaluated in order to determine their archaeological significance.

The mounds located on Middle Arm peninsula appear similar to the Anadara shell mounds described by Hiscock & Hughes (n.d.) just south of the area studied, on Haycock Reach. They also correspond with descriptions of shell and earth mounds of a continuum of sizes elsewhere in northern Australia, attributed by archaeologists to prehistoric human agency (eg. Bailey 1975; 1977; 1994:115; Baker 1981; Beaton 1985; Cribb 1986; Mitchell 1993; Roberts 1991; and Woodroffe et al. 1988).

Although the Anadara mounds in northern Australia are clearly composed of different shell to the mounds on Channel Island, Stone (1992:28) argues that "shell of any origin presents scrub fowl with no logistical difficulties". The features which are required for the adequate functioning of

a mound as an incubation nest for the eggs of the scrub fowl (see Jones 1989:148; Jones & Birks 1992:90) are not discussed by Stone. In this study, the Anadara shell mounds on Middle Arm peninsula are examined, particularly with respect to their composition, as a comparison to the analysis above, of the shell mounds on nearby Channel Island.

## 6.2 Location And Environmental Context

A survey of Middle Arm peninsula, of an area of approximately 25 km<sup>2</sup>, which concentrated on the coastline, was undertaken over three weeks. The aim of fieldwork was to locate, record and investigate any shell mounds and middens in that area of land on the peninsula, shown on the Bynoe 1:100,000 Map Sheet 5072 Edition 2, within a rectangle bounded by Grid References: 7040 86160, 7130 86160, 7130 86080 and 7040 86080. This survey involved inspection of the terrain by five fieldworkers walking in transects approx. 50m apart through various vegetation areas. The areas ranged from relatively open eucalypt woodland to patches of dense monsoon vine thicket, with clear sandy stretches between the hinterland and mangroves which fringe the coast.

Conditions of access and ground visibility varied, and some areas were surveyed by vehicle, with closer inspection on foot where features of the landscape suggested a possible presence of mounds. A total of eleven shell deposits were found, six of which were classed as mounds. These are described in section 6.2.1. Shell deposits were classified as mounds in this study if they had a depth of more than 30cm. Deposits of shell <30cm depth were called "middens" and are

dealt with separately in section 6.2.2.

### 6.2.1 Mounds

Two shell mounds were located at Grid Reference 7094 86085, designated locations MA1 and MA2, and two at Grid References 7079 86093 and 7080 86092, at locations MA3 and MA4. The remaining two mounds were found at separate locations, labelled MA5 and MA6, at Grid References 7091 86083 and 7080 86132 (Figure 4). The dimensions of the mounds found are given below (Table 11).

Table 11. Dimensions of mounds on Middle Arm peninsula.

Location	Length	Width	Height
MA1	10m	9m	0.5m
MA2	12m	12m	1m
MA3	11m	10m	0.8m
MA4	12m	9m	1m
MA5	8m	3m	2m
MA6	14m	12m	0.5m

The shell mounds located are similar in size and shape, being discrete, roughly circular mounds comprising predominantly Anadara granosa shell. This species of mollusc lives in intertidal sandy mud substrates, with the highest population densities found in the soft intertidal sandy muds of open areas bordering, but not within, mangrove swamp areas. They are also found near but not in the mouths of large rivers (Broom 1985), like the Elizabeth and Darwin/Berry Rivers which drain into Port Darwin harbour. Other species of mollusc were

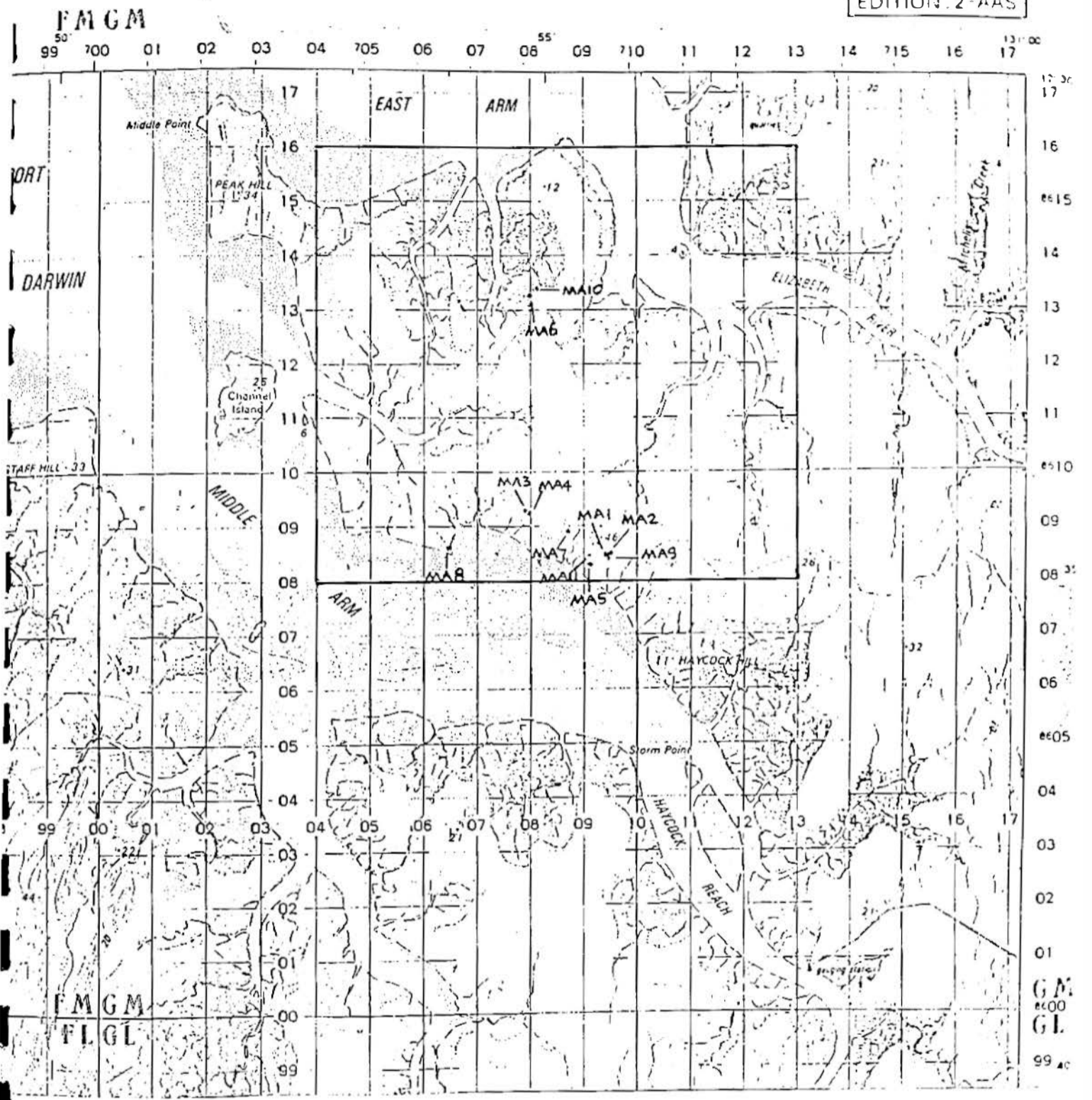


Figure 4. Location of mounds and middens in survey area on Middle Arm Peninsula

found in smaller numbers on the surface of the mounds. These species, Chicoreus capucinus, Telescopium telescopium, Terebralia semistriata and Volema cochlidium (Volegalea), are found in the mangrove zone (Blackburn 1982; Davis 1985:305).

Four of the mounds located lie in a line running southeast to northwest almost parallel to the southern coastline of Middle Arm peninsula. Less than 30m separates two of the mounds, labelled locations MA1 and MA2. Another two mounds, also about 30m apart at locations MA3 and MA4, lie 700m northwest from MA1 and MA2. All four mounds sit on the open woodland boundary, on rising ground abutting a strip of sand no more than 10m in width, which connects hinterland and mangrove zone. Vegetation around the mounds consists of open grassland with a few pandanus and eucalypt trees. To the north as the higher ground advances to the hills, the surroundings change to a more heavily wooded eucalypt forest and tracts of monsoon vine forest.

Found along the same three kilometre southern stretch of the peninsula, location MA5 is situated about 400m seaward of location MA1, just within the mangrove zone. Location MA5 comprises two mounds of Anadara shell grading into one another, then merging into a sandy mound with little or no shell, up against the side of a rocky knoll. This shelly ridge slopes from 0.5m to 2.0m height upwards towards the rocky knoll, which rises some 15m above the surrounding sandy mudflats. Other species of mollusc: Chicoreus capucinus, Telescopium telescopium, Terebralia semistriata and Volema cochlidium, were identified in smaller numbers on the surface of the mounds. An isolated patch of dense monsoon vine thicket

covers these mounds and the rocky knoll adjacent to it. Around the mounds is a strip of sand which merges into dense mangroves extending south to the sea. To the north a sandy salt pan approximately 20m across to the woodland boundary is sparsely vegetated with mangrove species.

On the northern side of the peninsula at location MA6 is a circular mound of Anadara shell, situated on a outcropping rock approximately three metres high. Shell of the species Chicoreus capucinus, Telescopium telescopium, Terebralia semistriata and Volema cochlidium could be seen in smaller numbers on the surface of this mound. Monsoon vine thicket also covers this mound and neighbouring outcrops of rocky knolls. Although on the other side of the peninsula, this mound too is located at the sandy interface between mangroves and open eucalypt woodland, in a similar environment to the other five mounds.

#### 6.2.2 Middens

Shallow shell deposits with an apparent depth of less than 30cm were also found during the survey, usually not far from the shell mounds. All these shell deposits appear similar in composition to the shell mounds, consisting predominantly of large Anadara shells, with a few Telescopium, Terebralia and Volema shells in evidence. Some of these shell deposits have previously been recorded, and are registered as Aboriginal midden sites with the N.T. Museum of Arts and Sciences. Therefore in this study all shell deposits of this type are referred to as middens.

Five middens were located during the survey of Middle Arm mainland at Grid References 7094 86085 (MA9), 7091 86085 (MA11), 7087 86089 (MA7), 7065 86086 (MA8) and 7081 86134 (MA10) (see Figure 4). The middens found during the survey are located in a similar environmental context as the mounds, close to the coastline, in the sandy intersection between mangroves and open eucalypt woodland. However, all the middens found, except one, are situated on top of rocky knolls or outcropping sandstone. Three of the middens are located on the southern side of the peninsula along the same 3km strip as the mounds at locations MA1, MA2, MA3, and MA4.

Found less than 30m away from the two mounds at locations MA1 and MA2, the first midden was designated location MA9. This midden sits on outcropping sandstone at the edge of the sandy strip described above. On the sandstone next to the midden is an engraving, identified as Aboriginal (pers. comm. Norma Richardson).

The second midden, labelled location MA11, lies one hundred metres north/northeast of location MA5, on top of outcropping sandstone on the edge of the mangrove zone. Behind this rocky ledge, eucalypt woodland slopes upward to meet the line of hills approximately 1km from the coast, running more or less parallel to the coastline along this southern stretch of the peninsula.

The third midden along this 3km strip, labelled MA7 in this study, and registered as site no. 5072 0087 with the N.T. Museum, lies midway between locations MA1 and MA4. This midden sits on a raised rocky ledge on the woodland boundary, on the



same parallel line along the coast as the mounds. Although similar in shape to the mounds, this midden appeared less than 30cm in depth, so was not classified as a mound. A large shell, Syrinx Aruanus (or false trumpet shell) was found on the surface of this midden. The exploitation by contemporary Aboriginal people, of large mollusca of this type has been recorded ethnographically (eg. Davis 1985:302; Cribb 1986:141). In addition to predominantly Anadara granosa shell, shells of the species Telescopium telescopium, Terebralia semistriata and Volema cochlidium were found on the surface.

On the northern side of the peninsula, a midden, labelled location MA10, was found on top of a rocky knoll over four metres high, fifty metres away from the mound at location MA6. This rocky ledge rises out of the sandy intersection between the mangrove zone and open eucalypt woodland. Again, this midden is composed predominantly of large Anadara shells, with a few Telescopium, Terebralia and Volema shells in evidence. A large specimen of the shell species Syrinx Aruanus was also found on the surface of this midden.

At the seaward end of a 6m high ridge running south-east toward the southern coastline of the peninsula, is an Anadara midden, labelled MA8 in this study, and registered as site no. 5072 0009 by the N.T. Museum. A large conical mound built on the edge of this midden is described by Stone (1989:61) as a "shell/earth mound... raked up by scrub fowl from the edge of an extensive Anadara midden". On inspection, this mound was found to consist predominantly of sandy soil, with a few Anadara shells, which have obviously been scraped up from the midden, scattered on the surface (Plate 1). Also noted on the



Plate 1. Mound described by Stone (1989:61) as a scrubfowl mound resembling the South Mound site



Plate 2. Mound MA2, looking toward mangroves and outcropping sandstone on which midden MA9 is situated

surface were an assortment of other articles such as plastic bottles and irrigation pipe. This mound is presumed (pers. comm. P. Hiscock) to be the one alleged by Stone (1989:61), to resemble in composition the "sediment rich" Anadara layers of the South Mound site described by Beaton (1985).

Most of the middens are located on outcropping rock some metres above the surrounding sandy flats adjacent to the mangroves, so can not be explained as washover features deposited by wave action (contra Stone 1992:58). Mounded shell deposits with an apparent depth of over 30cm, however, were positioned at the boundary edge adjacent to the sandy flats, at the foot of a gentle slope leading up to hills. Closer investigation of mound origin required analysis of the composition of the mound as per criteria discussed above.

### 6.3 Mound Analysis

Mounds MA1, MA2 and midden MA9, which are clustered within a 20m radius, were chosen for closer examination.

#### 6.3.1 Description Of Mounds At Locations MA1 and MA2

Both mounds at locations MA1 and MA2 (Plate 2) sit on a surface of silty clay and rocks at the lower boundary of gently rising ground. Approximately 35 to 40m south of the mounds is the mangrove zone which extends to the coast. The hinterland is separated from the mangrove zone by a 10m wide sandy strip. Overlooking this strip is outcropping sandstone on which midden MA9 is situated. The two mounds are similar in size and shape, though the mound at location MA2 is

slightly larger. Mound MA1 slopes down 30° to 35° on the southern and western margins, while the northern and eastern slopes appear continuous with the level of the rising ground.

Vegetation on mound MA1 consists of a few scrubby trees (<3m height) and bushes, and the surface was covered with leaves and ash. Mound MA2 was similarly covered with leaves and ash, but was more densely vegetated with vine thicket species, and exhibited considerable bioturbation, believed to be the work of goannas. Shell species on the surface of both mounds were noted to be predominantly the bivalve Anadara granosa together with smaller numbers of the gastropods Chicoreus capucinus, Telescopium telescopium, Terebralia semistriata and Volema cochlidium.

### 6.3.2 Excavation Of Mound MA1

The smaller of the two mounds, mound MA1, was selected for excavation, due to the constraints of time and resources which an honours thesis dictates. A 0.5m x 0.5m pit (Square D) was excavated slightly toward the southern edge of the mound.

A bulk sample from a 0.5m x 0.5m square (Square E) was also collected from the ground surface about 20m from the western edge of the mound. The purpose of collecting this sample was to provide a comparison of the sediments on the ground surface with those of the stratigraphic layers below the shell mound. There was no shell present either on the ground surface at this location, or in the bulk sample obtained. The sample from Square E was composed of a

yellow/brown silty clay similar to the sediment in Strata 2 from the excavation.

Excavation of the mound was carried out using the Johnson (1979:151) excavation technique, and with arbitrary spits of three to four 10 litre buckets. Eight spits were removed from the pit, to a depth of 45cm. The dominant constituent of Spits 1 to 6 was densely packed Anadara granosa shell in a matrix of dark greyish brown clumpy sediment. Less abundant species of shell evident in the excavated layers included Chicoreus capucinus, Nerita sp., Saccostrea echinata (oyster), Telescopium telescopium, and Terebralia semistriata.

During excavation, rocks and tree roots were evident throughout the deposit. The density of shell gradually decreased through spits 5, 6 and 7. At various depths of the square between 30cm and 42cm, the shell layer merged into yellow/brown clay sediment and rocks, to degrading bedrock in spit 8. A pH level of 8.5-9 for spit 3 and 9-9.5 for spit 7 was recorded on site. The entire excavated sample was retained, unsieved, and taken back to the laboratory for analysis.

### 6.3.3 Stratigraphy and Chronology

Two main strata were identified in the excavation of Square D at location MA1: a shell layer (Strata 1), being the mound itself, and a silty clay soil layer (Strata 2), with almost no shell, on which the mound rests (Figure 5). During excavation, two discrete layers were perceived in Strata 1, on the basis of the degree of weathering of the shells and

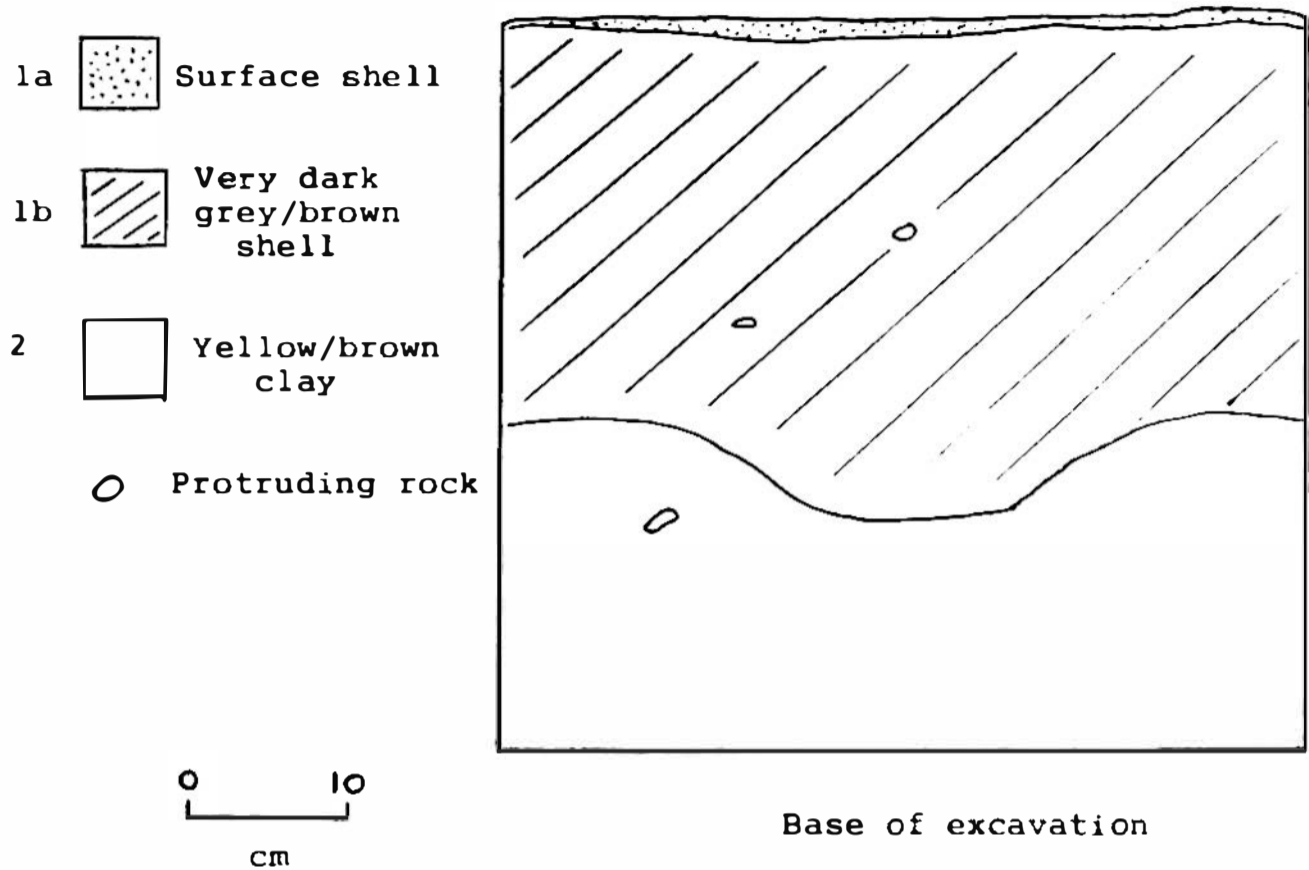


Figure 5. Stratigraphic profile, South Wall, Square D, Location MA1

degree of compaction of the sediment. Layer 1a, the surface layer of Strata 1, consisted of weathered loose shell, soil, ash, and vegetation such as leaves and small sticks. Layer 1b of Strata 1 contained a dense concentration of less weathered shell in a matrix of compacted, clumpy dark greyish brown sediment. Found within Strata 1 were stone artefacts, a small amount of charcoal and an otolith. Below the level of the mound itself, Strata 2 contained little shell, and was composed of more compacted sediment of yellow/brown clay and rocks. There were no other discrete layers identifiable from the stratigraphic profile in either strata.

#### 6.3.4 Laboratory Methods

Spits 1, 2, 5, and 6 of the excavated deposit from location MA1, Square D were weighed, then dried, and sieved through a nest of sieves of mesh sizes 5mm, 2mm, 1mm, and 0.5mm. Sieve residues 2-5mm, 1-2mm, 0.5-1mm, and <0.5mm were separated and each size category weighed and stored. The colour of the deposit retained as residue in the 0.5mm sieve was checked against a Munsell colour chart.

Examination of material retained in the 2mm sieve found only sediment, fragmented pieces of the larger shell species observed in the 5mm sieve, and a few juvenile specimens of Anadara. No new species or whole shells (other than juvenile Anadara) were observed in the 2 to 5mm sieve residue size. All other whole shells were retained in the 5mm sieve. Therefore only material over 5mm was washed, dried and sorted by hand into the different components: shell, vegetation, charcoal, rocks and quartz pieces, which were then weighed.

After separating all components, the shell component above 5mm was sorted into species, weighed and the minimum numbers of individuals (MNI) within the species calculated. Percentages were then calculated for both weight and MNI (following Bowdler 1983).

Shell species were identified with the help of Richard Willan and through comparison with collections in the N.T. Museum, and the use of photographs from Blackburn (1982), and Meehan (1982). The diagnostic features used for calculating MNI varied with the prevalence of that feature, so that the most prevalent feature for each species were used to estimate MNI. Thus MNI was calculated on spires for most gastropods, on flanges for Ellobium, Nerita and Cassidula, and on the largest number of left or right hinges for bivalves. For oysters, the "lids" with more than half the adductor muscle scar visible were used as diagnostic features. Analysis of the lengths of Anadara shell involved measuring from the umbo or hinge of the shell, to the outer edge.

#### 6.3.5 Marine Shell

All marine shell species identified in Square D, location MA1 are listed in descending order of frequency (Table 12), together with minimum numbers (MNI) and weight of each species, and Wt/MNI, which indicates shell sizes. The total number of species of marine shell in the spits from this site is eleven.

Clearly, the species Anadara granosa is the dominant mollusc for both MNI and weight, representing 71% by MNI, and



Table 12. Shell species identified in Square D location MA1.

SPECIES	MNI	MNI%	Wt(g)	Wt%	Wt/MNI
Anadara granosa	564	70.68%	11815.9	87.29%	20.95
Nerita sp.	49	6.14%	96.5	0.71%	1.97
Chicoreus capucinus	43	5.39%	381.9	2.82%	8.88
Terebralia semistriata	42	5.26%	553.5	4.09%	13.18
Saccostrea echinata	41	5.14%	152.2	1.12%	3.71
Cassidula angulata	21	2.63%	8.9	0.07%	0.42
Ellobium aurisjudae	17	2.13%	14.5	0.11%	0.85
Telescopium telescopium	13	1.63%	475.3	3.51%	36.56
Volema cochlidium	5	0.63%	35.6	0.26%	7.12
Marcia hiantina	2	0.25%	1.8	0.01%	0.90
Placamen sp.	1	0.13%	0.8	0.01%	0.80
<b>TOTALS</b>	<b>798</b>	<b>100%</b>	<b>13536.9</b>	<b>100%</b>	

Table 13. Non-shell components of location MA1.

Component	Wt(g)	% of Total Wt.
Rocks	8781.0	15.95%
Quartz	222.6	0.40%
Vegetation	68.2	0.12%
Land snail	2.6	<0.01%
Internal casts	0.6	<0.01%
Charcoal	0.2	<0.01%
Otolith	0.2	<0.01%
<b>Total weight</b>	<b>55057.9</b>	

87% by weight, of the total spits analyzed. Chicoreus capucinus, Nerita sp., Saccostrea echinata and Terebralia semistriata are the next common species by minimum numbers, representing around 5% to 6% each, and collectively making up 17% of the total shell numbers. Next in ranking by weight are Chicoreus capucinus, Telescopium telescopium, and Terebralia semistriata, comprising 3% to 4% each, and together 10% of the total weight of shellfish.

Analysis of the proportion of marine shell in the excavated material showed that marine shell >2mm comprised over 51% of the total weight of all material (excluding rocks) in Spit 1, and 42% in Spit 2. Marine shell between 2mm and 5mm in size consisted predominantly of fragmented pieces of the larger shell found in the 5mm sieve residue, and a few juvenile specimens of Anadara. The bulk of the shell from location MA1 is much larger than 5mm in size. Analysis of the lengths, measured from the hinge to the outer edge, of Anadara shell in all spits, demonstrated that more than 90% of this mollusc species is between 20mm and 32mm in length.

The percentage by weight of marine shell (>2mm) decreased with the depth of the excavated deposit, to 20% in spit 6. This decrease in the proportion of shell to sediment with depth in this mound is a phenomena observed in previous analyses of shell deposits (eg. Sullivan 1984:5) and especially in areas of the world with heavy rainfalls. This is explained as a process in which shell is leached out from the lower levels of shell mounds by seawater saturation or rainwater percolation of carbonic acids (Hughes & Lampert 1977:136; Stein 1992:11-15; Waselkov 1987:149).

### 6.3.6 Components Other Than Marine Shell

Analysis of sieve residue material > 5mm from location MA1 established the presence of several components other than marine shell. These included large numbers of rocks, small numbers of quartz rocks and stone artefacts, vegetation, a land snail, and small amounts of charcoal, internal casts and fish remains (Table 13).

Two stone artefacts were found insitu during the excavation of Square D, location MA1. A bifacial point with a length of 70mm and width of 20mm, was recovered just below the surface in spit 1. This artefact is manufactured from a fine grained non-local material, possibly Gerowrie tuff (pers. comm. P. Hiscock). A quartz flake, measuring 40mm in length and 30mm in width, was found in spit 2. The quantity of small quartz rocks and flakes which are not described, were found during sorting, in each of the spits analyzed.

### 6.3.7 Sediment And Component Sizes

As described for the Channel Island samples, the material from Middle Arm was separated into sediment and component sizes by sieving material through the sieve residues sizes: 0.5mm, 1mm, 2mm, and 5mm. The proportion of material in each sieve residue size category: <0.5mm, 1-2mm, 2-5mm and >5mm was calculated per spit. The term sediment is used rather than soil (following Anon 1979), for material retained in the 2mm, 1mm and 0.5mm sieves. Analysis involved weighing each of the size categories of the sieve residue material and calculating that proportion of the total weight per spit (Table 14).

Table 14. Proportion of sediment and component sizes (by weight) in spits 1 and 2 of location MA1. Because of rounding, not all totals equal 100.

LOCATION	SIEVE RESIDUE SIZE				SIEVE RESIDUE SIZE					
	<0.5mm		0.5-1mm		1-2mm		2-5mm		>5mm	
	Wt(g)	%Total	Wt(g)	%Total	Wt(g)	%Total	Wt(g)	%Total	Wt(g)	%Total
MA1 Spit 1	2732		718		1356		4390		9405	
+ Spit 2	+ 2000		+ 618		+ 985		+ 2123		+ 4732	
	<u>4732</u>	16%	<u>1336</u>	5%	<u>2341</u>	8%	<u>6513</u>	22%	<u>14137</u>	49%

Sieve residue less than 0.5mm from square D, location MA1, consisted of a very dark greyish brown sediment (10YR 3/2) with flecks of shell, which made up 15% of material in spit 1 and 19% in spit 2. This percentage increased with depth to 37% in spit 6. Sediment <2mm made up 26% of material in spit 1 and 35% in spit 2. Material >5mm constituted 50% of Spit 1, and 45% of spit 2, the proportion decreasing with the depth of the shell deposit, to 32% in Spit 6.

### 6.3.8 Conclusion

All the shell deposits examined on Middle Arm peninsula appear similar on surface inspection, being composed predominantly of large Anadara shells, and a few Chicoreus, Telescopium, Terebralia and Volema shells. All the mounded deposits are similar in size and shape, and located in a similar local environment, on rocky knolls or sloping ground overlooking the mangrove zone.

Anadara granosa, the dominant species in the Middle Arm mound sample from location MA1, is an edible bivalve mostly between 20mm and 32mm in size. Almost all of the marine shell identified in mound MA1 are of economic size. Component analysis of 2-5mm sieve residue material revealed only fragmented shell pieces and sediment, and a small percentage (<1%) of juvenile specimens of Anadara. Since the proportion of edible mollusca in this mound is more than 99%, this satisfies Hughes and Sullivan's (1974) criterion for a human shell midden.

Other criteria for the identification of shell deposits

as human, such as the presence of charcoal, artefacts and fish remains, were met by this mound. Also, like the Anadara mounds at Princess Charlotte Bay, this mound contains only a minor proportion of interstitial sediment (Beaton 1985:4). Material from spits 1 and 2 of mound MA1 contains approximately 20% sediment <0.5mm and 30% sediment <2mm in size.

## CHAPTER 7

### COMPARISON OF MOUNDS

#### 7.1 Introduction

Building on the work of previous researchers, Bailey (1991:22), Cribb (1991:24) and Mitchell (1993:12) have proposed criteria which they consider to be useful in distinguishing between megapode and human mounds. Briefly these include the composition, stratigraphy, shape and slope angle of the mound, the presence of artefacts, and environmental context. Following these criteria, mounds on Channel Island and nearby Middle Arm peninsula in Darwin harbour were examined, especially with regard to composition and environmental context. Differences in the local environment of mounds on Channel Island from those on Middle Arm are apparent.

However, the most marked difference revealed in this analysis is in the composition of the mounds. Detailed analysis of samples from mounds on Channel Island and from a mound on Middle Arm demonstrates that these differ significantly in composition. Features examined include the number of mollusc taxa and their range of habitats, the proportion of each species, and the size and condition of the shells. Content analysis also involved interpreting the significance of the presence or absence of components other than marine shell, and the proportions of sediment and

component sizes.

## 7.2 Environmental context

All the shell mounds on Channel Island are located around the coastline, sitting on marine sand and shell chenier ridges which lie between the inland rocky slopes of the island and the mangrove zone extending to the coast. Vegetation on the mounds and the surrounding chenier ridges consists of closed monsoon vine forest.

In comparison, four of the shell mounds located on Middle Arm peninsula rest on a silty clay terrestrial surface at the lower boundary of slopes rising to inland hills. Vegetation around the mounds consists of the more open surroundings of eucalypt woodland. Vegetation on the mounds consists of either a few scrubby trees or patches of vine thicket species. Discontinuous tracts of monsoon vine forest run along the hill-line to the north of the mounds.

One of the mounds along the same stretch of coastline sits just within the mangrove zone, on the sandy mudflat adjacent to a rocky knoll. Another mound is located on a three metre high outcropping rock on the northern side of the peninsula. Monsoon vine thicket covers this mound and neighbouring outcrops of rocky knolls. This mound too is situated at the sandy interface between mangroves and open eucalypt woodland. The main differences in environmental context between the mounds on Channel Island and those on Middle Arm peninsula are in the surfaces on which the mounds rest, and the type of vegetation of the area immediately surrounding the mounds.



### 7.3 Number and proportion of mollusc taxa and habitat range

Analysis of the excavated sample from location MA1 on Middle Arm revealed a total of eleven species of mollusc (Table 12 above). Seven of the eleven species identified live in mangrove habitats (Table 15). Three of the species identified, including Anadara granosa which makes up the bulk of the shell, live in intertidal sandy mud. The small number of species in this deposit taken primarily from two habitats are criteria which indicate a "degree of selection" which does not occur in natural shell deposits (Attenbrow 1992:9).

In contrast to this, samples from the mound at location A and chenier ridge at location B on Channel Island comprised 41 and 47 species respectively. The mound at location C comprised some 59 species of mollusc. Most of the species in the Middle Arm mounds were also found in the Channel Island mounds, but only in small proportions, (excepting Saccostrea echinata) usually as juveniles or pieces of larger shell. Also, two species, identified in the Middle Arm mounds, Chicoreus capucinus and Ellobium aurisjudae, were not found in the Channel Island samples, despite these samples containing a large number of taxa from a wide range of habitats (see Table 15).

On Channel Island, the sample from location C differs slightly in composition from that of locations A and B, which are very similar to each other. One species, Saccostrea echinata, dominates at location C in both minimum numbers (69%) and weight (95%). Saccostrea echinata, or oyster as it is commonly known, lives on intertidal rock platforms or

Table 15. Comparison Of Total Molluscan Species And Habitats  
(dotted line separates species in common from those  
unique to each site)

Middle Arm	Channel Island	Habitat
	<i>Anadara granosa</i>	IS/m
	<i>Cassidula angulata</i>	M
	<i>Marcia hiantina</i>	S
	<i>Nerita</i> sp.	IP/M
	<i>Placamen</i> sp.	S
	<i>Sacostrea echinata</i>	IP
	<i>Telescopium telescopium</i>	M
	<i>Terebralia</i> sp.	M
	<i>Volema cochlidium</i>	M
.....		
<i>Chicoreua</i> sp.		M
<i>Ellobium aurisjudae</i>		M
	<i>Acar avellana</i>	IP
	<i>Acar</i> sp.	IP
	<i>Aspella anceps</i>	IP
	<i>Bedeva blosvillei</i>	IP
	<i>Brachidontes ustulatus</i>	IP
	<i>Cardita muricata</i>	IP
	Cerithidae sp.	S
	<i>Cerithium coralium</i>	S
	<i>Chama fibula</i>	IP
	<i>Chlamys</i> sp.	IP
	<i>Circe australis</i>	S
	<i>Clementia papyracea</i>	I/BS/m
	<i>Clypeomorus bifasciata</i>	IP
	<i>Corbula</i> sp.	S
	<i>Cosa</i> sp.	S
	<i>Dentalium</i> sp.	S
	<i>Diodora jukesii</i>	IP
	<i>Emarginula rosea</i>	IP
	<i>Etrema</i> sp.	S
	<i>Eucithara arenivaga</i>	S
	<i>Fragum hemicardium</i>	S
	<i>Gafrarium tumidum</i>	M
	<i>Iravadia australis</i>	IP
	<i>Laemodonta octanfracta</i>	M
	<i>Littoraria articulata</i>	M
	<i>Littoraria filosa</i>	M
	<i>Marginella</i> sp.	sS
	<i>Merelina</i> sp.	IP
	<i>Meropesta nicobarica</i>	sS
	<i>Mitra rosacea</i>	IP
	<i>Monodonta labio</i>	IP
	<i>Montfortula</i> sp.	IP
	<i>Morula margariticola</i>	IP
	<i>Nassarius celebensis</i>	S
	<i>Nassarius</i> sp.	S
	<i>Notoacmea</i> sp.	IP
	<i>Nuculana</i> sp.	S
	<i>Patelloida saccharina</i>	IP
	<i>Petricola divergens</i>	IP
	<i>Philbertia</i> sp.	sS
	<i>Pseudoliota</i> sp.	S
	<i>Pupa alveolata</i>	sS
	<i>Pyrene essingtonensis</i>	S
	<i>Ringicula</i> sp.	sS
	<i>Rissoina</i> sp.	IP
	<i>Salinator</i> sp.	M
	<i>Seila</i> sp.	IP
	<i>Siphonaria</i> sp.	IP
	<i>Thais trigonus</i>	M
	<i>Thalotia aruensis</i>	S
	<i>Trapezium sublaevigatum</i>	S
	<i>Truncatella guerini</i>	M
	<i>Turbo cinereus</i>	P
	<i>Turbonilla</i> sp.	S
	<i>Turricula nelliae</i>	S
	<i>Vexillum vulpecula</i>	IP

I = Intertidal  
s = subtidal  
m = mud  
M = Mangroves  
S = Sandy substrate  
P = Rocky platform

reefs. Two species of mollusc, the small gastropod Cerithium coralium, which lives in sandy substrates, and Saccostrea echinata, make up the bulk of shell in terms of weight and MNI in locations A and B. One species, Anadara granosa, also dominates in the sample from location MA1 on Middle Arm peninsula, accounting for 87% by weight of all marine shell.

Differences between the samples from Channel Island and those from Middle Arm, are manifested in the number of species which make up the remaining small proportion (by weight) of marine shell after removal of the dominant species. In all three locations on Channel Island, this residue shell incorporates a large number of taxa from a wide range of habitats. In location A the remaining 17% of shell is made up of 39 species, while the remaining 16% of shell in location B contains 45 species. Similarly, the remaining 5% of shell in location C consists of 58 different species. By comparison, in the mound sample from Middle Arm Peninsula, the remaining 13% of marine shell contains only ten species.

#### 7.4 Size of shell

Another criteria used by archaeologists as an indication of human occupation is shell size. The difference in shell size between the mounds on Middle Arm and those on Channel Island, is demonstrated in this analysis. The great majority of the shells in location MA1 are larger than 15mm in length. Analysis of the size of Anadara shell in all spits in mound MA1 demonstrated that more than 90% of this mollusc species is between 20mm and 32mm in length (see below). Marine shell between 2mm and 5mm in the sample from location MA1 consisted

predominantly of shell fragments of the larger species identified in the 5mm sieve residue, and a few juvenile specimens of Anadara.

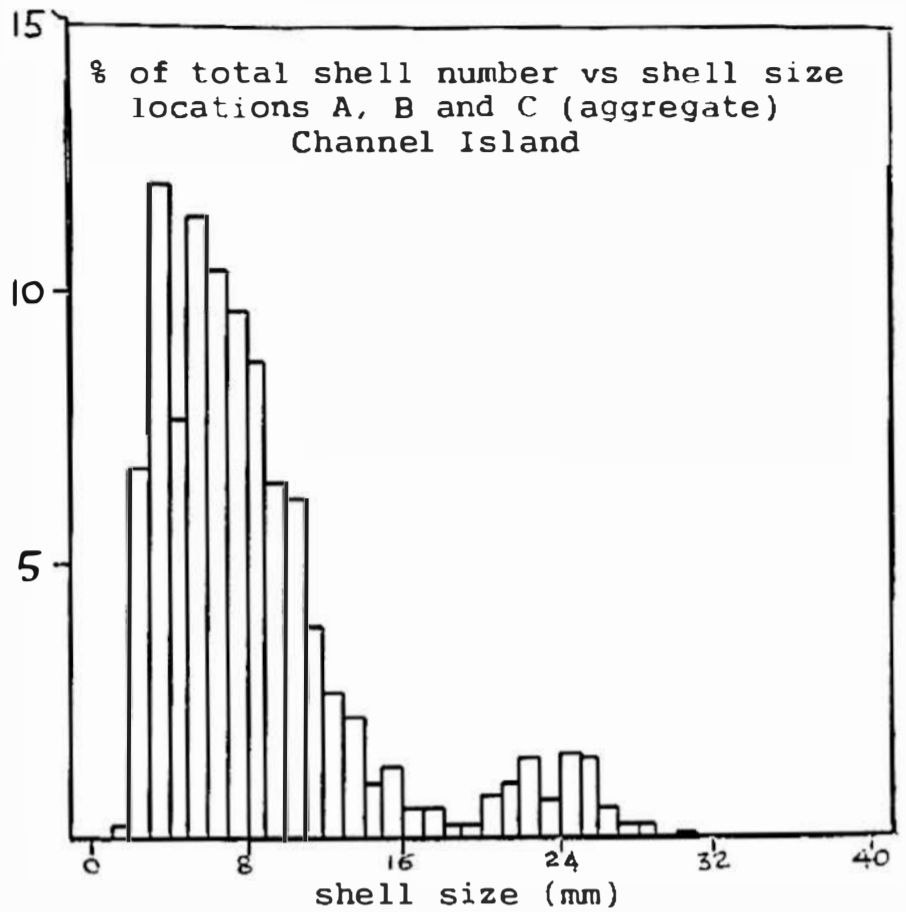
In contrast, the greatest number of shell species identified in the mounds on Channel Island are of marine mollusc species between 2mm and 5mm in size. These comprise a spectrum of whole shells of juvenile through to adult individuals, and fragmented pieces of larger shell. For location A the proportion (particularly according to MNI) of small (2mm to 5mm) non-economic species (ie. those species considered too small to provide a reasonable amount of flesh) such as the gastropod Cerithium coralium, is high. For location C, the bulk of marine shell (for both MNI and weight) comprises oyster shells ranging from 2mm to larger than 5mm in size. Over 50 species between 2mm and 5mm in size are also present in addition to the dominant species in location C.

In order to exemplify the difference in shell size apparent for location MA1 compared to locations A, B and C, the lengths of Anadara shells, common to both Channel Island and Middle Arm, were measured. Comparison of the results show a mean value of 23.5mm for the Anadara shell in location MA1. This is significantly larger than the mean values for Anadara shell, of 8.5mm in location A, 10mm in location B, and 5mm in location C (Figure 6; Appendix 2). The values for the shell sizes in Middle Arm are characteristic of the sizes of humanly collected Anadara shells found elsewhere, both prehistorically and historically (Koike 1986; Pathansali and Soong 1960).

A B C

n = 904  
 min = 6  
 max = 28  
 mean = 8  
 range = 27

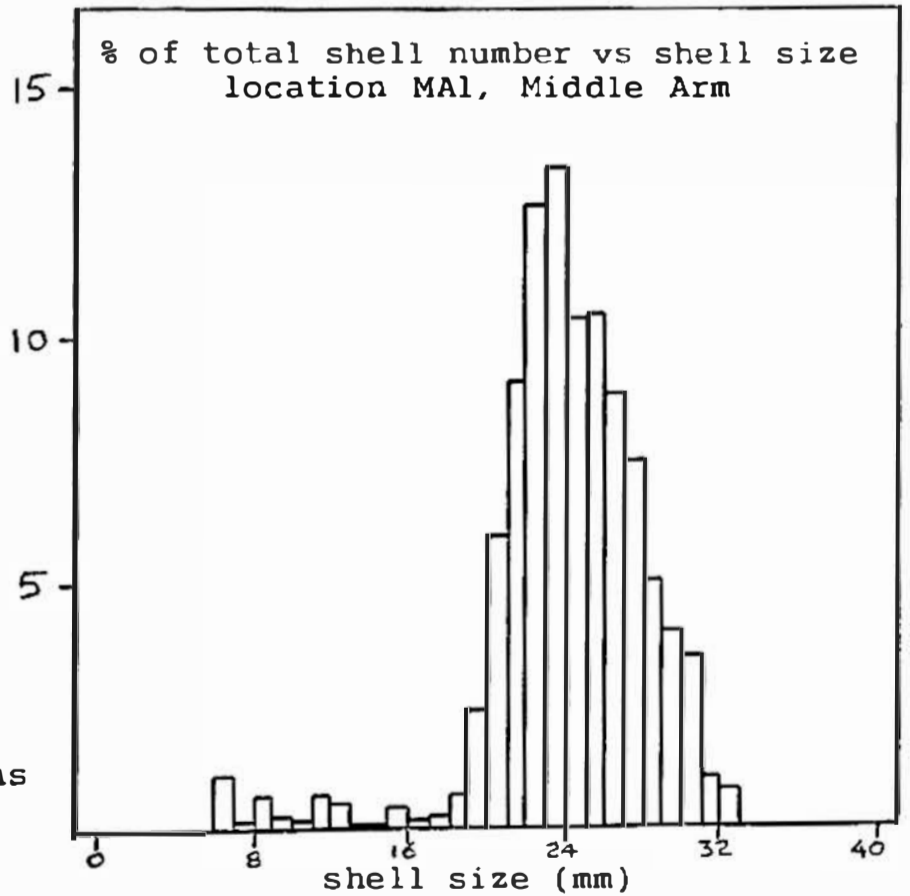
Number %  
 of total



MA1

n = 999  
 min = 6  
 max = 32  
 mean = 24  
 range = 26

Number %  
 of total



n = number of specimens  
 min = minimum size (mm)  
 max = maximum size (mm)

Figure 6. Comparison of size frequency data for Anadara granosa shells from Channel Island and Middle Arm

### **7.5 Condition Of Shell**

In all locations on Channel Island the shells were loose, bleached and water worn, like the shell debris found on beaches. The shells in the Middle Arm location however, although weathered, were not bleached or waterworn, but dark in colour and matted together with a dark greyish brown clumpy matrix.

### **7.6 Components Other Than Marine Shell**

Components other than marine shell found, which were common to both the Channel Island and Middle Arm samples, included rocks, pieces of quartz, vegetation, land snails, charcoal, and internal casts. Components only found in the Channel Island samples were coral, barnacle plates, the tubes of annelid worms, and crab carapace. Coral and worm tubes are both forms of life not known to be used by Aboriginal people (see Attenbrow 1992:18). Components other than marine shell which were unique to the Middle Arm sample were Aboriginal stone artefacts and fish remains.

### **7.7 Sediment And Component Sizes**

One marked difference between the samples from Channel Island and those from Middle Arm is in their proportions (by weight), of sediment and component sizes (sieve residue sizes). Comparison of the sieve residue sizes illustrates that the bulk of material from the mound at location A is finer material than that from the mound at location MA1 (Figure 7). In this analysis the top two spits, spits 1 and 2 of each

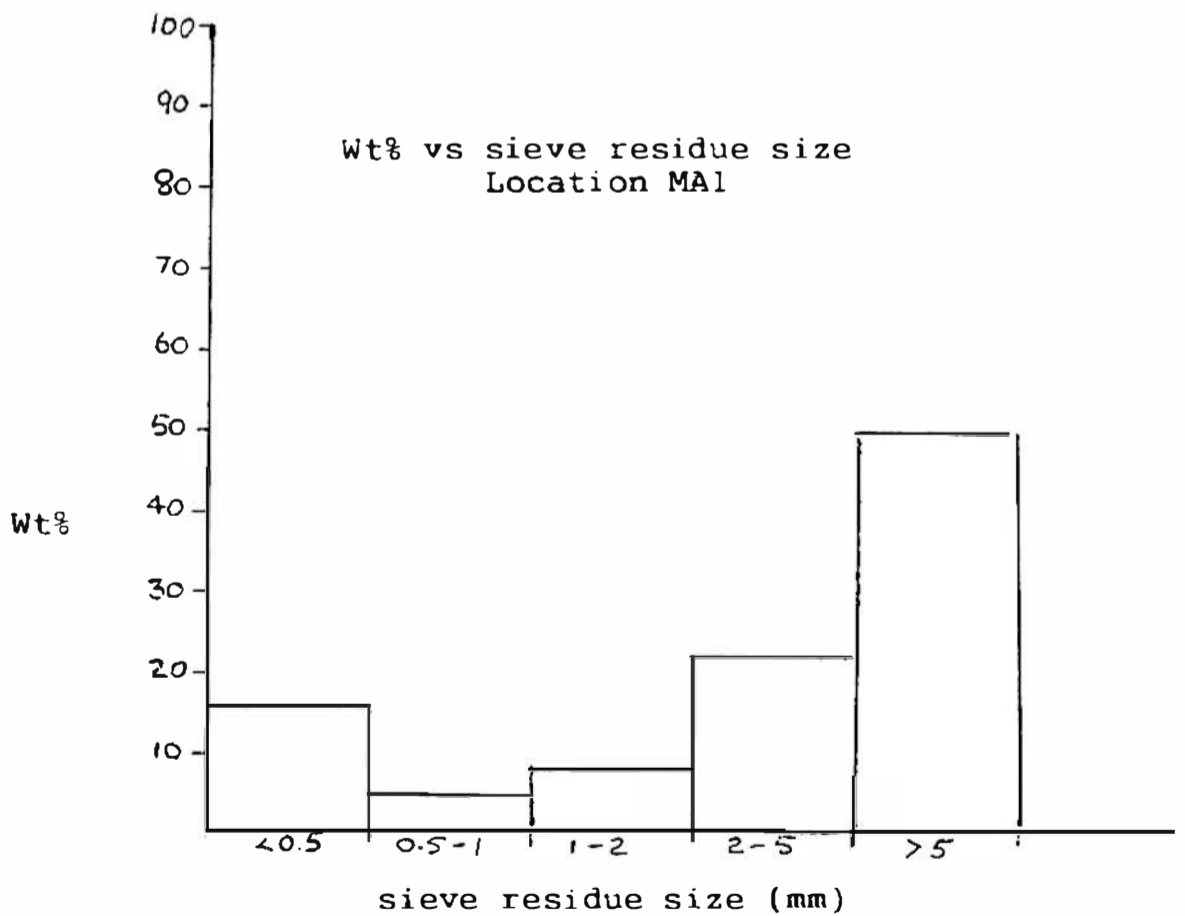
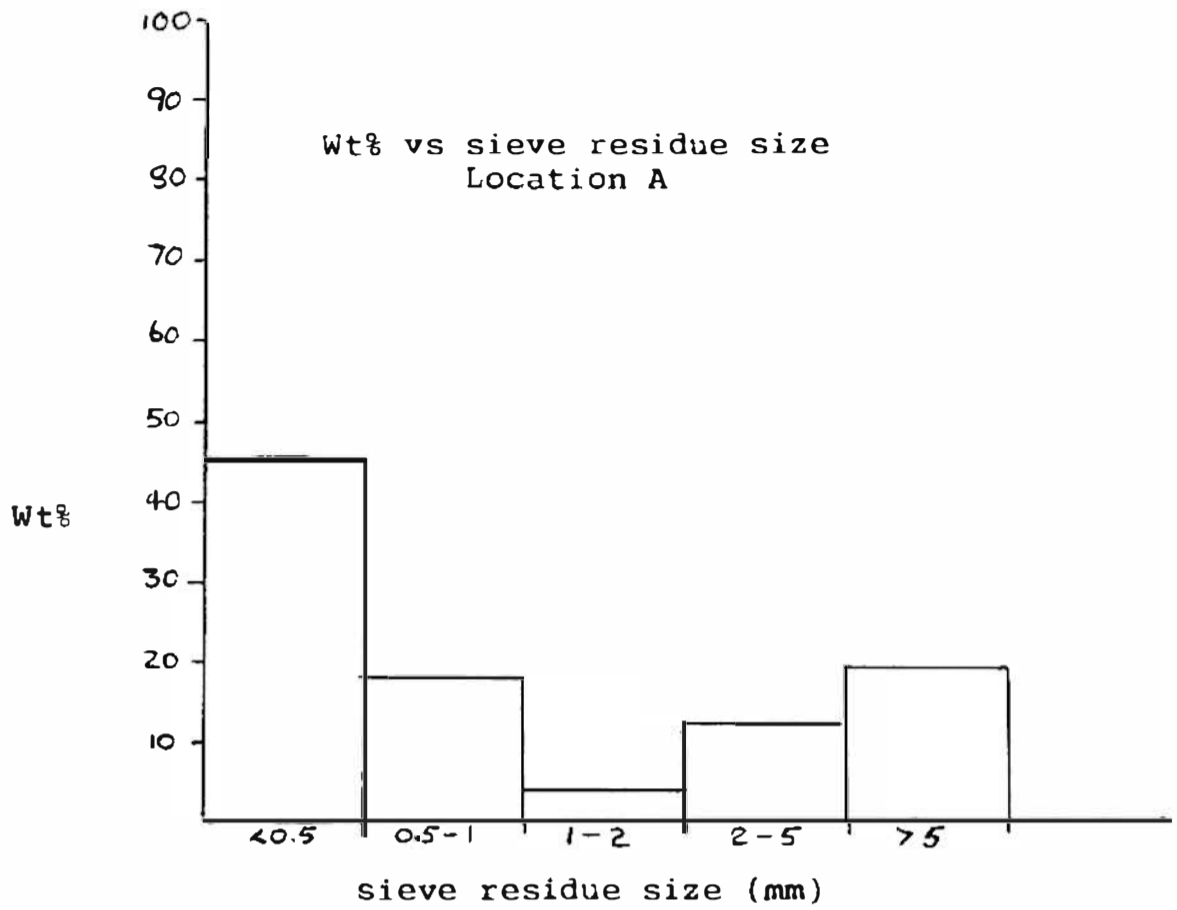


Figure 7. Comparison of proportion of sediment and component sizes (sieve residue sizes) from locations A and MA1

location were compared. Because of the process of leaching of shell from the lower levels of deposits (see above), it is surmised that the uppermost part of a mound would be most representative of this aspect of the mound in the past.

Sandy, dark yellowish brown sediment with shell grit which is <2mm in size, constitutes a significant component (68%) of the total weight of the sample in spits 1 and 2 from location A. This reflects the sediment component (64%) of the sample from the chenier ridge at location B on Channel Island. Only 20% of material from locations A and B is >5mm in size. This is less evident in spits 1 and 2 at location C which contained 38% sandy sediment <2mm. A higher proportion of material (43%) in location C is >5mm in size, this being mostly oyster shell.

In comparison, the sample from the Middle Arm mound contains much less interstitial sediment. The very dark greyish brown sediment (with flecks of shell) <2mm in size, comprises only around 30% of the total weight of material of spits 1 and 2 from location MA1. The composition of this sample does not reflect the composition of the sample from Square E of the surrounding ground surface. Almost half of the material in spits 1 and 2 of location MA1 is over 5mm in size, being predominantly Anadara shell larger than 20mm in length.

## 7.8 Conclusion

Like their counterparts on Channel Island, the samples from Middle Arm peninsula are dominated by one or two species. Shells of Anadara granosa account for 87% by weight of all shell in location MA1 on Middle Arm peninsula. Yet, although



the dominance of one species in a mound is consistent with selectivity by human gatherers, one of the other characteristics which must be considered are the number and range of species present in the mound (Attenbrow 1992:9; Bailey 1993:9). The shells in location MA1 are limited in the number and range of species present in relation to available mollusca in the local environment. They represent a small selection of economically sized species (ie. those species considered large enough to provide a reasonable amount of flesh), from the past environment of nearby mangrove habitat and adjacent sandy mudflats.

The sample at location C on Channel Island is also dominated by one species, with the shells of Saccostrea echinata accounting for 95% by weight. That this reflects the dominance of that species in the local environment, rather than selectivity by humans, is indicated by large number and range of species (58) which account for the remaining 5% of shell. In contrast to location MA1, the pattern shown by the shells in locations A, B and C, of numerous species from a range of different habitats, is consistent with the accumulation of shell debris in a chenier ridge. Furthermore, the high proportion by weight of sediment less than 2mm in size in location A is consistent with data on the composition of scrub fowl mounds in Northern Australia as described above (Mitchell 1993:3).

## CHAPTER 8

### IMPLICATIONS

#### 8.1 Discussion

Mounds on Channel Island accepted by Stone (1989:61; 1992:28) as megapode mounds, are said to demonstrate that scrub fowl can build their nests almost entirely from shell, and thus could have built the large Anadara shell mounds of northern Australia. Implicit in Stone's assertion is the assumption that the "shell" in the Channel Island scrub fowl mounds is the same as the "shell" in the Anadara mounds considered by archaeologists to be of human origin.

Stone's assumption is refuted by this analysis. The shell from the Channel Island mounds is predominantly small, loose, bleached, waterworn, of a variety of ages and species from wide range of habitats. The shell from the Middle Arm mound is predominantly large, adult individuals of a few species, bound together in an organic matrix. Seven of the eleven species identified in the Middle Arm mound come from the mangrove habitat (Table 15 above).

Stone's manner of expression gives the erroneous impression that shell is the dominant component of the scrub fowl mounds on Channel Island (Healey in prep.). Yet this analysis demonstrates that in the undisputed scrub fowl mound at location A on Channel Island, the dominant component is

sandy sediment <2mm in size.

However, the dominant component of the mound MA1 on Middle Arm, considered by archaeologists to be of human origin, is shell, as this analysis shows. Sediment <2mm in size makes up only around 30% of the total weight of material in the sample from this mound. Marine shell >5mm made up approximately half the total weight of material in spits 1 and 2 of location MA1. This contrasts with a sediment content <2mm of 68% (by weight) for the megapode mound at location A on Channel Island.

Yet the proportion of sediment and shell cannot be considered in isolation in interpretations of origins of shell deposits. The mound at location C on Channel Island, also considered by Stone to be a scrub fowl mound, consists of 38% sandy sediment <2mm. Like the mound at location MA1 on Middle Arm, shell >2mm in size, (predominantly oyster shell) makes up the bulk of this mound. Yet in contrast to location MA1, the pattern in location C, of numerous species from a wide range of habitats, is consistent with the accumulation of shell debris in a chenier ridge. Considering the similarity of the contents of the mound at location C with that of the chenier ridge at location B (see above), the mound at location C is interpreted as likely to be a chenier ridge<sup>3</sup>.

Like other comparable Anadara shell mounds of northern Australia, the mounds on Middle Arm peninsula do not share the characteristics which Stone (1992:83) claims suggest

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<sup>3</sup>Cheniers composed primarily of large quantities of oyster shell accumulated through wave action have been recorded by researchers (see Stone 1992:36).

deposition by wave-action. The mounds are circular, not elongate. Some are close to sea level, though not on the crest of beach ridges or cheniers but on terrestrial surfaces at the hinterland boundary. One mound is situated well above sea level on top of a steep rocky knoll, similar to shell mounds located by Hiscock and Hughes (n.d.) on nearby Haycock Reach.

Analysis has shown that the Middle Arm mound is not composed of crushed shell and does not extend beneath the ground surface sediments in the way that prograding shoreline deposits do. Criteria accepted by Stone as demonstrating that a shell deposit is of natural origin are absent from the Anadara mounds on Middle Arm. Similarly, features characteristic of other types of deposit, such as beach or chenier ridges, or megapode mounds, are absent from the Anadara mounds at Weipa (Bailey 1994:127).

This analysis demonstrates significant differences between the composition of Anadara mounds on Middle Arm and the composition of unequivocal chenier deposits on nearby Channel Island. Stone's hypothesis fails to explain why the composition of these deposits is so different if they are both formed through wave-action, or megapode activities. And as Bailey (1994:127) points out, it also fails to explain why the contents of the Anadara mounds at Weipa and elsewhere do NOT reflect the surrounding surface, as they should if they were built by scrub fowl, as Stone (1989:62; 1991a:26) himself recognises.

The area where the excavation was carried out incorporates two shell mounds (MA1 and MA2), an artefact scatter midway

between the mounds, and a midden (MA9) next to an engraving on a nearby sandstone outcrop. The artefact scatter, of chert and quartz flakes, and the Aboriginal engraving are accepted archaeological features. All these features are clustered within a 20m radius of each other, representing a "high density cluster of cultural variability" (Dunnell & Dancey 1983:272). Descriptions such as this are used rather than the term archaeological "site" following the debate by archaeologists over the effectiveness of the site concept (eg. Thomas 1975). Binford (1982:5) defines an archaeological site as containing assemblages or sets of artefacts (both items and features) which are found in clustered association. Notwithstanding the debate, this area is, according to accepted definitions, an archaeological site or "archaeological place" as termed in the Northern Territory Heritage Conservation Act 1991 (Hiscock 1994:56).

## 8.2 Significance Of The Study

### 8.2.1 Palaeoenvironmental Significance

Studies such as this on shell deposits, whether built by humans or scrub fowl, have palaeoenvironmental significance (Hiscock in press). They can be used in conjunction with geomorphic and palynological evidence to reconstruct past environments and explain coastal landscape changes (eg. Stocker 1971, Russel-Smith 1985, Woodroffe et al 1986). The predominance and large numbers of Anadara granosa deposited in these mounds suggests that they were once available in quantities large enough to be easily and heavily exploited. Large numbers of Anadara as would be required for the

construction of these mounds have not been reported in the Darwin harbour area in modern times. Today the dense mangrove zone fringing Middle Arm peninsula forms a barrier of several hundred metres between the hinterland and the tidal mudflats of the coast.

Hiscock and Hughes (n.d.), and Hiscock (in press) hypothesise that during the late Holocene, optimal habitat conditions of open sandy beaches with scattered stands of mangroves existed, which enabled Anadara to colonize in abundance. The presence of Marcia hiantina, which lives in sandy substrates, in mound MA1 and other Anadara shell mounds found elsewhere in Darwin harbour, supports this theory.

An explanation for the relatively abrupt cessation of mound construction could be found in the sensitivity of the Anadara mollusc to changes in salinity and temperature (see Sullivan 1987:102). Broom (1985) reports large scale mortalities over short periods for Anadara granosa, (which he noted to be a biomass dominant in areas he studied), corresponding with heavy rainfall and therefore decreased salinity. The effect of increased rainfall on the availability of mollusca that were part of the Anbarra diet, with fresh water significantly damaging the marine shell beds, was also observed by Meehan (1991).

Recent geographic evidence suggests large scale regional increases in flood magnitudes, around 700 to 500 years ago in the Mississippi region in the U.S (Knox 1993:431), and about 450 years ago in the Kimberley region in Australia (Lees 1992:7). Studies on shell deposits add to this data from which

palaeoenvironments can be reconstructed.

### 8.2.2 Socio-Political Significance

More specialised taphonomic analysis (Roberts 1990:3), ie. more detailed examination of the factors which contribute to the formation of these deposits may be required to corroborate archaeological significance of north Australian mounds. Yet the study of site formation - the processes of deposition of shell mounds - are "means to an end"; a concern with "ideas about people in the past" (Bradley 1987). These ideas have social and political implications for people living in the present.

Issues such as the origin of shell mounds are demonstrably important when political and management decisions are made on protection of sites or development projects. Stone's views on the Weipa mounds may influence executive decisions on the amount of protection these sites are afforded against the forces of expanding population, industrial and mining activities, and tourism in the area (Bailey 1994:109). A few studies on the destruction of coastal shell mounds through cyclonic activities (eg. Bird 1992:27) or human activities (eg. Ceci 1984) give some indication of the extent to which these sites have been removed from the archaeological record.

In the Darwin region, there is evidence in historical records to suggest that shell deposits were much more prevalent at the beginning of European settlement, but were destroyed by human activities during the process of settlement. One such report in 1873, by the Commissioner of

Crown Lands and Immigration on the Northern Territory, states:

there are large accumulations of shells just outside the township (of Palmerston) - some of these fifty to one hundred feet long, several feet high, and ten to twelve feet wide. These accumulations should be preserved, as a large proportion of them will be required for public buildings (my emphasis) (Reynolds 1873:8).

Thus protection of the remaining mounds on Middle Arm peninsula and Haycock Reach would appear to be a priority, given the plans for increased recreational facilities on Middle Arm and expansion of nearby Palmerston (Caldwell 1983).

### 8.2.3 Archaeological Significance

It is naturally of concern to archaeologists working in northern Australia that there should be a question over whether these shell and earth mounds are of archaeological significance. Stone's hypothesis throws in doubt all interpretations derived from shell mounds, of economic systems involving human activities and relationships of those assumed to be responsible for its formation (Bowdler 1976).

As "highly visible sites" shell deposits throughout Australia have been used as evidence in debates by prehistorians, on human population changes during the Holocene (eg. Beaton 1985; 1986; Cribb 1986; Lourandos 1985; Rowland 1989), and on the manner of initial colonisation of Sahul (eg. Bowdler 1977; Balme & Hope 1990). Interpretations have been put forward theorising on the extent of dependence on littoral resources; on the extent to which shell deposits are representative of the coastal economies of prehistoric



peoples. Such theories on the importance of coastal environments in the occupation of Australia (eg. Beaton 1985; Hallam 1987), would need to be re-examined if Stone's hypothesis was shown to have any substance.

### 8.3 Testing Theories

Archaeological research has shown that shell mounds form through complex processes involving many environmental, cultural and taphonomic variables (Waselkov 1987:142-150). Certain conditions are considered acceptable in the construction and testing of scientific hypotheses which seek to explain the processes of formation of shell mounds. Bailey (1991;1993), Cribb (1991) and Mitchell (1993) follow these conditions when they look for empirical data, derived from analyses of mound composition, to provide criteria against which hypotheses may be validly tested.

Accepted conditions for scientific argument and testing are not followed by Stone (1989; 1991a; 1992). His argument is inconsistent and lacking in critical evaluation. There does not appear to be any conditions under which Stone is prepared to admit that his hypothesis fails to provide the most coherent explanation for the shell mounds of northern Australia. Stone's hypothesis is not corroborated due to the flawed hypothetico-deductive logic underlying the method of testing the hypothesis that the Weipa shell mounds are of human origin. Stone's argument is not only poor science because of poorly designed methods of testing, but also displays cult archaeology characteristics as previously explicated.

What Stone's reasoning appears to misconstrue is the function of the criteria developed by archaeologists. The point is not to apply each criteria doggedly in isolation, but to use the criteria in conjunction with each other, within the context of the particular circumstances and location in which a shell deposit is found. One single criteria, such as the presence of artefacts, for example, is not applied uncompromisingly as being "proof" that a shell deposit is of human origin.

There are no absolutes in science, as discussed above, but some would argue that new hypotheses should have more explanatory capacity than the current theories (eg. Cole 1980:18). Although Stone dismisses the criteria developed by archaeologists to distinguish between mounds of human or natural origin, he does not provide any new criteria himself. In fact, his argument implies there can be no criteria by which to differentiate between mounds of human or natural origin, due to the a priori hypothesis that all shell deposits are of natural origin.

Given that Stone fails to provide an adequate explanation for the observed differences in characteristics of disputed shell deposits, this study accepts distinguishing criteria developed by archaeologists, in interpreting the shell deposits on Channel Island and Middle Arm. Archaeological criteria for the identification of shell deposits as human are met by the mound at location MA1 on Middle Arm.

#### 8.4 Conclusion

Comparative field data provided in this study, demonstrates significant differences between the composition of the mounds on Middle Arm, accepted by archaeologists as of human origin, and mounds of accepted scrub fowl or natural origin on Channel Island. These differences require explanation. The results of this analysis corroborate the interpretation of the low mound of shell at location MA1 on Middle Arm as being of human origin. The interpretation of the mound at location A on Channel Island as a scrub fowl mound built from the contents of the surrounding chenier ridge on which it rests, is also corroborated. In addition, these results corroborate the interpretation of location B and the mound at location C as chenier ridges.

It is clearly demonstrated in this analysis that the shell mounds on Channel Island are not the same as the Anadara shell mounds found on Middle Arm, which are typical of the Anadara mounds of northern Australia (see Roberts 1994:185). The data collected in this research does not support Stone's (1989) hypothesis. However, as Bailey (1993:13) remarks, many hypotheses have been proposed with an apparent lack of supporting evidence, their virtue being in the subsequent stimulation of the search for relevant evidence. This thesis is a result of such stimulation and provides new field observations and data to augment the current debate.

Fig. 2 describes the probable annual cyclic movements of the Larrakia people. Commencing on Channel Island (1) - the people walk in from the southeast during the late dry season from the vicinity of Noonamah gaining food from the bush but mainly from the monsoon forest patches along the creeks and also from the mangrove areas. Neritas, oysters, crabs and Teredo are collected from the mangroves around the edges of which Barramundi are taken. "Fat" diamond-scaled Mullet school in the upper estuaries and are fished. Reefs between the Island and the point teem with Skinnyfish, Tarrum, Trevally and Catfish are caught in the mangroves. Extremely low tides and clear calm waters allow "fat" rays to be speared well out on the flats. Water is obtained from springs along the point.

The typical year was described to me by Stephen Davis:

With the wet season, mosquitoes become troublesome in the mangroves but the rich resources of shellfish and Teredo provide the staple diet. During extremely low tides the people wade the wide flats of East Arm to the eastern shore making their way to (2) in the vicinity of present-day Hotel Darwin. Here they occupy shelters under the cliffy overhangs drinking from numerous springs there and fishing for Tarrum and Skinnyfish. By the late wet season bush food is very scarce but magpie Geese are nesting in the swamps near Mindil Beach (3) so eggs, birds and products of the shore are foods at this time.

Yams and fruits mature in March and April (some earlier, i.e. the Bush Apple) and the N-W storms stir the bays into a dangerous condition. But as the S-E winds begin the seas flatten and it is the time of "fat" mud crabs and abundant Tapes. Turtles come ashore to lay eggs up the beaches. The people move towards Lee Point fishing and foraging in the Ludmilla and Rapid Creek mangroves (4). Bushland on the drier ridges is drying out and spot burns are set in the knocked down Sorghum. Near present Casuarina Hospital, stands of Hibiscus are culled for spear shafts (5).

With the onset of the dry season, some of the people move onto the drier ridges and into the bush to hunt Agile Wallabies and Antilopine Kangaroos along with reptiles and arboreal animals. The previously burned patches are covered with a green pick attracting the herbivores where they are hunted. Birds and water are obtained from Knuckeyes Lagoons (6) as the parties slowly move in a great arc (7) to complete the annual cycle (8) - (1). Numerous rainforest pockets supply fruit, yams and birds. By the late dry dependence on the estuarine environment is again dominant.

(Constructed after pers. comm. S. Davis)

Appendix 1. Postulated movements of the Larrakiya people prior to European occupation (from Anon 1987:65)  
(Explanatory extract for Figure 2)

	A11	A12	B11	B12	C11
N OF CASES	126	166	156	165	186
MINIMUM	2.000	2.000	2.000	2.000	2.000
MAXIMUM	28.000	26.000	30.000	27.000	17.000
RANGE	26.000	24.000	28.000	25.000	15.000
MEAN	8.921	8.151	10.865	9.418	5.495
VARIANCE	31.514	28.335	43.872	37.586	11.819
STANDARD DEV	5.614	5.323	6.624	6.131	3.438
STD. ERROR	0.500	0.413	0.530	0.477	0.252
SKEWNESS(G1)	1.689	1.730	1.090	1.335	1.256
KURTOSIS(G2)	2.715	2.647	0.126	0.955	0.996
C.V.	0.629	0.653	0.610	0.651	0.626
MEDIAN	7.000	6.000	9.000	8.000	5.000

	C12	MA111	MA112	MA115	MA116
N OF CASES	105	256	259	313	171
MINIMUM	1.000	6.000	6.000	6.000	6.000
MAXIMUM	19.000	32.000	32.000	32.000	32.000
RANGE	18.000	26.000	26.000	26.000	26.000
MEAN	5.229	23.156	24.459	23.169	23.345
VARIANCE	9.428	23.960	15.986	13.256	19.145
STANDARD DEV	3.071	4.895	3.998	3.641	4.375
STD. ERROR	0.300	0.306	0.248	0.206	0.335
KURTOSIS(G2)	3.460	2.848	4.816	4.901	4.672
C.V.	0.587	0.211	0.163	0.157	0.187
MEDIAN	5.000	23.500	24.000	23.000	24.000

A11 = location A spit 1  
 A12 = location A spit 2  
 B11 = location B spit 1  
 B12 = location B spit 2  
 C11 = location C spit 1  
 C12 = location C spit 2

MA111 = location MA1 spit 1  
 MA112 = location MA1 spit 2  
 MA115 = location MA1 spit 5  
 MA116 = location MA1 spit 6

Appendix 2. Size frequency data for Anadara granosa shells from locations A, B, C and MA1.

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