Figure 7-21: Morphology of Conchoidal Flakes from Selected Sites
unspecialised core forms, repeated blade production (as opposed to fortuitous or one-off detachment) requires core preparation and maintenance involving on-going trimming and therefore small debitage production.

While only a modest proportion of the flakes whose L/W value exceeds 2 would satisfy other blade criteria (e.g. ideal shapes) it is apparent that the southern sites show a technological trend different from those in the north.

Figure 7.22 plots collected siliceous core lengths against weight. There are no systematic differences between cores from northeastern and southwestern locations. What is noteworthy is the extreme reduction in core sizes. Many are too small for convenient freehand percussion because of diminished mass and inertia, and too little surface on which to grip. This necessitates the use of a bipolar anvil technique, the use of such a technique is frequently indicated by distal crushing damage. This extreme reduction of cores has eliminated evidence of any former specialisation in their forms. Cores reflect the limits imposed by the technology rather than perhaps purposeful design.

**Figure 7-22:** Size Distribution, Siliceous Cores

![Graph showing size distribution of siliceous cores](image)

In Figure 7.23a, \( wt\ silic\ cores/total\ wt\ silic\ stone \times 100 \) is plotted for the same assemblages. By weight, discarded cores are clearly a greater proportion of the total weight of the earlier assemblages (with the exception of R.I 42 a significant large site). This trend
does not appear to be clearly controlled by geographic setting. Figure 7.23b confirms this trend with siliceous cores continuing to be a more significant component of the older deposits by number. Figure 7.23c compares the weight of siliceous cores with the weight of conchoidal silcrete only and the same general trend toward high discard during the earlier period is confirmed.

This strengthens the tentative conclusion above (see Figure 7.20) of overall smaller and more constricted size ranges for conchoidal products in the earlier period. It appears that in the earlier period cores were already small when entering the coastal zone and after the detachment of only a limited number of small flakes they were ready to be discarded. In the later period cores were larger when they arrived, more and larger flakes could be detached before discard. In both periods cores could be taken to a very advanced degree of reduction.

Three factors appear to govern variance in siliceous artefact assemblages in the study area independently of local adaptive circumstances:

- the inherent qualities of materials and technologies. The size ranges of backed blades, worked-out cores and their products all appear to be governed by factors such as design limits (eg. backed blades), and the limits to which they can be worked (eg. cores)

- spatial location. There are trends in artefact production between the SW and NE explainable in part by the availability of raw material, eg. greater use of local pebble material on Sperm Whale Head

- time. Time is a dimension of change. There are variations in the proportions of raw materials used over time which cannot be directly linked to environmental change. Some changes in archaeological patterns can be attributed to factors independent of local circumstances, eg. the spread of microlithic technologies over the last 4,5000 BP.

7.3.1.4. Quartz components of assemblages.

Informal experiments with quartz reduction indicate that:

- better quality pebble quartz can allow a limited control over fragments produced by freehand percussion, it is possible to produce a proportion of pieces broadly conforming to desired forms. There are however many failures as fractures follow internal structures. If the purpose of flaking is to produce implements to strict specifications a lot of waste material will be produced. If the aim is to produce sharp edges there are few problems

- retouch of quartz pieces is possible, but one must always be ready for erratic fracture
Figure 7-23: Proportions of Silcrete Cores in Assemblages
-like other stone quartz may be reduced to a point beyond which freehand percussion flaking is difficult or impossible. Beyond this point bipolar flaking is viable.

-bipolar flaking of relatively homogeneous quartz can produce characteristic results. This is assumed to result from the establishment of shearing stresses resulting in splitting into flattish fragments. If shattering is not excessive resulting fragments will be marked at opposite poles by crushing. If shattering has occurred at one pole the artefact produced will retain only a single impact point and may be indistinguishable from a fragment produced by freehand percussion.

Except for crystalline material, quartz tends to have an irregular hackly structure and unpredictable fracture. The heterogeneous internal structure has other significance for the lithic technologist, notably the generation of much shatter debitage during flaking, and the potential need to trim away large quantities of poor fissured material before relatively homogeneous stone is encountered. It can be postulated that a quartz assemblage contains a higher proportion of shatter and trimming debitage than one composed on an evenly fracturing stone (eg. siliceous material). The lack of conchoidal fracture and tendency to shatter limit the capacity of the lithic analyst to infer the intentions of the Aboriginal knapper. In addition the hardness and hackly structure of quartz also limit the applicability of edge-use studies.

These considerations have great importance in analysis of quartz assemblages. A proportion of the assemblage will be composed of waste material which cannot immediately be differentiated from implements on objective morphological grounds or macroscopic features. In addition deliberate reduction phases may not be identifiable on the bases of objective features such as distinguish conchoidal material. The exception is where a bipolar flaking technique has been used and distinctive crushing on opposite poles can be perceived. Recognition of these signatures is dependent on minimal shattering having occurred and both poles being preserved.

Bipolar Pieces Although reference is made in the literature to bipolar cores (eg. White 1968) it is not always possible in practice to be able to assert that one item can be called a core and another a product of it. For this reason the term core is not used here. Bipolar items occur in modest numbers throughout the study area. However numbers are insufficient to make valid inter-assemblage comparisons. Figure 7.24 is a combined plot of the lengths and weights of bipolar pieces from collections in the study area. There is a linear relationship between the length and weight of items at discard in this composite picture indicating that there is an underlying regularity in production and discard.
It would appear that at greater than around 2 cm length, reduction proceeds by diminishing mass rather than length, this reflects bipolar fracture through shearing or splitting. After that reduction is by loss in both length and mass. Two classes of artefact are therefore being produced. With splitting at a significant rate above 2 cm length one can assume that the products include a proportion of items suitable for use as hand-held implements. The second class includes items down to 1 cm length, (or less) too small to be useful hand-held, and requiring incorporation in composite tools. An obvious role for such small fragments is to arm the ethnographic "death" or "jagged" spear which the local ethnography, (see Chapter Six), indicates is a component of the hunting kit.

It is not possible to detect evidence of variation in quartz technology in space or time.

7.3.1.5. Other Stone

See again Figure 7.16.

Flint is a minor stone type occurring in a limited geographic area. Most worked nodules seen were small with numerous vesicles, thick cortex and irregular surface morphology, they are poor raw material. Flint represents only relatively short-distance transport of small quantities of mediocre raw material. On a number of sites in the northeast "other" stone includes relatively soft water worn sandstone pebbles. No use can be suggested except possibly as net weights.

Artefacts flaked from pebbles of volcanic rock are frequently associated with quartz rich
assemblages. Evidence of retouch is rare, and no formal implements were noted. Artefacts on this class of rock tend to be larger than those on siliceous rock. Use of "other" stone in northeastern deposits may reflect substitution of locally available stone for stone (siliceous) derived from more distant sources. It appears to complement an increased use of locally available quartz in younger deposits. This is in line with the general trend in late Holocene Southeast Australia.

Figure 7.25 shows the size distribution of assembled "other" conchoidal stone. On the whole artefacts tend to be larger than for siliceous conchoidal stone. This presumably reflects both the often inferior flaking qualities of the "other" class, and the likelihood that being widely distributed in regional gravels "other" stone would not have been highly curated.

Figure 7.26 is a plot of the ratios L/W and W/T of "other" stone. "Blade" forms are not significant. On other criteria, e.g. general shape, no "other" flakes would qualify as blades.

7.3.2. Organic Artefacts

Bone was utilised at Jack Smith Lake, poor exposure limited the likelihood that bone industries would be identified elsewhere. It is believed that as stone burins can be reasonably assigned a role in bone cutting their presence indicates the distribution of cut bone technology. See Tables 7.2 and 7.3.

At Jack Smith Lake a sequence of point production was recognised and described (Hotchin and May 1984, Flenniken and White 1985:145-7). The process involved the cutting of longitudinal grooves along macropod long bone until splinters between the cuts could be separated. Figure 7.7 illustrates scoring and grooving on cut bone. These splinters could then be ground into a number of point forms, see Figure 7.8. Figure 7.6 illustrates the sequence of bone point formation by this groove and splinter technique.

7.4. Discussion

7.4.1. Archaeological synthesis

Points to emerge from prior studies, and later application of radiocarbon dating are:

-the exploitation of Donax along this coast is a late phenomenon appearing in the last millennium

-three suites of midden have been identified on the Ninety Mile Beach estuarine shell
Figure 7-25: Size Distribution Assembled Conchoidal "Other" stone
Figure 7-26: Ratios L/W-W/T Assembled Conchoidal "Other" Stone
deposits associated with a microlithic technology and a high proportion of imported siliceous rock, dated 3-4000 BP; Donax midden with microlithic industries, and a greater proportion of local stone, found from the Ninety Mile Beach barrier to the escarpment, <1000 BP; Donax midden with rare worked stone, typical of foredune blow-outs. <1000 BP

- there is an apparent decrease in the use of imported siliceous stone, and a greater use of local pebble material in the last millennium

- a bone cutting industry developed in the region using an implement form equivalent to the burin form of the Old World

- the termination of large scale sheltered marine conditions in the Gippsland Lakes area proper appears to have occurred in the order of 4000-4500 years ago. At Jack Smith Lake the end of marine conditions was later, closer to 3000 BP.

- the evidence of estuarine shell in the the Red Bluff midden, and Ostrea valves in middens nearer to the Ocean Grange prior outlet both indicate that tidal exchange continued, perhaps on a diminished scale, until almost the historic period

- there have been two phases of coastal occupation in the region, coinciding with major cultural shifts over a broad area of coastal Southeastern Australia. The first is initiated at the same time as the appearance of microlithic industries and almost simultaneously terminated by hydrological change in the Lakes area proper. It persists until around 3000 BP at Jack Smith Lake after which tidal exchange is restricted. The second phase follows an apparent hiatus in coastal occupation and appears to be part of widespread cultural shift which includes the appearance of a number of technological items related to coastal exploitation, a de-emphasis on microlithic technology and a wide-spread change in targeting of rocky shore mollusca

- there is little evidence that the resources of the main tidal phase (ca. >4000 BP), particularly shellfish, were used by Aborigines away from Jack Smith Lake. This allows a cultural shift including the use of coastal resources and the appearance of microlithic technologies to be dated to the period after the termination of free tidal exchange in the lakes proper, and the later cessation of exchange at Jack Smith Lake

- the evidence suggests a hiatus in occupation at Jack Smith Lake after the cessation of tidal flow 3000 BP until the last millennium
-there is a coincidental hiatus in occupation evidence along the Ninety Mile Beach and on Wilson’s Promontory during the period 3-1000 BP

-while there is little evidence of use of coastal resources in the mid-Holocene, the last millennium (or two at Mallacoota) has witnessed a burgeoning of coastal occupation

Additional points to emerge from further survey are:

-the overwhelming number of deposits in the area appear to be relatively recent. Those which can be confidently assigned an age greater than 1000 BP are largely restricted to the Jack Smith Lake area

-the single most important cause of visibility of archaeological deposits is roads and tracks, which are the direct outcome of patterned recent human activity. It is not possible therefore to assume that perceived site location patterns directly indicate prior cultural-environmental patterning. Perceived regularities are therefore trends rather than absolute patterns. The boundaries of archaeological sites are often more correctly regarded as the boundaries of exposures rather than of behaviour

-a number of separate classes of late occupation site can be recognised. They can be differentiated according to their contents, and show differing distribution patterns. The principal variables in site contents are the numbers of artefacts and the materials used, and the presence of mollusc shell. Major environmental factors are distance from perennial water bodies, and distance from the sea

- at the peak of the site type hierarchy are the major scatters with a component of Donax shell and large numbers of artefacts made on a mixture of raw materials. These are closely related to perennial water bodies. On the next level are smaller sites with less evidence of intensive occupation including minor scatters, with or without associated midden deposits. These can range from small scatters commonly with only 10’s of artefacts to limited midden deposits with sparse artefacts. In many cases the sparse artefacts were made entirely on local stone. The lowest level on the hierarchy is locations where a restricted range of behaviour is indicated. This class is exemplified by the fore-dune middens with evidence only of Donax being eaten, or by isolated artefacts directly indicating only single events in time

-it is suggested that the major sites are central foci of population in which a range of activities appear to have been carried out. Under these are lesser residential/foraging locations where the sparser deposits indicate occupation was less frequent or by smaller
groups, possibly for the purpose of exploiting specific resources. At the base are apparently
task specific activity locations in which habitation is not indicated

-the paucity of earlier sites means that hierarchical organisation cannot be induced from
the available evidence. At Jack Smith Lake the diversity of material associated with earlier
deposits suggests that sites were generalised rather than function specific

during the earlier phase of occupation cores were considerably reduced prior to
introduction to the coastal zone, in the latter period the same degree of prior reduction does
not occur. This can be interpreted as representing the time spent in the particular zone by
the carriers of the cores. Under this interpretation there has been a more intense use of the
coast in the later period. This is complemented by the increased use with time of local
stone, indeed in some locations local stone may replace exotic stone.

-the two phases of coastal occupation can be linked to factors external to the local
population. Despite some thousands of years of sheltered marine conditions coastal
occupation coincides with the appearance of microlithic technology. In the lakes area
proper this coincides in turn with the termination of tidal conditions, there is only limited
evidence of utilisation of the disappearing sheltered marine resources, notably shell-fish. At
Jack Smith Lake tidal conditions persist for another millennium and there is abundant
evidence of utilisation of coastal resources. The second phase of coastal occupation
coincides with and parallels wider-scale regional changes in the last millennium or so. These
changes are reflected in changed targeting of shell-fish resources, changed use of stone raw
materials, and an increase in exploitation of the coastal zone

-an emphasis on aquatic resources is indicated by the siting of major occupation
locations, and some minor deposits, with easy access to perennial water. This is not so
marked with limited function sites. This can be restated as a positive relationship between
major population loci and water, and fishing and particularly the use of canoes and nets is
implied. For reasons discussed in Chapter Five these can be expected to hold settlement
close to the shoreline. Maintenance of a net fishery may require significant population
groupings be located close to shore because of the labour commitment implicit in
manufacture, and the impediment to overland movement presented by nets.
7.4.2. Comparison of ethnographic and late archaeological culture, and the importance of land-surface processes

Archaeological and ethnographic records do not draw identical pictures of late Holocene culture. Thus, although the major class of archaeological deposits in the area is conspicuous middens of Donax shell, Donax exploitation is not mentioned in the available ethnographic sources although radiocarbon dates indicate exploitation continued into the historic period. This anomaly is explicable in part by reference to both the visibility of midden deposits, and their occurrence in the sands of the ocean facing dunes, an area of intense erosion in historic times. Whatever the actual economic significance of Donax in the past it is clear that its archaeological representation owes much to non-cultural causes.

Conversely the archaeological evidence encountered could not be used to argue for the use of canoes or nets, indeed not even a fish hook was discovered among the masses of surface artefactual material in the region. This can be largely attributed to the nature of materials used, and the natural processes of decay of materials. Interpretation of deposits as representing organisation around fishing relies on ethnographic information, and inference, although more direct evidence might be found using conventional intensive excavation techniques. No evidence was recorded to suggest that any vegetable had been gathered or consumed in the area, although the ethnography again suggests they were. This is all the more interesting in comparison with the ethnographically insignificant, but archaeologically overwhelming, exploitation of Donax. Again it must be stressed that the archaeological significance of Donax is in large part due to land surface processes, and stamped with the imprint of later cultural activity. This stamp results from the later White Australian compulsion to trample sand dunes in order to lie on beaches, leading to considerable dune erosion and exposure. It can be reasonably anticipated that patterned behaviour such as that which governs the routes of roads similarly imposes non-archaeological meaning on archaeological data.

This also illustrates a fundamental problem of archaeological data, that of long-term preservation of evidence. It can be assumed that deposits in the well vegetated areas landward have possibly millennia before they are destroyed. Those on the seaward side are quite susceptible to both natural and anthropogenic deterioration and can be expected to be significantly depleted in a relatively short time from the present. Arguably a future archaeological survey would find the exploitation of Donax along this coast less significant, and perhaps lead to the assumption that this resource, being of little value, was consequently little exploited. The relatively better preservation of hinterland sites would argue for an essentially terrestrially or Lakes oriented culture and economy.
Ethnographically there are good reasons to believe that meat (and fish?) curing may have been carried out in the immediate prehistoric period. If this is so the archaeology of the area would be better approached informed by theory and assumptions on societies with stored surplus. In such a case theory and assumptions applicable to the conventionalised pan-Australian Aborigine are potentially misleading. However, without ethnographic information the archaeology of the area could not be judiciously contrived to demonstrate storage, and as a default position the pan-Australian model would be imposed. It is unlikely that direct and unambiguous evidence will ever prove meat processing. We would be lucky to find bone dumps, there are too many possibilities for their destruction, e.g. from natural decay, scavenging or even their use as fuel. The ethnography suggests we may not find recognisable stone butchering knives, but a concentration of *Phragmites* phytoliths which might result from butchering would be amenable to explanation by any number of causes. No trace of any above ground structure for containing smoke or heat is likely to survive in an area whose geology demands the use of organic materials, and whose vegetation structure and floristics invite regular burning. Direct evidence can really only be expected to survive in such structures as fire pits and post footings, and unusual concentrations of fat, blood or bone ash in soils.

Such an analysis, including testing for phytoliths, would only normally be undertaken if there were an expectation that evidence would be found, and not undertaken on a routine site inspection. In a sense therefore an unusual result is prevented by the use of conventional technique. Conversely if a site were tested and blood, fat, phytoliths and other traces proved, they provide no proof of specific activities.

Other ethnographic evidence appears to be archaeologically attested, for example the distribution of stone raw materials. The ethnography of the region indicates that stone hatchets from the central Victorian greenstone belt should not have been exchanged across the *Wea-Wuk* into Gippsland, as has shown to be the case. It can be argued that the historic pattern of hostility between Kurnai and uplanders should restrict exchange of materials into the study area. An example might be silicified sediments which are not known to occur naturally in the lowlands, and which may have been obtained from uplanders. Declining use through the later Holocene might be attributed to increasing tension between groups, leading to the animosity seen during the contact period.
Chapter 8
Human Adaptation and Ecology

In previous chapters it is demonstrated that major environmental changes have occurred in the study area since the end of the last glacial period. By 12000 BP increased warmth and effective rainfall lead to the appearance of modern vegetation, and by 6800 BP approximately modern sea-levels had been established. This was accompanied by the inundation of the valleys of the greater Latrobe and Mitchell Rivers behind the precursor of the modern Ninety Mile Beach barrier. By 4500 BP progressive restriction of tidal exchange is likely to have been attributable to a combination of continuing barrier accretion and hydro-isostatic rebound, isolating previously lower or sub-littoral shell beds above the sea-level controlled water table.

Inundation of the river valleys was accompanied by basin sedimentation and shoreline progradation, with an expansion of less salt tolerant vegetation with time and restriction of tidal flow. This had the combined effects of decreasing the area of open water, and increasing the extent and diversity of habitats, some of which like *Phragmites* grassland communities due to their role as breeding and feeding habitats for a number of birds and fish are of considerable direct and indirect human resource potential.

Despite the rich sheltered marine communities established behind the barrier precursor and the progressively more attractive resources of the Lakes human occupation does not appear in the coastal zone prior to 4000 BP. It is likely that the earliest occupation of the area will not be visible beneath the sediments of the inundated valleys, or reworked in the shoreline zone, but can be expected to be preserved on the landward side of the coastal wetlands. The earliest evidence of human occupation coincides with the appearance of microlithic industries during a period in which there is no evidence of geomorphological processes of a sufficient scale to comprehensively threaten the preservation of archaeological traces. This coincidence of expansion of occupation with the expansion of microlithic industries has been observed elsewhere in Southeastern Australia. It is concluded that there is a causal relationship between these phenomena and that occupation of the study area is not primarily or solely attributable to local causes.
This first phase of coastal occupation is apparently terminated by restriction of tidal flow to the back-barrier lagoons and extinction of prior rich shell-beds. This occurred by 3-4000 BP according to location. There is a hiatus in occupation until the last 1-2 millennia, with the greatest activity occurring in the last half of the present millennium. One of the most visible aspects of the latter period of occupation is wide-spread gathering of the ocean beach bivalve *Donax deltoides* which appears to have remained unexploited over the preceding 5-6 millennia. Stone tool use during this period is marked by a greater use of locally abundant pebble stone and evidence of cores spending a greater part of their lives in the coastal zone.

In other parts of coastal Southeastern Australia this period is characterised by a similar decline of use of exotic stone, proliferation of littoral exploitation, and apparently a greater use of molluscan resources of the upper rather than lower or sub-littoral zones. This period saw technological innovations in the appearance of fish-hooks, and it is suggested here, relatively sea-worthy tied bark canoes.

It is likely that with continuing sedimentation of coastal water bodies, the process of vegetation succession, and the evolution of rock platforms, the coastline in general was increasingly productive of humanly exploitable resources during this period. It is reasonable to assume that this increased potential lead to the development and spread of the familiar canoe-hook-spear complex of the southeast coast. This spread can be regarded, like the earlier expansion of microlithic industries, as a spread of information rather than repeated local independent inventions. It must therefore be seen as a conscious rather than unconscious process. It is possible that the use of nets seen in the study area pre-dates this set of innovations and can be dated to the earliest occupation of Australia.

In the historic period the Lakes supported a remarkably dense human population, the greatest densities being achieved by groups whose territories included Lakes frontages. It can therefore be assumed that the aquatic resources of the region, and notably fish, were the basis of this population density.

It would appear that the major trends in the prehistory of the study area can be better matched to general information flows in southern Australia rather than to the evolution of the physical environment. However details of trends do indicate a significant degree of adjustment to local conditions. This is well demonstrated by the emphasis on netting over the sea-grass shallows, or the seasonal pattern of summer mobility rather than sedentism. The observations above complicate the question of how human culture can be systematically related to natural conditions. The chapter to follow examines one theoretical
approach to this problem, application of the theory of biological evolution through natural selection to cultural process.

The terms adaptation and ecology are frequently used in the literature of small scale societies. Both are thematically related to the idea of organisms in articulation with their environments, and have explicit meanings in biological science as outcomes of the process of biological evolution. Their use in anthropological archaeology or geography therefore indicates a tacit proposition that human culture should properly be studied according to a biological program. In the section to follow their applicability will be examined.

The discussion begins with an outline of approaches to human ecological relations in geography, and archaeology/anthropology, and ends with a rejection of the concept in the study of cultural process. This is of immense significance in hunter-gatherer studies.

An explicit position taken in this chapter is that at any time human action is culturally informed, and liable to innovation, such as the adoption of new techniques and technologies, or invention of response to pressures within the natural and social environments. This involves a greater or lesser role for conscious processes and must therefore be shaped by extant cultural information. While it can be argued that other species display a capacity to initiate and learn group specific behaviour, and thereby approximate aspects of cultural process, human behaviour and cultural change are in significant part products of culturally informed perception, choice, goals and normative values. Cultural process therefore relies on cumulative building on, loss to or modification of, prior information.

8.1. Geographical and anthropological/archaeological approaches to the study of human-environmental interactions

How people interact with their environments is a shared concern of both geography and anthropology/archaeology. The fundamental concern of anthropological studies is culture and society. Central themes and associated specialist areas cover a broad range of topics including studies of human ecological relations. This has come to be called Cultural Ecology.

Geography is a similarly eclectic discipline whose defining theme is the study of the surface of the Earth and the phenomena which, combined, form its configurations. Geography is concerned with both human and natural processes, and conventionally divides into human and physical geography. Another defining concern of geography is space
although it is sometimes difficult to regard this as a unifying theme. When geography concerns itself with man's place in his environment some geographers like to think of it as *Human Ecology* (Grossman 1977:128).

Modern perspectives on man-environment relations in both geography and anthropological studies go back to the last century, and follow from post-Darwinian unilineal "evolutionary" models of cultural change (Grossman 1977, Solot 1986). This evolutionism is more Lamarckian than Darwinian (eg see Kirch 1980) and found its expression in the "environmental determinism" of the time.

In time heavy-fisted environmental determinism was broadly rejected in both anthropology and geography. Perhaps in reaction the intellectual pendulum swung back to the opposite polarity of *idealism* or *mentalism* which sought for explanation of cultural diversity and change in the the internal processes of individual cultures (Friedman 1974:444). Empirical particularism typified the anthropology of Boas, and the empirical inductive, spatially oriented geography of Sauer.

Idealist and particularist perspectives remained common into the second half of the twentieth century but were by no means the sole direction taken in anthropology or archaeology. Significant exceptions were V. Gordon Childe, and J.H. Steward. Childe's contributions include his promulgation of a materialist perception of socio-cultural systems in which "A culture is an organic whole whose constituent elements are integrally related..." (Childe 1950:177), in which technology for example was not merely an assemblage of artefacts but "could operate only in concrete economic and social settings.... The production and distribution of goods were determined not only by technology but also by social and political relationships" (Trigger 1986:6). Childe understood that cultural forms need to be understood against environmental conditions and their importance for economic and socio-political systems recognised.

Childe's materialism owes its origins to a Marxist intellectual position rather than an evolved theory of ecological interactions. Even so, in his rejection of particularism and his perception of cultural integration he unconsciously anticipated the systems approach of much later materialist, especially ecologically oriented, thought.

While Childe did not start a movement with an attached name plate, Steward is named as the founder of *cultural ecology* (Grossman *op. cit.*:131). Childe's failure to be widely imitated is more to do with ideology than intellectual content. He was a Marxist whose intellectual life included the period between the Bolshevik Revolution and the post-World
War 2 Cold War. The tag "Marxist" was a liability even though the content of work has many similarities with cultural ecology. In the United States Steward is more likely to be cited in reference to the evolution of anthropological materialism.

The aim of cultural ecology is to explain human cultures by reference to their environments and levels of technology (Steward 1955). Steward claimed that cultural regularities can be recognised between groups as a consequence of the techno-environmental constraints which they share. Differences between cultures in similar environments with similar technologies, could be explained by splitting them into two components, the culture core and secondary areas. The culture core is where culture impinges on ecology and subsistence, and in which regularities are induced by evolution. The secondary area is aspects of culture liable to variation for reasons other than environmental interaction.

Division demands that systems are amenable to compartmentalisation into technology, religion, ideology, and the like, such a division into independent units might be seen as researchers' artifice. Childe's method emphasising integration rather than compartmentalisation is at odds with Steward. As he wrote in definition/defence of his Marxist prehistory:

The relations between productive equipment, the organisation requisite for operating it and distributing the product (the economy), and the legal, religious and artistic institutions that inspire it are not one-sided, but dialectical like the relation between society and its members (Childe 1979:94).

There are explicit and necessary relations between what Steward regarded as core and secondary.

Childe anticipated much contemporary thought on the nature of adaptation, in his use of the term adjustment as equivalent to "culture" (1979:94), much as contemporary writers like to use adaptation as a descriptive definition (eg. Kirch 1980:102-8, Jochim 1979:79, Durham 1976:89-91) of what culture supposedly does in relation to the physical environment.

An emphasis on process marked the revolution in "anthropological archaeology" of the 1960's known as the New Archaeology. This was an essentially American phenomenon whose aims included taking the study of man from the humanities to the natural sciences, and included a concern for theory and methodology, if not self-conscious concern for epistemology. Fundamental themes were a re-affirmation of the American view of archaeology as a sub-set of cultural anthropology, a commitment to materialism, rejection of historicism, an emphasis on process, a faith in hypothetical-deductive method and
universal law and theory, and a commitment to biological science as both a rationale and source of inspiration. While idealist and particularist thought can cope without universal order or law, and lead to the proposition that Man is different, cultural ecology requires that Man be amenable to interpretation in the same terms as other biota. It follows from the fundamental assumptions of materialism that man is to be viewed as an ecosystem component in interaction with other components, just as all other taxa are. Differences in what people do can be directly related to differences in environmental parameters.

While anthropological studies are primarily of sociocultural matters geography is more concerned with processes and configurations on the Earth’s surface (although in fact sociocultural factors are essential components of much process and form). Together process and form define environment, studied via development of geographic theory and technique. Anthropology is not defined according to technique, theory or perspective on the physical environment. This weakness has been partially recognised and reflected in a tendency for anthropologists to seek out ways of coping from other disciplines, in the American tradition often the natural sciences. The associated risk of abusing or misunderstanding borrowed knowledge is neatly called, "The hazards of crossing disciplinary boundaries on search and seize missions..", by Hardesty (1980:161).

The concern of geographers with economics, politics and variable distribution of commodities within and between societies has lead to a recognition that the human environment is not merely composed of natural components. Indeed the world in which everyone lives presents numerous problems, options and rewards originating from membership of societies, and relationships between societies. Two further insights are recognition of the perceived environment as a mental entity distinct from the objective environment, and that interactions with the human environment are reciprocal. This is not to say that these factors have never been recognised in Anthropology, rather the prevailing paradigm appears to still have little use for them.

The significance of the perceived environment lies in the gap between it and the objective environment. It is to the perceived world that people, and other organisms react, while it is the objective environment in which processes such as evolution occur. Thus while the objective world demands adaptive response, the perceived world is what is culturally responded to.

Especially since the work of Sauer (see Grossman 1977, Solot 1986) geographers have thought of the interaction of people and their environments as a two way process. While this seems obvious, it is a point that frequently fails to reach home in ecological
anthropology. A common perspective of human ecological relations is that nature acts, and humans react. This mind-set is well illustrated in Bettinger (1980: 213-6) who touches upon attempts (by others) to understand hunter-gatherer adaptations (or perhaps more correctly hunting strategy) via "games theory". Broadly an adversarial role is established for a semi-personalised and vindictive Nature against which man must manoeuvre. Such a unidirectional scheme is perhaps more indicative of the environmental perceptions of the proponents than informed ecosystem analysis.

8.2. The Concept of Adaptation in Cultural Process

Incorporation of man in an ecological and evolutionary framework invokes the concept of adaptation. The term has both a general English usage, and a specific meaning in biological science. In general usage it has a meaning akin to change, making something suitable, adjusted or appropriate in a particular context. In evolutionary biology the term is related to the fitness of organisms. As Dunnell (1980:37) observes the intended usage in the anthropological literature may be unspecified, and the term used as "a heady synonym for change". The following discussion is directed toward use of the term as borrowed from biological science.

The mechanistic paradigm current in anthropological archaeology has lead to a search for universal laws governing human culture. An enduring candidate has been the theory of evolution through natural selection. The power of this theory in its own field, the appeal of objective science to intellectually insecure practitioners of the Humanities, and a mechanistic-materialist perspective of the world has recommended this appropriation.

Pending a dramatic rethinking in the event of sociobiology consolidating its position a common proposition is that culture is the main way that man becomes adapted (Durham 1976). Although other animal species also transfer normative information on how to act, humans are unique in almost total reliance on learned information, in the importance of cultural precedents and in holding values In essence, human cultural forms are shaped by prior cultural information.

Stated in general terms cultural adaptedness appears to be commonsense. As severe a critic of mechanistic materialism as Friedman suggests that adaptedness is tautological for a functioning society. He also stresses the need for recognition of the complement of adaptation, failure, as an historical phenomenon (1974:458,466). The success and failure of cultural forms is after all the stuff of archaeology. To seek after adaptation exclusively is to ignore half of prehistory.
In the short term success or failure is likely to be invisible, all socio-cultural forms will appear to be viable if seen as sub-systemic components of functioning systems. Adaptation as the long-term outcome of short-term processes is an historical process in which the present state is only the latest. This is recognised in the parent theory of biological evolution. Gould (1980) points out that the total organism seen in the present is not explicable solely in terms of present conditions, but like the Panda and his thumb must also be understood in reference to previous states.

An important factor in culture-adaptation studies is the scale at which phenomena are viewed (Head 1986:121-9). One important framework is time, depending on scale culture can be static in instantaneous time, or dynamic in the longer term. At a geological time scale culture moves rapidly indeed. Thus Rappaport (1967) examining a New Guinea highland population in an ethnographic time scale contrives to demonstrate cultural systemic properties leading to long term homeostasis as a goal of cultural-ecological interactions. If Rappaport’s Maring were looked at in an archaeological time scale, systemic stasis would be eclipsed by dynamism and change, especially since the introduction of the sweet potato to the western Pacific.

However the process of evolution by natural selection is generally seen as operating at closer to geological time-scales. The transformations occurring in the New Guinea Highlands in the few hundred years since Ipomea arrived, or on the southeastern coast of Australia since the appearance of fish-hooks are simply out of phase with evolution by natural selection. To invoke natural selection requires an understanding that the parameters implied in the parent theory can be redefined. However, pleading of special processes, or invocation of unusual causes sounds the deathknell of general theory. Thus while longer term cultural drifts may have some significance as adaptive outcomes it may be difficult to differentiate these given the rapid cultural changes seen everywhere in the Holocene.

Adaptation to specified factors cannot be invoked to comprehensively account for particular phenomena, eg. the skeletal morphology of the panda’s hand is only partially explicable in terms of holding bamboo (Gould op. cit.). If Maring ritual is linked to the regulation of sweet potato land now it says nothing of ritual pre-Ipomea or indeed in the modern era of cash-cropping, nor of the origin or content of ritual. That ritual appears to regulate crop-land or pig-herd may indicate that ecological regulation is an effect of ritual cycles, (and contributes to the success of the cultural system, and not that ritual has evolved to achieve regulation. That is the concept of adaptation is of little value in explaining the appearance of cultural specifics.
8.3. Problems with evolutionary models of cultural change

For the theory of biological evolution to be applicable to the study of cultural change, the concept of adaptation needs to be transferable intact and in toto. If this is not possible the value of the universal covering law is diminished or denied.

Culture is generally understood to be the corpus of of learned information shared by the members of particular societies. This knowledge is expressed in the characteristic behaviour of the members of each society. Cultural information and behaviour are therefore distinct from genetically transferred behavioural information.

This simple scheme has been disturbed over recent years by the rise of sociobiology, and the suggestion that much of what we imagined was cultural or voluntary behaviour is in fact based on genetic information. It is not possible or desirable to attempt to discuss this aspect of sociobiology at length, but neither can it be ignored. This impasse will be dealt with by recourse to an analogy with language. It is generally accepted that specific language codes are learnt rather than genetically encoded, there is no genetic cause for Africans to speak Swahili, or northwestern Europeans to have spoken archaic Norse. It is assumed that as a consequence of their genotype, humans are neurologically "wired up" to acquire and use language. That is, we acquire specific behaviours although a "predisposition" to generalised behaviour may be inherited.

Likewise whether or not there is "a gene" for self negation and "altruism" toward gene sharing kin, the expression of altruism is guided by learned values, be it proper enactment of Confucian kin obligations, or endowing wealth to family rather than to homes for stray cats. Until a genetic base for specific behaviours is identified, and variation in behavior can be explained away by other causes, culture will remain at the core of explanation of behavioural difference.

8.3.1. Transferability of the parent model of biological evolution

Cultural information is different from the genetic information upon which the theory of biological evolution is based. Liability to change sets cultural information apart from genetic information, which is essentially immutable throughout the life of an individual. This process of cultural change can occur therefore either as unconscious drift (eg. dialect differentiation) or conscious action (eg. technological innovations). The rest of this chapter is particularly concerned with conscious change.

Biological adaptation complements fitness, the state of being likely to be genetically
represented in future generations. The theory of organic evolution by natural selection relies on a set of conditions: that random variance in traits is generated within populations, that some traits are more potentially advantageous than others, that selected traits are differentially transmitted to subsequent generations and that selection of bearers occurs through natural selection. If these conditions can be applied to evolutionary change in cultural systems, it is valid to talk of selection of cultural variance in the same terms as selection of genetic variation.

The first condition seems to be true in real life, it is a common experience that individuals are not all identical, nor do all members of a population behave identically. Whether the generation of variance is random is another question. It will be argued below that cultural variance can be expected to be systematically generated and filtered.

The second proposition appears to be common sense. Doing some things and not others in specific circumstances can lead to advantages or disadvantages. This is not however as simple as it might sound. Both context and advantage/disadvantage bear closer examination. The context in which a trait is selected is critical, for example coloured plumage is decidedly advantageous for a courting bird of paradise. However the enhanced visibility incurred is disadvantageous when predators (eg. Melanesians looking for plumes) hunt by sight. While the types of potentially conflicting advantages we can expect with other species are fairly predictable, eg. in mating success, success in energy capture, avoiding predation, maintenance of equilibrium and so on, humans have a further range of goals to achieve. The list can be drawn out to a considerable length and includes affection, respect, ownership of non-subsistence material, political status and power, aesthetics and religion. These may conflict with each other and with biological goals. It may be difficult to unravel advantage from disadvantage, and conclusions as to the "evolutionary function" of a trait may be rationalisation after the fact.

The penultimate proposition appears similarly straight-forward. While cultural traits, like language codes, cannot be genetically endowed to humans (at least in the present climate of opinion regarding Lamarckian evolution) they can be learnt. The existence of educational institutions, initiation rituals and television advertising is proof enough of the transmissability of both ideology and specific behaviours. However variability can be expected in the degree of enculturation which occurs, and transmission of information remains possible or even likely rather than automatic.

The last proposition is the most difficult, and the cornerstone of the theory of biological evolution. The essence of natural selection is that in interaction with environmental
variables *individuals* with advantageous traits will reproduce more successfully, and their genes will be proportionally better represented in subsequent generations. The rigours of the "struggle for existence", to use a colourful turn of phrase, cull out the less adjusted.

To adapt this parent theory of biological evolution to fit cultural evolution we must substitute "cultural variants" as analogues for genes. The theory can now be restated along the lines that, because of the rigours of life individuals or groups with advantageous cultural characteristics are more likely to be genetically represented in future generations than those lacking them. This is the theoretical position of Durham (1976) who opines that the way to integration of biological and cultural evolution lies in the concept of *inclusive fitness*. Use of the concept of inclusive fitness for small scale societies hinges on the kinship of members of societies such as were found in Australia. However, as studies such as Barnes’ (1966), and the inter-territorial mobility of people in the study area suggest, close genetic kinship may be more notional than an actual condition of group membership. It cannot therefore be argued that evolution which benefits ego’s group infers substantial benefit to ego’s gene-sharers. Indeed competitive selection is problematic for human populations with their complexity and variable degrees of conformity and the difficulties in specifying whom is in competition with whom within and between populations.

If natural selection of cultural variants were to occur the question is what is to be reproduced. People with advantageous behavioural information *may* be in a better position to pass on their genes to children. This is not however informative on how cultural information can be transmitted. Without knowledge of the mechanics of Mendelian genetics Darwin could be confident that the off-spring of his pigeons carried information from their parents. We have no reason to presume to the same confidence regarding cultural information. Simply, information may or may not be transferred intact, there is no mechanical enculturation.

In the parent model genetic information is fixed in the individual, even if it is not expressed in the phenotype. The individual has no choice over his phenotype, nor his contribution to the genotype of his off-spring. This is not the case with cultural information, it is not fixed, it is capable of being modified and selected during life, and between generations. Further, change can follow culturally informed volition. Selection of cultural variants may be a conscious process directed to achieving specific ends, and anything but the selection of *randomly created traits* of the parent theory. Being culturally informed the changes achieved need not be linked to genetic survival, nor are they set, but liable to change again at any time.
That genetic identity can be related to cultural identity (eg. to equate cultural information with race), or that specific behaviours can have a genetic basis are unproven. Contemporary psychology and anthropology have yet to verify the links between behaviour and race, caste, class or ethnic group so ardently sought by nineteenth century Social Darwinists, and twentieth century Nazis.

Through cultural information, behavioural flexibility and a capacity to perceive and analyse their environments, people can bring into play pre-emptive cultural selection. This has been disregarded as less powerful than "inexorable" natural selection by a number of writers (eg. Price 1982:716), who claim that ultimately natural selection must prevail. Belief in preeminence of natural selection demands a faith which denies that cultural selection can be a continuing rather than terminating process. This objection is ultimately of little significance for field studies. Unless it can be argued that competing levels of populations have been satisfactorily identified, and that those populations have been competing in a closed stable environment over a considerable period of time, ie. that inexorable competition to evolve to specified conditions has been able to proceed, claims for evolutionary explanation are not warranted. The populations must also be non-sentient.

Cultural selection implies perception, cognition and response to stimuli. In this it is Lamarckian rather than Darwinian in character. Cultural selection is governed by cultural criteria and occurs according to culturally informed objectives, after the interaction of both culturally formed perceptions of the world, and culturally determined views of possible and desirable outcomes. Being systematically rather than randomly generated variants in a cultural system do not conform to the requirements of Darwinian evolution.

Biological-mechanistic approaches may be naive when defining Environment, as the physical environment, and ignore the complexity of the human world. Two of the better known famines (selection crises) of modern times, the Irish Potato Famine, and in Ethiopia in the 1980's illustrate the complexity of the environment in which humans live. Both crises can be portrayed as outcomes of contradictions between the subsistence economy and physical environmental parameters on one level. The Irish relied on a single staple subsistence crop in an area whose climate allowed the proliferation of blight organisms, and were thus maladapted. In Ethiopia subsistence crop growers were susceptible to drought. This analysis does not however fully explain the intensity of either crisis. This is because a purely natural perspective ignores the social, ethnic, political, and religious aspects of either case and the significance of these factors in shaping cultural responses.
8.3.2. Time Scale

Recognition of time scales imposes a severe test of the proposition that cultural forms can be explained as evolutionary outcomes.

Natural selection of genetic variation operates at close to geological time scales. To occur, and not simply act as an analogue, natural selection would be expected to proceed at a similar rate. The contradiction is well illustrated by the rate of evolution of the human brain which enables culture to operate, and the rate of change of culture itself. The human brain has been many millions of years in reaching its present size and geometry, that is, a Darwinian-geological rate of evolution. Indeed it may be argued that there has been barely perceptible change over the last 40 millennia. During the same time the changes that have occurred in human cultural systems have been considerable, particularly during the Holocene. To have occurred at the rate of Holocene cultural change, selection needs to have been accelerated by a hitherto unknown process. Pleading of special processes, or invocation of unusual causes sounds the deathknell of general theory.

Another problem with scale is its potential role in shaping observations. When viewed at a geological time scale Holocene cultural history is a very rapid process indeed. This is very adequately demonstrated in the reconstructed prehistory of the study area through the second half of the Holocene. Viewed at the ethnographic scale change can be replaced by stasis, and systems can be proposed to seek after stability. The latter circumstance may be preferred in cultural ecology as ecological equilibrium is a desirable indicator of evolutionary processes in the eternal moment of cultural ecology.

8.3.3. Complexity of social and economic organisation

A fundamental short-coming of simplistic ecological models is the assumption that populations are made up of like individuals whose behaviour, needs, production and consumption of commodities, and decision making capacity are essentially similar. This is more or less valid for other organisms where individuals act as redundant units, it is not the case with human populations. Humans are noteworthy in the development of social division of labour, pooling of production, maintenance of dependents other than infants, creation of dependent elites or non-productive privileged individuals, and distribution of resources to favour non-genetic kin.

Even in supposedly egalitarian societies ego’s environment and ecology are defined socio-culturally according to age, sex, gender role, classificatory relationships, seniority and the like. Although all members of a small-scale society may inhabit one set of habitats,
different social categories may fill different niches. In generalised Australian Aboriginal society systematic differences in diets of men and women (Bowdler 1976, Cowlishaw 1981) indicate differing access to resources, and differing nutritional status and ecology. Further ethnographically habitually high producers (women), may support a range of dependents incapable of production or genetic reproduction (aged, infirm,) partially effective producers (many men), or capable of production but retired from active productive service (eg. many mature men). In addition, members of the dependent categories (eg. mature men) may control or own the productive capacity of others (eg. women, young men) via social institutions such as marriage or male initiation, such ownership or diversion of others’ labour or product away from genetic kin is unique to humanity. The complexity of human production and consumption, and institutional inequality in access to the products of labour differentiate humans from other species where what individuals consume is what they produce. This perspective disallows a model based on simple competition between redundant individuals.

Social behaviours may work to the disadvantage of personal genetic continuity, eg. maintenance of non-genetic dependents with resources which might in another scheme be directed to genetically related dependents. This is controlled by ideology which at the present state of knowledge is the unique property of the human species. As Cowlishaw (1981) notes people (eg. women) may be rewarded for "lost" product only by the satisfaction of maintaining propriety.

In modelling Aboriginal society and economy, social complexity including the significance of dependents, is a factor to be modelled along with energy flux and optimality of risk management and returns. This is well brought out by Meehan’s work on the role of littoral resources in an Aboriginal economy (1982:159).

According to Meehan (1982), Osborn (1977), and others shell-fish or other gathered littoral resources are an objectively sub-optimal resource which Osborn (implicitly invoking a uniform and undifferentiated population) suggests should only be exploited under resource stress. Meehan's results demonstrate a rationality of resource and labour utilisation among the members of a functioning society unpredictable from Osborn's objective mechanistic modelling. Shell-fishing is transformed from an almost desperate alternative to a rational strategy in which sub-optimal producers maximise the value of a sub-optimal resource, and their own productive potential.

Maintenance of dependents, particularly by adult women, is likely to be a stimulus to efficient resource and energy use, ie. behaviour broadly analogous to optimisation in other
species. There is no reason to deny a role for culturally informed decision making and propose that the development of efficient and reliable exploitation strategies must be achieved via a process of unconscious natural selection. The opposite, conscious, induced responses to environmental states drawing on cultural options or inventiveness, is objectively no less valid a proposition. Indeed the demands on an Aboriginal woman to maintain other consumers will impose far greater stresses than merely providing for herself and children. In such circumstances cultural selection of foraging behaviour might be more rigorous than natural selection. Such rigours establish a systematic cause-effect relationship between environment and behaviour in which evolution proceeds by Lamarckian induction and acquisition of traits rather than Darwinian selection of randomly generated (non-induced) traits.

8.4. Ethnocentrism and use of biological analogies

It is almost regarded as axiomatic that small scale, low technology societies are more attuned to their physical environments (eg. see Childe 1979:94, Dunnell 1980:64-5) than large complex or urban societies. With a slight twist the proposition arises that small scale sociocultural systems being attuned to their environments must be amenable to explanation in terms of natural selection outcomes. Hidden in this are two unrelated propositions: that members of small scale societies are more sensitive to environmental variation, and small societies are more susceptible to environmental variation.

The first proposition stands. The second is fallacious as it requires that as technology and social complexity "advances", systems are isolated from matter and energy fluxes. The level at which the "inexorable" and "universal" principle of natural selection ceases to apply to graded human cultures is not at all clear. It bespeaks a shakiness of intellectual base that a universal theory should be bounded, it is worse that the boundary conditions are not specified.

The problem lies in sensitivity being confused with susceptibility. That a small scale society arranges itself, its structures, economy and so on in accordance with environmental realities need have nothing to do with greater susceptibility to natural selection, but simply to the greater immediacy of environmental factors. Immediacy of effects is primarily a question of scale and perception. In larger systems inertia and complexity may buffer the individual's perception without negating environmental realities. Arguably members of smaller scale societies may be in a better position to pre-empt natural selection crises through both a greater sensitivity to parameters, and minimal inertia. Complex societies may lack both sensitivity to variation, and a capacity (eg. by relying on career politicians
and public servants) to take pre-emptive steps. In this light it can be argued that larger complex societies are more susceptible to changes in natural parameters, and therefore natural selection, than smaller more sensitive ones. It would appear that the capacity to avoid environmental degradation in contemporary Australia, and the selection pressures that must follow, are to large part jeopardised by the conflicting ideologies of a complex society. Scale may also be reflected in the lapse between cause and effect.

It follows that complex societies may be at a greater risk of natural selection due to an incapacity to apply cultural selection than smaller scale examples. This contradicts the implicit position that modern hunter-gathers can be modelled on other biota, or that they can be used as models for more primitive hominids (eg. see Hayden 1972). Such positions rely on assumptions of helplessness, limited powers of perception and intelligence, and limited capacity to change or generate cultural information. A suspicion of ethnocentrism cannot be avoided when members of confident complex societies choose to distance themselves from their co-species members, perhaps (against the advice of their professional training) assuming them to be more primitive.

It is significant that formulations of integration of culture (normally seen as a group property) with biological evolution (essentially a process working on the genotype of individuals) arise in western capitalist societies. These societies, and significantly so in the United States, place a strong affective value on an ideology of libertarian individual competition. It is to be expected therefore that such a value system will be imposed on models of the world, and that culture will be assigned a significant role in the process of individual evolutionary competition, even though the adaptive tool of culture is transformed from a group property to an individual possession.

Problems in modelling human societies on the principles established for other taxa are particularly acute when dealing with subsistence and population regulation. Subsistence is the field \textit{par excellence} where environment, selection, adaptation, and human culture are construed as coming together. This arises from the truism that people have fundamental biological needs to satisfy and the assumption that the mechanics of selection applicable to other simpler species are applicable. Population regulation, matching the size of the consumer population to resources, is at the root of the subsistence-adaptation nexus.

However, it has already been argued that human behaviour is more complex, with more competing goals than other species'. With a sentient organism it is impossible to simply attribute the existence of behaviour to some adaptive advantage separate from the motivation of the actor. Actions can occur as consequences of consciousness, with purpose
or meaning not found in entirely programmed behaviour. There is an information content in human behaviour not found in the "dawn chorus" of birds or the tail-wagging of dogs. If people in New Guinea time feasts to regulate expanding pig herds, they also do so to please their ancestors, pay debts or put others in obligation. While economic behaviours may be construed as serving multiple functions, such as the "emics" and "etics" of pig feasts, others are difficult to post hoc rationalise in adaptive terms. They are value-rich behaviours such as systematic redistribution of product from producers to consumers; division of labour and economic roles according to status or wealth; claims on the labour and productivity of others; claim to property ownership; conscious fertility control and regulation of the above according to metaphysical and symbolic systems of law, religion and propriety. Population regulation when it involves infanticide, abortion, abstinence or contraception is a conscious and meaning-rich process, and not comparable to the waxing and waning of non-cultural populations through objective processes of resolution of numbers of consumers-versus-mass of resources.

Resource stress can also be managed through social organisation. It is clear from the ethnography of Gippsland (eg. Howitt 1904) that inter-group mobility occurred, and that it was enabled by the bonds of relationship built-up between the youths of diverse groups in the process of initiation, and by the practice of group exogamy. Within the study area at least inter-group mobility and presumably recruitment could eliminate the need for resolution of resource stress through natural processes such as starvation.

Hunter-gatherers are generally believed to maintain themselves well below environmental tolerances (eg see Bettinger 1980:190). The level at which they feel the need to regulate population need therefore have nothing to do with objective levels of disequilibrium. Ways of dealing with a perceived excess demand on resources include calling on rights of usufruct and inter-group mobility, or limiting the number of children raised. In Australian societies it is generally accepted that populations were significantly regulated by women limiting the number of children they would raise (but see Cowlishaw 1978). The critical factor is the level of effort for return which women in a society define as acceptable. Arguably then it is not environmental stress which stimulates population regulation but a function of it, culturally defined levels of acceptable effort, and as Cowlishaw suggests the relationships between segments of populations.

The process of sensing resource stress presents problems if mechanistic selection of behaviours is demanded by theory. Negative selection demands that populations approach objective levels, take no pre-emptive action, and selection occurs through under-
nourishment, disease or related processes. This demands that real and absolute environmental thresholds must be reached and exceeded to initiate selection. Validation requires thresholds to be defensible, according to biological criteria. If this is not achievable the theory is invalid, i.e. not capable of refutation. To invoke absolute natural selection without defining tolerances might be properly regarded as an exercise in wish fulfilment, causality cannot be asserted unless linkages are demonstrated to be operative.

On this reasoning, explaining archaeological culture change by population stress, according to an evolutionary model, is non-explanation unless objective values can be demonstrated on objective biological grounds.

8.4.1. Evolutionary expectations of environmentally controlled cultural development: optimisation of foraging

In an attempt to understand the function of human cultural systems cultural ecology has sought theoretical models of human ecological adaptation. Among the more hopeful candidates is optimal foraging theory which applied to generalist human foragers attempts to predict how resources would be used if people were behaving in an optimal way. Optimality is a predicted outcome of the application of the theory of natural selection to human economic behaviour (Foley 1985). The linkage is that with natural selection pressures, organisms positively selected become more optimally adapted to their environments. Optimality is expected to be expressed in efficient resource utilisation and economic behaviour.

Thus it can be argued that if fishing in the Gippsland Lakes were operating at an optimal level we should be able to predict that strategies would target key taxa, that among their characteristics the targeted taxa would be able to be bulk harvested, that they would be common and that they would have high nutritional value. As discussed in Chapter Two two groups of fishes are likely to fulfill these requirements and more, the mullets and anchovy/sprats. They are schooling fish and are easily bulk harvested, they feed low on the trophic pyramid and form a considerable biomass, they are perennially available and are oily and therefore potentially higher calorie yielders. If therefore fishing strategies were naturally selected according to objective and impartial processes it would be reasonable to expect to see the local Aborigines preferentially netting both these classes of fish. From the ethnography of the area it would appear that the requirements are only partially fulfilled, the mullets do appear to have been important the smaller fish not so, while it would appear numbers of other taxa were also taken.
Foley (ibid:223) notes that because of the potential for competing goals optimality should apply to the whole organism, and not simply to components, eg. morphology and behavioural repertoire. In this lies a major problem for the application of the theory, the total adaptedness of an organism is impossible to evaluate with objectivity. Studies must therefore be of isolated components, eg. foraging behaviour. There is no theoretical justification however for this carve-up of organisms into independent parts, indeed it is recognised by Foley as a violation of the theory. Theoretically therefore optimality as an outcome of the evolution of whole organisms cannot be refuted or demonstrated. If it is our wish that optimality be demonstrated we must hypothesise that the taking of other fish was advantageous for some subtle reason which we failed to build into the model. This may not be science.

Optimality can only be assumed in stable systems. This is because the key process of selection is specific to its time and place. In a changing environment what is selected for in one context may be selected against as parameters change. A long term trend to optimality cannot be assumed in a dynamic environment, rather we should expect to find a trend to generalism or flexibility.

As has been established, natural selection within Homo sapiens populations is not an adequate explanation for differential reproduction of cultural variants, nor can it be assumed to be an inevitable process. If natural selection is possible rather than the only process of selection the process of optimisation cannot be assumed to be a necessary outcome. Conversely, as has been argued above the intensity of pressures applied through membership of human societies might apply more stringent selection of variance and lead more directly to optimality-like outcomes than purely natural selection.

A fundamental requirement of optimality theory or any other scientific proposition is verifiability. Because of the complexity of the human cultural organism it is impossible in practical terms to talk of sub-systemic optimality far less systemic optimality. Optimality is impossible to falsify archaeologically because of the impossibility of comprehensive quantitative reconstructions of either subsistence systems using archaeological evidence, or natural systems when dynamism is anticipated. In practice optimality studies in archaeology rely on modelling of diets (eg. in terms of time and energy budgetting, diet breadth and so on) so that the archaeological record can be tested against the derived ideal of adaptation to environment.

Such difficulties can be well demonstrated in the study area in reference to the probable plant staples Typha and Solanum discussed in Chapters Six and Four. There are reasons to
believe that the availability of both may have been increased as a consequence of human action. The difficulty lies in attempting to model their availability at any period of history prior to, after initial human occupation, during lapse periods and during the final period of occupation. It is likely that any reconstructions must be based on a number of assumptions about actual availability at the time concerned. Problems also occur with the resource potential of the Lakes. Using contemporary data it is likely to be possible to estimate productivity in the recent past, allowing for changed salinity and sediment distribution. It is likely to be a different story when the Lakes were recently inundated, deeper, less in-filled, and with more salt-tolerant fringing vegetation lacking macrophytes.

As for archaeological verification of diet models it is improbable that *Solanum* or *Typha* will be detectable in any kind of quantifiable form, similar problems will occur with aquatic resources other than shell.

8.5. Discussion

The preceding has centred on the concept of *adaptation*, as a property of the theory of organic evolution by natural selection, with the aim of assessing its value in explaining cultural change and diversity. A number of short-comings have been identified.

Recourse to the single evolutionary "Big Theory" follows dissatisfaction with "soft" or unscientific alternatives such as historical particularism. However in the attempt to reduce the complexity of human sociocultural forms to single causes the importance of time scales, historic processes, intelligence and sentence are ignored. However as Chappell (1981:163), quoting Kuhn observes, "...scientific paradigms are often accepted for psychological, aesthetic or other non-empirical or non-rational reasons". That is the quest for the single big theory may not itself be objectively justifiable.

The term *natural selection* explicitly requires that selection be as a result of interaction with that entity called *Nature*. The human environment is of course also social, and cultural. While biological stresses may be applied by the "natural" environment these are mediated if not transcended by socio-culturally generated stresses. The famines of Ireland and Ethiopia illustrate the complexity of the environments with which people must cope. Within Aboriginal society, the fact that a woman might feed numerous dependents and remain marginally nourished herself similarly illustrates the point. To suggest that the natural environment is the only significant source of selection stress implies a profound naivete regarding the human environment.
The value of *natural selection* as the central concept and process behind explanation is weakened if there are other *selection* processes at work. It is here argued that not only may cultural selection occur and possibly pre-empt natural selection, but the criteria of selection may not accord with biological criteria. It may be argued that "in the end" it is only *natural selection* that matters, however as long as cultural selection is possible "natural" selection remains as merely a possibility. Indeed, it has been argued above for the time scale involved in this and many other Australian studies, natural selection is virtually irrelevant.

It can be suggested that in the long term cultural ideological, value and perception structures themselves are natural selection outcomes. That is, the ideologies, goals and values which filter cultural variation have been positively selected in the long term process of natural selection. As a consequence, cultural selection might be seen as complementary to natural selection and the acquisition of fitness. Scale imposes a serious difficulty on this hypothesis. The persistence of such filtering structures demands a high level of inertia, compatible with the time scales of change through natural selection. To be so, a level of immutability equivalent to that expected of genetic information is required. Without recourse to metaphysics, the best place to locate such information is in the genes. On this basis we must assume that our current ideologies and value systems are, like our physical forms, essentially similar to those of our medieval or even Pleistocene ancestors. There is no basis to assume such continuity, if however cultural filter structures are liable to change in the shorter term they are liable to lose their adaptive significance. A further problem with naturally selected filters guiding cultural evolution is the risk of imposing *purpose* on genes, that is having genes whose role is to keep culture "on track".

Without hypothetical genes for values and ideology, evolutionary cultural changes (eg. in technology, economy or spatial distribution of population) need to occur at a far greater rate than biological evolution. This requires a special process of acceleration more at home in "creation science" than real science.

A major flaw with models of natural selection of cultural variation is confusion over what is actually being selected. Durham (1976) suggests that while cultural variants may be subject to selection stresses it is genes which are reproduced. This poses serious problems. If gene survival is the criterion of the success of cultural variants there is an implied link between human behaviour and genotype yet to be demonstrated. The emphasis on genetic continuity reflects theorists' prejudice. That is, a commitment to biological rather than social, cultural or even psychological definition of human evolution. It is interesting that little emphasis may be placed on the reproduction of sociocultural systems. It is as if they
serve merely as a vehicle for genetic perpetuation, and are insignificant in themselves. From other perspectives or ideological commitments, the process of socio-cultural reproduction might be seen as the most significant outcome irrespective of the genetic identities of the bearers.

It is questionable whether reproduction of socio-cultural systems needs to be assumed to allow satisfaction to whole populations, as is suggested for instance by Ryle (1973). As Cowlishaw (1981) suggests, the social division of labour, male claims to female labour, and culturally generated dictates of propriety typical of Australian societies may have left the adult female portion of the population marginally nourished, that is under-satisfied. Arguably, the satisfaction which may follow from maintaining propriety, and ensuring the reproduction of socio-cultural systems, may exceed the satisfactions sought by the hypothetical individual of biological theorists.

The units of selection are different when genes or behaviours are being selected. The process of natural selection discriminates against the genes of individuals whose phenotype is disadvantageous. Cultural traits can be selected at the level of the individual, or at the group level, there is no specific node or level at which cultural selection works. While natural selection is unconscious and independent of volition cultural selection may involve conscious process, volition and prediction of outcomes. While natural selection works upon the individual phenotype so that the locus of the effect is the same as that of the cause, cultural selection may have a separate locus of effect. For example, effects upon less powerful groups may be brought about by cultural selection by more powerful groups. Thus in mechanistic site location analysis there may be a temptation to assume that sites are placed as a democratic resolution of the competing demands of all classes of producers. Implied is a belief that this serves to allow for ease of access to and transport back of product to be placed in single hearth pools. Recognising the fallacy of this model in Australian contexts, and that there is no necessary correlation between productivity and consumption, it must be assumed that democratic site location may not be strictly adhered to.

There is a serious weakness is the proposition that small scale autonomous human societies can be modelled on other biota (eg. see Hayden 1972) while large scale societies are immune to environmental pressures. The proposition that at higher technological levels systems are abstracted from the realm of matter and energy barely needs refutation.

It is concluded that Darwinian evolution does not provide an adequate model of cultural change, despite the initial appeal of objective process. The single most important difficulty
is systematic internal selection and generation of cultural variants. As the idea of natural selection of cultural variants is inadequate, the term *adaptation* should be avoided in cultural discussion as it can imply a *particular* process. Childe’s term *adjustment* is preferable in that it avoids this problem. What is lamentable is confusion of *natural* selection with selection through any (unspecified) agency. Specific attribution of cultural phenomena to *natural selection* outcomes occurs frequently in the literature (e.g. Gamble 1987:236, Mulder 1987), where it could not have occurred. To invoke *natural selection* is to invoke a specific process.

### 8.6. Integration of anthropological and geographical approaches to human ecology.

As an archaeological paleoecologist Head (1986) has confronted the question of integration of ecological inputs in Australian archaeology, and has suggested criteria which should characterise an integrating ecological-archaeological theoretical framework. She suggests that it should be historical, and take into account long-term processes in real time. Variability is integral in both cultural and ecological systems. This is exemplified by Head in the notion of vegetation *climax*. She observes this has little reality in the Holocene vegetation of Australia. Dynamism results from such factors as burning “strategies” of vegetation communities themselves, the continued inputs of man as an element in Australian ecosystems and on-going "catching-up" by post-Pleistocene vegetation.

In the study area additional processes such as the Lakes’ sedimentation are also relevant. The decreased area of open water, and increasing environmental complexity indicated for the Holocene mean that the Lakes of 6000 BP cannot be compared with those of 4000 or 400 BP. It would certainly not be valid to attempt to model resource potential simply on the basis of of modern data.

Head suggests also that variability is to be expected to be generated both internally and externally to both cultural and natural systems. This contradicts views of uni-directional effects, particularly on cultural systems. Eurocentric views would have fire as an intrusive and "bad" thing for vegetation, an externally derived visitation, rather than as the Australian experience has taught, integral to vegetation communities.

It has been suggested in this thesis that significant plant species were increased by Aboriginal cultural practices. The availability of these resources in turn contributes to the potential of the area for human exploitation. The area is also affected by flows of information, including technological innovations from beyond the local system, eg
microlithic technologies, hooks and canoes. It is information, presumably realised outside
the study area which transforms elements of the natural landscape (eg. fish) to resources.
Once introduced to the local area adjustment according to local conditions can occur.

A satisfactory approach would be cognisant of scale, both temporal and spatial. The use
of different scales will produce differing pictures and perceptions. There may be
considerable differences between the short-term and local, and the long term and general.
The historic population of the study area may be seen as part of a southeast coast
community defined by a suite of extractive technology. At a closer scale this community
might be atomised according to other technological or ecological criteria.

Head's approach is that of a paleoecologist or biogeographer, and therefore does not
pretend to a perspective on the functioning of cultural systems. For this reason it is
necessary to add some additional principles on human environmental relations. A
satisfactory approach must recognise that cultural systems are dynamic and driven in part at
least by conscious actions and choices, and variants are not independent particles of
information, but work within larger systems of interaction.

It would clearly distinguish between biological evolution involving *natural selection* only
and leading to the differential reproduction of genetic information, and cultural change
involving both the possibility of natural selection of cultural populations, and cultural
selection of cultural information. A satisfactory approach would recognise that selection of
cultural traits is not analogous to selection of genetically based traits. Selection of cultural
traits is not necessarily Darwinian in character in that:

- variants are not necessarily randomly generated, but are likely to be based on pre-
  existing cultural structures, ideology and directed toward goals

- variants generated and selected in response to perceived needs or goals are subject to
  essentially Lamarckian processes. While Darwinian evolutionary change can be related
  only to the specific physical context in which it occurs cultural selection can be said to be
directed

- selection of cultural variants may, but need not, be related to the future representation of
  particular genes

- cultural variants need not figure in natural selection "crises", that is, unlike genetic inputs
  they can be "turned off", nor need advantageous variants be necessarily reproduced after
  "crises"
natural selection accounts primarily for the survival of genetic variation while cultural selection accounts for continuation of cultural variants.

The Lamarckian character of cultural selection hinges on the proposition that selection pressures can induce cultural variants by triggering response to environmental stimuli. In the short term cultural selection need not necessarily lead to a process of differential reproduction of variants. In the longer term preferential reproduction of variants depends on continuing systemic evolution rather than reproduction of specific particles of information. The operation of cultural selection, and our inability to assume absolute adaptation to extant conditions, mean that natural selection alone is not a sufficiently robust explanation of cultural phenomena.

Another function of cultural selection is reproduction of cultural forms. By shaping both the generation of variance, and selection of variants, cultural systems reproduce themselves, albeit with successive modifications through time. This may be incompatible with ensuring the genetic reproduction of populations, and does not demand that socio-cultural continuity serve to benefit populations. Reproduction of sociocultural systems is not a democratic process and does not demand all members of a population benefit.

In disallowing the clear mechanism of comprehensive Darwinian evolution and allowing the function of cultural selection of variants, we appear to abandon the security of a universal theory, replacing it with a process whose operation is uncertain. Variants may or may not arise, may or may not be selected, and may or may not be reproduced. This appears to offer an insecure basis from which to begin to assess phenomena. There are however continuities: the necessity of a minimum of systemic rationality against environment, the necessity that cultural selection process have roots in prior cultural states, and the likelihood that evolution and reproduction of socio-cultural systems can proceed without necessarily "benefitting" genetic populations.
Chapter 9

Synthesis

The aim of this thesis has been to study the interplay of environment and culture in the Gippsland Lakes study area, and determine the extent to which local cultural history, and by extension the culture of small scale societies in general, can be explained as the outcome of local environmental conditions. To achieve this end this work has confronted three questions: what correlations can be determined to exist between the cultural (archaeological and ethnographic) record and the natural environmental record; what other influences can be seen or anticipated to alter the cultural record, including biases imposed on ethnography by culture contact, and landscape processes affecting the preservation and exposure of archaeological traces; and what theoretical basis can be devised whereby the evolution of cultural systems can be understood in terms of natural environmental factors.

Chapters Two, Three and Four describe the background against which both cultural and natural processes occur, and which are also likely to distort the cultural record. Chapter Two outlines general and Aboriginal history, and describes physiography, climate, hydrology, flora and fauna in historical times. Chapters Three and Four are accounts of the evolution of the landforms, vegetation climate and sea-level of the area, particularly through the Holocene. These are of significance not merely in the ecology of cultural development, but in the processes of archaeological discovery.

Chapter Five outlines the aims of, and approach to, archaeological studies, and is particularly concerned with physical constraints imposed upon cultural records. The research strategy is discussed in light of these concerns, particularly in regard to its extensive rather than intensive nature.

Chapter Six is an ethnographic reconstruction of aspects of the late prehistoric and historic culture of the region. It begins with a discussion of possible proto-historic results of colonial expansion. This is followed by descriptions of aspects of economy, technology, and population numbers, distribution and density. The local technology contained a substantial component of elements appearing over the last few millennia and shared by
adjacent coastal populations. This suggests that movements of information are an important historic process to some degree overriding local "adaptive" processes. The chapter suggests however that developments in fishing show significant adjustments to local conditions.

An outline of archaeological results of both this and other work in the region is presented in Chapter Seven. No evidence of coastal occupation prior to the spread of microlithic industries was found. A correlation of local culture with larger scale flows of information in the Holocene is strongly indicated and brings into question the primary value of evolutionary explanation of local cultural phenomena. Site survey and stone artefact analysis both indicate a pattern of more intense coastal occupation in the last millenium, and a distribution pattern consistent with the seasonal coastal mobility recorded by Bulmer (in Smyth 1878), and compatible with the size and hydrology of the lakes.

The chapter concludes with the proposition that, taken on face value, much of the archaeological profile of past cultural, and particularly economic activity, is non-cultural in meaning. That is, the archaeological record owes much to land surface processes and the spatially patterned behaviour of the present regional populations.

Chapter Eight is concerned with examining the theory of evolution by natural selection to determine its transferability to cultural process. It is found to be inadequate to account for comprehensive cultural change although long-term trends in the evolution of culture cannot be discounted.

9.1. Geographic Constraints on Archaeological Results

The value of an encounter-based survey depends upon sampling, and on the operation of factors which permit the discovery of cultural deposits. The potential for discovery is controlled by the deposition, preservation and later exposure and visibility of traces.

Discovery of archaeological deposits depends initially upon past activities and the materials involved, but many activities may leave no permanent traces. If traces are generated archaeological encounters depend upon their preservation. In normal circumstances few materials will be preserved beyond the short to medium term. Important variables affecting the rate of erosion and weathering are moisture, pH, through flow of water, permeability of the sediment matrix, temperature and the range of fluctuation of each parameter.

Mollusca, particularly sheltered marine taxa, were expected to be important in relative dating as their ecology could be linked to hydrological phases. As shell is likely to be
weathered and eroded by dissolved carbon dioxide or humic acids a critical question was how long it could be preserved in the local environment. Hughes (1977) expressed the opinion that shell may only last a short time on the eastern Australian coast, deposits older than even a few hundreds years may not survive. In the drier cooler climate of the study area, dating of shell in good condition to close to 4,000 years indicated that there would be few problems. Preservation was expected to be enhanced as calcareous grains in the local sands were expected to be preferentially eroded by acidic water throughflow.

Exposure and visibility are related, and are the sum of factors which together allow deposits to be discovered. Exposure involves ground surface visibility, eg. through erosion, and depends upon accidents of erosion, although the likelihood of erosion is in fact systematically controlled, eg. according to sediment type or the location of disturbances such as rabbit warrens or tracks. Visibility involves factors such as plant cover and background, eg. in the study area silicified sediments are often a light brown or buff colour similar to dry Eucalypt leaves. Survey in areas of leaf litter is very chancy. Similarly drift sand can obscure older deposits.

Above all, general geomorphic factors such as whether a landform is catching sediment, neutral or eroding will determine whether cultural deposits are likely to be preserved and ultimately encountered. This is modified by factors such as vegetation density. Because there is no equivalence between accidental ground surface erosion and the boundaries of past human activity, the concept of the archaeological "site" in spatial analysis of behaviour must be used circumspectly. In many circumstances the "archaeological exposure" may be a more useful concept.

Sample validity is therefore dependent upon many levels of coincident circumstances which may be overlooked in an ideal survey design. In practice a range of factors impinges upon site survey, they may be difficult to control for, and bring into question the achievability of valid field sampling. Factors which can seriously alter the internal consistency of results include how recently rain has fallen, whether authorities have decided to gravel parts of tracks and leave other sections bare, or whether land-owners allow access. The intensity of glare and the incident angle of the sun on the day can affect the discovery of low density artefact scatters. Visual acuity of field-workers appears to be poor on the first day of work, and after long periods in vehicles.

The degree to which information on low density cultural deposits can be quantitatively analysed is therefore limited. Honest qualitative assessment is likely to be less potentially misleading than meaningless quantitative results. Furthermore, because of systematic
variation in preservation of traces, and the likelihood that many traces will never be preserved, archaeological data cannot be taken to represent the whole range of activities undertaken over any defined area.

As the study area is well-watered with abundant grass or forest cover the possibility of archaeological discovery is limited to areas of invasive erosion or disturbance. It is virtually impossible to achieve a valid coverage of the archaeology of certain landforms due to the limitations of exposure. Systematically high erosion is demonstrated along the ocean facing foredunes where survey encountered numerous similar *Donax* middens. Such modern practices as going to the beach are leading to erosion of foredunes and disproportionate exposure of *Donax* middens. Their imminent obliteration will mean that in the event of future similar surveys this class of site will be, for similar reasons, underrepresented.

9.2. Outline of cultural and environmental history.

9.2.1. 12,000-6,800 BP

Post-glacial warming appears to have led to close to modern climatic conditions after 12,000 BP. Marine transgression followed climatic amelioration, with approximately modern sea-levels being attained 6,800 BP. That is, there is a time lag between the two phenomena in the order of 5,000 years. There is in fact little archaeological evidence of what occurred during this phase throughout Southeast Australia, and none identified for the study area. There is however evidence of occupation in the adjacent piedmont zone at Clogg’s Cave, and on the Bassian Plain on what is now Hunter Island during the terminal Pleistocene.

It is probable however that the Bassian Plain was able to produce a greater standing crop during the post-glacial period of warmer and moister conditions between 12,000 and 7,000 BP. There is insufficient evidence to suggest details of the ecology of this tract, but it can be assumed that the carrying capacity for a number of consumer species, including man, increased during the initial period. However, given both the structure of vegetation on the Bassian Plain and the evidence for the developments of a specialised hunting economy on the tundra of Southwest Tasmania it is possible that the extensive steppe could have allowed the development of a specialised, and necessarily mobile, large game hunter society.

There is a temptation to imagine that if population had a capacity to expand with
improving conditions on the Bassian Plain, rising sea-levels could lead to resource stress and displacement of population as the Plain disappeared. It could then be suggested that this should be archaeologically demonstrated on the uninundated edges of the Plain eg. the study area. This retreat of population has not been archaeologically demonstrated to have occurred on the older deposits of the study area. However, as we can expect water to have been a significant factor in site location evidence for population retreat might be expected to be found beneath the Holocene sediments of the Lakes and rivers.

An expectation of large-scale population displacement is more melodramatic than it is necessary. Unlike other species whose populations will be regulated by objective feed-back human population regulation can occur via subjective information. It is not necessary that populations suffer trauma, if it is valid to project ethnographic ways of sensing and reacting to stress back in time. Women may feel resource stress indirectly as unacceptable difficulty in carrying and caring for children. Beyond a culturally defined level of tolerance women can chose such options as abortion or infanticide (eg. see Hayden 1972, Cowlishaw 1981). There is no necessity to invoke human lemmings and refugees when the possibility exists that women could sense stress and regulate their fertility by exercising cultural options.

Shore-line reworking of sediments, and redistribution off-shore of reactivated sediments is likely to have led to this being a period of disequilibrium in sediment erosion and deposition, and therefore instability along the shore-line. Coastal occupation during this period, as with the previous glacial, is not likely to be archaeologically represented because of reworking of traces under advancing shore-lines. Because of shore-line instability and the immaturity of the shore-line succession before rising water levels it is probable that the coastal zone was an unstable habitat which might favour opportunistic rather than long-term strategies.

9.2.2. 6,800-3,000 BP

Shore-line stability was achieved around 6,800 BP, with the fore-runner of the modern Ninety Mile Beach barrier already in place. Shore-line erosion was replaced by a nett on-shore sediment movement, barrier accretion and local shore-line progradation. A second mode of barrier growth is lateral elongation driven by ocean swells and SW winds. A reverse drift driven by waves and wind from the E-SE may have operated to the East. The Ninety Mile Beach barrier precursor, and finally the Ninety Mile Beach barrier, established sheltered marine waters in the Lake Reeve precursor while river discharge ensured that the main Lakes maintained a seasonally migrating salinity cline. The main lakes with their large catchments can be expected to have been more estuarine in character, and therefore
more prone to salinity fluctuations than Lake Reeve from which much evidence of hydrological history has been drawn.

Sediment delivery and internal circulation led to in-filling of the Lakes and river valleys, and initiation of deltaic deposits. At the heads of the lagoon or lower river reaches lower salinity vegetation such as Phragmites grasslands enhanced shore-line progradation. Further downstream higher salinity demanded more salt-tolerant vegetation, notably cosmopolitan saltmarsh taxa (eg. see Bridgewater et al nd).

By 4,500 BP the Lakes were being isolated from exchange with oceanic waters. This isolation was not absolute for the remaining 4,500 years, nor it would appear, permanent. Isolation is expressed as decreasing salinity, diminished tidal exchange, and increased susceptibility to flooding.

Another influence coming into play during the mid-Holocene is ambiguous, and can be presented as evidence of local relative higher sea-level, or climatic amelioration, or both. Some palynological records indicate wide-spread improvement in precipitation/warmth conditions during this time. The amplitude of these oscillations is not as easily determined as the fact of their supposed effects, and qualitative descriptions of effects are all that is possible. Their effects if any on human niches are not demonstrated.

Sea-level rise and fall can raise and lower the floating fresh water table and mimic increased effective precipitation. A subsequent relative fall can mimic decreased water availability. Outlet constriction can mimic either climatic amelioration or relatively higher sea levels by impairing discharge and maintaining relative high average lake levels. This can be complicated by increasing flood frequency. Prior to the establishment of the artificial outlet flooding was an regular event and the lakes are said to have been held on average 50cm higher than at present (Bird 1978). Water table fluctuations and mixing of lenses will induce salt stress and mimic aridity. Evidence for relative sea-level change has come from two locations, Jack Smith Lake and Lake Reeve. Mid-Holocene higher relative sea-levels are more likely the result of hydro-isostasy after inundation of the wide shelf than eustatic.

Tidal connection at Jack Smith Lake appears to have been maintained longer than in the main Lakes, although constriction of the area of inter-tidal habitat, possibly through emergence, is apparent at 4,500 BP when tidal exchange in the main Lakes appears to have begun to be constricted.
Archaeological deposits of the period 3-4,000 BP occur only at Jack Smith Lake and belong to a single class of generalised occupation site. Resources represented include fish and shell-fish from the tidal lagoons as well as birds and terrestrial mammals. Abundant stone material includes highly reduced cores, backed blades, a range of small generalised flake products and a burin technology. Assemblages are dominated by exotic silicified sediments which demonstrate a pattern of transport from quarry sources in which cores are significantly reduced prior to entering the coastal zone. This ends with the final discard of a relatively large number of highly reduced core discards for a relatively few flakes. These are relatively small and even in size compared to later deposits.

While the deposits adjacent to Jack Smith Lake (and possibly a single exposure on Sperm Whale Head) contain a proportion of estuarine shell and some fish bone, the presence of other material including terrestrial bone and generalised stone artefacts indicates that marine exploitation was only one aspect of behaviour on these sites. The structure of the midden deposits is of a relatively few isolated discrete heaps compared to the extensive lenses typical of the later Donax deposits with their relatively sparse stone component. Earlier sites can therefore be interpreted as significantly terrestrial rather than marine oriented. This is compatible with the evidence of cores spending a greater part of their lives being reduced elsewhere.

There is no case to link the beginning of lagoon constriction or emergence to the appearance of shell-fishing. A weak link to climate might be made if Anadara trapesia were at the edge of its climatic tolerance in the study area. If climate were warmer in the mid-holocene Anadara might have been a more abundant and more viable resource.

The sudden appearance of exploitation of the lagoon system simultaneously with the appearance of backed blade technology in Southeast Australian assemblages suggests the possibility of them being related. This also coincides with a wide-spread expansion of human habitat through Southeast Australia, eg. the Alpine zone (Flood 1980) or the Victorian Mallee (eg. Ross 1981, 1985). This coincidence is made more remarkable when it is noted that over much of the eastern Australian coast the dates of early coastal occupation follow the appearance of microlithic technologies (eg. see dates in Beaton 1985). Microlithic industries do not move over landscapes, but the idea of them does. It is suggested here that what we are seeing is a geographic expansion of information. This includes technology, expansion of the subsistence base, occupation of new territory and subsequently ecological change.

A conventional explanation for such behaviour is resource stress caused by population
growth (eg. see Beaton 1985). An alternative explanation is that the apparent expansion of population in the mid-Holocene could be a result of ecological changes generated from within the human socio-cultural system. Such a hypothetical ecological change might result from the exploitation of new niches, for example a greater emphasis on the hunting of larger herbivores, or exploitation of coastal waters. Alternatively the innovation may be the achievement of a capacity to expand niche space. This can involve both behavioral, and technological changes. Evidence of such change can include proliferation of specialised equipment, (eg. backed blades) and differing settlement patterns. Holding population steady, a change in targets for exploitation means a changed human trophic level, and necessitates altered settlement patterns and mobility strategies. For example, if the microlithic period of Southeast Australia represented an increased efficiency in hunting, and subsequently a greater commitment to the hunting of major herbivores, the position of man might change from a generalist consumer to one of a limited number of top consumers in the trophic pyramid. This might have considerable implications for human distribution, territory and mobility strategies, and ultimately archaeological representation, without any change in population numbers.

Adoption and utilisation of common information has been wide-spread through the Holocene. Similarities in Aboriginal technologies, particularly in fishing equipment, (eg. see Lawrence 1969) along the Southeast coast suggest that in the Holocene basic information packages were adopted over a wide area. Multiple coincidental episodes of inventiveness leading to a similar range of outcomes, across a range of environments, is difficult to maintain.

Why this reorganisation should occur so widely and when it did, and include the study area is not clearly apparent. It is difficult to argue that single cultural solutions happened to resolve all the "adaptive problems" of large tracts of the coast simultaneously. Any such attempted explanation raises some puzzles; how essentially similar technological/behavioural packages can happen to be repeatedly and independently produced as response to the different conditions along the coast, and how the innovations can come to appear at approximately the same time.

The relatively sudden expansion of occupation, coinciding with other changes through Southeastern Australia, does not support the hypothesis that local phenomena are explicable in terms of adaptation to environment. Were this adequate one would expect to be able to explain perceived cultural phenomena in terms of the environments in which they are found, rather than as generalised phenomena applicable to a wide range of environments.
Further one would expect to be able to trace a progression from an earlier state to a later state over a period of time appropriate to the evolutionary process. One would also like to be able to see the pool of behavioural variants from which successful variants have been selected over time. Convincing evidence might indicate for instance sorties into shell-bed exploitation in the period prior to the arrival of backed blades, just to indicate that behavioural variance had been selected to survive in the local cultural repertoire. Failure to identify these signs suggests a local evolutionary process has not occurred.

9.2.3. 3,000 BP-1,800 AD

The period 3,000 BP to 1840 AD saw continuing restriction of tidal exchange and decreased salinity. Response must include expansion of less salt tolerant vegetation, such as Phragmites grassland and Melaleuca scrub. Dense salt-intolerant shore-line vegetation can be expected to enhance shore-line progradation and isolate extensive areas of river valley flood plains and shorelines from salinity. The result, as suggested by the history of Lake Curlip on the lower Brodribb River (Ladd 1978) is establishment of useful aquatic plants, eg. Triglochin in deeper water, and Typha in the Phragmites zone over previously saline areas. Shoreline progradation and valley alluviation established extensive freshwater and brackish wetland feeding and/or breeding habitats for a range of significant bird and fish taxa.

The Lake Curlip record is interrupted, apparently by burning (Ladd op cit), so that Phragmites grassland community (and its significant member Typha sp.) was advantaged over the Melaleuca scrub which would be expected to replace it. Although Ladd does not explicitly attribute this directly to Aborigines, Head’s palynological studies (1983) in Western Victoria, indicate Aborigines fired Typha beds there as part of resource management. It is valid therefore to entertain the possibility that this was a wide-spread Aboriginal strategy.

As suggested by Lampert and Hughes (1974), another factor in the general late expansion into coastal areas is the development of rock platforms on hard rock coasts. As these features are obviously related to modern sea-level they are a habitat whose area, and therefore value has been increasing through the Holocene. Increased rocky shoreline resources may have stimulated coastal economies elsewhere, this can be of relevance to the study area in that information on resource exploitation might be adapted to local conditions, for example line fishing may have aided exploitation of both estuary and rocky ocean shore. It is also argued here that expansion of wetlands over time made the coastal zone increasingly favourable for human occupation. During this period there was an increasing
stimulus to exploit coastal and near coastal resources, and to master or refine the techniques
of coastal exploitation according to local conditions, and to integrate this knowledge into
the totality of socio-cultural organisation. The implied processes are anything but
Darwinian in nature.

While sedimentation and increased environmental complexity can characterise processes
within the Lakes this period saw a major geomorphic process in the deposition of the last
suite of beach and near-shore deposits (Thom 1984), as elongate sand bodies now
separating the lakes from the sea adjacent to Cunninghame Arm and Bunga Arm. This
Thom attributes to a period of possibly increased storminess in the last 1-2 millennia.

If a period of relatively higher sea-level had occurred in the mid-Holocene, the later
Holocene must have been a period of falling sea-levels. An expected effect is a degree of
beach progradation and addition of further barrier deposits as off-shore topography is
re-established. The possibility cannot be ignored that the sand bodies off Cunninghame
Arm and Bunga Arm follow re-establishment of equilibrium profile after emergence, rather
than storminess. A lowering of lake levels can be expected to lead to emergence of
prograded shorelines and possibly isolation of further low-lying land from saline water.

The detailed hydrological history of the system is not clear, it is impossible to say whether
exchange remained constant, maintaining similar mean conditions, or if the outlets were
prone to significant variation, and if so what intervals of time are involved. While
exploitation of the tidal lagoon persisted at Jack Smith Lake until 3000 BP there is little
positive evidence of exploitation of the Lakes or coast until about the last millennium, with
the exception of a single, suspect, date on a back-barrier Donax midden. This is the earliest
evidence of exploitation of Donax in the region where repeated dates on middens suggest
that Donax exploitation is typical of the last millennium.

 Deposits containing Donax are located from 1-2 km. inland to the fore-dune, and have
been dated from locations across this range. This indicates that the recent date of
exploitation is not a result of erosion of earlier deposits from unstable environments (eg.
fore-dune) biasing the sample, and that the presence of Donax in a deposit can be used in
relative dating. The late appearance of extensive Donax exploitation is not explicable in
terms of habitat availability, sandy beach habitat has been present through the Holocene.
Nor is it explicable as resource replacement after the termination of tidal flow, there is too
long a hiatus in deposition.

Molluscs, and many other types of "sea-food" may be perceived as of limited value in a
subsistence diet due to low calorific value, high transport costs, and mediocre return rate (Osborn 1977, Perlman 1980, Yesner 1980). It would be expected on these criteria that in a mechanistic evolutionary framework, shell-fishing as an inefficient use of time and energy, would be selected against. However as Meehan (1982) observes there are objective positive off-sets against the apparent maladaptiveness of littoral exploitation. This is likely to be significant for women whose diet can be dominated by low protein gathered foods, and whose labour is called upon by numbers of other consumers. Meehan also notes that in her study group people gather shell-fish because they happen to enjoy them. Thus Osborn’s (op. cit.) deduction that coastal gathering is exploitation of sub-optimal resources under population-resource stress is inadequate. When observed in a functioning society composed not of producer-consumer units, but of people of varying ages, capacities to produce, and with sexually defined diets, the practice demonstrates a high level of rationality. Despite the short-comings of mollusca they are not a resource to be utilised only in extremis.

Activity increased in the last millennium with huge areas of Donax waste being deposited from the ocean facing dunes to a couple of kilometres inland. Sites range from deposits equivalent to Meehan’s (op. cit.) “dinner time camps”, through small sites with a limited range of other materials to major sites where shell is a fraction of the archaeological assemblage. Roles played range from being dominant components of day-time meal breaks to limited contributions to the economy of central camps whose contents indicate broader technological and economic activity. The stone assemblages associated with these deposits differ from those of the earlier period. The most obvious difference is a greater use of locally abundant gravels, particularly quartz, which becomes the major raw material encountered in deposits. Siliceous stone continues to be used for formal implements including backed blades, and siliceous cores are still highly reduced, but associated debitage shows a wider range of flake sizes, and the ratio of debitage to cores is higher suggesting that they have spent a greater part of their lives in coastal locations than previously.

While quartz and other stone types are easily procured from regional gravel deposits silicified rock was probably obtained at more cost from quarry sources in the hinterland. The difficulties of analysis of quartz use modification preclude an assessment of whether quartz was substituted for exotic stone, or if it was included for new purposes. Given the generalised nature of Southeastern Australian stone assemblages, and the relatively amorphous forms of quartz artefacts this question will not be answerable morphologically. It is possible however to postulate that siliceous stone became more difficult to acquire and local material was substituted.
Coastal hunter-gatherers are conventionally seen as relatively sedentary (e.g. see Poiner 1974;201, Perlman 1980:292-3, Yesner 1980:730). This view is contradicted by ethnographic descriptions of the Aborigines of the study area who are described as relatively mobile during coastal residence, and relatively sedentary during winter (Bulmer in Smythe 1878:142). Site survey complements this view. A pattern of sedentism implies the formation of substantial central occupation deposits with a restricted range of minor or satellite locations. An alternative is a broader based hierarchy of deposits with fewer less utilised central locations and a wide range of smaller more ephemeral deposits. Site survey located a hierarchy of deposits ranging from a few central localities to minor deposits indicating single function (e.g. fore-dune middens) and intermediate locations where a restricted range of activities appears to have been carried-out. Such a pattern can be compared to other estuarine locations (e.g. Mallacoota Inlet, Coutts et al 1984) where even allowing for the obtrusive bulk of mounded middens there is a trend toward organisation around very substantial central sites.

Outlet constriction led to an increased tendency to flood. Effects of flooding followed by breaching of outlets are inundation of large areas and rapid shifts in isoahalines. A capacity to cope with such environmental flux is an attribute of estuarine taxa, and can be expected to occur in any successful human exploitation strategies. Residential mobility makes sense in light of the large size of the Lakes system. The large catchment and impeded drainage mean that heavy rainfall events, flooding and sudden discharge following outlet breaching can be expected to lead to possibly rapid migrations of isoahalines over distances of many kilometres. In a smaller estuarine system with a limited catchment and unimpeded drainage (as may typify many East Coast drowned valleys) these effects may be unimportant as a substantial proportion of the estuary may fall within a convenient radius of any location and be accessible by water-craft. In contrast if Gippsland Lakes Aboriginal fishermen intended to pursue particular resources, eg. Bream gathering over salinity-defined spawning habitats, it may be necessary to pursue shifting isoahalines many kilometres from any central location. In such cases mobility and site hierarchy may be more efficient. In this case, relatively decentralised residential patterns demonstrate adjustment to prevailing conditions.

Howitt's (1904) reconstructed population distribution suggests perennial coastal/lakeside occupation by some clans. The simple topography of the northern shore of the estuary, like much of the east coast of Australia, permits a simple juxtaposition of habitats from uplands to the coast. It is feasible for groups to be located so that each has a comparable range of habitats accessible along a transect striking inland. This is not the case in the study area
where the potential annual ranges of the clans differ, sometimes markedly. It is necessary therefore that in order to satisfactorily use available resources different groups must evolve differing patterns of habitation, seasonal movement or group aggregation.

A capacity to exploit differing environments implies knowledge of technology, technique and organisation. The evidence of the historic period suggests that coastal technology incorporated a suite of items common to the southeast corner of the continent. This is most economically explained as the result of the spread of information rather than an evolutionary process of separate local development. Important information flows are demonstrated by the distribution of tied bark canoes and fish hooks. Because of their frail construction we are unlikely to ever be able to date directly the introduction of the tied bark canoe in the study area, although the use of water-craft of some sort must be as old as the human occupation of Australia. Archaeological deposits on Glennie Island off the west coast of Wilson’s Promontory have been dated back as far as 1850±120 BP (ANU 3832), although more certain dating suggests transient occupation commenced around 1480±120 BP (ANU 2429), becoming more intense over the last millennium (Head et al 1983:99-112). This timing is coincident with wide-spread increased use of coastal resources.

It is immaterial whether the midden builders were gallant sailors or castaways, beside the fact that they were able to keep afloat over a number of kilometres of open water. Historic Aborigines were able to fish off the Southern NSW coast in tied-bark canoes similar to the Gippsland model (see Chapter Six), so it is reasonable to suggest that the historic craft can be used as a model for the Glennie craft. Glennie dates suggest 1,500-1,900 BP for the the bark canoe. The earliest indications of shell fish hooks on the Southeastern Australian coast date to <1,100 BP (Sullivan 1987:98). Although the ethnographic Gippsland hook was made of bone it was of the same form as the shell hook and presumably a local variant dictated by material and of a similar pedigree (Massola 1956).

On the available evidence it is apparent that spreads of information on coastal exploitation occurred within the last 1-2 milleniums. It is possible however that nets were in use during the earlier occupation at Jack Smith Lake, manufacture of nets in Australia may date to the late Pleistocene (White and O’Connell 1982:36). The appearance of burins in the earlier deposits indicates bone cutting, and bone pronged spears too may have been part of a prior kit.

A greater human presence, indicated by the proliferation of evidence of coastal occupation during this period, can be expected to have effects favouring “fire weeds” and
opportunistic plant taxa. This is likely to include the proliferation of *Solanum* in association with habitation and refuse locations, and *Phragmites-Typha* communities in fresh water wetlands. There is reason to believe that the population during the latter period of prehistory was high, up to 5,000 people.

9.3. Post-1,800 AD

This is the period from which our picture of Aboriginal life in Australia, and by extension models of life throughout the late Pleistocene-Holocene, are derived. It is also a period of profound impacts on the cultural forms developed in previously autonomous times. The possibility must be considered that what we think we know of the Aboriginal population is derived from descriptions of people losing autonomy, with limitations on how they could interact with their environments, suffering exotic disease and depopulation, with potentially increased conflict between indigenous ethnic groups, a decline in morale and generally operating under stress. It must be considered that historical Aboriginal behaviour was to an unknown extent atypical of the past.

This phase commences with the arrival of the sealing industry by the early 1800’s. Among the first possible changes is depopulation from the introduction of exotic diseases. The effects of early contacts with local or adjacent populations are potentially profound. Disruption continued with introduction of sheep and cattle, alienation of land, disease, murder and other contact effects. Autonomous Aboriginal populations persisted only in peripheral areas: wetlands, the lake shores and ranges. Whether out of revenge or necessity cattle were taken in large numbers, and as a result the determination of the British to do away with the Aborigines increased.

A complement of cattle raids is the appearance of beef preservation through smoking (and presumably drying). A capacity to prevent the decay of flesh was however present in pre-1840’s Aboriginal culture, demonstrated by the practice of keeping the smoked and preserved hands of loved ones, *bret*, suspended on a string around the neck of the bereaved (McMillan in Bride 1983, Howitt 1904, Warman in Cuthill nd). To the west the preservation of small mammals by drying was undertaken in order to put down rations for use while travelling (Thomas nd). On the Coorong in South Australia, Harvey (1943:109) reports the existence of an indigenous tradition of fish smoking and preservation. It seems likely with this weight of evidence that the techniques of meat preservation practised by the fugitive Aborigines of the wetlands were traditional, but adapted to new circumstances. It is not necessary to invoke imitation of European practices, although the possibility of imitation (cultural diffusion) should not be discounted.
Meat preservation raises two important points about environmental adjustment. The first is to emphasise the potential significance of the social environment in imposing stimulus to "adaptive" response. The second is that whether preservation of flesh for subsistence purposes was practiced prior to 1800, or was an innovation, beef curing by the fugitive population demonstrates conscious, Lamarckian or induced cultural change. This is distinct from the the random, unconscious Darwinian evolution demanded in the original model of cultural change.

In the northeast of the study area Aborigines followed a seasonal cycle of coastal occupation in the spring-summer, and hinterland occupation in autumn-winter (Bulmer in Smyth 1878) superficially similar to that proposed for the southeast coast of New South Wales (Poiner 1974, Lawrence 1969). The availability of fish to spear and line fishers seems to be the chief factor in the abandonment of the coastal zone in the cooler months. This pattern appears to be linked to considerable summer sedentism and winter mobility. On the evidence of Bulmer (in Smyth 1878) Gippsland population were more mobile in summer than in winter. This is explained here as a response to the size of the Lakes, migration of isohalines and therefore fish aggregations, over considerable distances. The most appropriate response is that practised by modern fishermen of, in effect, following isohalines.

The human population distribution suggested by Howitt for groups adjacent to or within the study area indicates that the standard model of winter/inland, summer/coastal transhumance may not be possible for many groups if territorial integrity is assumed. Simply, some groups may be be blocked by intermediate populations, and restricted to a relatively small range of environments. In the Northeast there are populations which could have practised the simple pattern. It is almost certain that Bulmer's seasonal information came from these groups. Proceeding southwest to the vicinity of the Lake Wellington Depression there are populations so placed as to be able to use the plains, river valleys and lake shores but not the ranges or foothills. There are other groups so placed as to have easy access to higher levels of the river valleys, plains and higher country, but not the wetlands. One group (Darigo, and presumably there had been others) appears to have been restricted to the ranges and inter-montane valleys. Further to the Southwest groups had access to high energy ocean beaches, a coastal plain and the Strzelecki Ranges. In this case summer fisheries on the coast may not have been possible except in the vicinity of the sheltered waters of Corner Inlet. Perhaps the most specialised populations are those of the essentially undifferentiated barrier deposits and islands within the lakes who had little scope for seasonal movements and are likely to have been dependent on aquatic resources throughout the year.
Historic accounts of population distribution indicate that the location of the major ethnic group, its component "tribes", clans, and ultimately residential family-based groups are delineated to a considerable extent by landscape features dictated in the final instance by the underlying structural geology of the region.

9.4. Correlation of Prehistory and environmental change

From the preceding discussion it is clear that major shifts in the archaeological culture of the area show a poor correlation with the reconstructed environmental history. The only exception is the cessation of littoral gathering with the termination of tidal exchange and the extinction of the resource. This is in itself an unremarkable outcome given the lack of alternatives. The remarkable aspect is the apparent abandonment of the near coastal zone despite the range of other resource possibilities after the termination of tidal exchange. If it is believed that the cause of the initial move to exploitation of the littoral was pressure of population it would be assumed that the same pressure to use the resources of the non-tidal lakes would be maintained.

Environmental factors which might be expected to have archaeological expression are the putative mid-Holocene climatic optimum, constriction of tidal exchange and possible sea-level variation since 7,000 BP. Of these the first is not well demonstrated in regional pollen sequences. It might be argued that effects are not clearly apparent in vegetation the effect on higher level consumers may be difficult to pursue. The most apparent environmental shifts, notably in hydrology and possibly sea-level variation, are similarly difficult to relate to archaeological culture change apart from the apparent termination of littoral gathering. It is a matter of perspective whether this should be seen as culture adjustment or resource failure.

An interesting result is the lack of evidence of exploitation of the immediate coastal zone prior to 4,000 BP. To claim that this reflects the low value of littoral resources, particularly the apparently rich shell-beds established almost 3,000 years earlier, is to ignore the potential complexity of human social behaviour and organisation of labour. Ethnographic evidence shows littoral gathering can be a valuable component of economies, the value of littoral resources is proved by the fact that they did come to be integrated into a functioning system despite all their apparent short-comings. Arguments against the potential of inter-tidal gathering are weakened by the apparent abandonment of near coastal occupation with the end of tidal exchange. As mollusca are only one of many resources available in coastal water bodies, whether tidal or not, one wonders why their loss appeared to be so significant and why a modified coastal economy did not emerge.
The coincidence of initial adoption of littoral gathering and the appearance of microlithic technology also occurs in the adjacent region of New South Wales. This coincides with an Aboriginal expansion into previously unoccupied regions of southeastern Australia, and accelerated initial occupation of sites within regions with prior occupation (this is discussed by Lourandos 1983). The possibility must be considered that these phenomena are causally related. If microlithic technologies are evidence of more efficient hunting kit (and presumably practise) the question arises as to whether their use complements prior economies, or if there was a shift toward larger game, and with that a shift upward in the trophic pyramid. Such a shift implies a reduced carrying capacity, possibly greater mobility and initial occupation of sites, and possibly use of a greater range of habitats even if holding population constant. The effects of such a shift, as yet not widely debated in Australian studies, may mimic the effects of population growth with increased initial occupation of sites, pressure to exploit "inferior" resources, and expansion of range.

There appears to be little if any occupation following the termination of tidal conditions 4-3000 BP. This continues until the last millennium, or possibly earlier. During this period wide-spread changes continued, including an overall increase in coastal occupation, changes in artefact use and manufacture, and changes in target mollusc species. The coincidence of change throughout a wide region again leads to the conclusion that local phenomena cannot be perceived purely in local terms.

During this period the productivity of coastal and near coastal zones was increasing due to evolution of rocky shore platforms and sedimentation of lagoons, estuaries and coastal lakes. This increased both the area of habitat for human prey species, and habitat diversity. It was therefore increasingly worthwhile learning to more effectively exploit these areas. This occurred over much of the Southeastern Australian coast over the last 2,000 years with the spread of new coastal technology and increased archaeological deposition.

In the study area netting appears to have developed as the major fishing technique for both sexes. It is possible that nets had been in use in the study area previously, net fishing may go back to the earliest occupation of Australia (White and O'Connell 1982:36). The importance of netting in the study area is likely to owe much to the bathymetry of the Lakes, typified by large areas of shore-fringing shallows extending sometimes many hundreds of metres from the shores (Blackman and Hinwood 1983). These are rarely more than 1-2 m. deep and support abundant plant growth and a rich invertebrate fauna (Poore 1982), they are therefore prime resource areas for net fishing, particularly for schooling fish.
The most conspicuous development of the last period of Aboriginal occupation is intense exploitation of ocean beach *Donax deltoides*. There is nothing in the environmental history of the region to suggest a cause for this phenomenon. The open sandy beach habitat in which *Donax* is found has been available since the marine transgression. The coincidence with a period of wide-spread changes in the exploitation of littoral resources suggests that the cause is not to be found solely in the local interaction of cultural and natural factors. The significance of *Donax* exploitation may however be artificially inflated, a relatively modest deposit is visually obtrusive and current patterns of erosion ensure that *Donax* middens are being exposed at a greater rate than other classes of archaeological deposit.

The cultural changes witnessed in the study area can be viewed at a number of scales. In the widest scale it is possible to determine that major cultural changes are to be related to almost continental flows of information during the Holocene. It is possible to argue that these occur without reference to local conditions and cannot be regarded as "adaptive" to the particular environments in which they occur. At a closer scale developments can be seen to be significantly compatible with local environmental conditions. Thus although sharing much technology and organisation with other areas the local population had made a number of adjustments to prevailing conditions. This is demonstrable in mobility in coastal occupation, or the emphasis on netting in the extensive shallows of the Lakes.

It is not possible therefore to assume that observed phenomena can *a priori* can be explained in terms of the local environment.

### 9.4.1. Intensification and demographic change.

Late Holocene shifts in Aboriginal culture have most frequently been explained as a response to population growth through the Holocene (eg. Beaton 1983, and discussion in Lourandos 1984:31). Lourandos' fieldwork in Western Victoria lead him to perceive increasing social complexity during the Holocene, leading to the emergence of interlocked competing populations under the influence of competing dominant personalities. These changes in social structure lead to a process of "intensification", increased socio-economic complexity and population growth (Lourandos 1983, 1984). *Intensification* according to Lourandos is a process whereby a population increases its harvest through increased production or productivity, effort management, resource management or husbandry. The definition can allow niche expansion through expansion into new habitats (eg. see Ross 1981, 1985).

Population growth and intensification assume increased demand for resources which in
turn leads to ecological change, eg. through niche expansion, manipulation of resources to increase productivity, or shifts down in trophic levels. As has already been argued adoption of new information may bring about ecological change without initially changing the size of the population. It is not necessary therefore to turn to population growth or resource stress as a first line of explanation of apparent ecological change, or of changed demographic patterns. On the other hand adoption of new techniques may incur advantages allowing for population increase, that is as an effect rather than a cause, in time this might lead to stress. It must be remembered that stress is subject to cultural definition, while its management, eg. by regulating the number of children raised is similarly a function of culture. In culture studies objective levels of stress may be chimerical.

9.5. Inadequacy of Natural Selection as explanation in cultural process.

Selection is the defining concept in biological evolution, and an essential process in the establishment of ecological interaction in the short term, and a state of "adaptedness" in the longer term. Through a lack of specific definition, and association with evolutionary terminology, archaeological, anthropological or indeed geographic literature may imply natural selection is the process behind cultural change without actually saying so. Individual workers may specify natural selection as the ultimate process whereby nature forms culture (eg. Price 1982), or suggest that while short-term (ecological) adjustments may be achieved by conscious process it is a long-term process of resolution which leads to adaptation. The up-shot of both positions is to assign to natural selection a role of final, inexorable and inescapable selector of cultural variance. This evolutionary approach to human culture is widely favoured in contemporary literature and is discussed by Durham (1976), Price (1982), Dunnell (1980), Kirch (1980).

The first problem with the evolutionary model of cultural change is definition of the subject of selection, genes, cultural traits, genetically defined populations or culturally defined populations. If cultural change is the subject of interest, selection of individuals or populations who activate cultural variants is presumably the process by which variants are presumed to fail or persist. The problem with this is that there is no intrinsic connection between organism and specific cultural variants. A simple proposition that organisms with disadvantageous cultural traits are selected against and fail to reproduce themselves and their culture fails in that it assumes that cultural information, like genetic information is fixed to the individual so that selection of the behavioural phenotype is selection of the genotype. This disallows organisms changing or learning behaviour, or anticipating the outcomes of behaviours in specific contexts. However as learned information culture is
changeable. Thus while natural selection is not precluded the potential of on-going cultural selection to pre-empt natural selection is not bounded. In addition, because there is no equivalence between genotype and cultural information, and because cultural variants are potentially optional, natural selection of variance can only occur if disadvantageous behaviours are persisted with.

It can reasonably be expected that people have frequently anticipated natural selection outcomes and altered or suspended disadvantageous behaviour. It is yet to be demonstrated that any other species has an equivalent capacity to make reasoned (or unreasonable) decisions. Cultural change requires a capacity to generate or learn abstractions of perceived reality according to culturally informed paths. Other human attributes dependent upon abstraction and complicating the course of entirely mechanistic processes are conscious ideology, perception, volition, notions of propriety and purpose. Thus not only may natural selection be pre-empted, it may be so according to rules or prior conditions. An intellectual commitment to natural selection can imply a position that human interaction with the physical environment is unidirectional, i.e. that "Nature" selects against the variants displayed by a passive humanity. This reasoning is flawed for two reasons. The first is its denial of intelligence and sentience. Secondly the impacts of even low-technology societies on their environments may be significant. Human reaction to environment will be to a variable extent interaction with an artefact. The perceived dichotomy between active environment and passive, alien, humanity is perhaps an artefact of enculturation.

There is a problem in the definition of environment. This has often signified an organism’s natural or physical milieu, and is an inadequate definition for the human environment. Human society is unique in the degree of its complexity, this is demonstrated by culturally specific expressions of a number of characteristically human phenomena, exercise of power derived other than by physical prowess, exercise of power over others to ends other than ensuring future genetic representation, development of specialist social roles, separation of production from consumption, delayed reciprocation, the use of complex systems of symbolism in communication, motivation and social organisation, and expansion of the concept of kin to include classificatory as well as genetic relations.

The nature of social organisation imposes a number of potential problems with which members must cope, in their simplest terms these problems involve conformity, redistribution of resources away from producers, and power relations. At any time social structures and cultural forms may impose stresses and require accommodating action independently of variations in the physical environment. Membership of human society
itself creates personal and group stresses which are not only additional to natural stresses, but interplay with them to create new problems not encountered by other species. In other species a population-environment imbalance can be expressed in a simple arithmetic form

\[ \text{stress} = \text{resource/consumers} \]

for a given area of land. The complexity of human social, ideological, technological, symbolic, economic and redistributive systems makes such a simple expression impossible. An Ethiopian or Irish famine victim must adjust how he earns his living not only in terms of climate and blight, but with military and colonialist forces, church and state, and systems of faith and symbolism.

A fundamental requirement of neo-Darwinian evolution by natural selection is the random generation of variance. In this it differs from Lamarckian evolution in which environmental conditions induce the generation of variance, that is variants are made to order. This is essentially the process involved in conscious choice, invention, imitation or alteration of behaviour practiced by humans. If environment is fluid rather than stable induced responses to short-term variations may overshadow or disallow long-term adaptation. The process of Lamarckian induced evolution is at odds with Darwinian selective evolution, and its property, evolutionary adaptation. Hence we must consider replacement of adaptation with its explicit meaning and process with a more appropriate concept such as Childe's adjustment. Continued use of adaptation in relation to cultural process is only valid where natural selection of randomly generated variance is meant. In situations of induced evolution adjustment is a more honest and less pretentious term.


It has long been held that a good fit should exist between cultural behaviour in small scale societies, and environmental parameters (e.g. see Thomson 1939). This position follows from the proposition that continuity is dependant upon the satisfaction of physical needs, requiring that factors such as economy, demography and so on are compatible with physical realities. Having dismissed a simplistic selection process it is necessary to attempt to describe a more appropriate approach to human ecology.

It is desirable to reiterate Head's (1986:123-4) requirements of a theory integrating culture and physical environment: It should be historical and take account of long-term processes of change in real time. Variability is to be expected. Stability is not to be assumed in either natural or cultural systems where resolution of competing forces is a dynamic process. Change should be able to be generated within or without the system under study. Nor, should change be approached as stemming from a single class of cause within or
without, or irrelevant or intrusive to the field of study. Scale, either spatial or temporal is a
critical consideration. A single phenomenon, viewed at differing scales may be perceived as
different phenomena. Phenomena may be artefacts of scale.

The model of adaptation based on evolutionary theory fails in explanation not because of
false assumptions about man’s organic nature and the need to satisfy fundamental
requirements of matter and energy. Nor is the model wrong in asserting there are better and
worse ways about going about living. The major problem is that the model fails to
recognise man’s quantitatively, and possibly qualitatively unique nature. As human
behaviour is believed to be governed by learnt cultural information rather than specific
inherited genetic information we can pose further principles.

Although powerful, natural selection is not inevitable. Exercise of options, choice, or
judgement can pre-empt natural selection. There is no link between organic selection and
the transmission of cultural information. Selection of organisms, individually or in groups,
can only affect the transmission of genetic information but has no necessary link to the
transmission of learnt information. Unlike the genotype which identifies the individual and
is essentially immutable throughout life, the individual’s cultural package is liable to
change through addition, loss and modification of information throughout life.

Human society is unique in that altruism is extended to non-kin, or to classificatory kin
who bear little or no genetic relationship, ie. with whom ego is in potential competition.
Thus, cultural behaviour is neither necessarily transmitted to off-spring, nor is it necessarily
beneficial in biological terms to off-spring or other co-gene holders.

Unlike genetically informed behaviour, culturally informed behaviour is potentially
optional. It needs to be activated to be selected and need not be activated. Personal or group
volition is totally incompatible with the parent theory but is a critical element of cultural
selection. The complement of volition is judgement of alternatives, choices between
options and informed decision making. While other species may be able to make decisions
between imminent options humans appear to be unique in that decisions may be made in
anticipation of future conditions, and according to value structures.

Human social behaviour is markedly different from that of other social species in its
complexity and extent of dependence on learnt forms. Humanity is also almost certainly
distinguished by the possession of value, ethical and aesthetic systems involved in the
process of decision making. While it may be argued that there are innate drives to behave in
particular ways, eg. altruistically toward co-generic lineage members, there is no evidence
to suggest that the particular forms taken are genetically programmed.
Human social systems are unique in the development of relationships of power not immediately based on reproductive competition or other objective biological demands. Humans appear to be unique in bestowing value on non-subsistence or non-utilitarian objects, symbols or ideas. The concepts of ownership of objects, materials, territory, resources, the bodies and the labour of others, or of propriety appear to be uniquely human. This extends to systematic separation of consumers and consumption from producers and production, alienation of producers (and their kinred) from the results of their labour, and sanction of these behaviours by systems of symbolism and ideology.

Socio-cultural precedents are built into the generation and selection of variance. As a consequence socio-cultural forms are reproduced in the process of selection of variance. In contrast natural selection involves random generation of variance, and selection according to objective criteria. Human socio-cultural systems are unique in that through the process of selection they can become self-replicating independently of the genetic identity of the holders, that is they have identity, and a capacity to reproduce and acquire continuity independent of the identity of their human constituents.

There is no necessity that membership of specific human socio-cultural systems benefits all individual members in terms of matter and energy requirements, reproductive success etc. Socio-cultural systems do not exist or evolve according to the principle of bestowing the greatest benefit and satisfaction to individuals and kin groups. In contrast the existence of social behaviour among other species can be confidently expected to be attributable to the fitness enhancement it bestows to genetic lineages.
Appendix A

Site recording format

The information recorded for each site is:

1. Site name/identification

2. Transect/survey area in which the site was located

3. Site type. This code identifies elements making up a deposit. Thus it is possible for a site to be identified as simultaneously classed as Sc, MD The code is:

Sc Scatter of artefacts

A Isolated Artefact (here defined as no more than three artefacts, located no closer than 5m from each other. Where the number of artefacts exceeds three, or they are found closer than 5m the location is recorded as Sc

T Scarred tree. A large old (usually) Eucalypt with evidence of having a sheet of bark deliberately removed by man (at this point race is not important). The criteria used to define a scarred tree are: the scar has a flat or curved upper margin, it commences clear of any branch, knot, or split and runs down without encountering any similar scar in the underlying wood, ideally the scar terminates above the ground, with a straight or slightly curving lower margin, ideally the scar will be close to symmetrical, if the scar dates from the historic period there may be marks of a steel axe around the edges, particularly on the wood below the upper margin of the scar. Rarely do marks from stone axes survive, there must be considerable thickening of tissue around the whole margin of the scar, and distortion of the trunk of the tree indicating that the scar is old, there must be no indication of any pathology which might lead to bark loss, nor of limbs being lost, lightning strike etc..

MD Midden containing shell from the sandy shore bivalve Donax deltoides.

ME Midden containing shell from estuarine mollusca.

MR Midden containing shell from rocky shore mollusca.
Ot Other, any other type of site, description required.

4 Map Identification of 1:100000 topographic sheet on which the site is located, by name and number.

5 Grid References Six figure grid refs. of centre of site.

6 Owner, administering authority Those responsible for the land upon which the site is located.

7 Recorder Names of persons involved in recording the site. Field work was not always conducted alone.

8 Date Of site record.

9 Condition 1- substantially undisturbed, material largely in situ 2- moderately disturbed, some material in situ 3- not intact, no material in situ

10 Exposure Identify agent(s) Wind, water, traffic, road cutting, development, animal tracks or burrows.

11 Ground cover Percentage estimate of ground cover (leaf, grass etc.) affecting ground surface visibility

12 Site situation A Landform eg. barrier foredune, levee etc B Topographic location eg. crest, swale, mid-slope

13 Vegetation A Structure B Dominant Taxa

14 Surface Water Type eg. lagoon, river, Distance in hundred metre units

15 Stone Artefacts Estimate of numbers 10's, 100's, 1000's.

16 Stone raw materials Rank, 1, 2, 3,...6 Qtz Quartz;Sil Siliceous rock, "Silcrete";Rhy Rhyolite;Vol Volcanic other than Rhyolite;Qte Quartzite;Oth Other stone

17 Cortex present Weathering or pebble surfaces present on stone.

18 Sample Collected Record 1 or 0

19 Area of Sample Number of square metres sampled.

20 Formal Implements Types present. Sym Symmetric (geometric) microliths Ass
Assymetric (eg bondi, woakwine) microliths Burin Thu "Thumbnail" Ret Retouched flakes

21 Bone Artefacts Long Longitudinal Cuts Tran Transverse Cuts

Poi Pointed end. Spa Spatulate end. Hoo Hook

22 Bone Artefacts, Sample Collected Record 1 or 0

23 Shell Taxa Present Rank Order 1, 2, 3,...n Anadara Brachidontes Donax Ostrea Subninella Mytilus Cellana Donacilla Dicathais other sheltered marine Other rocky shore

24 Other Fauna Rank Order 1, 2, 3,...n Bird Fish Egg Shell Reptile Human Mammal Unidentified vertebrate

25 Photographic Record B&W Roll Number, Colour Slide Roll Number

26 Artefact Analysis Sheets Done Record 1 or 0

27 Research Potential Notes.

28 Communications re. Site Record of letters, phone calls etc..

Radiocarbon Samples Notes on samples collected etc.

30 Aboriginal interest or concern Notes.

31 Additional notes

32 Scarred Trees Additional notes, Measurements Species Scar Dimensions:

Length Width Thickness of "Callous": Wood wood and Bark

Curvature: Longitudinal Transverse Height of base cm. Sketch 33, 34 Site Plan and Site Location Sketch, including scale, North and environmental information
Appendix B

SITES LOCATED DURING SURVEY

RBlu1 MeMr 8522 935083 2 \( \text{WlWaTrl Du Ms Ls Cs} \) St 1 1 QQ 0 OsMyRp
LBun1 Sc 8522 918083 3 \( \text{Wa 2 Lf Fl WlCs EuSt} \) St 1 2 QS 0 0
Ltty1 Me 8522 951113 1 \( \text{Cu 0 Lf Fl Wl Eu} \) La 1 1 0 0 Os
Ltty2 Sc 8522 989139 3 \( \text{TTrWa 1 Bl Cr Wl Eu} \) La 1 1 0 0 0
CCon Mr 8622 520135 2 \( \text{CuTrWl Du Ms Ls Cs} \) 3 3 0 0 0
Yxer1 Mr 8622 561158 3 \( \text{TtrWi 0 Du Cr Ls Cs} \) St 2 2 0 0 RP
CaEv Sc 8622 003152 3 \( \text{Wii 0 Dc Cr Wl Eu} \) ? 2 QQ 0 0
LW1 Sc 8321 368845 2 \( \text{Wii 1 Du Cr Wl BeAu} \) La 1 1 0 0 0
LW2 A 8321 367835 1 \( \text{Tr 1 Du Cr Wl BeAu} \) La 1 0 0 0 0
LW3 A 8321 368836 1 \( \text{Tr 1 Du Cr Wl BeAu} \) La 1 0 0 0 0
LW4 A 8321 368837 1 \( \text{Tr 1 Du Cr Wl BeAu} \) La 1 0 0 0 0
LW5 Sc 8321 369842 2 \( \text{Tr 1 Du Cr Wl BeAu} \) La 1 1 0 0 0
LW6 Sc 8321 367888 2 \( \text{Cu 1 Du Cr Wl BeAu} \) La 1 2 QQ 0 0 DoOt
V1laq Sc 8321 298886 2 \( \text{Wii 2 Du Cr Wl BeAu} \) La 1 2 QQ 0 0 DoOt
WaB1 Sc 8422 557969 3 \( \text{Tr 1 Sh Fl Wl BeAu} \) La 1 1 0 0 0
WaB2 Sc 8422 557678 3 \( \text{Tr 1 Te Ba Wl BeAu} \) La 1 1 0 0 0
Tabl Sc 8422 728064 3 \( \text{Tr 1 Te Cr Wl Eu} \) La 1 1 0 0 0
NoAr Sc 8422 861806 3 \( \text{Tr 2 Te Ms Wl Eu} \) St 3 1 0 0 0
V1O Sc 8422 565158 4 \( \text{Qu 1 Du Cr Wl Eu} \) St 3 2 QQ 0 0 Ma
V117 Sc 8422 563154 4 \( \text{Tr 1 Te Cr Wl Eu} \) St 2 2 QQ 0 0 0
V106 Sc 8422 637045 3 \( \text{WaWi 2 Sh Fl Hf Sm} \) La 2 2 0 0 0
V108 Sc 8422 612027 3 \( \text{Tr 2 Te Cr Wl Eu} \) La 1 2 QQ 0 0 0
V109 Sc 8422 744063 3 \( \text{WaTr 1 Te Cr Wl Eu} \) St 1 1 0 0 0
OS1 Me 8220 703222 3 \( \text{Tr 2 Bl Cr Wl BeAu} \) La 1 1 0 0 0 Do
OS2 Me 8220 714205 3 \( \text{Tr 0 Bl Cs Le} \) Es 1 0 0 0 0 Do
MclB1 Sc 8220 917260 3 \( \text{Tr 0 Du Ms Cs} \) Le La 3 0 0 0 0 DoEs
MclB2 Md 8220 918259 3 \( \text{Tr 0 Du Cr Wl BeAu} \) Es 2 0 0 0 0 Do
RB1 MdMm 8220 938283 3 \( \text{TTrWl 1 Du Ba Wl Ba} \) We 2 0 0 0 0 DoOsEs
RB2 MdMm 8220 939284 3 \( \text{TTrWl 1 Du Ba Wl Ba} \) We 2 0 0 0 0 DoS
RB3 MdMm 8220 942283 3 \( \text{TTrWl 1 Du Ba Wl Ba} \) We 2 0 0 0 0 Do
RB4 Md 8220 944289 3 \( \text{TTrWl 1 Du Ba Wl Ba} \) We 2 0 0 0 0 Do
RB5 Md 8220 946291 2-3 \( \text{TTrWl 1 Du Ba Wl Ba} \) We 2 0 0 0 0 Do
RB6 Md 8220 948293 3 \( \text{TTrWl 1 Du Ba Wl Ba} \) We 2 0 0 0 0 Do
RB7 Md 8220 949294 3 \( \text{TTrWl 1 Du Ba Wl Ba} \) We 2 0 0 0 0 Do
RB8 Md 8220 951296 3 \( \text{TTrWl 1 Du Ba Wl Ba} \) We 2 0 0 0 0 Do
RB9 Md 8220 952297 3 \( \text{TTrWl 1 Du Ba Wl Ba} \) We 2 0 0 0 0 Do
RB10 Md 8220 955300 3 \( \text{TTrWl 1 Du Ba Wl Ba} \) We 2 0 0 0 0 Do
RB11 Md 8220 956301 3 \( \text{TTrWl 1 Du Ba Wl Ba} \) We 2 0 0 0 0 Do
MarB1 Sc 8220 970316 3 \( \text{TTrWl 1 Du Cr Cs Le} \) We 2 3 8 MaBu 0
WooB1 MdMm 8220 974223 2 \( \text{TTrWl 1 Du Cr Cs Le} \) We 2 0 0 0 0 DoMy
WooB2 MdMm 8220 977326 3 \( \text{TTrWl 1 Du Cr Cs Le} \) We 2 0 0 0 0 DoMy
JSLs1 MeKd 8221 065401 2 \( \text{Wii 0 Du Cr Wl BeAu} \) Li 1 3 QS 0 0 MaBu DoOs
Sc
JSLs2 MsSc 8221 035401 3 \( \text{Wii 0 Du Cr Wl BeAu} \) Li 1 3 QS 0 0 Do
JSLs3 MeMd 8221 034400 3 \( \text{Wii 0 Du Cr Wl BeAu} \) Li 1 3 QS 0 0 Ma
JSLs4 MeMd 8221 054416 2 \( \text{Wii 0 Du Cr Wl BeAu} \) Li 1 3 QS 0 0 DoAn
Sc
JSLs5 MsSc 8221 035401 2 \( \text{Wii 0 Du Cr Wl BeAu} \) Li 1 3 QS 0 0 MaBu Do
JSLs6 MsSc 8221 040407 2 \( \text{Wii 0 Du Cr Wl BeAu} \) Li 1 2 QS 0 0 Ma
JSLs7 MeKd 8221 054412 2 \( \text{Wii 0 Du Cr Wl BeAu} \) Li 1 1 QS 0 0 DoOs
Sc
JSLs8 MsSc 8221 032409 2 \( \text{Wii 0 Du Cr Wl BeAu} \) Li 1 1 QS 0 0 Do
JSLs9 MeKd 8221 054412 2 \( \text{Wii 0 Du Cr Wl BeAu} \) Li 1 1 QS 0 0 DoOs
JSLs10 MsSc 8221 061422 3 \( \text{Wii 0 Du Cr Wl BeAu} \) Li 1 1 QS 0 0 Do
JSLs11 MeKd 8221 061419 2-3 \( \text{Wii 0 Du Cr Wl BeAu} \) Li 1 1 QS 0 0 DoAn
Sc
JSLs12 MeKd 8221 060418 3 \( \text{Wii 0 Du Cr Wl BeAu} \) Li 1 1 QS 0 0 DoAn
JSLs13 MsSc 8221 059418 3 \( \text{Wii 0 Du Cr Wl BeAu} \) Li 1 1 QS 0 0 Do
| RI7 | A | 8422 649470 | Tr | 0 | Du Cr Wl BaEu | La 2 | . Q | 0 | 0 |
| RI8 | A | 8422 646969 | Tr | 1 | Du Cr WlCs BaMe | La 2 | . Q | 0 | 0 |
| RI9 | Sc | 8422 624955 3 | Tr | 1 | Du Cr Wl BaEu | La 2 | 1 Q | 0 | 0 |
| RI10 | A | 8422 634955 | Tr | 0 | Du Cr Wl BaEu | La 2 | . Q | 0 | 0 |
| RI11 | MdSc | 8422 636955 3 | Tr | 1 | Du Ms WlCs BaMe | La 2 | 1 Q | 0 | 0 |
| RI12 | MdSc | 8422 637955 3 | Tr | 1 | Du Ms WlCs BaMe | La 2 | 1 Q | 0 | 0 |
| RI13 | A | 8422 639956 | Tr | 1 | Du Ms WlCs BaMe | La 2 | . Q | Bi | 0 |
| RI14 | A | 8422 640958 | Tr | 1 | Du Ms Sc Me | La 2 | . Q | 0 | 0 |
| RI15 | MdSc | 8422 643960 3 | Tr | 1 | Du Ms WlCs EuMe | La 1 | 1 Q | 0 | 0 |
| RI16 | A | 8422 646962 | Tr | 1 | Du Ms Wl BaEu | La 1 | . Q | 0 | 0 |
| RI17 | A | 8422 647962 | Tr | 1 | Du Ms Wl BaEu | La 1 | . Q | 0 | 0 |
| RI18 | A | 8422 648963 3 | Tr | 1 | Du Ms WlCs BaMe | La 1 | 2 Q | 0 | 0 |
| RI19 | MdSc | 8422 649963 3 | Tr | 1 | Du Ms WlCs BaMe | La 2 | 1 Q | 0 | 0 |
| RI20 | A | 8422 650963 | Tr | 1 | Du Ms WlCs BaMe | La 2 | . Q | 0 | 0 |
| RI21 | A | 8422 651964 | Tr | 1 | Du Ms WlCs BaMe | La 2 | . Q | 0 | 0 |
| RI22 | MdSc | 8422 653964 3 | Tr | 1 | Du Ms Wl BaEu | La 2 | 1 Q | 0 | 0 |
| RI23 | A | 8422 654966 | Tr | 1 | Du Ms Wl BaEu | La 2 | . Q | 0 | 0 |
| RI24 | MdsSc | 8422 658968 | Tr | 1 | Du Ms Wl BaEu | La 2 | 2 Q | 0 | 0 |
| RI25 | Md | 8422 671978 3 | Wi | 0 | Du Ms Ls Cs | La 3 | 0 | 0 | 0 |
| RI26 | Md | 8422 671977 3 | Wi | 0 | Du Ms Ls Cs | La 3 | 0 | 0 | 0 |
| RI27 | Md | 8422 669974 3 | Wi | 0 | Du Ms Ls Cs | La 3 | 0 | 0 | 0 |
| RI28 | Md | 8422 667973 3 | Wi | 0 | Du Ms Ls Cs | La 3 | 0 | 0 | 0 |
| RI29 | MdSc | 8422 665971 3 | Wi | 0 | Du Ms Ls Cs | La 3 | 1 Q | 0 | 0 |
| RI30 | MdSc | 8422 663969 | Wi | 0 | Du Ms Ls Cs | La 3 | 1 Q | 0 | 0 |
| RI31 | MdSc | 8422 661969 3 | Wi | 0 | Du Ms Ls Cs | La 3 | 1 Q | 0 | 0 |
| RI32 | MdSc | 8422 660968 | Wi | 0 | Du Ms Ls Cs | La 3 | 1 Q | 0 | 0 |
| RI33 | Md | 8422 657966 3 | Wi | 0 | Du Ms Ls Cs | La 3 | 0 | 0 | 0 |
| RI34 | MdSc | 8422 656965 3 | Wi | 0 | Du Ms Ls Cs | La 3 | 0 | 0 | 0 |
| RI35 | Md | 8422 653963 3 | Wi | 0 | Du Ms Ls Cs | La 3 | 0 | 0 | 0 |
| RI36 | Md | 8422 649960 3 | Wi | 0 | Du Ms Ls Cs | La 3 | 0 | 0 | 0 |
| RI37 | Md | 8422 646959 3 | Wi | 0 | Du Ms Ls Cs | La 3 | 0 | 0 | 0 |
| RI38 | Md | 8422 645958 3 | Wi | 0 | Du Ms Ls Cs | La 3 | 0 | 0 | 0 |
| RI39 | Md | 8422 643957 3 | Wi | 0 | Du Ms Ls Cs | La 3 | 0 | 0 | 0 |
| RI40 | Md | 8422 642955 3 | Wi | 0 | Du Ms Ls Cs | La 3 | 0 | 0 | 0 |
| RI41 | Md | 8422 639954 3 | Wi | 0 | Du Ms Ls Cs | La 3 | 0 | 0 | 0 |
| RI42 | Md | 8422 637952 3 | Wi | 0 | Du Ms Ls Cs | La 3 | 0 | 0 | 0 |
| RI43 | Md | 8422 634950 3 | Wi | 0 | Du Ms Ls Cs | La 3 | 0 | 0 | 0 |
| RI44 | MdSc | 8422 615940 2-3 | Wi | 1 | Du Cr Wl BaEu | La 2 | 3 QSO Ma | 0 | 0 |
| RI45 | Md | 8422 627948 3 | Tr | 1 | Du Cr Cs Me | La 2 | 0 | 0 | 0 |
| RI46 | Md | 8422 630950 3 | Tr | 1 | Du Cr Cs Me | La 2 | 0 | 0 | 0 |
| RI47 | MdSc | 8422 633952 3 | Tr | 1 | Du Cr Cs Me | La 2 | 1 Q | 0 | 0 |
| JUHea | Sc | 8422 674986 3 | Wa | 0 | Sh Fl HF Sm | La 1 | 2 QSO | 0 | 0 |
| BPPI | Sc | 8422 713010 2 | Tr | 0 | Du Ms Wl BaEu | La 2 | 1 Q | 0 | 0 |
| BPP2 | Sc | 8422 716011 2 | Tr | 0 | Du Ms Wl BaEu | La 2 | 1 Q | 0 | 0 |
| BPP3 | Sc | 8422 718013 2 | Tr | 0 | Du Ms Wl BaEu | La 2 | 1 Q | 0 | 0 |
| BPP4 | Sc | 8422 710008 2 | Tr | 0 | Du Ms Wl BaEu | La 2 | 1 Q | 0 | 0 |

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

KEY

Column 1 Site Name

Column 2 Site Type A isolated artefact, Sc Artefact Scatter, Md Midden of Donax shell, Me Midden of estuarine shell, Mr midden of rocky shore shell

Column 3 Map sheet (1:10000 topo)

Column 4 Grid refs.
| Column 5 | Site condition 1- largely intact, 2- fair, 3- largely destroyed |
| Column 6 | Exposure Tr- track, An- animal, Wa- water, Wi- wind, Cu- cutting, Qu- quarry |
| Column 7 | Cover 0: no cover, 2: 0-50% cover, 3: 50-100% cover |
| Column 8 | Location/Landform Du- dune, Te- Terrace [spur or plateau], Bl- bluff [or cliff], Sh- shore, Lf- Lake flat [prograded shoreline, alluvial flat] |
| Column 9 | Location/Topographical Cr- crest, Ms- mid-slope, Ba- base of slope, Fl- flats |
| Column 10 | Vegetation/Structure Wi- woodland, Cs- closed scrub, Hf- herbfield, La- low shrubland |
| Column 11 | Vegetation/Dominants Ba- Banksia, Eu- Eucalypt., Me- Melaleuca, Le- Leptospermum, Sm- Saltmarsh taxa, Cs- coastal succession, Ot- other |
| Column 12 | Water La- Lake/lagoon perennial, Li- lagoon intermittent, St- stream, We- wetland |
| Column 13 | Water/distance 1: 0-100 m., 2: 100-500 m., 3: >500m. |
| Column 14 | Artefacts/estimated numbers. 1: 10’s, 2: 100’s, 3: 1000’s |
| Column 15 | Artefacts/raw materials rank order. Q: quartz, S: siliceous rock, V: volcanic, O: other |
| Column 16 | Artefacts/formal types. Ma: assymetric microlith, Ms: symmetric microlith, Th: "thumbnail", Bu: burin, Ax: hatchet, Bi: bipolar piece |
| Column 17 | Mollusca Do: Donax, An: Anadara, Os: Ostrea, My: Mytilus, Ot: other [uncertain habitat], Rp: rocky shore taxa, Es. other estuarine taxa |
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