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THE PREHISTORIC GEOGRAPHY OF NORTHWEST TASMANIA

by

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This work is a thesis submitted
for the degree of
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Except where otherwise stated in the acknowledgements and in the text, this thesis is based entirely on my own fieldwork and research.

Jim Stockton

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ABSTRACT

This study explores the potential of a systematic survey approach to archaeology, emphasising the integration of archaeological and biophysical data. The primary focus of the study is the northwest coast of Tasmania, an island lying between the latitudes of 40 S and 44 S.

The historical development of surveys as a means of collecting archaeological data is reviewed in Chapter 1. Problems of sampling in archaeological surveys are considered, and general principles^{are} outlined in Chapter 4. Criteria for selecting an appropriate sampling scheme were discussed.

A range of coast types were sampled by a disproportional stratified sampling scheme. Data collected on middens and other archaeological materials in these quadrats is used to examine the relationship between sites and their biophysical settings in Chapters 5 to 7.

A number of relationships between coast type and the number and volume of middens were found. On areas with steep shore profiles no middens were found. The greatest number and largest volume of middens were found on coasts which contained a mixture of rocky headlands and short sandy beaches. On long sandy beaches, the volume of midden was found to decline with distance from the rocky coast, with only small amounts being transported for several kilometres. In contrast to this, on the mixed coast, midden materials were only transported several hundred metres inland. In combination these data are used to describe a linear foraging zone which has implication for foraging models such as site catchment analysis. A model of the landscape association of an ideal location is developed from these survey data. Extrapolation of midden volume per length of coastline is then used to estimate the prehistoric population. This result is compared with ethnographic evidence and an estimate based on the number of hut sites. Middens and artefact sites are found to differ in their landscape associations, and it is proposed that these differences are a function of their being related to different activities.

The antiquity of a number of middens on the northwest coast is established. From these and other data, a pattern of late exploitation of the west coast is proposed, beginning about 4,000 years ago. As it is now known that people were present in the west coast hinterland during the last ice age, new problems concerning this apparently late arrival of Aborigines on the west are proposed. Evidence for an increase in the number of shell middens in use over the last 1,000 years is used to argue for an increasing population.

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CONTENTS

CHAPTER 1 TOWARDS A PREHISTORIC GEOGRAPHY OF
 NORTHWEST TASMANIA

- 1.1 INTRODUCTION
- 1.2 OBJECTIVES
- 1.3 REVIEW OF SURVEY METHODS
 - 1.3.1 Targeted reconnaissance
 - 1.3.2 British "field archaeology"
 - 1.3.3 North American survey approaches
 - 1.3.4 Australian surveys
- 1.4 SURVEY TECHNIQUES
 - 1.4.1 Area survey
 - 1.4.2 Sampling
 - 1.4.3 Environmental variables
 - 1.4.4 Physical, biological and cultural variables
- 1.5 THE LANDSCAPE PERSPECTIVE WITHIN AUSTRALIAN
 PREHISTORY
 - 1.5.1 Introduction
 - 1.5.2 The changing emphasis
 - 1.5.3 Public Archaeology
- 1.6 ARCHAEOLOGY IN TASMANIA
 - 1.6.1 Archaeology and maps

CHAPTER 2 THE BIOPHYSICAL SETTING

- 2.1 INTRODUCTION
- 2.2 PHYSICAL COMPONENTS
 - 2.2.1 Introduction
 - 2.2.2 Geology
 - 2.2.3 Land units
 - 2.2.4 Coast types
 - 2.2.5 Climate
- 2.3 NON-MAMMALIAN MARINE FAUNA
 - 2.3.1 Introduction
 - 2.3.2 Fish
 - 2.3.3 Rock Lobster
 - 2.3.4 Shellfish
- 2.4 SEALS
 - 2.4.1 Introduction

- 2.4.2 Synopsis of relevant biological data
- 2.5 HISTORIC VEGETATION CHANGE IN NORTHWEST TASMANIA
 - 2.5.1 Introduction
 - 2.5.2 Background
 - 2.5.3 Vegetation communities and landforms
 - 2.5.4 Vegetation change and the stability of sandsheet landforms
 - 2.5.5 Aboriginal and European firing patterns
 - 2.5.6 Seasonality of burning
 - 2.5.7 Summary of the vegetation changes
- 2.6 CONCLUSION

CHAPTER 3 TYPES OF ARCHAEOLOGICAL SITES

- 3.1 INTRODUCTION
- 3.2 PREHISTORIC SITES
 - 3.2.1 Overview
 - 3.2.2 Definition of terms
- 3.3 A MIDDEN MODEL
 - 3.3.1 Purpose
 - 3.3.2 Inputs
 - 3.3.3 Outputs
 - 3.3.4 Review of the modelling exercise

CHAPTER 4 SAMPLING METHODOLOGY IN SURVEYS

- 4.1 PURPOSE
- 4.2 SAMPLING METHODOLOGY
- 4.3 SURVEY METHODS
 - 4.3.1 Stratification of the study area by coast type
 - 4.3.2 Quadrat size
- 4.4 DESCRIPTION OF THE SAMPLING SITES
 - 4.4.1 Introduction
 - 4.4.2 Sampling sites
- 4.5 DATA RECORDING
 - 4.5.1 Purpose
 - 4.5.2 Quadrat data
 - 4.5.3 Site data recording method
- 4.6 METHODS OF ANALYSIS
 - 4.6.1 Multidimensional scaling of shellfish content of

quadrats

4.6.2 Profile comparisons of shellfish content of quadrats

4.7 PROBLEMS AND LIMITATIONS OF THE DATA

4.7.1 The data set

4.7.2 Disturbance

4.7.3 Limitations of surface observations

4.7.4 Problems of measuring deflated midden volumes

4.7.5 High tides and storms

4.7.6 Area to volume relationship

4.7.7 Bedrock types and deflation of middens

4.8 CONCLUSION

CHAPTER 5 THE NATURE AND DISTRIBUTION OF WEST COAST SHELL MIDDENS

5.1 METHODOLOGICAL CONSIDERATIONS

5.1.1 Graphical and statistical approach to volume descriptions

5.1.2 Midden field descriptions and volume

5.1.3 Interaction of bedrock type, rock platform and coast type with midden volume

5.2 LANDSCAPE PARAMETERS

5.2.1 Potential fresh water distance

5.2.2 Potential fresh water source

5.2.3 Landform

5.2.4 Slope

5.2.5 Shelter of middens from wind

5.2.6 Orientation of middens

5.2.7 Substrate and matrix

5.2.8 Vegetation on and adjacent to middens

5.2.9 North versus west facing coast

5.2.10 Transport of shellfish along the sandy beaches of the coast

5.2.11 Location of middens in relation to rock platforms

5.2.12 Rock shelters and caves

5.2.13 Hut depressions

5.3 DISCUSSION

5.3.1 The ideal west coast location

- 5.3.2 Seals as a locational factor
- 5.3.3 Site 118 - the "West Point midden"
- 5.4 CONCLUSIONS

CHAPTER 6 REGIONAL DIFFERENCES IN TASMANIAN ARCHAEOLOGICAL SITES

- 6.1 INTRODUCTION
- 6.2 WESTERN BASS STRAIT
- 6.3 MACQUARIE HARBOUR
 - 6.3.1 Survey methods and results
 - 6.3.2 Discussion
- 6.4 THE HUNTER GROUP
 - 6.4.1 Hunter Island
 - 6.4.2 Three Hummock Island
 - 6.4.3 Islands
- 6.5 THE SOUTHWEST
- 6.6 EASTERN BASS STRAIT
- 6.7 DERWENT ESTUARY
- 6.8 CONCLUSION

CHAPTER 7 WEST POINT AND THE ANTIQUITY OF SHELL MIDDENS OF WESTERN TASMANIA

- 7.1 INTRODUCTION
- 7.2 WEST POINT
 - 7.2.1 Background
 - 7.2.2 Ethnographic information
 - 7.2.3 Archaeological sites
 - 7.2.4 Shellfish
 - 7.2.5 Midden volume in relation to the distance
- 7.3 COMPARISON OF MIDDEN AND ARTEFACT SITES
 - 7.3.1 Introduction
 - 7.3.2 Distance to fresh water
 - 7.3.3 Distance to rock platform
 - 7.3.4 Height above sea level
 - 7.3.5 Slope
 - 7.3.6 Substrate
 - 7.3.7 Landform
 - 7.3.8 Shelter and view

- 7.3.9 Vegetation
- 7.4 ANTIQUITY
 - 7.4.1 The problem
 - 7.4.2 Results
 - 7.4.3 Hut depressions
 - 7.4.4 Seals
 - 7.4.5 Stone artefacts
- 7.5 REGIONAL DIFFERENCES IN STONE ARTEFACT MATERIALS
 - 7.5.1 Method
 - 7.5.2 Rock types and sources
 - 7.5.3 Distributions of artefact materials
- 7.6 INLAND SITES
 - 7.6.1 Introduction
 - 7.6.2 Results
- 7.7 CONCLUSIONS

CHAPTER 8 CONCLUSION

- 8.1 INTRODUCTION
- 8.2 A MODEL OF BASE CAMP LOCATION
 - 8.2.1 Base camps
 - 8.2.2 Reliable resources
 - 8.2.3 Risky resources
 - 8.2.4 Regional locational models
- 8.3 POPULATION
 - 8.3.1 Introduction
 - 8.3.2 Population by the number of households
 - 8.3.3 Population from volume of rubbish
- 8.4 POPULATION CHANGES OVER TIME
- 8.5 RETROSPECT
- 8.6 SURVEYS AND CULTURAL RESOURCE MANAGEMENT

BIBLIOGRAPHY

- APPENDIX 1 MAPS USED IN THIS STUDY
- APPENDIX 2 MAPS, VEGETATION TRANSECTS AND INFORMATION SUMMARIES
- APPENDIX 3 STONE WALL FISH TRAPS
- APPENDIX 4 SUMMARY OF CODES USED ON SITE DATA CODING SHEETS.
- APPENDIX 5 HISTORIC AND MODERN VEGETATION PATTERNS
- APPENDIX 6 FIELD EQUIPMENT
- APPENDIX 7 EXAMPLE OF SITE DATA FILE
- APPENDIX 8 LOCATIONS OF MIDDENS CONTAINING SEAL BONES IN NORTHWEST TASMANIA
- APPENDIX 9 RADIOCARBON DATES FOR ARCHAEOLOGICAL SITES IN TASMANIA

Two published papers which derive from this project are enclosed in the back pocket.

LIST OF FIGURES WITH SHORT TITLE

	Following Page	
1.1	Levels of resolution in this study	11
1.2	Components of the prehistoric geography of the west coast of Tasmania	12
2.1	Northwest Tasmania coast types	40
2.2	Southwest Tasmania coast types	40
2.3	Northeast Tasmania coast types	40
2.4	Wind direction of Cape Sorell, 1957-1971	43
2.5	Historic locations of <u>Mirounga leonina</u> colonies	52
2.6	Modern observations of fur seals	53
2.7	Historic locations of <u>Arctocephalus</u> spp. colonies	54
2.8	Place names referred to in Section 2.5	56
2.9	Map of the north-west quarter of Van Diemen's Land to accompany the Third Annual Report of the VDL Co.	57
2.10	The coastal strip of Figure 2.9 redrawn on a modern base map	60
3.1	Site 59, a typical example of a "medium midden dump"	70
3.2	An example of a large midden with a number of hut depressions	70
3.3	Flow of materials into and out of a shell midden	73
4.1	Location of sampling quadrats in northwest Tasmania	87
4.2	Location of sampling quadrats	88
4.3	Data coding sheet	92
4.4	Data coding sheet	92
4.5	Comparison of contents of deflated and undeflated middens	104
4.6	Crosstabulation of surface area to volume of middens on the west coast	106
4.7	Regression of volume on area for middens larger than 0.01m ³ on the west coast	106
5.1	Volume profiles for middens	113
5.2	Midden volume distributions for platform types	115
5.3	Graphs of cumulative frequency of distance from midden to fresh water and to rock platform	116
5.4	Crosstabulation of landform and midden volume	119

5.5	Midden volume frequency profiles by landform	120
5.6	Frequency of midden aspect and shelter	122
5.7	Comparison of north and west facing quadrats	126
5.8	Location of quadrats on Sandy Cape Beach	128
5.9	Midden volume to distance from rock platform on Sandy Cape Beach	128
5.10	Average volume of midden per hut depression	130
5.11	Distribution of middens with hut depressions	131
5.12	A Distribution of seal remains B Distribution of <u>Arctocephalus</u> spp. remains	
5.13	A Distribution of <u>Mirounga</u> remains B Distribution of <u>Hydruga</u> remains	135
5.14	Seal remains in northwest Tasmania	135
6.1	Boundaries of the eight regions	140
6.2	Diameter ranges of <u>Subninja undulata</u> operculae	143
6.3	Macquarie Harbour	144
6.4	Cumulative frequencies of distance from middens to rock platforms	145
6.5	Volume of midden per quadrat	150
6.6	Midden volume profiles	150
7.1	Midden volume against distance to rock platform (scattergram)	170
7.2	Midden volume against distance to rock platform (graph)	171
7.3	Height above sea level for middens and artefact sites	175
7.4	Shelter for middens and artefact sites	177
7.5	Direction faced by middens and artefact sites	177
7.6	Midden volumes and C14 dates	181
7.7	Venables Corner excavation section	182
7.8	Dates of seal remains	185
7.9	Sources of raw materials for stone artefacts	189
7.10	Spongolite and Black Chert distribution	189
7.11	Quartzite and Quartz distribution	189
7.12	Mount Owen transect	194
7.13	Site 157, artefact scatter at East Queen River	194
8.1	Schematic model of shell midden distribution	210
8.2	Near basal ages of shell middens	216

- A2.1 Key to the quadrat and transect maps
- A2.2 Key to species in vegetation transects
- A2.3 Alert Creek quadrat
- A2.4 Arthur River Bridge quadrat
- A2.5 Australia Point quadrat
- A2.6 Bakers Beach quadrat
- A2.7 Bluff Hill Point quadrat
- A2.8 Burgess Cove quadrat
- A2.9 Burgess Point quadrat
- A2.10 Cannonball Bay quadrat
- A2.11 Chimney Corner east quadrat
- A2.12 Chimney Corner west quadrat
- A2.13 Cuvier Bay east quadrat
- A2.14 Cuvier Bay west quadrat
- A2.15 Cuvier Point north quadrat
- A2.16 Cuvier Point south quadrat
- A2.17 Daisy River quadrat
- A2.18 Dead Horse Point quadrat
- A2.19 Doctors Creek quadrat
- A2.20 East Queen River 1 quadrat
- A2.21 East Queen River 2 quadrat
- A2.23 Gardiner Point quadrat
- A2.24 Gibsons Point quadrat
- A2.25 Granite Creek north quadrat
- A2.26 Granite Creek south quadrat
- A2.27 Greenes Creek quadrat
- A2.28 Griffiths Point quadrat
- A2.29 Henty Dunes quadrat
- A2.30 Mount Cameron West quadrat
- A2.31 Nelson Bay quadrat
- A2.32 North Point quadrat
- A2.33 Ocean Beach quadrat
- A2.34 Ordnance Point quadrat
- A2.35 Porter Bay quadrat
- A2.36 Ranger Point quadrat
- A2.37 Sandy Cape Beach quadrat
- A2.38 Rocky Cape quadrat
- A2.39 Shepherds Bay east quadrat
- A2.40 Shepherds Bay west quadrat

A2.41	Suicide Bay quadrat	
A2.42	Sundown Point quadrat	
A2.43	Swan Basin quadrat	
A2.44	Thornton River quadrat	
A2.45	Trial Harbour quadrat	
A2.46	Valley Bay quadrat	
A2.47	Waterhouse Point quadrat	
A2.48	West Point middens - northern part	
A2.49	West Point middens - central part	
A2.50	West Point middens - southern part	
A2.51	West Point artefact sites - northern part	
A2.52	West Point artefact sites - central part	
A2.53	West Point artefact sites - southern part	
A2.54	Wild Wave River quadrat	
A2.55	Balfour track transect	
A2.56	Hill 49 transect	
A3.1	Fish trap locations	A3-2
A3.2	Plan of a fish trap	A3-3
A6.1	The probe auger	A6-2

LIST OF TABLES WITH SHORT TITLE

	Following Page	
1.1	Ships logs and journals of visitors	13
1.2	Diaries and journals of settlers	13
2.1	Lengths of coast types in several regions	40
2.2	Shallow sea water temperatures at West Point	44
2.3	Most common species for remnant grassland area of West Point	62
2.4	Robinson's observations of bush fires and recently burnt areas.	65
4.1	Rock and coast type for quadrats on the west coast	87
4.2	Frequencies of site types on the west coast	100
4.3	Comparison of contents recorded from surface observation and excavated samples	102
4.4	Proportion of deflated middens for seven volume classes	105
4.5	Rates of erosion for three bedrock types	107
5.1	Rock type, platform structure, coast type and midden volume	115
5.2	Cross/ tabulation of substrate and matrix	124
5.3	Vegetation setting frequencies	125
5.4	Dominant vegetation types on middens	126
6.1	Rock and coast types for quadrats in areas other than the west coast	140
6.2	Percentage frequency of middens on landform types	145
7.1	Vegetation types on middens and artefact sites	178
7.2	C14 dates for middens on the northern part of the west coast	181
8.1	Factors affecting the location of base camps	203

LIST OF PLATES WITH SHORT TITLE

	Following Page
2.1 Bluff Point land system at Mount Cameron West	35
2.2 Granite Creek land system and plunging granite coast	36
2.3 Rebecca Lagoon	59
2.4 Stable and unstable dune landscapes	61
3.1 A doughnut midden	70
5.1 Middens on pebble banks	118
5.2 West Point heath	118
7.1 Air photograph of West Point	164
7.2 A typical small midden dump	167
7.3 The hills of Queenstown	194
A3.1 A fish trap	A3-2

CHAPTER 1 TOWARDS A PREHISTORIC GEOGRAPHY OF NORTHWEST TASMANIA

1.1 INTRODUCTION

Over the past decade there has been a change in the intellectual orientation of prehistoric studies in which the emphasis has shifted from the diachronic study of Aboriginal cultural evidence, through stratified deposits in cave sites, to a concern with the description of the prehistoric landscape. This thesis is concerned with the study of the people who lived in northwest Tasmania. It will be shown that there has been an increasing concern with the prehistoric landscape in recent Tasmanian studies, but none of these has systematically explored the possibilities a regional approach. In this study it is argued that it is first necessary to try to describe the prehistoric landscape before the cultural landscape can be understood.

Many of my conclusions about the prehistory of Tasmania differ from conclusions which have been drawn by earlier projects. My conclusions are drawn from systematically collected primary data on sites and their landscape associations. Those of the earlier projects were based primarily on excavation or unsystematic reconnaissance survey data. I firmly believe that, without systematic information on the nature of the biological and physical setting of sites, the study of archaeology will simply generate speculative and theoretical papers. Although most of the variables I have discussed are in a sense inanimate or natural things such as land forms, climate, sea state and vegetation patterns, they describe the stage on which people lived. In the final analysis, it is those people - the Aborigines of Tasmania - who are the focus of this study.

1.2 OBJECTIVES

The study is concerned with the major components of sites, such as shellfish, stone artefact materials or sediments, and with broad scale patterns in the use of the landscape by people in northwest Tasmania.

The basic questions I am investigating are:

1. Where are the detectable archaeological sites of the Tasmanian Aborigines located?
2. Was the location of archaeological sites determined by environmental factors?
3. Are there any observable changes in the pattern of land use over time?
4. Are there regional differences in the pattern of archaeological sites?
5. What cultural conclusions can be drawn from these patterns and changes?

Butzer (1972:4) proposes a similar approach under the title of a 'prehistoric geography', embracing the broad spectrum of studies dealing with man, with the environment, and with man-land interaction. Sauer describes the same integration of themes in his "Foreward to Historical Geography" (Sauer 1973:351-379). This landscape approach has implications for field techniques, analysis, and interpretation.

As Chang (1967:128-130) has pointed out, an archaeological theory is nothing more than a systematic set of concepts under which we believe our archaeological facts can be consistently dealt with and explained. Therefore "a piece of archaeological work in the field is an intellectual exercise from beginning to end, and the archaeological remains and their contexts are recorded in the process" (ibid). In this way our theoretical framework conditions the type of fieldwork we do. It is impossible to review the vast number of regional and survey projects which are being published world-wide, so I have chosen a few examples to show the range of approaches being used.

1.3 REVIEW OF SURVEY METHODS

1.3.1 Targeted reconnaissance

In a review of surveys in archaeological research, Ammerman (1981:63) notes that it is worth recalling that the main function of early surveys, as well as of some more recent ones, was to locate an appropriate site for excavation. "The survey served as a preliminary lightweight bout which preceded and complemented the main attraction" (ibid).

This could be more correctly termed a "targeted reconnaissance" than a survey. The questions of the landscape associations of sites are discussed in only the most general terms, and sampling methodology is considered to be irrelevant. The search is not for typical sites, but for excavatable sites with good preservation qualities. MacNeish (1978:67) asserted that

"The ultimate goal is to find sites that will give a stratified chronology of artifact complexes, as well as enough archaeological contextual information, so that the cultural systems of each time level can be constructed. The better the survey, the easier will be the excavation and field research."

MacNeish's notion of the ideal reconnaissance involves trying to find more sites on the basis of information which you already have. It would seem that, if an archaeologist has preconceptions about site distribution patterns, this approach will simply serve to confirm them.

In tracing the development of early surveys, Ammerman (1981:65) notes the increasing attention paid to formulating research questions in regional terms rather than site terms. With the increasing sophistication of survey studies they have begun to include questions such as population density, patterns of land use and agricultural potential, and the extent of urbanism in a region.

Ammerman reviewed examples of the successful use of the survey approach by a number of archaeologists in three different areas: the southwest of the USA, the Valley of Mexico and the Euphrates floodplain in Mesopotamia. It is worth noting some of the features of these areas, because they are all very different

from a coastal mid latitude landscape occupied by hunters such as the Tasmanians. All three are relatively warm and dry. Pottery is found in quantity on the surface of sites and provides a marker artefact for dating sites. The economies are predominantly agricultural and occupation is usually in sedentary settlements which often have a coherent and compact form. None of these attributes applies^{to} Tasmania, so it has been necessary to develop tactics to search for and record the relics of a highly mobile coastal hunting culture which left literally hundreds of thousands of sites dotted all over the landscape during a period in excess of 23,000 years.

1.3.2 British "field archaeology"

There is a long standing British tradition of landscape archaeology, stemming in part from the early antiquarian studies. It has generally gone by the term "field archaeology", and has been seen as emphasising the outdoor study of prehistoric relics without excavation, as opposed to 'dirt' or excavation, museum or laboratory approaches. A handful of examples will serve to demonstrate the types of studies which have resulted from "field archaeology" and some recent trends.

The Ordnance Survey office employed O.G.S. Crawford in 1920, promoting a combined interest in monuments and maps, which has remained one of the key techniques in field archaeology (Ashbee 1972:62). Crawford was also early in exploiting and systematising the use of a new form of map - the air photograph. Grinsell (Ashbee 1972:65) recorded barrows and their settings, and developed regional patterns and chronologies of types.

Cyril Fox also studied the distribution of field monuments, but to this he added distribution studies of small items, such as certain types of tools and vessels, which were frequently collected and housed in museums. One of the best known examples of Fox's work was his essay The Personality of Britain, which first appeared in 1932. In this essay, he used a combination of the distributional data of archaeological finds, and biophysical information. Physical landform data were used in a systematic way to describe the structure of the landscape, and then biological data were used to describe the vegetation and fauna which lived in that landscape. Against this background, Fox was

able to assess long term changes in population distributions and their causes. An appendix to this study even considers the potential role of a sheep parasite in determining early herding activities. Herdsmen may have soon learned to select drier ground for their grazing as dry conditions are not suitable for the parasite.

In time text books on field archaeology appeared. One of the most famous was Field Archaeology by R.J.C. Atkinson (1953). Bradford (1957) published a text on the application of air photo interpretation to archaeological sites under the title Ancient Landscapes: Studies in field archaeology. Another example is Landscape Archaeology by Aston and Rowley (1974). All three books are characteristic of British field or landscape archaeology. They are texts of methods and techniques for locating and recording field movements - not of results or syntheses.

This preoccupation with recording, often it would seem without prior questions in mind, may be partly the result of a perceived need to record sites before they are destroyed. For an example of this sentiment see Rathz 1974, Fowler 1972. It is therefore ironic to learn that, as more fieldwork is carried out, particularly in association with construction and economic development programs, sites are being found at an increasing rate. To some extent British archaeologists now find themselves in the potentially embarrassing situation of being able to document far more sites than were ever believed to have existed, which to some extent undermines their case for the conservation of sites.

Some see the conservation problem as a moral imperative, believing that we need to save material or cultural heritage items for the future (Fowler 1972:97). "It therefore falls, whether we like it or not, to the archaeologists active over the next 30 years to record what they can, because what they do will stand as the primary material thereafter." In an extreme view (Fowler 1972:113) excavation is seen as oversupported (both in terms of funding and the commitment of manpower) and a moral case for more field work (i.e. field recording as opposed to excavation) is presented.

The British tradition of field archaeology had a distinctive

preoccupation with techniques, especially for locating and recording sites. Where studies of paleolithic and mesolithic hunters have examined site distributions, they have looked at extremely large areas on a reconnaissance basis (eg. Fox 1952; Mellars 1974; Campbell 1977: Map 2). This is probably the only realistic approach given the highly modified landscape of Britain and the apparent scarcity of surviving sites from hunting cultures.

Although there has been a long~~g~~standing tradition of regional studies in Britain (for examples see the BAR series), it is difficult to find information on recent surveys or survey methods. For example, the edition titled Rescue Archaeology (Rahtz 1974) in which I would have expected survey to play a major part, has only one entry under "survey" in the index, and this deals with specialised aerial reconnaissance. Foard (1978:357) argued that a survey method which he terms "fieldwalking" - the systematic collection of artefacts from the surface of ploughed fields - was until recently a method of archaeological research which was "sadly neglected by all but a few dedicated amateurs".

Foard (1978:369) used this method to elucidate loosely nucleated Saxon settlement patterns, and demonstrated that there was probably a strong element of continuity in settlements in spite of changes in cultural affiliation of the settlements as inferred by changes in the pottery. In particular, fieldwalking demonstrated dense pagan and Middle Saxon occupation in the study area (1978:372), and so provided the basis for an alternative to the idea that modern settlement originated with nucleated Saxon villages. Foard (1978:372) concludes that the haphazard manner of site recovery and lack of intensive surveys in the past has meant that most archaeological sites have been discussed in isolation, often being treated as unique in their own locality, and so a false picture of settlement distribution has been created.

1.3.3 North American survey approaches

From North America have come analytical reviews which have concentrated on the role of surveys in acquiring data for regional studies and settlement patterns (eg. Ammerman 1981; King 1978; Schiffer et al., 1978; Schiffer and House 1977). Ammerman (1981:63-64) in a review of American archaeology asserts that surveys have begun to outpace excavation in the scope of their contribution to the discipline. Schiffer et al., (1978:1) note that surveys are the principal source of regional data. Ammerman (1981:65-67), as I have already mentioned, traces the development of north American surveys from the early reconnaissance surveys, through a period of formulation of research questions in regional terms, to the present when there is a greater emphasis on explanation, the use of analytical models, and the exploration of more theoretical issues.

There has been considerable effort to formalise a jargon of survey archaeology (eg. Schiffer et al., 1978) in order to define the concepts which are involved. Out of a wide ranging review of archaeological surveys, Schiffer et al., (1978:19) concludes that there is a need^{for} variability in the aims and in the methods applied to archaeological surveys so it is impossible to set forth a specific design or even specific activities that can be employed in all study areas. Rather, they demonstrate that each factor, such as regional physiography and surface visibility, can be assessed theoretically, and its effect on survey techniques considered. The formality of such approaches contrasts with the potentially more cookbook British literature of the "locate and record" type (eg. Bradford 1957; Fowler 1972; Aston and Rowley 1974).

1.3.4 Australian surveys

In Australia, surveys have received little critical assessment. By and large, until the 1970's most surveys were carried out as a reconnaissance to find sites suitable for excavation. It was these sites which provided the data to resolve the questions the archaeologist wished to address. This period is considered in more detail in the discussion of the role of the landscape approach in Australian archaeology in Section

1.5, and I do not propose to dwell on it further at this point. With the development of cultural resource management programs the standards of surveys and survey results gradually began to improve, generally following the North American lead towards predictive surveys (Witter 1979a, 1979b, n.d.) and more rigorous design (Smith 1980; Luebbbers 1981).

1.4 SURVEY TECHNIQUES

1.4.1 Area survey

There are four main methods of areal survey, each with its own constraints and potential advantages.

First, there is the non-sampling approach. An example would be a 'reconnaissance' survey, which is usually based almost entirely on data already available, published or unpublished, supplemented perhaps by a limited amount of fieldwork. A reconnaissance survey can be used to obtain a regional overview, as in the cultural resources survey of the Tasmanian southwest by the author and Waterman (1977). However, a survey of this kind is usually not aimed at producing data at the level of detail required to investigate prehistoric settlement patterns. Another example of a non-sampling survey is the narrowly targeted search approach described by Beaton (1977:20) which aimed to find sites to excavate. This approach relied on two methods of reconnaissance, one method guided by reports of local informants, the other involving looking at areas where previous experience suggested there would be sites.

Where sampling is undertaken, three broad types of sampling strategy may be used: free, grid and physiographic.

The free or 'eyeball' survey is based on using maps, air photographs or driving through or flying over an area and selecting sampling sites where obviously different zones are found. The zones can be chosen on the basis of landform or whatever appears important to the investigator at the time. The free survey approach lacks discipline, and it is easy to get an imbalance in effort given to different parts of the region, or different types of features. Where ground transport is relied on, sampling is particularly biased towards areas along the

access routes (Richley 1978). Also, the investigations are likely to concentrate on the spectacular or visible aspects to the detriment of an overall assessment of the area.

In a grid survey an imaginary rectangular grid is placed over the study area. This grid can be based on lines of latitude and longitude, topographic map grid lines, or on an arbitrarily constructed coordinate system. This method assumes no prior knowledge about the study area, nor the presence of any pattern in the variables to be studied. Within the grid structure, sampling sites are often selected by simple random sampling. A grid survey is mostly used in small scale ecological studies. It is often costly, particularly because of the problems of access to the sampling areas. A related problem is the difficulty of locating the quadrat boundaries on the ground. This difficulty was experienced by Smith in a project in the arid lands of South Australia (1980:74-76). For my Tasmanian study this was not a suitable method because the main area of interest was the coast which formed an irregular linear pattern. Secondly, physical access to much of the coast is still poor, and the effort required to work in these areas would have been excessive.

The physiographic survey strategy is based on classifying the area by physiographic units. Topographic information, such as relief, elevation, slope or other criteria relevant to the study area and aims of the survey, is used to define the units which will be sampled. The physiographic survey approach was selected for this study, with coast type being used to determine the units to be sampled (Chapter 2).

1.4.2 Sampling

Sampling theory is a well developed branch of applied statistics. In recent years a number of attempts have been made to apply statistical methods developed in geography and the biological sciences to archaeology. The traditional archaeological approach has used known archaeological evidence to indicate which unknown areas should be investigated. A statistical approach is an alternative method of determining which areas to investigate.

The kinds of data collected will vary with the research objective, the level of cultural complexity, the ways data are to

be collected, the project budget, and training of the archaeologist. To be able to assess the effectiveness of the sampling procedure, these variables should be stated and kept constant throughout the project. The variables used in this project are set out in Chapter 4.

1.4.3 Environmental variables

Stickler (1974:215-31) argues that there are two main classes of environmental variables, social and natural, which induce variations in culture. The social environment is made up of interaction within a group and between groups. For example, activities and movements may be scheduled by the need to perform certain ceremonies at special places, or to carry out a raid on a distant group. The natural environment is made up of all the physical and biological factors which affect human activities. Both of these have spatial manifestations and operate in concert to determine variability in human settlement patterns. This formal division has proved a useful reminder in this study to try to avoid confusing the effects of the two processes. However, I find the pragmatic simplicity of Sauer's list of requirements for the study of historical geography far more appealing.

"The reconstruction of critical cultural landscapes of the past requires (a) knowledge of the functioning of the given culture as a whole, (b) a control of all the contemporary evidences, which may be of various kinds, and (c) the most intimate familiarity with the terrain which the given culture occupied." (Sauer 1963:362)

Our knowledge of the functioning of Tasmania's Aboriginal societies is poor, being based on a limited post-contact ethnography. For example, Hiatt's (1967) exhaustive review of the Tasmanian literature for information on the Aboriginal diet found only 287 observations. Because of this, the study of the archaeology of the initial contact period "baseline" has become of greater importance to our understanding as we strive to understand "the contemporary evidences" of this past society. Even though there is now no opportunity for direct observation, further understanding of these societies and the landscapes they lived in has been, and can continue to be achieved by

archaeologists. Sauer's third point, in which he directs the scholar to "the most intimate familiarity with the terrain" is far more demanding of time and energy than it first appears. Sauer supplied detailed directions such as:

"Take into the field. . .an account of an area written long ago and compare the places and their activities with the present, seeing where the habitations were and the lines of communication ran, where the forests and the fields stood, gradually getting a picture of the former cultural landscape concealed behind the present one." (Sauer 1963:367)

Doing just this with the journals of Robinson, Hellyer, Wedge and other nineteenth century explorers allowed me to compare in detail the landscape of the early 1800's with the way the same areas appear today. In some cases, the present landscape was sufficiently similar to the historical descriptions to demonstrate that little had changed. In areas where the historical descriptions differed from the present landscape, additional information from government reports and later newspaper articles helped to show how and when the processes of change had occurred.

Sauer (1963:308) makes some very important criticisms of regional studies.

"What problems are stated and at least partly resolved in an average regional thesis? The incipient regional geographer is either sadly at a loss to determine what he wishes to describe, or else follows a routine grouping of data that depresses his job to pedestrian performance."

On the other hand, without regional data I do not see how archaeologists can develop generalisations about the landscape - associations of archaeological sites; and without generalisations how are higher order questions to be tackled?

The levels of resolution within the present study are shown in Figure 1.1. The terms used to describe the levels, from macro scale to micro scale, are regions, quadrats, sites and components within sites.

For the coastal sections of this study the regions are defined as areas with uniform wave energy conditions. Dividing the areas examined by wave energy gave the west coast, north coast and Derwent estuary groupings with high, medium and low wave energy respectively. Subdividing these groupings by location gave the Tasmanian mainland west coast and the west coast of Hunter Island as high energy examples: Three Hummock Island, western Bass Strait and eastern Bass Strait as medium energy examples; the Derwent estuary with low wave energy; and Macquarie Harbour with low wave energy diluted by fresh water. The areas of Bass Strait, Hunter Island and Macquarie Harbour were chosen to surround the core study area of the northern part of the west coast. The Derwent estuary was sampled because it was an accessible estuarine system similar to Port Davey on the west coast. These regions are discussed in greater detail in Chapter 6 and illustrated in Figure 6.1.

Components include such things as the types of bone, shell, stone and sediment. Excavations which deal with only a few sites may look at this range of components in greater

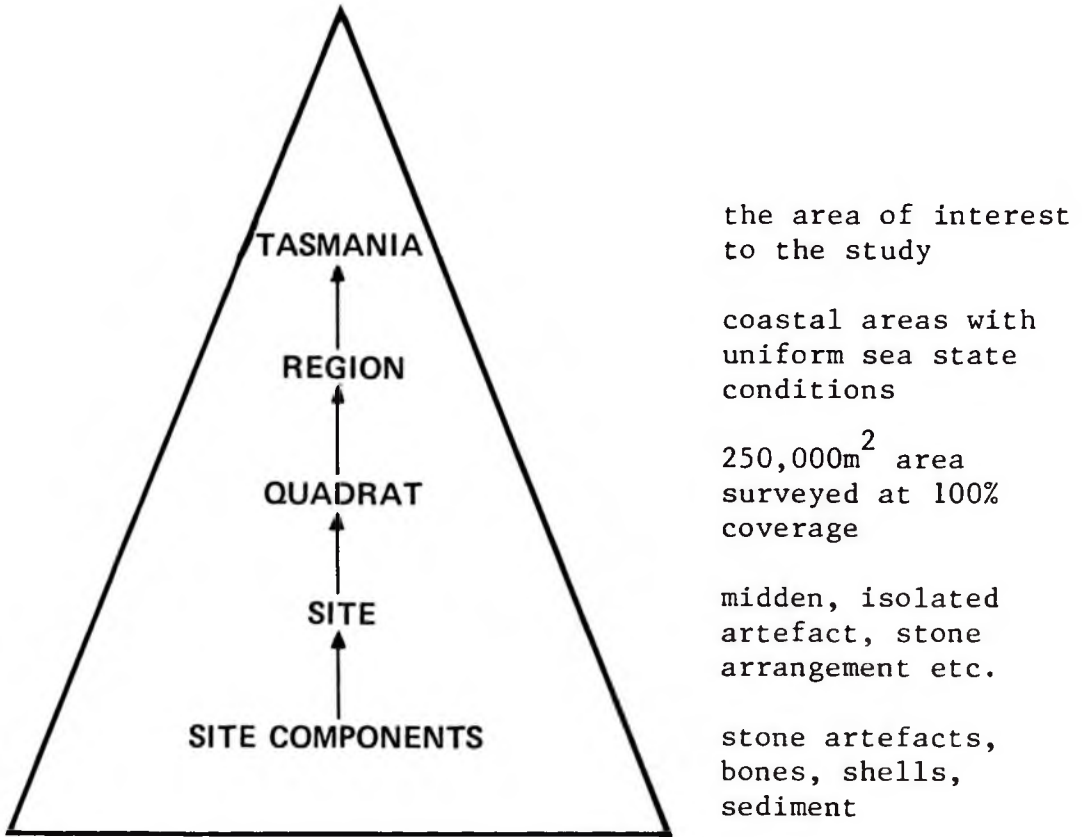


Figure 1.1 Levels of resolution in this study

detail, and also at the attributes of certain groups of components. Examples of studies at this level of resolution would include investigation of the growth lines on shellfish (Cane and Stockton 1978), or the typological analysis of artefacts. However, in order to investigate these "micro" attributes, it would only be possible to examine limited samples from a small number of sites, and so this level of detail was not possible or desirable for this study.

1.4.4 Physical, biological and cultural variables

There are three major groupings in the variables which make up this study: physical, biological, and cultural (Figure 1.2)

The physical variables include geology, landform and climate. These are described in Chapter 2 to establish a picture of the physical landscape. An important variable which is determined by the geology is the type of coast which a particular rock group forms. To a large extent, geology also determines the shape and character of the terrestrial surface landforms. Whether theorists (for example see Thomas 1981) like it or not, climate does determine the limits of what people can do in an area; it sets limits on what can live in an area, including humans; it determines many of their needs, and so affects much of their behaviour. This view is a long way from the now unfashionable environmental determinism but nevertheless you cannot, to take an absurd exaggeration, grow wheat on top of a glacier. Climate also fashions the wind, waves and currents which control the sea state. In combination, these physical variables of the region set the stage for all the other aspects of the study. In particular, in this study it was found that the combinations of bedrock type and the sea state determine the biological resources of a length of coast, and so the ways in which people can exploit it.

Traditionally, biological variables can be arbitrarily divided into terrestrial and marine categories. Most of this study is concerned with the coast, where the two systems meet, and where marine resources can be obtained by that essentially terrestrial animal, man. In this study, therefore, the two sides of this division are often considered together. Specific aspects of the biological environment which are studied are: 1) the

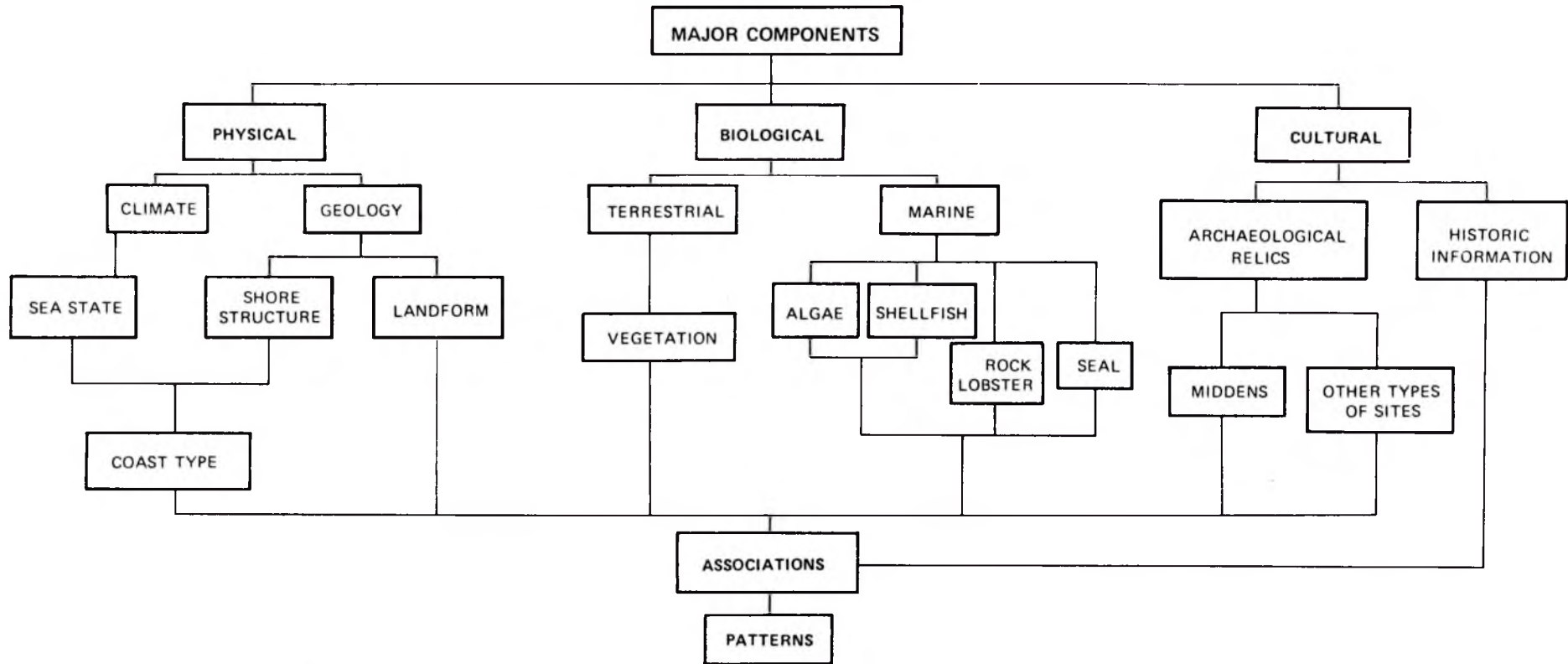


Figure 1.2 Components of the prehistoric geography of the west coast of Tasmania.

former distribution of several types of seals with the aim of providing information on where and when they were available to prehistoric hunters; 2) through the study of midden contents, regional patterns of shellfish species distribution and dominance are proposed. These patterns are similar to those which can be observed in modern shellfish populations.

Two types of cultural variables are examined in this study: 1) physical 'relics' of Tasmanian Aboriginal behaviour such as middens, stone artefacts, engravings and stone arrangements, which now lie scattered over the landscape. Of greatest interest to this study are shell middens, but some attention is also paid to sites which contain only stone artefacts and to stone arrangements; 2) observations of Aborigines by early European explorers and settlers, which constitute the ethnographic record.

All my ethnographic studies are based on published editions, with the exception of one field diary by Hellyer and a number of unpublished maps. I have not attempted to review original archival material, in the way Ryan (1975), for example, has done. The best chronological overview of explorers and their comments on Aborigines and the landscape before settlement is still Giblin's The Early History of Tasmania; the geographical era, 1642-1804 (1929). For the early years of settlement Binks' work on the Explorers of Western Tasmania is an excellent synthesis of geographical and historical information (1980).

The historical accounts which describe the landscape and its Aboriginal inhabitants at the time of European contact fall into three classes. The first group are the logs and journals of the visitors who came to Tasmania by ship before the settlement at Risdon Cove near Hobart in 1803 (Table 1.1). These French and English explorers were involved in missions whose primary aim was to discover and describe new lands. Their records describe their impressions from their encounters with the landscape and its inhabitants. Most of these encounters were brief, communication was poor, and unfortunately the outbreak of hostilities was frequent.

The second group of historical accounts used in this study are the writings of settlers who lived in Tasmania between 1803 and 1835. These sources are listed in Table 1.2. In spite of the rapid development of hostilities between the Tasmanians and

Observer	Period	Reference
Baudin	1802	Cornell 1974
Bligh	1787 1788 1809	Mackaness 1976
Burney	1773	Hooper 1975
Cook	1773 1777	Beaglehole 1969 Beaglehole 1967
Cox	1789	See Mortimer
Crozet	1772	Plomley 1966:37
D'Entrecasteaux	1792 1793	Hogg 1938
Flinders	1798	Flinders 1801
Furneaux	1773	Beaglehole 1969
Labillardiere	1792	Labillardiere 1800
Marion	1772	See Crozet
Mortimer	1789	Mortimer 1975
Peron	1802	Peron 1809 Micco 1971

Table 1.1 Ships logs and journals of visitors.

Observer	Period	Reference
Backhouse	1832-1834 1837	Backhouse 1843
Fossey	1827	Fossey 1861
Goldie	1826	Goldie 1826
Hardwicke	c. 1824	Hardwicke 1861
Hellyer	1827	Hellyer 1827 m.s. Hellyer 1861
Hobbs	1824	Hobbs 1861
Kelly	1815-1816	Kelly 1927 Warden 1971
Knopwood	1805-1808	Wardspeth and Angel 1947;1948 Lord, 1928
Lorymer	1827	Lorymer 1861
Robinson	1829-1834	Plomley 1966
Sharland	1832	Sharland 1861
Wedge	1824-1835 1828	Crawford, Ellis and Stancombe 1962 Wedge 1861

Table 1.2 Diaries and journals of settlers

the Europeans, there was intermittent and sometimes amicable communication, for example, Kelly in 1816, and Hardwicke in c. 1827. However, for the most part the accounts of this period detail observations of Aborigines from a distance, or of skirmishes. The outstanding exception of this period, George Augustus Robinson, spent the greater part of five years living and travelling with Aborigines in the bush during his Friendly Mission. He was the only European during this period who appears to have tried to learn to communicate in Aboriginal languages, and to appreciate the Aboriginal view of events. Ironically, the success of his mission was the final blow to the prehistoric culture of the Tasmanians. They were persuaded to live on offshore islands where attempts were made to educate them in European habits and Christianity.

After this event there are numerous secondhand accounts based on gossip, hearsay and reminiscences which form the third class of historical records. The reliability of many of these accounts is doubtful, because propaganda, cultural prejudice and myth have clearly become incorporated into them. Secondhand accounts were avoided as much as possible in the reconstruction of the daily activity and the description of the landscape in pre-colonial Tasmania.

Although historical accounts often seem full of life and detail compared to the mute presence of archaeological relics, they are limited in their own ways, and their use poses many problems. The events were recorded by someone else for their own reasons in the past. The majority of these records were never intended to be published. From almost the first contact there were outbreaks of skirmishing and violence. With the exception of Robinson, all the descriptions were based on brief encounters with Aborigines where verbal communication was poor or non-existent. Some of the accounts convey more about the personality and the preoccupations of the observer than details of the Aborigines or their landscape. If these are limitations of the ethnography, can it still be used? I believe that it can be used with care, but it cannot be accepted uncritically.

I have chosen to work with and develop models from the physical variables of the landscape first. Subsequently, where ethnographic information was available, I have tried to compare

and contrast it with the data which are based on biophysical and archaeological evidence. If the two approaches produce conflicting results, the need for more data or a reassessment of the problem is indicated. For example, Robinson's diary clearly records that Aborigines travelled to Eddystone Rock (Plomley 1966:379). However, this is a sheer monolith of rock rising out of the ocean and is very difficult to land on even with modern boats. It lacks firewood and probably has no fresh water (N. Brothers pers. comm.). It should be beyond the distance range of Tasmanian watercraft (Jones 1976). Given all these factors, it would appear that Robinson had misinterpreted the location, and so his observation cannot be uncritically accepted.

1.5 THE LANDSCAPE PERSPECTIVE WITHIN AUSTRALIAN PREHISTORY

1.5.1 Introduction

A number of themes have^{been} intertwined to shape the course of Australian prehistory. Exemplary excavations and reports of stratified sites with cultural changes appeared in the 1920's and 1930's, but this approach then lapsed until the 1950's. An emphasis on artefact collecting in the intervening period led to regional comparisons, but^{also to} a neglect of the concept of change through time. The rapid development of diachronic cultural sequences based mainly on excavations of rock shelters and radiocarbon dating techniques after 1950 provided the basis for a series of "culture historical" reconstructions which eventually attempted to integrate ecological or landscape information. When these archaeological sequences were well established on their own merits, the theme of regional comparisons and then landscape associations of sites began once again to receive greater attention.

1.5.2 The changing emphasis

Mulvaney sees 1929 as the crucial year when Australian prehistory became firmly based on stratigraphy and a theme of cultural change was accepted (1961:65). The stratigraphy was of a limestone rock shelter site at Devon Downs on the Lower Murray valley, excavated by Hale and Tindale. The cultural change was

expressed in the stratigraphic changes in the types of stone tools. This work led to a proposal of ecological and cultural succession, and demonstrated the validity of excavation as a method of prehistoric data collection. Even though a similar demonstration of change in Aboriginal culture was presented by Towle and McCarthy's excavation of Lapstone Creek in 1936 (published in 1948), the general focus of archaeological interest in stone artefact collection from surface sites was not affected.

The general attitude of the period can be exemplified by S.R. Mitchell's opinion of the potential for excavation in Australia. Mitchell not only believed that stone implements had not changed from the earliest times to European contact, he did not think that deep or stratified deposits would be found (Carter 1978:9). Even though Mitchell stressed the importance of field work, his reports seem very brief today (Carter 1978:1). The Tasmanians rated so poorly at this time that they were dismissed as "an unchanging people in an unchanging environment" (Pulleine 1929:310). In spite of this, stone artefact studies were carried out to make regional comparisons. Tindale (1937) used stone artefact analysis to suggest similarities between Australian and Tasmanian cultures. This study also included geographical information on the location of sites on Kangaroo Island, and used geomorphology to describe site settings and as a basis for speculation on the possible antiquity of the sites in a way which foreshadowed the geo-archaeology of the present.

The growing recognition that Aboriginal artefacts could offer more than their intrinsic value as objects of curiosity was to gain impetus during the 1950's. Mulvaney began to carry out systematic excavations at this time, while also stressing the need for artefact distribution studies and accurate site setting information. In his 1959 excavation on the Aire River near Cape Otway, Mulvaney concluded that the future study and understanding of Australian prehistory should examine its regional nature (Mulvaney 1962).

McBryde commenced a regional archaeological study of the New England area in the 1960's, which comprised two aims. A regional field survey directed towards "a total objective record" of all archaeological sites was to be complemented with a program of excavation of stratified deposits to provide evidence for the

reconstruction of the regional prehistoric cultural sequence (McBryde 1962-63:12; 1974:14). McBryde (1974:19-23) was one of the few writers of this period who described the ways in which the survey was carried out. The method was to make contact with local historical societies and interested amateurs to find out where sites were known to be, and to obtain other local information. Small areas were then selected for intensive survey either by vehicle or on foot.

The first major book synthesising Australian prehistory was that of Mulvaney in 1969. Chapter 4, which addressed itself to prehistory, opened with a concern for 'time-depth' from controlled excavations. Before elaborating the results of his own work, Mulvaney reviewed the two competing stone tool sequences then in vogue. The first was proposed originally by Hale and Tindale for Devon Downs and the second by McCarthy for sites in the Blue Mountains. Both proponents then generalised their results and annexed parts of Australia into their classificatory systems. The remainder of Mulvaney's chapter attempts to sort out the nature and significance of stone tool sequences, and the distribution of several distinctive tool types across Australia.

By 1971, in an impressionistic review, Mulvaney listed two highlights of current research. The first was the focus on environmental change from the Pleistocene to the present. The second was the emergence of ethnographic and ethno-archaeological studies (1971:229-233). These themes were also prominent in Aboriginal Man and Environment (Mulvaney and Golson 1971).

In 1975 Mulvaney published a revision of his earlier book as a Penguin paperback. This survey volume has stood as the only comprehensive synthesis of the field and is probably the most cited reference in the entire literature related to Australian prehistory. A need to convince the reader that Aboriginal society and culture were not static was expressed again (1975:124). In this edition only two chapters deal specifically with stone tools, though they are often discussed in other sections. A wide range of themes were explored in the review of the research which had been carried out since the first edition. Some open sites received lengthy treatment, notably Lake Mungo and West Point.

Acknowledging the critics of the first edition who 'deplored' the emphasis on cultural change as expressed in stone technology rather than the study of the interaction between human societies and a changing landscape, Mulvaney still argued that artefact study was worthwhile, and that environmental reconstructions were premature (1975:126). He emphasised caution when he pointed out that contemporary data on cultural ecology needed to be systematised, and the form of 'a valid terrain' established for the past before environmental and demographic reconstructions could be made.

Mulvaney's advice was slowly being accepted. The publication of Sunda and Sahul showed this adjustment of the central preoccupations of Australian archaeology to the interplay of geography and history, now that cultural sequences and antiquity were becoming established (Allen *et al.*, 1977:4). Although Part 1 of the volume was titled 'Stone Tools and Social Judgments' it was not concerned with typology and sequence. Rather, the three papers of this section were addressed to archaeologists, and shared a theme that 'stone tools alone do not adequately reflect the complexities of the prehistoric past' (1977:11), as against the view that sophistication in stone tool assemblages is automatically to be equated with complexity in cultural process. This parable was surprisingly similar to that offered by Thompson (1939:209) almost 40 years earlier.

The majority of archaeological studies carried out in Australia up to the 1970's dealt primarily with excavation data and ethnographic information, although a sketch of the environmental setting was usually attempted. There has also been a great deal of work on the ethnography of the contact period, but the aims of this work have been the description of social and economic behaviour, or of such things as seasonal mobility (for examples see McBryde 1978). There has not been enough emphasis on the archaeological implications of this ethnography, such as the location of camps, and use of the landscape. Notable exceptions who tried to relate ethnographic descriptions to archaeological finds include Jones (1974, 1976), and Lourandos (1980).

The increasing use of geographical data and the development of a landscape approach in Australia have been the most important

developments of the last few years. As opposed to ethnographic studies, that part of the archaeological record which has been most neglected is the time of early colonial contact. In many ways, this point in time is a baseline from which it is possible to work in two directions, either towards the present, or away into the past. In Australia, archaeology is either blessed or cursed with a wealth of ethnographic information. The use of historical information in archaeology has been rather like an ibis stalking small animals in the shallows of a swamp; we have plunged our beaks into the murky waters of history and pulled out what looked like tasty morsels. Relocation of the precise places at which events occurred has rarely been attempted. Until the landscape at that point of initial contact between European and Aboriginal culture is understood, extrapolation of cultural and biophysical information into the distant past, and the search for cultural and landscape change, is premature.

There were a number of calls during the 1970's for the development of a landscape approach to archaeology (Hallam 1977) and several exemplary studies were completed (e.g. Hallam 1974; Lampert and Sanders 1973; McBryde 1974, 1978; Binns and McBryde 1972; Lampert 1981; Megaw 1974; Beaton 1977). Although these studies all stressed the spatial aspect of archaeology, addressing the distribution of sites and their landscape settings, they did not attempt to search an area in a systematic way, or to extract as much information for the landscape variables as might have been possible. For example, Lampert (1981:28-31) in his table of sites for Kangaroo Island only provides information about the location, distance to the sea, altitude, aspect, situation, nearest fresh water and tool types present. Although Lampert's aims included "an examination of the locational relationships between Kartan sites and their environments to learn of the interaction of people and their resources" (Lampert 1981:2), it must be noted that his primary aim was to find intact stratified sites which had not been previously collected. Lampert devoted several pages to discussing the locational variables of sites before moving on to an examination of the tool types which formed the basis of his chronological control.

Another ingredient in this change is uniquely Australian - the development of a "land systems" approach to geographical mapping. This approach was originally developed in large area surveys in the Northern Territory by CSIRO to give a quick overall appraisal by air photo interpretation of the major components of a study area. These major patterns will be the result of a combination of many landscape and vegetation factors. Although land system mapping has generally been replaced in land use research with approaches requiring finer resolution, it has provided a two-fold benefit to archaeology. The approach shows simultaneously which areas are similar, while distinguishing those which contrast in some way. The first point allows one to attempt to extrapolate archaeological patterns to other parts of the same land system, while the second point requires the examination of other land systems in the overall regional pattern to see if they have different archaeological patterns.

There is another branch of archaeology which I have neglected to discuss, the study of living peoples with a view to examining not only the type of archaeological garbage they will leave behind, but how they use and affect their landscape. The trendy term for this is "ethno-archaeology", but its origins can be traced back to the observations of social anthropologists and ethnographers who dominated this field until the 1960's (Lampert 1975:204). An excellent early example of ethno-archaeology was Thompson's (1939) paper on the effects of the seasons on the activities and movements of a nomadic hunting group. This study demonstrated the closeness of the relationship between people and their environment. Recent examples of this use of ethnographic observations to provide insight into archaeological problems include Gould (1974), Peterson (1971;1973), Meehan (1975;1977a;1977b) and Jones (1980c). Gould (1974:162) provided a definition of this approach to "living archaeology" as "the actual effort made by an archaeologist or ethnographer to do fieldwork in living human societies with special reference to the archaeological patterning of behaviour in these societies". Peterson considered the problems of open sites and camp site location in hunter-gatherer societies. Meehan studied the diet of a coastal group with particular attention to their use of shellfish. Jones used observations of the activities of a

coastal group of people to provide comments on the processes of rearrangement of site materials and on appropriate excavation techniques for stratified archaeological deposits.

1.5.3 Public Archaeology

The development of agencies in each State and the Northern Territory to manage archaeological sites from the prehistoric and historic past has had a profound effect on approaches in Australian archaeology. New types of archaeological information were required, which archaeologists in Australia had largely ignored in their preoccupation with cultural sequences from caves, and the 'holy grail' search for the oldest date. A new field of synchronic regional studies and survey methods developed partly in response to these changes. Early examples of this shift in emphasis to systematic regional assessments include Smith (1980), Stockton (1979e), Attenbrow (1981), Sullivan (1975;1976;1977;1980) and Luebbers (1981).

The studies of landscape archaeology being carried out in the 1980's are not new in principle, but they do have the potential to employ better methods. In particular, the integration of recent landform research and a land systems approach has allowed prehistorians to recognise the significance of associated camp sites, and to extend their field research beyond the caves and rock shelters which had been the focus of their attention (Lampert 1975:4). At the same time, there has been an increasing recognition of the need to integrate information on human adaptation and use of the landscape into ecological studies (for example see Campbell 1980).

This parallels the world-wide trend towards surveys. Most of these surveys have a duality of purpose, seeking information relevant to land management on the one hand, and archaeological information on the other. A wide variety of methods is being tried, and there has been a rapid development in the related theoretical perspectives for surveys and sampling. The results of some of these task specific surveys are already appearing in the secondary literature, but it is still too early to determine the long term effects of this methodological and theoretical emphasis.

1.6 ARCHAEOLOGY IN TASMANIA

"We are subject to shifts of focus as we learn more about whatever we are working at. The start of one theme may turn into a different one." C.O. Sauer in *The Education of a Geographer* (Sauer 1963:390).

In the period before 1960 studies of Tasmanian prehistory concentrated on two facets, the evolutionary status of Tasmanians and their society, and the nature of their stone tools. Interpretation of one facet was frequently used to give support to interpretations about the other (for a detailed review of this period see Jones 1971b:17-32). Simple stone tools could be a mark of a low evolutionary status or vice versa. The Tasmanians were typed as "a primitive race with an early Palaeolithic civilization" (Meston 1934:179) - they were at the bottom end of the evolutionary ladder.

Perhaps the least valid assumption which was made was that "everything points to the conclusion that they were an unchanging people in an unchanging environment" (Pulleine 1929:310). Ironically, this same author indicated the site which was to prove his conclusion to be wrong. "If any light could be thrown on their culture by excavation . . . the Rocky Cape talus offers the best deposit in Tasmania"(1929:310). He was perfectly right. Historic precedence must go to Meston for his excavations at Rocky Cape in the 1930's (1956:7-8). However, very little was reported on this work and his posthumously published notes did not state his objective. The site was, however, visited by Tindale during the excavation, and he collected artefacts from the sides of the pit. After an examination of the artefacts, Tindale (1937) proposed a cultural relationship between Australia, Tasmania and southeast Asia on the basis of similarities in the stone artefacts from these regions. Tindale's Tasmania-Australia connection was not to be fully vindicated until the 1970's.

A scientific assessment of Tasmania's archaeological status (or lack of it) in the Australian context was presented by Mulvaney (1961). The bulk of this assessment was concerned with cultural affiliations as revealed by stone tools. Ironically, he concluded in the same way that Pulleine concluded in 1928, with

the note that "systematic excavation at Rocky Cape is highly desirable, and until that time correlations with mainland and insular prehistory are premature" (1961:99).

What types of questions have successive researchers working in Tasmanian prehistory asked, and what sorts of archaeological data have they used to seek answers to these questions? All the archaeological studies carried out in Tasmania have included some element of survey and I will be paying particular attention to how these surveys were carried out, their general objectives, and the results which were reported.

In 1965 Jones stated that the objective of his recent Tasmanian work was to "carry out a reconnaissance of archaeological sites in Tasmania, and to excavate some of those which seemed most promising. My particular interest was to try and isolate total (stone) industries" and also to investigate any ecological or geographical variations or adaptations within the island." (1965:191). At the Bay of Fires, for example, "small scale excavations were carried out in order to get an idea of the (stone) industry. This proved to be quite rich, but as it consisted almost entirely of amorphous quartz its value to the typologist is much diminished" (1965a:191-192). The site was briefly reported (1965b) and never returned to. At Sisters Beach, disappointment was expressed when "we only found a maximum depth of 5 feet (1.5m) of midden . . ." (1965a:193). Although the site was rich in bone, few stone artefacts were found.

The last site excavated on his 'reconnaissance' was the midden site at West Point. Of the seven points listed about the site the first is that "the depth was the greatest that I found . . ." and the second that the stone industry was quite rich. By way of pointing to the change that has occurred over the last two decades in the scale of excavations, the 'sounding' of the midden was a pit 5 ft (1.5m) square, and 2m deep. The total volume excavated was in the order of 5 cubic metres. Further excavation the following year was on an even more dramatic scale.

In outlining the proposals for future work, the top priorities set by Jones (1965a) were as follows:

1. to excavate at West Point (for the reasons outlined above);
2. to excavate at Rocky Cape.

The reasons for this were outlined in Jones (1971b). Jones' principal research interest was to address the question of the origin of the Tasmanians. In order to do this, his reconnaissance had sought sites which were old, and contained deep sequences with bones and stone tools, on which he wished to develop a cultural and economic history.

This highly targeted approach has also been characteristic of Jones' later work on the problem of the prehistory of Bass Strait (Jones and Allen 1979; Jones 1979). There is a combination of opportunism and a clear "search image" as he reconnoitred the islands of Bass Strait for stratified sites which could provide data on the period when Bass Plain was drowned.

Although the result of the West Point site excavations have never been described in more than a cursory fashion by Jones, Coleman (1966) in her B.A. honors thesis set out to analyse a series of small samples from the excavation. She used this information to describe the composition of the midden and from this to interpret some aspects of the prehistoric economy. Coleman was the first of a tradition of undergraduate students who have carried out analyses of previously excavated material (Gaffney 1978; Neal 1981; O'Connor 1980, Geering 1980). All of these projects have concentrated on food remains from individual sites and have demonstrated the enormous potential for further excavations in Tasmania to investigate prehistoric diet and economy.

Lourandos set out to tackle very different problems of a landscape nature. The opening sentence of his MA dissertation, 'Coast and Hinterland: the archaeological sites of eastern Tasmania', begins "This thesis is concerned with cultural variation, with mainly its spatio-functional aspects, but also its diachronic, and the ways in which these can be detected archaeologically" (1970:2). This reflects the orientation of the discipline at that time towards the types of cultural variation, both in geographical space and through time, which can be found with archaeological techniques. Lourandos saw his theme

developing in two ways. Firstly, he would survey what he perceived as distinct ecological (and archaeological) areas. His somewhat simplistic approach divided eastern from western Tasmania, along the lines originally proposed by Kemp (1963). Then he would excavate two eastern sites, one on the coast and one inland (1970:3-4).

I would like to quote the totality of Lourandos' survey method section (1970:16). "An extensive survey was carried out along the east and southeast coasts, with less detailed extensions through the inland to the area of the mountain moorland on the Central Plateau. Most of the observations in the west and northwest were carried out during participatory archaeological field work in that area in 1965 and 1967. Finally, I managed to visit all major areas and habitats excepting the southwest". There is no information on where he went, how long was spent in each area, what actual localities were sampled or in what way. I am not intending to be critical about the omissions in a "holier than thou" way^(Johnson 1980). This type of information was usually lacking in reconnaissance reports from that period. However, it is now very difficult to assess the reliability of his conclusions, because the field data on which they were prepared are unknown. The excavation data, which in fact became the focus of the study, are well presented, and his attempt to tackle open middens and inland sand sheet sites with large excavations was innovative in the Australian context.

In contrast to his earlier landscape emphasis, however, when Lourandos returned again to Tasmania in 1981 to excavate two sites, the projects were site-centered and typical of the themes which had dominated Australian and Tasmanian projects in the earlier pioneering phase. One site was a shell midden at Carlton Bluff which was known to be very old, and the other was a rock shelter in the Mersey Valley.

Vanderwal's stated aim in his first Tasmanian report was to examine patterns of economic use of environments which were difficult to exploit, and again the approach was site-centered (n.d.:1). The first area he looked at was the highland lakes area, but the project was abandoned when open sites (other than on eroding lunettes) proved hard to find, and there seemed to be no rock shelters. Vanderwal later settled on a project at Louisa

Bay in southwest Tasmania, which had a large complex of open middens and shelter sites. The stated aim was to "archaeologically document economic patterns of adaptation to the environment of the Tasmanian southwest". Into this he incorporated the use of caves because they "afforded additional protection during the most severe weather" (n.d.:24). The early reports are characterised by this preoccupation with a theme of environmental stress.

Another site-centred project by Vanderwal which must be mentioned is the excavation of a rock shelter at Bedlam Walls, near Shag Bay in Hobart. There is no reference in the report as to why this site was excavated. This site was located near a bay in which the Electrolytic Zinc Company of Australia wished to dump refining wastes and a grant was provided by the company towards the cost of the excavation.

The same tension between initial aims and subsequent practice can also be seen in the work of Bowdler. The first aim was to study hunter and gatherer strategies in the exploitation of offshore islands (1974:3) following papers by Jones (1968; 1974) on Tasmanian watercraft and the use of islands. To do this she proposed to carry out a systematic survey of part of the Hunter Group and excavate some sites. However, in direct contrast to these early aims, after the Pleistocene age of material from Cave Bay Cave had been confirmed, "It seemed the significance of the site warranted the project being focussed on it more closely, entailing less attention being paid to the recent economic evidence." (1974:46). In the major report of this study, attention was focussed on the 23,000 year old sequence of the deposits excavated from Cave Bay Cave and the economic evidence from other more recent sites was only reported summarily (1979:abstract). So, much the same as with Jones initial work, the focus shifted to a site-centered emphasis on old material in caves.

Ranson started his Tasmanian work with a spatial approach by making an intensive field survey of a small section of the west coast between Sundown Creek and the Nelson River (1978). The methods he used were explicitly described, although the survey was still seen as the means to find a site to dig, rather than as an end in itself. The survey results were only presented in an

impressionistic way, and no attempt was made to substantiate the conclusions. The report reflected this bias by concluding that he proposed to carry out a total excavation of one small midden which contained a hut depression, as he thought this was the key feature of west coast shell middens (1978:157). Ranson's study differed from all other excavations in Tasmania. By using open area techniques he attempted to look at the spatial arrangement of all the components within one site. Ranson's work was thus primarily synchronic in approach, but in contrast to my study it was focused on the micro scale. The one paper so far published from this project deals only with his methods of excavation and technical aspects of a method of plotting finds on plans (1980).

Under the National Sites of Significance Program described earlier, the AIAS funded a position for a Site Recorder in Tasmania attached to the NPWS, which was filled in late 1974 by the author. In retrospect, I think there were two important results from the project. Firstly, the Tasmanian Aboriginal Sites Index was established, including a master file containing information on sites from throughout Tasmania. Secondly, it created an institutional base in Tasmania which had a long term interest in archaeological surveys. It was at that point that the present project really begins. It became necessary to sample large areas quickly and to assess regional priorities in order to decide which areas should be acquired as reserves of Aboriginal relics, or managed in some other way. In the next few years a number of decisions of this type were made on what was obviously an unsystematic basis, but this reconnaissance work laid several important foundations on which the present project could be structured. It gave me a chance to work in all parts of Tasmania and many of its islands. Working in multidisciplinary investigation teams, with plant and animal ecologists from the NPWS and other government departments, gave an introduction to the Tasmanian landscape at the ground level and led me to appreciate its many subtle patterns. A number of field techniques were tested, many were eventually discarded, but a few were to be refined and kept.

Towards the end of this project, a series of syntheses of the state of archaeological knowledge was prepared for several regions (Stockton 1976, 1979a; Stockton and Waterman 1977;

Stockton and Wallace 1979). A series of student projects developed as 'flow-ons' from the AIAS Program.

Morris (1979) set out to determine the maximum shellfish productivity of an area adjacent to the lower Derwent by a procedure which combined surface surveys with midden volume estimates. There was no information on how the 'survey' part of the project was carried out.

Mottram (1979) set out to record the distribution and apparent composition of Aboriginal sites in a small area of the Huon River in southeast Tasmania.

Officer (1980) aimed to provide an overall picture of Derwent estuary sites by preparing an inventory with sites classified according to their state of preservation. The field methods and areas covered are not explicitly described, apart from a statement that both banks of the river foreshore and "hindshore" were walked. In areas with no houses, Officer's survey went up to 1km inland. In this way Officer believed the study would "increase the general archaeological data base" but it was "not intended to provide any specific information to the broadening picture of Derwent River prehistory" (1980:pages are not numbered). Implicit in this almost apologetic approach was the idea that only well preserved sites could be excavated, and only excavation would add to this picture. Officer's study recorded 745 middens during 8 months of field work. However because his field data system recorded few details about each site, the subsequent analysis provided almost no information other than a few distribution maps.

Another approach to spatial problems is the thematic approach, where one type of site is examined in intensive detail. Such projects were completed by Sutherland (1972a) on stone quarries and by Sims (1979) on rock art.

Tasmanian archaeology has in some ways diverged into two streams. One branch has looked at the prehistoric economy and ecology of individual sites in detail. The other branch has looked at regional patterns of sites and their landscape associations. This project, by its subject and themes, is clearly in the second group, but it draws heavily on data provided by the first.

1.6.1 Archaeology and maps

"The most precise expression of geographic knowledge is found in the map, an immemorial symbol" (Sauer 1963:317)

Speaking at the conclusion of the President's address to the Anthropology Section of the 1928 meeting of the Australasian Association for the Advancement of Science, Pulleine felt that "the great thing needed is to have a map prepared on which Tasmanian anthropologists can fill in all the camping areas known and to be discovered" (1929:311). In the same year, Giblin argued that:

". . . a comprehensive topographical survey of the workshops of the natives is essential, to show their location and relation with the geological formations or out-crops from which they drew the raw material for their industry. Every factory requires its own detailed survey or examination, because, to an observant eye, what appears to be mere debris may have scientific value. The location of kitchen-middens should be included in such a systematic chart, in order that any implement found therein may be correctly associated with its own group or tribal area." (1928:308)

It was to be a very long time before this suggested map was published (Sutherland 1974), but the call for a geographical approach to prehistory is clear, even if that call now appears simplistic. Fifty years later I have come back to what is basically the same problem, but with the benefit of new techniques and much better background information.

A series of maps has been produced over this time, each showing the accumulation of information, and the interests of their authors. It is unfair to be too critical of the early attempts. Just as we can now readily highlight their inadequacies, no doubt the work of this decade will be seen as inadequate in 50 years time.

The first map of Tasmanian archaeological sites to be published was in an article by Kemp (1963:243). It is a photograph of a museum panel in the Queen Victoria Museum of Launceston. The figure is called a "Map of Tasmania showing

localities where stone implements have been found". No other information was provided on the data used for its compilation.

An identical map was published by Bryden and Ellis in 1965 (Davies 1965:38). The information on which Ellis prepared this map is not given, but I suspect it was mostly from museum collection localities. The main problem with this approach is its total lack of systematic sampling. The collectors were concentrated in the area of densest European settlement, and tended to sample in places which were accessible. Ploughed fields, eroding beach dunes and rock shelters were favourite places to search. This distribution map conveys more about where collectors have been than where sites actually are. Gaps in the distribution cannot be equated with an absence of Aborigines, unless it can be clearly shown that searches were made and yet nothing was found. This type of data is unfortunately not available.

The same map was published by Plomley (1966:4), who noted that, although it represented little more than a preliminary survey, "it indicates a high density of sites in the Midlands as well as along the coast". This is precisely the sort of limited interpretation which can be made on the basis of museum collection data, but the absence of collections from other places cannot be read as absence of archaeological sites. In the study of museum collections, relocating the source is often difficult, if not impossible. It was the usual practice of collectors to use only a general locality or property name. In fact, it has sometimes proved very difficult even to relocate the collection within the museum.

For the purposes of prehistory there is one other fundamental limitation with this approach; it cannot accommodate the time factor. Artefacts may lie within metres of each other, yet be thousands of years apart in age. An extreme example will serve to illustrate the point. The Midlands valley contains numerous sites on fossil dunes, and some of these sites will probably be found to date from the Pleistocene. Yet Aborigines were known to be active in the area up to the 1830's. To a surface collector picking up artefacts from an eroding dune, artefacts from the Pleistocene would be ascribed to the same provenance as those from the 1830's.

In 1966 Jones (1966:4) published a map of archaeological sites in Tasmania which differed from the previous maps. This map was based on site locations which were either published or which Jones had observed. It did not include locations of surface collections, and so had far fewer points than the map of Bryden and Ellis. The 1966 map divides archaeological sites into eight classes; shell midden, cave with midden, rock shelter, quarry, rock carving, human remains, stone arrangement and eroding dunes with midden. This is the first time different types of sites had been represented. In the northwest region ten rock shelters or caves with midden are shown, out of fifteen for the whole of Tasmania (including Hunter Island). The densest cluster of these is around Rocky Cape, the area Jones was to eventually concentrate on. Nine shell middens are shown in the northwest, but there are extensive areas marked as eroding dunes with midden, so the count does not mean very much. The difference between shell middens and eroding dunes with middens appears to be based on a judgment of their potential for stratigraphic excavation. In addition, the Jones map also shows eroding dunes with middens on the southern part of Ocean Beach, which is just to the north of the entrance to Macquarie Harbour. This is incorrect, and I will return to this in Section 5.2.10. An identical map was republished in 1967 (Jones 1967:360).

In 1968 Jones published another map, this time showing the sources of stone artefacts from collections in two museums, and ethnographic observations of Aborigines (1968:209). The artefact locations came from the Westlake collections of the Pitt Rivers Museum at Oxford, and the Amos, Balfour, Bremer, Cooke and Dyer, Heywood, J.F. Jones, Legge, Salter, Whittle and Wilkinson collections of the Queen Victoria Museum in Launceston. The ethnographic observations were derived from a map by Hiatt (1968). This ethnographic distribution is similar to the artefact map, as the ethnographic accounts of Aborigines largely coincided with the then known locations of artefacts. This map also includes some of the major Aboriginal tracks at contact, especially where these pass through rainforest. The ethnographic data are by their very nature unsystematic observations, and once again an absence of a record cannot be equated to an absence of Aborigines. The map shows a conspicuous absence of sites from

the southwest coast, but again this is a reflection of where collectors had been. The archaeological data used in this map are similar to those used by Bryden and Ellis (1965) and so suffer from the same limitations.

An almost identical map was published in 1971 (Jones 1971:276), but the tracks were omitted. As far as I am aware, this was the last attempt to chart all the Aboriginal sites of Tasmania on one map.

The last major mapping exercise was published by Sutherland (1972a), who plotted the locations of over 160 sites and classified the materials of some 15,000 stone artefacts from them. These artefacts came from various collections in the Queen Victoria Museum in Launceston, Tasmanian Museum in Hobart, Australian Museum in Sydney and some private collections. Thus Sutherland's data suffer from the same biases and limitations as those considered in the discussion of other maps based on museum collections. Sutherland was aware of the problem of diachronic change in artefact types (1972a:13). Jones had shown by this time that two distinct industries could be isolated in the West Point midden (site 118). The lower industry contained 40% spongolite, 30% quartzite and 30% black chert while the upper industry had 94% spongolite, 5% quartzite and 1% black chert. Thus there was a marked change in the proportion of artefact materials through time. Sutherland noted for the West Point locality that early collections showed marked differences in the proportions of raw materials, and attributed this to indiscriminate sampling from surface float from the two horizons. It may have also been a reflection of bias in the types of artefact materials which appealed to individual collectors. Sutherland was in fact aware of these major limitations of his data base; that the artefacts had been unsystematically collected, and that there was no control of time. The latter probably did not appear so crucial at the time the study started in 1963 (Sutherland 1972a:1), when it was generally believed that the human occupation of Tasmania was of short duration, and that Aboriginal culture had been static.

In addition, Sutherland plotted the locations of 180 sites which were believed to be quarries. Many of these locations were not visited by Sutherland, however, and the entries contain only

the vaguest location data. A map of these locations shows only two quarries in the southwest between Point Hibbs and the D'Entrecasteaux Channel. This is yet another example of the problem of using unsystematic data. The gap in the distribution shows that collectors had not examined this stretch of coast where access was difficult.

Research during the last decade has revealed so many sites that the task of mapping all archaeological sites in Tasmania has been made futile, if not impossible. It is no longer satisfactory to look at Tasmania-wide distributions, especially in view of the Pleistocene antiquity of people in Tasmania and the dramatic environmental changes which have occurred since man arrived. The time is ripe for looking at smaller areas in detail.

2.1 INTRODUCTION

The present study examines an interrelated set of variables, as illustrated in Figure 1.2. These variables fall into three broad categories, cultural, physical and biological.

The marine and terrestrial physical environments are described first to provide a background to the biological information. The marine resources of the area included fish, rock lobster, shellfish and seals. On land, it is shown that changes have occurred in the vegetation patterns and sand dune landforms over the last 150 years to such an extent that much of the west coast would probably be unrecognisable now to a person who had visited it in the 1820's or 1830's when the European settlers first arrived.

There is a fundamental problem in any archaeological study. The landscape we can observe today is altered from that in which the prehistoric people lived, in Tasmania until 150 years ago. Some historic changes are obvious, such as where forests were cleared for agriculture or where urban centres developed. But even areas which today seem to have had minimal human impacts and are termed "wildernesses" have often undergone significant changes which resulted from human activities. On the other hand, some aspects have not changed. Therefore, I will argue that some features of the biophysical setting such as the geology and climate have remained constant since European colonisation, while others such as the vegetation and animal species distributions have undoubtedly been modified by human activity.

2.2 PHYSICAL COMPONENTS

2.2.1 Introduction

This section describes aspects of these physical variables for northwest Tasmania under the headings:- geology, land units, coast types, climate and sea state. Aspects of the sea state are given the most attention, because this is the dominant factor controlling the ecology and Aboriginal use of the interface of land and sea.

2.2.2 Geology

Bedrock geology determines the nature of the shore, and hence the biota it supports. There are only four main rock types that crop out along the west coast north of Macquarie Harbour (Burnie, King Island and Queenstown sheets of the 1:250,000 Geology Atlas Series). The most common rock type is a Precambrian, relatively unmetamorphosed sedimentary group which includes mudstones, sandstones, orthoquartzite, quartzwacke turbidite successions, and conglomerate. The next most common type consists of the Quaternary sediment especially unconsolidated sand, which mantles much of the bedrock of the region. In the southern end of the study area there are outcrops of Lower Carboniferous-Upper Devonian rocks of adamellite-granite, and in the north of the study area are Tertiary basalts and related breccias. The coast types formed by these different rock types will be discussed below. For a list of the geology maps relevant to this study see Appendix 1.

2.2.3 Land units

Published materials dealing with the study area or similar areas were examined, but none dealt specifically with coastal land units (Davies 1965; S. Jones 1977; Richley 1978; Russell 1978). The Coastal Study conducted by the Tasmanian Conservation Trust prepared geomorphology working maps at a scale of 1:50,000 for the survey area. Examination of the published maps showed that they contained no data beyond those derived from preliminary air photo interpretation. The divisions between the mapped geomorphic units were vague, or only partly defined. Unfortunately, because of these limitations the maps were unsuitable for use in the preparation of the land units data base. Thus it was necessary to prepare simplified land unit descriptions of each sampling quadrat, which are presented as tables opposite each quadrat map in Appendix 2. In these descriptions it was possible to include Richley's land systems as a useful descriptive term to characterise the major classes of land surfaces in the study area. A brief description of the major features of each land system follows.

Bluff Point land system (Richley 1978:36-37)(Plate 2.1)

On the northwest tip of the northwest region, at Mt

Plate 2.1 Looking north from the base of Mount Cameron West. The foreground is typical of the basalt soils of the Bluff Point land system. In the distance is an example of the Temma land system. The huge white ridge on the left is a mobile dune.



Cameron West and on Trefoil Island and The Doughboys, coastal bluffs rise steeply from the sea. The scarp slope gives way abruptly to plateau-like crests 80-100m above sealevel, which on the landward side pass into rolling hills and gently undulating footslopes. Grey and brown duplex soils are derived from Tertiary basalt. Sand evident in the surface horizons of some profiles is probably of aeolian origin and derived from adjacent sandy deposits. Vegetation on the seaward scarps is severely wind pruned, a feature absent in the lee of the bluffs. Paperbark dominates the associations on most sites but eucalypts and bracken seem to occupy areas of better drained soils.

Temma land system (Richley 1978:92-93)

Scattered along the west coast from Woolnorth Point to the Interview River are strips of sandy beaches, dunes and flats up to 4km wide. Soils near the coasts are calcareous. Further inland, leaching has removed the carbonates. The pale sands on the beaches are undifferentiated but there is a pronounced darkening of the surface horizons in the dunes. The predominant sandy soil covers the undulating hinterland and has a surface layer of grey to light grey sand varying from one to almost 2m in depth. Nicolls (1955) has described this soil as a groundwater podzol. Scattered outcrops of Precambrian rocks, mainly sandstone, are a feature of the system, especially near the coast. The native vegetation is mostly an open heath, although areas of scrubland also occur. In places small swamps appear immediately behind the dune system. In these swamps a central lagoon is often ringed by a narrow band of closed paperbark scrub.

Granite Creek land system (Richley 1978:148-9)(Plate 2.2)

Two strips of low hills about 3km in width have developed on exposures of granite along the west coast. The first is in the foothills of Mt Heemskirk and Mt Agnew and extends from Trial Harbour north to Granville Harbour. The other strip lies further north, beginning at Ahrberg Bay, extending north along the coast to the Pieman River, where it swings inland and lies

Plate 2.2 The Granite Creek land system has a mixed
sedgeland dominated by Gymnoschoenus
sphaerocephalus. The Cumberland Hills rise
into the clouds in the background.

The plunging coast of the Trial Harbour quadrat
is typical of the hard coast type where no
shell middens were found. In the distance is
the long curving sweep of Ocean Beach.



behind a strip of Temma land system. The soils are stony or very gravelly, dark colored organic soils. The typical vegetation over most of the area is heath and sedgeland. The principal species on the crests and slopes are Leptospermum nitidum, Epacris lanuginosa, Banksia marginata, Leptospermum scoparium, Gymnoschoenus sphaerocephalus and Restio oligocephalus.

Thornton River land system (Richley 1978:100-101)

This system is composed primarily of a peneplain about 15km wide, extending from south of Marawah to the Interview River. For most of this extent it lies inland, but abuts on the coast at West Point. Bedrock is principally siliceous Precambrian strata and the soils are mainly organic, consisting of gravelly, sandy peat. Bedrock outcrops are common.

The open heath community of the plain contrasts with the closed scrub in the drainage lines and the open forest found on the better quality soils. This system is similar to the Temma land system, but lacks the extensive sand dunes and sand sheets along the coast.

Macquarie Harbour land system (Richley 1978:162-3)

This land system occupies areas on the eastern side of Macquarie Harbour and round its northern end, with one small occurrence in the Badger River further north. It consists of a low plateau with gentle scarp slopes. Dimmock (1952) postulated that the present landscape was built up by Pleistocene outwash material deposited by melting glaciers. These deposits, which consisted of unsorted rounded boulders, gravel, sand and clay were redistributed by the subsequent erosion to give the country its present general undulating form. In recent times the area was inundated by sand, which finally became stabilised by vegetation. A sedgeland dominated by Gymnoschoenus sphaerocephalus occurs on the plateau, while on the scarps there is a heath where Leptospermum scoparium and Sprengelia incarnata are the principal species.

Rosebery land system (Richley 1978:184-5)

The Rosebery land system comprises an extensive belt of

mountainous terrain in the southern part of the northwest region. It represents a major part of the Dundas Trough in the southern part of the region and stretches 90km north to the Que River and Middlesex Plains. This belt of country averages about 12.5km wide, but its distribution is interrupted by areas of Tullah and Henty land systems. It consists mainly of Cambrian volcanic rocks but a feature of the area is scattered occurrences of periglacial deposits. Nothofagus cunninghamii, Antherosperma moschatum and Phyllocladus aspeniifolius dominate the closed forest vegetation on the generally brownish yellow soils of the steep hillslopes. The dark coloured soils on the peaks and those formed from periglacial material support a markedly different plant community. Here shrubs and sedges constitute an open heath and sedgeland.

Strahan land system (Richley 1978:168-9)

Situated along sections of the west coast south of the Pieman River are strips of Quaternary sands. These vary in width and extend over 6km inland just north of Strahan. Low ridges formed by sand inundating Pleistocene glacial deposits indicate a relationship with the Macquarie Harbour land system (Dimmock 1952). A prominent feature of the land system consists of high sand ridges forming as a result of disturbance to the vegetation. The sandy soils are calcareous along the beaches but non-calcareous further inland. Generally they are deep but wet in the swales. An open scrub now covers the low sand ridges and stabilized dunes, but it has obviously suffered considerable disturbance since European settlement. The principal species are Acacia mucronata, Acacia sophorae, Leptospermum scoparium, Eucalyptus viminalis, Eucalyptus nitida and Pteridium aquilinum var. esculentum. A closed community occurs in swales and on flats. In part this was a scrub dominated by Melaleuca ericifolia, Leptospermum scoparium and Melaleuca squarrosa, while in other parts it was a sedgeland of Gymnoschoenus sphaerocephalus, Calorophus lateriflorus and Leptocarpus tenax.

2.2.4 Coast types

Because of the importance of the coast as a resource zone, it has been isolated for detailed description. The coast was initially divided up on the basis of structure into hard and soft shore, along the lines used by Morton and Miller in New Zealand (1968). However, it was immediately apparent that there was a third structural type which was a mixture of these two. This mixed shore structure was defined as an area where hard and soft types occurred within a distance of 500m of each other.

Hard shore areas are found where the bedrock geology is granite, basalt, or metamorphosed sedimentary rocks. Soft shores occur in Quaternary sands. The mixed coast areas are mostly found on the relatively unmetamorphosed sedimentary rocks where rocky outcrops and small sandy beaches are mixed together. Small areas occur on the other bedrock types. The other major factor of the coastal setting was the amount of wave energy. Bird (1976:22) defines three classes of wave energy which are used in this study.

"High wave energy coasts could be defined as those with mean annual significant wave height exceeding 1.0m, moderate wave energy coasts 0.3 to 1.0m, and low wave energy coasts less than 0.3m."

A further division in the low energy class can be made with the distinction of water bodies which are diluted by fresh water, eg. Macquarie Harbour, from those which contain marine waters of normal salinity.

The cross-tabulation of coast structure and wave energy gave a matrix of twelve possible combinations. This system was used to stratify the coast into major types so that quadrats could be chosen which sampled each type. The details of how quadrats were chosen are described in Chapter 4 which elaborates the sampling scheme in detail. Much of the analysis presented in subsequent chapters is based on comparisons of samples from these different coast types.

All of the westward facing coast receives high energy waves. On the basis of both tide range and tide type, Easton distinguished Bass Strait from the west coast (1970:29;290). For this study, Bass Strait is typified by its moderate wave energy. Although the boundaries are vague, Easton assumes the limits of Bass Strait are King Island to the west and the Furneaux Group to the east. I have

taken the western boundary of Bass Strait as an arbitrary line joining Woolnorth Point and Weber Point of Hunter Island, and another joining Cape Keraudren of Hunter Island and Stokes Point of King Island. Thus Three Hummock Island, Stack Island, Penguin Island, Harbour Islets and the east coast of Hunter Island fall in the Bass Strait zone, while Steep Island, Bird Island and Trefoil Island fall in the west coast zone. As all my sampling is confined to the northern half of the west coast, I have arbitrarily divided the west coast into a northern sector extending from Woolnorth Point to the entrance to Macquarie Harbour and a southern sector extending south from Macquarie Harbour to South Cape.

From field observation, aerial reconnaissance and air photo interpretation these coasts were mapped as hard, mixed and soft on 1:100,000 base maps. Small scale reductions of these maps are presented in Figures 2.1, 2.2 and 2.3. I was able to determine the relative lengths of the different shores according to arbitrary criteria. The measurements were made by using the MAPARE program on the DEC-10 computer in combination with the Tektonics graphics tablet which contains a point grid of 39.6 points per 10mm. Measurements from the 1:100,000 base maps in this way gave the results listed in Table 2.1 This does not entirely avoid the problem of measuring coasts, the lengths of which have been shown to be a function of the scale of the mapping base (Galloway and Bahr 1979), but it does give an idea of the relative proportions of the various coast structures in different regions. Figures 2.1, 2.2 and 2.3 show that there are proportionately more soft shore sandy beaches in the northeast of the island and more hard shore areas in the southwest. This is in general agreement with Davies (1965:22), who estimated that less than 10% of the southern half of the west coast was occupied by beaches, while the proportion in the northeast was greater than 50%.

There is a problem with islands in these measurements. In the southwest and northwest Aborigines regularly visited some islands, but not others. The factors involved include the range of watercraft, the availability of fresh water and firewood and the risk of missing the landfall. These problems will be considered in more detail in Section 7.6. In the measurements in the table I have included the islands which have archaeological sites or which were described as visited by the Aborigines.

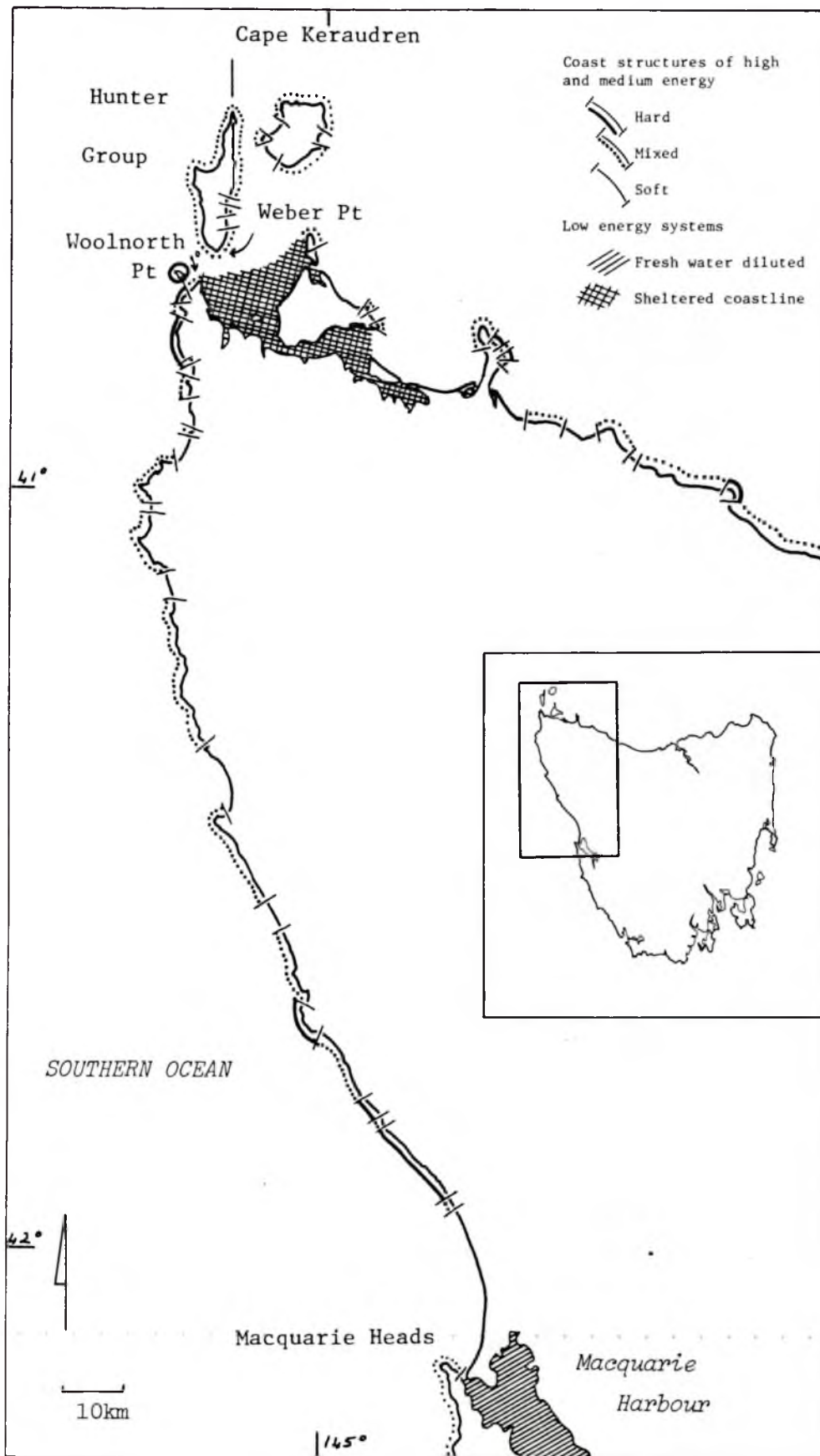


Figure 2.1 Northwest Tasmania coast types

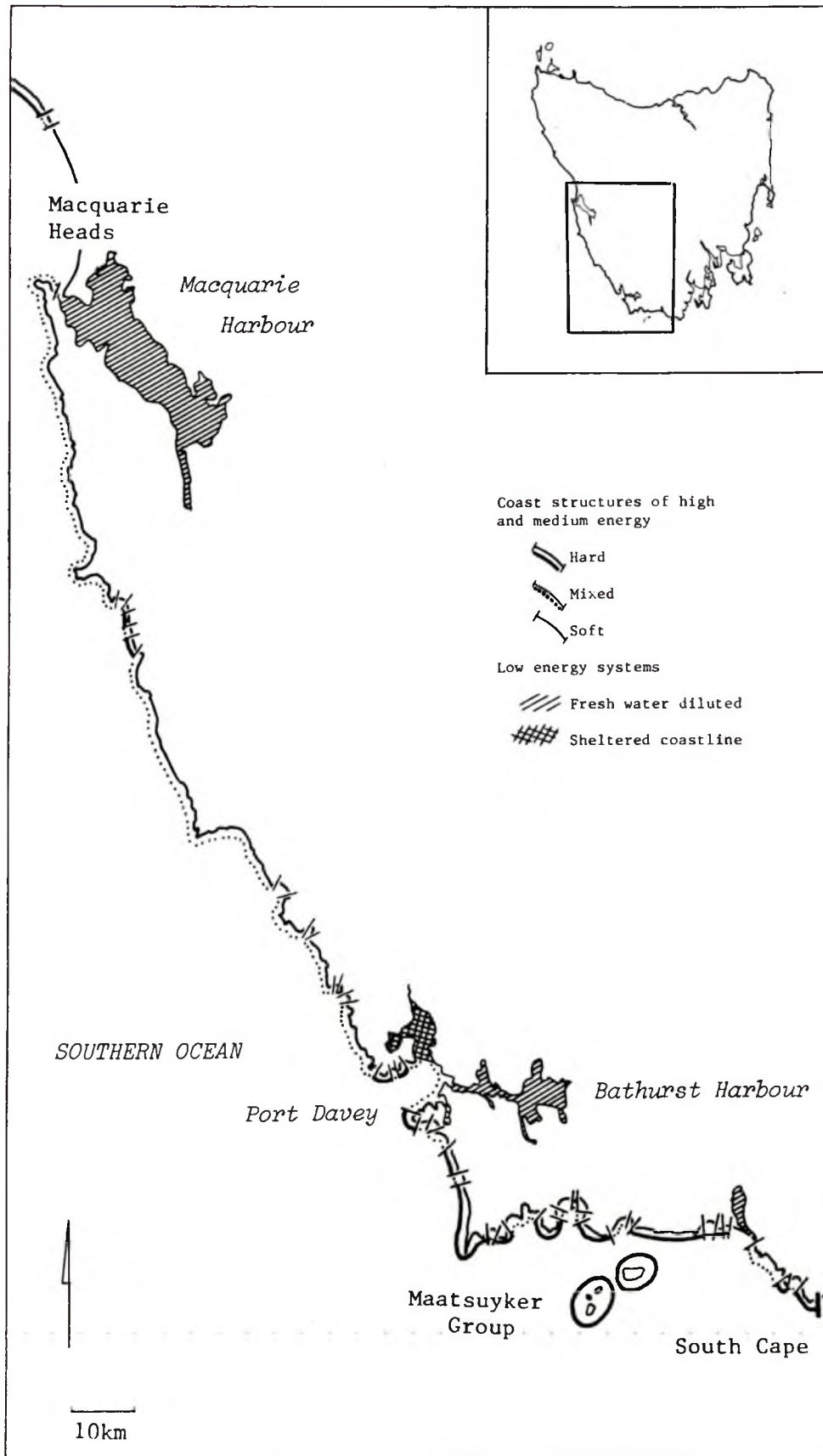


Figure 2.2 Southwest Tasmania coast types

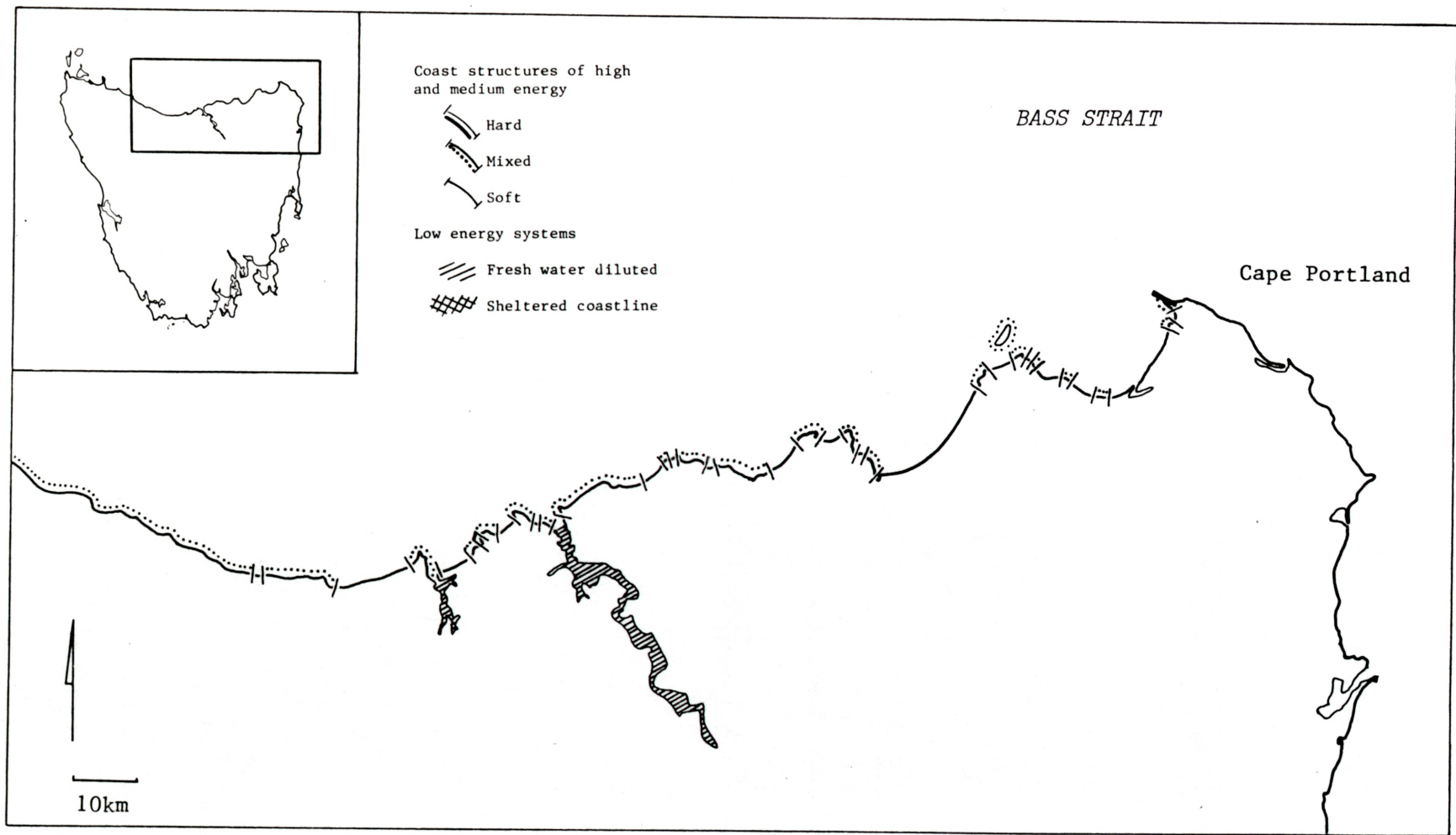


Figure 2.3 Northeast Tasmania coast types

COAST TYPE

REGION	hard	mixed	soft	low energy and fresh water diluted
NORTHWEST	41	163	75	184 (Maquarie Harbour)
SOUTHWEST (Inc. Id du Golf, Hen and Maatsuyker Group)	163	318	29	249 (Bathurst Harbour, Port Davey, New River Lagoon)
NORTH (i.e. Bass Strait, exc. Waterhouse, Ninth and Swan Islands)	15	239	162	663
HUNTER GROUP WEST (West coast of Hunter, and Trefoil, and Bird but exc. Albatross and Steep Heads Islands)	6	43	1.1	-
HUNTER GROUP WEAST (East coast of Hunter, and Trefoil and Penguin Islands)	-	67	15	-
KING ISLAND WEST (West coast of King, and New Year Islands)	-	103	13	-
KING ISLAND EAST (East coast of King Island)	-	50	49	-

Table 2.1 Length of coast types in several regions.

2.2.5 Climate

Firstly, an overview for the region is presented to give a general idea of the regional climatic setting. Following this, a detailed review of information on the seastate of northwest Tasmania is presented with a discussion of its implications for prehistoric life.

Basically the region has a temperate maritime climate. Heat absorption and storage by the sea produces milder winters and cooler summers than in continental climates at the same latitudes. This effect diminishes with altitude and distance from the sea.

Annual rainfall ranges from approximately 900mm at Northdown near Smithton, on the Bass Strait coast, to over 3000mm in the highlands northeast of Queenstown.

The general trend is for an increase in the reliability of annual rainfall from the north to the south but with a decrease again around Corinna and Strahan. The percentage variability figures range from 17-12%. Although rain is the principal form of precipitation, significant amounts of snow occur above about 600m. Falls of snow in coastal and low lying areas are rare and on the few occasions when they do occur, snow seldom remains on the ground longer than overnight.

Along the west coast mean monthly temperatures lie between 12°C and 16°C in January and between 7°C and 11°C in July. The sharp increase in frost incidence away from the coast and with increasing altitude is another characteristic of the marine climate. Generally, coastal areas may receive light frosts anytime from April to November, but severe frosts do not begin until May.

The maximum hours of sunshine received at any one place is reduced by cloud cover. From records of two stations near Burnie, there are 7 to 8 hours of sunshine each day on average in summer, while the yearly average is 5 to 6 hours. Charts of average monthly radiation estimates (Bureau of Meteorology 1964) show figures for the region ranging from 500 to 550 calories per square centimetre per day in mid-summer, dropping to only 125 to 150 calories per square centimetre per day in winter months. This means that during winter there is little sunshine and that the sun gives little warmth.

2.2.6 The sea state of northwest Tasmania

The sea state is the cumulative result of all the physical processes which operate on the sea, such as winds, tides and currents. This summary is based primarily on Matthews (1978) with reference also to Newell (1960), Rochford (1957, 1974), Silvester and Mitchell (1977), Macphail *et al.* (1975) and Davies (1972). The behaviour of the sea determines not only the ecology of the near shore marine zone, but also the ways in which the Aborigines were able to exploit this environment.

-Meteorological factors

The work of Karelsky (1972) summarises the average and changes of cyclonicity and anticyclonicity for the Australian region. The seasonal pressure system patterns described for the west coast of Tasmania are summarised by Matthews as follows:

Summer - Autumn (December - May)

During summer there is a southerly movement of the mean cyclone and anticyclone paths with Tasmania being primarily influenced by the passage of slow moving anticyclones across the state. This brings milder wind conditions with a weak westerly air stream and a tendency toward northerly winds in late summer. During autumn there is a tendency for stationary anticyclones to form over the Tasman Sea with an associated northeasterly air stream. In late autumn the northerly movement of the anticyclone belt brings increased intensity of the westerly airstream.

Winter - Spring (June - November)

Winter is characterised by the northerly movement of the mean cyclone and anticyclone paths with anticyclones to the north of Tasmania and cyclones to the south, so that the south west of Tasmania is exposed to the prevailing westerly airstream. Cold fronts cross the State during this period bringing associated gale force winds shifting from northwesterly to southwesterly in direction as the front crosses. During spring the southward movement of the mean cyclone and anticyclone paths brings less intense and more variable wind conditions and a lower frequency of cold fronts crossing the state.

- Wind Regime (Matthews 1978)

Although regional wind patterns may be obtained from a consideration of the mean paths of cyclonicity and anticyclonicity together with differential pressure gradients, the actual sea surface wind or gradient wind in a particular location may differ significantly in both direction and speed from the regional norm. In addition, coastal landforms have a considerable effect on the actual sea surface wind pattern and these must be taken into careful consideration when assessing observed nearshore swell patterns.

Records from Cape Sorell, an exposed location on the west coast, show the annual percentage of calms to be very low and over 60% of the observed wind speeds are greater than 12 kilometers per hour. Wind speeds are higher in the winter months.

Wind conditions for Cape Sorell Lighthouse summarised from 9am and 3pm readings from 1957 to 1971 are presented as wind roses (Figure 2.4). These roses show that morning winds are distributed around the compass, but afternoon wind is predominantly from the south, west and north sectors.

The wind data show a small but persistent increase in wind speed during winter and spring months (Matthews 1978:4). The importance of this to hunters in the survey area lies in the creation of a combined cold stress. Firstly, air temperatures are already low for the region. Secondly, cold stress is enhanced by the wind chill factor. Wind chill factor is the convective heat losses from a body caused by air movement. A number of formulae are available for the calculation of wind chill index (Munn 1970:188-93) and it is possible to calculate comparative figures from them. Secondly, wind chill factor is enhanced significantly if the subject, i.e. the hunter/gatherer, is wet. The summary implication is that winter, with lower air temperature and higher wind speeds, is a time of potentially greater cold stress for people exploiting the coast of western Tasmania.

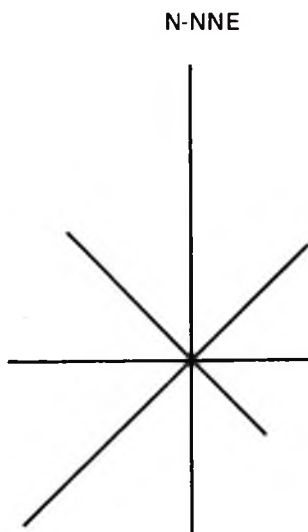
-Sea water temperature

Newell (1960) has presented average surface salinity and temperature distributions for the Tasmanian region based on CSIRO data from oceanographic studies carried out between 1938 and 1959. He has grouped the data into two broad categories: namely summer

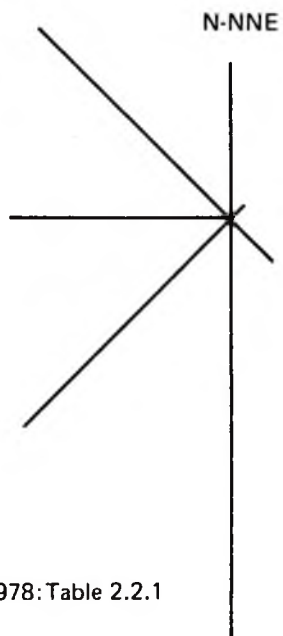
Wind direction at Cape Sorell, 1957-1971

ANNUAL PERCENTAGE FREQUENCIES

09.00 hrs
calm = 2%



15.00 hrs
calm = 1%



SOURCE

Mathews 1978: Table 2.2.1

Figure 2.4 Wind direction at Cape Sorell, 1957 - 1971

(November-March) and winter (May-September). April and October are not included in Newell's figures. In summer the temperatures of the coastal waters of the northwest region of Tasmania are in the range 15-15.9°C. In winter the figures reflect the presence of colder sub-Antarctic waters with temperatures of less than 13°C.

Monthly mean sea surface temperatures based on Bureau of Meteorology charts are presented by Bosworth (1977:112-127). These charts are based on actual sea surface temperature readings. For example in summer (February) the sea temperature on the west coast is shown as between 14 - 16°C. In winter it is shown as 10 - 14°C. These charts reflect the lag in sea temperatures behind seasonal air temperatures. The monthly charts are in broad agreement with those of Newell.

Rochford (1974) presents surface temperature data for the Tasmanian region based on CSIRO data from 1963 to 1969. These data are grouped into two categories: namely summer (maximum weight on February data) and winter (maximum weight on August data). Rochford shows surface temperatures near the west coast of 16°C in summer and 11°C in winter, which again are in general agreement with those of Newell and Bosworth.

At irregular intervals during the summer 1979-80 I took surface sea water temperatures at a set spot near the NPWS field station at West Point. These figures are shown in Table 2.2. Although the readings were infrequent and the observation period was short, one trend is apparent. The shallow water temperatures are extremely variable from day to day. For example in January, the month with the most complete records, the readings varied from 19°C to 14°C, with a mean of 16.8°C. This mean falls within the range of estimates given by Newell (1960), Bosworth (1977) and Rochford (1974). The charted temperatures in the survey area range from about 16°C in the summer to less than 13°C in the winter.

Although the three published sources differ in detail, the variation in temperature estimates at the actual coastline is minimal. Also, short-term temperature measurements taken at the coast in 1979-80 suggest strongly that the generalised patterns described for offshore waters can be confidently applied to the inshore shallows.

These data are relevant to any questions about the seasonal use of sea resources, such as types of shellfish or rock lobster which

SEA WATER TEMPERATURE (Shallows)

Measured at NPWS West Point Field Station.

Date.	^o c.	Monthly mean ^o c.
2/1/80	17	16.8
3/1/80	19	
5/1/80	14	
9/1/80	19	
12/1/80	16	
13/1/80	18	
14/1/80	16	
17/1/80	19	
18/1/80	15	
20/1/80	17.5	
21/1/80	19	
22/1/80	15	
23/1/80	15.5	
24/1/80	16.5	
29/1/80	15	
30/1/80	17	
31/1/80	17	
1/2/80	17	15.9
2/2/80	15.5	
4/2/80	15	
5/2/80	16	
21/2/80	17	
22/2/80	16	
23/2/80	17	
24/2/80	15	
12/3/80	18.5	15.9
13/3/80	15.5	
14/3/80	15.5	
15/3/80	15	
21/3/80	14.5	
26/3/80	16.5	
3/4/80	13.5	14.2
4/4/80	15	

Table 2.2 Shallow sea water temperatures at West Point.

require diving or wading to collect. Water conducts heat approximately 25 times faster than air (Edmonds et al. 1976:220). Robinson regularly noted that in all seasons the women went to dive for shellfish. Other Tasmanian observers also noted that diving was done by the women (Labillardière vol. 2:57-58; Péron 1809:179). Several other examples of coastal foraging in cold water off Korea and Tierra del Fuego reveal it as an activity usually carried out by women (Bridges 1948; Hong and Khah 1967), whose physiology makes them better adapted to withstand cold stress (Hong and Kahn 1967:2). Bridges (1948:63-64) recorded in Tierra del Fuego how "In winter, when the kelp leaves were coated with a film of frost, a baby girl out with her mother would sometimes make pick-a-back swimming difficult by climbing onto her parent's head to escape the cold water and frozen kelp." Nevertheless, in the Korean example, women spent less time per working day in the water in winter than in summer (Hong and Rahn 1967:2). Charts of the expected survival time for a person submerged in cold water have been developed over the last 20 years (Edmonds et al. 1976:221). Although individuals may develop tolerance to cold stress (Burck and Baum 1975), the charts can be used to highlight the seasonal effect water temperature would have had on the length of time which the Aboriginal women would have been able to spend foraging in the sea.

If the summer water temperature is taken at 16°C, then the time shown by the graph published by Edmonds et al. (1967:221) until the onset of marginal hypothermia is 2.5 hours. In contrast, for the winter water temperature of 13°C, the time is only 1.5 hours. To help minimise heat loss, the Tasmanians wore a coating of grease from the fat of an animal such as a seal mixed with ochre (for example see Plomley 1966:278). I have not been able to find any information on how effective such a coating might be, but it would also have a second effect. The oily coating would cause water to run off the skin, thus reducing the cooling effect caused by evaporation of water on the skin after emerging from the sea. .

-Tides

The most important characteristic of the tide is its range between high and low water. Very little is known of the tidal variations along the west coast of Tasmania. The information available indicates that the tides of northwest Tasmania are of mixed

micro-tidal type, with a range of less than 2m (Easton 1970:290). Meteorological influences on the sea levels in this area are significant and may dominate other factors particularly in winter months. The area of the littoral zone depends on the slope of the beach, but the small tide range means that the additional littoral zone area available for foraging at low tide is small.

- Storm surge

Storm surges or storm tides are occasioned by the piling up of water against the coast by very strong onshore winds and waves (Davies 1972:46). In this way the sea level may be raised by as much as several metres (though most commonly rather less), so that the wave attack is lifted to an unusually high level. These changes may last from a few hours to several days.

This feature seems to be of particular importance at Macquarie Harbour where large deviations from expected sea levels have been reported under wind conditions associated with the movement of cold fronts across the area.

These storm surge levels are significant when compared to the expected tidal levels and highlight the influence of meteorological forces on the coast. It is also suggested that fluctuations in tidal regimes caused by meteorological conditions will affect the predictability of low tides suitable for foraging.

-Waves

Waves actively being impinged on by the wind are 'sea' waves and are contrasted to 'swell' waves which have travelled out of their zone of generation (Davies 1972:26). Sea waves include not only the conspicuous storm waves but also the small choppy wavelets produced by the lighter breezes.

Oceanic swell and sea state information has been recorded by the Bureau of Meteorology at Cape Sorell. The most common swell size throughout the year is low i.e. from 0-1.2m. However, moderate to heavy swell (1.2-14m) combined account for over 30% of the observations. These data have some seasonal pattern, with the incidence of moderate to heavy swell being more common from April to November.

The implications of storm swell are immediate for sub-littoral foraging. The Cape Sorell data show that in February-March and

December very rough to very high seas with heavy swell are not recorded. However, it is not the extreme cases that matter, because safe foraging would be impossible even in much calmer seas. For the sake of the exercise, a cutoff point can be taken with calm to slight seas on a low swell. This then gives a picture of marginally better access to the sub-littoral from December to March, so maximum opportunity to exploit the sub-littoral occurs in summer.

There is an important factor in the interaction of coasts and swell. Waves cast shadows just as light does (Morton and Miller 1973:31), so the leeward of an island or promontory will be smooth water. Without implying that foraging is limited to times of smooth water, it will be safer and more productive in calm seas. This means that irregularly shaped coasts will offer more points of access for sub-littoral foraging than relatively straight coasts.

2.3 NON-MAMMALIAN MARINE FAUNA

2.3.1 Introduction

This section deals with three of the four types of marine fauna which made large contributions to the prehistoric diet at some time in prehistory: fish, rock lobster and shellfish. Because seals are mammals and because their distributions have been more drastically altered since the demise of the Aborigines than the other animal groups, they are dealt with in the section following that in which their former range is reconstructed.

In my original proposal I outlined a plan to map the zones of marine vegetation. The primary interest was to isolate the floral zones which supported the marine fauna, particularly gastropod shellfish, which were important food sources in prehistory. Descriptions of marine vegetation on different classes of shore type were prepared from a literature review and from several sample field transects from the high tide mark to a depth of 10m. While doing these transects I soon realised that the important types of edible shellfish were found in a variety of types of algae, but that the algae were limited to areas of rocky bottom, so the exercise was discontinued. In later discussion on the volume of middens in relation to different shore types, I will return to this problem and indicate some of the variables which appear to be important.

2.3.2 Fish

As fish ceased to be a major part of the Tasmanian diet after 3500 BP (Jones 1978), fish will not be described in detail here. No fish bones were found in any of the sites examined in this study; this is consistent with my findings that very few of the sites are more than several thousand years old. A few fish bones have been found in more recent deposits at Maatsuyker Island (R. Vanderwal pers. comm.), Sundown Point (D. Ranson pers. comm) and Rocky Cape (1978:26), but they are so rare that these bones could easily be accounted for by their having been brought onto the site in the guts of cormorants and seals. Jones gives recoveries of fish bones from his Rocky Cape excavations (Jones 1978:27). Of a total of 3196 fish bones, all but four were of Labridae (Pseudolabrus) species. The other four were unidentifiable. Three species of Pseudolabrus are found in Tasmania today, namely P. tetricus, P. fucicola, and P. sittaculus (Peter Last pers. comm.). They are all shallow water species, living on molluscs, small crustaceans and generally scavenging. P. fucicola is the species most likely to be living off Rocky Cape. Further consideration is given to fish remains in Appendix 3 in the discussion of stone walled fishtraps.

2.3.3 Rock Lobster

The Southern Rock Lobster, Jasus novaehollandiae (Holthuis 1963), was recorded ethnographically as an important food source (for examples see Kelly 1920:162; Plomley 1966:174; Labillardière 1800 vol. 2:58; Bligh in Mackannes 1943:21; Beaglehole 1969:735). Fragments of rock lobster carapace have been recognised in Tasmanian prehistoric middens (D. Ranson pers. comm.). The Southern Rock Lobster does not undertake large scale migration. However, as it has a nine month pelagic larval phase, it has a high dispersal potential. Rock lobster habitat ranges from the shallows to depths in excess of 100m. It occurs wherever there are rocky reefs on the sea bed. The modern catch/effort figures prepared by the Fisheries Research Development Authority show an area of low productivity in central Bass Strait (T. Dix pers. comm.).

My early ideas on the calculation of potential cropping rates were abandoned for three reasons. Firstly, modern amateur and commercial fishing has truncated the size range by removing the

larger lobsters and disrupted their distribution. Secondly, with prehistoric exploitation probably limited to around 4m depth, only the individuals from the upper part of the depth range would be accessible, leaving the major part of the population in the vicinity available for recolonisation. Thirdly, the speed of the rock lobster and its use of protective shelter such as crevices give it some biological and behavioural potential to avoid capture. This would be very effective against the unaided swimmer. These unknowns could be assumed to have certain maximum and minimum limits and a potential cropping rate could be guessed, even if the real figures are unknowable. However, as the problem can only be described in such speculative terms, I have abandoned the idea of trying to calculate potential cropping rates.

Rock lobsters shed their shells periodically in order to grow. After the old shell is shed and before the new one hardens, the lobster is relatively defenceless, as the spines of the carapace are not rigid and the animal cannot wedge itself into crevices effectively. Shell replacement in adults occurs mainly in October and November and it is possible that Aboriginal swimmers were able to collect large numbers of lobsters by hand at this time of year. No form of trap for catching rock lobster was recorded in the contact period.

2.3.4 Shellfish

There are four recorded prehistoric uses of mollusca, as food, as vessels for water and food, as scraping tools and as ornaments. A large number of species occurs in shell middens (see shellfish list in Appendix 4), but only a few species provided the vast bulk of the meat.

As this study relies heavily on the use of molluscs as indicators of prehistoric sites, some of the problems of this approach need to be considered. Although it may be possible to say that shellfish arrived at a site by human transport, it is very difficult to show how they were collected, or at what time of the year, or by which members of society. The ecological relationships of most species are only vaguely understood, particularly below the low tide limit (Morton and Miller 1973:591-608). The main reference to Tasmanian shellfish is simply a check list (May 1958), so for ecological and distributional information it is necessary to use

sources which concentrate on other parts of Australia (Dakin et al. 1966; Macpherson and Gabriel 1962) or New Zealand (Morton and Miller 1973). Additional distributional information has been obtained from the collections held by the Tasmanian Museum and Art Gallery.

The most important meat weight contributors on the ocean coast are the gastropods Subnivalia undulata (Solander, 1786); Notohaliotis ruber (Leach, 1814); Cellana solida (Blainville, 1825) and Dicathais sp. A minor meat contributor is the small bivalve Brachidontes rostratus (Dunker, 1856). All these shellfish are rock-dwellers, either as attached sedentary forms or as browsers on algae.

There are no prehistorically important food species on the soft shore, high energy coast, so the shellfishing resource zone is identical to that of the hard and mixed shore types, i.e. the areas where the algae occur. On the Australian mainland, from southeast Queensland to South Australia, the sandy ocean beach habitat is occupied by the bivalve Plebidonax deltoides (Lamarck, 1818). This species has been recorded in Tasmania at Circular Head (Macpherson and Gabriel 1962:370, E. Turner pers. comm.), but it is very rare. The scarcity of this species is the cause of one of the most important differences in midden distribution between Tasmania and southeastern Australia. Along Australian beaches eroding Plebidonax middens are a common sight. The species is most numerous in New South Wales, where it is the most common mollusc of any size on ocean beaches (Dakin et al. 1976:297) and has been fished commercially (Macpherson and Gabriel 1962:370). Plebidonax is often the only species in middens along Ninety Mile Beach of eastern Victoria (Witter pers. comm.; Simmonds and Irish 1977:11). It is common in sites on Wilsons Promontory (Coutts 1970) and in middens on sandy beaches between Warrnambool and Portland (Coutts et al. 1976:33). Further west in Discovery Bay it is often the only species found (D. Witter pers. comm.). Although little is known of its ecology, some general observations are recorded by Luebbers (1978:51-52). The clam inhabits fine to medium-coarse sandy beaches, living a few centimetres below the sand from mid-tide to about one metre below low tide. It can reach densities of 100-500 individuals per square metre. The larvae are pelagic, so their opportunity for dispersal and recolonisation of exploited areas should be good. In South Australia fluctuations in the modern population have been

observed. Since Tasmania falls within the same Maugean biogeographic province as South Australia (Bennett and Pope 1953:153), the absence of large numbers of this species from the long sweeping ocean beaches of Tasmania is enigmatic. In conclusion, although Plebidonax is recorded for Tasmania, I have never observed a shell of this species in a midden, nor found a live specimen on the beaches where I have searched for it.

The small bivalve Donacilla nitida (Deshayes, 1854), is found in both Tasmanian and Victorian sandy surf beaches. Although it has been found in Victorian middens, (Coutts et al. 1976:32), I have not observed it in Tasmanian sites. There is a hint that because this species is small, i.e. maximum shell length 25mm, and therefore required an excess of handling and processing to obtain a reasonable meat return, it was only used in Victoria when other resources were depleted (Coutts et al. 1976:32).

The situation is different in sheltered bays. Ostrea angasi (Sowerby, 1871) lives in sandy sediments in low energy areas, often in quite shallow water, and Mytilus planulatus (Lamarck, 1819) is found on rocks. Pecten meridionalis (Tate, 1886) lives in fine silts usually at a depth in excess of 25m, thus effectively limiting its potential for prehistoric exploitation. However, Pecten meridionalis shells have occasionally been found in excavations at Alum Cliffs and Sundown Point. Although it is possible that they were used for food, they are so rare that their numbers could easily be accounted for by beach scavenging of dead shells. Pecten shells may have been used for ornaments as examples have been found which appear to have been artificially pierced (Stockton 1978:9).

The same dominant species occurs around the coast of Tasmania, for example, in Bass Strait, most of the species mentioned above are still found, but towards the eastern end of the strait the mussel Mytilus planulatus becomes the most common species.

There is no information available on the prehistoric distribution of shellfish in Macquarie Harbour. There is very little information even for the present day. A Department of the Environment report (1975:5) notes the presence of Modiolus pulex (Lamarck, 1819) near Settlement Island and Trus (Notopaphia) grisea (Lamarck) and Donacilla erycinaea (Lamarck, 1818) between Liberty Point and the Harbour entrance. All three are large enough, and appear to be of sufficiently shallow habit, to have been used by

Aborigines as food.

2.4 SEALS

2.4.1 Introduction

In prehistoric midden sites in coastal northwest Tasmania the numerous remains attest to the importance of seals as a meat source for the Aborigines. In this section I have synthesised the relevant biological information on the species which were present in Tasmania and mapped the locations of seal colonies at the time of European contact.

The data for this section fall into two broad classes, biological and historical.

2.4.2 Synopsis of relevant biological data

Biological data relevant to the prehistoric use of seals were taken from a variety of published and unpublished sources (Gaskin 1972; Horton 1978; Hyett and Shaw 1980; Troughton 1965; Warneke 1975, 1976 and pers. comm.; Wood Jones 1925). In the period when Europeans first entered Tasmanian waters, there appear to have been four common species of seal around Tasmania and in Bass Strait: the Southern Elephant Seal, Australian Sea Lion, Australian Fur Seal and New Zealand Fur Seal. The Leopard Seal is and was an occasional visitor and was never abundant. Although Wood Jones referred to Australian Sea Lion remains having been found in Aboriginal middens in Tasmania (1925:363), they have not in fact been identified in subsequent excavations and will not be dealt with in this section. It is quite possible that Australian Sea Lion remains will be found in future excavations.

-Southern Elephant Seal, Mirounga leonina

At the start of the Nineteenth Century, large colonies of the Southern Elephant Seal occurred on the Hunter Islands, New Year Island and on King Island (Péron in Micco 1971:23)(Figure 2.5), but today the colonies nearest to Tasmania are on Macquarie Island (Green 1973:63). Reproductive behaviour of this species has been summarised by Warneke (1976). Breeding sites are usually sandy

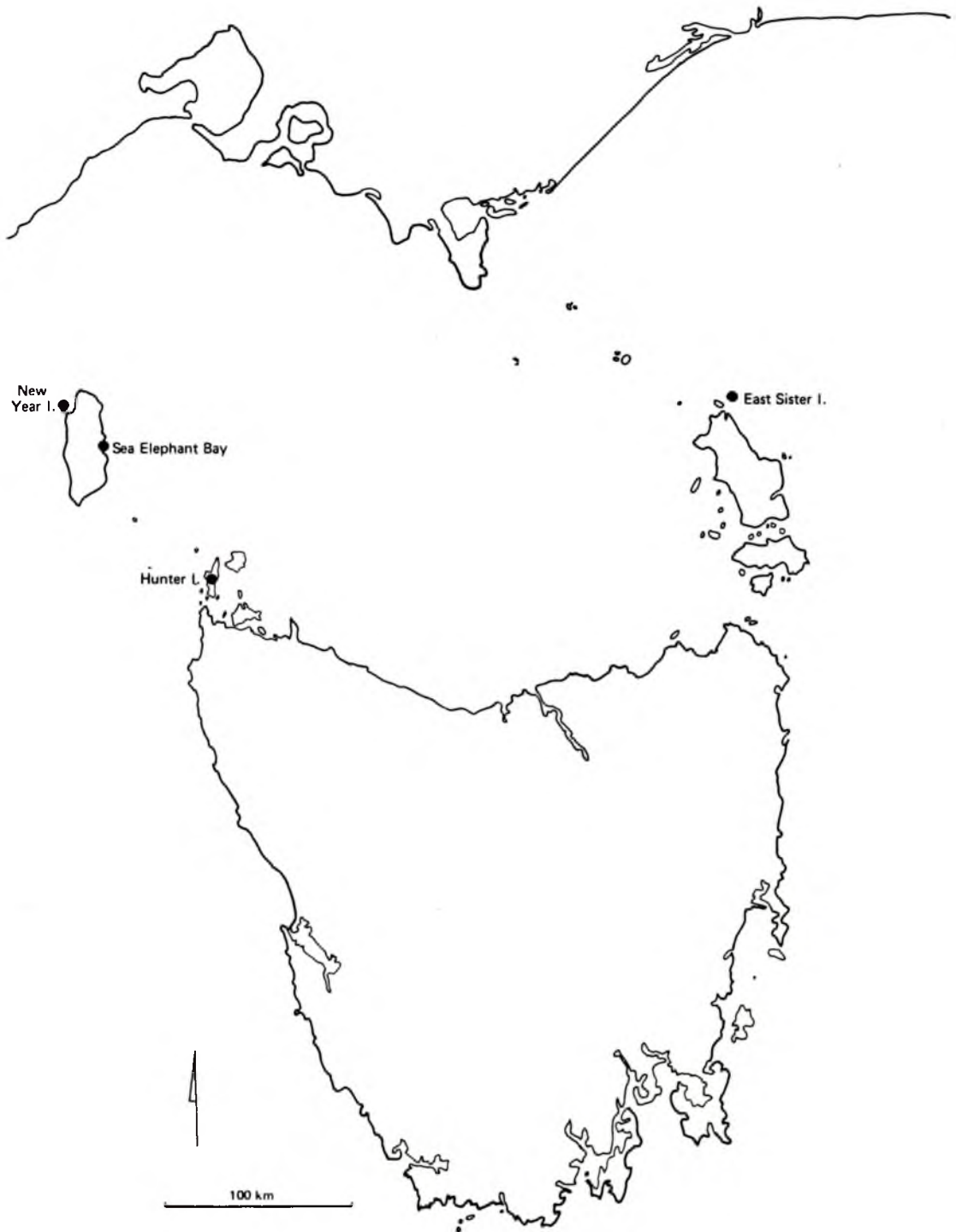


Figure 2.5 Historic locations of *Mirounga leonina* colonies (source: Warneke 1976).

beaches. Mature males come ashore from early August to early December, while mature and pregnant cows start arriving in September. Groups of females form harems with large male 'beachmasters'. On average a female remains on the breeding site for 28 days, during which time she does not eat. Lactation lasts about 23 days (Hyett and Shaw 1980:233). During this time pups gain about 5kg in weight per day (Warneke 1976). The male Southern Elephant Seal is the largest seal occurring in Tasmanian waters. At maturity it may attain lengths of 6m and weights of 3,600kg. Females weigh about 900kg at maturity and attain lengths of 3-4m.

The Southern Elephant Seal also spends a period ashore during December, January and February, when adults of both sexes haul out on suitable beaches to moult. This process takes about 20 to 40 days, during which time the animals cease feeding and rarely go near the sea unless disturbed. When the moult is complete, the animals return to the sea to feed and large concentrations of Elephant Seals are not seen ashore until the following breeding season. However, breeding sites may not be completely abandoned as there are usually some resting young present all year round (Hyett and Shaw 1980:233)

-Australian Fur Seal, Arctocephalus pusillus doriferus and New Zealand Fur Seal, Arctocephalus forsteri

As the Arctocephalus remains in middens cannot usually be identified to species, the life history of both species will be considered together.

Fur seals were recorded in early accounts at numerous locations throughout Bass Strait. The Australian Fur Seal is the only seal which is still a regular breeding species in Bass Strait (Green 1973:65). The distribution map of modern seals is based on Pearse (1979)(Figure 2.6). The map is somewhat misleading as the number of sites cannot be directly equated with abundance; some of the locations had very few individuals. Although there is little detail on historic colonies of seals in the southeast and south, they were present.

Australian Fur Seal males grow to about 2.25m long with weights of up to 360kg, while females grow to around 1.5m and 90kg (Hyett and Shaw 1980:229). New Zealand Fur Seal males grow up to 2m and 110kg, while females are up to 1.6m and 80kg (Hyett and Shaw 1980:230). Breeding locations, usually exposed rocky beaches, are



Figure 2.6 Modern observations of fur seals (source: Pierce 1979)

occupied by males from October. Most females give birth in November (Australian Fur Seal) and January (New Zealand Fur Seal). Pups weigh around 4-5kg. Australian Fur Seal pups congregate in groups of up to 50 while their mothers are away feeding.

Observations on the vulnerability to capture of Australian Fur Seal have been made by Warneke (pers. comm.). Young pups less than eight weeks of age are almost helpless on land. If harassed, they quickly take refuge in the sea but soon tire and return to shore. If the hunter lay down and remained still, the pups would approach quite closely. By three months of age they are strong active swimmers and are much more difficult to catch by pursuit; they are quite curious, however, and will approach a stationary crouching person. Around 20% of pups die of natural causes in the first three months (Horton 1978:30).

The reconstructions of the distribution of Southern Elephant Seal and of fur seals shown in Figures 2.6 and 2.7 are based on historic records cited in Warneke (1976). In spite of the limitations of the historical records, the maps show the highest density for both groups is on the inaccessible islands of Bass Strait.

-Leopard Seal, Hydrurga leptonyx

The Leopard Seal ranges widely through the Southern Ocean but is a rare visitor to Tasmania. The species is migratory, with both immature and adult seals moving northwards in the autumn and winter. The younger animals tend to wander further afield than reproductively mature adults. Fully grown, a female may weigh 450kg and attain a length of 4m. Males weigh about 270kg and attain lengths of about 3m at maturity. On land Leopard Seals are quite agile (Gaskin 1972: 145-147).

The distribution maps for seal remains indicate few records of seal bone in the northeast and southeast. Whether this is a reflection of the true distribution or an artefact of a lack of archaeological work in these regions could be tested by systematic site survey and sampling. The large numbers of seals in the Furneaux Group and Maria Island at contact suggests that seal remains should be common in middens on the adjacent coasts.

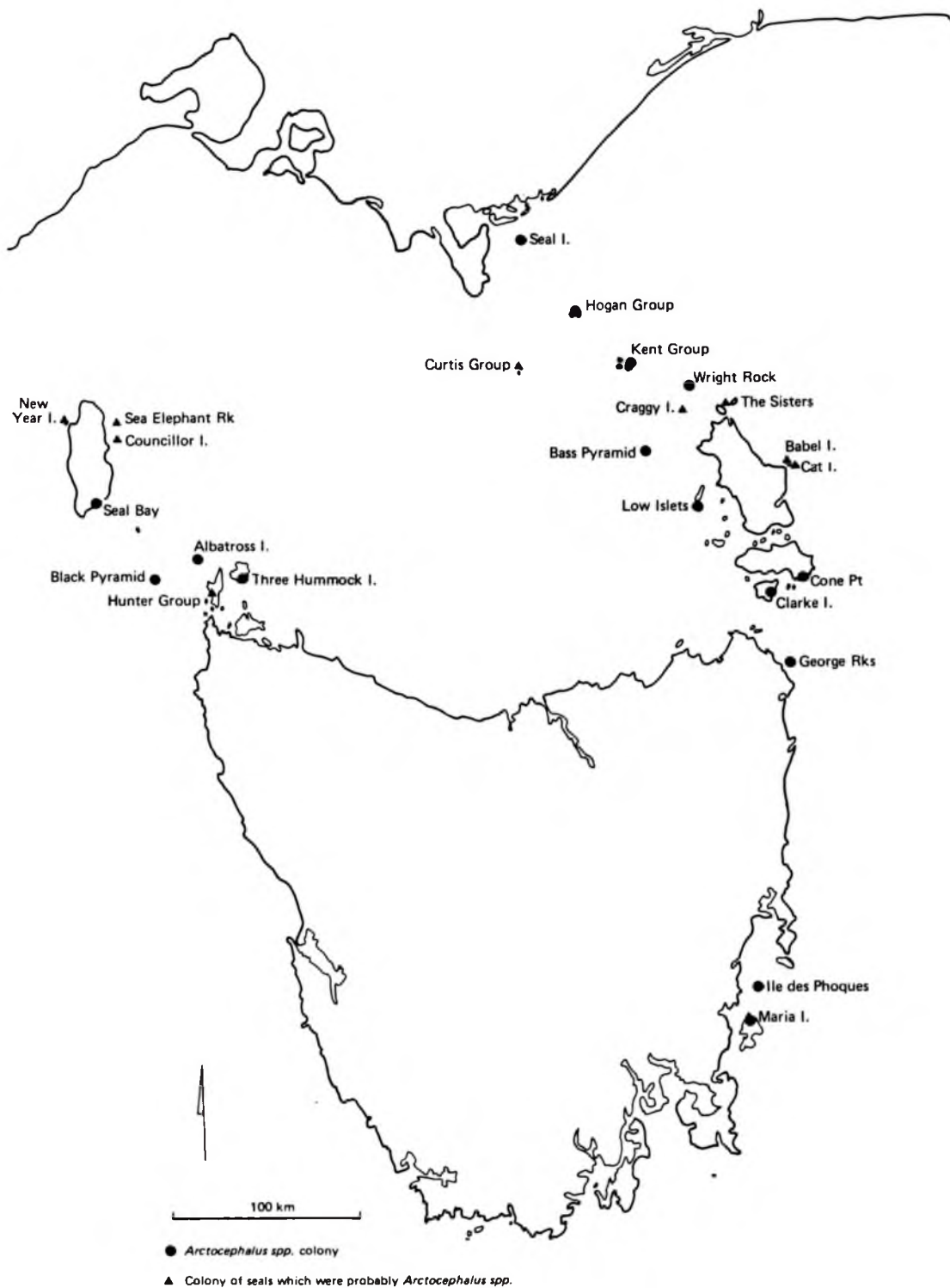


Figure 2.7 Historic locations of *Arctocephalus* spp. colonies (source: Warneke 1976).

2.5 HISTORIC VEGETATION CHANGE IN NORTHWEST TASMANIA

2.5.1 Introduction

There are various methods available to study vegetation change. For example, fossil pollen can give an indication of the types of plants growing in an area, or historical accounts can describe what an area looked like when people with a written language first arrived. For this study I have used one of the approaches of historical geography, studying historical documents and trying to relocate the precise locations to which the descriptions refer, and then comparing the present scene with the historical description. Much the same as an archaeologist studying Roman Britain would have to take into account the history of the land use of the last 2,000 years, the Australian archaeologist must be cognizant with Australian history. The subjects we study as archaeologists, however, are not the usual preoccupations of historians, so recourse to the original documents is often necessary to find those small scattered facts which are individually no more than isolated clues, but which cumulatively begin to reveal the pattern and process of historical change in the landscape since the departure of the Aborigines.

This approach is to be found in a number of Australian studies. Flood (1980) examined historical descriptions of the Southern Tablelands and the Southern Alps in order to reconstruct the landscape which the Aborigines knew and in order to assess the impact of Aboriginal man on that environment. Flood (1980) concluded that though the evidence is not conclusive, the Aborigines were probably not "wantonly" destructive. In Tasmania Jones (1969; 1971b:72-77) examined the interplay of biophysical factors and the use of fire by the Aborigines. Jones used early descriptions of the vegetation by explorers as a baseline and then observed the changes which had occurred since that time (1971b:77). Of particular interest was the change of grasslands to rainforest in the Surrey Hills and Hampshire Hills areas, and the argument that the floristic mosaic of mixed Eucalypt and rain forest species could be seen as a human artefact, in the same way as a cleared field. Jones' conclusion was that in both cases man is using his technology to degrade a vegetation succession into a botanically simpler one, which increases the food supply available to him.

Fire is central to Hallam's (1979) study of Aboriginal use of the landscape and the changes which have occurred to it since European settlement. Hallam (1979:105) saw the use of fire by the Aborigines as part of an overall pattern of increasing exploitation and population. While in the European view it was usual to consider Aborigines as hunters and gatherers, Hallam (1979:111) concludes from her study of vegetation that the Aborigines had indeed worked for their crop of grass and their stock of herbivores and that their effects on the landscape may have been more crucial than can be demonstrated at present.

Luebbers has described extensive swamps of the contact period landscape of southeast South Australia by synthesising the historical descriptions with data on the physiography, geology, climate and hydrology. In this physical landscape he was then able to describe the results of vegetation and paleobotany studies to convey an overall impression of the changes which have occurred through time from the early Holocene to the present.

While searching explorers' diaries and reports I encountered descriptions of vegetation patterns that were often quite different from those which are observed today. This section developed out of an attempt to synthesise the early vegetation descriptions for the coastal strip of the region. Arbitrary geographical limits are set at the entrance to Macquarie Harbour in the south and Big Duck Bay, Hunter Island, to the north (see Figure 2.8). The coastal strip discussed is approximately 1km wide.

2.5.2 Background

Because it has few permanent residents and is of low economic value, road access is poor. The heath areas on quartzite bedrock have a rugged moonscape quality.

The west coast of Tasmania is often regarded as a wild landscape with the term "wildscape" being coined to describe its southern portion (Macphail 1978). Indeed, so much has been written about the less accessible southern portion that by comparison the north has been neglected. One could almost propose an hypothesis that "the more remote an area, the more likely it is to attract research". It is however, this neglected northern area which I wish to examine. To many visitors it does not appear to have changed greatly since Aboriginal times, and so appears to present a great

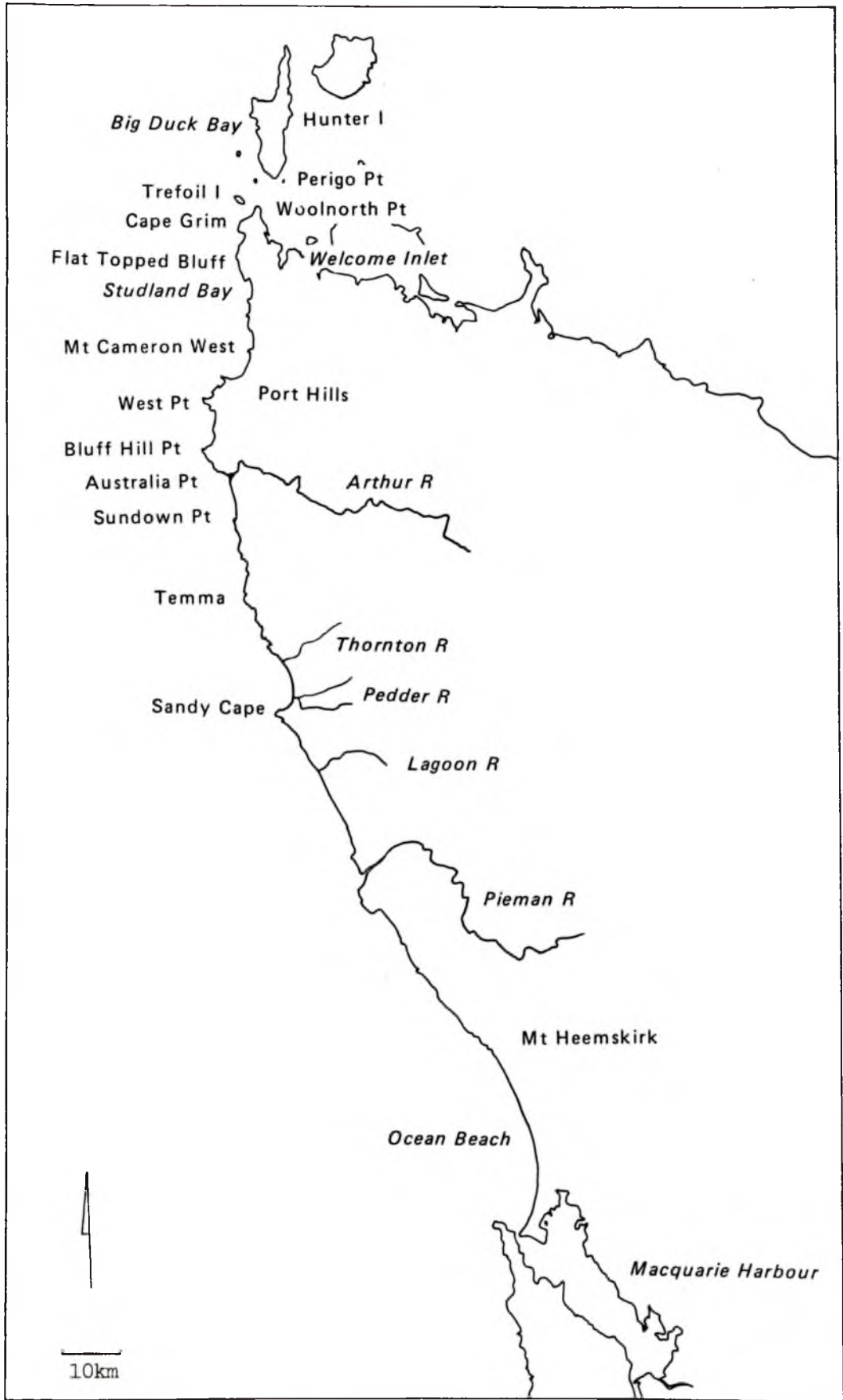


Figure 2.8 Places referred to in Section 2.5

opportunity for reconstructing the landscape of the contact period. It is not that change has not occurred, but that the changes appear to have been of small orders of magnitude. It seems, therefore, that the prehistoric landscape can be perceived with not too much difficulty under the mantle of the present one.

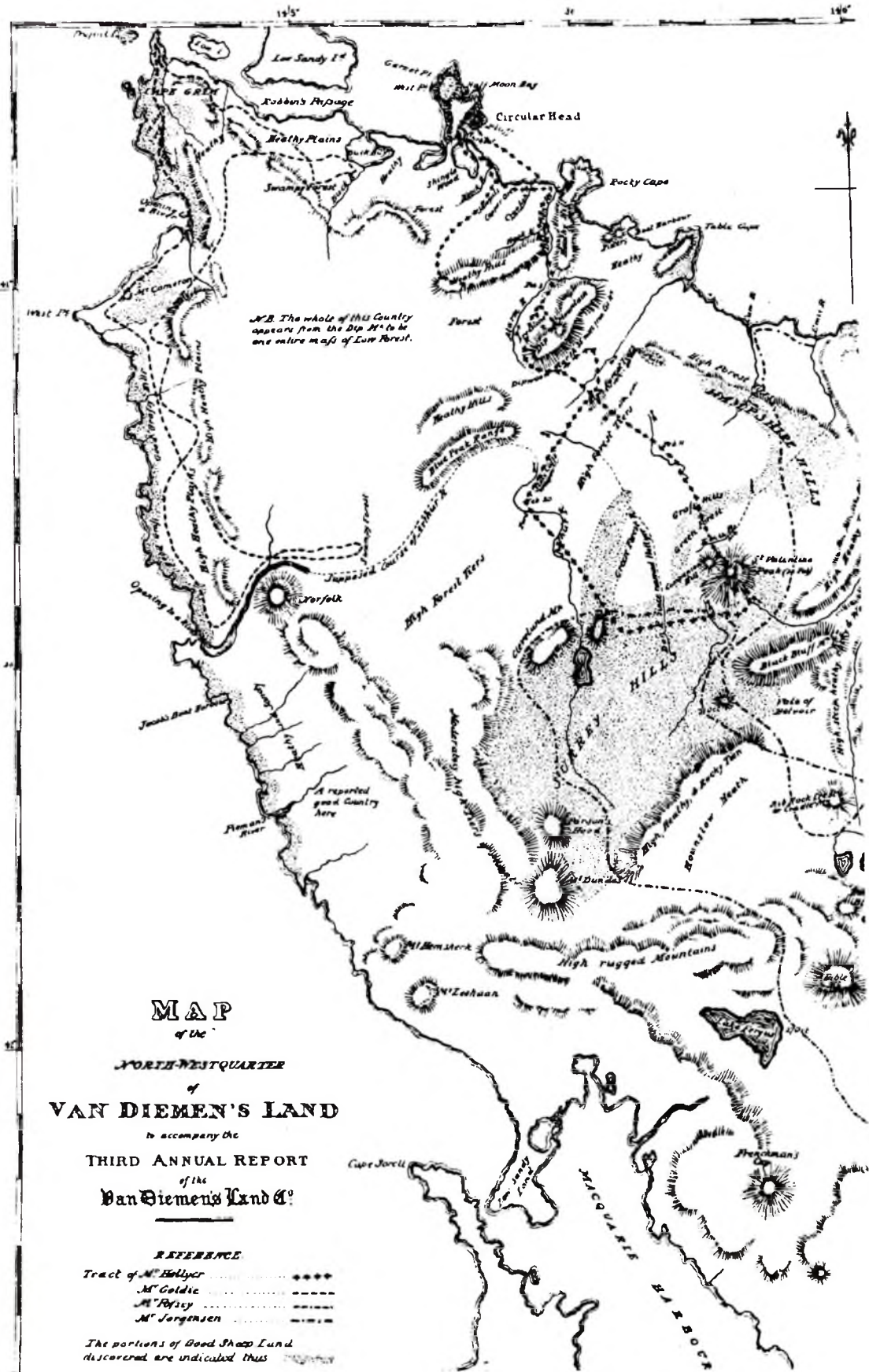
I propose to look at only two related aspects of the landscape in detail, landforms and vegetation patterns. Historic descriptions of vegetation and landforms along the coast at the period of European contact will be compared with the patterns of vegetation and landforms of the region today.

There are a number of problems in attempting this, some familiar to historians but others more familiar to botanists, ecologists and geographers. Many of the place names in early accounts are no longer used, while other names have been moved in the landscape (Stockton 1979:31; Mackarness 1976:39), making relocation of what an observer was describing extremely difficult. This relocation can sometimes be achieved by map reading, air photo interpretation or by visiting the locality, but some descriptions could not be used as the localities of the given place names are no longer known.

Some travellers gave only the vaguest hints of the route they followed and some even had their major landmarks like mountains and large rivers confused (e.g. see Plomley 1966:903). Others, particularly surveyors, drew maps to accompany their reports and diaries. Although these were often wildly inaccurate, some maps gave boundaries to the types of vegetation they observed and described (see Figure 2.9). Appendix 5 sets out the total of 43 observations which can be accurately relocated.

Common plant names have remained stable in the area over the past 150 years and most of the terms of 1820 are still in use today. Scientific names were a little more fluid as taxonomic studies progressed.

The final problem is that few of the early explorers were trained observers competent to describe plants, plant communities, soils, landforms and geology. All were recent immigrants to the colony to whom Tasmania was new and alien. Hardwicke (1861) was a ship's captain and carried out a reconnaissance from the sea about 1824. C.P. Lorymer (1861), Joseph Fossey (1861), Alexander Goldie (1861) and Henry Hellyer (1861) were surveyors and agriculturalists



MAP
of the
NORTH-WEST QUARTER
of
VAN DIEMEN'S LAND
to accompany the
THIRD ANNUAL REPORT
of the
Van Diemen's Land Co.

REFERENCE
Tract of M. Hollyer
M. Goldie
M. Poyy
M. Jorgensen
The portions of Good Sheep Land
discovered are indicated thus

Figure 2.9 Map of the north-west quarter of Van Diemen's Land to accompany the Third Annual Report of the Van Diemen's Land Co. The stippling shows areas of what was thought to be good sheep land. See Figure 2.10 for this map redrawn to scale.

working in the 1820's for the Van Diemen's Land Company, a large agricultural business granted land in northwest Tasmania but managed from England. Original maps from these surveys have survived, which together with the reports provide excellent geographical records. John Helder Wedge (1861, 1962) was a government surveyor sent to inspect the land available for selection by the Van Diemen's Land Company. George Augustus Robinson was by trade a builder, but was appointed Conciliator to the Tasmanian Aborigines. All these men showed courage and endurance in travelling through the unknown landscape of Tasmaniaⁱⁿ the early 1800's. That they managed to record their field observations so well was a feat of intellectual stamina.

2.5.3 Vegetation communities and landforms

In the following sections the patterns of relationships between vegetation communities and landforms will be examined. Evidence for changes in these patterns will be presented for each community. Four broad categories were used by the early explorers to describe the vegetation patterns they encountered : heath, tea-tree swamp, forest and grassland.

- Heath communities

In the historical record large areas of heath are described. Banksia marginata is the most commonly noted species. The descriptions probably include sedgeland heath in this community, though it is rarely explicitly stated. There are few references to vegetation so dense that it impeded progress. Either the explorers did not encounter dense scrub on the coast, or they failed to record it. Heath species will develop into dense scrub if allowed to grow tall enough. On the coast plant height is regulated by nutrition, waterlogging, buffeting by wind, salt spray and fire frequency. Nutrition, waterlogging, wind and salt spray factors can be taken as constant over time, so the variable to examine is fire frequency.

Today, in the Lands Department cattle agistment runs which extend from West Point to the Pieman River the preferred fire frequency interval is about 3-5 years (J. Hanson pers. comm.). It is believed that this is the correct frequency to keep up the supply of 'green pick', as the fresh shoots are called. This regularity of burning is only obtained in areas of easy access, such as along

roads and tracks. Extensive areas of less accessible heath community have moved towards a closed scrub. References to Aboriginal burning are abundant and I shall return to this point later.

- Tea-tree swamp communities (Plate 2.3)

Sheltered waterlogged locations are described by the explorers as supporting tea-tree communities. These are easily recognisable as the Melaleuca spp. and Leptospermum spp. dominated communities which develop into a very dense forest of low trees in sheltered swamp localities. The blackwood tree, Acacia melanoxylon, which is cut for milling, grows in the larger swamps. East of the coastal strip, some large areas of tea-tree swamp have been altered by draining and clearing for farmland, e.g. Togari, but the swamps near the coast are not large enough to warrant this sort of activity.

- Forest communities

When the Europeans began to explore the west coast, there were no rainforests along the coastal strip, although large areas inland were dominated by a Nothofagus cunninghamii community. Patches of eucalypt forest did occur on areas of better soil, such as the basalt soils of Mount Cameron West and the Port Hills. The vegetation structure appears to have tended towards an open woodland.

Today the Port Hills are largely cleared for pasture, but stumps of large Eucalyptus trees remain. The southern and eastern lower slopes of Mount Cameron West are now an open woodland of E. viminalis-E. ovata over a Poa grassland and Lomandra longifolia tussock understorey (Brown 1980:26). This area probably looks much as it did when the first settlers arrived, but other parts of the mountain are under pasture.

- Grassland communities

The early explorers were looking for areas suitable for sheep and cattle, so perhaps these communities were 'over recorded' in their diaries and reports, while too little mention was made of less economically valuable communities. Fortunately, maps of areas suitable for sheep were made by Van Diemen's Land Company surveyors and the diaries and reports can be cross-checked against these. The level of agreement is surprisingly high. Figure 2.9 is an example of



Plate 2.3 Rebecca Lagoon. A large dune barred swamp
with a stand of tall Melaleuca ericifolia
trees on the left side.



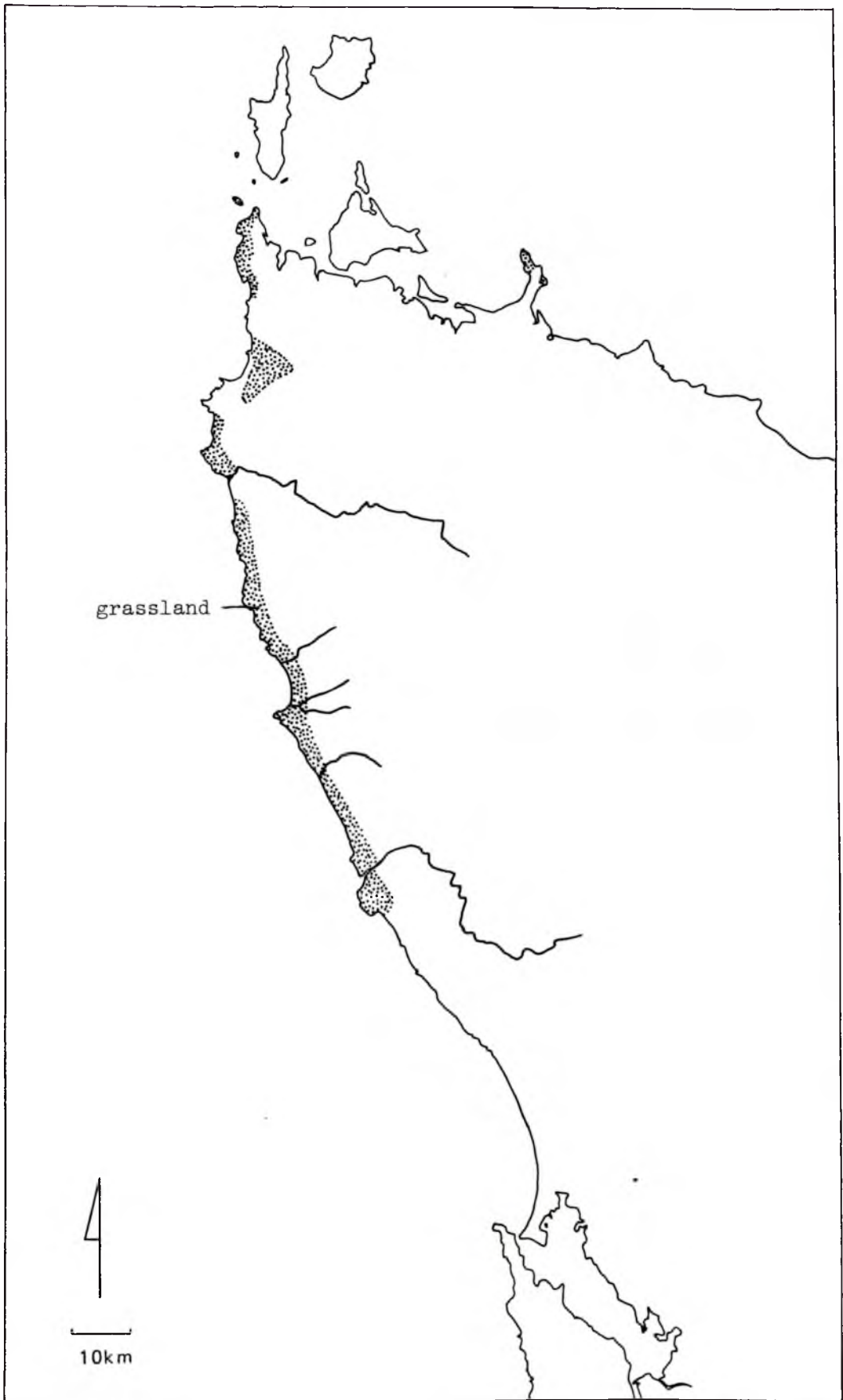


Figure 2.10 The coastal strip of Figure 2.9 redrawn on a modern base map

one of these maps. Figure 2.10 is an attempt to redraw this on a modern base map. The scenario conveyed by the early accounts is of large tracts of grassland with scattered trees and shrubs on southwest Hunter Island, Woolnorth Point to Studland Bay, Mount Cameron West and a discontinuous coastal strip from Mount Cameron West to about 10km south of the Pieman River. The descriptions repeatedly mention grassy hills, park-like appearances and suitability as sheep runs. The scattered trees noted in this community are Banksia marginata, Melaleuca spp., and dwarf gum - probably the mallee form ^{of} E. nitida. The only grass species named is 'kangaroo grass' (Goldie 1861:6, Plomley 1966:619). J.D. Hooker in the Flora of Tasmania describes Anthistiria australis R. Br. as having the "Colonial name - Kangaroo Grass" (1860:107). The scientific name for this species has since been changed to Themeda australis but it is still called 'kangaroo grass' (M. Cameron pers. comm.). However M. Brown (pers. comm.) suggests that the habitats which Robinson describes do not sound right for Themeda but seem more appropriate for Poa poiformis or possibly Poa labillardieri. Themeda occurs on calcarenite ridges and swales but avoids siliceous sands or recent dunes. The Poa spp. are rarely found more than 500m from the sea (G. Hope pers. comm.).

The attempts to run sheep on these grasslands were short lived, lasting less than five years. Soil mineral deficiencies, particularly of cobalt and copper (C. Bastick pers. comm.), produced a condition called 'coastiness' and many animals died. By 1834 the sheep had been removed from West Point and Studland Bay (Plomley 1966:844). Later cattle, which are more resistant to these deficiencies, were tried, usually on a short term basis such as while being driven to market at the mining towns further south. Today most of the region is only used for winter agistment of cattle, a form of regulated free range grazing.

These prehistoric grasslands grew on two soil types - basaltic soils at Cape Grim and the Port Hills, and sandy soils on Quaternary sandsheets on Hunter Island, at Studland Bay, north of Mount Cameron West and on the discontinuous strip south of the mountain to the Pieman River. The basaltic soil areas have mostly been cultivated and sown to pasture (see Appendix 5, references 4, 7, 8, 9, 10, 15, 18, 19, 21, 23). The sandsheet grasslands have changed in other ways.

The sandsheets on which the grassland community grew have been drastically altered in most areas (Plate 2.4). Deflation of the sand dunes by wind is one of the outstanding features of the west coast today. The development of the sand blows is poorly documented but they are not mentioned by any of the explorers. Legge (1929:323-324) cites second hand description of the process starting after 1880.

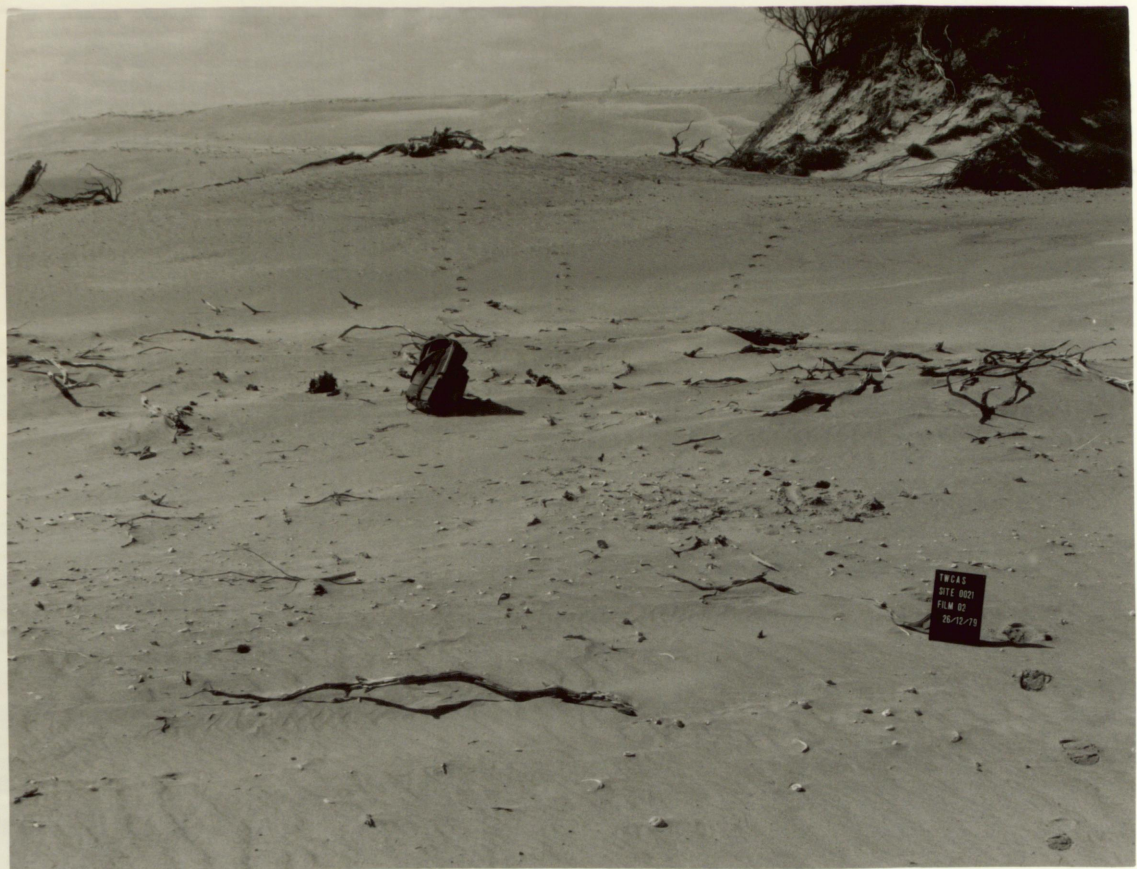
"Pioneer settlers of this coast, such as those of Marrawah, for instance, can remember, when, some 45 years ago, they first took up land out there, these great sand-dunes being covered with dense coastal scrub right down close to the edge of the wild beaches, but since the introduction of stock, and on account of the periodical burnings by the graziers for improvement of the rough pastures, the surface of the light soil has been broken, and tracks and pathways have been made, allowing the wind to make inroads upon the sandy soil, laying bare the roots of plants and trees, carrying on its work of denudation, leaving today many areas of absolute desert land"

The process is continuing today in spite of some 50 years of marram grass planting programmes in the area (D. Steane pers. comm.).

It would normally be difficult to estimate the area of these landscape units without lengthy calculations. Fortunately, the coastal mapping operation of the CSIRO Division of Land Use Research provided a way of estimating the total Holocene sand area and the area of bare Holocene sand (Galloway et al. 1980). The CSIRO system's measurements are based on point samples spaced over air photographs so as to give one sample per 3 sq. km (Galloway et al. 1980:7). Application of this method of sampling for the coastal strip from Woolnorth Point to Macquarie Harbour gives estimates of 165 sq. km of Holocene sand, of which 66 sq. km or 40% is bare of vegetation. As restabilised areas of marram grass are not included in the bare sand unit, the area of Holocene sand which has been unstable in the recent past is even greater. So of the areas formerly described as grassland communities on stable sand dune landforms less than 60% remain. The largest grassland remnants are at Temma, Australia Point, Arthur River mouth and southwest Hunter Island. Of these, Hunter Island conforms most closely to a structure commonly described in 1820-1840, i.e. of a grassland with scattered emergent low trees of Banksia marginata and Eucalyptus spp. - almost a 'savannah' pattern.

Plate 2.4 Open grasslands on stable sand dune landforms which are reminiscent of the accounts of early explorers. This example comes from Cuvier Point on Hunter Island. In the background is Steep Island.

Mobile dunes with deflated midden materials are typical of most areas of Quaternary sediments on the west coast. In the upper right corner is a small vegetated remnant which gives an idea of the height of the original surface.



Relict dune landforms with grassland seem to have survived where the foreshore contains extensive rock platforms e.g. Greenes Creek, north of Temma, north of Lagoon River or where the beach line is aggrading e.g. the south half of the Ocean Beach. These situations lessen the probability of the front dune being undercut by wind or wave removal of sand. Kirkpatrick (1977:70) describes small areas of natural grassland on a narrow coastal strip and in a few swales in the Holocene sand dune complex at Ocean Beach. The coastal strip north of Trial Harbour is dominated by Poa poiformis tussock grass.

In the summers of 1979/80 and 1980/81 samples of the most common grasses of the remnant grassland community in the vicinity of West Point were collected. Surprisingly, about half the species in this area of marginal land with minimal management proved to be exotic (Table 2.3). Management today consists solely of firing the vegetation to produce new growth, or 'green pick' in the local vernacular. In the past there may have been more intense management. There is a folk tradition that farmers would travel along the coast on horseback and flick lighted matches into the vegetation to start fires. On the return journey they would carry a bag of mixed grass seeds on the front of the saddle and scatter seed over the burnt ground. At least one of the grasses in the mixture was likely to find conditions suitable for growth. Introduced grass species would also be carried into the area in the gut contents of horses and cattle. Many of the species in the list are no longer regarded as pasture grasses, but were introduced for that purpose. Some have a very short growing season and could not compete in modern pastures. The presence of clovers adds an interesting complication. These nitrogen fixing legumes increase soil fertility, thus facilitating invasion of new species not adapted to the poor native soils.

2.5.4 Vegetation change and the stability of sandsheet landforms

In describing the coastal landforms of Tasmania Davies notes two forms of dunes. One of these is the small 'beach ridge' type which lies parallel to the shore, while the other is a 'transgressive dune originating from wind erosion of a pre-existing stabilized dune' (1965:22). Davies suggests there is evidence from many coastal areas that the present cycle of transgressive dune development began in the nineteenth century as a result of burning and stocking of

	Indigenous	Exotic
<u>Agrostis stolonifera</u>		x
<u>Asperula conferta</u>	x	
<u>Bromus diandrus</u>		x
<u>Cakile edentula</u>	x	
<u>Dactylis glomerata</u>		x
<u>Danthonia sp.</u>		x
<u>Danthonia sp. (not the same)</u>		x
<u>Dichondra repens</u>	x	
<u>Epilobium hirtigerum</u>	x	
<u>Holcus lanatus</u>		x
<u>Juncus articulatus</u>	x	
<u>Lepidosperma gladiatum</u>	x	
<u>Lotus australis</u>	x	
<u>Lythrum hyssopifolium</u>		x
<u>Medicago lubulina</u>		x
<u>Melilotus indica</u>		x
<u>Parentucellia viscosa</u>		x
<u>Plantago coronobus</u>		x
<u>Plantago lanceolata</u>		x
<u>Poa pratensis</u>		x
<u>Poa rodwayi</u>	x	
<u>Scirpus nodosus</u>	x	
<u>Senecio hispidulus</u>	x	
<u>Stipa stipoides</u>	x	
<u>Tetragonia implexicoma</u>	x	
<u>Trifolium repens</u>		x
TOTALS	12	14

Table 2.3 Most common species for remnant grassland area at West Point.

dune country previously stabilized by vegetation.

The mechanics of the formation of unconsolidated dunes is described by Macphail et al. (1975:59).

"This process starts usually with fire damage to the vegetation on the front of the foredune, or from damage by vehicles or cattle to the base of the dunes. Removal of sand undercuts the vegetation higher up the dune, with consequent slumping and removal of the unconsolidated sand by wind funneling. Sand moved from the dune front is deposited on the lee of the front dune, burying the heath and scrub. Eventually a break in the front is established and the wind funneling through the gap moves the sand landwards, covering extensive areas of dune ..."

Causes of dune destabilisation are often commented on in other botanical studies in the region. Brown (1980:29) suggests mechanical damage through over-grazing and too-frequent use of fire to provide 'green pick'. Cattle are certainly new factors, but fire has been used by people to alter the coastal vegetation for millennia (Jones 1969). The questions are - what was the prehistoric fire pattern like? Why did the Aborigines burn the vegetation? What were the patterns of seasonality and frequency? Did these reasons and patterns change with the arrival of Europeans?

2.5.5 Aboriginal and European firing patterns

Fires can be started by lightning (Mount 1964). In this discussion the reasonable assumption is made that the nature, frequency and intensity of natural ignition events did not change with the arrival of Europeans.

The first recorded indication that Tasmania was occupied was the sighting of bush fires by Abel Tasman in 1642 (Chapman 1980:40). Later accounts by the early explorers contain numerous references to sightings of fires or smoke. Some descriptions may refer to either Aboriginal camp fires or bush fires. Only rarely is there an unequivocal statement like Baudin's description of the D'Entrecasteaux Channel in 1802 "... the mountains... had been constantly on fire since our arrival". A day later he states "the entire coast to port was ablaze" (Cornell 1974: 331-332).

Robinson recorded a variety of reasons for burning the bush. Fire was used to drive animals from cover in hunting (Plomley 1966: 840,629). Another aim of burning was to open up dense vegetation (Plomley 1966:54,376). This would be done to make travelling easier (Plomley 1966: 287-288) or to keep tracks open (Plomley 1966:520). This practice was continued by many explorers and prospectors. There is a hint by Robinson that the Aborigines with him burnt dense underwood to get rid of mosquitoes (Plomley 1966:840). This would be an extremely effective mosquito repellent! Bush fires were used by groups of Aborigines to advertise their position (Plomley 1966:862-863, 288, 513, 740). Aborigines with Robinson on a hill slightly west of Bothwell were prepared to assert that a yellow tinge in the sky far in the west was the result of the natives of the west coast "burning the woods in those parts" (Plomley 1966:523). Lighting fires to mark location was also practised by Europeans (Cornell 1974:441).

While on a lookout, a companion showed Robinson the route of a "native track which was visible from the burnt ground" (Plomley 1966:905). This pattern of firing along access routes has continued up to the present. It is particularly noticeable on modern air photographs of the study area. Many of the modern roads follow prehistoric routes through the study area, perhaps because they developed along routes of easy foot travel through open (i.e. well burnt) country.

As the Aborigines travelled they would light bushfires which could supply them with fire if the firestick they carried went out (Plomley 1966: 560; Cornell 1974:307). If their fire did go out, they had no means of kindling another (Plomley 1966:740).

The earliest firestick description I am aware of is from 1772 when two of Marion's men were presented with a firebrand after swimming ashore (Roux in Plomley 1966:38 and Duclesmeur in Plomley 1966:39). In 1789 Mortimer observed several natives "with pieces of lighted wood in their hands" (Mortimer 1975:18). There were probably preferred types of wood for firesticks. Use of sheoak, *Casuarina* spp. (probably *C. stricta*), is mentioned by Robinson (Plomley 1966: 385), but casuarinas are not available in many parts of Tasmania, so other types of wood must also have been used. Labillardiere (1800:62-63) noted that one of the natives "carried a piece of decayed wood in his hand, lighted at one end, and burning slowly",

but did not comment on what type of wood was used. Robinson also notes the use of tea-tree bark (Melaleuca spp.) for torches. His use of the term 'torches' shows he distinguished them from firesticks. The tea-tree has a layered papery bark which burns very rapidly. It provides a very good light, but is not suitable as a means of transporting fire.

With the arrival of European settlers with their stock, the practice of firing the country was quickly adopted. It was formally advocated in 1828 by a government surveyor as a means of making land suitable for grazing (Wedge 1861:1). Robinson notes his uncertainty as to the origins of a fire just below the Western Tiers in 1831 (Plomley 1966:546). In 1834 he notes: "saw the white man's smoke near Port Sorell" from the top of a hill near the Western Tiers (Plomley 1966:905 ; 920 n 136).

2.5.6 Seasonality of burning

To look at the seasonal pattern of Aboriginal burning I have confined my search to Robinson's journals, and within them to his observations of bushfires or recently burnt ground. Some fires recorded may have been started by lightning, but this factor cannot be evaluated.

There are not enough records from the northwest corner of Tasmania, so I have listed his observations throughout Tasmania. The occurrence of fires by month of year and region is shown in Table 2.4. Even though the total of 19 observations is small, there is a surprising agreement between the pattern for the northwest coast and the remainder of the island. The overall pattern can be interpreted in several ways. Firstly, burning occurred at all seasons of the year. This is an important point; lightning fires would have mostly occurred in summer. Secondly, the summer season of December through to March accounts for 9 out of 19 observations, suggesting three possible interpretations. One, firing was more common in summer. Two, summer fires burnt for longer. Three, summer fires covered larger areas than winter fires and so were more visible. Also, Robinson preferred to carry out field operations in summer, which leads to an imbalance in the seasonality of his records. One longtime resident of the west coast, Mr. R. Wainwright, has described the burning patterns followed in the 1920's and 1930's on Woolnorth, the Van Diemens Land Company property at the north end of

	N part of W coast	Other parts of Tasmania	Total
Observations			
January		839,840	2
February	849	842,842	3
March	858,862	136	3
April			
May			
June	172,184		2
July	760	188,375,898	4
August			
September			
October	673	249,260	3
November		285	1
December		560	1
		GRAND TOTAL	19

Table 2.4 Robinson's observations of bush fires and recently burnt areas.

Page numbers refer to Plomley (1966).

the study area (pers. comm.). Management here was typical of the northwest region from the 1830's to about 1950. All the country was kept well burnt. The higher plains country was fired in September as soon as it was dry enough. The lower country and swamps were fired in summer, but while the peat was still too wet to burn. If the grazing land was not burnt regularly it would change from grassland to scrub. The transition from grazing land to scrub has since occurred at Welcome Marsh and several other areas as regular firing was not continued after about 1950. Mr. Wainwright also commented on two important prehistoric food species which were snared for skins and meat by settlers, the Brush Possum, Trichosurus vulpecula and the Red-bellied Pademelon, Thylogale billardieri. In his days as a snarer, they would burn eucalypt forest to encourage the regrowth on which the possums feed. Unburnt forest had very few possums. Similarly, snarers got few wallabies in unburnt areas and these animals were usually in poor condition. So burning improved the living conditions of both possums and wallabies.

The study of fire ecology is a relatively recent development of botanical research in Tasmania and it is sometimes an area of emotional contention. To date attention has focused on forest succession (Jackson 1968; Mount 1964:1979), with only passing comment on coastal heaths (Jackson 1965:30). Kirkpatrick's review of heath communities (1977a) deals only with Hunter Island in the study area. Judging from the evidence reviewed, there were no detectable major changes in fire frequency in the transition from Aboriginal to European occupation of the west coast (Kirkpatrick 1977b). If this is so, then a change of fire frequency is not the cause of the present sandsheet mobility. Although the ultimate aims of the two cultures were irreconcilable, the means they used to manage the vegetation were similar. The arrival of cattle on the landscape is the factor which coincides with the destabilisation of the grassland community on sandhills. Historical evidence in the study area suggests that the effect of cattle grazing on the sandsheet landforms does not necessarily lead to the development of sand blows, but in the majority of locations this has occurred.

Today, there is a new vegetation type which dominates a large proportion of the coast - the marram grass community. Marram grass, Ammophila arenaria, is a species which colonises and binds free sand much more rapidly than native grasses. It was introduced to

Australia by Baron von Mueller and was being used in northwest Tasmania at Stanley to stabilise mobile dunes by 1895 (Ashworth and Le Souef 1895:136). Being a specialised colonising plant, it cannot compete with established vegetation, but the destabilisation of the coastal sandsheets and deliberate planting programmes account for its widespread distribution. In the vegetation of the 1820's and 1830's it would probably not have been able to gain a place.

2.5.7 Summary of the vegetation changes

Of the vegetation communities found on the west coast during the exploration period of 1820 to 1840 the one which has persisted most successfully is the heath community. The small swamps of the coastal fringe have also remained. The bulk of the woodland community on the basaltic soil areas has been cleared and sown to pasture, while the woodland community is now seen only as remnants. The grassland community on stable sand dune landforms has changed in two ways. Firstly, the remnant stable dunes in the area now contain many introduced species. Secondly, a large proportion of this landform has destabilised into mobile sandsheets. On these unstable sandsheets a new community has developed, the marram tussock grass community.

The date of the initial development of the sand blows is uncertain, but none of the explorers record observations of unvegetated sand dunes, although it seems probable that some existed.

By 1894 there were sandblows at Stanley on the north coast (Ashworth and Le Souef 1895:136). By 1934 sand blows at Sandy Cape had extended 3.2km inland (Circular Head Chronicle 31.1.34 p.1). The probable date of the start of the process is between 1848 and 1890.

From the evidence reviewed on Aboriginal and European use of fire, there is no definite indication of a change in frequency or seasonality pattern. The introduction of European stock is the factor which coincided with the start of widespread sand dune mobilisation.

2.6 CONCLUSION

This chapter has described aspects of the biophysical landscape of Tasmania in the recent past. It has been demonstrated that in some ways the landscape has changed since the time of European contact to an extent which was not recognised by previous archaeological or biophysical studies. The physical environment affected people in many ways, for example, by determining the distribution of littoral animal resources such as shellfish and rock lobster. Other effects could operate directly on people, such as where the sea state controlled access to these animal resources. Another important marine resource was seals. It was shown that the different species vary widely in habits and size, so any reconstruction of their seasonal availability or importance in the diet will need to deal with each species separately. Although changes in the distribution of seals since the contact period have been well documented, changes in the vegetation patterns of the coastal fringe have not previously been clearly recognised. Much of the Quaternary sand areas which were originally described by explorers as grasslands suitable for sheep grazing are now mobile dunes. In this destabilisation process, any archaeological sites would have been deflated or buried, so that any attempt to map the settlement patterns of Aborigines must take this landscape change and its archaeological impact into account.

3.1 INTRODUCTION

The purpose of this chapter is to introduce the types of archaeological sites which are found in the study area, and the terms that I use to characterise them. A model of the flow of materials into and out of a simplified midden is presented. The model is based on the ethnographic material and the archaeological information presented in this chapter, as well as the biophysical information presented in Chapter 2.

3.2 PREHISTORIC SITES

3.2.1 Overview

The most common types of archaeological relic in northwest Tasmania are shell middens. The descriptive system used here for middens was proposed by Ranson (1978:12). It is objective but arbitrary, implying no order of "primitiveness", frequency of use or cultural importance. Other types of sites encountered in the survey were scatters of worked stone, isolated artefacts of worked stone, rock engravings and stone arrangements.

3.2.2 Definition of terms

Small midden dump

Small midden dumps are middens up to 5m in diameter. They often have a distinctly convex form. In the survey an arbitrary minimum number of shells had to be observed before the site would be recorded as a shell midden. This was set at 10 shells.

Medium midden dump

Medium midden dumps are between the small midden dumps and the larger linear or West Point types in size. The minimum diameter for the medium midden category was set at 5m. Once again they often have a distinctly conical or near conical mound shape.

As no medium midden dump has been illustrated previously, a typical example was chosen for mapping (Figure 3.1). The example is site 50 at West Point. In shape it is roughly circular, with a raised centre. It caps the sloping end of a raised cobble beach ridge. It is composed of shells of Subnivalia undulata and Dicathais sp. in a matrix of sand. The surface supports a dense cover of short herbs. Its volume is estimated at 10 cu. m.

Doughnut midden

Doughnut middens are toroid in shape with an outside diameter of up to 13m. The depression in the centre is generally about 5m in diameter and 0.5m deep (see Plate 3.1). On the basis of the ethnographic observations and archaeological excavations (J.F. Jones 1947:1; Ranson pers. comm.), it is likely that ^{they mark} the remains of huts.

The dimensions and construction of huts were described ethnographically (Plomley 1966; Beaglehole 1969:734). I believe they were first described in a field archaeological sense by J.F. Jones (1947:133). Doughnut middens often occur in clusters and are then classed as West Point type middens.

'West Point' type midden

The 'West Point' type midden derives its name from the excavation by R.M. Jones of a site near West Point in 1964 and 1965 (Jones 1966). Jones called this site the 'West Point midden'. In my records it is number 118. This type of midden consists of a collection of doughnut middens, usually capping a dune (Figure 3.2). They correspond to Robinson's description of 'villages' (Plomley 1966) and to a sketch of one of the 'villages' which Robinson described: "Saw several native habitations on the declivity of a hill dug out of the sand and towards the top, thus" (Plomley 1966:790). I feel it is preferable to use the term West Point type midden rather than village site at this stage. The term 'village' implies a stable residential group living in permanent houses, but it does not appear that Robinson was referring to permanent residential bases when he used the term. There is evidence of seasonal mobility with groups moving up and down the coast using a series of

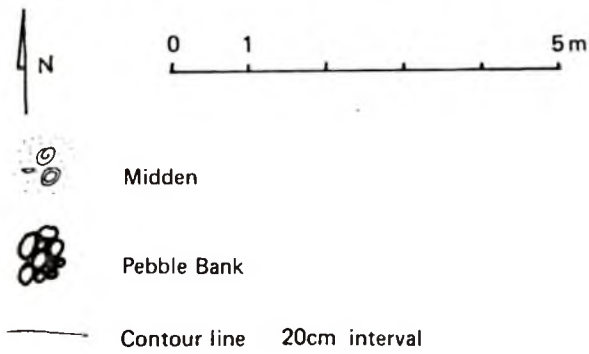
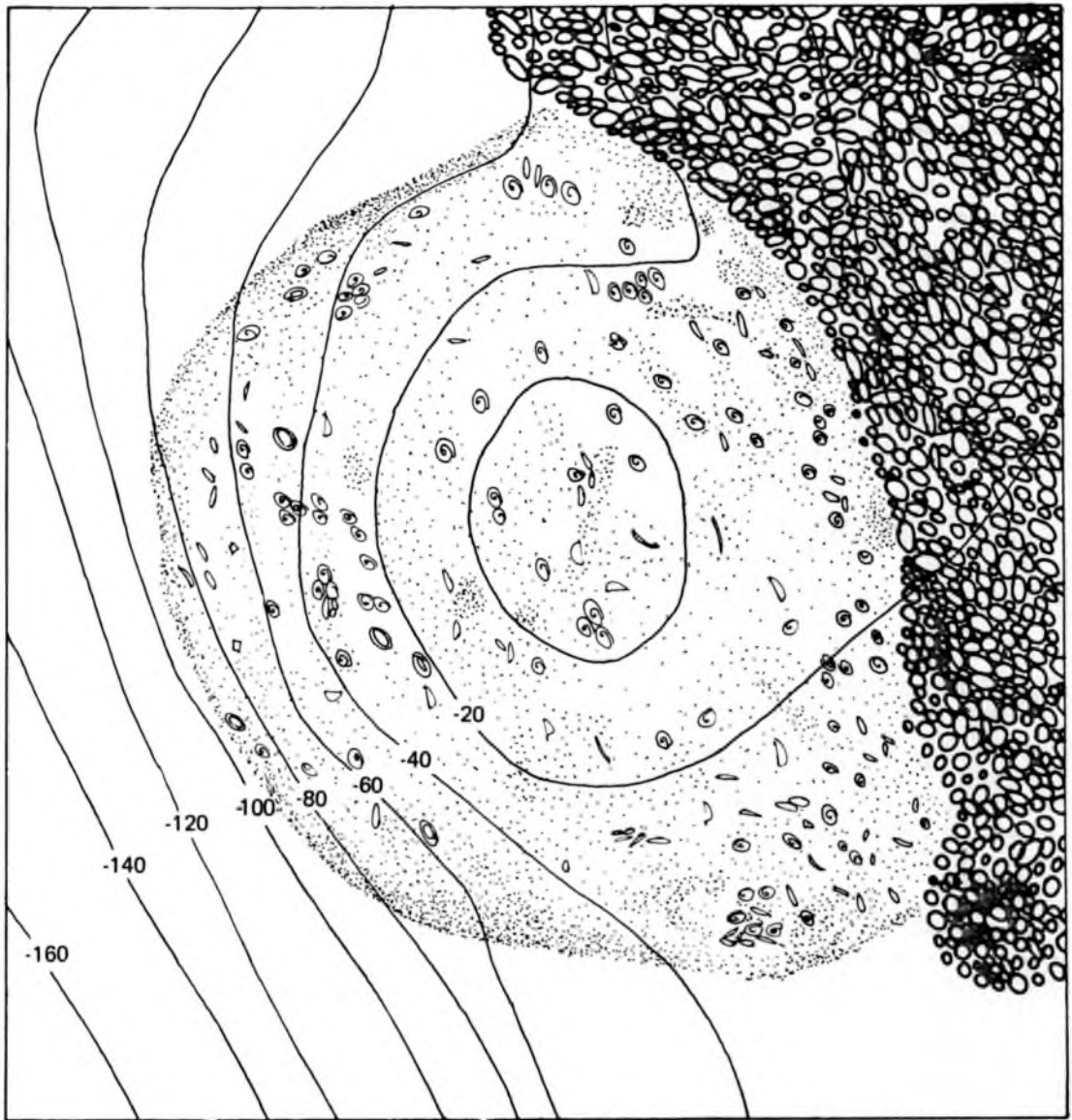
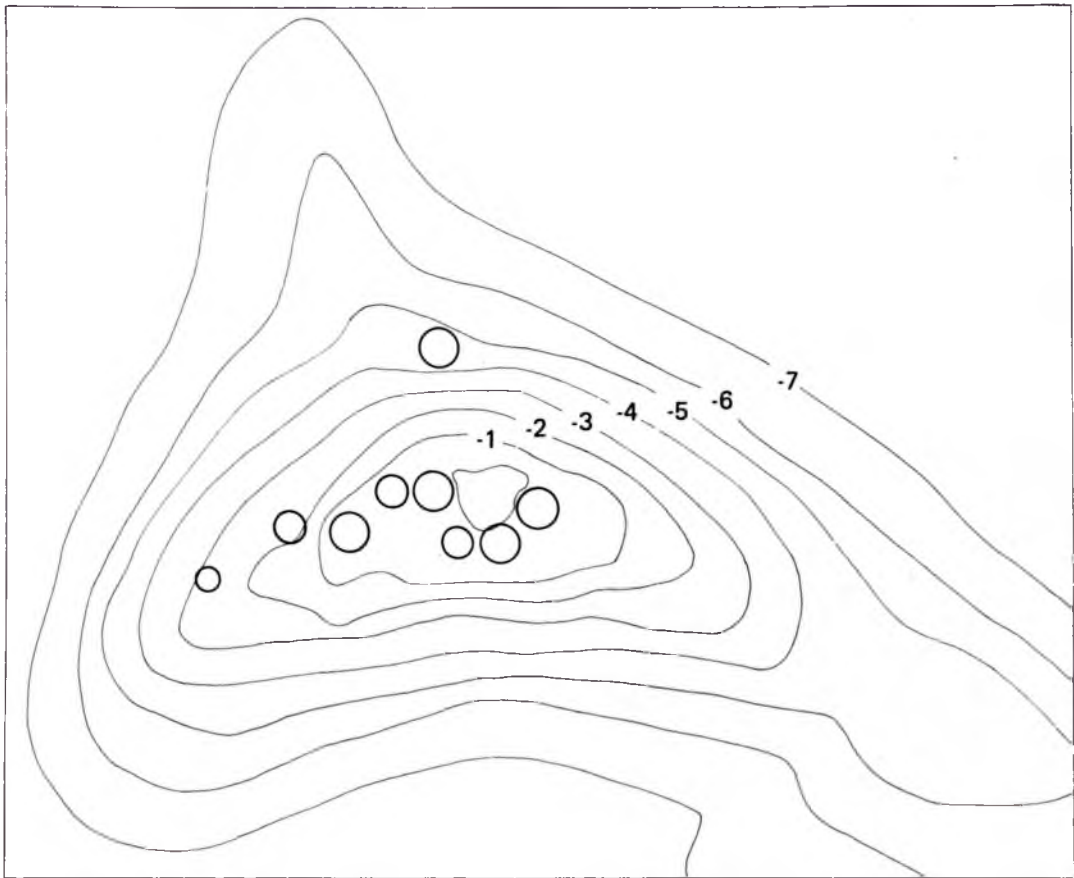


Figure 3.1 Site 59, a typical example of a "medium midden dump".



10m

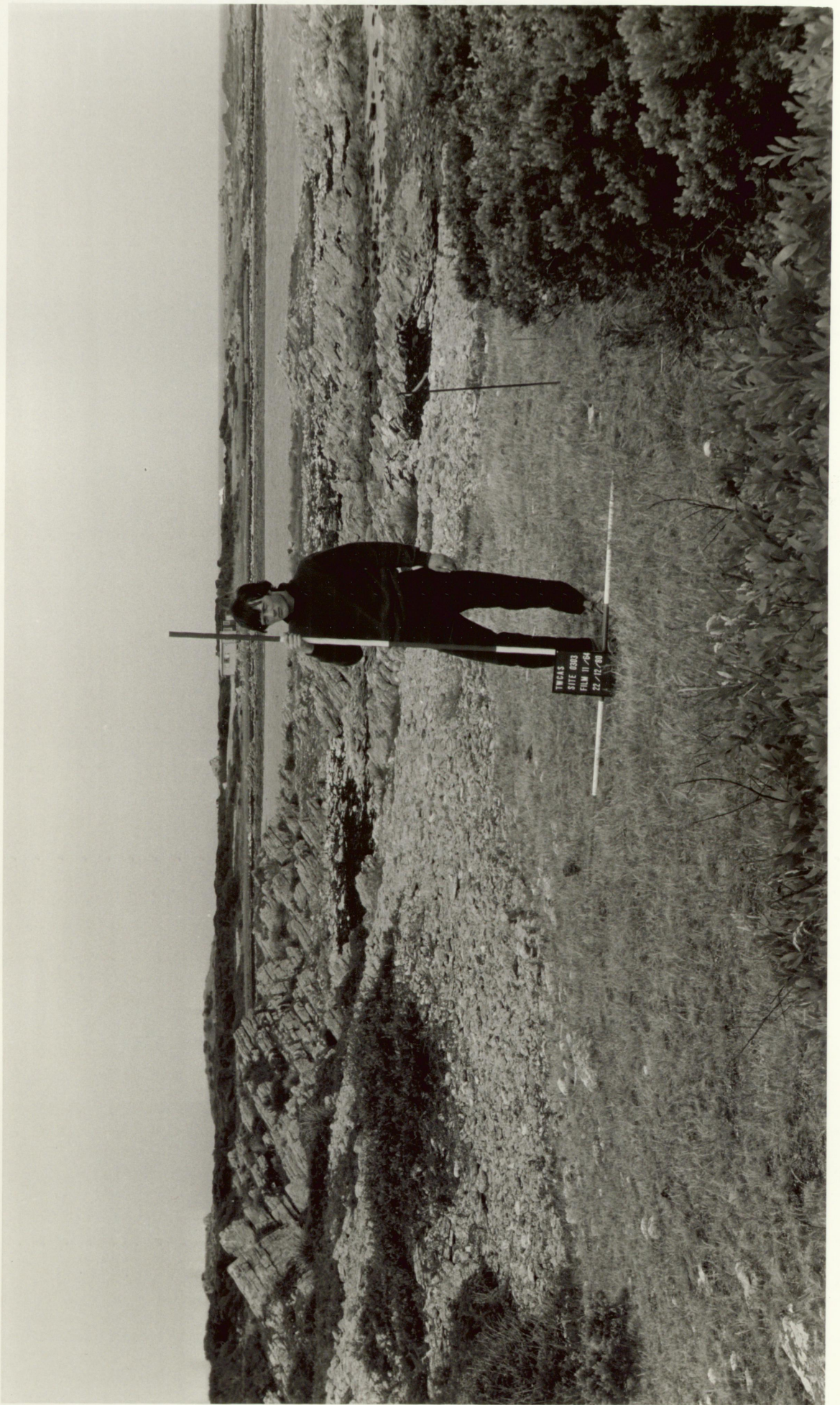
Contour interval 1m

○ ○ Depression

Site 118, the 'West Point midden' excavated by Jones.

Figure 3.2 An example of a large midden with a number of depressions which are believed to be the remains of huts

Plate 3.1 Site 303 is a small "doughnut" midden resting on a pebble bank at Nettley Bay. The shallow circular rim of the midden is about two metres across. The grassy vegetation on the surface of the site is typical of shell middens.



'villages' along well defined footpaths.

Linear midden

Linear middens are large amorphous areas of continuous or near continuous shell deposits. They are sometimes composed of a series of discrete but overlapping mounds, which gives the impression of the deposits having accumulated in successive occupations.

Deflated midden

Deflated middens are sites which have been destroyed by wind erosion. Before deflation, the middens could have been any of the types described above. Wind removes the sandy matrix and substrate, and leaves a lag deposit of the heavier materials, e.g. bone, stone and shell. Although deflated middens pose problems for accurate calculation of volume, an attempt was always made to estimate the original volume. On the other hand, the extremely high visibility of the components enhances the description of the contents.

Rock shelter midden

This term describes any midden in a rock shelter or cave. The volume and contents of the deposit were recorded in the usual way on a coding sheet so these could be compared with open sites. Supplementary data on the floor plan and cross section were recorded in the field note book.

Isolated finds and scattered worked stone

An isolated find is one flaked stone artefact found with no other archaeological material in the vicinity. A scatter of worked stone is simply a number of stone artefacts found together, but with no other cultural material nearby. Artefacts were arbitrarily considered to be associated if they lay within 20m of each other. Isolated finds and scatters of worked stone were not usually recorded in deflated dunes because of the problems of determining the original context of the artefacts. In undeflated areas they were fully detailed in the standard data

sheet format up till site number 553. After this site, my survey strategy was changed. A sufficiently large sample of non-midden sites had been obtained and it became important to increase the number of middens in the total survey. As it took as long to record an isolated artefact as a large midden, the saving in terms of time in the field was considerable. Subsequently to site 553, isolated and scattered artefacts were only recorded if of special interest.

Engraving

An engraving site is a simple name for any Aboriginal engravings on rock. Engravings were recorded in this study, but not in detail. For descriptions of various engravings see Stockton (1977d), Sims (1977), Meston (1931, 1932), Scott (1931), Bowdler (1974), Murray (1980) and Gunn (1981).

Stone features on cobble banks

As with rock engravings, a detailed investigation of stone features was outside the aims of this project. Stone features on cobble banks have been identified as probable Aboriginal constructions (Jones 1965a; Stockton and Rodgers 1979; Cane 1980) but there is a lingering doubt about their origin. Such features occur on the surface of raised banks of stones which are probably stranded storm beaches from one to four metres above the present sea level. The features consist of rocks forming cairns, bird-nest shapes, pits and other irregular shapes.

That natural factors could account for the range and distribution of all stone features which have been recorded in Tasmania is unlikely (pers. comm. E. Colhoun). It is conceivable, however, that isolated simple pits could form by an erosion and slumping mechanism. Therefore, in the present study I have chosen to err on the side of caution. If there was any doubt as to whether a stone feature was Aboriginal in origin, it was not recorded.

Stone wall fish traps

Fish could have provided an important protein resource in

the recent prehistoric past, yet they do not appear to have been exploited after about 3,500 years BP. Although all the traps I have found in Tasmania are probably of European origin, it is worth considering whether fish traps could have been the method by which the Tasmanian Aborigines caught fish before dropping them from the diet. If the Aborigines had used fish traps, a wide range of species would be expected in sites. This does not occur, since parrot fish dominate the fish bones at Rocky Cape (Jones 1978:27) and leatherjackets at Little Swanport (Lourandos 1970:42). Historical records describe the use of fish traps by colonists in the 1870's and it seems probable that it was during the colonial period that such traps were first made. This problem is discussed in more detail in Appendix 3.

3.3 A MIDDEN MODEL

3.3.1 Purpose

Analysis of ethnographic and archaeological sources presented earlier in this chapter provides information with which it is possible to construct a model of the flow of materials into and out of a midden. A midden is a rubbish heap, with elements such as food and building materials which were transported by various means from a variety of sources (Figure 3.3). Generally, people added components which came from close at hand, but some such as fine stone materials for tool making were from places over 50km away (Jones 1971b; Sutherland 1972a). Physical agencies such as wind and waves brought sediments and reworked or removed midden deposits; animals came on to sites both as food and as scavengers; and chemical and physical breakdown of organic material occurred as it became part of the midden.

The model is concerned only with material flows. It does not consider behavioural variables such as the choice of a site or the pull to a particular location in order to exploit a favoured or seasonally abundant resource. The remainder of this chapter discusses this model as a background to the analysis of the results of my survey data in the subsequent chapters.

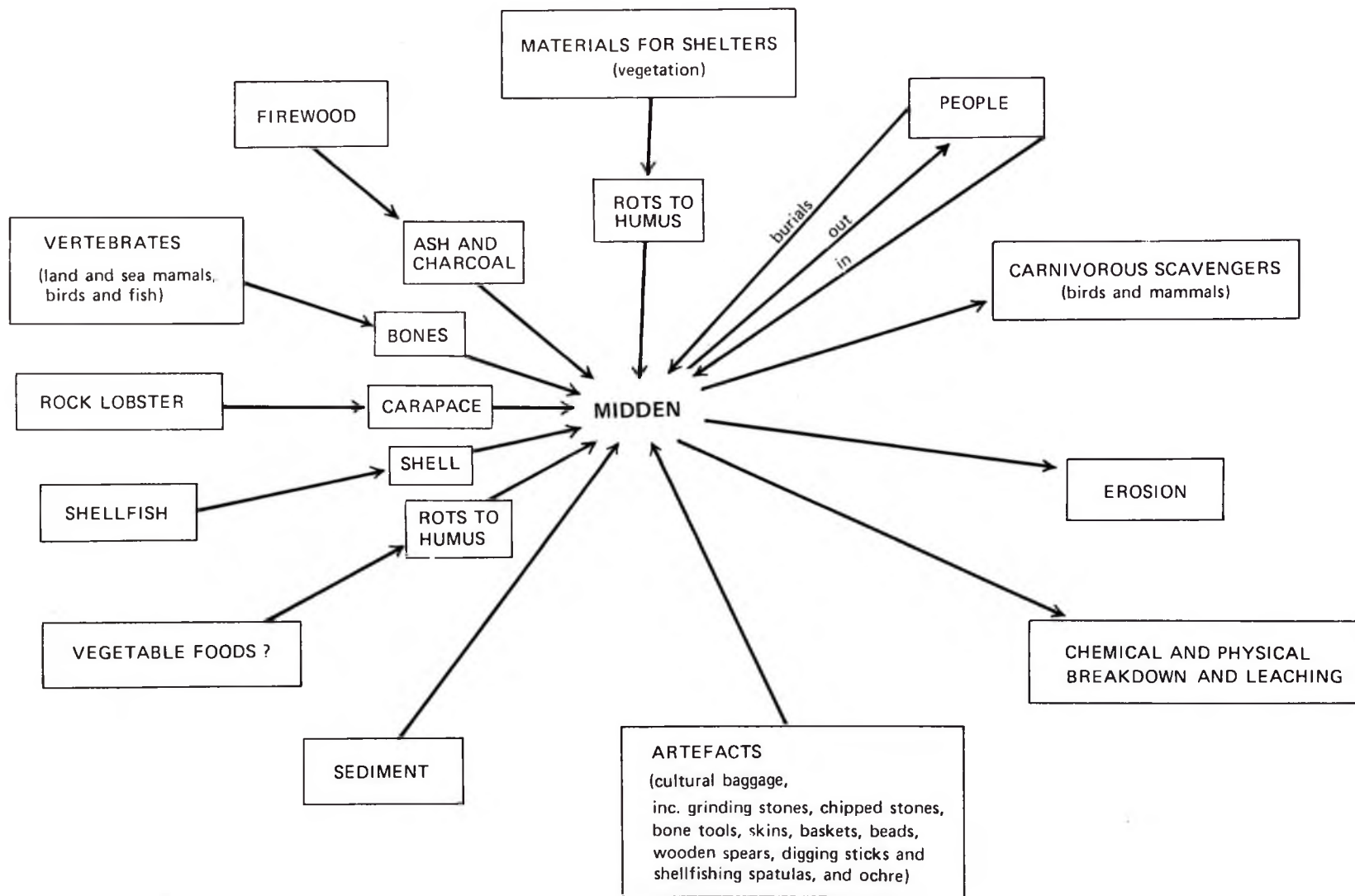


Figure 3.3 Flow of materials into and out of a shell midden

3.3.2 Inputs

The remains of mollusc shells are the most conspicuous components of coastal middens. They form a large fraction of both the volume and weight of a typical midden. Because shells weather to a white colour, they are easily seen in the field, even if only a few shells are scattered on the surface. Because shells are large robust objects, middens are less susceptible to physical disturbance than, for example, fine sediments in rock shelters, or open sandy sites. So even though some surface disturbance is to be expected (Hughes and Lampert 1977; Jones 1980c), once buried they are likely to remain undisturbed. A wide range of species was found, generally reflecting the larger types which are available in the nearby shallow waters. Where large accumulations of shells occur, they create an alkaline environment, so inhibiting their own deterioration by chemical attack. This alkaline environment also favours the survival of bone, which is often excellently preserved.

Vertebrates were used for food and this has left bones, many of which are broken into fragments. In this study bones of land and sea mammals and birds were recorded. Fish bones have been recovered by excavations of sites older than 3,500 years (Jones 1978:26), but none was found in this study. It appears from other evidence that very few middens are old enough to contain fish bones. This is a point which I will return in Section 7.4

Invertebrates, crustaceans and molluscs appear from the ethnography to have been very important (Hiatt 1967:110 and see Section 3.3). No crustacean ~~carapace~~ remains were recorded in the survey, but they have been found in the excavation of site 478 at Sundown Point (D. Ranson pers. comm.).

The use of vegetable foods is well documented in the ethnography and has been summarised by Hiatt (1967:131). In open sites these materials would decay and leave no macroscopic archaeological evidence and none was recorded in this study.

Fire for cooking and warmth was part of everyday life, so vast quantities of firewood would have been collected, bought onto the site and burnt. Ashy sediments and charcoal were the end results of this process.

In Tasmania people built wind breaks and huts. The frames were made of saplings and branches and the covering consisted of leafy branches, bark sheets and grass. These materials would decay to leave no archaeological traces.

The occupants themselves move onto and away from sites, bringing with them and taking away their cultural baggage. Some people died on the site, their skeleton either to be purposefully buried (Jones 1966:8) or apparently simply incorporated into the midden (Stockton and Wallace 1979:149). People used a range of artefacts, and after a time some of these became incorporated into the midden. By far the most common artefacts found in this study were made of flaked stone. Grinding stones or spatulas and points made of bone were rarely found. Bone points have not been found in deposits which are younger than 3,500 years, so their absence is consistent with my dating results which show that most west coast middens are not that old (Chapter 7). What appear to be beads or pendants made from larger shells and pieces of stone have been found in archaeological sites (Stockton 1976:158; Jones 1966:8), but their identification as beads is usually speculative. Several unusual shells with holes were recorded in this study, but they were quite rare. Ochre mixed with grease was used by members of both sexes to dress their hair and coat their skin. Although ochre has been found in several excavations (Lourandos 1970:51; Jones 1965:195), it was rarely noted during this study. Other common items of cultural baggage were skins which were used as rough capes, baskets of kelp and grass, and wooden spears, clubs and digging sticks. None of the items on this list has been found in an archaeological context in Tasmania, but the possibility of their survival cannot be overlooked.

Sediment transport was part of the coastal geomorphological process and sediments were trapped in archaeological materials. This typically involved the aeolian transport of sand from the coast to the hinterland, where it was trapped in middens to form the "matrix" of the cultural remains.

3.3.3 Outputs

Materials could be removed from the midden in a variety of ways, including scavenging by larger animals such as the Tasmanian Devil, Tiger Cat, Thylacine and Quoll. The Tasmanian Devil coprolites found in the Enclosed Chamber of Rocky Cape South Cave contained fish and vegetable remains. It is likely that the Devils were scavenging from the Aboriginal midden. Birds such as Skuas and Gulls would have rearranged and removed small items from the midden. Decomposing animal remains would have been especially likely to be removed by these scavengers. In contrast to the mainland, dogs did not reach Tasmania until introduced by the Europeans, so dogs were not a major agent in the reorganisation of camp debris.

Erosion by wind, creeks or wave action may have led to reworking or complete removal of the midden. Sites on the beach or resting on aeolian sand landforms would have been particularly vulnerable.

Finally, chemical and physical breakdown and leaching would remove materials from the site. The soils of much of the west coast are very acidic and would react with bone and shell.

The effects of these processes are collectively called taphonomy which has become a major field of study in its own right. (Shipman 1981, Behrensmeyer and Hill 1980). My review of the taphonomic processes was intended to highlight their importance, and its brevity is not intended to denigrate their significance.

Since the European invasion of Tasmania, middens have been used for their lime content for mortar and garden dressing (Taylor 1892), and artefacts of bone and stone have been removed by collectors. The extent of these activities is difficult to establish, but some sort of fossicking seems to have occurred in every part of the west coast.

3.3.4 Review of the modelling exercise

This simple model was developed to elaborate the processes by which materials can move into, or be removed from, a midden. It does not deal with the internal organisation and rearrangement of these materials during or after occupation. This would be more

profitably done with archaeological excavation or by ethnoarchaeological studies in the context of a living group of hunters and gatherers. Once the material is buried, however, disturbance of the elements can be expected to be minimal.

The information on which the model is based was drawn from historical, archaeological and biophysical sources. Most importantly, it has illustrated that there are not only inflows but also outflows by which cultural materials can be expected to be removed from all middens. In the extreme case, complete sites will disappear. The model has illustrated the sorts of materials which can be expected to survive in a Tasmanian midden site, and thus to be observed in the course of the archaeological survey. Because people were the transporting agents, the sorts of materials brought onto the site and the patterns in which they were deposited were conditioned by cultural factors, so by studying the materials and the ways they were deposited on the landscape, it is possible to study the cultural behaviour of the people.

4.1 PURPOSE

Archaeological survey, the principal method I have chosen to use, can be defined as the application of a set of techniques allowing the controlled discovery of archaeological materials in order to estimate parameters of the regional archaeological record (Schiffer et al. 1978:2). In Chapter 1 I outlined the theoretical issues and practical problems involved in choosing a survey strategy. From that assessment I now turn to the problem of defining an appropriate scheme by which to select areas for intensive sampling. This leads to a discussion of the location and nature of the sampling quadrats, and the methods used to collect field data at both the quadrat and site levels of resolution.

4.2 SAMPLING METHODOLOGY

Archaeologists have asked, and will probably continue to ask, questions concerning the validity of conclusions based on a survey of less than 100% of an area. However, the reality is that most archaeologists cannot survey the entirety of an area, but are able to observe only a part of it. It is important to remember that it is more useful to make careful measurements on a small sample than to take rough measurements of the whole population.

Archaeologists have long recognised that inferences about past human behaviour are in fact based on small and sometimes inadequate samples. Early archaeological surveys did not even consider the problem of sampling. Later attempts led to the use of simple random sampling systems, and eventually to stratified and other formal variations of sampling schemes. Both with and without probability sampling, the nature of archaeology is such that assumptions are being made that the sample is representative of something, whether or not it is representative of the total cultural remains, or even more unlikely, the total culture (Chenhall 1975:4).

The problem with an intuitive procedure is not so much that wrong decisions are made about which sites to excavate, but that

the results cannot be generalised to the unknown parts of the region. Jones noted this problem in his elaboration of a regional sequence for northwest Tasmania from the results of excavation of three cave deposits and one open shell midden. He based his regional sequence on the acknowledged assumptions 'that my excavations are a good sample of my sites and my sites are a good sample of the area' (1966:8). If the aim of the exercise is to work out a cultural sequence then the archaeologist will look for sites which appear to ^{provide} long time spans and which contain artefacts or food remains which can be used to develop a sequence. This is exactly what Jones (1964; 1965a; 1966) set out to do and is a clear example of how aims determine methods, which in turn prescribe the types of results which will be obtained. A systematic sampling survey might well record hundreds of sites but miss the few which could reveal most about the cultural sequence. Having excavated the sites however, the archaeologist is then faced with the problem of trying to relate the findings to the broader landscape, and in particular to the overall distribution of archaeological sites.

The general purpose of a sampling scheme is ^{to} provide a systematic basis for selecting which parts of an unknown area should be surveyed. The selected areas should give a representative cross-section of the study area, such that it reflects all the variability that is present. If the sample selected does not include certain aspects, but is biased in an uncontrolled way and portrays only a limited picture, then it will be impossible to generalise the results of the analysis of the sample to the whole study area. At the same time, it must be noted that the ever popular "random sample" does not guarantee a representative sample, particularly when the sample fraction is small.

A number of sampling procedures have been tested in real and simulated archaeological surveys (for examples see Mueller 1974, 1975; Chenhall 1975; Read 1975; Thomas 1975; Judge *et al.*, 1975). I examined the results of these projects and what appears to be the best approach for the aims of this study was selected. This was a disproportional stratified scheme (Mueller 1974).

Stratified sampling means that the research area is subdivided, or stratified, on the basis of some prior knowledge into various groups called strata (King 1978:83). The criteria for stratification may be archaeological or environmental, but in any

case should be related to the research objective (Mueller 1974:32). The objective of my Tasmanian study was to describe the prehistoric landscape of the northern half of the west coast over the last few thousand years, and to examine the distribution of sites on that landscape. A disproportional stratified scheme is characterised by the unequal sampling intensity among the various strata of the total population. For example if one stratum does not produce any archaeological remains, this would soon become apparent during fieldwork. Since the aim is to describe the pattern of cultural remains, it would then pay to sample more intensively in the strata where remains do occur. This would give more detail in the area where it is needed.

The distribution of the prehistoric sites in the study area was known in general or qualitative terms from previous work Legge (1929), Pulleine (1929), Meston (1931; 1932; 1934; 1936; 1956), Lourandos (1968; 1969; 1970; 1977), Jones (1964; 1965a; 1965b; 1967; 1971b; 1974; 1976; 1979a), Bowdler (1974a; 1979), Vanderwal (1977b; 1978a; 1978b), Ranson (1978), the present author and others, but accurate information on the size, position and distribution of all the sites was not available for any area. The qualitative descriptions which were available suggested that numerous middens occurred along the coastal fringe (Jones 1964;1967) and that they were most numerous and largest along the rocky west coast (Jones 1967:359). The west coast sites contained a range of animal bones and stone artefacts as well as shell, while the east coast site contained little other than shells (Lourandos 1971). My own work had suggested that many large middens sat atop sand dunes (see also Jones 1967:361), but whether or not this impression was the result of the deflation of dunes making these sites visible was not certain. Doughnut sites were believed to be limited to the west coast (Lourandos 1970). This then was the qualitative state of the knowledge of the archaeological site pattern of the west coast - and I set out to quantify that pattern. It was not possible to sample on the basis of prehistoric sites as such, because site locations were not known, so a sampling scheme based on environmental units was developed. As the study was looking at coastal resources and occupation patterns I chose coast type as the criteria on which to base my stratification. Clarke's "spatial archaeology" points out that such an approach can examine

any form of cultural remains (Clarke 1977:9). The study emphasises sites and landscape, and as such falls into Clarke's macro level of investigation. By contrast, Ranson's work at Sundown Point with its detailed examination of the contents and the local setting of one small site is at Clarke's micro level (1977:11-13).

4.3 SURVEY METHODS

4.3.1 Stratification of the study area by coast type

Having selected the survey method and having decided to sample on the different types of coast, I realised that there was sufficient biophysical background information to stratify the samples on the basis of shore structure and wave energy. I chose coast types rather than land systems as the basis of the sampling stratification for several reasons. Firstly, I was concerned with coastal site patterns and as a result wanted to isolate any variation in resources which might be provided by different types of coast. Secondly, within the one land system, it was not unusual to find more than one coast type. Thirdly, land systems are a synthetic description of terrestrial patterns of geology, soil etc., and although land systems provide a convenient label with which to characterise an area, they inherently contain a mosaic of components or land units which may have diverse characteristics. While the characteristics of these land units may have been crucial in determining the locations of individual sites, they are too small a unit to form a basis for sampling in this study. Land systems are a descriptive tool, but for the purposes of this study a superior basis for stratification was available - the coast. The shore structures chosen were based on New Zealand work by Morton and Miller (1973) and are hard and soft, and a combination of these two called mixed. The wave energy classes were high, medium and low energy (Bird 1976:22) This gave a number of discrete combinations:

1. hard shore/high energy, eg a rocky ocean headland exposed to surf
2. hard shore/medium energy, e.g. a cliffed area in Bass Strait such as Table Cape
3. hard shore/low energy, eg a protected rocky shore in an embayment
4. mixed shore/high energy, eg the area around West Point
5. mixed shore/medium energy, eg the quartzite coast of Rocky Cape in Bass Strait.
6. mixed shore/low energy, eg in a bay such as Duck Bay near Smithton
7. soft shore/high energy, eg a sandy surf beach
8. soft shore/medium energy, eg a sandy beach in Bass Strait
9. soft shore/low energy, eg a sheltered beach of sand or mud in an embayment

In general, in the study area, high energy waves are limited to the west coast, medium energy waves are found in Bass Strait and low energy waves are found in embayments around the coasts. There is a further possible set of complications. The low energy examples can occur in harbours where fresh water dilution can affect salinity. This will have immediate effects on the marine ecology. This gives three additional combinations:

10. hard shore/low energy/fresh water diluted
11. mixed shore/low energy/fresh water diluted
12. soft shore/low energy/fresh water diluted.

One other system was considered, namely the mouths of the major rivers. In a sense this system is similar to the freshwater dilution classes, but it appeared that it might be sufficiently different in character because of freshwater flow and high wave energy for the resultant ecology to be isolated. However, it quickly became apparent that this category was not distinctive and so it was subsequently discontinued.

Having formally listed the possible types of coast which I could expect to encounter in the study area, I made a series of exploratory reconnaissance trips to find suitable locations for the sampling quadrats for my detailed investigation. The locations for quadrats were chosen on two criteria. Firstly, they were typical of one of the coast types, and secondly, they were relatively easy to get to. I saw no benefit in sampling in remote areas if the same type of coast could be studied near a road or a track. Later, on the basis of air photograph interpretation, aerial and walking reconnaissances, I was able to satisfy myself that the areas were indeed typical of each coast type and that the results of my analysis could be extrapolated to the more remote parts of the west coast of Tasmania.

Away from the coast I was not able to survey in such a systematic way because of problems of surface visibility. To overcome this problem, I chose places where ground surface visibility and the likelihood of finding sites if they existed would be high, such as around old ore smelters or along tracks where the vegetation had been destroyed.

The names selected for the sampling quadrats are the names of the nearest major features on the relevant 1:100,000 maps.

4.3.2 Quadrat size

Although there are established formulae in the biological sciences for selection of optimum quadrat size for such tasks as vegetation sampling, these procedures have not yet been applied to archaeology in Australia (Kershaw 1973) and I myself was ignorant of the procedures when I started the project. Experimentation along these lines could be instructive, with modifications appropriate to a linear system such as a coastline. The quadrat size for this study was chosen following discussion with members of my department on what was felt to be a manageable size and what would cover the inland distribution of shell middens. An area of 250,000 sq. m was chosen, to be formed where possible by using a 500m by 500m square placed with one edge along the coast. Because the coast is rarely straight, the shape usually became a figure with three arbitrary sides and the fourth side formed by the coast. In some cases this means that small areas of land have been included even though they fall outside the 500x500m square, for example, between the formal

boundary and the shore. In other quadrats, the ocean intrudes across the quadrat boundary. In cases such as the Mount Cameron West and Bluff Hill Point quadrats, they form promontories jutting into the ocean, producing a triangular sampling area. In the West Point quadrats, small offshore islands have been included. This approach is justified for several reasons. The area^{of} each quadrat was not rigorously measured on the ground, but usually done by air photo interpretation. Early attempts to measure the boundaries of quadrats accurately all failed because of the ever present wind blowing the tape measure, and dense vegetation. Furthermore, the study is not investigating archaeological patterns per area, so much as per length of coast and type of shore structure. To study sites per area would need to allow for sloping land surfaces (M. Noble pers. comm.). Once in the field it became apparent that there were problems with the visibility of archaeological materials in many of the quadrats.

No area was excluded from survey because it was believed that no sites would be found there. However, there is the question of the likelihood of archaeological remains being detected if present. This is the result of a combination of factors:

1. Ground surface visibility which is determined by the nature and extent of the ground cover of grasses, shrubs and vegetation litter such as twigs, bark and leaves.
2. Burial of the original land surface by for example windblown sand, flood alluvium or slope wash material which may completely cover a site.
3. Exposure of the original land surface by water, wind or wave erosion forming features such as blowouts in dunes, gullies or washouts along vehicle tracks.
4. Site obtrusiveness - some sites such as rock shelters or mounded shell middens are easier to detect than for example sparse surface scatters of chipped stone artefacts.

The use of the probe auger which is described in Appendix 6 made it possible to find middens which were covered by sand or dense vegetation, but of course did not find buried artefacts. This tool was far more efficient for subsurface sampling for middens than a

shovel (King 1978:52) or a post hole auger.

Although it was relatively easy to ensure that all sizeable middens were located, isolated artefacts were a different matter. Accordingly a number of sampling areas were chosen to take advantage of disturbance to the ground. The boundaries in these cases are erratic, but the area is as near to 250,000 sq. m as could be calculated in the field.

4.4 DESCRIPTION OF THE SAMPLING SITES

4.4.1 Introduction

Sampling quadrat locations were chosen on two quite different sets of criteria. The first considerations relate to the stratified sampling scheme and were outlined above.

The second set of criteria was based on convenience. As a coastal type was assumed to be relatively homogeneous, it should not matter where a sampling quadrat was placed within it. That is, there should be a consistency in the nature and distribution of the archaeological sites regardless of where the quadrat was placed within a coast type stratum. Although the patterns proved to be slightly more complex than this, there was certainly more variation in archaeological patterns between coast^al strata than within them.

Although the gear required for a day's fieldwork was easily carried in a rucksack, the logistics of getting to many parts of the west coast would have involved extensive use of off-road vehicles, walking, and for more remote areas in the southwest, the use of helicopters to ferry people and supplies. Besides, almost 20 years of archaeological research had shown that the northern half of the west coast was very rich in sites. As there was nothing to be gained by looking at these remote areas, I deliberately chose to work near roads and tracks. In northwest Tasmania this is not as limiting as it might appear from a glance at a road map. Numerous, if ill-defined, tracks extend along almost all of the coast, but again a cost efficiency factor must be considered. I saw no reason to drive for several hours down a rough track when the same coast type could be surveyed near a good road. The potential of an approach which considered ease of access to introduce an element of

bias is obvious, but by sampling on the basis of coast type as the first consideration, then choosing a convenient area within the coast type strata as a second stage, the problem should be controlled. As a further check, I carried out a series of reconnaissances from the air and by driving and walking through the area to make certain that my coastal and landscape units which had been mapped by air photo interpretation were in fact coherent geographical units and accurately mapped. From the beginning of the study I was reasonably confident that my coast types represented real divisions in coastal form and ecology and this confidence increased as the study progressed. It also became apparent that I had hit on a major archaeological division as well, although I was not able to demonstrate clearly the correlations between coast type and archaeological sites until after my first field season. The remainder of this section describes the locations and general nature of the sampling areas in conjunction with Appendix 2 which contains a map and summary of the major features of each quadrat.

4.4.2 Sampling sites

By the time the first field work for the study commenced it was clear that there was considerable variability in the coastal landscape, so my first quadrats were placed to examine the major types of coast: mixed rocky and sandy shore, steep plunging cliffs, steep cliffs with level platforms and sandy beaches. Quadrats on the latter three types of coast had few midden or artefact sites and so received only a little more sampling to ensure that the initial samples had given a reliable result. On the other hand, the mixed rocky and sandy shore produced more sites and larger middens and these were distributed in a complex way across the landscape. In accordance with the disproportional sampling scheme I had adopted, additional attention was then devoted to this coast type in order to get a larger sample in the stratum, which was not only the most complex to describe but offered the most information about prehistoric activities and their landscape associations.

In the 1979/80 and 1980/81 summers a total of 52 quadrats was surveyed. Twenty eight are on the west coast between Woolnorth Point and Cape Sorell (Figure 4.1) Table 4.1 lists their location, bedrock type and coast types. Of the west coast quadrats 18 are on

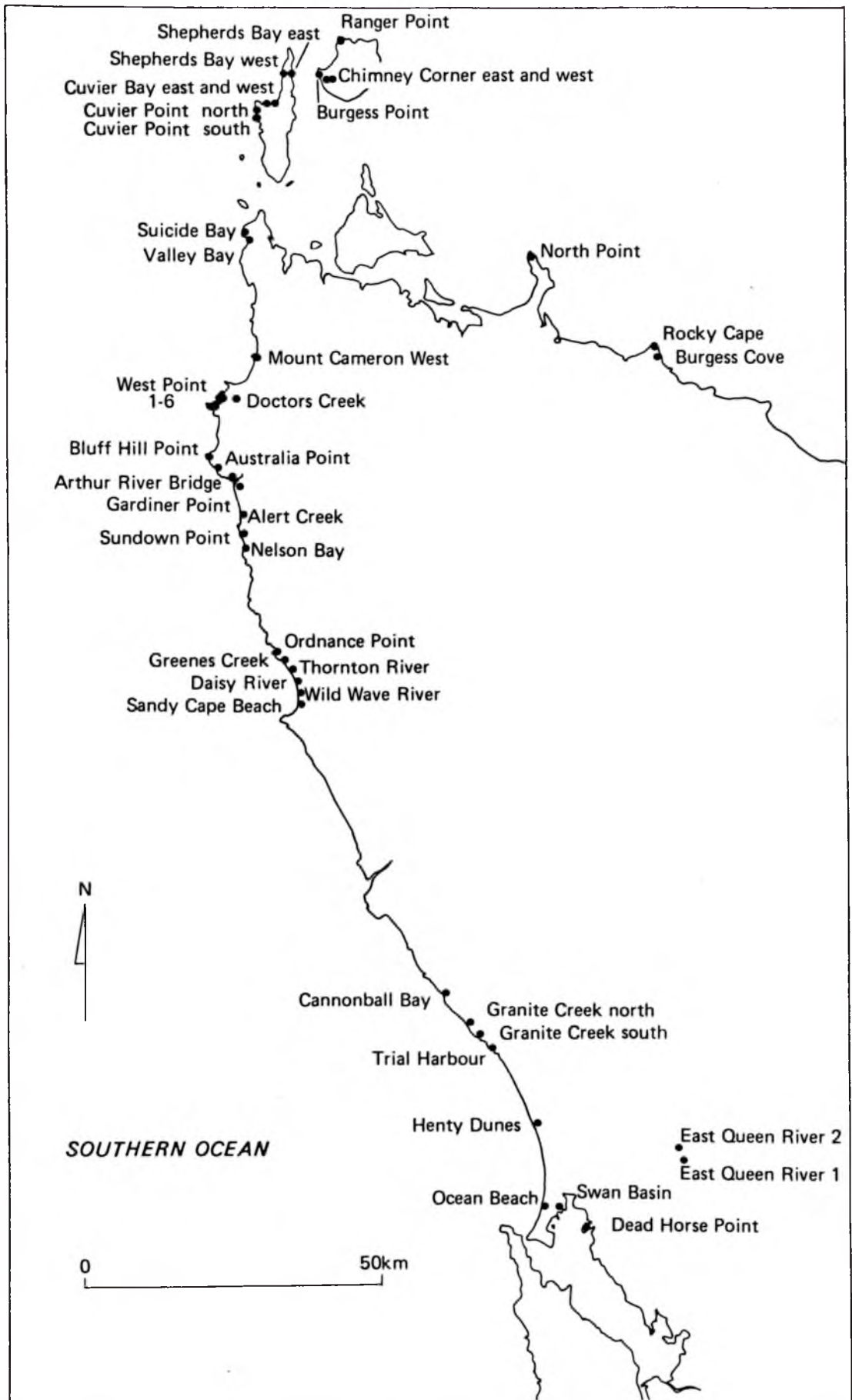


Figure 4.1 Locations of sampling quadrats in northwest Tasmania.

Quadrat name	Rock type	Coast type
Alert Creek	sand	soft
Arthur River Bridge	M	mixed
Australia Point	M	mixed
Bluff Hill Point	M	mixed
Cannon Ball Bay	granite	hard
Daisy River	sand	soft
Gardiner Point	M	mixed
Granite Creek north	granite	hard
Granite Creek south	granite	hard
Greenes Point	M	mixed
Henty Dunes	sand	soft
Mount Cameron West	basalt	mixed
Nelson Bay	M	mixed
Ocean Beach	sand	soft
Ordnance Point	M	mixed
Sandy Cape Beach	sand	soft
Suicide Bay	breccia	mixed
Sundown Point	M	mixed
Thornton River	M	mixed
Trial Harbour	granite	hard
Valley Bay	breccia	mixed
West Point 1	M	mixed
West Point 2	M	mixed
West Point 3	M	mixed
West Point 4	M	mixed
West Point 5	M	mixed
West Point 6	M	mixed
Wild Wave River	sand	soft

M = Relative unmetamorphosed sedimentary rocks group

Table 4.1 Rock and coast type for quadrats on the west coast

mixed coast, four on a hard coast of steep plunging cliffs and six on a soft coast of sandy beaches. The irregular boundary of the quadrat follows the edge of the burnt area. The Sandy Cape Beach and Henty Dunes quadrats are examples of high energy sandy beaches where extensive sand dune deflation has occurred. The irregular boundaries of these quadrats follow the edges of the deflated areas and thus exclude areas of recent sand accumulation. The aim in these irregularly shaped quadrats was to sample an area of approximately 0.25 sq. km where the visibility of archaeological materials would be greatest. A further 21 coastal quadrats were surveyed in other parts of Tasmania (Figure 4.2). Seven of these were scattered along Bass Strait in the hope of being able to quantify the variation in the contents of shell middens along the strait. In the Hunter Group off northwest Tasmania I surveyed six quadrats on Hunter Island and four on Three Hummock Island. On the opposite side of Tasmania in the low energy Derwent estuary two quadrats were surveyed. Even more enclosed than the Derwent estuary is Macquarie Harbour and here I completed two quadrats. I also wanted to sample in inland areas, in the hope of comparing inland site distribution patterns with those of the coast.

Because of the problems concerning the detectability of archaeological remains these samples were deliberately placed to take advantage of different types of disturbance to the vegetation and topsoil. The two inland East Queen River quadrats are devoid of topsoil because of erosion induced by bushfires and smelting. The Doctors Creek quadrat had been burnt a few weeks before it was surveyed.

Supplementing the northwest quadrats, two long transects were made inland at Hill 49 and the Balfour track. Both follow the route of vehicle tracks which have cut through the thin layer of sediment overlying bedrock or into the sand of the sandsheets. The wind has blown the sandy soil away, leaving the deflated artefacts exposed.

Although I do not believe it to have been a problem, it was possible the artefacts had been transported along the tracks, e.g. in the mud carried by four wheel drive vehicles. However, to guard against this, where more than one artefact was found in the 100 X 100m area of one set of grid co-ordinates on the 1:100,000 sheet, these artefacts were lumped together in the coding as one scatter of worked stone. In undisturbed areas they would have been recorded

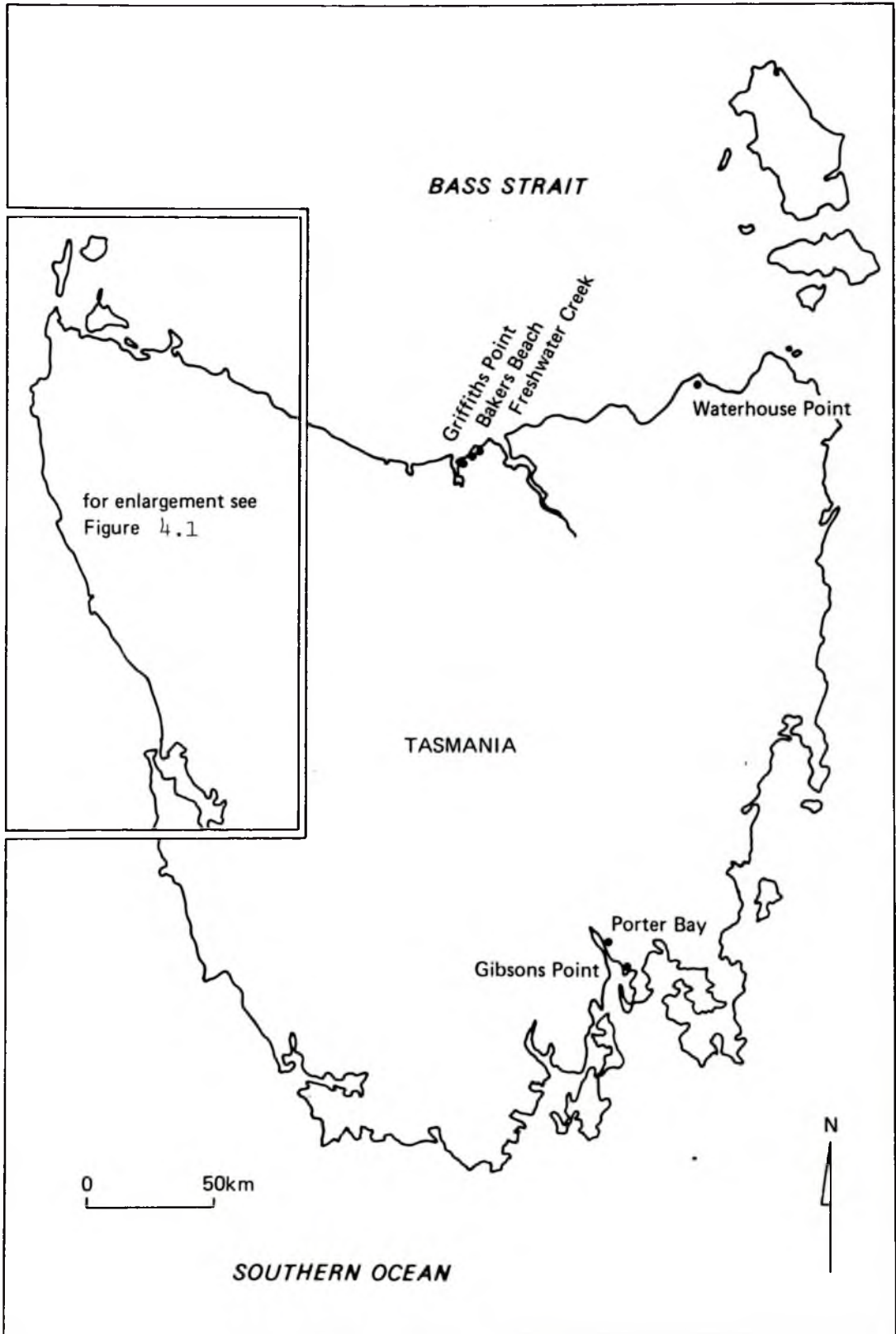


Figure 4.2 Locations of sampling quadrats.

separately. No artefacts were found in situ in the cut edges of the tracks.

In Appendix 2 there is a map of each quadrat together with a summary table under the following headings:- rainfall, land system, geology, vegetation, prehistoric midden volume and present land use.

4.5 DATA RECORDING

4.5.1 Purpose

The purpose of this section is to describe methods used to collect field data at both quadrat and site levels of resolution and the ways in which these were recorded. A fundamental limitation of any survey is the need for the archaeologist to remain mobile, which limits the amount and type of gear which can be used. At the same time the exercise must collect data of sufficient quantity and quality to be usable. The type of equipment developed for this study and the ways in which it was used are described in Appendix 6.

4.5.2 Quadrat data

A number of base mapping formats was tried before a satisfactory one was found. Tried but rejected were published 1:100,000 maps, 1:50,000 unpublished dyeline maps, 1:15,840 and 1:20,000 unpublished M-Plot map compilation sheets, air photographs at 1:40,000 and 1:50,000. The problems were as follows:

1. Difficulty in matching map and landscape
2. Difficulty in accurately locating finds with respect to one another and to natural features at these scales.
3. Scales were unsuitable for subsequent analysis and presentation.

Eventually I found that air photo enlargements were suitable. All air photography used was from the Tasmanian Lands Department, usually at scales of 1:40,000 or 1:50,000. At this scale a 500m x 500m quadrat is 10mm or 12.5mm square respectively. It was found

that the maximum possible enlargement of Lands Department imagery was X7 times for areas near the centre of the negative. This degree of enlargement produced scales of around 1:5,700 and 1:7,100 and meant that many small natural features could be discriminated with the unaided eye, e.g. clumps of shrubs or a large rock. Almost all the quadrat plans were drawn from air photographs. During the field work I often wished there was a simple and inexpensive way to take low level vertical air photographs. As a helicopter or light plane was beyond the budget, I toyed with designs of balloons or kites which could lift a camera with a radio controlled shutter, but none of the plans got beyond the drawing board. Because the area has such reliable winds, I think that a harness attached to a kite so that the camera is suspended vertically in the direction in which to experiment. It would certainly facilitate the preparation of illustrations and site plans for small areas.

Having selected a sampling area on the criteria outlined in the previous section during a reconnaissance, an enlargement of the relevant air photograph was obtained. The scale of the original air photograph was checked against published maps or ground measurements, while the factor of enlargement was checked against the original photograph. With this information the boundaries of the quadrat could be drawn in on the enlargement. For field marking of air photographs Staedtler brand Mars Omnicrom pencils were found to be superior to Chinagraph pencils because their harder 'lead' meant that a sharper point could be maintained and finer markings resulted.

The next step in the field was to locate the quadrat boundaries accurately on the ground. Early attempts to determine quadrat boundaries by measuring distances with a tape failed because of deflection of the tape by wind. Known lengths of string were then tried, in the hope that this would offer less wind resistance, but these failed because of irregular ground surfaces, dense vegetation and stretch in the string. Where I could test the air photo measurement method for establishing ground distance, I found its accuracy to be within +5%, which for my purposes was adequate. Also, it is a very fast method. It can be prepared in the laboratory, thereby minimising field time.

As a standard procedure, the first step was to walk around the boundaries of a quadrat and mark strategic points at the corners

and sides with flagging tape. The actual route followed while working within a quadrat depended on the layout of the landforms, vegetation, drainage channels, etc.

When an archaeological site was located, its dimensions and distance to key landscape features were noted and the information entered on the coding sheet (see data recording below). Supplementary observations could be recorded in the field notebook and if desired photographs could be taken. It took from one to seven days to work through a quadrat in this way. At the finish of the quadrat a landform cross-section was drawn through a typical area and a descriptive vegetation transect prepared on this, as a result of the following considerations.

Published references to the study area and similar areas were reviewed (Macphail et al. 1975; Faircloth 1978; Jarman and Crowden 1978; Edwards 1978). None of these supplied an established descriptive system which could be used, but they did provide an introduction to the vegetation of the region.

A structural classification of plant communities was developed for native vegetation which involved a simple two-dimensional table using two variables - height/life form of the dominant plants (tree, shrub or herb) and the projected area of ground covered by the foliage of dominant plants in the ecosystem. This system has been used in an analysis of important structural formations and alliances in Tasmania (Specht et al. 1974:Table 6.1, 323-40). In the recording of botanical information for individual sites a structural description of the vegetation was prepared following the Specht system. Initially I experimented with formally controlled vegetation transects where a line was run out across the zones to be sampled and then quadrats at known intervals were placed along this line. For example I used 15m intervals and 4 sq. m quadrats and measured canopy cover of the dominant species. This procedure was laborious and time consuming, and the results far too detailed for my requirements of a descriptive cross-section of a 0.25 sq. km area. After discussion with plant ecologists working in Tasmania I decided to record:

1. a cross-profile of the relief of the sample quadrat
2. the dominant life forms along this cross-profile
3. the dominant floristics of these life forms.

Cross-profile were prepared from aerial photos, field measurements, clinometer calculations, published contour maps or a combination of these data sources. On this cross-profile the vegetation structure, density and most common species were recorded. By the time the field recording of all the quadrats had been completed, I had noted repeated patterns of association of certain plants. Although the individual species were recorded in the field, in the final illustrations they are grouped under one symbol for each alliance.

4.5.3 Site data recording method

The concept, and much of the format, for the site data storage system were based on a site file developed by Marjorie Sullivan for use in her study of shell middens on the coast of NSW (M. Sullivan pers. comm.). Sullivan has developed an excellent system in which computer data sheets are completed in the field in a code system which can be easily read back. By coding in the field the operation of preparing data for input to the computer is reduced to one step. Once coded the data are in a very compact format and the data sheets were photocopied to make a safety copy. My site file is illustrated in Figures 4.3 and 4.4.

There are limitations in the type of fixed column format used in this study and freeform systems have been designed (S. Wild pers. comm.). However the design and initial management of a freeform system requires specially written programs. One of the aims of the file was to produce a system which could be manipulated using standard package programs available at most computer installations. These programs may be verbose and inelegant, but they are readily available and can be used by operators with a minimum of computing knowledge.

Using coding sheets in the field obliges the observer to make a decision or to note the problem for later resolution. There is always the option of creating a new variable code. The use of fixed variable codes can be criticised as limiting the archaeologist's

perception of the field reality to the established codes. To avoid this would require a verbal text system, which would inherently contain ambiguities. Analysis on a verbal text system would require a dictionary of keywords with specified meanings with defined formats for the use of the keyword and a specially designed matrix.

To illustrate how the system worked, I would like to describe how a site was recorded drawing from time to time on information from site 77 at West Point (see Figures 4.3 and 4.4). This description covers the time between arriving at and leaving the site. The first step was to inspect the general setting of the site and to examine the ground surface, especially any exposed areas where vegetation or overburden were absent. Following this, I would record the information in codes on the data sheet. The first entry was the site's number. The sequence of these numbers simply reflects the order in which sites were recorded. The number would also be written on flagging tape with an ink marker, and this would be tied to a nearby shrub. This helped with navigation within the quadrat and prevented double recording. The location of each site was recorded by a four figure map reference and a six figure grid reference to the appropriate 1:100,000 sheet. This gave an easting and northing which defined a 1mm by 1mm square on the map, equivalent to 100m by 100m on the ground. The site type description was entered, e.g. 'WPM' for a midden with a number of hut depressions on the surface.

Two qualifying factors were assessed, the state of preservation and the type of disturbance if any: for example, 'G' for good condition and 'X' for no disturbance. The direction in which the site faced or had the best view was recorded as a three figure magnetic bearing. Site 77 had its best view to slightly east of south on a bearing of 140° . The length, width, depth, area, volume and height above sea level measurements were recorded in centimetres, with a two digit exponential system. The first digit was a factor, which was multiplied by 10 raised to the power of the second digit. Thus the length was '23' (2×10 to the power 3 = 2,000cm = 20m). The width was the same. The depth was '12' (1×10 to the power 2 = 100cm = 1m). The area was '56' (5×10 to the power 6 = 5,000,000 sq. cm = 500 sq. m). The volume was '18' (1×10 to the power 8 = 10,000,000 cu cm = 100 cu. m). Height above sea level was '13' (1×10 to the power 3 = 1,000cm = 10m). With a

little practice, it was easy to read the codes without the need to calculate the distance in metres. The advantages of this system were that it could handle values from extremely small to very large.

The next set of variables to be recorded concerned the contents of the deposit. Up to six shell types were listed in order of numerical dominance. Each type had a two letter code. For site 77 the entry reads 'SUNODIXXXXXX'. This shows that the most numerous type was 'SU' (Subnina undulata), followed by 'NO' (Notohalotis ruber) and 'DI' (Dicathais spp.). As no other shell types were found, the remaining columns were filled with an 'X'. The types of bone found were recorded at the simple descriptive level of land mammal, sea mammal, bird, fish or unidentifiable. The entry for site 77 shows that bird, land and sea mammals were found. Up to three types of stone artefact material were recorded, again in order of numerical dominance in the site. The entries show that quartzite was most numerous, followed by spongolite. The last item of this group to be recorded was a description of the nature of the sediment which formed the matrix. 'SAN' for sand was recorded for site 77.

The next block of coding recorded the location of the site. The first entry described the nature of the substrate on which the site rested. Site 77 rested on sand ('SAN'). The landform was recorded as a foredune ('FDN'). The vegetation around the site was recorded using Specht's classification of density, height and life form. At site 77 very open low shrubs surrounded the midden. In addition, the type of vegetation which covered most of the surface of the deposit was noted. Typical of many of the middens on the west coast, site 77 was largely covered by herbaceous plants.

If the surface of the site sloped, this was measured in degrees with a clinometer and was noted with a two digit code. The entry for site 77 is '00', showing that the surface was level.

Shelter from wind by a landform was recorded. The first two letters show the direction of the shelter using eight combinations of N, S, E, and W, for example NN for north and NE for northeast. The third letter in this group describes the type of landform which provided the shelter. Typical of so many of the large middens, site 77 is fully exposed to wind from all directions.

The distance to the nearest potential fresh water sources was entered. This was estimated by pacing or measured from an air

photograph. The nature of this water source was coded with a three letter combination. Site 77 was 100m from the nearest drinkable water, which was a swamp.

The next group of entries described the distance from the site to the rock platforms at the shore, the length of the edge of the platforms within 500m and its structural form. The terms used in this study to describe the form of rock platforms were:-

- S smoothly eroded (e.g. granite)
- J jointed, cracked, etched, honeycombed, etc.
(e.g. relatively unmetamorphosed sedimentary rocks)
- L level, differentially eroded to discrete surfaces
(e.g. Porter Bay or the basalts of Suicide Bay)
- B for beach, if no rock platforms within 1km
- P for pebbles, e.g. North Point
- X if not applicable

Site 77 was 30m from the nearest rocks, there was in excess of 1,000m of platform edge within 500m, and its structure was jointed and cracked in the way which is typical of the local bedrock. The word platform is slightly misleading as it conveys an impression of level wave cut benches. Actually, this area typically has jagged rocky reefs and convoluted rocky shorelines. The type of bedrock for the area was recorded with a two letter code. This information was taken from published geological maps. The entry 'US' for site 77 stands for the comparatively unmetamorphosed sedimentary rock group.

The final block of information contained filing and cross-referencing data. If photographs were taken, the film roll numbers were noted. Site 77 was photographed on black and white roll number six and colour slide roll number fifty-seven. If supplementary notes were made in a note book, the book number and page were then entered. Notes for the calculation of the area and volume, together with a site sketch plan, were made for site 77 in book 2, on page fifty-four. The last entry was the nearest printed name on the 1:100,000 sheet, e.g. West Point.

Back in the field laboratory the data coding would be checked for errors and omissions and an overlay tracing of the air photo enlargement with site markings would be made. During visits to town, the data sheets, overlays and vegetation transects would be

photocopied and these copies posted back to Canberra as safety copies.

Appendix 4 is a summary of all the codes and their meanings, together with any comments relevant to variable coding. Because of the size of this data set, it was not possible to include a print out of the complete computer file in this thesis. The data file is available, however, on a magnetic computer tape and floppy disk in the Department of Prehistory archives and a floppy disk and a hard copy have been lodged with the AIAS under accession number 07846 September 1982. This site information has also been incorporated into the Tasmanian Aboriginal Site Recording Program of the Archaeology Section of the NPWS of Tasmania.

4.6 METHODS OF ANALYSIS

The ultimate aim of my analysis was to describe the fundamental parameters which controlled the nature and distribution of archaeological sites.. Up to this point I have discussed how I collected field data and the types of site variables which were recorded for each site. The end result was a data file for 653 sites (Appendix 7), which is really only an enormous string of numbers and letters. For each site there were up to 34 variables describing the site type, its dimensions, contents and setting. The potential number of combinations of variables not counting dimensions, slope, view and distance measurements was in excess of 2 times 10 to the power of 23. Other surveys have noted this potential problem of generating a glut of data (Foard 1978; Ammerman 1981).

As I had prepared maps of each survey quadrat, some qualitative patterns were immediately apparent. The number of middens declined with increasing distance inland from the rocky shore, while stone artefact sites appeared to be scattered without obvious pattern. Large sites and small sites were mixed together in an unorganised fashion. On long sandy beaches there were fewer middens as one moved along the beach away from the rocky areas at the ends of the beach. In addition to these impressions observed during mapping, it was clear that the most numerous species of shellfish varied between different parts of the coast.

My next problem was how to set about analysing this mass of data to extract quantitative information on patterns and relationships in an effort to isolate the controlling parameters. Initially, principal component analysis (Doran and Hudson 1975:195) looked attractive, but it soon became apparent that it was inapplicable. This technique is designed to find the minimum number of variables which account for the greatest amount of variation in the data, with these variables assumed to have major importance. However, my data set contained nominal, interval and ratio measurement scales. Almost all of the ratio scale data proved to have highly skewed distributions. Since principal component analysis, and similar techniques such as factor analysis, all assume multivariate normality, they were simply inapplicable.

An alternative approach was to try non-metric methods which did not require multivariate normality. I hoped that these methods would define internal divisions in the data and that these would give archaeologically and geographically meaningful comparative groups. Since the most sensitive connection between ecological setting and the contents of a midden was the types of shellfish it contained, I chose to look at variations between the shellfish species found in each quadrat.

4.6.1 Multidimensional scaling of shellfish content of quadrats

The way in which field data on shellfish was recorded is described in detail in Appendix 4. In brief, in each midden the shellfish present were recorded with up to six mnemonic codes in order of numerical dominance. For example, a typical entry might read "SU,NO,DI". This notes that Subnina undulata was the most numerous species, followed by Notohalotis ruber and the Dicathais spp.. No attempt was made to quantify this pattern of dominance. The data base presented two problems, namely, that the number of middens per quadrat varied, and also the volumes of the individual middens. Because of this, the initial analysis was carried out at the quadrat level by pooling the data from individual sites and using simply the data on the presence or absence of species within the quadrat. The binary nature of these data precluded the use of multivariate techniques such as discriminant analysis or multivariate analysis of variance which require multivariate normality. This situation prompted the choice of a scaling method

to see if groups of quadrats with similar components could be discriminated and the method of non-metric multidimensional scaling was chosen as the most suitable (Kruskal 1964a, 1964b). For example, did all the west coast quadrats have the same species, or did the west coast and Hunter Island samples show different species compositions, and so on?

The aim of multidimensional scaling is to represent n objects geometrically by n variables in a t -dimensional space, so that the interpoint distances correspond in some sense to the observed dissimilarity between objects. In this case there were 41 objects (sample areas) with up to 17 variables (shell species). Put another way, non-metric multidimensional scaling can be used as an exploratory technique which seeks patterns of similarity or dissimilarity within the data and then reduces these to fewer dimensions. In this way, if the data can be presented in two dimensions, it becomes much easier to see clusters if they exist. As the number of dimensions is reduced, the 'stress' or distortion necessary to reduce the number of dimensions is calculated. The greater the value of this stress coefficient, the less reliable is the resultant plot.

The scaling operation is carried out on either a similarity or dissimilarity matrix. In this case the Jaccard similarity coefficient was used to prepare the matrix. After several runs it became apparent that the most important difference between regions was the relative dominance of species, but that this information had been lost in the recoding of the shellfish to presence or absence per quadrat, so the technique proved to be unsuitable. The reason for this lies in the opportunistic nature of the Tasmanian shellfish. Although each species has a distinct optimum environment, most can tolerate a wide range of conditions or else survive in suitable but small and isolated habitats. This is reflected in the middens, which often contain a few specimens of what were locally uncommon species. The most important differences were the relative numerical dominance of the main species which varied from region to region. In the next series of analyses I tried to compare this relative dominance.

4.6.2 Profile comparisons of shellfish content of quadrats

Because the statistical procedures described above were of little use in exploring for similarities between quadrats, a technique which compared the distribution profiles was attempted. A similar approach has been used in studies of archaeological sediments (Hughes 1977:49). In the first stage the information for the most numerous shell species in each site was used (columns 36-37 of Appendix 7). With this information I first listed the most numerous species present in each site. Next, I totalled for each of the quadrats the number of times that each species dominated. For each quadrat the frequency figures were then converted into proportions. This gave a list which detailed the most numerous species in the middens of each quadrat and their relative frequency within the quadrat. It did not take into account the different sizes of sites or the number of middens per quadrat.

This information was then plotted with dominant species on the x axis and relative proportion on the y axis. Although the species are nominal units, these points were nevertheless connected to form a continuous profile. Conventionally a bar graph would be used for such nominal data but for graphical simplicity and visual clarity I drew a line joining the points. The profiles were transferred onto sheets of transparent acetate film which could be superimposed and visually compared for similarity.

Working in this way with information about the most commonly occurring shellfish species gave a series of associations or clusters. Two of the clusters contained only one dominant species, Subnivalia undulata and Mytilus planulatus. All the other quadrats had more than one species.

The same operation was performed on the column for the second most numerous species for the quadrats in the S. undulata and M. planulatus clusters in order to differentiate between quadrats within these. The S. undulata cluster subdivided into a number of subclusters. In the M. planulatus cluster the profiles for the second most numerous species showed no resemblance to each other, ie. there were no subclusters.

On the assumption that similarity in the species composition of middens will be a function of ecologically similar foraging zones, this technique did show some of the elements of regional patterning. For example, it became apparent that Hunter Island

differed from the west coast, and that the middens of Three Hummock Island had similarities to the middens of the western part of Bass Strait. Several important points can be made at this stage about the exercise. Firstly, adjacent quadrats which appear to be ecologically similar in the field and which contain the same shellfish as their most numerous component may be different in terms of their second most numerous species. As most middens are overwhelmingly dominated by only one species while the others make an almost negligible contribution, I would suggest in retrospect that this system should only be used on the most numerous components.

For the third series of comparisons a different approach was used with considerable success. Rather than using the entire data set and looking for divisions within it, the data were divided into regional data sets on the basis of location and wave energy. The largest of these regional divisions is the focal area of the study, the northern part of the west coast of Tasmania, and the analysis of this region will be presented first. Twenty eight quadrats were completed in the region and a total of 258 middens and 148 artefact sites were recorded (Table 4.2). All midden types were represented, with 78 "small midden dumps" being the most common type. The table shows, however, that 28% of the middens were so deflated that their original form could only be estimated. It may also be observed that middens with hut depressions, ie. "doughnut middens" and "West Point type middens", account for only 3.9% of the sample. Similarly, middens in rock shelters form only 1.6% of the sample. I will return to these problems in Sections 5.2.12 and 5.2.13.

Only one rock engraving site lay within the sampling quadrats. This was the Greenes Creek site which is described elsewhere (Stockton 1977c).

4.7 PROBLEMS AND LIMITATIONS OF THE DATA

4.7.1 The data set

Because of changes in the search criteria used during the project, less attention was paid to locating and recording artefact sites in some quadrats. In the West Point area artefacts were recorded as an equal priority with middens. These data will be used

SITE TYPE	Frequency	Frequency %
Middens		
- deflated	73	28
- small	78	30
- medium	37	14
- linear	56	22
- doughnut	7	3
- 'West Point' type	3	1.2
- rock shelters	4	1.6
	<u>258</u>	<u>100</u>
Stone artefacts		
- isolated	69	
- scatters	148	
	<u>217</u>	
Other		
- engraving	1	
- stone arrangement	13	
	<u>14</u>	
Grand total	489	

Table 4.2 Frequencies of site types on the west coast.

in the next chapter to compare the landscape association of middens and artefact sites.

Because the nature of my archaeological data are so different from the traditional excavation samples of sediments and cultural materials from hopefully stratified deposits, I would like to explore some of the limitations of this archaeological survey data. Many sites have been disturbed by natural processes and human activity. Different bedrock geologies result in soil types which have different levels of susceptibility to erosion. Middens on aeolian landforms which have been deflated by wind pose special problems for the calculation of their original area and volume. Middens which were deposited on beaches within reach of high tides and storms have been removed. In this study the data on the contents of middens are based on surface observation of many sites, whereas excavation data are usually based on very detailed observations from a few sites. All of these factors affect the ways in which the survey data can be used in the reconstruction of the patterns of prehistoric use of the coast.

4.7.2 Disturbance

The archaeological sites of the northern part of the west coast of Tasmania are rapidly being destroyed, even though it is not a high impact development area. Only 119 (46%) of the middens recorded were rated as undisturbed. 27 (11%) were described as having some disturbance but with some of the deposit still in situ, while 112 (43%) had most of the deposit disturbed or destroyed.

The most common disturbance factor was deflation by wind, which appears at first glance to be a natural process. However, as outlined in Section 2.5, the rate of wind erosion of dune landforms has been accelerated since the introduction of sheep and cattle. Other important disturbance factors include human activities, such as road cutting, construction and the use of vehicles, and natural processes, such as the erosion of middens by wave action.

4.7.3 Limitations of surface observations

The survey data on the contents of middens recorded in this study were all based on what was visible on the surface of sites. To test how valid or representative these data were I compared samples excavated or augered in the course of obtaining shell samples for C14 dating. Ten middens which had been previously recorded were sampled by auger or small test pits. This provided information which could be used to contrast the site contents recorded from surface examination to that obtained from small excavated and sieved samples. These samples were dry sieved in a 5mm mesh sieve and sorted. The shell, bone and stone components were then recorded on site forms in the usual way. Shell types were recorded by species, stone artefacts were coded by rock type and bone type was classified as land or sea mammal, or bird bone. A summary of the results is presented in Table 4.3

From surface examination, the average number of shell, stone and bone types per midden was 2.1, 0.6 and 0.4 respectively. For the excavated samples the averages rose to 4.3, 0.9 and 0.5. These represent proportional changes of a factor of 200%, 50% and 25% respectively. Although these appear to be significant increases at first sight, it is important to note that the most common elements (shells) had the greatest proportional increase and that the ratio for the frequency of observations of the three types of components remained in the same order. The most common species of shellfish remained the same in all 10 samples.

On average it required 30 minutes in the field to excavate, sieve, sort, record and bag a sample for dating. To have done this for all sites would have required much more time than simply making surface observations. The argument for using excavated samples would be that it is better to make fewer observations with more detail than a large number of observations which are so superficial as to be practically useless (for example see Officer 1980). Although such an argument is a basic element in the philosophy of sampling, there is a number of counter arguments in the case of this study. The extra information gained from excavated samples was about the less conspicuous and less common elements of the midden. This sort of information would be most valuable in an excavation project where small scale resolution of site components was desirable. However, in a regional context it is very difficult to

Site number	SURFACE OBSERVATION			EXCAVATED SAMPLE		
	number of types recorded:-			number of types recorded:-		
	shell	bone	stone	shell	bone	stone
77	3	2	3	3	3	2
86	3	-	-	6	-	-
87	3	1	1	5	1	1
88	3	-	-	4	-	-
120	2	-	-	5	1	-
121	2	-	-	6	-	1
122	1	-	-	5	-	1
123	1	-	-	2	-	1
124	1	-	-	5	-	-
131	2	-	3	2	-	3
\bar{x} =	2.1	0.4	0.6	4.3	0.5	0.9

Table 4.3 Comparison of contents recorded from surface observation and excavated samples.

deal quantitatively with observations of minor components other than in a presence/absence manner. The excavated samples were very small, usually in the order of 0.006 cu. m. To have increased their size would have changed this study from its survey orientation into an excavation project, but this would have been necessary to ensure that the samples were a reliable (whatever that may mean) estimate of the total composition of the midden (Barz 1977). In a Tasmanian case study, Ranson (1980) has argued that in order to gain behavioural and spatial information it is necessary to use open area excavation, preferably of the entire site. Anderson (1973b:124) has concluded that any procedure which samples a midden by some formal sampling scheme in order to be able to predict the composition of the midden as a whole is dubious. This is based on the argument that in situations where the qualities of the sampling universe (e.g. the midden) are unknown and cannot be assumed, there are no methods available which can produce a sample known to be representative and, according to Anderson, there is no way of determining the degree of bias in any sample obtained, short of examining the nature of the universe as a whole (i.e. excavating the entire midden). Having argued so negatively, Anderson concludes with a more positive proposition with which I agree. Since formal sampling strategies are not applicable to the problem of choosing how much and which parts of a site to excavate, then the decision should be based on the objectives of the archaeologist and common sense. Finally, although a total sample of 653 sites may sound reasonably large, when it was broken up into regional samples, many of these contained only a handful of middens. The size of these small regional samples could have been increased, but only with proportionately less time being spent on the west coast, which was the primary focus of the study. Although it would have been desirable to have larger survey and even excavation samples elsewhere, the primary aim was not to satisfy the needs of statistical procedures, but to collect a minimum working sample of the archaeological character of these areas.

There was one other way to obtain detailed information on the contents of middens without excavation. This was to record the contents of sites where these were highly visible due to damage to the surface of the site. The most useful sites for this were middens which had been deflated by wind, with the cultural

materials left behind as a lag deposit on the surface. But do the data for deflated middens have more attributes recorded than undeflated middens?

The total midden sample was split into deflated and undeflated, giving 90 and 279 sites respectively. For each subsample I determined the number of shell types recorded per midden and then calculated the proportions with 1, 2, 3, 4, 5 or 6 species of shell. Because the data are based on counts of nominal types, summary statistics could be quite misleading in this situation, so the results are presented graphically in Figure 4.5. Surprisingly, the graphs are remarkably alike, suggesting that the records from deflated and undeflated middens describe similar frequencies of attribute detail.

The same procedure was carried out on the bone column of the site file (Figure 4.5). This presents a slightly different picture from the shell graph. In deflated middens there were fewer cases with no record of bone (67% as opposed to 83% for undeflated middens). Similar proportions of both samples had only one class of bone recorded, while a greater proportion of deflated middens had two or three classes of bone. The average number of classes of bone per midden was 0.68 for deflated middens and 0.27 per undeflated middens.

The picture is similar for the records of the types of stone artefact materials found in the sites. A smaller proportion of deflated middens had no record and a greater proportion had two or three stone types (Figure 4.5). The average number of types of stone artefact materials per midden was 1.2 for deflated as opposed to 0.78 for undeflated middens.

This evidence can be interpreted to show that greater visibility of the contents does not significantly change the pattern of observation for the most common elements (shells), but that the rarer components such as stone artefacts and bones are more likely to be found and recorded in extensively deflated middens. It appears that a more comprehensive picture of the contents is likely to be obtained from deflated middens than from undeflated middens if only because more of the site components are visible.

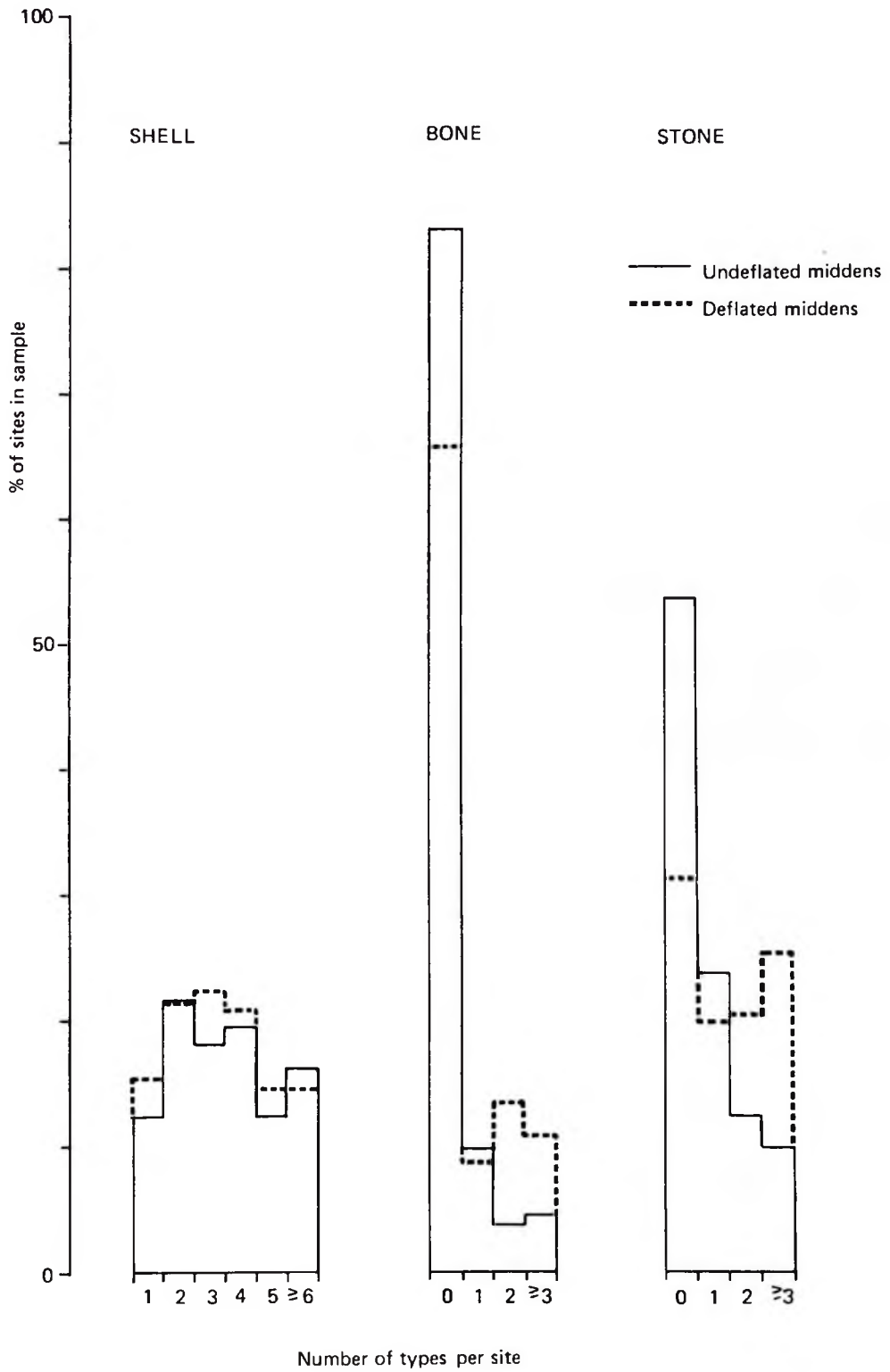


Figure 4.5 Comparison of the number of types of shell, bone and stone recorded for deflated and undeflated middens.

4.7.4 Problems of measuring deflated midden volumes

The original volumes of deflated middens were calculated from their estimated original area and thickness. Area was relatively easy to establish as the larger midden components were left behind as the sandy matrix ^{was} winnowed away. Unless residual blocks of the deposit remained in situ however, ^{the} depth could only be guessed. There is no direct way to test the accuracy of these calculations. As an indirect check, I have compared the frequency of deflated middens with other midden types (excluding those in rock shelters) in a range of seven volume classes for the quadrats on the west coast of the Tasmanian mainland (Table 4.4). The volume intervals were arbitrarily chosen to highlight the extremes of the size range, where I had the greatest difficulty in estimating volume. The proportions of deflated middens in each volume class interval range from 44% to 14%. The highest proportions occur at the extremes of the volume range at less than 0.4 cu. m and greater than 30 cu. m. At the small end of the scale I would argue that sites of less than 0.4 cu. m occurring in stable vegetated dunes will generally not be found because of ground surface cover and lack of obtrusiveness. Deflated middens of this size would generally be highly visible in blowouts. At the large size end of the scale, it has been shown that the largest volume middens are found on dunes. The dunes supported the grasslands which attracted cattle grazing, so the likelihood of damage to the dune vegetation cover and subsequent erosion by wind is high. This would account for the high proportion of large sites which have been deflated.

4.7.5 High tides and storms

Shellfish contain little meat in relation to their weight, so an optimum processing location would be as near as possible to the edge of the sea. At times processing and consumption would be done on the beach or foreshore, within reach of high tides or storm waves (for examples see Meehan 1975:167; Hughes and Sullivan 1974). How much midden was deposited on these landforms and then scattered by waves or reworked with natural shell deposits within a few years cannot be measured. Possibly reworked deposits were only found in a few locations. One example is in the small sandy cliff behind the beach adjacent to site 56 at West Point. It contains large

Volume m ³	Total number of middens in volume interval	Deflated middens	
		frequency	% of total
0-0.4	103	40	38.8
0.5-0.9	21	3	14.3
1-9	66	10	15.2
10-19	24	6	25.0
20-29	12	2	16.7
30-50	12	5	41.7
>50	16	7	43.8
	total 254	total 37	

Table 4.4 Proportion of deflated middens for 7 volume classes in surveyed quadrats on west coast of mainland Tasmania

Subnivalia undulata which have been water rolled and abraded, along with pebbles, clean white beach sand and small shells. The composition is quite different in appearance and composition from a typical cultural midden deposit (cf. Hughes and Sullivan 1974), but the probability that some of its contents were at one time discarded by Aborigines cannot be ignored. This deposit was not included in the midden sample.

4.7.6 Area to volume relationship

One of the aspects I wished to investigate was the relationship of the area of the surface of a midden to its volume to see if it was possible to develop a formula by which it would be possible to calculate volume from area. In calculating volume, I used depth measurements obtained with a probe auger which is described in Appendix 6. This relationship of midden volume to surface area is most clearly shown in a scattergram of all the middens recorded in the west coast quadrats with the axes scaled in log to the base 10 (Figure 4.6). The correlation coefficient is 0.60818. The standard error of the estimate is 1.13455, so by calculating the equation of the regression line it is possible to predict site volumes from area within given confidence limits. Could this be used to avoid the effort of augering and calculating volume by trigonometrical formulae? By excluding from the sample middens with volumes of less than 0.01 cu. m, it is possible to narrow the range of the confidence limits to 0.57429 and increase the value of r to 0.90922. Since these sites would be recorded in the field as having an insignificant volume, their exclusion is not a problem. This leaves a sample of 194 middens.

The equation of the regression line now becomes: VOLUME in cu. m = AREA in sq. m X (0.90922) + 1.32078

This can be graphed, along with the 95% confidence limits of ± 2 times 0.57429 (Figure 4.7).

But can this really be used for field estimates? Two examples are sufficient to show the limits of the equation's usefulness. If area equals 10 to the power 4 in sq. cm (1 sq. m), then volume in cu. m equals 10 to the power 4.95 \pm 1.148, giving a range of 3.80 to 6.09. These values correspond to 0.006 to 1.2 cu. m respectively. If area equals 10 to the power 6 in sq. cm (100 sq. m), then volume in cu. cm equals 10 to the power 6.77 \pm 1.148,

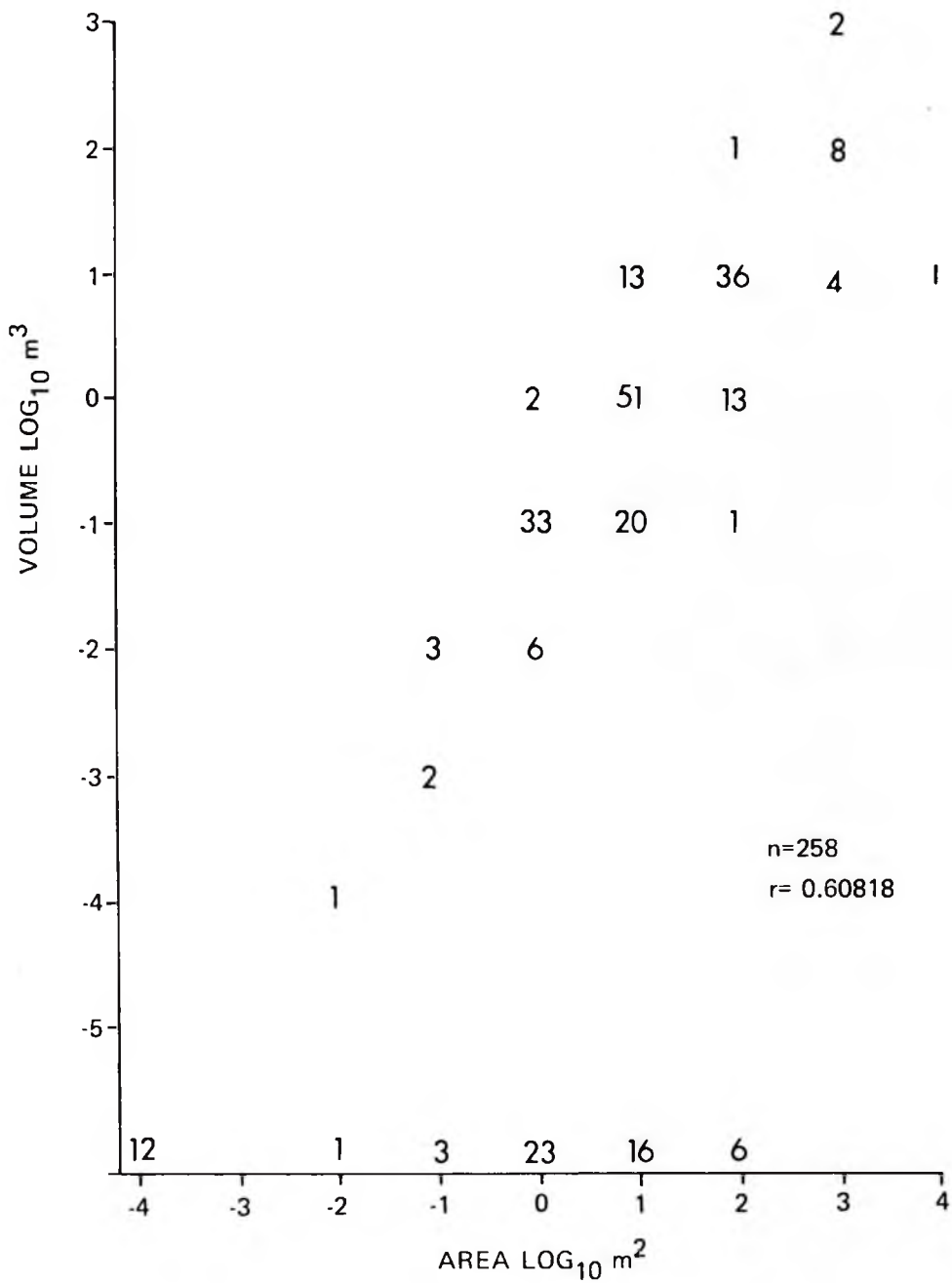


Figure 4.6 Crosstabulation of the surface area to volume of middens on the west coast

$$y=x(0.90922) + 1.3278$$

regression of volume on area

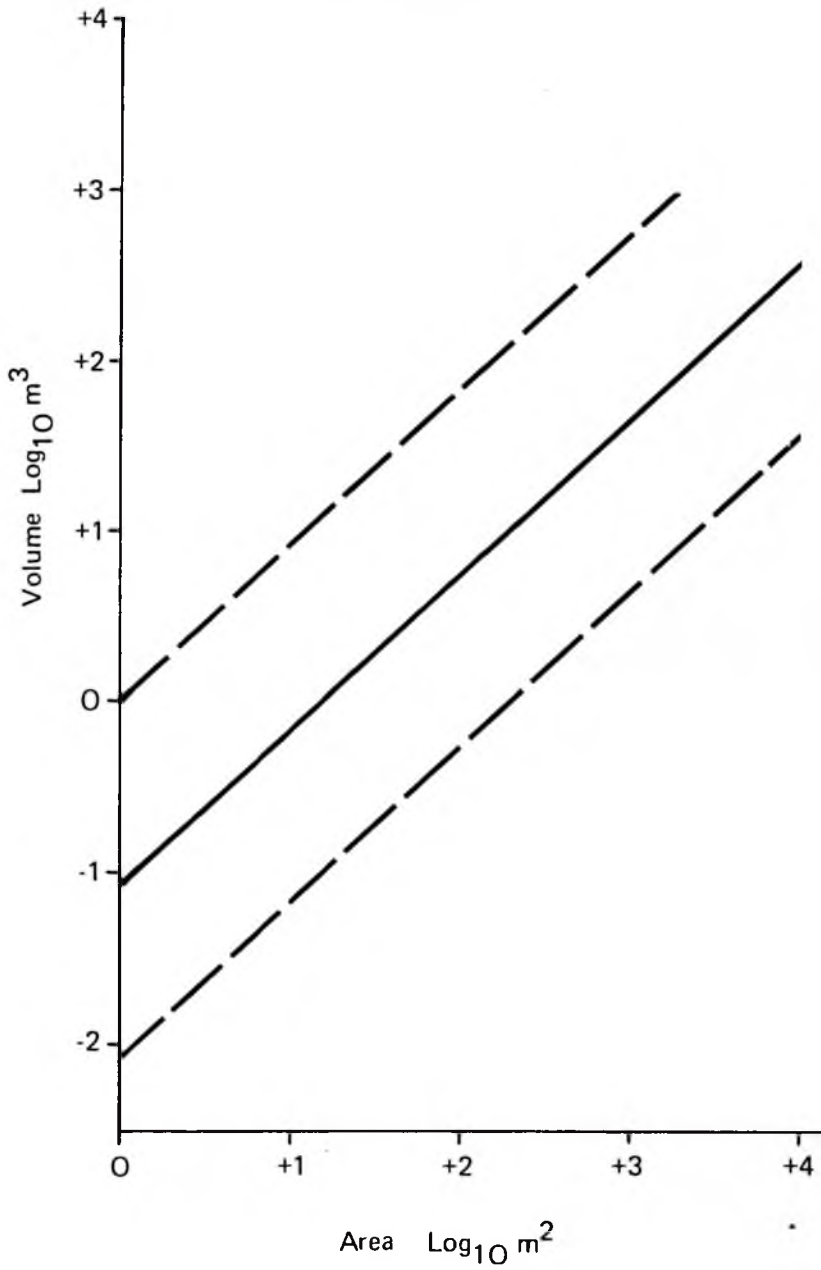


Figure 4.7 Regression of volume on area for middens larger than 0.01m^3 on the west coast.

giving a range of 5.62 to 7.92. These values correspond to 0.4 to 83 cu. m. So although the correlation coefficient is high, because it is necessary to use log scales for the axes, even the small error of the estimate obtained on the truncated size range produces an extremely wide spread of possible volumes when transformed back to values in cubic metres. This analysis shows that the method of estimating volume from surface area used by Morris (1979:23) is suspect.

4.7.7 Bedrock types and deflation of middens

If my volume estimates for deflated middens are accepted as reasonably reliable at least in terms of order of magnitude, the rate at which sites have been eroded can be estimated. Alternatively, the volume factor can be ignored, and the number of middens which have been deflated as a percentage of the total in a quadrat can be used as a measure of the erosion rate. The latter is a more simple calculation. The Mount Cameron West, Australia Point and Daisy River quadrats were chosen to illustrate this exercise. They are typical of three types of country rock on the west coast: basalt, relatively unmetamorphosed sedimentary rocks and Quaternary sand respectively. The calculations give the results shown in Table 4.5.

In Section 2.5 I have argued that massive dune mobilisation on the west coast began after 1850, with most of the large sand blows being already well developed between 1900 and 1930. With these figures the rate of loss of middens can be calculated for the three types of bedrock. The assumptions in this model are that the rate at which middens have been deflated has been constant over time and that there were few deflating middens at the time of European exploration in the early 1800's. For this exercise, I have assumed that middens began to be deflated in the year 1830, which is about the time of the first grazing of the west coast by sheep and cattle. The final assumption is that my estimates of the original volumes of middens which are now deflated are reasonably accurate.

Taking the basalt example first, it was found that none of the middens in the quadrat was deflated, so there was a 100% survival rate. The implication was that the fine basaltic soil with its dense cover of tussocks forms a very stable surface which is ideal

Quadrat	Rock type	Sample size		Deflated middens as:	
		total number of middens	total volume ₃ of middens m ³	% of total number	% of total volume
Mount Cameron West	basalt	12	140	0	0
Australia Point	metamorphic rocks	9	138	55	69
Daisy River	Quaternary sands	11	171	82	99

Table 4.5 Rates of erosion for three bedrock types

for the preservation of middens. The surface of site 218 however, was slightly eroded, so even on this most stable of land systems there was some visible erosion of middens.

In the Australia Point quadrat on metamorphic rocks, 55% of the middens had been deflated, and these accounted for 69% of the total volume of midden in the quadrat. By extrapolation, if 55% of all middens had been deflated in the 150 years between 1830 and 1980, then all the sites will be destroyed by the year 2102. In contrast, extrapolation from the rate of volume which has been lost predicts that all the middens will be destroyed a little sooner, by 2047. Either way, this is a startling conclusion, which demonstrates not only the rate at which middens have been destroyed in this quadrat, but that all the middens may be gone by about 2110. There is one site, however, which will probably not be deflated. Site 339 is a tiny midden in a small rock shelter. The tilted bedding planes have formed a narrow shelter where softer strata have been eroded away. So in our desolate scenario of the year 2100, the archaeologist of the future may have only this one site remaining. It is the only shelter site out of the nine middens in the quadrat and contains only half a cubic metre of midden. The estimate of the original volume of all the middens in the quadrat was in excess of 138 cu. m.

If this scenario looks bleak, then it is time to examine the Daisy River quadrat on the Quaternary sediments. Of the total number of middens in the quadrat, 82% are now deflated, so by extrapolation all middens will be deflated by the year 2012. The final calculation is even more alarming. Of the total volume of midden in the quadrat, over 99% has already been deflated. All that remains are two very small midden dumps. At the speed predicted by the volume deflation rate, these small sites will have been deflated within the next two years.

In all these calculations I have taken a conservative baseline date of 1830 as the date of the initiation of major sandsheet mobilisation. It is probable that the process did not reach its full rate for some years and therefore that the massive scale sand erosion did not develop till the 1850's or even later. If this is so, then my rates of deflation are underestimated and the length of time till the destruction of almost all shell middens on the metamorphic rocks and the Quaternary sediments will be shorter than

the model has predicted.

What then will the archaeologists of the future find when he or she looks at the landscape associations of middens? Even allowing almost 100 years as a margin of error in the measurements of the basic parameters, the model predicts that by the year 2200 there will be no in situ open sites on the Quaternary sand and metamorphic rock areas. There will however be a tiny rock shelter with a small volume of midden protected inside it. In contrast, on the basalt soils there will be a high number of middens and some of them will still be relatively large. The social reconstruction of such an archaeological pattern would run something like this. Aborigines preferred to exploit the shellfish of the boulder strewn basalt coast and to camp on the fine basaltic soils. There will be such an overwhelming concentration of sites on the basaltic soils that this is obviously the home base of a band. The band made occasional forays along the coast, where they used a small shelter as a bivouac and ate a few shellfish. The shelter, however, is very small and could only accommodate a couple of adults, so it is obviously only a transitory hunting camp. It was probably used by a few men on a distant excursion from their home base. I will demonstrate in the remainder of this thesis that this reconstruction is totally at odds with the picture presented by a survey in the 1980's.

4.8 CONCLUSION

One of the first methodological questions I was confronted with in this study was something like - "What type of survey is suitable?". The alternatives were considered and a survey based on physiographic units of the landscape was chosen. Any variable could have been chosen, for example, land system, landform etc., but because the study is primarily concerned with coastal site distributions, the actual physiographic feature chosen as the basis of the sampling was coast type. In the jargon of sampling, the survey area was "stratified" on this variable. A review of information available on coastal structures and wave energy types suggested that combinations of these two variables could be used to characterise any stretch of coast. After formally tabulating the possible types of coast which I could expect to encounter in the

study, I selected areas within each coast type to become the locations of my sampling quadrats. This was a "stratified disproportionate selective sample". This selection was also determined by a secondary consideration, convenience. Quadrats were deliberately placed near roads whenever possible so as to minimise the difficulty and time required to get to them. There was no advantage in travelling to the least accessible parts of the study area when the same coast type could be sampled in an easily accessible location. Quadrat size was set at 250,000 sq. m. Ideally, a quadrat should have been a square with one side placed against the coast. Unfortunately, coasts do not conform to ideal geometric straight lines, and other shapes had to be used in some situations. This study is an example of how formal approaches to sampling in archaeology have to be modified to handle the awkward problems of sampling along a coast.

There was also the question of the likelihood of archaeological remains being detected if present. Factors pertinent to this problem include ground surface visibility, burial or exposure of the original land surface and site obtrusiveness. To a large extent the effects of these factors can be minimised by appropriate changes in the search strategy.

The landscape features which were defined for each quadrat were described and the site data recording method was illustrated. This combination of field equipment and recording technique enabled a wide range of variables to be recorded quickly and efficiently for each site. General or supplementary data on quadrats or sites were kept in field notebooks. The use of a coding sheet system in the field had several advantages. It ensured consistency and that all variables were recorded for each site. It also greatly reduced the amount of time which was required to record field observations. The results of the analysis of these field data forms the basis of the remainder of this dissertation.

At the end of the fieldwork I was faced with an enormous amount of archaeological and geographical data. With the benefit of hindsight, I can see how lucky I was in finding suitable methods of analysis. It is all very well to say that the ultimate aim was to describe the fundamental parameters which controlled the nature and distribution of archaeological sites - but which parameters were important, and how does one set about searching for correlations

between groups of data which may include interval and nominal units? I think now that it was fortunate that highly sophisticated techniques such as multi-dimensional scaling proved to be inadequate. Their failure to define meaningful patterns forced a re-evaluation of the quality of the data and brought me back to the fundamental strength of this survey, i.e. that the sampling was related to physical criteria - wave energy and shore structure.

If this was one of the strengths of the approach, what were the weaknesses of the data? An analysis of the west coast data has shown that many sites are disturbed and this lead to measurement problems. A survey tends to record the larger and more numerous elements in sites and of course cannot account for sites which are not found because they are now covered or have been eroded away. Middens on different bedrock types have been shown to have varying chances of survival. This affects the type of archaeological pattern we can record today and so our reconstruction of prehistoric activities. With these limitations in mind I would now like to turn to an investigation of the shell middens of the west coast.

CHAPTER 5 THE NATURE AND DISTRIBUTION OF WEST COAST SHELL MIDDENS

The concluding section of Chapter 4 ended on a cautionary note and in the light of this I now wish to turn to a consideration of the results which were obtained.

To begin with, I will look at my case study area on the northern half of the west coast of Tasmania. For ease of definition, this region is taken as extending from Woolnorth Point in the extreme northwest to the entrance of Macquarie Harbour in the south. The outstanding feature of this region is the ocean swell which meets this westward facing coast. Within this stretch of coast I completed 28 quadrats (Figure 4.1), recording a total of 258 shell middens (Table 4.2). Before describing these middens, I would like to elaborate the way in which I have handled the parameter of size as this proved to be a very important site attribute.

5.1 METHODOLOGICAL CONSIDERATIONS

5.1.1 Graphical and statistical approach to volume descriptions

In the following discussion, volume is used as a measure of the size of middens. Because the distribution curves of midden volume measurements were extremely skewed a number of transformation procedures were applied. The best approximation to a normal curve was achieved with a logarithmic transformation to the base 10. Such a transformation for the volumes of all 258 middens gave a distribution with two distinct components. The main body of the distribution approximates to a normal curve with 67% of middens falling between 0.1 cu. m and 10 cu. m. To the left of this curve was a small spike representing middens with less than 0.01 cu. m. As very small middens make no substantial contribution to the total volume of deposit in the samples, they can be ignored in some of the statistical calculations. The arbitrary cut off point for these very small middens was set at less than 0.01 cu. m. This bimodality may be an indication of an important archaeological fact. When describing middens Meehan (1975:166-245) distinguishes 'dinnertime camps', 'processing sites' and 'home bases'.

5.1.2 Midden field descriptions and volume

The basic midden categories were outlined in Section 3.2.2 as: linear midden, small midden dump, medium-sized midden dump, doughnut midden, West Point type midden, deflated midden, rock shelter midden. They were chosen as concise field description terms on the basis of shape, area and surface features. To what extent do the midden categories separate out on the basis of size, in this case as indicated by volume? A distribution of percentage frequencies for volume class was prepared for each midden type (Figure 5.1). The 'small midden dumps' have, as expected, the highest proportion of volumes less than 0.01 cu. m, at 29%. There is, however, some overlap between 'small midden dumps' and 'medium midden dumps'. 'Small midden dumps' were arbitrarily defined as being those less than 5m in diameter (an area^{related} measurement) and the overlap in the volume distributions shows that the correlation between area and volume is not perfect. Using the Kolmogorov-Smirnov two-sample test, however, these distributions were shown to be different at the 0.05 level of significance. There is also overlap between volumes of 'linear middens' and 'medium midden dumps', with the former tending to be larger.

The Kolmogorov-Smirnov two-sample test showed these two distributions to be similar at the 0.5 level of significance. This supports my field impression that linear middens are typically composed of smaller units.

The distinction of medium midden dumps and linear middens is purely a descriptive artefact based on the surface configuration of the midden, and is not an accurate indication of their relative sizes. Because of the problems outlined earlier for volume estimates of deflated middens, I propose to say nothing further about them here. There are only three 'West Point type middens' so no statistical statement can be made, although the profile shows they tend to have large volumes. Because of the small sample size for 'rock shelter middens' and the physical constraint on volume imposed by being enclosed within walls, a statement about average volumes of rock shelter middens would be meaningless.

The almost perfect symmetry of the distribution curve for the volumes of all middens in the total sample is not maintained in the curves for the sub sets of descriptive types. Because of this, the only measure of central tendency I will present is the mean of the

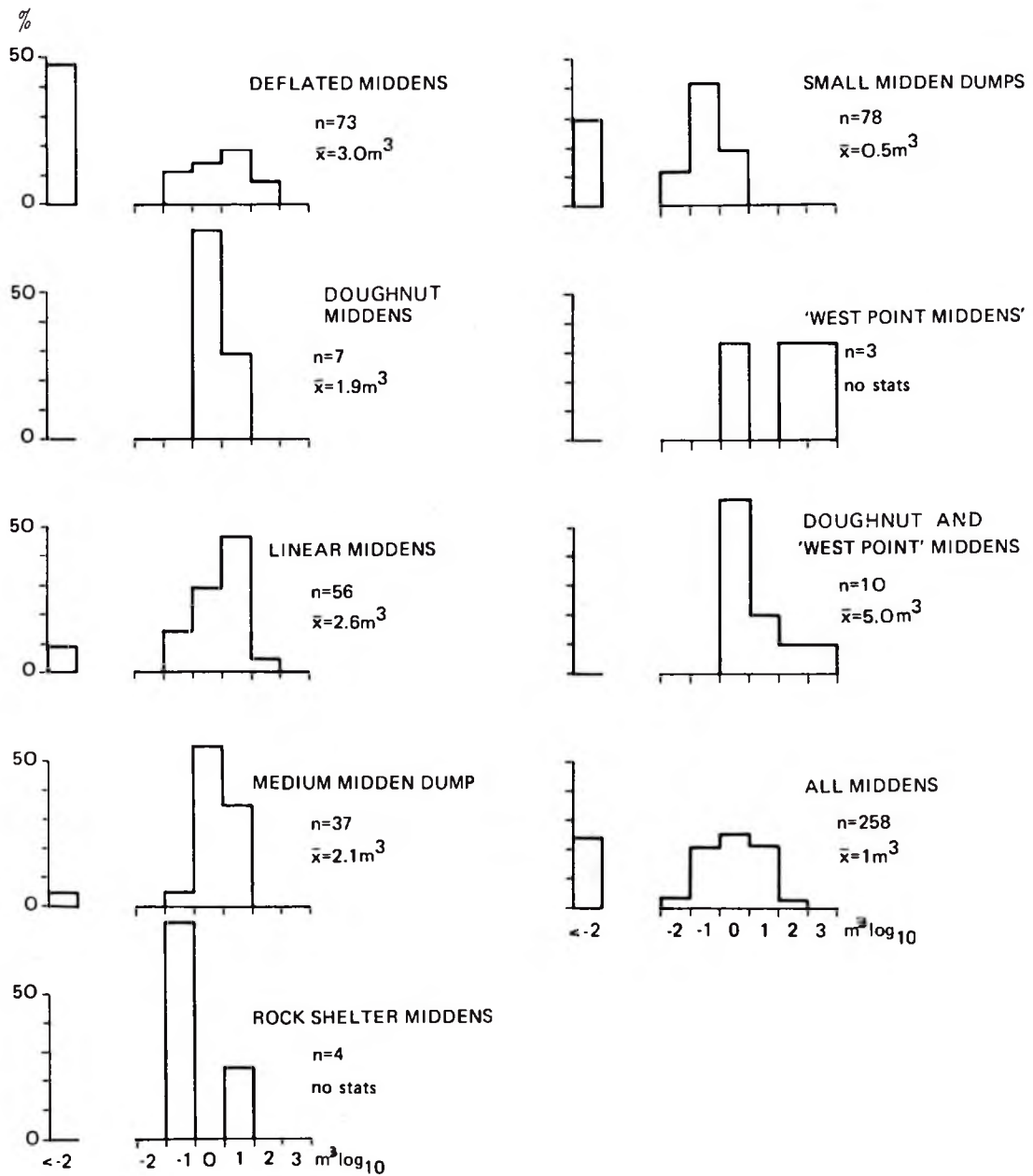


Figure 5.1 Volume profiles for midden types on the west coast

transformed volumes. Sites with volumes of less than 0.01 cu. m were not included in these calculations. Viewed in this way, the 'small midden dumps' and 'medium midden dumps' classes are quite different, with mean volumes of 0.5 and 2.1 cu. m respectively. The contrast between 'medium midden dumps' and 'linear middens' is proportionately less, with the 'linear middens' average at 2.6 cu. m.

Taken separately, 'doughnut middens' and 'West Point type middens' have mean volumes of 1.9 and 46 cu. m respectively. Taken together, they have a mean volume of 5 cu. m.

The midden types were originally defined largely on nominal criteria supplemented by arbitrarily defined areal limits. These types have also proved to be useful in characterising midden types on the basis of volume, but in most of the remaining analyses I will use volume rather than midden type to characterise middens. Can we now interpret the bimodal distribution pattern?

Meehan's dinnertime camps normally consisted of a cleared area, one or two hearths and discrete piles of shellfish and other debris located on the periphery of the camp. Dinnertime camps were usually near fresh water. All that would remain in time would be shells and perhaps other animal remains. At processing sites Meehan describes how the shellfish were cooked and the meat extracted to be carried back to the home base. Processing sites resemble dinnertime camps, though they were often without water. In contrast, home bases contained a variety of food remains from a number of foraging locations. The process of midden formation involved cycles of deposition and rearrangement which continued as long as the site was occupied. It is tempting to speculate that the very large middens on the Tasmanian shore were home base camps, especially when they contain hut depressions. This is a notion to which I will return in Section 8.2. It is also possible to see the very small Tasmanian middens as dinnertime camps or processing sites which were only used once or twice. The larger sites, say up to 10 cu. m, could be regularly used processing sites.

5.1.3 Interaction of bedrock type, rock platform and coast type with midden volume

As explained in Chapter 2, I categorised the coast into the following major units; hard, mixed and soft. Bedrock, platform and coast type are closely correlated in the sampling quadrats. From air

photo interpretation it appears that the situation is similar on the middle west coast south of Cape Sorell.

The size ranges for middens from the various bedrock and shore structure combinations are summarised in Table 5.1 and Figure 5.2. Granite with a smooth coast structure does not have middens. Volcanic breccia with level platforms does have middens and these are similar in size range to those from the jointed platform type. This jointed platform type is found where metamorphic rocks and basalt crop out along the coast. Quaternary sediments produce sandy beaches, which I have classed as a soft coast type. The average size of middens on the soft coast was much lower than the mixed coast type. As a result of this tabulation, I grouped the quadrats in the following way. The four quadrats on granite were taken as examples of the hard coast type. The eighteen quadrats from basalt, breccia and metamorphic rock areas were combined to give a mixed coast sample. The six quadrats from sandy beaches which lacked rock platforms became my soft coast sample.

Smooth platforms on the high energy hard granite coast are not associated with shell middens. When I examined the sublittoral using SCUBA diving equipment, it appeared that the granite substrate supported in gross terms the same marine ecosystem as other rock types, so there was no shortage of shellfish and rock lobsters. There is a very interesting reference by Robinson which is pertinent to my findings. While passing this area Robinson noted that 'the shore is bold, consisting of high rocks, and there are no fishing rocks along this range' (Plomley 1966:760). The reason for the lack of shell middens on this coast type would appear to be behavioural, because where granite forms a mixed coast type large volumes of shell midden are found e.g. Sandy Cape. The likeliest explanation is the problem of access to the littoral zone. The coast from Trial Harbour to Granville Harbour is rocky and relatively straight, so it lacks headlands and embayments where entry and exit from the water would be sheltered. Even on very calm days there is usually some wave action on this coast. While it may be easy to get into the water, getting out by scrambling up smooth wave washed rocks is difficult. The attraction of the resources may not have been sufficient to warrant the risks involved in collecting them. In contrast, stone artefacts were found along the granite coast, showing that Aborigines traversed this area. Site 472, the largest of these, is on a small outcrop of

PLATFORM TYPE

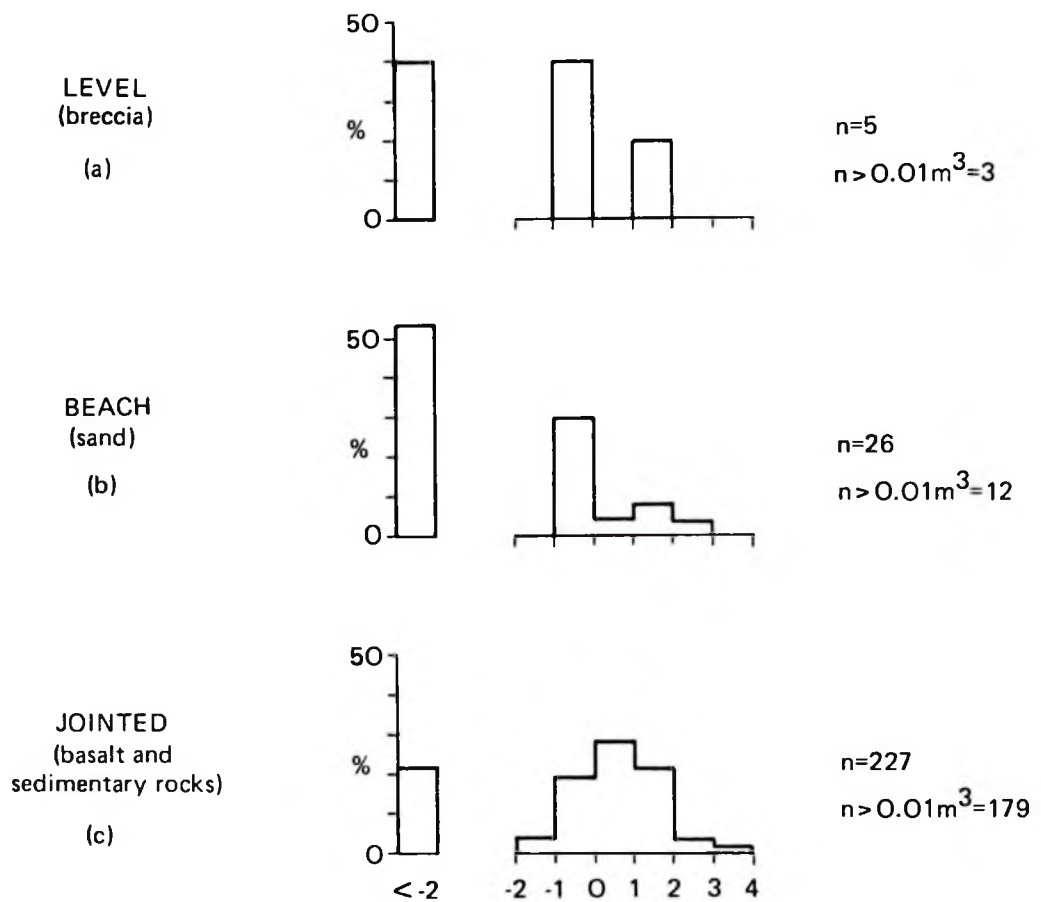


Figure 5.2 Midden volume distributions for west coast platform types.

Bedrock	Platform	Coast	Sample number	Sample of middens $\geq 0.01\text{m}^3$	\bar{X} on transformed values of sample of middens $\geq 0.01\text{m}^3$	Number of Quadrats	Comment
Granite	smooth	hard	0	-	-	4	No middens, but artefacts sites
	smooth	mixed	not sampled	-	-	-	
Volcanic breccia	level	mixed	5	3 (60%)	$10^0 = 1$	2	Both quadrats rise steeply from the shore.
Basalt	jointed	mixed	12	12 (100%)	$10^{0.416} = 2.6$	1	On rocky headland.
Relatively un-metamorphosed sedimentary rocks	jointed	mixed	215	167 (78%)	$10^{-0.029} = 1$	15	Most common coast type
Quaternary sediments	beach	soft	26	13 (50%)	$10^{-0.538} = 0.3$	6	

Table 5.1 Summary of the relationship between rock type, platform structure, coast type and midden volume

brown basalt soil surrounded by peaty granite soils. It probably contains in excess of 1,000 artefacts. This small area of fertile soil may have been a preferred camping place if it supported an island of eucalypt trees in an area which was dominated by heathlands. The trees would have provided firewood and building materials and shelter from the elements. This scenario is purely speculative as the area has been mined intensively for over 100 years and has been repeatedly burnt during that period. In 1981 the basalt soil supported only shrubs, but similar soil areas which have not been burnt so frequently supported woodland or forest.

On mixed coasts basalt and volcanic breccia produce level and jointed platforms respectively. The small number of middens recorded in the two quadrats with level platforms was similar in size range distribution to middens recorded on jointed platforms on the mixed coast produced by the basalt and relatively unmetamorphosed sedimentary rocks group. Because of this similarity I propose to combine the survey results for quadrats on these three rock types.

Finally, beaches of Quaternary sediments have a greater proportion of middens with volumes of less than 0.01 cu. m and the low mean size of 0.5 cu. m. As all the shellfish of the middens of the west coast either live attached to the bedrock or graze on the algae which grows attached to bedrock, as discussed in Chapter 2, any shells in beach areas must have been transported along the coast. There are no beach species to exploit.

5.2 LANDSCAPE PARAMETERS

5.2.1 Potential fresh water distance

The distance in metres to drinkable fresh or slightly brackish water was measured from maps or air photographs for each site. There were 12 middens where the distance could not be estimated with confidence because the original dune landscapes in which these are set have been markedly altered by post-European dune mobilisation. Two sites were more than 1km from the nearest known source of water. However it is likely that there were sources at a closer but unknown location, so they are excluded from these calculations. Of the remaining sample of 244 middens, 50% are within 120m of fresh water and 90% are within 400m (Figure 5.3). The remaining 10% of the sample

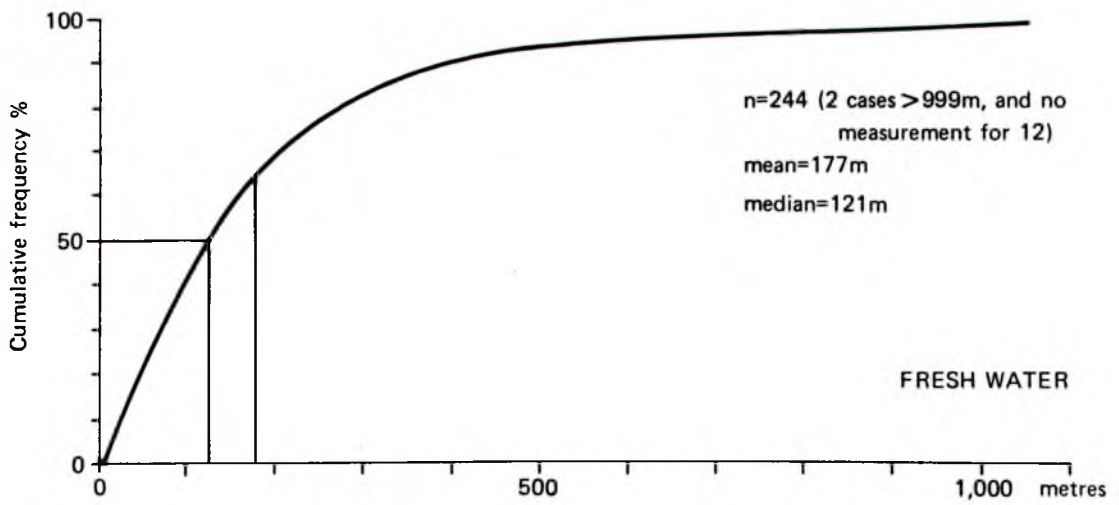
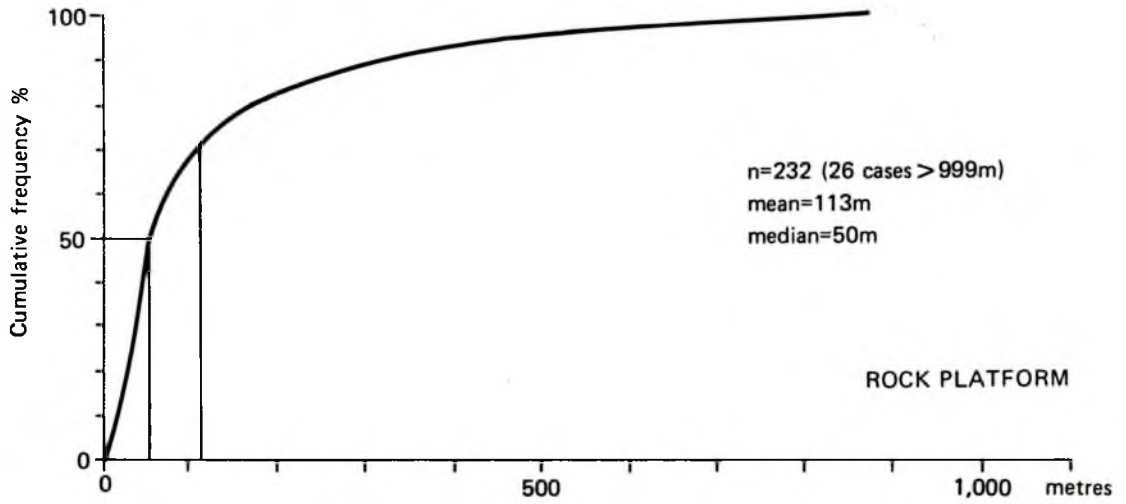


Figure 5.3 Graphs of cumulative frequency of distance from midden to fresh water and to rock platform on the west coast.

range between 400m and 990m. Because of the marked skew to greater distances, it is more meaningful to use the median of 121m rather than the mean to convey an idea of the average distance to fresh water. The underlying assumption in these data is that generalist hunters such as the Tasmanians used the nearest source of water regardless of its nature.

5.2.2 Potential fresh water source

The most frequently recorded source of drinkable water on the west coast was a swamp or ponded water (64%). This was followed by creeks or surface runoff (24%) and by an outfall of ground water seeping through sand or alluvium (11%). The relatively flat quartzite heathlands of most of the west coast quadrats have very shallow depths to bedrock and are dotted with small semi-permanent swamps. If these swamps were also exploited for foods such as swamp plants and crustacea, this would have increased the attraction to camp near water. Robinson indeed makes reference to Aboriginal collection of swamp plants (Plomley 1966:170).

There are two problems inherent in these observations. Firstly, it has been demonstrated elsewhere that fresh water can be obtained easily on sandy coasts by locating groundwater with small wells (Stockton 1974). Aboriginal wells were observed by Robinson. One example was simply noted as 'two small holes', but at another time Robinson wrote 'Saw a native well, a small spring not more than two feet in diameter....and (it) had steps down to it and muttonfish shells to drink out of' (Plomley 1966:874,170). They would not be recognisable archaeologically. On the Sandy Cape 1:100,000 map sheet is the place name 'Native Well Bay', but the origin of the name is not known. Finally the effects of occasional long term droughts must also be considered. The 1979/80 and 1980/81 summers, for example, were considered to be drier than most years by local farmers. Towards the end of each summer, many of the swamps which looked so formidable at the beginning had dried completely and remained dry for several months. My own observations over seven years at West Point show that this drying out does not happen every year, but it does add an element of unreliability to any observations about the distance to water and to the strength of any predictions that sites will be located near water.

5.2.3 Landform

Middens occur on all the landform types available on the west coast. It has been necessary to create a few new terms to describe features which are not strictly landforms in the accepted use of the concept. Examples of this are the 'pebble banks' and the 'bedrock outcrops' landforms. The 'pebble banks' are linear mounds of pebbles which lie more or less parallel to the shore about two or three metres above the present high tide level (Plate 5.1). 'Bedrock outcrops' are jagged exposures of base-rock which rise as bare monoliths and ridges above the surrounding landscape in the relatively unmetamorphosed rocks areas (Plate 5.2). The sample has been divided up on the basis of landform and slope in the following way:-

	less than 5° slope	more than 5° slope	total
Beach	3	-	3
Pebble bank	41	3	44
Cliff or rock outcrop base	3	1	4
Cliff top	1	1	2
Dune complex	84	10	94
Sandsheet	19	-	19
Flat	1	-	1
Bedrock outcrop (top, slopes)	17	6	23
Stream or swamp bank	15	1	16
Hill or ridge slope	3	11	14
Hill or ridge top	36	-	36
Island	2	-	2
Totals	225	+ 33	= 258

The most frequently occurring location is for middens to be on sand dunes (94 or 36%). Such middens are usually on the crests of the dunes which have a 360 degree view and are exposed to winds from all quarters. The distinction between dunes and sandsheets is rather arbitrary. It is based on my field observations of two distinct forms of aeolian sand landforms. I have called dunes where the sand is in mounds or ridges. Where it is spread as a level shallow mantle it is termed a sandsheet. The 19 sandsheet middens (7%) in the sample could

Plate 5.1 Site 86, a linear midden overlying a raised pebble bank at West Point. Shells from the base of the midden gave a C14 age of 3,300 years BP.

Site 390, a linear midden on a pebble bank at Nettley Bay.

Section through a pebble bank formed by stream erosion.





Plate 5.2 Bare rock outcrops rise out of the low heath at West Point. The West Point lighthouse is to the right of the plate.



be added to the dune category to give a total of 113 middens (44%). Surprisingly, the fossil 'pebble bank' systems account for the locations of 44 middens (17%). These banks are difficult to walk on and not particularly comfortable to sit on. However, they are extremely well drained, providing the driest place to sit during wet weather. As no vegetation grows on most of the pebble banks, there is no shelter from wind. It is possible that stone features which occur on these banks (Stockton and Rodgers 1979; Cane 1981) were windbreaks, but then it would be difficult to account for the variety of shapes and sizes of such features and the lack of food remains such as shell.

Thirty six middens (14%) occur on hill tops or ridge tops and a further 23 (9%) occur on outcrops of bedrock. The remaining 42 (16%) are on beaches, at the tops or bases of cliffs, on flat areas of the undulating quartzite heath, on ridge or hill slopes, along swamp or stream edges and islands. The use of small offshore rocky islands is surprising as they lack drinking water and have little firewood. I did not find bones or artefacts on either of the middens on islands. It is very unlikely that people spent nights on these islands, but they may compare to Meehan's 'dinnertime camps' or 'processing sites' (1975:166-170). From my observations of their contents, they appear to contain the same shellfish as are found in other West Point middens. However, comparison of island middens with onshore sites by excavation could show differences in composition at the micro scale.

The different landforms offered a range of choices for the location of sites to the Aborigines. However, the optimum location for various activities would change from day to day and season to season, with such variables as wind, angle of sun, rain, insects, availability of drinking water, etc. For example, in summer people may have chosen to use the crests of dunes in order to be exposed to any wind which would help to keep troublesome flying insects away. In winter, such a choice would cause them to be exposed to a considerable wind chill factor in addition to the already lower temperatures and more sheltered locations would have been preferred.

To examine the choice of landform from a different perspective I have cross-tabulated midden volume with eleven landform categories (Figure 5.4). The cliff base, cliff top, flat and island landforms all comprise less than 5% of the sample and will not be described in detail. The modal volumes for the remaining classes are:-

	PEBBLE BANK	CLIFF BASE	CLIFF TOP	DUNE COMPLEX	FLAT	ISLAND	ROCK OUTCROP	SWAMP OR STREAM BANK	HILL OR RIDGE SLOPE	SAND SHEET	HILL OR RIDGE TOP	Row Total
less than -2	7	0	1	25	0	0	6	8	3	7	7	64
-2	1	0	0	3	1	0	0	1	1	2	0	9
-1	12	2	0	17	0	0	10	1	1	5	6	54
0	16	0	0	20	0	1	3	1	6	4	15	66
1	8	2	0	22	0	1	4	5	3	1	8	54
2	0	0	1	8	0	0	0	0	0	0	0	9
3	0	0	0	2	0	0	0	0	0	0	0	2
Column Total	44	4	2	97	1	2	23	16	14	19	36	258
	17.1	1.6	0.8	37.6	0.4	0.8	8.9	6.2	5.4	7.4	14.0	100.0

Figure 5.4 Cross tabulation of landform and midden volume for the west coast

	cubic metres
Sandsheet	less than 0.01
Stream or swamp bank	less than 0.01
Bedrock outcrop	0.1
Hill or ridge slope	1
Hill or ridge top	1
Pebble bank	1
Dune	10

The smallest modal values occur on sandsheets and stream or swamp banks, while middens on rock outcrops tend to be slightly larger. Middens on pebble banks and slopes and tops of hills share the larger mode of 1 cu. m, but the largest modal volume is found on dunes. Not only are middens more commonly placed on dunes, they tend to be much larger. The volume distributions for some of these classes are shown in Figure 5.5. To make the distributions comparable the volume frequencies are given as percentages of the number of middens recorded for each landform type. Earlier in this section, I noted that the distinction between heaped sand forming dunes and more level sandsheets was arbitrary and therefore suggested that the two samples might be amalgamated on the assumption that people prefer to camp on sand regardless of its surface configuration. If this was all that influenced the location of sites, then it would be expected that the distribution curves for sandsheets and dunes should be similar. They are, however, noticeably different, in that the sandsheet middens tend to be very small whereas the others are large. Here is the expression of a definite cultural preference, not only in terms of gross numbers of middens, but also in their relative size. All sites with more than 100 cu. m are on sand dunes. The distribution curve most like that for dune sites is that for 'pebble banks', but the largest sites are only 10 cu. m and the modal volume is down to 1 cu. m. Hill or ridge top middens have the same maximum size and mode, but the clustering around the mode is more pronounced. Similarly, hill or ridge slope middens have the same maximum volume and the same prominent modal volume. Middens on rock outcrops are conspicuously small with their modal volume of 0.1 cu. m. This is the smallest midden volume of any landform, but they range in size up to 10 cu. m. In contrast, although stream or swamp bank middens have the highest proportion with insignificant volumes, the modal value for the eight which are larger than 0.01 cu. m is 10 cu. m. This extreme skew

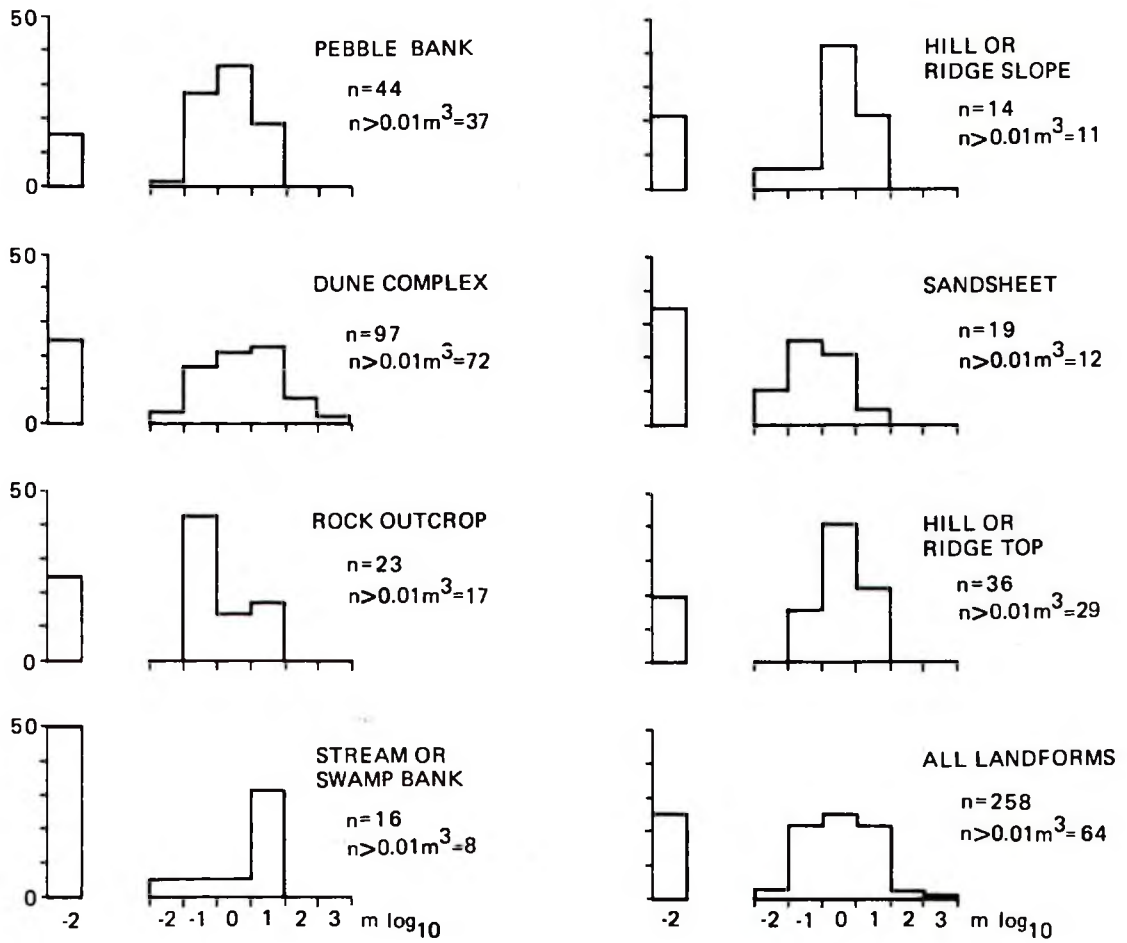


Figure 5.5 Midden volume frequency profiles by landform for the west coast

suggests that the sample is not drawn from a normal distribution, while there is a suggestion of bimodality.

In the case of the larger samples with almost normal distributions, a t-test can be used to compare the means. However, this test assumes that the populations have the same variance and this condition is only approached by the pebble bank and hill top/ridge top landform samples. The test showed that the means were similar at better than the 0.05 level of significance. The same test was used to compare the means of the dune and sandsheet samples. As they occur on similar sediments, I would have expected them to have similar volume averages. The means were shown to be different at greater than the 0.05 level of significance, but the results must be treated with caution as the variances are not equal. Similarly, the means of the 'pebble bank' and dune samples were dissimilar at the 0.05 level of significance. In these examples, the t-test supported the interpretations offered from the visual interpretation of the distributions.

To test the overall similarity of the distributions the nonparametric Kolmogorov-Smirnov two-sample test was used. This was chosen because it is sensitive to all types of differences which may exist between two distribution functions. No differences were found between any of the distributions at the 0.05 significance level using the large scale Kolmogorov-Smirnov approximation formula. The same test was recalculated using only the middens with volumes equal to or greater than 0.01 cu. m. Again, no significant differences were found at the 0.05 level.

This formula is slightly conservative for small samples. In addition, with small samples it is less easy to reject the null hypothesis that the distributions are similar. There is even doubt about the validity of the use of the Kolmogorov-Smirnov test to compare distributions of unequally sized samples (Siegel 1965:129).

5.2.4 Slope

Two hundred and nineteen (85%) of these middens are on level surfaces. The distribution of the other 39 is as follows:

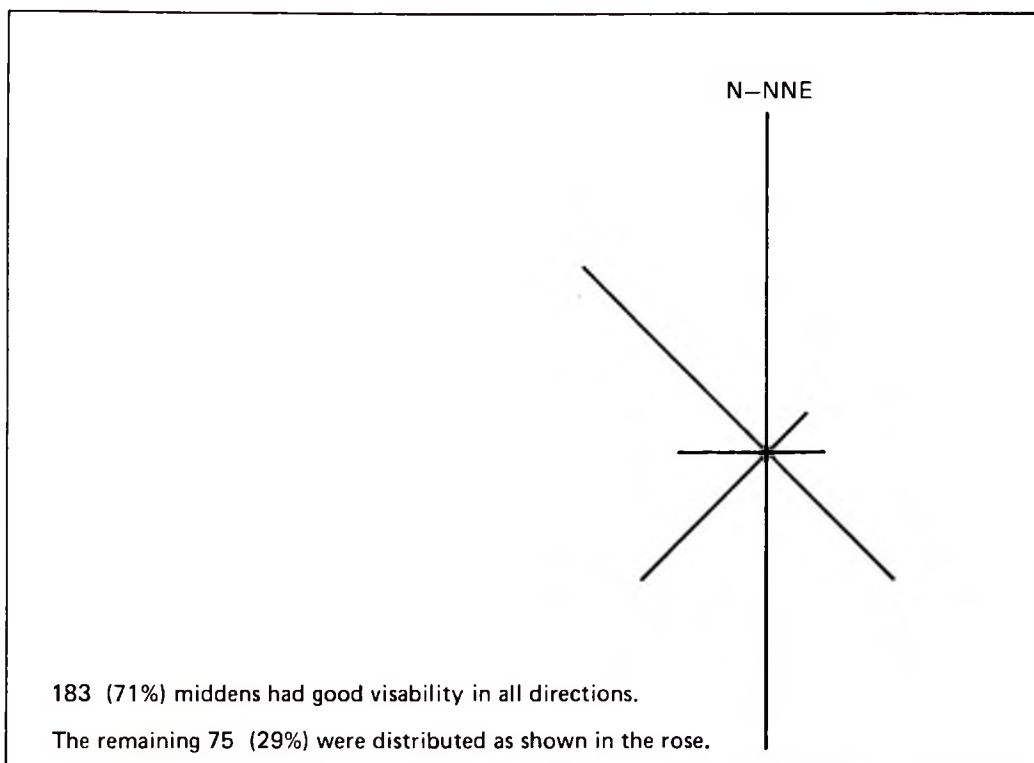
Slope in degrees	Frequency
less than 5	6
5-9	18
10-14	6
15-19	3
greater than 20	6

Why would people have chosen to dump midden rubbish on sloping ground? Some of the positions are against bedrock outcrops or the sides of sand dunes which provide shelter from wind. Perhaps in other cases a sloping surface may be better drained during rainy weather. Overall, however, there was clear preference for camping on, or at least dumping refuse on, a level surface.

5.2.5 Shelter of middens from wind

The direction to any landform which gave shelter from wind to a midden was recorded. One complex linear midden (site 521) was excluded from this analysis because it was really a large number of small point sites scattered over a series of dunes. Of the remaining 257 middens in the west coast quadrats, only 74 (29%) were sheltered by a landform. Thirty three were sheltered by dunes, 25 by headlands, cliffs or hills, 14 by rock outcrops. Comparable data are available from eastern New South Wales. Sullivan (1980:144) describes a tendency for middens to be sheltered from wind, particularly from the cold southerly and southeasterly winds. I would have expected protection from wind to have been much more important in Tasmania where air temperatures are lower and wind speeds higher, but it appears to have been a more important factor in New South Wales than in Tasmania. It is likely that many sites were positioned to be sheltered by vegetation in prehistoric times but this cannot be demonstrated now as the vegetation has changed. For example, the Sundown Point doughnut midden excavated by Ranson contained Banksia marginata pollen but is now surrounded by herbs and tussock grasses (pers. comm.). The surroundings of this site have probably changed from an open low woodland which gave some shelter from wind to an exposed grassland.

Only 6 (2.3%) middens were protected from all directions. The direction of shelter for the remaining 68 is shown in Figure 5.6. This figure shows that sites are sheltered from the south more often



Frequency of midden aspect on the west coast

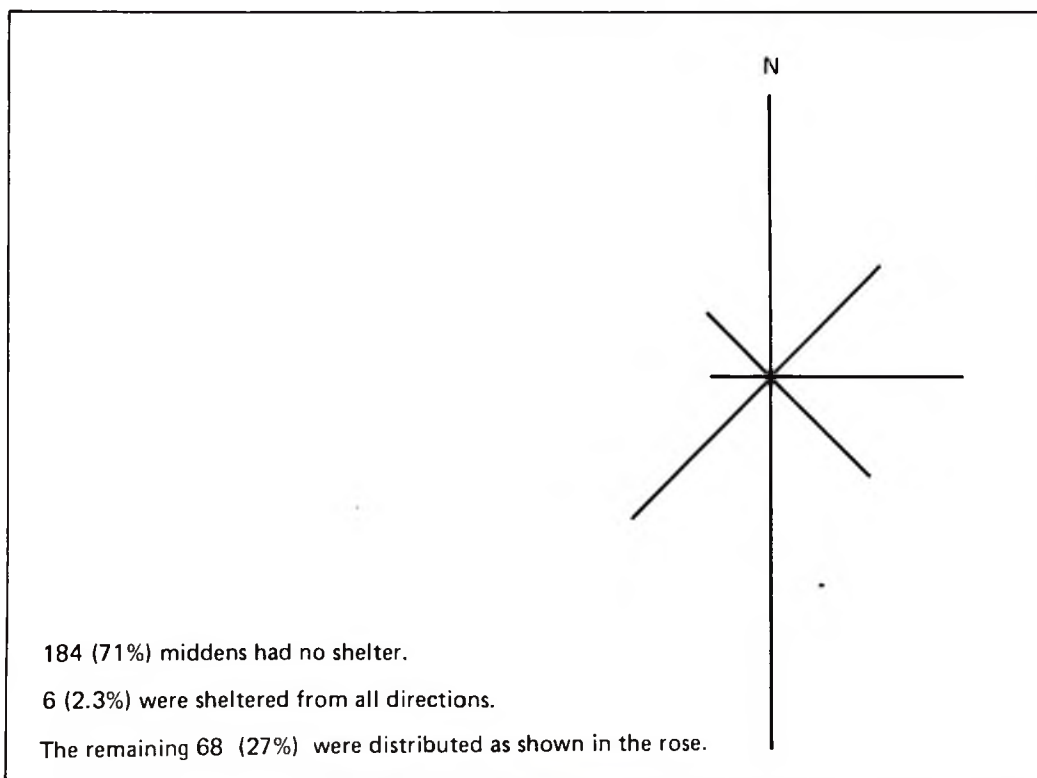


Figure 5.6 A. Frequency of midden aspect on the west coast
B. Frequency of middens sheltered from wind on the west coast

than any other direction, while it is least common for sites to be sheltered from the west and northwest. The other directions take about equal shares of the sample.

Background information on wind strength and direction was outlined in Section 2.2.6. The data from Cape Sorell shows that the most frequent and strongest winds are from the south and southwest, while there is very little wind from the eastern quadrant (Figure 2.4). The positions of middens do not reflect this pattern except in that protection from southerly winds is the most common. However, with 73% of middens having no shelter from wind at all, it appears that this was not an important factor in determining location. It can be argued that locations exposed to wind were deliberately chosen to drive away flying insects (cf. Meehan 1975:44). During calm days in summer, a variety of blood sucking insects which are common along the coastal fringe can make life miserable. The most troublesome of these ectoparasites are the March-flies (family TABANIDAE), Mosquitoes (family CULICIDAE) and Sand-flies (family CERATOPOGONIDAE). On these days any breeze is welcome. Additionally, ticks (class ARACHNIDA) and leeches (Order HIRUDINEA) which live in the vegetated areas would be avoided if camps were sited on exposed dunes. In some parts of the west coast the latter could have been exceedingly troublesome.

5.2.6 Orientation of middens

For each site I noted which direction had the least obstructed view, in an attempt to record some idea of which direction the site faced. If the visibility was equally unobstructed in all directions, the site was described as having no preferred orientation. Out of the sample of 258 middens, 183 (71%) did not face any particular direction, so a large proportion has an unobstructed view in all directions. The orientation of the remaining 75 (29%) is shown in Figure 5.6. There is no clear preference for any particular direction, but sites facing NE-ESE and E-ESE were the least common, while those facing N-NNE and S-SSW were the most frequent.

Several points can be made from these data. Locations with a good view in all directions were generally preferred. Sites were most likely to face NW to NNE, probably in order to take advantage of the northerly sun. On Kangaroo Island, Lampert noted that sites were usually on slopes with a northerly aspect which provided optimal conditions both for protection from inclement weather and for taking

advantage of the sun's warmth (1981:36). However, the next most common orientation was SE-WSW, an orientation for which there is no obvious explanation.

To what extent was the direction a midden faced a function of being in a sheltered position? For example, if a midden was sheltered from the south, did it face north? There were 50 middens which had records for both factors. A cross tabulation by the eight points of the compass was prepared. The cross tabulation showed that the most common combinations were to be sheltered from the south and to face north (11 cases), or the exact opposite, to face south and to be sheltered from the north (9 cases). No other combination had more than 3 cases. The conclusion can be stated quite simply: if a midden is sheltered it will tend to face the opposite direction, but the pattern contains a large element of randomness.

5.2.7 Substrate and matrix

The term 'substrate' was used in its geological sense to characterise the material lying immediately under the deposit. In contrast to what lay underneath the deposit, the term 'matrix' was used to describe the sediment trapped within the archaeological deposits. There were three types of substrate - bedrock, pebble and sand, with sand being the most common (56%). Four matrix sediment categories were recorded - soil, sand, pebbles and no matrix. There were only three records of middens with no matrix. These consisted of scatters of shells on either bedrock or pebble banks. The frequencies of substrate and matrix sediment types were cross tabulated for middens in the west coast sample (Table 5.2). Predictably, sand was the most common sediment of the matrix (98%), but it is greatly overrepresented in relation to its frequency as a substrate. This means that shells trapped sandy sediments which did not lie on that spot before the midden was deposited. This is an example of Jennings' (1965:152) 'quasi-natural' processes, i.e. the transport of sandy sediment is a natural process, but the accumulation of trapped sand only began after people had dumped midden material on the pebble banks.

In spite of the potential number of combinations of these two variables, the most commonly recorded arrangement was for a midden to rest on a sandy surface and to have sand trapped within it. Reasons for the initial choice of a sandy location as a camping site could

		SUBSTRATE			
MATRIX		Bedrock	Pebbles	Sand	Total
					f %
SOIL		2	0	0	2 0.8
SAND		64	44	144	252 97.7
PEBBLES		0	1	0	1 0.4
NIL		2	1	0	3 1.2
Total	f	68	46	144	258
	%	26	18	56	100

Table 5.2 Cross tabulation of substrate and matrix for middens on the west coast

include its good drainage properties and therefore its relative warmth. It is also easy to dig and comparatively 'clean'. All these factors might make a sandy substrate a tempting camping spot but the location would soon be covered with discarded shells and other food remains, as well as ash from fires. Would the location then be less desirable? Jones (1980c) and Meehan (1975:167) have given examples of how regularly used camps are cleaned by scraping rubbish away to the side, so we are often dealing in archaeology with the reuse of locations which have already been culturally modified, not just by deposition of material, but by its removal and redeposition, and in the case of the west coast by the trapping of aeolian sand. If a location was reused frequently, it must have been worth the effort of some 'housekeeping' to clean it up. There is an additional complication, as once the midden mound had trapped sand it would become covered with grassy vegetation for reasons which were outlined in Section 2.5. Of these reasons, soil pH seems to be the most important factor. This culturally created grassy mound then becomes an ideal spot for reuse. In this way, even places which were never used as over night camps could accumulate a considerable volume of midden in time.

5.2.8 Vegetation on and adjacent to middens

Vegetation is not a static factor. The very presence of cultural remains can cause changes in the micro-environment by increasing fertility, adding ash from fires and trapping sand. Twenty nine middens of the 258 in the west coast quadrats are in deflated areas where the vegetation setting could not be determined (Table 5.3). One hundred and twenty three are in low shrubland, 49 are in herbland, 49 are in tussock grassland and eight are in tall shrubland.

Within the sample, it was possible to work out the most favoured combination of vegetation forms in which to place middens. These were very open low shrubs (46 or 20%), open low shrubs (37 or 16%), very dense herbs (32 or 14%) and dense low shrubs (28 or 12%). There is a strong bias to low shrublands (123 or 54%). I do not know to what extent this is a function of the regional dominance of heathland, but it does demonstrate an avoidance of the tall shrubland parts of the coastal hinterland.

	Vegetation setting of midden		Vegetation growing on midden	
	f	f%	f	f%
HERB	49	21	137	60
TUSOCK GRASS	49	21	40	17
LOW SHRUBS	123	54	37	16
TALL SHRUBS	8	4	-	-
FERNS	-	-	6	3
BARE	-	-	9	4
Subtotal	229	100	229	100
NO RECORD (AS NOW BLOWOUTS)	29		29	
Total	258		258	

Table 5.3 Vegetation setting frequencies

In contrast to the vegetation setting, the dominant species growing on the surface of the midden was also recorded. This information on the basis of plant form is summarised in Table 5.4. In 137 middens of this sample herbs were dominant, followed by tussock grasses and Leptospermum laevigatum. If middens in deflated dunes are excluded from the sample, 177 out of 229 (77%) are dominated by herbs or tussock grasses. This includes 10 with Ammophila arenaria, which is an introduced species. Only 37 middens (16%) of the sample were dominated by shrubs. The balance is comprised of nine with more than 50% of the surface unvegetated and six with the fern Pteridium esculentum.

The most frequently recorded combination of vegetation on the surface and in the vicinity of a midden was 43 cases with herbaceous cover on a midden which was situated in a low shrubland. The factor which appears to control this micro-pattern of vegetation change between on and adjacent to a midden is soil pH. Large accumulations of calcium carbonate in the shells produce alkaline conditions with readings of 8 - 8.5 pH. The surrounding soils give slightly to moderately acid readings of around six and wet or marshy areas even more acid readings of about five. Grasses do not compete well with the heath shrubs on the acid soils, while the shrubs do not appear to be able to invade the alkaline soils of the middens. Similar localised effects of middens on Tasmanian west coast vegetation have been noted by Kirkpatrick (1977c:152). In this way the presence of cultural materials may change the micro-environment, making a place more attractive for use in the future.

5.2.9 North versus west facing coast

During fieldwork I noted that middens were smaller and less numerous where the coast faced north rather than west. To test this I looked for locations where all the coastal characteristics were the same except for the orientation of the coast.

The first area chosen was the Nettley Bay section of the West Point to Pavement Point coastline. The area was divided into six quadrats of which West Point 1, 2, 5 and 6 faced west and West Point 3 and 4 faced north. In the four west facing quadrats, 55 middens were recorded of which six (11%) had volumes of less than 0.01 cu. m (Figure 5.7). The average volume was 28 cu. m. In the two north facing quadrats 29 middens were recorded, of which 10 (34%) had

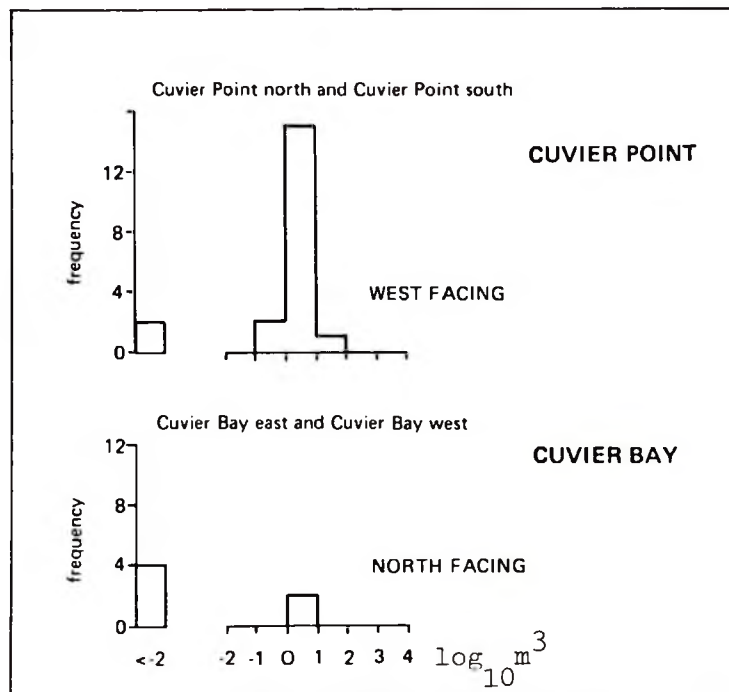
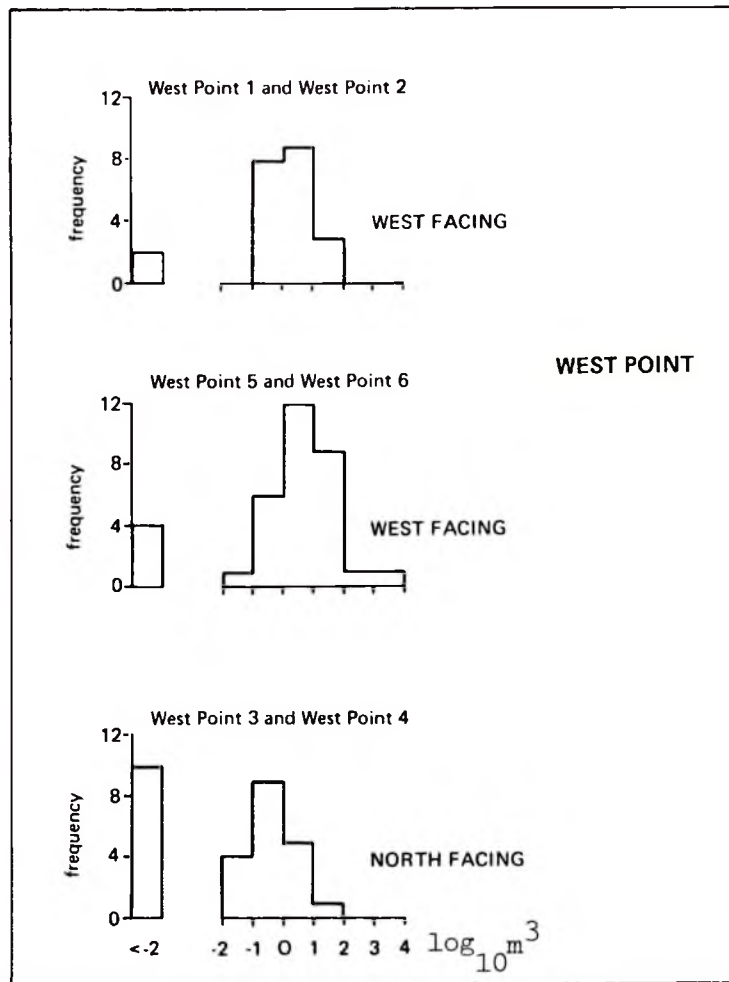


Figure 5.7 Comparison of north and west facing quadrats.

MODIFIED SURFACES	f	
No record for deflated middens	29	
<u>Ammophila arenaria</u> (introduced sp.)	<u>10</u>	
Total	<u>39</u>	(excluded from percentages)
BARE		
Bare (more than 50% of surface)	<u>9</u>	
	Bare total =	9
GRASSES		
Herb	137	
<u>Juncus</u> sp.	8	
<u>Lomandra longifolia</u>	5	
Tussock grasses	<u>17</u>	
	Grasses total =	169
FERNS		
<u>Pteridium esculentum</u>	<u>6</u>	
	Ferns total =	6
SHRUBS		
<u>Leptospermum laevigatum</u>	16	
<u>Leucopogon parviflorus</u>	7	
other spp.	<u>14</u>	
	Shrub total =	37
	vegetation record sub total	<u>219</u>

Table 5.4 Summary of dominant vegetation types on middens along the west coast

volumes of less than 0.01 cu. m. The average volume for the sample was 1.3 cu. m. Quadrats West Point 1 to 6 contain 58, 19, 8, 30, 1024 and 436 cu. m respectively. Quadrat West Point 3 is the most sheltered from a west or southerly aspect and contains the lowest volume of shell midden as might be predicted. Quadrat West Point 4, less sheltered and nearer to the westward facing coast, has a significantly higher volume. However, if site 121 is excluded from West Point 4 because of its proximity to the west facing coast, then the quadrat is left with only 10 cu. m and compares closely with West Point 3. The other inconsistency in the pattern is West Point 2 which contains only a few small middens. Even though it faces west, the adjacent coastline is protected from the southwest, the direction of the dominant swell. It is possible that a southwest facing coast is more productive than a west facing coast. This would be worth testing but I do not have suitable sample areas.

As variables other than the aspect of the coast were similar in the test case, the conclusion can be drawn that where the coast faces north rather than west the number and average volume of middens and the sum total of volume per quadrat are less. I would have expected that because there is less violent wave action on north facing coast lines, their nearshore resources would be more accessible, and therefore more easily exploited, producing larger middens. If the archaeological pattern is a reflection of shellfish productivity, the factors most likely to be responsible are the effects of high wave energy which aerates and stirs up the water, increasing oxygen content, and thereby, making nutrients more available. In Chapter 6, it will also be demonstrated that the size of Subnivalia undulata shells is substantially smaller in the calmer waters of Bass Strait than on the more violent west coast.

5.2.10 Transport of shellfish along the sandy beaches of the coast

A map by Jones (1966:4) shows middens on the southern part of Ocean Beach near Macquarie Harbour. From my work further north I felt that it was unlikely that shell middens would be present on such a long sandy beach and set out to test this in three ways. Firstly, I chose a stable dune area as a sampling quadrat (Ocean Beach quadrat). This quadrat was searched and, although a few stone artefacts were found, there were no shell middens. I then established a second quadrat (Henty Dunes quadrat) in an area which had been completely

deflated, where if archaeological remains were present, they would most likely be detected. Once again, artefacts were found, but no shell middens. As a final check I drove along Ocean Beach to look in the foredunes for any sign of eroding middens and then walked three transects from the beach to 1km inland. No shell midden was found and so Jones's representation is incorrect. The long sweeping sandy beach which forms the southern part of Ocean Beach does not appear to have shell middens.

To examine the possibility of shell middens occurring on areas of sandy beach, I set up a test using a series of quadrats placed along Sandy Cape Beach, starting at the mixed rocky shore and moving along the sandy beach away from shellfish sources (Figure 5.8). As it had become apparent that middens tended to occur near fresh water, I attempted to control this variable, by placing all the quadrats on streams. The Sandy Cape Beach quadrat lies in the path of a stream which has now been dammed by a mobile dune but which in the past, would either have flowed through it or formed a large swamp. The volume of midden per quadrat was plotted against the distance of the quadrat from the nearest rock platforms. The resulting graph (Figure 5.9) shows that there is a rapid decline in midden volume as one moves away from the mixed shore (Figure 5.9). However, some midden material (greater than 1 cu. m per quadrat) was found 3.5km from the nearest gathering area, but by 4.1km this had dropped to below 1 cu. m per quadrat. When compared to the 727 cu. m of midden in the Greens Creek quadrat on the rocky shore, these figures are very small.

5.2.11 Location of middens in relation to rock platforms

In contrast to the previous discussion, I also looked at the location of middens in relation to rock platforms in all the 33 quadrats on the west coast. The distance in metres from each site to the nearest rock platform was calculated from air photographs or maps. The resulting pattern is very different from that described in Section 5.2.10, with implications for both prehistoric site distribution modelling and site catchment analysis. Of the total west coast quadrats (258 middens), 26 were located in sandy beach areas more than 1km from rock platforms. Of the remaining 232, 50% were within 50m and 95% were within 460m of rock platforms (Figure 5.3). These figures are from all the middens in the west coast quadrats,

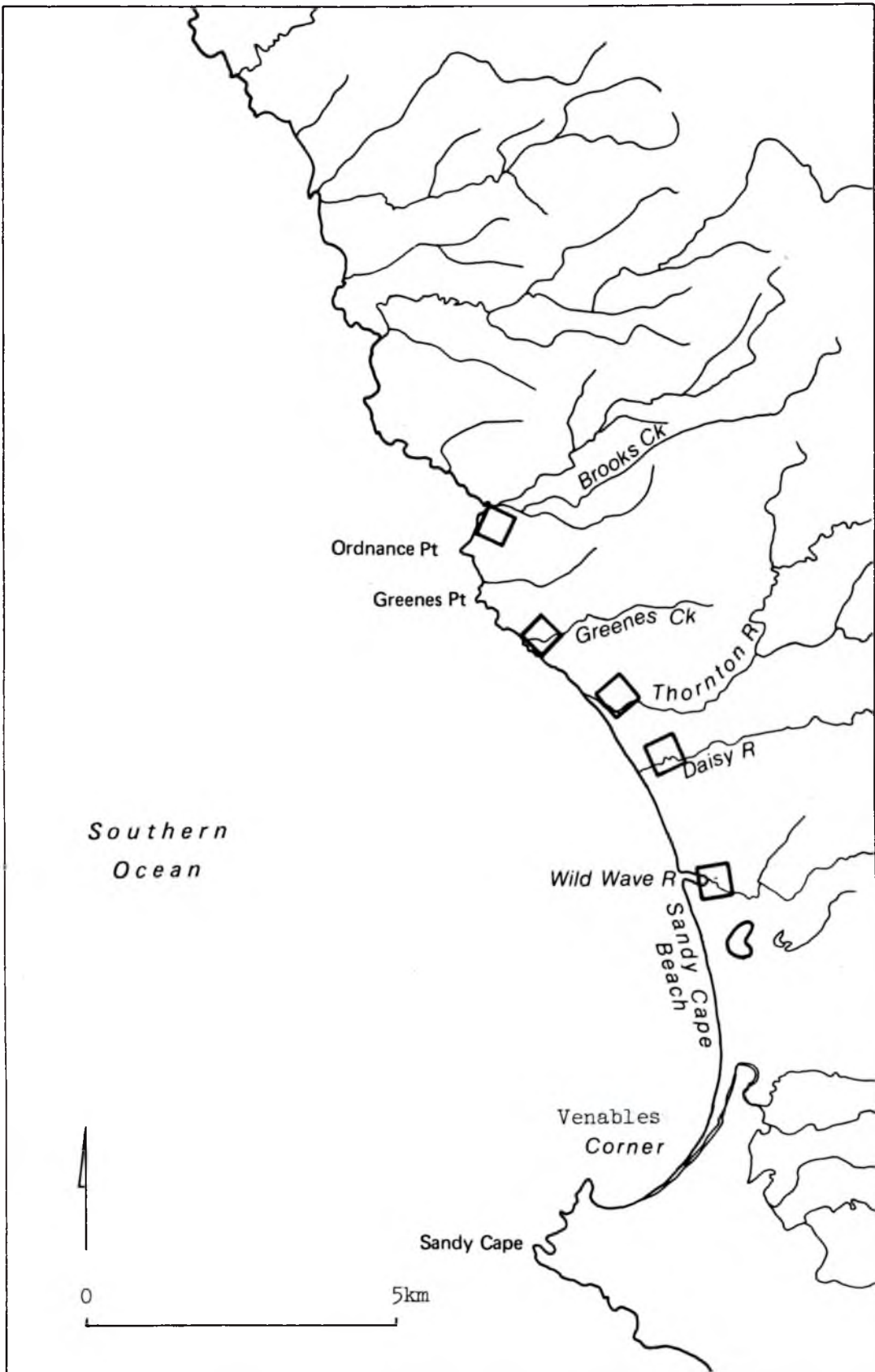


Figure 5.8 Location of quadrats on Sandy Cape Beach

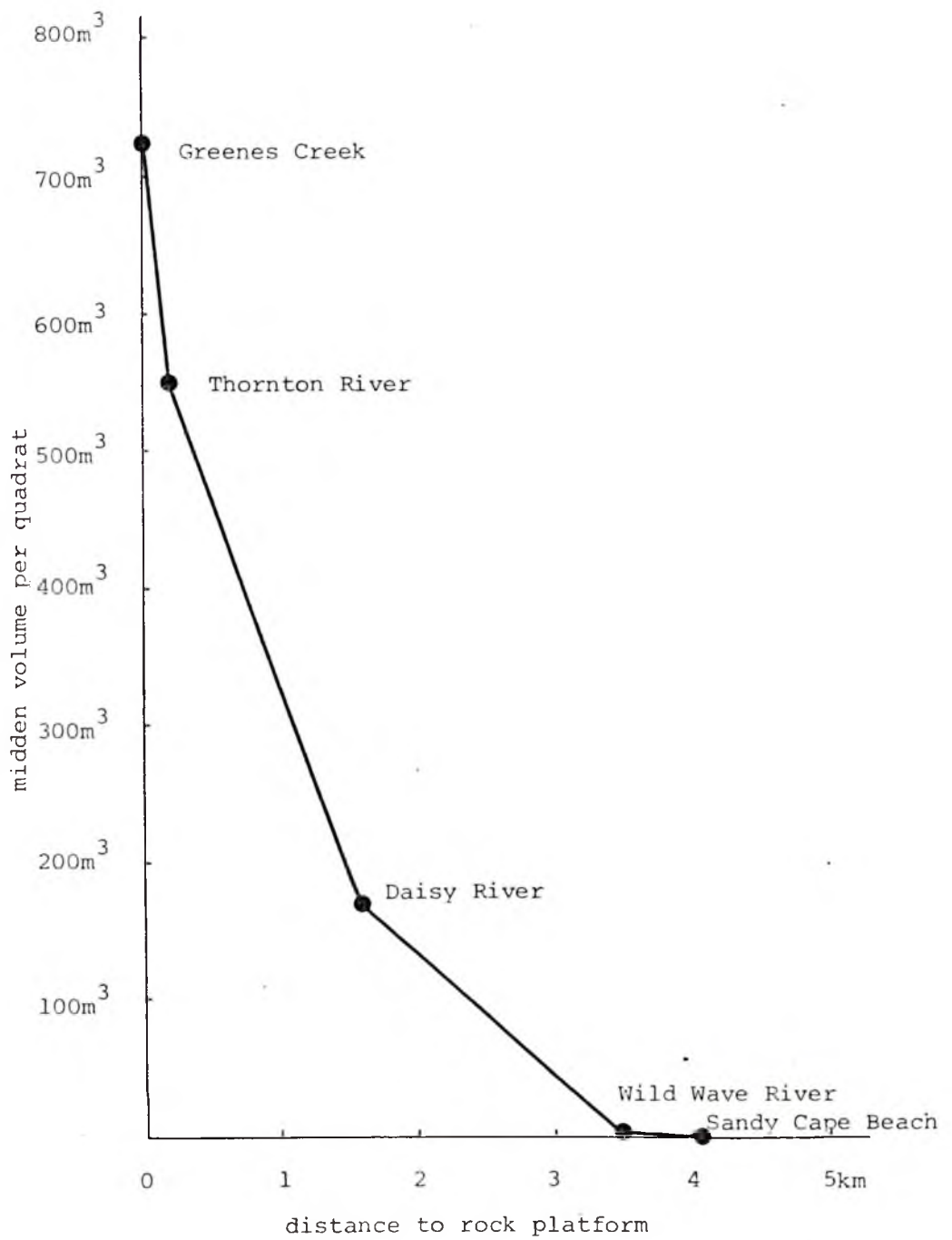


Figure 5.9 Graph of midden volume to distance from rock platform for Sandy Cape Beach quadrats

but the pattern of differential transport along the coast as opposed to inland is apparent. Although middens may be deposited a long way away from the source of the shellfish, they are unlikely to be more than 1km from rock platforms. Because this sample included quadrats on long sandy beaches, this pooled data could not be used to calibrate the distance people would carry shellfish inland from a shellfishing area. To calculate this it was necessary to restrict samples to an area which contained continuous rock platforms. West Point provided such an area, and I will discuss this problem in more detail in Chapter 7.

5.2.12 Rock shelters and caves

Only four rock shelter sites were found in my quadrat surveys. One is at the base of the basalt cliffs of Suicide Bay. The floor at the mouth is composed of smoothly rounded pebbles. At the very back of the dark interior there is a small reworked midden. Robinson's diary noted this cave and commented that it was used for shelter by Aborigines (Plomley 1966:183).

The other three rock shelters are in the relatively unmetamorphosed sedimentary rock group at Bluff Hill Point, Australia Point and Nettley Bay. These four sites are an almost insignificant 1.5% of the sample. The midden volumes were 0.8, 20, 0.1, and 0.5 cubic metres. At Bluff Hill Point, which is the largest of these (20 cubic metres), the bulk of the deposit lies well outside the shelter. This volume is much smaller than the midden material within Rocky Cape or Cave Bay Cave sites. From this systematic survey of the west coast, it is clear that there are only a few of these middens in rock shelters and ^{all} are very small. Later I will show that a similar pattern was found on Hunter Island. In contrast, the literature of Tasmanian prehistory is based on excavations of large cave deposits. Besides being potentially atypical of the midden sites, rock shelters and caves are also the natural homes for owls, Tasmanian devils and other animals which can cause the problems of interpretation discussed by Balme et al. (1980), Archer et al. (1980) and Bowdler (1979).

In addition, Robinson found the Tasmanian Aborigines could not be induced to explore a limestone cave near Den Plain. 'They would proceed about a yard or two and then rush out in greatest terror shouting vociferously and crying out that the devil was coming...' (Plomley 1966:908). This is hardly the behaviour to be expected of

troglodytes.

Before discussing an 'average' or 'typical' site, I would like to discuss one other feature of the archaeological pattern which has attracted a great deal of attention.

5.2.13 Hut depressions

As discussed in Chapter 3, one of the most distinctive midden types is the 'doughnut' midden with its raised circular rim. Originally I thought the depressions developed as rubbish was dumped around the wall of an existing hut. However, I have recorded a number of circular depressions with very little shell in them, or shells in only part of the arc of the rim. I began to suspect the depressions were intentionally excavated during the construction of the hut and that the presence of shell was a secondary process resulting from rubbish being discarded during the hut's use. One reference by Robinson supports this idea that hut floors were deliberately excavated: 'Saw several native habitations on the declivity of a hill dug out of the sand...' (Plomley 1966:790)

In the 28 quadrats on the west coast only 10 middens (3.9%) contained hut depressions. I recorded a further two sites with hut depressions on Hunter Island, and one near the town of Marrawah, giving a total of 13. As this number is very small, all these records were pooled to form the sample used in the following discussion.

Of the 13 middens with circular depressions recorded in detail during the survey, 11 occur on dunes or sandsheets, one rests on a pebble bank and one is on the crest of a small rise. All are in well drained locations. They range in size from a single doughnut, with a volume of 1 cu.m, to the West Point midden (site 118) which is more than 1,500 cu.m.

One question which can be asked concerns the relationship between the volume of a midden and the number of depressions on the surface. To determine this the total volume¹ of midden in each site was divided by the number of depressions on the surface. The results are presented as a frequency graph in Figure 5.10. Ten of the 13 sites have between 1 and 5 cu.m of shell midden per hut depression, one has 10 cu.m, one has 20 cu.m and one in excess of 100 cu.m. The latter figure for site 118 (Jones's West Point midden) is extremely large compared with the range of the others. The median volume of the sample is 3 cu.m per depression.

1. The shape of these complex middens was broken up into a number of simple geometric sub-units for which the volume could be calculated. For example, most single hut depressions can be visualised as a broad cone from which an inverted cone has been removed from the apex to produce the depression. By subtracting the volume of the inverted cone from the larger cone an estimate of the net volume of midden can be

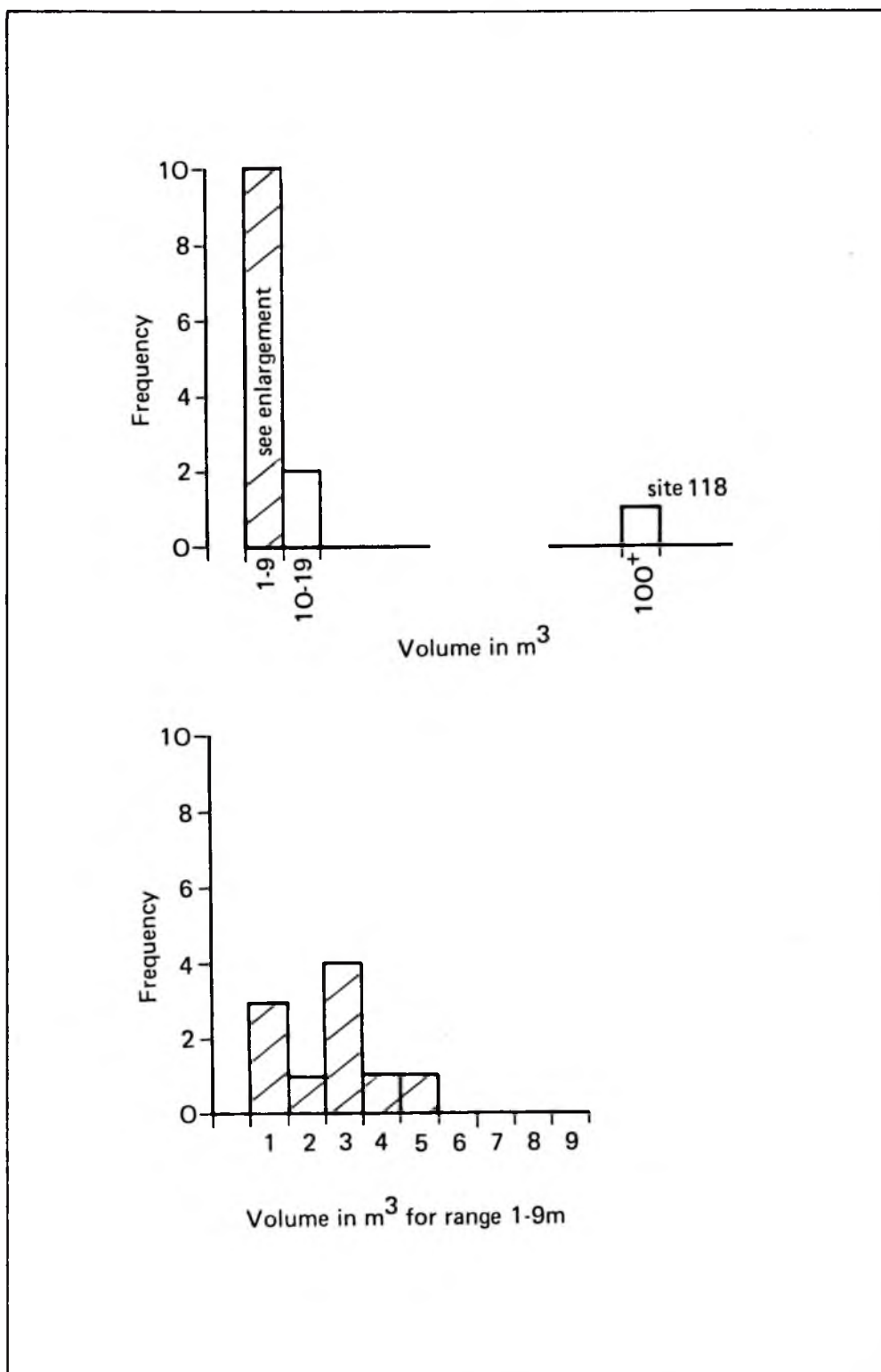


Figure 5.10 Average volume of midden per hut depression for 13 sites on the west coast.

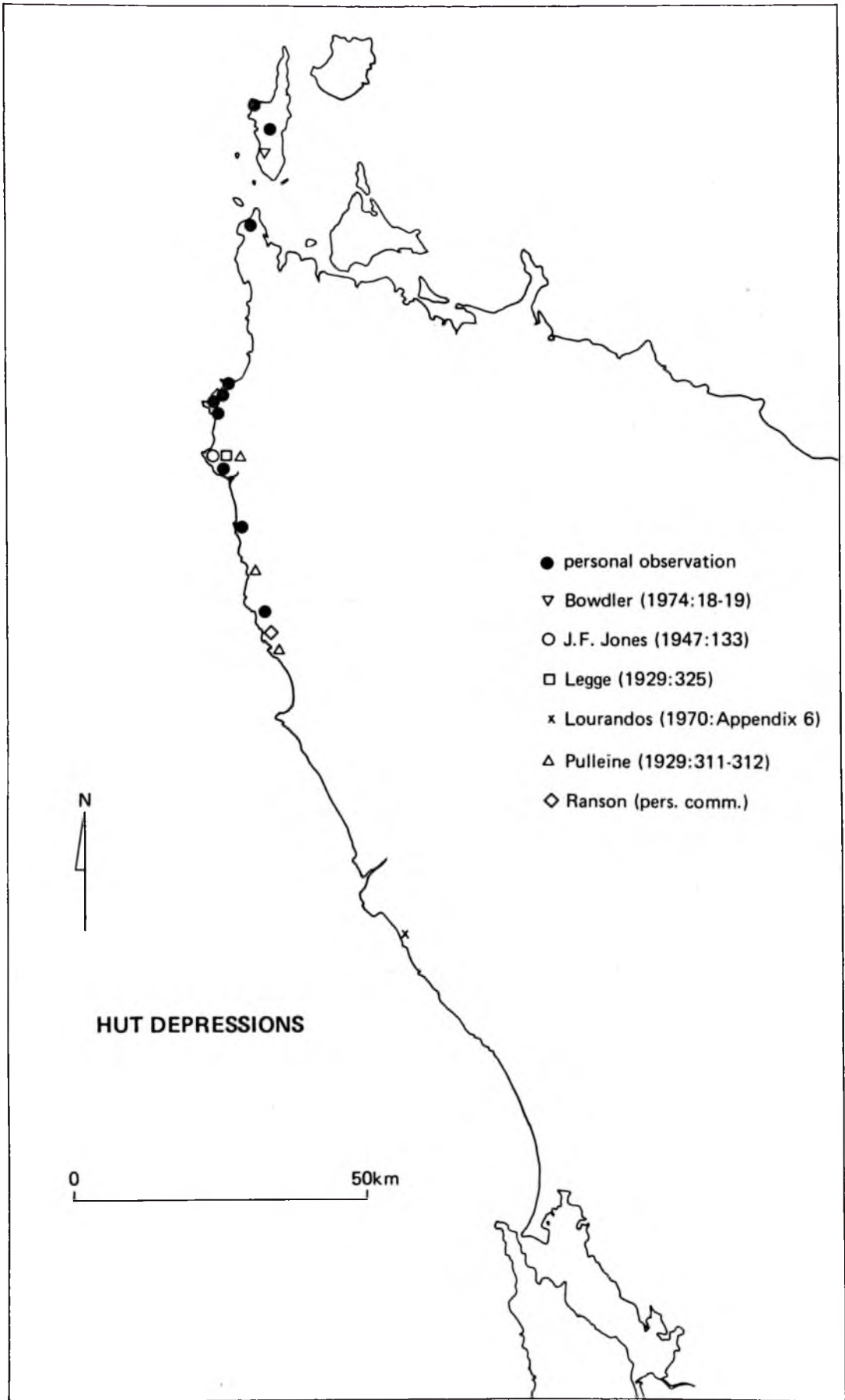


Figure 5.11 Distribution of middens with hut depressions in northwest Tasmania.

It is clear from these figures that sometimes a locality has been used over and over again, while others may have been used only once or a few times. A more meaningful comparison might be achieved by comparing the number of depressions with the total area of the midden. I did not have the appropriate measurements from three of the sites.

The area estimate for site 635 includes areas between the midden associated with hut depressions. The records for sites 488 and 489 included only the area of midden in the sites, not the total area of the hut depression. The mean of the remaining sample of 10 middens is 80 sq. m, with a standard deviation of 45 sq. m.

The sample is not large enough to be compared in a statistical way with other midden types in the northwest region. In all characteristics such as the types of shellfish, vertebrate remains, stone artefact materials and sediments, these sites are essentially the same as other types. They occur on similar landforms and substrates and have similar vegetation communities growing on their surfaces.

Almost all the hut depressions shown in Figure 5.11 are in areas where the country rock is of relatively unmetamorphosed sedimentary bedrocks. The only exception is that of the southernmost example, which is on the Precambrian Oonah quartzite and shale group. Both of these rock types erode into angular jointed rock platforms, which were shown in Section 5.1.3 to be the coast type with the highest number and volume of middens, reflecting not only productivity but accessibility. The presence of hut sites argues for a third factor: a yield of food resources which could be sustained for long enough to warrant the effort of building a permanent shelter.

Figure 5.11 illustrates the distribution of middens with hut depressions. This distribution agrees with ethnographic accounts of the west coast as summarised by Lourandos (1970: Figure 7.3). The extension of the pattern to Hunter Island is not surprising. Hut depressions have not been recorded either ethnographically or archaeologically on sandy or plunging cliff coasts, nor in Bass Strait or Macquarie Harbour. The absence of hut sites on the north coast stands in sharp contrast to the west coast. In the southwest the same association of hut sites with mixed coast type is found by comparing Lourandos' figure 7.3 with Figure 5.11.

After reconnaissance observations, Jones stated 'Practically

every large stable and well grassed midden that I have seen on the coast between Mount Cameron West and the Arthur River has these well defined and standard shaped depressions on their surfaces,....' (1971a:278). The survey data collected by this study do not support this impression. Hut sites, either alone or in clusters, are not common. This is another example of a systematic survey producing very different results from those of a casual reconnaissance. The outstanding point is that there were few hut sites in either gross numbers or relative proportion compared with other types of middens. Hut sites have preoccupied archaeologists in western Tasmania. Even though this type of site accounts for only 10 out of the 258 middens in the sample, three of the six sites excavated on the west coast had hut depressions on their surfaces (West Point midden, Sundown Point, Little Duck Bay). One entire PhD project, that of D. Ranson, was concerned solely with the excavation at Sundown Point of one hut depression in a cluster of three. Why did the Aborigines choose to build substantial huts on some occasions in these locations but not others? Are they home bases? Were huts built for only a short period in prehistory? If so, was hut building an expression of sedentary life which depended on the availability of certain resources e.g. seals?

5.3 DISCUSSION

5.3.1 The ideal west coast location

A field survey records the blur of reality. Underlying this is a pattern which reflects people's choice of a good place to sit for a short time or for a long term camp site. Can we see this pattern within the archaeology and describe the criteria by which the Tasmanians chose the locations for their sites?

Given the limitations of the analyses outlined in the preceding sections, as well as the methodological problems of sampling and recording geographical information, the next section is an exercise in gaming and should be seen as such. I am going to describe the 'ideal' location for a midden on the west coast by taking the most common value for the attributes described in the previous sections. These will be used as if they were probability statements of the likelihood of each event occurring and used to calculate the

probability of a site from my field sample occurring on an 'ideal' location.

The analysis has demonstrated that larger and more numerous middens are associated with westward facing stretches of mixed coast type on relatively unmetamorphosed sedimentary rocks.

The key parameters for the location of sites can be tabled as follows:-

	%
Flat surface	85
360° view	71
No shelter from wind	71
Nearest water source is a swamp	64
Sand substrate	56
Within 230m of drinking water (set at 75% of sample)	75
Within 130m of rock platform (ditto)	75

Although the attributes of 360° view and no shelter from wind appear to be related, it is possible for a site to have one but not the other. So, if all these physical attributes were not related in any way, the cumulative probability of all these attributes occurring at a site in the west coast sample is only 1.4%. This is equal to 3.6 middens of the sample of 258. By running a series of sortings of the sample I was able to find that there were 15 middens which actually had all these attributes. The sorting was carried out on the columns for each of the seven attributes using the SORT package program. The result is much higher than the 1.4% predicted on the assumption that the attributes are not correlated in any way and shows that this assumption is not correct. Therefore, landscape attributes cannot be treated as independent random variables. Although this type of statistical probability approach is not appropriate as a means to describe reality, it is still possible to model the key parameters of an ideal location.

The middens ranged from insignificant volumes to in excess of 1,000 cu. m. The mean volume of the sample was 149 cu. m, and the standard deviation was 358 cu. m. In such a skewed distribution, the median volume of only 3 cu. m is a more useful indicator of central tendency. This shows that even in supposedly ideal locations, sites

may not be large. The two largest sites recorded in the survey, however, are on ideal locations. My conclusion is that there is a process of cultural opportunism operating. The Tasmanians placed their biggest middens at ideal locations, but such locations do not necessarily have big middens.

In addition to these physical attributes, two biological attributes of the setting based on the vegetation records can be described. The most common vegetation types on the surfaces of the middens are herbs or tussock grasses (77%). The most likely vegetation structure nearby is low shrubs (54%).

Several internal attributes can now be added to the list. There is a 98% probability that the midden will contain a sandy matrix. Subnivalia undulata will be the most numerous species (87%) and Notohaliotis ruber will most likely be the second most numerous species (45%).

5.3.2 Seals as a locational factor

There is an additional factor which could have had an overwhelming influence on site location. If a colony of seals lived on the coast it could outweigh all other factors in attracting a group of hunters to reside nearby. To examine this question I must look at Aboriginal sealing from Tasmania as a whole.

The importance of seals in the Tasmanian Aboriginal diet has long been recognised, (Legge 1929, Pulleine 1929, Wood Jones 1925:363), but was first quantified at West Point (Jones 1966; Coleman 1966). Background information for this discussion on the historic distribution and abundance of seals in Tasmanian waters was presented in Section 2.4, and a review of Aboriginal use of seals can be found in Stockton (1982, enclosed with this thesis).

The distribution of archaeological seal remains were compiled from published and unpublished sources. The majority of the observations are of fragmentary bones noted during field reconnaissance. Under these conditions it is easy to distinguish seal bone from other mammals, but difficult to identify species. Identifications to generic level for Arctocephalus spp. and specific level for other seals were available for remains from excavated sites (Jones 1966,1971; Bowdler 1979; Vanderwal 1978). The distribution of archaeological sites with prehistoric seal remains shows a marked concentration on the northwest coast (Figure 5.12a), from the Pieman



Figure 5.12 A. Distribution of seal remains
B. Distribution of Arctocephalus spp. remains

Heads to Cape Grim, with a lower frequency along the remaining coast of Tasmania. The lowest frequencies occur on the Bass Strait coast east of Port Sorell, and Tasman Peninsula and Bruny Island. The patterns for Arctocephalus spp. (Figure 5.12b) and Mirounga (Figure 5.13a) remains are similar. The remains are found on the northwest, west, and southwest coast. These patterns reflect the locations of analysed excavations where accurate generic identifications are available, and so the absence of records from other areas may not be significant. This could be tested by sampling sites in other areas for seal remains. This could be done quite easily by collecting material from deflated sites around the coast. Figure 5.13b for Leopard Seal shows that its occurrence is less common than the other species. The species was recorded ethnographically, and an Aboriginal word, 'TOPER', has been recorded for it (Plomley 1976:310). The present day distribution of fur seal is in contrast to the archaeological and contact period distributions. The modern pattern is strongly centered on the south and southeast coast. Several hypotheses can be advanced in an attempt to explain this.

Did Aborigines exterminate or drive away the seals of the coastal breeding populations before European arrival, as Jones speculated for the Southern Elephant Seal at West Point (1966:7)? There is no evidence that seals breed on 'mainland' coasts (R. Warneke pers. comm.), so it is extremely unlikely that Mirounga was breeding on the Tasmanian coast at any time. Secondly modern C14 dates have been obtained for sites containing Southern Elephant Seal at Sundown Point (D. Ranson pers. comm.) and at Venables Corner. Both of these sites also contain fur seal.

Did Aboriginal activity reach just the fringe of the range of seals? Were the main seal areas on inaccessible islands in Bass Strait or the far south? Was it just the stray wandering seal which came ashore on the mainland and fell prey to the Aborigines? Because of the extremely high density of seal remains along the northwest coast, I have plotted the distribution for the region at a larger scale than was used in Figure 5.12a (Figure 5.14). The high density of site information here is partly because the coast from Cape Grim to Macquarie Harbour has been surveyed more frequently and more intensively than any other part of Tasmania. Also, shell middens in the northwest are more numerous and larger than elsewhere in Tasmania. Consequently, in this well studied area we find an almost



Figure 5.13 A. Distribution of Mirounga remains
B. Distribution of Hydruga remains

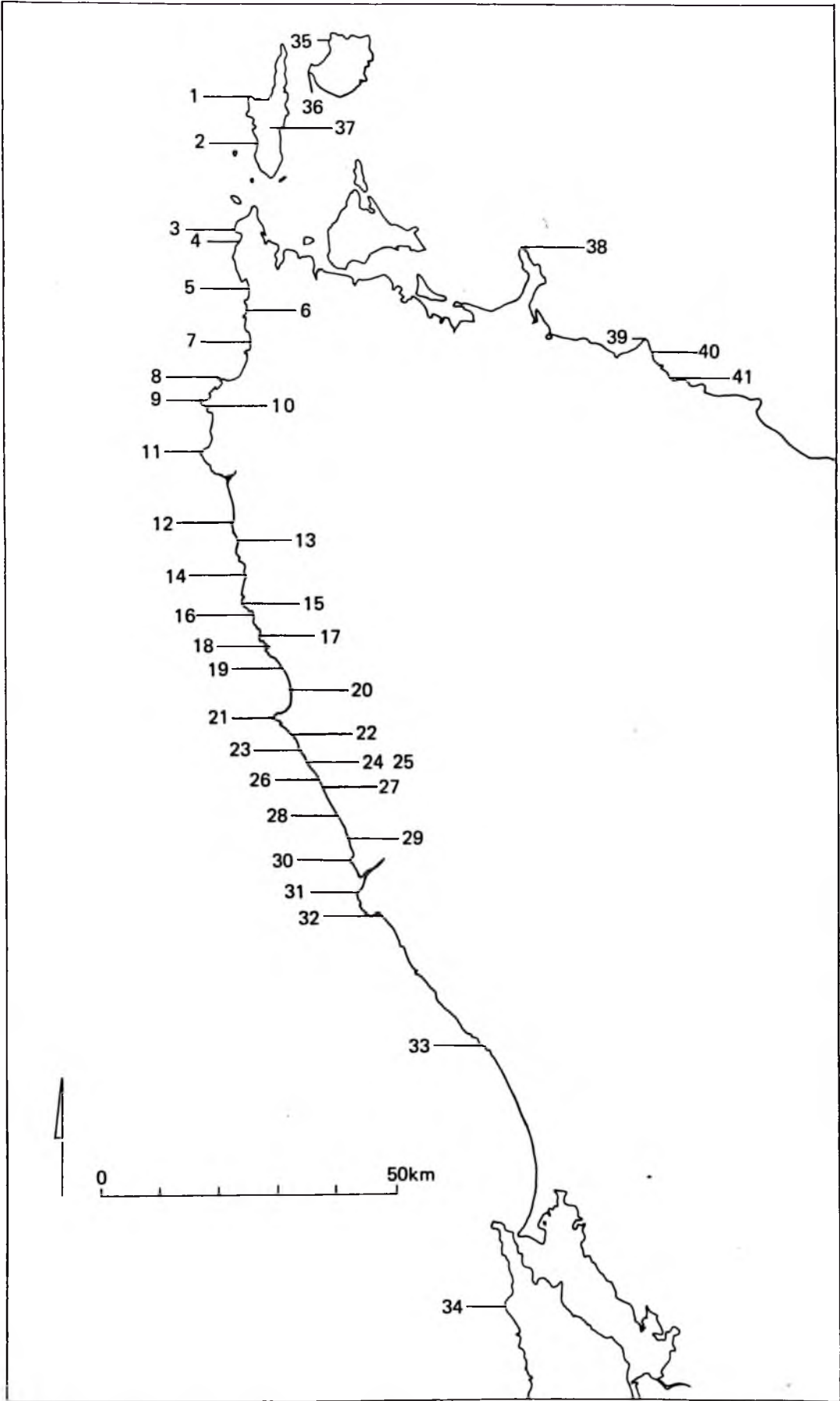


Figure 5.14 Distribution of seal remains in northwest Tasmania

continuous occurrence of seal remains. This suggests a resident population of seals, or regular visitors, all along the coast. At West Point, Jones' tentative minimum numbers estimate for seals in the whole site is several thousand individuals (1966:7). Supplementing this, analysis of the Southern Elephant Seal canine teeth has shown that all specimens were young animals, with some teeth belonging to seals less than three months old (1966:7). All this evidence suggests a large breeding colony of Southern Elephant Seals in the immediate vicinity - but where was it located? There are no offshore islands or rocks any distance from the coast, but there are a few little islands less than 100m away. Some of these have shell midden on their surface, and in 1980 two were rookeries for the Little Penguin, Eudyptula minor. The simplest explanation of the evidence is that breeding Southern Elephant Seal colonies were on the shore of the Tasmanian mainland, or on these islands just off shore, where they are accessible to Aborigines. In fact, given the age structure of the seals found at West Point, is it possible the Aborigines were just scavenging dead juveniles (Horton 1978)? On the other hand, there is historical evidence for a concentration of Mirounga to the northwest of Tasmania on King Island, New Year Islands and Hunter Island (Peron in Micco 1971:23). The prevailing winds are southwesterly i.e. onshore. With significant seal activity in the offshore waters it is inevitable that some freshly dead, sick or tired individuals will end up on the coast. The presence of the remains of juveniles of less than three months of age at West Point is not surprising as the pups are weaned when they are one month old (Warneke 1975:8). This evidence does not imply that there was a breeding colony at West Point. The same argument also applies to Arctocephalus. During a seven year period Warneke recovered 170 tagged pups within a radius of 140km from the Seal Rocks colony of A. pusillus doriferus. This is just 2% of the total sample tagged in the same period. The sealer Kelly estimated that the Albatross Island colony off Hunter Island had a population in the order of 12,000 (Plomley 1966:697 n.124). Reid Rocks further to the northwest probably had more than 2,000 animals and the many colonies around King Island possibly exceeded 50,000 (R. Warneke pers. comm.). With these population numbers, beach scavenging could account for all the fur seal remains in northwest Tasmanian coastal middens (R. Warneke pers. comm.). No reference to historic sealing on the northwest coast

of Tasmania has been found (Warneke 1976).

Therefore, from a combination of biological, historical and archaeological evidence it seems unlikely that a seal colony existed on the Tasmanian mainland. Isolated seals were to be found along the coast, but they were not a prime site location factor. Therefore, the landscape factors discussed earlier were the most important parameters.

5.3.3 Site 118 - the 'West Point midden'

The large midden at site 118 (West Point) has posed scaling problems throughout this analysis because of its huge volume. It is now possible to argue that it is so large because it is an optimum location. The setting is an extremely convoluted westward facing section of relatively unmetamorphosed sedimentary rock coast. The top of the site is flat if the hut depressions are ignored. It is exposed to all winds and has an excellent view in all directions. The nearest source of water is a swamp only 20m away. It rests on a sand substrate. It is within 40m of rock platforms. Thus it scores on all the physical attributes listed above.

An additional attribute not listed above because of its low frequency is the tendency for middens to occur on dune landforms (36%). This site mantles a small detached dune. The nearest dunes are over 700m to the south and there are none for several kilometres to the north, though some limited areas of shallow sandsheets occur about 300m inland to the east of the site.

The most common vegetation on and around a west coast midden is herb growth on the surface of the site, while around the site shrublands grow. The vegetation of the surface of site 118 consists of herbs and tussock grasses, while inland is a heathland of low shrubs. Internally, the site contains a sandy matrix and from my observations Subnivalia undulata is the most common shell species, followed by Notohalictis ruber. Once again, this was the most frequent species combination on the west coast.

This location and site have now met all the optimum conditions. Although partial combination of these attributes are common, the total combination is not repeated until 700m to the south or several kilometres to the north. The enormous size need have nothing to do with seal exploitation as postulated by Jones (1966:7; 1981:7/88).

5.4 CONCLUSIONS

This thesis has now progressed from a description of the survey data to an exploratory analysis of some of the internal and external patterns of site attributes of some 258 middens on the west coast. This analysis has dealt with only one class of sites on the west coast, and has ignored stone artefact sites and the distribution of raw materials from which artefacts were made. This is because they are part of a different movement system which is the manifestation of another behavioural system. After exploring the regional patterning of shell middens in the next chapter, I will return to a discussion of stone artefact sites and materials in the northwest in Chapter 7.

A strong correlation has been found between bedrock type, the structure of the coastal rock platforms, the coast type and the volume of middens to be found in the vicinity. No middens are found where granite forms cliffs which plunge into the sea. At the other extreme, the largest middens and the greatest volume of midden per quadrat occur when sedimentary rocks form jointed and angular platforms. To judge from midden volumes, the sedimentary rocks areas were the most productive or the most exploited and plunging granite cliffs were the least productive. The pattern is not so simple, however, because stone artefact sites were found along the granite coast, which demonstrate Aboriginal presence in these areas. Along sandy beaches, the volume of midden per quadrat has been shown to decrease with increasing distance from rock platforms. In addition, westward facing lengths of coast are found to have more and larger middens than north facing sections.

Proximity to fresh or drinkable water proved to be a strong determinant of site location, with 50% of the middens being within 120m of drinkable water. The most likely source of drinking water was ponded water. The most common landforms on which middens were found were dunes and pebble banks. These landforms offered the best drainage and were elevated giving a good view in most directions or exposed to wind from all directions. The latter appears to have importance in selecting camping sites, as 71% of the middens recorded were exposed to wind from any direction. Also, 85% of middens were on level surfaces, showing that people usually avoided sloping surfaces for camping sites. Sand was the most common sediment to form the matrix of the middens, but it was greatly over-represented in

relation to its frequency as a substrate. This implies that shell middens can trap sediments which would not otherwise accumulate in that location. So although aeolian sand transport is a natural geomorphic process, the presence of cultural remains can operate as a sediment trap and change the pattern of sediment movement across the landscape.

With all these results it was possible to describe an 'ideal' location for a midden and its typical contents. It was then argued that site 118 was exceptionally large because of its ideal location and that a similar combination of landscape conditions is not replicated for some distance.

In spite of the attention rock shelters and middens with hut depressions have received in the Tasmanian literature, these types of sites proved to be rare on the west coast. The middens with hut depressions recorded in this study were, however, essentially the same as other middens in contents and locational variables. On the other hand, this result could be seen as the effect of the coarse grained resolution of survey techniques. It has been demonstrated that survey techniques emphasise the most frequent and visible site elements. If the difference between very large sites and small sites corresponds to the difference between base camps, processing sites and dinner time camps then a finer level of resolution may be needed to perceive these differences. The apparent similarity of content could be tested by excavation, but therein lies another thesis.

In general, the analysis of the landscape associations of the west coast has produced quantified but 'common sense' results. The behaviour of the Aborigines was affected by the environmental variables which dominate all human groups - food and water resources, the topography, the climate etc. There is however a definite robustness about the results. The effects of these variables on the cultural activities of the Tasmanians are manifest in the locations of their shell middens and these can be accurately described in a quantitative way. In later chapters I will explore how these west coast patterns compare with other parts of Tasmania and look towards the problem of comparison with southeast Australia.

CHAPTER 6 REGIONAL DIFFERENCES IN TASMANIAN
ARCHAEOLOGICAL SITES

6.1 INTRODUCTION

In the previous chapter the nature and distribution of west coast shell middens were described. This information provides the setting against which the contents and landscape associations of middens from other regions will be compared. A number of writers (Jones 1966, Lourandos 1968, 1970, Bowdler 1979) had suggested in a qualitative way that such regional differences did occur. During the field surveys for this study I became increasingly aware of apparent differences and the aim of this section is to determine whether these impressions are supported by the quantitative data. The survey data were divided into regional data sets on the basis of wave energy and location following the same principles outlined for the subdivision of the west coast by physical attributes. Dividing the regions by wave energy gave west coast, north coast and Derwent estuary groupings with high, medium and low wave energy respectively. Subdividing these groupings by location gave the Tasmanian mainland west coast and the west coast of Hunter Island as high energy examples; Three Hummock Island, western Bass Strait and eastern Bass Strait as medium energy examples; the Derwent estuary with low wave energy; and Macquarie Harbour with low wave energy and diluted by fresh water. The areas of Bass Strait, Hunter Islands and Macquarie Harbour were chosen because of the core study area on the northern part of the west coast. The Derwent estuary was sampled because it was an accessible estuarine system similar to Port Davey on the west coast. (Figure 6.1).

In Chapter 5 it was shown that coast type influenced the size and distribution of middens. Therefore the samples for my analysis of midden distribution from other areas of Tasmania were all drawn from quadrats with mixed coast type. Table 6.1 gives details of these quadrats from areas other than the west coast.

As the orientation of the coast may significantly affect the volume of midden found in an area of the west coast, for comparability only west facing quadrats will be considered. Thus my

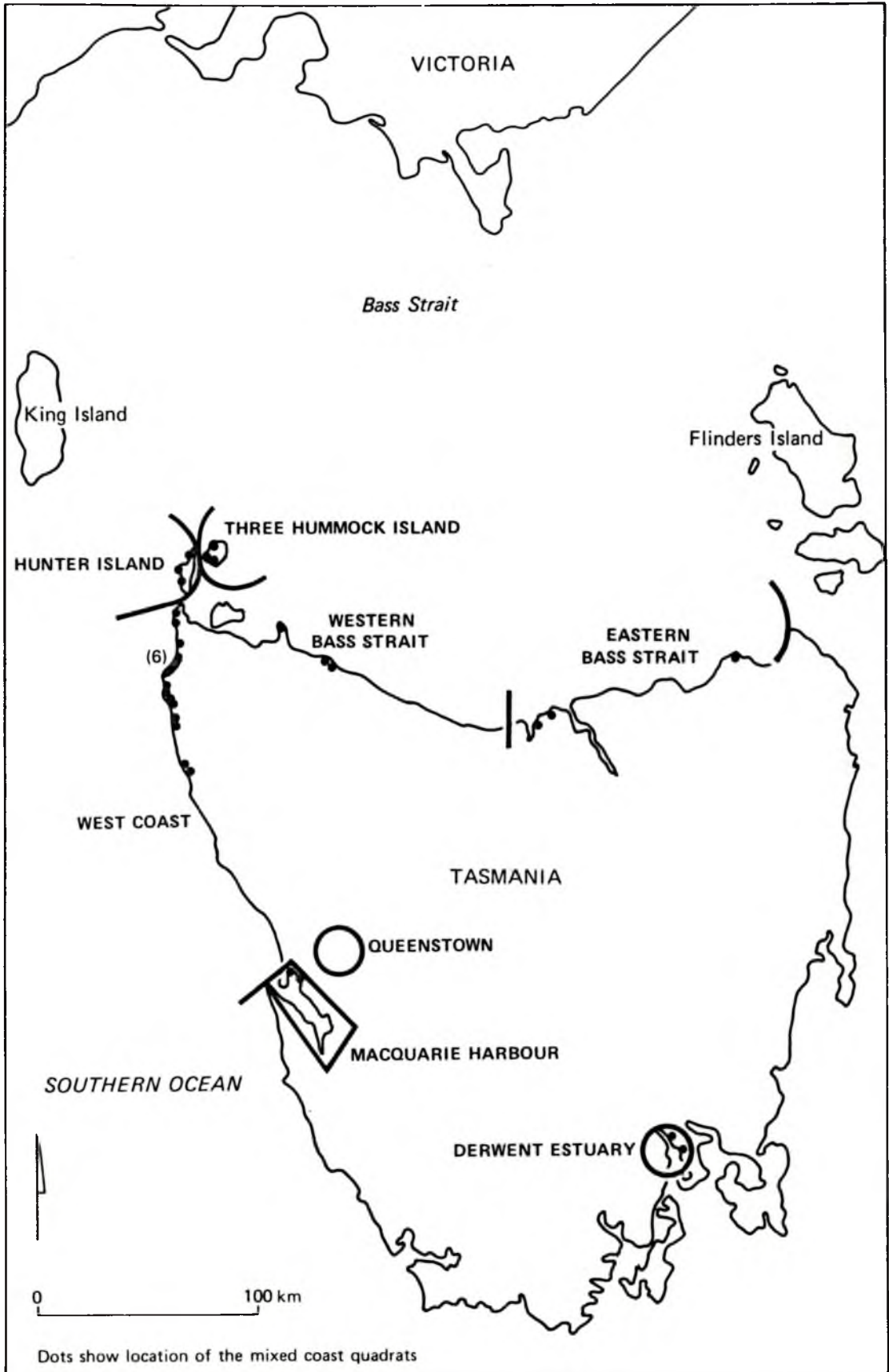


Figure 6.1 The boundaries of the eight regions discussed in the text

Quadrat name	Rock type	Coast type
<u>HUNTER ISLAND</u>		
Cuvier Bay east	M	mixed
Cuvier Bay west	M	mixed
Cuvier Point north	M	mixed
Cuvier Point south	M	mixed
Shepherds Bay east	M	mixed
Shepherds Bay west	M	mixed
<u>THREE HUMMOCK ISLAND</u>		
Burgess Point	granite	mixed
Chimney Corner east	granite	mixed
Chimney Corner west	granite	mixed
Ranger Point	granite	mixed
<u>NORTH COAST</u>		
Burgess Cove	quartzite	mixed
Freshwater Creek	quartzite	mixed
Griffiths Point	dolerite	mixed
North Point	basalt	mixed
Rocky Cape	quartzite	mixed
Waterhouse Point	granite	mixed
<u>DERWENT ESTUARY</u>		
Gibsons Point	dolerite	mixed
Porter Bay	siltstone	mixed
<u>MACQUARIE HARBOUR</u>		
Dead Horse Point	SSCC	mixed
Swan Basin	SSCC	mixed
<u>INLAND</u>		
Doctors Creek	M	-
East Queen River 1	volcanics	-
East Queen River 2	volcanics	-
Transects: Hill 49	M	-
Balfour Track	M	-
M = relatively unmetamorphosed sedimentary rocks group		
SSCC = interbedded sandstone, siltstone, clay and conglomerate with lignite		

Table 6.1 Rock and coast types for quadrats in areas other than the west coast

Tasmanian west coast comparative sample is now reduced to the following quadrats, which contained a total of 193 middens; viz

Arthur River Bridge
Australia Point
Bluff Hill Point
Gardiner Point
Greenes Point
Mount Cameron West
Nelson Bay
Ordnance Point
Suicide Bay
Sundown Point
Valley Bay
West Point 1, 2, 5, 6

Hunter Island and Three Hummock Island have open stretches of water separating them from each other and from the mainland. I particularly wished to compare the composition and setting of middens on these islands to nearby 'mainland' areas, to see if they were more similar to the west coast or the Bass Strait patterns. Work by Bowdler (1979) had stressed that although the isolation of Hunter Island from Tasmania in post-glacial times had a dramatic effect on the occupation of the island, there was an overall similarity between island and mainland in the nature and contents of shell middens.

In each region, except for the west coast, the number of middens is low. Because of this, the data do not lend themselves to statistical manipulation. Rather, the questions were pitched at a very simple level, e.g. were sites from different parts of Tasmania more or less similar in content and setting, or were there differences? For these comparisons, the master field record file (see Appendix 7) was split up into regional subfiles. Using the SPSS frequency routine, the frequency of different variable attributes was then computed. The remainder of this chapter discusses the significance of these results.

6.2 WESTERN BASS STRAIT

Bass Strait is over 300km from east to west with a gradual change in the character of middens from one end to the other. For this analysis, Bass Strait was arbitrarily divided into two regions, with the division near the middle at the Mersey River. The coast of western Bass Strait is characterised by medium wave energy. It is predominantly a mixed coast of alternating rocky headlands and sandy beaches but there are a few small stretches where volcanic rocks form plunging cliffs. As on the west coast, these plunging cliff areas do not appear to have middens. Towards its western end there is a series of large estuarine inlets with low wave energy sandflats and mudflats. At low tide, these areas form extensive sandy flats. Although I have not surveyed quadrats in this low energy system, I have looked for middens on several kilometres of the coast near Stoney Point in Robbins Passage and further east along the eastern side of Duck Bay, but found no sites. Inspection of shells washed up on the beach showed that none of the important food species now live in large numbers in the vicinity, and it is likely that they never have. This area has extensive bays with low energy wave systems and sandy bottoms like the Derwent estuary, and I expected to find Ostrea angasi beds and Mytilus planulatus on the rocks, as in the southeast such as at Carlton, Storm Bay and Little Swanport, but with shell beds absent there are no shell middens.

An extrapolation of the pattern found in the low energy Derwent system would seem plausible on the basis of wave energy and coast type, but would have been incorrect. Although these areas look very similar on a map, there are differences in terms of currents, tidal range and sediment loads which make their biological systems different. This case also shows the danger of simplistic models which calculate midden densities in relation to the total coast length, without considering differences in the 'usable' productivity for different coastal types.

The western Bass Strait sample was formed from the middens of the North Point, Rocky Cape and Burgess Cove quadrats and contains 19 sites. Pebble banks at Rocky Cape have stone features similar to those found on the west coast and Hunter Island. All the middens in the western Bass Strait region contain Subnivalia undulata as the most numerous species. This is similar to the west coast, where 87%

of middens were dominated by this species.

During fieldwork I often noticed that the shells in middens along Bass Strait tended to be smaller than on the west coast. Of the species available, I chose to study Subninella undulata as it was common in both regions and because it was easy to measure the operculum as an index of overall shell size. Random samples of opercula were collected from the surfaces of middens along the edge of Bass Strait from site 653 at North Point and Lee Archer Cave at Anniversary Bay. West coast samples from sites adjacent to the Southern Ocean came from Italian Creek, site 193 at Venables Corner and site 56 at West Point. The samples numbered 54, 27, 106, 97 and 73 respectively. The Bass Strait samples had means of 11.6 and 11.3mm respectively. The Southern Ocean samples had means of 16.9, 17.3 and 19.9mm respectively. By calculating the Standard Error of the Mean it was shown that the means were within 1.6mm of the population mean at the 95% confidence level in all cases. It is clear from the difference of the means that the amount of meat per shellfish was much less in Bass Strait. Although the means of the Bass Strait samples are almost identical, the distribution curves are markedly different (Figure 6.2). The Lee Archer Cave midden sample is strongly clustered around the mean, with a standard deviation which is almost half that of the North Point sample. Similarly, the west coast samples have means in the range 16.9 to 19.9mm, but the actual distributions and standard deviations vary widely.

I initially hypothesised that the difference in mean size was the result of a higher predation stress in Bass Strait due to the Aborigines being able to get access to the shellfish more regularly in the calmer waters. Later, however, while diving at several locations along the coast my observations were that even the modern unexploited populations of Subninella undulata were smaller in Bass Strait. It is likely that there are biophysical factors controlling the growth of the species, possibly related to either oxygen or food availability. These factors relate to wave energy rather than the nature of the substrate.

This regional difference in average size of Subninella undulata would need to be incorporated in any calculations which attempted to estimate meat weight from minimum numbers of shellfish such as was done by Coleman (1966). Although the impression from field observations suggests that other species are also smaller in Bass

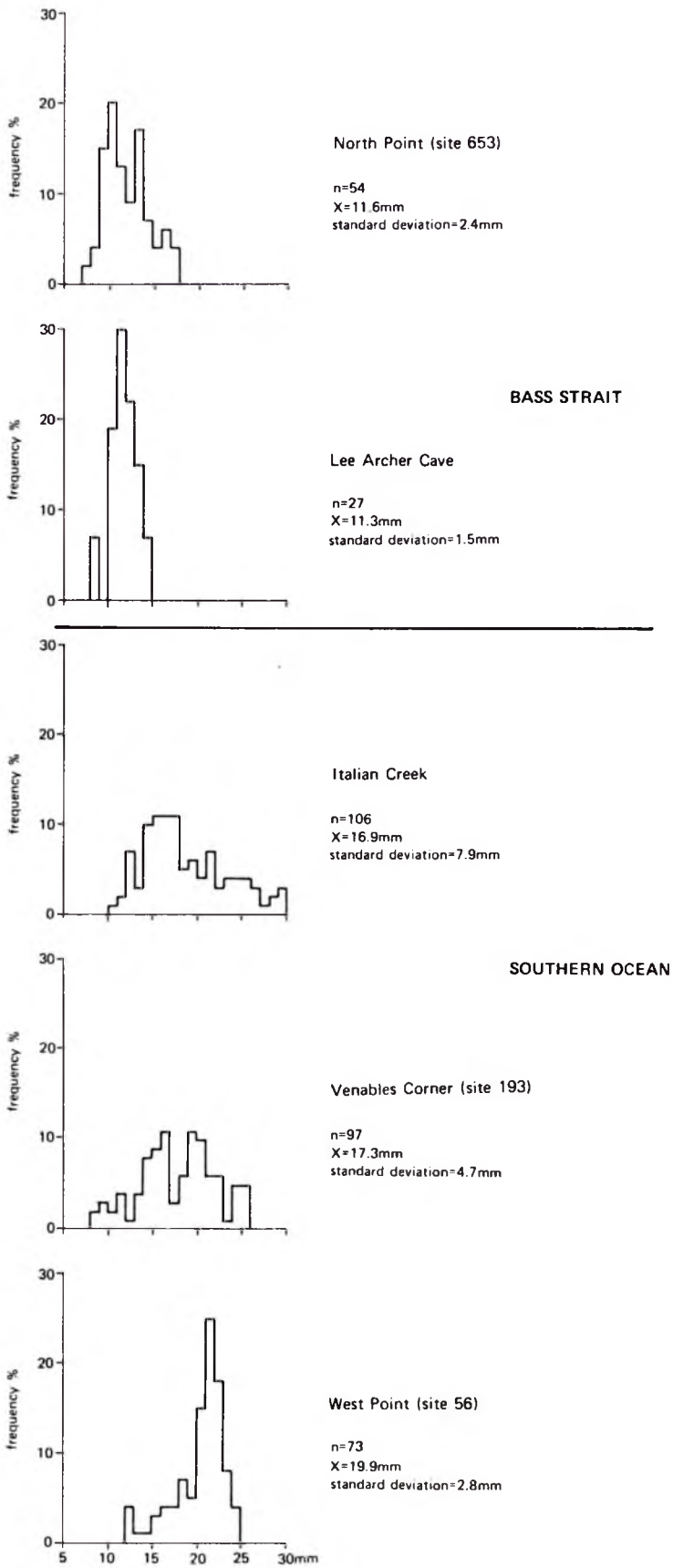


Figure 6.2 Diameter ranges for samples of Subnivalia undulata operculae

Strait, I have no figures for this and it would need to be tested. This is an obvious direction for further research.

In my sample, shellfish were not transported inland for more than 100m. This is the shortest distance found for any region and suggests a tightly constrained coastal use of shellfish resources (Figure 6.3).

The volume of midden per quadrat in the west Bass Strait sample is biased because it includes the unusually large North Cave in the Rocky Cape quadrat (Figure 6.4). Along the quartzite section of coast from Rocky Cape to Jacobs Boat Harbour is a number of large caves and smaller crevices which, by providing shelter, acted as foci for occupation (Jones 1971b). Almost all contain some shell midden and the larger ones contain hundreds of cubic metres. Unlike open sites, they were relatively protected from erosion processes, so there is a greater likelihood of material surviving in them. In comparison with the volume of midden in the large caves, the open sites are all very small.

On the north coast, I do not have sufficient quadrats to draw conclusions about the relative frequency of shelter sites. However, in the western half of the north coast a total of 10 caves or rock shelters with middens have been described. Of these, four have been excavated or sampled. The only contact period description of Aboriginal midden in a cave comes from North Cave.

In 1827 Henry Hellyer was detained at Rocky Cape due to adverse sailing conditions. Hellyer's diary contains a sketch of the location of the North Cave where 'The bottom is covered with shells which the natives have carried there to cook viz mussels, muttonfish, limpets and warriners' and notes how he 'Proceeded with caution expecting the natives might be there' (Hellyer 1827). He also described an open camp site nearby.

'Inspected the place...where Mackie went ashore and surprised the natives, they had made two fires among some low bushes of Tea Tree and honeysuckle and had been roasting shellfish. I saw a great many shells there burnt and broken, the grass on which they reposed and marks of their breaking through the bushes to make their escape...' (Hellyer 1827)

The quartzite bedrock of this area forms the most jagged platforms and irregular shore of the various rock types which crop out along Bass Strait. It probably also has the highest mollusc

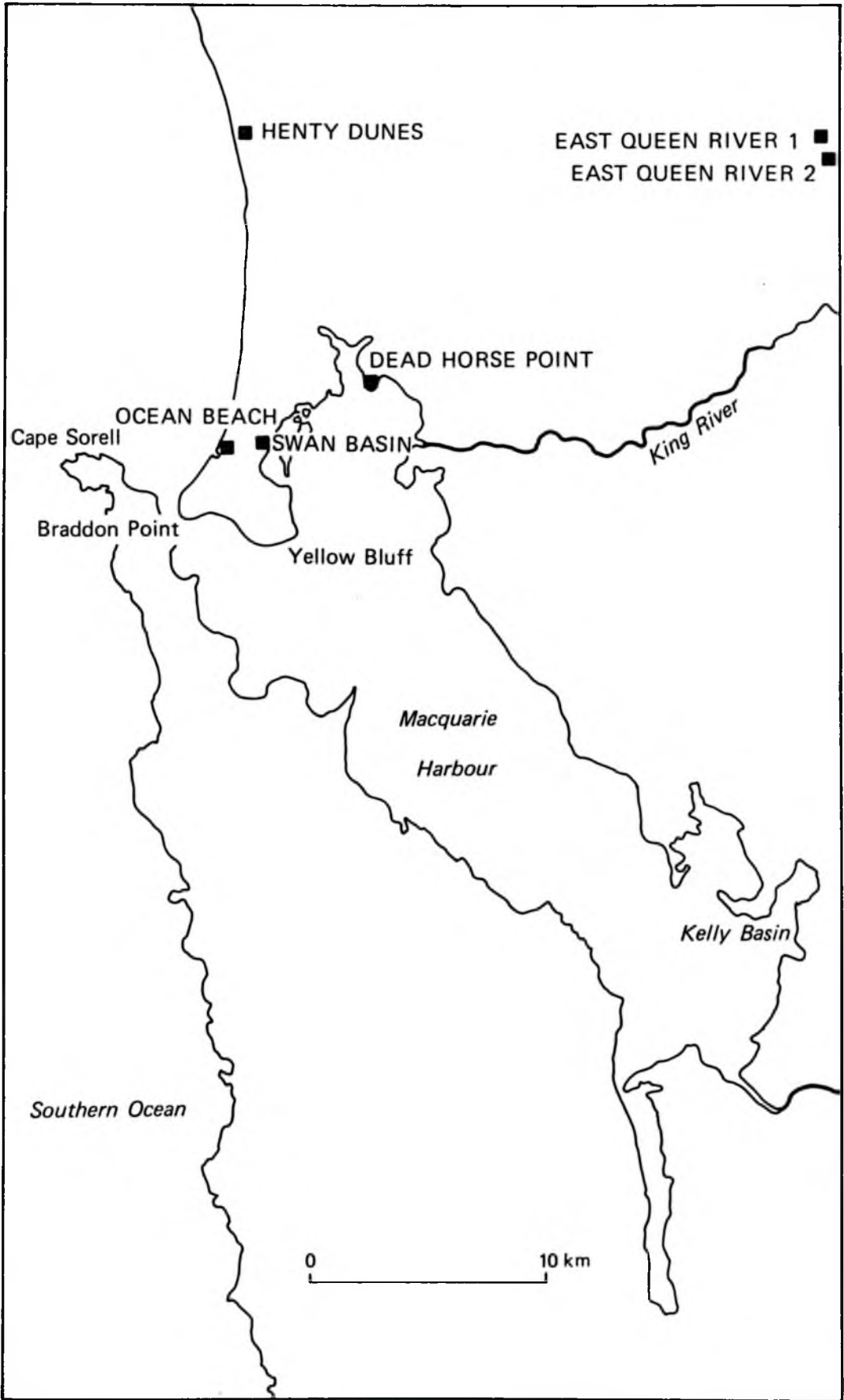


Figure 6.3 Macquarie Harbour

productivity because it provides a greater area of rock platforms per length of coast than the other rocks. As can be seen from Figure 6.4, the western Bass Strait quadrats tend to contain smaller aggregate volumes than the west coast quadrats. This is another indication that although the calmer waters of Bass Strait may be more accessible to Aboriginal foragers, the actual shellfish productivity is less.

In the western Bass Strait sample 42% of the middens were on pebble banks (Table 6.2). This is probably unrealistically high as the greater part of the North Point quadrat is fringed by pebble banks. What it does show is a preparedness to use pebble banks wherever they occur. Only 5% of the sample was on dunes. Although sandy cheniers do occur in some areas such as Perkins Island and Robbins Island, aeolian dune landforms are not common in the western Bass Strait region and were not common in the quadrats. The remaining 52% of the sample lay on the tops or slopes of hills and ridges or in rock shelters. With the exception of the Derwent, this is the highest proportional use of these landforms. It appears that hill and ridge tops and slopes up to about 10m a.s.l. are used if dunes and pebble banks are not available.

Therefore, in this region where strong similarities with the west coast could have been expected, there are a number of differences which indicate less intensity of exploitation of shellfish. The absence of doughnut middens or hut sites from Bass Strait may be related to this lower productivity. This is probably based on a less productive marine ecosystem which may be correlated with the lower amounts of wave energy it receives. In addition, differences in the range of available landforms is reflected in differences in the landscape associations of middens.

6.3 MACQUARIE HARBOUR

For a variety of reasons I took my west coast sample only as far as the entrance to Macquarie Harbour. Unlike the western part of Bass Strait which appears superficially similar to the west coast, I expected to find ecological and archaeological differences between Macquarie Harbour and the west coast.

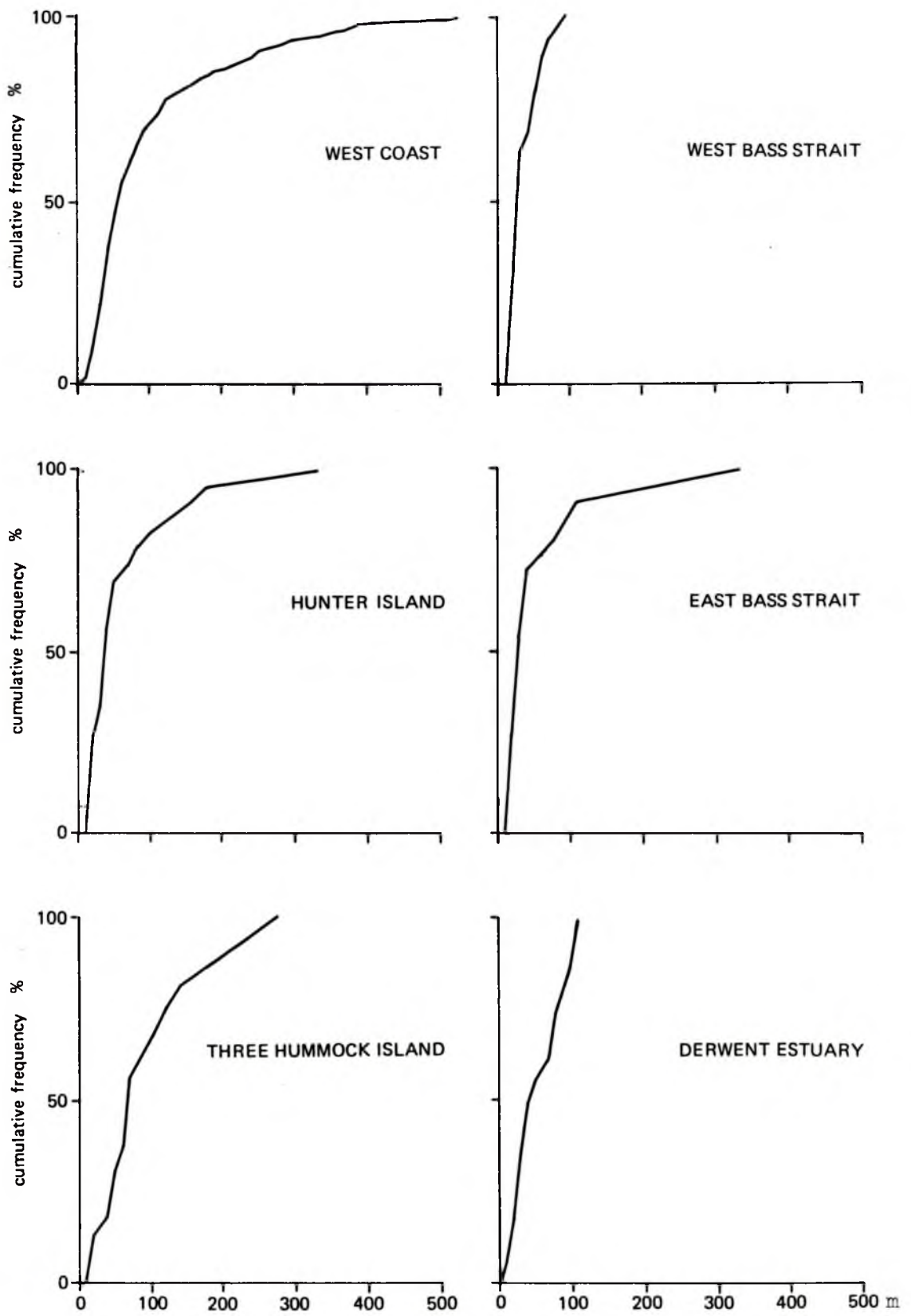


Figure 6.4 Cumulative frequencies of distance from middens to rock platforms for different regions

REGION	LANDFORM					
	Pebble bank	Dune	Hill top, ridge top or cliff top	Sandsheet	Hill slope or ridge slope	other
West coast	13	43	17	3.1	6.2	18
Hunter Island	56	43	-	-	-	
Three Hummock Island	-	56	18	18	6.3	2
Western Bass Strait	42	5	21	-	31	-
Eastern Bass Strait	-	100	-	-	-	-
Derwent estuary	-	-	37	-	62	-

Table 6.2 Percentage frequency of the occurrence of middens on five landform types for six regions.

6.3.1 Survey methods and results

Two approaches were used in the search for shell middens on the shores of Macquarie Harbour. Two formal quadrats were completed at Swan Bay and Dead Horse Point (Figure 6.3). When no evidence of Aboriginal sites was found at either, I then reconnoitred on foot sections of the shore between Braddon Point and Yellow Bluff near the entrance, and at Kelly Basin at the southeastern end. Swan Basin is on the northern shore of the Harbour with a mixed sedgeland heath community dominated by buttongrass on a peaty soil. The quadrat had been burnt about two months prior to my survey, so the ground surface visibility was excellent. The Dead Horse Point quadrat was on a narrow promontory on the northeast corner of the Harbour. It is also in the Macquarie Harbour land system. The vegetation consisted of a closed sedgeland of buttongrass, with trees and shrubs lining the shore. Like Swan Basin, part of the quadrat had been burnt, and in this part the visibility of the ground surface was around 90%. No shell middens or stone artefacts were found in either quadrat.

I then made a reconnaissance of one area near the entrance, extending from Braddon Point to Yellow Bluff on the north side of the entrance. The beach is mostly sandy. Around Braddon Point there are aggrading sand dunes, which would obscure any archaeological remains. However, further into the harbour the shoreline is eroding and forming a slumped cliff. Any shell middens along this section should have been clearly visible, but none were found.

The reconnaissance of Kellys Basin looked at a sheltered area where freshwater dilution would be greatest. The shore was formed of small pebbles, and immediately behind the shore was a regenerating rainforest on deep peaty soils. Dense vegetation and leaf litter meant that none of the soil surface was visible, so I walked along the edge of the harbour where there was a small eroded bank. No evidence of shell midden or of artefacts was found.

6.3.2 Discussion

As measured on 1:100,000 maps, the shoreline of the harbour is 184km long. The Harbour is formed by a graben orientated southeast-northwest, which is 8km across and some 30km long (Figure 6.1).

Information on the shellfish which now live in the harbour was

presented in Chapter 2. In summary, none of the usual food species of the West Coast or Bass Strait occur, but Xenostrobus securis, Venerupis dimenensis and Donacilla erycinaea are found in places. The former has been found in middens along the Derwent estuary, and the latter two species appear to be large enough to have made collecting them for food worthwhile.

Although this harbour would appear from a glance at a map to be similar to estuaries in other parts of Tasmania, it is in fact very different in physical and therefore biological composition. Freshwater enters the Harbour from numerous creeks and several rivers, the largest of which are the King and the Gordon. This water is stained with brown tannins leached from the peaty soils of the catchments. The entrance to the Harbour is very narrow and the tidal range along the west coast is generally small, so tidal flushing of the harbour is minimal. This affects its ecology and so determines the ways in which Aborigines could exploit it, and thus the types of archaeological sites which will survive.

I have found only a single reference to Aborigines in Macquarie Harbour. One of Robinson's camps during his mission was at the west end of Swan Bay (Plomley 1966:759). This must have been in the neighbourhood of my Swan Basin quadrat as Robinson's 'Swan Bay' would appear to be Swan Basin (See Chart of Van Diemen's Land 1832, Crofts:London). Here Robinson noted the Aborigines apparently exploited swans (and their eggs) and wallabies. These foods would leave only bones and egg shell, and these would chemically deteriorate quite quickly in the acid soils of the area. Macquarie Harbour was used for penal settlements during the 1820's, and there was considerable British activity around its shores until the settlement was closed down in the 1840's. This colonial presence, and in particular its military component, would have discouraged Aborigines from visiting the area, although there were Aborigines on the adjacent west coast during this period.

Although some use of the area is to be expected, it does not share the west coast ocean or southeast estuarine ecology which allowed Aborigines to develop the enormous shell middens characteristic of these areas. The only conclusive statement which can be made is that no shell middens were found in my survey. The likelihood of finding sites with bone food remains is low, as the soils of the area are acidic, rainfall is high, and no rock shelters

are presently known. On the other hand, stone artefacts which are comparatively durable will probably be found in time. Of a necessity determined by environmental factors, the prehistoric activities carried out around Macquarie Harbour must have been different from those of the west coast.

6.4 THE HUNTER GROUP

Although Meston (1936), Sutherland (1972) and Bowdler (1974, 1979) had provided a great deal of information about the archaeological sites of some of these islands, my purpose in going to the Hunter Group was to carry out a formal survey using the same analytical criteria that I had already used on the west coast. The islands of the Hunter Group provided an opportunity to compare island patterns with those of the north and west coasts.

The Hunter Group lies off the northwest corner of Tasmania. The largest islands of this numerous group are Perkins, Walker, Robbins, Three Hummock and Hunter. It is possible to walk to Perkins, Walker and Robbins at low tide, so they were not sampled as they could be easily exploited on a commuter basis from the mainland. The remaining two large islands provided my Hunter Island and Three Hummock Island samples. I did not visit any of the smaller islands.

6.4.1 Hunter Island

Hunter Island resembles an aircraft carrier in shape in its long but narrow outline and relatively flat top and steep sides. It is composed of metamorphic rocks which are overlain in places by Quaternary sediments. The metamorphic rock areas are remarkably similar in topography, vegetation structure and floristics to the mainland west coast around West Point. The Quaternary sediment areas are generally characterised by undulating dunes which support a grassland with scattered trees and clumps of shrubs. The west coast of the Hunter Island sample shares the same high wave energy and coastal orientation as the west coast samples, so similarities such as those shown by Bowdler (1979) in their archaeological patterns were to be expected.

One of those similarities was the difference in midden volume on north and west facing sections of coast, for example on the west facing coast of Cuvier Point in contrast to the north facing coast of Cuvier Bay. At each location two adjacent quadrats were surveyed (Cuvier Point north and south, Cuvier Bay east and west). The difference in the number and volume of middens is quite marked (Figure 5.7). Six middens were recorded at Cuvier Bay and 22 at Cuvier Point. Only two (33%) of the north facing sample have a volume of greater than 0.01 cu. m, compared with 18 (90%) of the west facing sample. The average volumes were 0.3 cu. m and 3.0 cu. m respectively. The total volume of midden per quadrat of the west facing quadrats was 34 and 33 cu. m while the north facing quadrats each contain 1 cu. m.

Because of these results, the Cuvier Bay east and west quadrats were not included in the Hunter Island sample so as to make the sample as comparable as possible with the mainland west coast. The Hunter Island sample was composed of the Shepherds Bay west, Cuvier Point north and Cuvier Point south quadrats. The Shepherds Bay east quadrat was also not included as it faced into Bass Strait. The Hunter Island sample contained 23 middens.

In the middens on Hunter Island the most numerous shellfish observed on the surfaces of middens were Notohaliotis ruber (26%) and Patellanax peronii (39%). Surprisingly, Subninelia undulata which is the most numerous species on both the west coast and the north coast was dominant in only 22% of the Hunter Island sample. Why Patellanax peronii should be so common on this island is not clear, but the unusually large contribution of Notohaliotis ruber could be explained by a combination of two factors. If, as suggested by Coleman (1966), there was a cultural preference for this large, easily collected species, then there would be a degree of cropping stress on this resource. This could affect not only the numbers of this shellfish but also the age structure of the population in the exploitation zone (Swadling 1977:12). If the island was infrequently visited, then there would be greater numbers of these preferred shellfish available at the time of such infrequent visits than would be the case on the more regularly exploited mainland coast.

Hunter Island has extensive areas of dunes and pebble banks and these two landforms account for all the middens, with 56% and 43% respectively. The extensive pebble banks of Hunter Island also have

stone features which are similar to examples found elsewhere in Tasmania.

The distribution of middens in relation to the nearest rock platforms is similar to the west coast (Figure 6.4). The actual volume of midden per quadrat is considerably smaller. This supports the idea advanced above that the west coast of Hunter Island was exploited less intensively than the west coast of the mainland.

The Hunter Island sample has the same modal volume class as the west coast, but the mode accounts for a larger proportion of the sample (Figure 6.6). There are proportionately fewer sites with volumes of less than 0.01 cu. m and the distribution does not extend into the larger than 100 cu. m class. In fact the largest site, a linear midden at Cuvier Point south, was only 10 cu. m in volume.

On Hunter Island all three quadrats contain 10-100 cu. m of shell midden, showing that there is significantly less volume of midden per sampling unit than on the west coast. Of the Hunter Island quadrat samples, only one midden out of 33 was in a shelter. This site is nothing more than a thin scatter of shells against a slightly overhanging wall of quartzite. Once again, a systematic survey has shown that middens in shelters are only a small proportion of the overall pattern.

I also looked at one place where it was possible to take a transect from the Southern Ocean to Bass Strait across Hunter Island. In Appendix 2, this is described as the Shepherds Bay east and Shepherds Bay west quadrats. In the field the area between the quadrats was also surveyed, giving a transect 500m wide and 1.1km long from beach to beach. In such a situation, I predicted that the counterbalancing 'pulls' of the resources of the two coasts would result in the formation of middens in the sheltered swales of the dunes in the middle of the island.

I found no sites in the dunes in the middle of this transect. The distribution of middens in both quadrats was limited to small and scattered sites along the coastal fringe. All the middens contained the same shellfish types.

There is, however, three times more midden volume in Shepherds Bay west than in Shepherds Bay east, which supports the proposition that the Bass Strait is a less productive system than the west coast.

In contrast to these results, a midden known as the Stockyard Site (Bowdler 1974:18) on Hunter island lies midway between the east

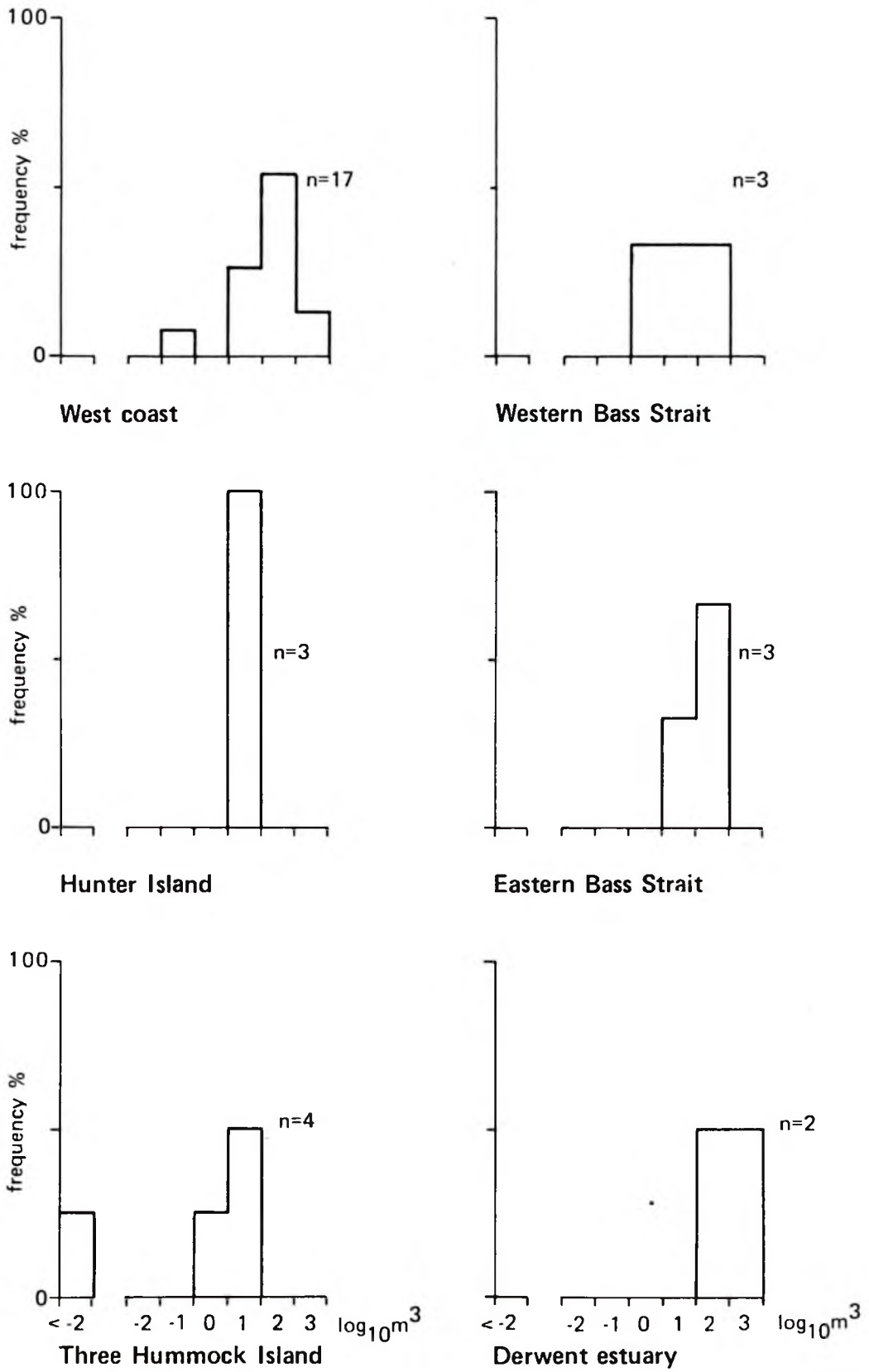


Figure 6.5 Percentage frequencies of volume of midden per quadrat for six regions

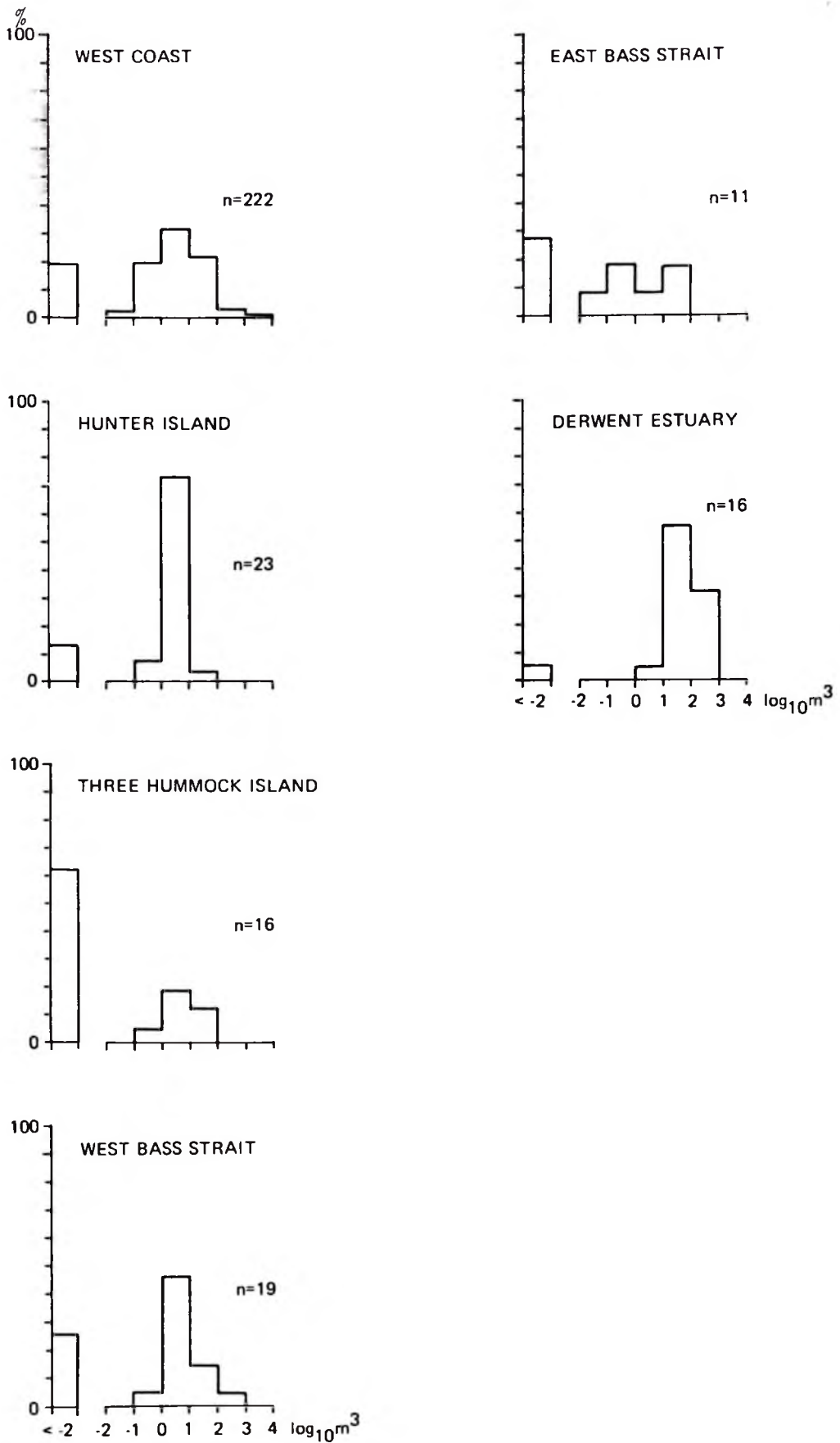


Figure 6.6 Midden volume profiles for mixed coast type quadrats in six regions

and west coasts, 2km from both; it is the most inland midden that I have seen in Tasmania. It owes its position to the same factors which induced the modern occupants of the island to place the homestead for their farming operation in the immediate vicinity of the midden. It is one of the most central locations on the island. It is also adjacent to a stream of fresh water. I have estimated the volume to be in the order of 20 cu. m, so by Hunter Island standards it is very large. Its function could be described as a home base (O'Connor 1980) and it is possible to envisage people foraging at the coast during the day and returning to the site in the evenings. This does, however, indicate that the transport of shellfish for 2km was not considered excessive, which is in agreement with my earlier examination of the transport of shellfish along sandy beaches (Section 5.2.10). It does not contradict the general conclusion that midden materials tend to be deposited in a tightly prescribed pattern along the coast. Rather, it is the situation which is an exception. It may well be that there are other sites which lie along the north-south axis of Hunter Island for the same reasons.

The difference between these results and those of my Shepherds Bay transect may be partly explained as a function of scale. The shorter distance of 1.1km at Shepherds Bay made it a relatively short walk from one side to the other so there was little benefit in placing a camp at a halfway point. The narrower width of the island may have meant that the available foraging area was too small, in spite of the length of coast available. Perhaps most importantly, drinkable water was only found near the shores at Shepherds Bay, and a sizeable base camp would need a reliable water supply.

From the shellfish and midden volume data presented it appears that the coast of Hunter was less intensively exploited than similar coastal areas on the mainland. It would therefore seem that the narrow passage between Woolnorth Point and Weber Point was a sufficient barrier to remove Hunter Island from the everyday exploitation realm of the Tasmanians.

Models of island use often only consider the linear distance of water which must be crossed. In this case there are additional factors. The channel between Hunter and Tasmania experiences a tidal flow of up to seven knots (W. Alliston pers. comm., see also Meston 1936:157), so the timing of a crossing would have to be carefully calculated. The actual route used to cross the passage was recorded

by Robinson as 'from Cape Grim to Trefoil, thence to an island midway between Trefoil and Hunter (Bird Island), and thence to the Hunter; crossed over in catamarans' (Plomley 1966:641). I will return to the problems of the use of islands after a description of the shell middens of Three Hummock Island.

6.4.2 Three Hummock Island

Three Hummock Island is very different in character from Hunter, even though Hope Channel which separates them is only 3.8km wide.

Except for a small area of basalt near East Telegraph Beach on the eastern side, Three Hummock has granite bedrock or is mantled by Quaternary sediments. The surface topography is gently undulating except for the steep sided core called South Hummock. The vegetation structure is a fire controlled mosaic of shrublands and forest.

Many of the dominant species are similar to those found on Hunter Island and the west and north coasts of the Tasmanian mainland. The Three Hummock Island sample was drawn from the Ranger Point, Burgess Point and Chimney Corner east and Chimney Corner west quadrats (Figure 4.1). These contained a total of 16 middens.

On Three Hummock Island a large proportion of the sites was on sandsheets. The island is mostly granite, but in the sample quadrats the granite is mantled by a sandsheet which has blown up from the beaches to the west. On the west coast of Tasmania, it was shown that middens on sandsheets tended to be very small, as though this was not a preferred landform given the nearby presence of dunes. On Three Hummock Island at least, sandsheets were selected as the preferred camp site location simply because there were no dunes. Although the Three Hummock Island sample is similar in volume range to that from Hunter Island, a much larger proportion of the middens have volumes of less than 0.01 cu. m. The tendency to small volumes of midden per quadrat seen on Hunter is even more extreme on Three Hummock Island, where one quadrat out of the four contained less than 0.01 cu. m, one had 1-10 cu. m. and two had 10-100 cu. m. I would argue that the smaller size of middens here can be explained by the island's location. Firstly, it is in Bass Strait and thus shares the lower productivity of the more sheltered coastline. Secondly, it is the last link in a chain of islands, requiring at least two major water crossings to reach it. The trend is towards less volume of midden per length of coast as one moves out along the island chain. This trend

is best explained in terms of the lower intensity of exploitation of the island's coastline (at least as far as shellfish are concerned) and difficulty of access which led to infrequent use of its shellfish resources by Aborigines. This explanation ignores the possible use of muttonbirds, seals and land mammals, but to incorporate these resources into an economic model would require additional evidence from ethnographic sources and archaeological excavation such as was done by Bowdler and Vanderwal. The former is limited, but research of the latter is the obvious direction in which to explore this extreme island situation.

6.4.3 Islands

King Island has a special place in this discussion. Of the larger islands in the Tasmanian archipelago it is separated by the widest water barrier from the Tasmanian mainland. We know from early historic records that it was not occupied by the Aborigines (Péron in Micco 1971:11). Although several people have looked briefly (Jones 1979a, A. Wallace pers. comm.), no shell middens have been found. The only site dated is a stone artefact scatter older than 7,000 BP. I went to King Island to check on this apparent absence of middens. I stratified the coast into hard, mixed and soft shores, and then concentrated my search in the mixed coast strata as my Tasmanian work had shown that this stratum had the highest probability of containing shell middens. Although some of the areas I searched resembled my 'ideal location' on the west coast in almost every way, I could find no evidence of shell middens. I also interviewed several of the islands residents, but found no knowledge of shell middens, or of caves or shelters which might contain archaeological materials.

The results of the survey of islands in the Hunter Group and King Island has implications for other parts of Tasmania. Tasmania is an archipelago stretching over 500km from the Hogan Group in the north near Wilsons Promontory to Pedra Blanca in the south. It is not surprising that questions about how people arrived in Tasmania, and which islands they used, have been central to speculation about the Tasmanian Aborigines since Flinders sailed through Bass Strait in 1798. To address this problem it is necessary to examine ethnographic and archaeological information about which islands were regularly visited and examine some of the biophysical reasons why others may not have been used, such as was done by Meston (1936), Jones (1976,

1977) and Bowdler (1974).

In the northwest, all of the Hunter Group appear to have been visited except Steep Island (Bowdler 1974:4; R. Jones pers. comm.) and Albatross Island (R. Jones and D. Ranson pers. comm.). A lack of firewood and materials with which to repair a canoe could account for these two exceptions. These islands were excluded from the coast length figures for the Hunter Group (Table 2.1). Having once had an Aboriginal population, the question of King Island is a question of extinction. We know that it had a population well after its separation from the mainland (Jones 1979), but no shell middens survive.

The people of the northeast did not use watercraft (Plomley 1966:389; Flinders 1814:clxx). The resources of even the nearest islands and rocks were unavailable to them, so islands such as Waterhouse, Swan, Ninth and Tenth are not included in the estimates of coast length. As a check on this pattern I made a reconnaissance of Waterhouse Island but found no evidence of prehistoric visitors. In recent years, children from the nearby high school at Scottsdale have swum from Waterhouse Island to the Tasmanian mainland for an adventure activity. The distance is about 3.5km and there is a rock called Little Waterhouse Island about half way, so it is quite possible to reach the island and its extensive muttonbird colonies. Why the people of the northeast did not exploit their nearby islands is one of the mysteries of Tasmanian prehistory.

In the southwest, the Maatsuyker Group was visited (Plomley 1966:379). Vanderwal (1978:19) has argued that De Witt Island of this group was not visited but was bypassed enroute to the more distant Maatsuyker Island. Vanderwal's argument contains three strands. Firstly, seals do not live on De Witt and seals were the main attraction of the islands. Secondly, Vanderwal found no middens on De Witt during a brief reconnaissance of the most likely areas. Thirdly, 'the sea currents are predominantly westerly or easterly and the winds are mostly westerly, so that even with optimum conditions it would be difficult to navigate a bark canoe from De Witt to Maatsuyker.' The first point about seals appears to be correct (see Section 2.4 and Figure 2.5, 2.6 and 2.7). On the second point, any advantage the seasonal current may give in one direction will be a penalty on the return journey in the opposite direction. A review of the seasonal circulation pattern of the southwest waters indicates a

northwesterly summer flow and a southeasterly winter flow (Matthews 1978:18). However, Matthews stresses that the oceanographic information available is very limited and provides only general conclusions about the offshore water mass. Localised nearshore patterns will be different (Matthews 1978:19).

In the absence of measured data I am forced to rely on information supplied by a fisherman (P. Willson pers. comm.) and sailors who regularly use the area (D. King, T. Brown and J. Kennedy pers. comm.). They stress that the tides and currents have only a minor effect and that wind is the most important factor governing the sea state of southwest Tasmania.

Wind data are available for Maatsuyker Island (Matthews 1878:3-4). These data show a predominance of winds from the northwest quadrant, which is slightly off Vanderwal's direction. In addition, there are calms, and winds from other quarters, throughout the year. The patterns of currents and wind are not as simple nor as consistent as Vanderwal implies. To claim that people would not use De Witt as a staging point is unreasonable. A survey of De Witt is the easiest way to resolve the debate. In the meantime I have included De Witt in my calculations for the southwest.

Another problem in this area is the use of Eddystone Rock, which would have required a water crossing of some 25km. Although Robinson clearly states that it was visited (Plomley 1966:379), it should have been beyond the extreme range potential of Tasmanian watercraft (Jones 1976:248). It also lacks firewood and drinking water and seals have not been recorded on the rock (see Section 2.4). Nearby Pedra Blanca does have a seal colony (Warneke 1976:25), so it is possible that Robinson's informant was referring to this rather than Eddystone as he was specifically talking about sealing expeditions. These islands lie outside my southwest region and so are not included in the coastal calculations.

A variety of biophysical and cultural factors seem to determine which islands were used by the Aborigines in the recent past. The availability of drinking water and firewood on the island, the size of the island, the risk of missing the target island and not being able to make a landfall probably all played a part. However, there were also cultural factors involved. The people of the northeast did not use watercraft, so the rich resources of even nearby islands like Waterhouse were beyond their reach, even though equivalent islands

were used with available technology in other parts of Tasmania. We do not know why the people of the northeast did not use the watercraft which they must have seen their neighbours use.

6.5 THE SOUTHWEST

The southern half of the west coast has similar bedrocks to the northern half, with a similar high proportion of mixed coast from Macquarie Harbour to Port Davey (Figure 2.2). The dominant coast type changes at Port Davey to steep plunging cliffs which continue with only short interruptions to South Cape. I examined several of these cliffed areas in 1975 and found no shell middens. This is similar to my more detailed findings in the northwest. In the breaks of the cliff line there are mixed coast areas and these have numerous middens. Fieldnotes from my surveys in the southwest in 1975 recorded the same shell and animal species as were described for the northwest.

Elsewhere I have explained why during the present study, because of reasons of access, I did not sample to the south of Macquarie Harbour, but I would argue that the patterns found in the northwest can be extrapolated to the southern section because of similarities of ecology and coast type along the entire west facing coast. One similarity between north and south was the practice of making huts, marked by doughnut middens today. The ethnography does suggest that fewer people lived in the southwest. The average band density was about half that of the northwest (Jones 1974:327). This may be partly explained by the nature of the coast, with the southwest containing a greater proportion of steep plunging cliffs which my analysis has shown were not good areas for shellfish exploitation.

Zakharov's (1981) argument that there is a major difference in the modern abalone and rock lobster productivity of the northern and southern parts of the west coast, is based on catch-effort records for fishermen compiled by the Tasmanian Fisheries Development Authority. These figures are for the weight of rock lobster or abalone caught per unit of time. The fishermen are using high technology equipment including echo sounders and radar on diesel powered boats, which has little to do with prehistoric harvesting. In addition, the southwest coast is worked by larger boats as it is further from port and larger boats must catch more per unit of time

to be economically viable.

There is an additional element in the pattern of midden location in the southwest. Port Davey forms a large low energy estuarine system such as is not found in the northern part of the west coast. In 1975 and 1976 I recorded middens around the shores of Port Davey which contained estuarine shellfish such as Ostrea angasi (Tasmanian Aboriginal Sites Index, NPWS, Hobart). The presence of these shellfish suggest ecological similarities with the Derwent estuary which is discussed later.

A very long and narrow entrance called Bathurst Channel separates Port Davey from the extensive Bathurst Harbour. Like Macquarie Harbour, Bathurst Harbour receives large volumes of fresh water from numerous streams and rivers. The tidal range is small, so the Harbour is not flushed by sea water and therefore remains relatively diluted with the fresh water. This is similar to the situation described for Macquarie Harbour. As a result, by extrapolation of the results of my survey of Macquarie Harbour, it is unlikely that shell middens will be found on the shores of Bathurst Harbour. It is possible that the fresh water tolerant Xenostrobus securis may be present, and if so may be found in middens, but this is unlikely. Stone artefacts have been found around the shores of Melaleuca Lagoon which enters the southeast corner of the Harbour (D. King pers. comm.). These artefacts demonstrate the presence of Aborigines but give us no idea of when this may have occurred. Melaleuca Lagoon may well have been a staging point for an Aboriginal path from the mixed coast areas of Coxs Bight and Louisa Bay to the inner reaches of Port Davey and from there to the west coast. Such a route avoids the extremely rugged South West Cape and Melaleuca Ranges and the predominantly hard coast of the Southwest Cape area where coastal resources were not readily available. The South West Cape coast is one of the few parts of the Tasmanian coastline which Robinson did not visit in his search for Aborigines. It is tempting to speculate that his Aboriginal assistants had told him that it was an unimportant area. It seems reasonable therefore to suggest that the presence of artefacts at Melaleuca Lagoon can be explained as marking an Aboriginal road which linked high productivity coastal areas while avoiding an area of little value.

6.6 EASTERN BASS STRAIT

The eastern half of Bass Strait is on the opposite corner of Tasmania from the southwest and has a marine ecology which is markedly different. It is characterised by medium energy waves, there is a large proportion of sandy beaches and cliffs are absent. Towards the eastern end there are long sweeping sandy beaches interrupted by short stretches of mixed coast around headlands and points. The east Bass Strait sample was formed from mixed coast quadrats at Griffiths Point, Freshwater Creek and Waterhouse Point. It is comprised of 11 middens.

In marked contrast with all the west coast and the western part of Bass Strait samples, the most numerous shellfish in all the middens in eastern Bass Strait was Mytilus planulatus. All sites were on dunes, but as most of the area of the three quadrats in the sample was composed of dunes, the result must be interpreted with caution. For example, there is at least one midden on a reddish yellow clay soil in the bay between Badger Head and Little Badger Head, so other landforms were used.

The east Bass Strait sample has a large proportion of sites with volumes of less than 0.01 cu. m, but the right hand part of the distribution is bimodal (Figure 6.5). It is clear from my site records and fieldnotes that the 10-100 cu. m class is mostly comprised of linear middens, which are composed of numerous overlapping small midden dumps. This pattern of complex linear middens contrasts with the usual scattered pattern of the west coast and western Bass Strait.

In Section 5.2.10 it was demonstrated that midden volume per quadrat on sandy shores declined with the distance from the mixed shore. To see if this pattern also occurred along Bass Strait, a quadrat was surveyed in the middle of the long sweep of Bakers Beach. It is about 4km from both the rocky headlands of Griffiths Point to the west and Little Badger Head to the east. In this quadrat only six small middens were found. One had a volume of 0.05 cu. m, while the remainder were all less than 0.01 cu. m. The aggregate volume is insignificant when compared to the 200 cu. m and 500 cu. m estimated for the Freshwater Creek and Griffiths Point quadrats at either end of the beach where there is a mixed shore type. This shows that as on the west coast middens can be found in sandy coast areas but the

volume per length of coast is much less than on nearby mixed coast areas.

The three quadrats in eastern Bass Strait (Griffiths Point, Freshwater Creek and Waterhouse Point) have volumes of 500, 200 and 17 cu. m respectively. Because the sample is small, the locations are far apart and the volume estimates range so widely, definite summary statements about volume trends are not practical, but the following observations are offered:

1. The Griffiths Point quadrat on the eastern part of Port Sorell has an estuary to the west side and a Bass Strait shore to the north. The middens contained estuarine species, especially Mytilus planulatus and Ostrea angasi and Bass Strait species e.g. Subnina undulata and the large volume of midden in the quadrat is a function of having two different types of shellfishing area nearby.

2. The Freshwater Creek quadrat lies on the junction of a sandy beach with a rocky headland. All the middens of this quadrat were on the sand area. A brief reconnaissance along the moderately steep cliffs to the east gave the impression that there is very little midden along that stretch of the coast.

I consider the eastern Bass Strait pattern has three elements, similar to those described for the west coast. Long sandy beaches and steep cliff areas have only small amounts of midden, whereas where there is a combined rocky and sandy shore with easy access the largest volumes are to be found. Unlike the northern half of the west coast and western Bass Strait, estuaries provide an additional source of shellfish. The most important species appear to be Ostrea angasi and Mytilus planulatus, the former lives in the estuarine sediments, and the latter on rocks. It is likely that the entrance to the large Tamar estuary is flanked by shell middens containing these species.

The most easterly sample comes from Waterhouse Point. A point was chosen because in other areas it has been consistently shown that points and headlands tend to have the greatest volume. However, the total volume for the quadrat was only 17 cu. m. This low figure can be interpreted in at least two ways. Firstly, shellfish could have been an unimportant food source in the extreme northeast. This seems unlikely as there are middens behind almost every rocky area of the coast where shellfish could be found. Rather, the evidence suggests that it is a low productivity region. This may be the result of a Bass Strait situation and having rock platforms of smoothly rounded

granite. However, rather than to try to argue for the integration of the eastern Bass Strait samples with the northwest and western regions, it would be sensible to admit that the area requires much more sampling. Until this is done, any statement about the archaeology of the northeast must remain speculative.

I do not have carefully surveyed samples from the east coast, but from work which I did before this project, and from other sources (Lourandos 1970), it is clear that Subninella undulata dominates the middens of the rocky coast which faces the Tasman Sea, while Mytilus planulatus and Ostrea angasi are found in sheltered bays and inlets.

The Little Swanport site excavated by Lourandos (1970) is actually located in a low wave energy estuary (Lourandos 1970: Figure 4.1). This estuarine setting is also apparent in the major shellfish types of the site, namely Ostrea angasi and Mytilus planulatus (Lourandos 1970:36-37). The Little Swanport site is therefore typical of an estuarine setting such as was described for Port Davey on the west coast.

6.7 DERWENT ESTUARY

The Derwent estuary was formed when a deeply downcut river channel was flooded by the rising post glacial seas. The enormous expanse of protected harbour which resulted is now the site of the capital city of Hobart. The most common bedrocks along the shore are dolerite, mudstone and siltstone.

A low energy mixed coast is characteristic of the upper reaches of the estuary. Further out in the estuary there is a range of shore types subjected to medium wave energy. The present shoreline is typically bordered by sloping hillsides which either extend down to and beneath the present sea level or have been cut back to form cliffs. Some embayments have formed narrow beaches, but there is little or no dune development behind them.

I was able to survey two quadrats on the low energy banks of the Derwent at Porter Bay and Gibsons Point. The 16 middens from these comprised my Derwent estuary sample. These middens are dominated by Mytilus planulatus. In this respect they are similar to the eastern Bass Strait sites. Ostrea angasi is also present in large numbers. This combination of Mytilus planulatus and Ostrea angasi is similar to that noted in the Port Davey estuary in the southwest and Little

Swanport in the east.

Middens were found more frequently on the hill slopes than on the cliff tops. This is surprising because if one walks along the cliffs around Hobart the impression is gained that there is a more or less continuous string of middens eroding into the sea. It was only by systematically searching the hill slopes that the less conspicuous vegetated sites were found.

On the west coast it was demonstrated that dunes and pebble banks were the favoured landforms on which to deposit middens. In the Derwent where these landforms were absent the Aborigines made use of slopes and tops of hills, ridges and cliffs. An unusually high proportion of the middens rested directly on bedrock (69%). The remainder rested on soils, which is also unusual. In spite of the nature of the substrates, 62% of the middens still contained sand as the sediment matrix between the shells. The remaining 38% contained finer grained sediment as the matrix, which is the highest proportion of non-sand matrix found in middens.

A pattern of large complex linear middens is prominent in the Derwent estuary sample, where the modal volume is 10-100 cu. m (Figure 6.5). There is a significant proportion of sites with volumes of more than 100 cu. m. These linear middens are deep and extensive and do not show the aggregate point site pattern found along the north coast.

Although I have only two quadrats in the Derwent estuary, there is other archaeological information available against which the findings of this study can be tested (Stockton and Wallace 1979; Gaffney and Stockton 1980; Neal 1981; Healey and Stockton 1980). From the information available in these studies, it is clear that the two quadrats are typical of the extensive coastline of this vast estuary. The large linear midden sites in the quadrats are typical also, so the pattern can be generalised with some confidence.

The total volume of 1232 cu. m for the Porter Bay quadrat is the largest volume estimated for any quadrat surveyed in this study and is probably typical of the upper reaches of the estuary. Further towards the sea at Gibsons Point on the side of Droughty Point, the quadrat volume is down to 540 cu. m, but this is still very large. For example, it is 79% larger than the average of 302 cu. m computed for the mixed shore on the west coast. Although the volumes are greater along the Derwent than anywhere else, the middens are

composed almost entirely of shell, while mammal bones are very rare. For example, no bone was recorded in either quadrat, while in my excavations at the Jordan River I found no bone in the 0.7 cu. m of deposit which was sieved. Most notably, no seal bone has been found in any of these sites. Although the estuarine coastline produces a greater volume of midden per length of coast, the actual energy production would be less than the west coast.

6.8 CONCLUSION

A comparison of the contents and landscape associations of middens from around the Tasmanian coastline shows several regional differences in a broad economic strategy of collecting shellfish. Although the locations of middens show some degree of preference for certain environmental settings, the overall pattern is one of opportunism. Middens were found wherever suitable shellfish could be obtained and the shellfish were never carried very far.

The species of shellfish vary with differences in the coastal ecology and so appropriate foraging tactics would have varied. In low wave energy environments shellfish collecting would have been an extremely safe and simple operation which could have been performed at low tide. Along the west coast there are high energy waves, a small tidal range and the more important species are mostly found on rocks below the low tide mark. To collect shellfish here was potentially risky as it required diving in turbulent water. There were some areas of plunging coast where the risk was sufficient to deter foraging for shellfish altogether.

The medium wave energy western Bass Strait coast would have provided a foraging environment with the same species as the west coast but with less risk. On several independent lines of evidence it has been shown that the western Bass Strait coast was less productive of shellfish and so could not have supported the same exploitation intensity as the west coast. Similarly the west coast of Hunter Island should have been able to support the same level of intensity of exploitation as the west coast of Tasmania, but the effort and risk of access was sufficient to curtail foraging intensity. As a result midden volume per length of coast was much lower than on the west coast. This problem of 'islandness' where risk and effort outweigh the rewards or exceed the seafaring technology of a people

is seen even more clearly on King Island. It was probably not occupied for two distinct reasons. It was beyond the range of the watercraft of either the Tasmanians or the Australians and probably too small to support a viable group of people for a long period.

CHAPTER 7 WEST POINT AND THE ANTIQUITY OF SHELL MIDDENS OF WESTERN TASMANIA

7.1 INTRODUCTION

The West Point area is used in this section to examine a number of aspects of the archaeology of the west coast which could be dealt with more effectively in one large sample area than in dispersed quadrats.

The West Point area was chosen for intensive study primarily because it is representative of the heathland of the relatively unmetamorphosed sedimentary rocks group which was shown in Section 5.1.3 to have the largest number and greatest volume of middens. Also archaeological information for West Point was available from work by Jones (1966;1981a) and Coleman (1966).

Examination of the West Point midden data leads to a discussion of the antiquity of shell middens and the exploitation of seals. This is followed by a change in emphasis to examine artefact sites on the coast and inland. This introduces the broader economic questions which can be addressed by examining the distribution of certain types of raw materials from which artefacts were made.

7.2 WEST POINT

7.2.1 Background

The land surface of the West Point area showed little evidence of change other than the construction in the last 30 years of holiday cottages and four wheel drive tracks linking them to the lighthouse road. These tracks made access relatively easy. The original lighthouse was built in 1919, but the present road to it was constructed about 20 years ago. Because the area has very poor soil, agricultural activity has been minimal. The area is presently used for winter agistment grazing. The southern boundary of the study area was deliberately placed to exclude the areas of large scale dune mobilisation. These are visible on the air photograph as areas of even tone light grey and white (Plate 7.1). The light grey is marram grass and the white is bare sand. Within the West Point study area there does not appear to have been any major change in

Plate 7.1 Air photographs of West Point. (copyright Tasmanian
Lands Department)

- 1 Pavement Point
- 2 Nettley Bay
- 3 Site 118
- 4 Lighthouse
- 5 West Point



the biophysical setting for several millennia. There are swamps from which pollen could be obtained to test this assertion. Unlike my usual 500 X 500m quadrat, the West Point area sample extends over a straight line distance of 4km. It includes 9km of convoluted coastline from a sandy beach south of the West Point lighthouse, northwards to the cleared land of the Green Point farm of Mr. Richard Nicholls (Figures A2.48 to A2.53). The total area of rock platforms measured on the 1:100,000 sheet is in excess of 400,000 sq. m. The offshore islands add a further 3km of coastline. The sample extends 500m inland from the high tide mark and has a total area of approximately 3.5 sq. km. The field survey took in excess of 60 work-days to complete. A further six work-days were spent on test excavations and collecting radiocarbon dating samples. Twelve work-days were required to prepare detailed contour maps of sites 118 and 69 which are examples of a West Point midden and medium midden dump respectively. These site types were defined in Section 3.2.2.

Previous work at West Point by Jones (for example see 1966, 1967 and 1971) and Reber (1965) had established the antiquity of the largest two middens between 2,000 and 2,600 years BP and provided information on their contents and structure. The midden excavated by Jones as 'the West Point midden' (site 118) is the type site for my 'West Point midden class' (see Section 3.2.2 and Figure 3.2). Jones had described the importance of seals in the diet and changes in the types of materials used for stone artefacts (1971:609; 1981a). Coleman (1966) had analysed shell samples from the excavation and showed that there had been a decrease in the average size of Notohaliotis ruber shells from 1,800 BP to 1,300 BP.

West Point is typical of the hard, relatively unmetamorphosed sedimentary rocks type of coast which extends from Hunter Island to south of Macquarie Harbour. The area has gently undulating terrain with ill defined drainage, giving rise to numerous small swamps. The vegetation is typically composed of a narrow zone of salt resistant grasses and tussock grass near the sea where the salt and wind exposure is greatest, merging into a dense low shrub heath with a structure controlled primarily by fire, wind, salt spray and trampling by cattle. Important shrub species include Leptospermum scoparium, L. glaucescens, Melaleuca squarrosa, M. ericifolia, Banksia marginata, Acacia sophorae, A. verticillata and Pultenaea

daphnoides.

Although the name of West Point, which was given by Matthew Flinders, suggests that this is the westernmost part of mainland Tasmania, Bluff Hill Point some 7km to the south lies about half a minute of longitude further to the west.

7.2.2 Ethnographic information

A limited amount of ethnographic information is available for this area from Robinson's journals. The locality was the home territory of a band called the PAN.NER.BUKE.ER, PEE.RAP.PER, PEE.WRAP.PEE, or PEEWRAPPER (Plomley 1966:97-97). Green Point was called TYBERLUCKER, West Point was NONGOR (Plomley 1966: 184;690 n58;957) and the point now called Pavement Point was known as PON.ER.RUD.DICK (Plomley 1966:616). Robinson described an area with 'miles of grassy sandhills at West Point, an excellent sheep walk' (Plomley 1966:616). These grassy sandhills are now partially restabilised dunes extending southwards from the point. While travelling about 3km inland of West Point, Goldie (1861:6) described wet heathy plain and tea tree swamps, which is how this area looks today.

7.2.3 Archaeological sites

Although isolated artefacts and scatters of worked stone were recorded whenever they were found during this project, it was only in the West Point area that the survey aimed to locate systematically and record this kind of archaeological debris along with middens. The difficulties of locating such sites because of their low obtrusiveness meant that this change in emphasis increased the time required to search the ground surface by a factor of four to five times. In some places the distance surveyed per day dropped to about 100m of coast.

The frequencies of site types are listed below:-

SITE TYPE	FREQUENCY	FREQUENCY %
Middens		
-deflated	2	1.9
-small	50	48
-medium	15	14
-linear	32	30
-doughnut	3	2.9
-West Point type	2	1.9
-rock shelter	1	1
middens total	105	100
Stone Artefacts		
-isolated	53	
-scatter of 2 or more within		
20m	107	
artefact sites total	160	
Other		
-stone feature	9	
	TOTAL 274	

This breakdown shows many interesting features. The West Point and doughnut middens which are emphasised in the literature are a minor component of the archaeological record, at least in terms of frequency. Having said that, it must be stated that site 118 is bigger than all the other middens in my West Point sample added together. Out of a total of 105 middens in the area, only five had hut depressions and three of these had only a single depression. Similarly, rock shelter and cave sites on which the Tasmanian archaeological sequence has been established are extremely rare. The West Point area was deliberately chosen for its stable landscape and this is reflected in there being only two deflated middens, both of which occur on sand landforms. Small midden dumps are the most common type of midden (Plate 7.2). Records of isolated artefacts or scatters of worked stone outnumber middens, yet the single large midden at site 118 probably contained more artefacts than all the other sites combined.

Plate 7.2 Site 371 at Nettley Bay is typical of a number of very small middens which rest on the tops of rocky outcrops.



TWCAS
SITE 0371
FILM 11 / 64
1-1-81

-Stone features

A variety of stone features have been recorded in Tasmania including pits, cairns, birdnest shapes and linear depressions. They were formed by removal or piling up of boulders on the shingle banks. The boulders average about 12 cm in diameter. An isolated pit or cairn would be very difficult to identify, but they are usually found in clusters. Cane (1980) has discussed the nature, distribution and origin of stone features throughout Tasmania.

Nine areas of stone features on raised pebble ridges occur within the area. All are on unvegetated ridges between 4 and 7m above the high tide mark. They range from 20 to 60m distance from the shore and all have shell middens nearby. Ethnographic references to stone features are sparse and generally second hand.

At Cape des Tombeaus on Maria Island a number of cairns were reported by Murray and Vanderwal (pers.comm.). This cape was named by the Baudin expedition of 1802 from the discovery of several burial structures. Baudin provides an excellent description of the find but does not mention anything resembling a stone cairn. Roth cites a description by Peron of a tomb at Cape Maurouard, also on Maria Island. It consisted of a conical frame of saplings with bark covering. Inside were layers of circles of grass held down with sticks and rocks which rested on a small pit filled with burnt human bone. (Roth 1899:117-118). Roth also cites Jorgensen with a description of a small pyramid of flagstones which covered a grave (Roth 1899:118-119). Bonwick in a discussion of the religion of the Tasmanians states that 'circles have been recognised in the interior of Van Dieman's Land, piles of stone have been noticed, evidently of human design ...' (Bonwick 1870:192, cited in Jones 1965:78). Roth dismissed this statement claiming that no Aboriginal stone or other circles had been discovered (1899:57). During Robinson's Friendly Mission he noted passing 'a heap of large pebbles' (Plomley 1966:170), but he dismissed it as the work of children. These sound similar to the features described here, but it has been impossible to relocate the features that Robinson described. We do not know what role these stone features played in the lives of the Tasmanians.

-Quarries and pebble missiles

Although no quarries were recorded, there is ample evidence for the use of local stone for artefacts. Quartzite artefacts were commonly noted. The material is indistinguishable from outcrops of the local bedrock which rise up as monoliths and ridges across the landscape or erode into jagged saw-edged formations along the shore.

Throughout the heathland there are scattered water rolled quartzite pebbles, many of which show evidence of flaking.

These pebbles must have come from the beaches or from pebble ridges. The unflaked pebbles must have been transported from these sources to their final location. Use of pebbles as missiles is well documented, and this may account for their seemingly random distribution (Baudin 1974:320-321,346; Plomley 1966:37-39,58,220,310,373,531,557; Kelly 1920:163,167; Giblin 1929:38; Collins 1804; Lord 1928:135). Kelly describes the stones collected for missiles as 'about the size of hens' eggs' (1920:167). I suspect that a hen's egg in 1815 would have been about the size of a modern bantam egg, around 3 to 4cm long. This is consistent with the size of the pebbles scattered through the West Point heathland. This does not sound like a very heavy missile, but it is obviously effective enough for Kelly, who was on the receiving end of several volleys, to mention stones along with spears. Robinson describes the use of pebbles for killing game as large as swans, but they were also accurate enough for small waterfowl like teal or duck (Plomley 1966:310). Baudin, who was hit by 'a fairly large stone', received only a grazed hip (1974:321).

7.2.4 Shellfish

Ten types of shellfish were recorded in the sites, of which only about six can be regarded as important components of the shellfish diet. The tiny Hipponix conicus was common but is not regarded as significant as its habit of living attached to Notohaliotis ruber shells means it would be unintentionally transported on to sites. The relative percentage frequencies with which the common types of shellfish were observed in the middens at West Point were:-

	% of 105 middens with this species
<u>Subnivalia undulata</u>	100
<u>Notohaliotis ruber</u>	57
<u>Dicathais spp.</u>	43
<u>Austrocochlea spp.</u>	21
<u>Cellana solida</u>	21
<u>Brachidontes rostratus</u>	16
<u>Pleuroploca australasia</u>	7
<u>Patellanax peronii</u>	6
<u>Scutus antipodes</u>	2
<u>Cabestana spengleri</u>	1

In all middens at West Point, Subnivalia undulata was the most numerous species. The second most numerous species was usually Notohaliotis ruber followed by Dicathais spp. I would estimate that these three would account for about 95% of the meat provided by shellfish in the West Point area. In contrast, when Coleman worked on excavated samples from site 118, she described the small Austrocochlea as the most common species but calculated that the meat contribution ranking was Notohaliotis ruber, Subnivalia undulata and Austrocochlea spp. (Coleman 1966:37, 51). This is another example of excavation results emphasising smaller and less visible components than are recorded by surface observation (cf. Section 4.7.3).

The meat of a N. ruber weighs about 5 times that of a S. undulata (Coleman 1966:53-54). Even though S. undulata are consistently making a greater numerical contribution to the diet, N. ruber may actually be providing more meat. Added to this, S. undulata have robust spiral shells, while N. ruber have a more fragile thin bowl-shaped shell, so S. undulata shells are more likely to survive and be recognised than a N. ruber.

In all my West Point dating samples, S. undulata was the most numerous shell type. This means that it has maintained its dominant contribution to the formation of middens for over 3,000 years. In all but three of the middens, N. ruber was the next most numerous species. The exceptions were sites 123, 272 and 273, which had Dicathais spp. These three sites span a period from 1,100 BP to the present. These data support the hypothesis advanced by Coleman (1966) from analysis of site 118 that between 1800 and 1300 BP N. ruber shells were becoming smaller and less numerous as a result of exploitation stress. N. ruber shells were, however, regularly observed in middens dating right up to the contact period, so the species continued to play a regular role in the accumulation of middens.

7.2.5 Midden volume in relation to the distance to the nearest rock platform

A scattergram of midden volumes against distances to the nearest rock platform was prepared for 104 middens in the West Point area (Figure 7.1). Site 118 was excluded from the scattergram because its extremely large volume of in excess of 1,000 cu. m

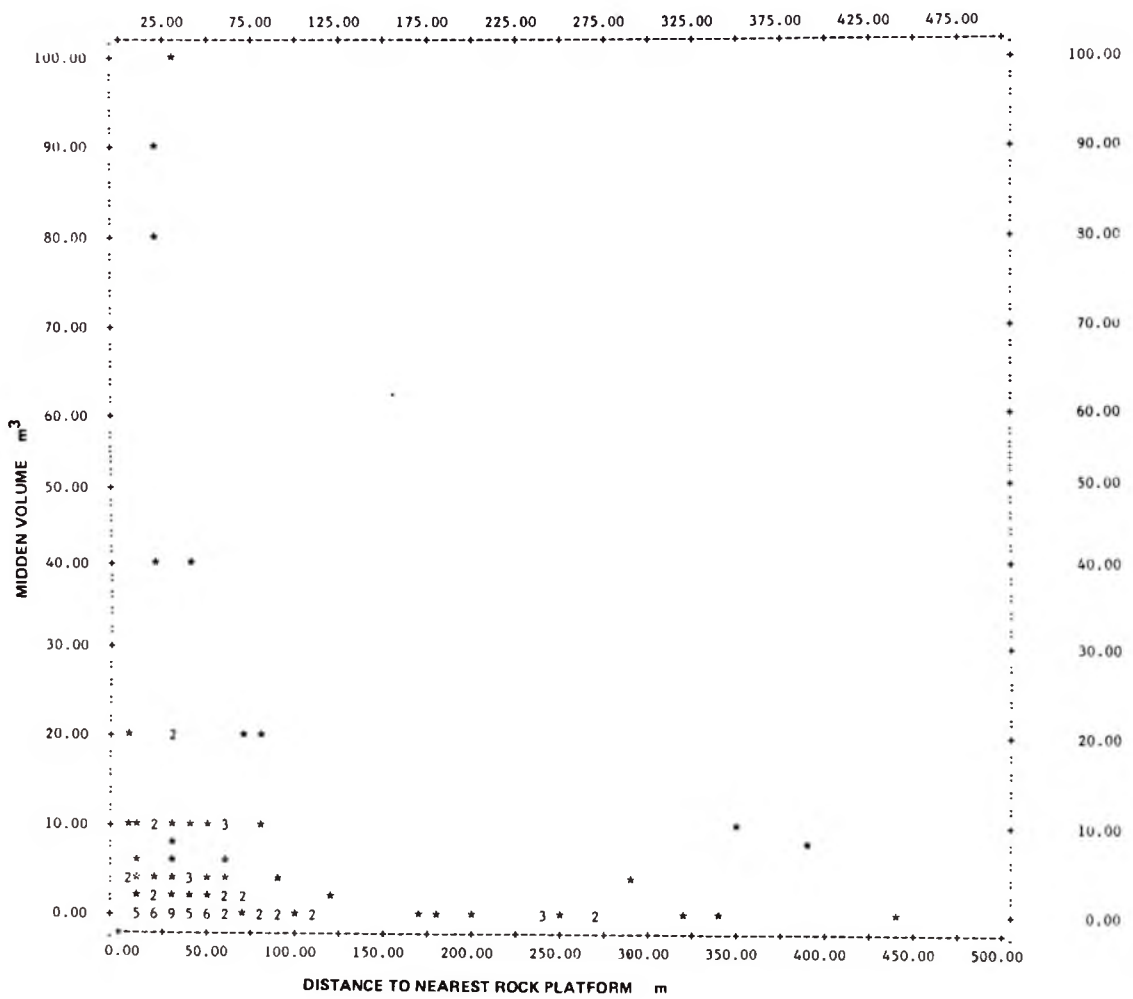


Figure 7.1 Scattergram of volume against distance to the nearest rock platform for middens in the West Point area sample (site 118 which has a volume of 1,500m was excluded).

caused scaling problems. The next largest site was only 100 cu. m. The plot shows that large middens lie close to rock platforms and that smaller middens were distributed from the coast to 440m inland. Sites larger than 20 cu. m are all within 90m of rock platforms, while those larger than 40 cu. m are within 50m. To some extent this scattergram hides the rapidity with which the volume of midden declines as one moves away from the rock platforms. To show this more clearly I have reanalysed the data to show the aggregate volume of middens against distance from the rock platforms (Figure 7.2). This histogram shows ^{that} a small volume of midden lay within 20m of the rocks. From 20 to 40m inland there was an immense volume and the amounts rapidly decline with further distance, such that the volumes beyond 100m from the rock platforms amount to only 1.2% of the total volume in the West Point area.

The position of site 118 in this distribution is interesting. This one site accounts for 59% of the total midden volume in the West Point area sample. It lies in the range of 20 and 40m from the nearest rock platforms, where the highest proportion of midden volume was recorded. It can be demonstrated, however, that even if site 118 is excluded, this range still has the greatest proportion of midden volume. The contribution of site 118 is shown in cross hatching in the histogram.

There is little comparative data available from other parts of Tasmania or Australia on the transport of shellfish. Because it is a truism that 'middens tend to be near shell sources', it appears that there are no accurate figures that have been published on this phenomenon in Australia. Qualitative statements and generalisations are available for some areas, but the data on which they are based are not presented.

At Discovery Bay in Western Victoria, midden deposits have been found as much as 2km inland, where they are often associated with freshwater lakes and swamps (Witter 1978:57). Godfrey (1980:25) later worked in the same area and concluded that 'it seems the Aborigines were not carrying shellfish much further inland from the coast than 1.75km, for all the sites recorded beyond this distance have no shells on them'. In a study near Gellibrand in Western Victoria all the middens except one were within a few hundred metres of the coast (Coutts et al., 1976:36). In all cases, however, non-midden sites consisting of stone artefacts are found further

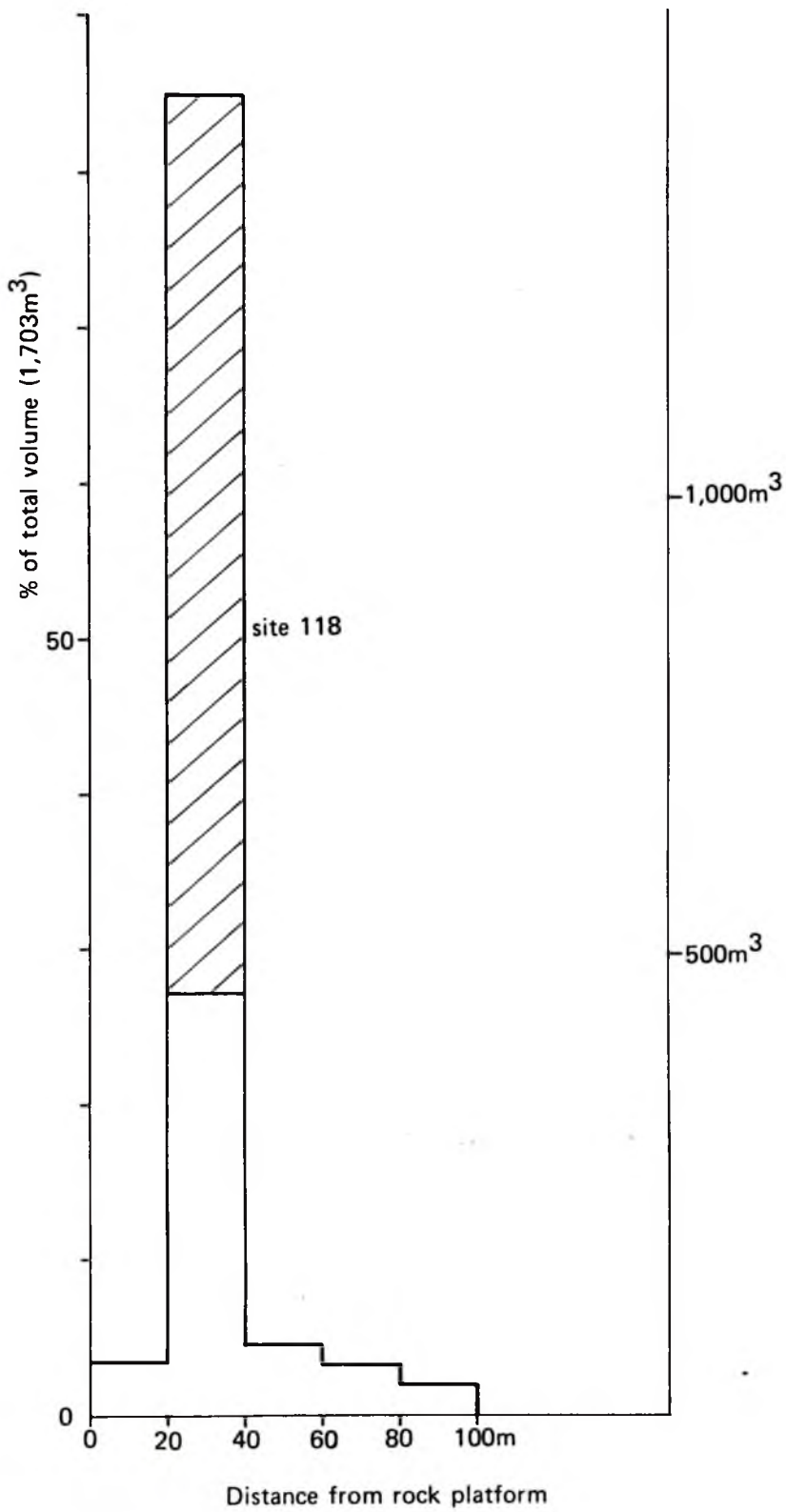


Figure 7.2 Graph of volume of midden against distance from rock platforms. (From 100m to 440m from the rock platforms contained only 1.8% of the total volume)

inland, obviously related to the exploitation of inland resources. From these data it can be seen that the Tasmanian pattern is more tightly clustered around the resource zone than occurs on the mainland.

One reason for this may have been a greater emphasis on coastal resources in general, which caused base camps to be placed nearer to the coast. A second reason could be that the Tasmanians had a greater degree of dependence on shellfish, with the same result that camps of all kinds were drawn nearer to the coast.

In section 5.2.10 it was shown that shellfish were carried for several kilometres along the coast. It is evident from the West Point distribution pattern that people did not transport shellfish inland for anything like the distances they moved them along the coast. Gunn (1846:334) is the earliest reference I have found which expressed the opinion that shellfish were never carried very far inland. There is an interesting implication in this for the "site catchment" approach to site analysis, which usually assumes a more or less circular foraging zone with some sort of working radius modified by the difficulty the terrain poses for walking (Vita-Finzi 1978:25-29). To start with, people foraging on a coast are in practice confined to a semicircular tract of land. Shellfish were apparently transported up to 3.5km along the coast but only about 500m inland. However, Figure 5.9 suggests that the effective distance for transport of shellfish along the coast is less than 3km. I took 2km as an arbitrary cut off point because about this distance the graph changes gradient to less than 45°. I then examined the relationship between the volume of midden in each of the west coast quadrats on a mixed coast type and the length of coast within 2km. Coast length within 2km of the centre of quadrats was measured on 1:100,000 maps with the Tektronics graphics tablet using the Mapare program. The results revealed no significant correlation between the length of coast within 2km and the total volume of midden in a quadrat. Suspecting that the catchment radius was too large, I tried the same approach with the length of coast within 100m of each quadrat boundary. The length of coast was measured from the quadrat maps using the same procedure as for the 1:100,000 maps. Once again, there is no significant correlation between the length of coast within 100m and the total volume of midden in a quadrat. Finally, the length of rock platform edge

within 500m was plotted against volume, but again the result showed no correlation. Therefore, for the west coast sample, there is no simple relationship between the length of coast available for foraging and the volume of midden on the adjacent land.

Modern holiday shacks at West Point show a similar distribution pattern to the shell middens. There are very few right on the shore. They tend to sit back a short distance from the water's edge and are usually on a rise where there is little or no shelter from the prevailing wind. They are commonly built on dunes and pebble banks. The main windows are always orientated to face out to sea. It is not really "ethno-archaeology" but there is something to be gained by examining the activities pursued by modern shack users who have chosen to mimic the prehistoric occupation pattern so closely. The resources which draw the shack users are abalone and rock lobster and to a lesser extent fish and wallaby. Much of the wallaby hunting and some of the net fishing is done in order to get bait for the lobster pots. With the depletion of abalone by indiscriminate collecting over the last 15 years (T. Nicholls pers. comm.), abalone have declined as an attraction although they are still present. Early commercial abalone diving operators talk of taking hundreds of kilograms of flesh each day when the wind was off-shore and there was no swell. Like the Aborigines, they were little troubled by the notion of a minimum size limit. Rock lobsters are still numerous enough for professional fishing boats to appear off West Point whenever the weather is suitable. Most of the shack users fish intensively for rock lobsters on an amateur basis.

The scenario at West Point has thus changed from a time when a hunting culture relied heavily on coastal resources to the present situation where the same resource area forms the basis for recreational hunting. Because they hunt the same coastal resources, the two groups have chosen to put their activity areas in the same types of places. Although behavioural analogies beyond this are inappropriate because of technological factors, it does illustrate a principle whereby exploitation of the same resources produces similar occupation patterns.

7.3 COMPARISON OF MIDDEN AND ARTEFACT SITES

7.3.1 Introduction

So far I have concentrated on describing the nature and distribution of midden sites. I now wish to examine other types of site such as artefact scatters, isolated artefacts, stone features and quarries in the West Point area. Their distribution and landscape associations will be compared with those of shell middens.

But how important are these artefact sites in the overall pattern of prehistoric use of the West Point area? Many of these sites consist of an isolated artefact and none contained more than 10 pieces. When they are compared to the estimated 30,000 artefacts from the excavation at site 118 (Jones 1966:6), they pale into numerical insignificance. Because they are impossible to date, I do not know if they date before, are contemporary with or after the formation of the large West Point type middens formed. Similarly, because the Tasmanian stone artefact assemblage is so amorphous, I have no idea with what activities these artefacts were associated. They could mark camps at which people did not exploit shellfish or brief stops during hunting excursions where a stone tool was used and discarded after sharpening a spear point or trimming a wooden shell fishing spatula.

7.3.2 Distance to fresh water

Midden and artefact sites ^{are} compared in the following way in their distance from drinkable water:-

Distance to drinkable water

	mean	median
	in metres	in metres
middens	142	126
artefact sites	99	93

Because of the skew in the distributions of the measurements for midden sites, both mean and median are listed. It is clear that middens tend to occur further away from water sources on average than do artefact sites.

7.3.3 Distance to rock platform

In contrast, the figures for the distance to the nearest rock platform show that middens are considerably closer than artefact sites:-

Distance to rock platforms

	mean	median
	in metres	in metres
middens	74	40
artefact sites	242	220

In this respect the difference is very marked, with middens showing greater proximity to the coast. Shellfish are heavy in relation to the amount of meat they contain, so processing or consumption of the catch near the sea requires less effort for transportation. Some middens were even formed on small off-shore islands where little firewood and no freshwater is available but which obviously had the advantage of being near the shellfish areas. The median distance for artefact sites is approximately half the width of the sample strip. This wide dispersal is also shown in the mean distance of 242m for them and the rather large standard deviation of 139m.

7.3.4 Height above sea level

An alternative perspective on these horizontal patterns is available if the elevation of sites above sea level is considered. For each site, the height above high water mark was estimated and recorded in the same logarithmic code used for spatial dimensions. Figure 7.3 shows the height distributions for the two types of sites. The West Point area sample slopes gently down to the coast in the west, with only minor expressions of local relief such as ridges, dunes or bare bedrock exposures. It is strikingly apparent that middens are closer to sea level than artefact sites.

7.3.5 Slope

The slope of the surface on which each site rested was measured with a clinometer. The relative frequency percentages for slope were as follows:-

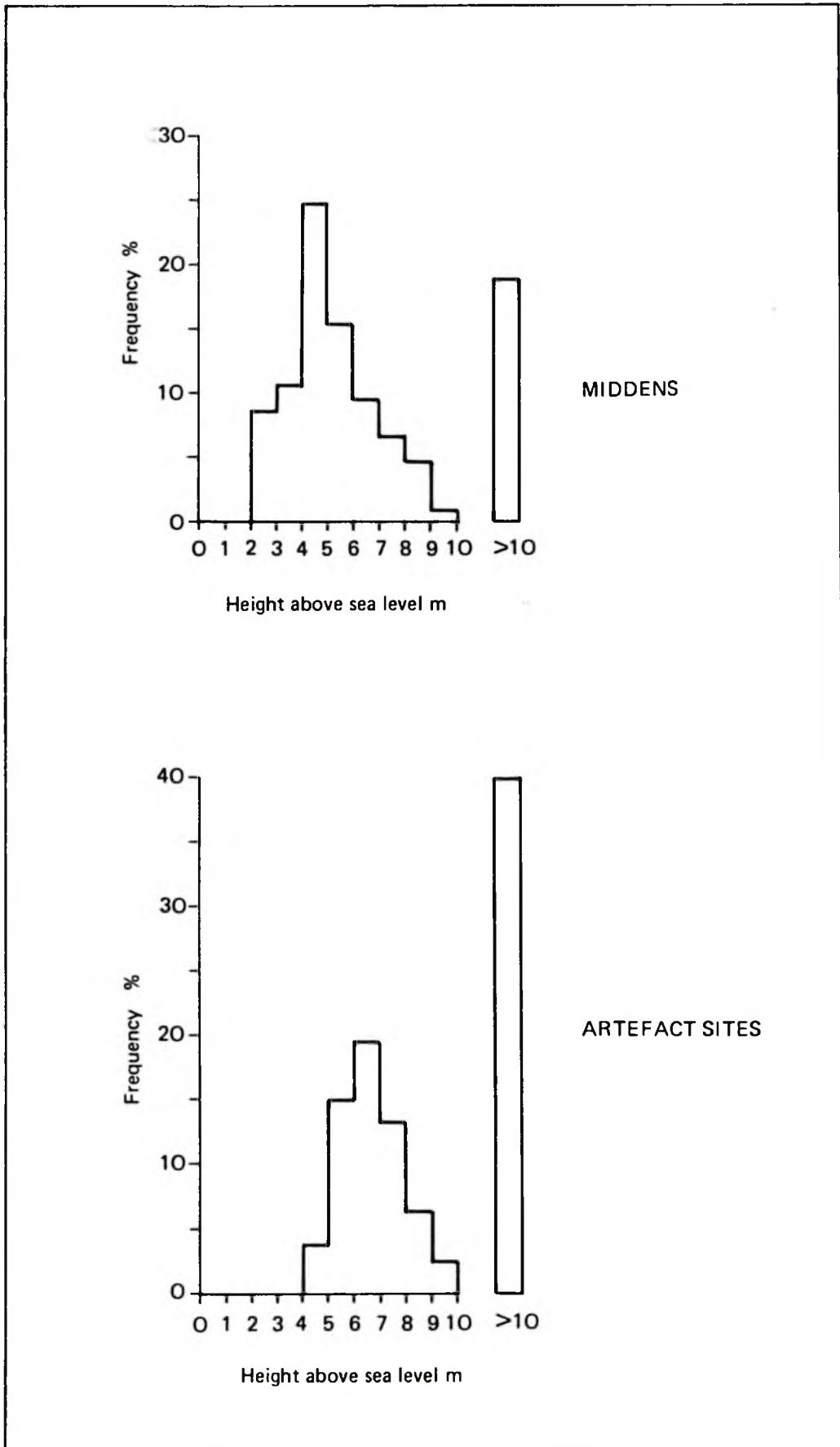


Figure 7.3 Height above sea level for middens and artefact sites in the West Point area sample.

	level	less than 9°	10 - 19°	greater than 19°
middens	81	10.5	5.8	1.9
artefact sites	70	19.2	8.8	2.6

A slightly higher proportion of middens occurs on level surfaces, but a higher proportion of artefact sites is in the less than 9° slope class, so approximately the same proportions of each site type were found on level to gently sloping surfaces.

7.3.6 Substrate

A comparison of substrates on which sites rested gave the following percentage frequencies:-

	bedrock	pebbles	sand
	%	%	%
middens	44	35	21
artefact sites	65	3.1	32

Strangely, middens are more common on pebble substrates, while artefact sites are more common on bedrock exposures or sand. The choice of substrate is affected by the type of landform which is chosen, so that the two variables are best discussed under landforms.

7.3.7 Landform

Approximately the same proportions of midden and artefact sites occur on cliff base, sandsheet and hill or ridge top landforms.

Middens are more common on pebble banks and dunes. However, this may simply reflect problems of ground surface visibility. For example, if an artefact was dropped on a pebble bank, it would probably fall into the crevices between the rocks and not be visible. Artefacts have been found in a stone cairn at Quiet Cove, Recherche Bay (Stockton and Rodgers 1980:10) and in association with stone features at West Point (Cane 1980:87 and pers. obs.). In contrast, if a midden formed on a pebble bank it would stand out as a grassy mound on the otherwise bare surface (see Plate 5.1). It is not surprising then that while 35% of the middens are on pebble banks, only 1.3% of artefact sites are found on them.

If artefacts were dropped on a sand dune, it could be predicted that they would be covered by additional sediment or by vegetation.

They would only be found if the dune was eroding or the vegetation had been disturbed. Artefact sites are proportionately more common on flat areas, on the sides or tops of outcrops of bedrock, on the edges of streams or swamps and on hill or ridge slopes.

Landform	midden frequency %	artefact site frequency %
Pebble bank	35	1.3
Cliff or rock outcrop base	1	1.9
Dune complex	7.8	-
Sandsheet	5.7	6
Flat	1	10
Bedrock outcrop, top or slopes	21	46
Stream or swamp bank	1	7.9
Hill or ridge slope	5.7	16
Hill or ridge top	21	20
Island	1.9	-

7.3.8 Shelter and view

Shelter from the normally gusty southwest wind might have been expected to be an important consideration when choosing a camp site at West Point. However, the samples show that most sites are exposed to wind from all directions. The proportion is approximately the same for midden and artefact sites (78% and 74% respectively). Only one midden and two artefact sites were protected from all directions. The directions of shelter for the remainder of each sample are shown in Figure 7.4. If a site is sheltered, it is most likely to be protected from the south. However, the proportions protected from the south are only 45% and 35% of the sheltered sites, so this bias in the pattern does not account for a very large part of the total samples.

As with shelter, only a small fraction of the sites face a definite direction - 28% of middens and 25% of artefact sites. Figure 7.5 shows the distributions of these fractions. For middens, the combined north and northwest-facing fraction of the sample accounts for 65%. For artefact sites this northerly aspect is not so pronounced and the overall pattern suggests more randomness.

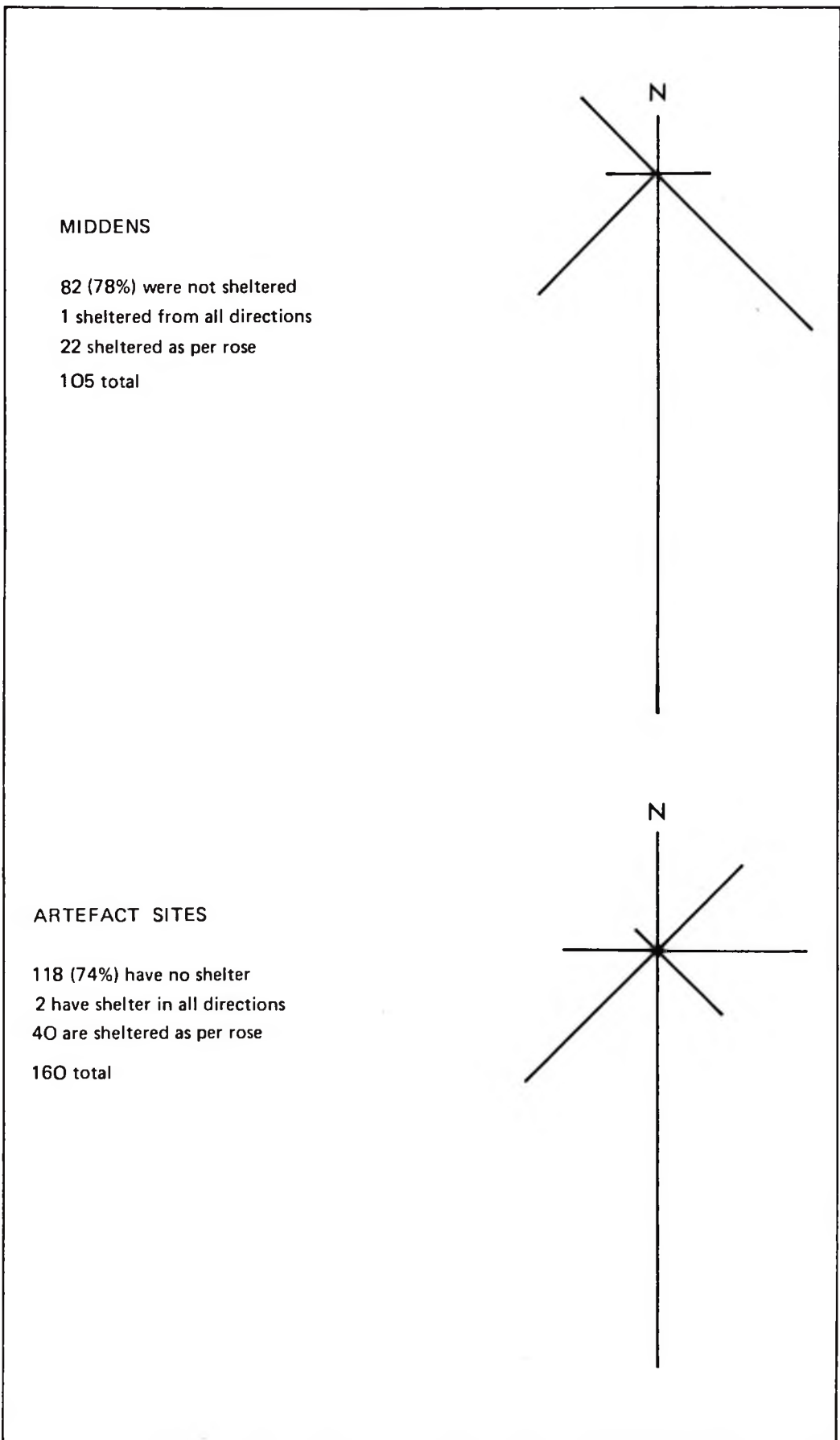


Figure 7.5 Shelter for middens and artefact sites in the West Point area sample.

7.3.9 Vegetation

Plants are a useful marker for the interaction of a wide range of variables such as soil type, pH, drainage, aspect and exposure to coastal wind and salt spray. The plant which covered the greatest portion of the surface of each site was recorded as the dominant vegetation type as an index of this synthesis of variables. The most common plants on midden sites were the herbs group (72%). Herbs were not identified to species for each site, but the most common are listed in Table 7.1. In contrast, herbs accounted for only 1.9% of the artefact sites. The problem of ground surface visibility discussed under the heading of Landform is relevant here. The most common record for them was for more than 50% of the surface to be bare of vegetation. Even so, there was a greater variety of plants on artefact sites.

The most common plant growing on artefact sites was Leptospermum scoparium (17%). It was never recorded growing on a midden. A wide variety of other species make up the remainder of the samples.

I have now completed a comparison of the landscape associations of stone artefact sites and shell middens at West Point. In some ways this may be a false division, because stone artefacts are found in middens. It is even possible that some stone artefact sites are simply the residue of durable artefacts left behind after the shell has disintegrated. If this were so, then the landscape associations of the two groups of sites should be similar. This is certainly not the case as there are marked differences on a range of variables but especially important are the differences in proximity to rock platforms and drinkable water. The difference in landscape associations argues for the two groups of sites having different functional relationships with the environment.

Species or group	% frequency	
	midden sites	artefact sites
<u>Acacia sophorae</u>	1.9	0.6
<u>Acacia verticillata</u>	-	0.6
<u>Atriplex cinerea</u>	2.9	-
<u>Banksia marginata</u>	-	3.8
<u>Calocephalus brownii</u>	1	-
<u>Casuarina monilifera</u>	-	1.3
<u>Disphyma australe</u>	1	-
<u>Eucalyptus nitida</u>	-	2.5
<u>Leptospermum glaucescens</u>	3.8	26
<u>Leptospermum laevigatum</u>	-	0.6
<u>Leptospermum scoparium</u>	-	17
<u>Leucopogon collinus</u>	-	1.3
<u>Leucopogon parviflorus</u>	4.8	0.6
<u>Melaleuca ericifolia</u>	-	0.6
<u>Melaleuca squarrosa</u>	-	1.9
<u>Pteridium esculentum</u>	4.8	0.6
<u>Pultenaea daphnoides</u>	-	12
Bare	4.8	29
Herbs	72	1.9
Tussock grass	2.9	-

Table 7.1 Percentage frequencies of vegetation type for midden and stone artefact sites

7.4 ANTIQUITY

7.4.1 The problem

One of the greatest problems confronting survey archaeology in Tasmania is the question of the age of sites. Without suitable artefacts to use as "marker fossils", archaeologists are forced to rely on radiocarbon dating (see Appendix 9). In surveys where ideally hundreds of sites would be dated, there are never going to be sufficient funds for more than a small fraction of this number. To obtain maximum benefit from the available quota of radiocarbon dates, most of my dating samples were drawn from the area which had been studied in greatest detail around West Point. Several C14 dates were already available for the West Point area. The West Point midden excavated by Jones (site 118)(1971:609) was divided into two distinct stratigraphic units. The base of the lower midden had a near basal date of $1,850 \pm 80$ (V-69) and a near top date of $1,890 \pm 100$ (V-68). Given the standard deviations, the inversion is not significant. The upper midden had a basal date of $1,760 \pm 120$ (V-67) and a date from 30cm below the surface of $1,330 \pm 80$ (V-66). Before presenting the dating evidence from other sites on the West coast and their significance to the prehistory of this part of the continent, it is pertinent to consider Jones' interpretation of the significance of the West Point midden chronology. Although the figures on which the conclusions are based have not been published, Jones has claimed that:-

Converting the number of bones and shells to the animals which they had originally represented and then calculating the food energy involved, shows that such a group (40 people) could have lived on this site for three or four months of every year for the 500 years that the site was occupied. We have then a picture of a semi-sedentary 'village', located next to the rich food resources, especially the presumed elephant seal colony. (1981:7/89)

An alternative way of calculating the length of time people could have lived on this midden is possible using data from Meehan's work in a very different region, the coast of Arnhem Land, and Coleman's analysis of samples from site 118. By combining their estimates it is possible to calculate that a band of between 30 and 40 would

generate 16 cu. m per year (see Section 8.3.3 for calculation details). From this we need to subtract an allowance for midden materials dumped at other locations such as dinnertime camps and processing sites. From observations in Arnhem Land, Jones estimates that 30% is dumped elsewhere in this manner, then the rate of accumulation of food rubbish by a band living at site 118 becomes 11.2 cu. m per year. Dividing 11.2 cu. m into the volume of site 118 gives a result of about 133 band-years. If we accept the uncertain premise of Jones' reasoning that people could have been living at site 118 for 3 or 4 months of each year, then the remains could account for occupation of that duration of each year for between 400 and 530 years. This supports Jones' estimates of the amount of energy which was available in the formation of the midden.

A near basal date of $2,600 \pm 120$ BP (GX0-420) was available for another large midden with hut depressions slightly to the south of the West Point lighthouse (Reber's site 9, my site 77)(Reber 1965:266).

My dating samples were chosen with several questions in mind. Firstly, were these enormous middens contemporaneous with the numerous small sites which have volumes ranging from almost nothing to around 10 or 20 cu. m? In a sense this was trying to place a number of middens into a chronological sequence in the same way an excavator might use stratigraphy or the correlation of artefact types. Secondly, many of the middens rest on raised pebble banks which so far have not been dated. A series of samples was obtained from sites on these because they would indicate a minimum age for the formation of these enigmatic features. Thirdly, although a near basal date was available from the large site 77, I wanted to know if the time of abandonment of this site was similar to that of site 118.

7.4.2 Results

The oldest date obtained from West Point in this study was $3,380 \pm 96$ for the base of site 86. This is a large linear midden with a depth of over 1m. The site lies along the ridge of a pebble bank which runs parallel to the shore at a height of 2-3m above the present high tide mark (see Plate 5.1). There is nothing at all distinctive about this site. The midden is composed of Subnina undulata, Notohaliotis ruber, Austrocochlea spp. , Brachidontes

rostratus, and Dicathais spp. It has a sand matrix and herbaceous cover on its surface. It is 20m from an extensively convoluted rock platform. In all respects, it is a typical West Point midden.

The near top date of 310 ± 78 BP is also significant. This is very recent and lies within the general cluster of recent dates for the area shown in Table 7.2 and Figure 7.6. Even though the site spans some 3,000 years, there was no discernible difference between the top and basal samples collected by auger in terms of the most common shellfish present and the nature of the dark sandy matrix. This is the largest age span of any of the sites I have dated around West Point.

Several of the sites have near basal ages of less than 500 years. These range in size from a tiny 0.01 cu. m midden to a sizeable 10 cu. m midden. It would be tempting to suggest either that they do not survive as long as large deep middens or that small sites are a more recent cultural pattern. Was there a period during which very large middens were formed, possibly around semi-sedentary villages, followed by a later period which was characterised by the formation of small scattered middens? Contradicting this hypothesis, two very small sites, numbers 273 and 122, which are 0.1 and 0.5 cu. m respectively, are over 1,000 years old. From my small sample, it could be argued that small volumes can survive for at least this time. These sites show that the potential survival time of small sites is somewhat less than 2,000 years.

While it is true that the oldest dates in Figure 7.6 are from the bases of large middens, the dates from the upper parts of the deposits of the large sites 86 and 77 are less than 1,000 years old, showing that these locations continued to be used at least occasionally into relatively recent times. No date for the very end of deposition is presently available for the largest midden, site 118. It is possible, however, that about 85% of the volume had accumulated by $1,330 \pm 80$ BP. This is the age of a sample from 25-30cm below the present surface (R. Jones pers. comm.). This leaves some 200 cu. m to accumulate after this date. The problem for this site is our lack of understanding of how it accumulated. If each successive occupation deposited an even mantle over the whole site, it would produce a series of layers. Dates from any depth could then be extrapolated to that depth across the site. If on the other hand, it accumulated as a series of small discrete mounds,

NETTLEY BAY AND WEST POINT SAMPLES

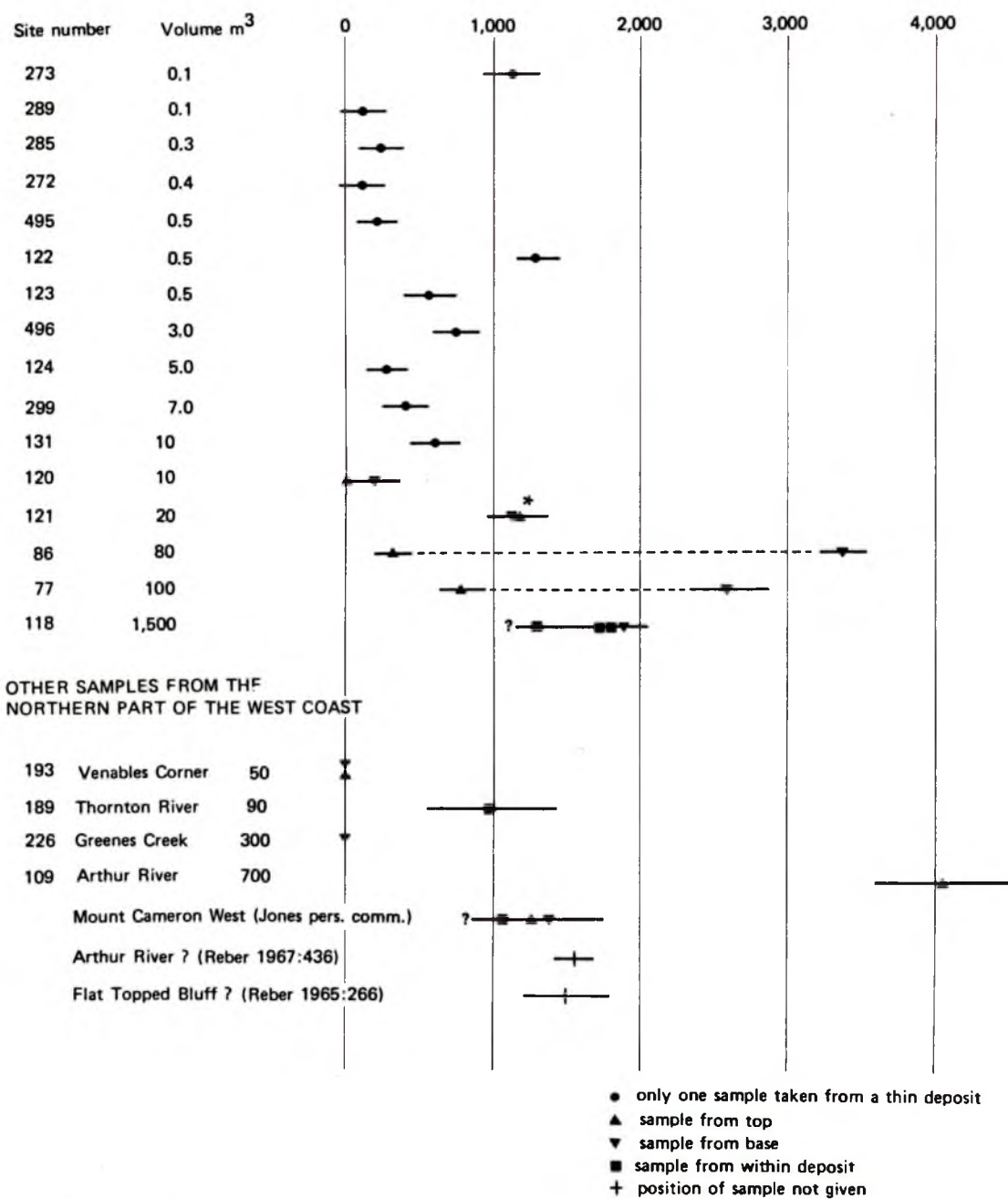


Figure 7.6 Comparison of volumes and C14 dates \pm two standard deviations for west coast middens

site number	locality	lab. number	age	corrected age for shell samples (-450±35)	comment
77	West Point	ANU-2889	1,220± 80	770± 87	top
"	"	CXO-420	2,600±120		base ¹
86	West Point	ANU-2890	760± 70	310± 78	top
"	"	ANU-2891	3,830± 90	3,380± 96	base
109	Arthur River	ANU-2493	4,050±240		
118	Nettley Bay	V- 66	1,330± 80		30cm down ²
"	"	V- 67	1,760±120		within deposit ²
"	"	V- 68	1,890±100		within deposit ²
"	"	V- 69	1,850± 80		base ²
"	"	I- 322	2,350±150		base ¹
120	Nettley Bay	ANU-2841	modern		top
"	"	ANU-2844	modern		base
121	Nettley Bay	ANU-2892	1,630±100	1,180±105	top
"	"	ANU-2893	1,580±100	1,130±105	base
122	Nettley Bay	ANU-2839	1,750± 80	1,300± 87	
123	Nettley Bay	ANU-2894	1,020± 90	570± 96	
124	Nettley Bay	ANU-2895	720± 80	270± 87	
131	Nettley Bay	ANU-2896	1,050± 90	600± 96	
189	Thornton River	ANU-2491	980±230		within deposit
193	Venables Corner	ANU-2490	modern		upper midden
"	"	ANU-2492	modern		lower midden
226	Greenes Point	ANU-2494	modern		base
272	West Point	ANU-2845	550± 80	100± 87	
273	West Point	ANU-2897	1,580±100	1,130±105	
285	Nettley Bay	ANU-2898	690± 80	240± 87	
289	Nettley Bay	ANU-2840	560± 80	110± 87	
299	West Point	ANU-2899	850± 80	400± 87	
495	Nettley Bay	ANU-2843	670± 80	220± 87	
496	Nettley Bay	ANU-2842	1,200± 90	750± 96	

1 Reber (1965:266)

2 Jones (1971:609) and pers. comm.

Table 7.2 Sites and C14 dates described in the text

then the dating becomes much more problematic. Then a dated sample cannot be confidently extrapolated to more than the particular lens of material from which it is taken. Examination of section photographs of Jones's excavation shows the latter pattern of numerous discrete mounds.

We are left with two possible interpretations. The first is that the site ceased to be used shortly after 1,300 and was effectively abandoned. The alternative is that some 15% or about 200 cu. m accumulated after this time, in a process of intermittent occupation which continued up to the ethnographic present.

With the results of the C14 dating, it is now possible to demonstrate convincingly that the larger middens do tend to have earlier basal dates but that they may have continued to be used into the more recent period when the smaller sites started to form.

I would now like to examine the antiquity of these sites in the broader context of the colonisation of the west coast. To do this I will draw on data from other middens on the west coast, with particular attention to sites which contain hut depressions and seal bones.

The Arthur River Bridge site (site 109) is a large midden along a foredune which is now almost totally deflated. The main shellfish species were Brachidontes rostratus, Subnivalia undulata and Dicathais spp.. Bones of land mammals and birds were found in the deflated material. The date was taken on a sample of charcoal from the lowest level of a residual 3 sq. m block of deposit, so dating the earliest surviving phase of midden accumulation. The date was 4,050 \pm 240 BP. This is the oldest date so far obtained for a midden on the west coast of Tasmania. At this antiquity, Jones' cultural sequence model for Tasmanian middens would include bone points and fish bones. The midden was re-examined after this date was communicated by the laboratory, but neither fish bones nor bone points were found. This may not be a problem, because although fish bones are common at Rocky Cape South Cave, they are rare in other sites such as Cave Bay Cave and Little Swanport which contain middens older than 3,500 BP.

Site 193 at Venables Corner on Sandy Cape is a residual block of midden surrounded by slumped and deflated deposit (Figure 7.7). It contained two lenses of midden separated by a layer of sand. Working from the surface downwards, there was 40cm of sterile grey

MATRIX AND CULTURAL COMPONENTS

Light brown sand with no evidence of soil profile development

Dark grey sand with shell midden

Light brown sand with no cultural material

Dark grey sand with shell midden

Medium brown sand with no cultural material

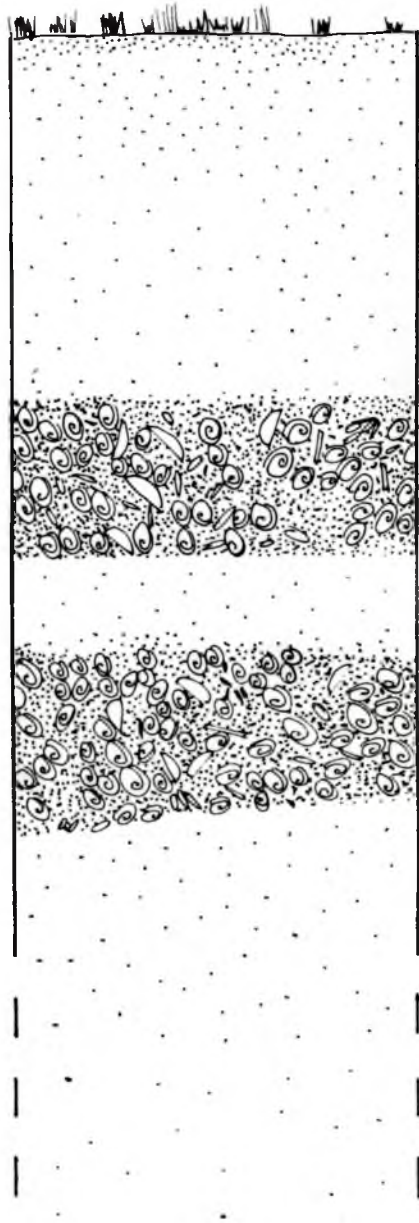


Figure 7.7 Section through the test excavation of site 193, Venables Corner, Sandy Cape.

sand lying over 25cm of midden. Under this was a 25cm thick layer with only scattered shells and then a 10cm layer of dense shell midden. Underlying this lower midden was sterile brown dune sand. The midden lenses were indistinguishable in their major components. The main shellfish species were Subnina undulata, Notohalotis ruber and Cellana solida, while bones of land and sea mammals and birds were found in the excavation. The sea mammals included both Arctocephalus sp. and Mirounga leonina. Dates of modern (i.e. less than 200 years) were obtained for charcoal samples from both of the midden lenses. This means that the intervening period over which 25cm of sand accumulated was 'instantaneous' in terms of C14 time and similarly that the 40cm of sand overlying the upper midden has occurred in 'modern' times.

The Greenes Point midden (site 226) was an extensive but shallow linear midden mantling the foredune system. The seaward edge of the dune is eroding, creating a vertical section in the midden along this slumping edge. The main shellfish species were Subnina undulata, Brachidontes rostratus and Notohalotis ruber. Land mammal bones were found in the exposed section. The charcoal dating sample was taken from the base of the midden exposed in this section. It gave an age of modern.

The Thornton River midden (site 189) is a 90 cu. m complex of linear midden composed of discrete mounds in various horizons, with a maximum total depth of more than 1m. It lies in the junction of the lagoon at the mouth of the Thornton River and a small creek which enters from the left side. The deposit overlies a small dune complex on the edge of the river, which has exposed a vertical section by eroding the dune out from under the midden. The most numerous shell species of the deposit were B. rostratus, S. undulata and N. ruber. There were bones of birds and land and sea mammals. The charcoal sample was taken from this section in association with seal bones collected for another project (Noller et al. in press). The sample came from about 50cm below the surface and gave an antiquity of 890 \pm 230 BP.

With all these widespread samples, it is now possible to offer several observations on the use of sand dunes by the Tasmanian Aborigines. The oldest date of around 4,000 years obtained for the northwest is from a midden on a sand dune, so dunes were used very early in the occupation of this coast. However, that site has been

almost totally destroyed as the dune has been deflated and rebuilt. Although I have argued that present erosion has been greatly accelerated since the European invasion, the process must have been operating before then for these aeolian dune landforms to have been formed in the first place. It seems probable that there have been some unstable dune areas at all times, with the destruction of any middens on their surfaces. Occupation of the west coast could have begun before the sea reached its present level, so the people would be moving inland with the retreating coastline. In that case, sites dating from this period around 6,000 to 8,000 BP should exist along the west coast, as they do in the north and southeast. Large numbers are not to be expected, because the mobilisation of dune sands has presumably destroyed or buried them.

Since so many middens and stone features occurred on the pebble bank landform, it became important to try to establish its maximum age. As the pebble formations were not directly datable, samples were taken from the bases of overlying middens at sites 86, 120, 121, 122, 123, 124, 495 and 496. Site 86, which has already been described, gave the oldest date of $3,380 \pm 96$ BP. The youngest date of 200 ± 96 came from the base of site 120. This is recent enough to be taken as contemporary with the arrival of the Europeans. The remaining dates in this sample are scattered through the range of 1,300 BP to several hundred years ago, showing that the use of pebble banks continued through this time span.

7.4.3 Hut depressions

I would now like to look at the antiquity of hut depressions, one of the distinctive elements of the archaeology of the west coast. The spatial distribution and contents of hut depressions was presented in Section 5.2.13. Six sites with hut depressions have been dated.

Sundown Point (487)	modern	(D. Ranson pers. comm.)
Nettley Bay (118)	less than $1,330 \pm 80$	(Jones 1971:609)
Nettley Bay (131)	600 ± 96	(this study)
Little Duck Bay	$1,000 \pm 60$	(Bowdler 1979:309)
West Point (77)	700 ± 87	(this study)
Mainwaring River	less than 740 ± 100	(Zakharov 1981:24)

The sample from site 118 was taken from 30cm below the surface and so must be interpreted as a maximum possible age for the top of the site. Similarly, the date reported for a site near the Mainwaring River appears to refer to the base rather than the top of the deposit, so it must be taken as a maximum possible age (Zakharov 1981:24). There is a definite cluster of ages between about 900 and 600 BP in this small sample. However, any suggestion that this period was the only time which witnessed sedentary villages or even just intensive hut building is challenged by two facts. Firstly, there is the modern date for site 487. Secondly, there are the numerous references to Aboriginal huts during the ethnographic present.

I would propose that this evidence can be interpreted to show that this pattern of behaviour of making huts, which then became the hut depressions of archaeology, was in existence around 1,000 BP and continued up to the 1830's. We still do not know when people first began making these types of huts but it would appear to be more than 1,000 years ago.

7.4.4 Seals

How long have seals formed part of the diet of the coastal people of Tasmania? I have plotted the C14 dates \pm two standard deviations for all the sites where seal remains occur throughout the deposit (Figure 7.8). The Rocky Cape sequence demonstrates some 8,000 years of continuous exploitation of seal. It also provides the earliest date so far obtained for seal remains at around 8,000BP. It was about this time that the rising post-glacial sea level reached the vicinity of the Cape and so shows that seals (and seal hunters) came with the encroaching sea. Jones (1978:32) noted that there was a steady diminution in the contribution of seal bones in terms of the total weight of bone from about 86% in the oldest layers to about 54% in the younger layers. However, he also presented minimum numbers estimates which showed the seals' numbers did not decrease, so the results are ambiguous. These minimum numbers estimates were based on mandibles, which may not necessarily be the most common element of the skeleton to become incorporated in the deposit. Jones believes that the gross weight proportions give a more accurate idea of what he believes to be the real trend of a decreasing use of seal (see also Jones 1971b:541). The next dated appearance of seal bone

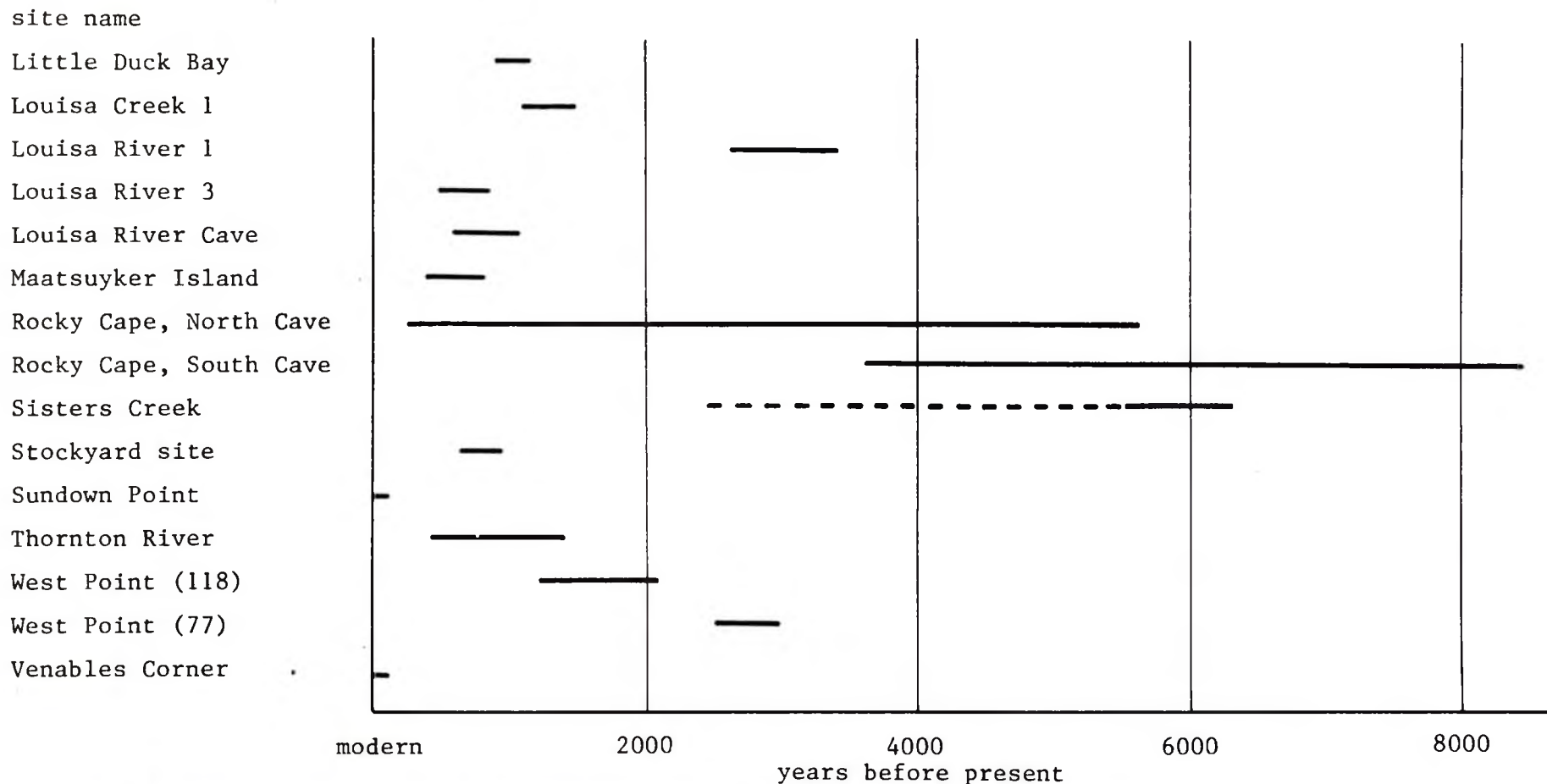


Figure 7.8 Dates of seal remains in Tasmanian archaeological sites. The dotted line for Sisters Creek is based on stratigraphic correlation with Rocky Cape.

is at Sisters Creek at around 6,000BP. No top date is available for the Sisters Creek site, but on stratigraphic correlation with Rocky Cape its upper layers (which do not contain fish bones) are taken to be less than 3,500 years old (R. Jones pers. comm.). The remaining dates show the occurrence of seal remains from around 3,000BP to the present for west and southwest sites. The figure shows a pattern of long-term exploitation of seals in coastal sites up to the contact period. It would appear therefore that seals were always present along the coast, although fluctuations in their numbers cannot be ruled out.

7.4.5 Stone artefacts

Stone artefacts were not found at many of the West Point sites which were dated, but the following observations are offered. Black chert was recorded in sites 122, 131 and 118. Because site 118 is so large and a near top date is not available, I would like to exclude it from this discussion as it may contain areas which do not date within the span of ages established by the C14 samples. The remaining sites dated to 1,300 and 600 BP. Spongolite was found in sites 77, 123, 131, 285 and 289. Because site 77 has such a long time span, I would like to exclude it from the group. For the remainder, the ages range from 600 BP to recent. Can these data be interpreted to show a change from black chert to spongolite around 600 BP? Data from elsewhere on the west coast contradict this proposition. Sites 226 at Greenes Creek and 193 at Venables Corner both contained spongolite and black chert and both had ages of modern. Data from sites 77 and 118 can also be interpreted as contradicting this hypothesis. This points to two factors which need to be highlighted. Firstly, for observation of trends in stone artefact materials or other small elements, it is desirable to look at several sites in a regional setting. Secondly, observations of the surface of sites, or of augered samples, are too limited because stone artefacts were not observed in many of the sites, even though they are almost certain to be present. To look at trends in small elements, it would be far better to excavate large but carefully dated samples from a number of sites within a region.

Jones' (1971b:260-290) analysis of excavated stone artefact materials at Rocky Cape showed that spongolite first appeared in his unit 2 and increased in popularity in unit 1 (Jones 1971b: Figure

25). The upper part of unit 1 was about 400 years old and unit 2, which lies below unit 1, had a basal date about 2,500 BP (Jones 1978:24). Therefore spongolite first appears at Rocky Cape some time after 2,500 BP and rapidly increases in importance.

At West Point Jones described a similar increase in the popularity of spongolite such that in the "upper midden" 95% of the artefacts were made from it (Jones 1966:6). This upper midden had a basal age of around 1,800 BP.

From an analysis of the stone tools of Rocky Cape Jones (1971b:290) developed an argument that in more recent times the stone technology became more refined with an increasing use of specialised, well-made tools. To make these tools, the Aborigines began to exploit better stone materials such as spongolite. Does the presence of spongolite as a raw material provide a chronological marker for the period after about 2,000 years ago? It may, but in terms of the time span with which this study is concerned such a marker is of limited use because almost all of the middens sites which have now been dated on the west coast were used after 2,000 BP and so can be expected to contain spongolite artefacts.

A number of general statements can now be made about the antiquity of occupation of the west coast. Although many sites are on relatively unstable sand dune landforms, they can survive for at least 4,000 years. The lack of older sites, however, cannot be entirely attributed to landform instability, as of the many middens dated in the relatively stable area around West Point, none proved to be more than 3,300 years old. Nor can the lack of early dates be blamed on the lack of rock shelter sites, because the open middens of the Derwent are mostly older than this age. The data pose several problems. Why is the first archaeologically visible evidence of occupation only about 4,000 years old? Why are there so few sites more than 2,000 years old and a substantial increase in the number of sites starting to be used after this time? These are questions which I will return to in Section 8.4.

7.5 REGIONAL DIFFERENCES IN STONE ARTEFACT MATERIALS

I have just outlined the problem of the chronological development of west coast exploitation. Another perspective is to look at the spatial limits of this economic system. To introduce this approach, it is necessary to look at some recent research. Jones (1966,1971b,1974) developed a regional view of the northwest economy spanning both the Bass Strait and western coasts. In particular he saw the significant increase in spongolite artefacts at Rocky Cape after 2,500 years BP as evidence of an expanding economic network as this material had to come from the west coast, some 80km away.

Using new data, Bowdler (1979) also saw the northwest as an integrated economic unit. The recolonisation of Hunter Island about 2,000 years ago was a manifestation of an intensifying economy in the northwest which began to make more use of resource areas which were difficult to get to. Similarly, in the southwest, Vanderwal (1978b) saw the use of offshore islands as part of a developing watercraft technology which gave access to previously unexploited areas of difficult terrain.

Following Jones' line of reasoning, I have looked at the distribution of certain stone artefact materials as part of the regional economic system of northwest Tasmania. In this way it is possible to define both an economic 'boundary' in which stone materials were transported, and examine the internal spatial patterning of these materials within it.

7.5.1 Method

My concern in this section is to identify sources of raw materials in the northwest corner of Tasmania and to map where these materials are found as artefacts in middens and artefact sites. Two forms of information are used, published records and my own observations. I have confined my investigations to this aspect of stone artefact analysis because previous research in Tasmania (Jones 1971) has shown it is not possible from the study of stone tools to define clear typological sequences or chronologies. In the 8,000 year sequence at Rocky Cape, Jones (1971:447; 1981a:7/86-87) concluded that there was a basic continuity of each of his implement types, with every type in the most recent assemblage also present in

the oldest one, though in somewhat differing proportions. Tasmania did not share in the Australian small tool phase. Stone technology is a poor reflection of the total culture (Peterson 1971:143), so the unchanging nature of Tasmanian stone tools does not mean that other aspects of the culture were conservative. Even if there is no major change through time, there may be changes from site to site which express differences in site function (Mottram 1979). This is a line of enquiry which could be informative, but the nature of my samples precluded its consideration here. My data are based on what can be observed on the surface of sites and on most sites only a handful of stone artefacts was observed. Not only are the numbers small, but the sample was not drawn in any systematic way which would make it possible to extrapolate from the analysis of the sample to the midden as a whole. For the same reasons, I have not tried to seek correlations between the type of raw material and the type and size of artefacts which were manufactured from it along the lines followed by Jones (1971b).

In sites along the coast I recorded five categories of stone which were used as raw material: spongolite, black chert, quartz, quartzite and miscellaneous. Information on the distribution of artefacts of these four classes was extracted from published sources which, together with my field observations was used to prepare distribution maps (Figures 7.9 to 7.11). As many sites have been described several times, the references cited on the distribution maps for the localities that were not personally observed are the earliest published descriptions of that rock type. I have not included Sutherland's references to artefacts from Strahan in Macquarie Harbour because he appears to use the names Strahan and Ocean Beach interchangeably (1972a:36).

As this section draws heavily on work by Sutherland (1972a), I would like to describe the nature of his data and study as a prelude to my own analysis. The flaked stone materials from over 160 sites held in museum collections were classified for rock type and the relative proportions of the different materials computed for each site. In addition, 180 known or presumed Aboriginal stone sources were listed. Sutherland's study indicated the use of a wide variety of materials, with some favoured types being carried overland up to 80km, and across water to the northwest islands.

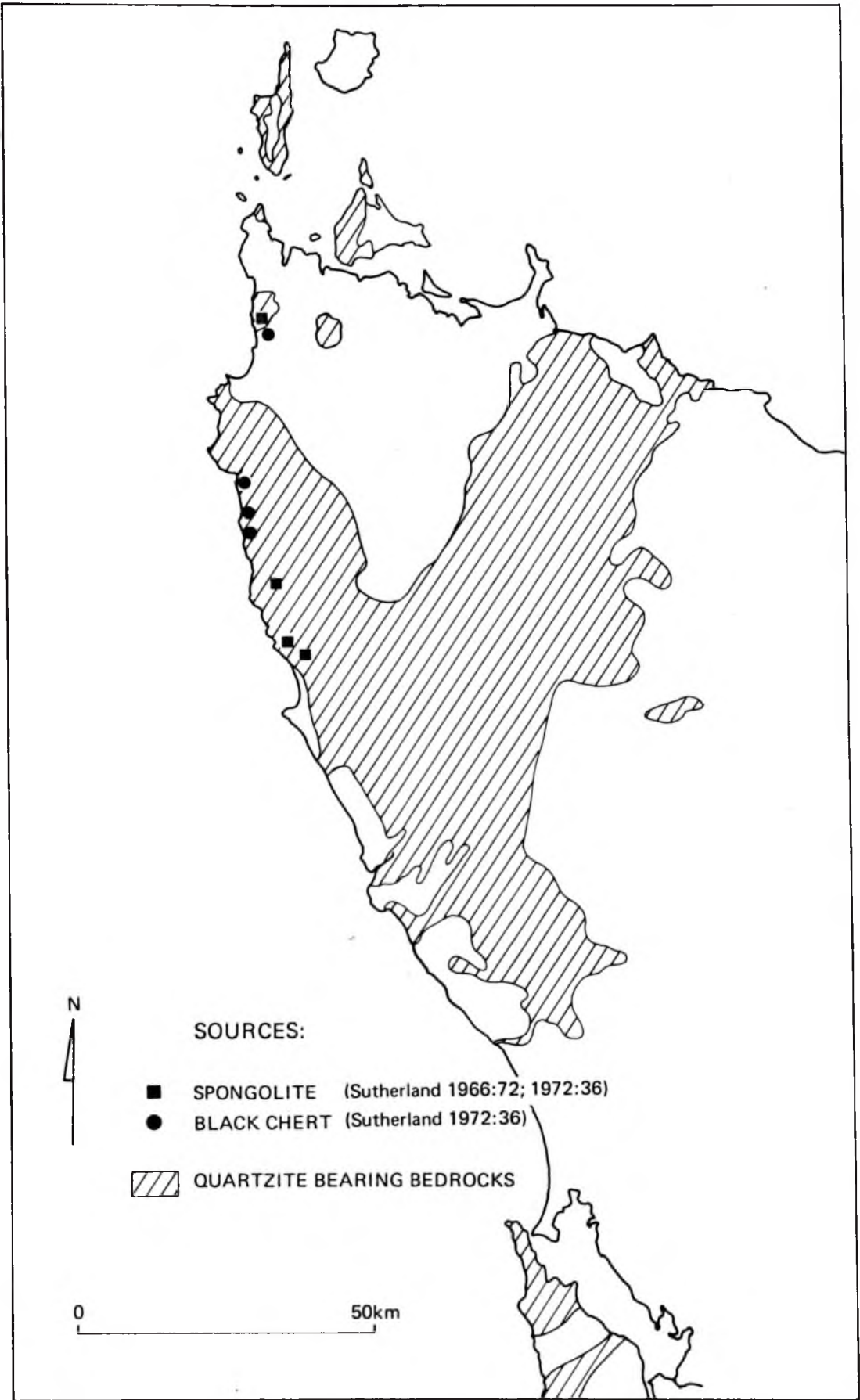


Figure 7.9 Sources of raw materials for stone artefacts

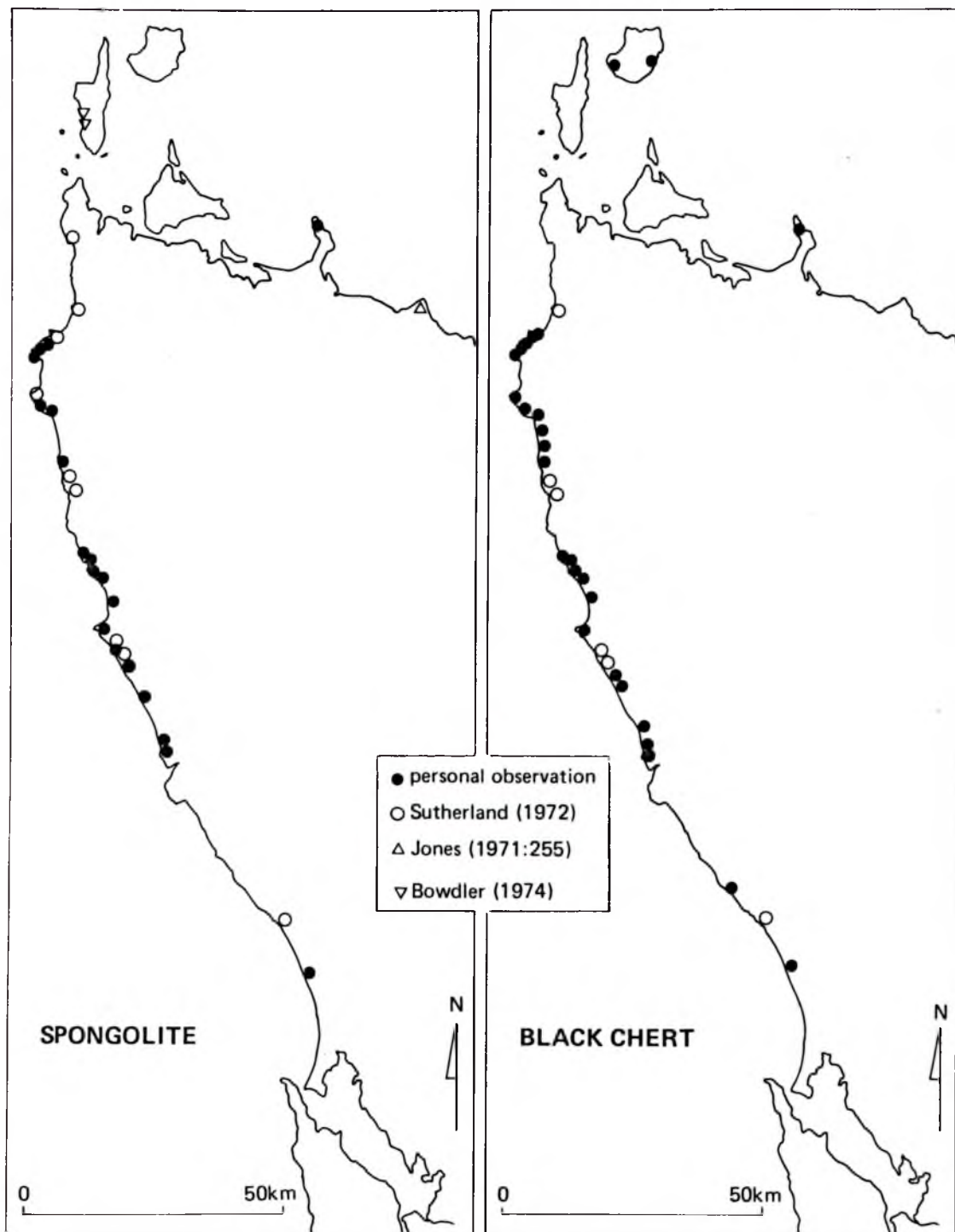


Figure 7.10 Distribution of spongolite and black chert artefacts

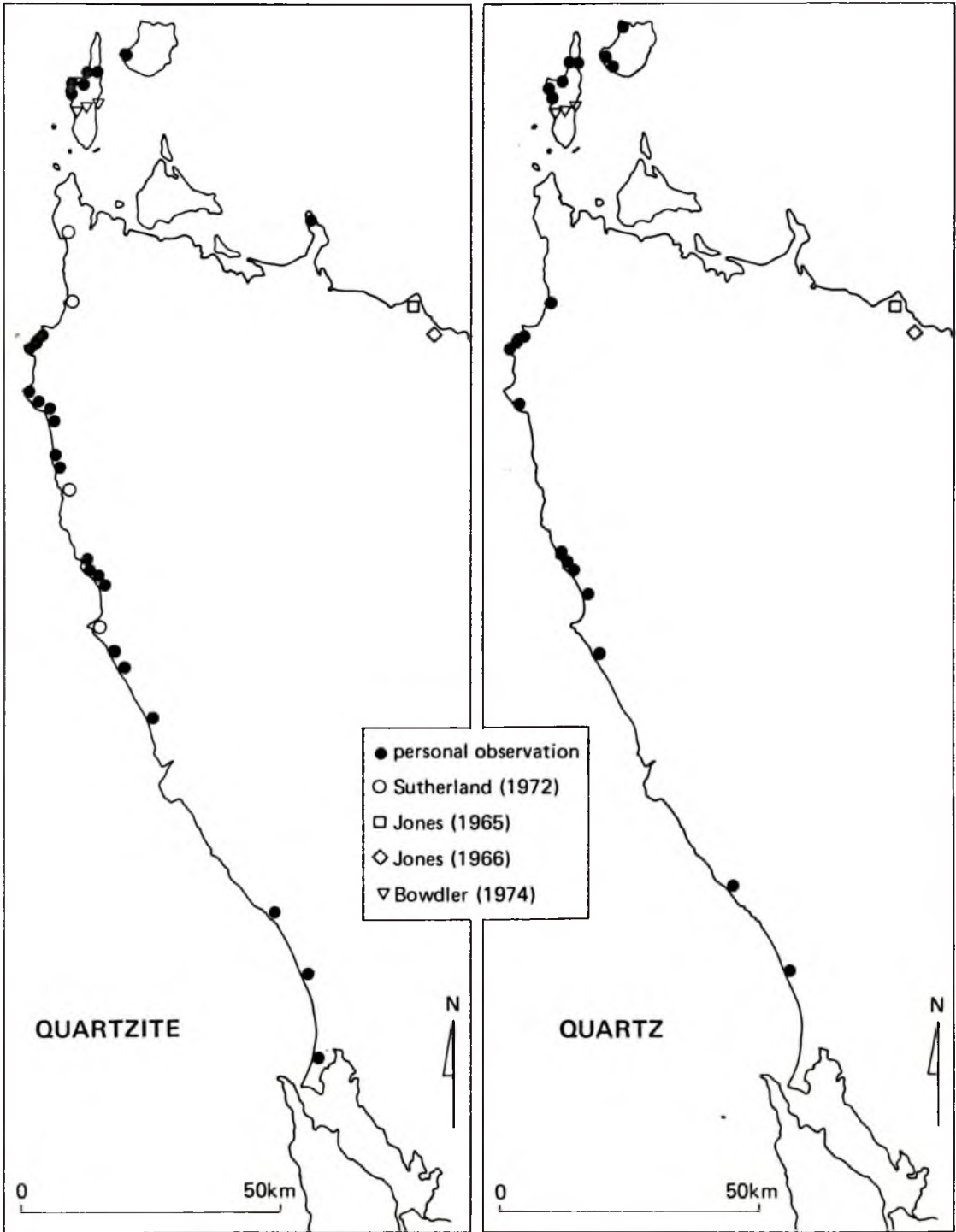


Figure 7.11 Distribution of quartzite and quartz artefacts

In some ways my conclusions duplicate Sutherland's but our approaches to the problem were very different. Sutherland worked from museum collections which had been accumulated under uncontrolled conditions. Provenance data were often vague as in the example cited above.

My own observations were systematically located by grid references to 1:100,000 maps, so providing a much greater degree of spatial control. Where Sutherland was concerned with the relative proportions of artefact material types, I was concerned with the actual distribution of each type, which can be seen as a function of a stone transport system. To gather accurate information on relative proportions would require extensive excavations at a number of carefully dated sites, which may well be the direction future research in Tasmania will take.

7.5.2 Rock types and sources

-Spongolite

Although several sources of spongolite have been described (see Figure 7.9), none has been documented as an Aboriginal quarry.

-Black chert

The black chert recognised in this study is the equivalent of Sutherland's 'impure chert suite' (1972a:9). A number of black chert sources have been described.

-Quartz

Quartz occurs ubiquitously as veins or as pebbles across most of the landscape of northwest Tasmania. However because of its erratic flaking qualities it is notoriously difficult in the field to recognise flaked material from such sources with confidence. Because of these problems, I have not attempted to map quartz sources.

-Quartzite

I suspect that the numerous quartzite outcrops and beaches with quartzite pebbles on the west coast were used wherever they occurred. As a result, all areas where suitable quartzite occurs as bedrock are shown in Figure 7.9.

-Miscellaneous

Other types of raw materials accounted for only 7.9% of the artefacts observed on the west coast, Hunter Island and Three Hummock Island. The miscellaneous category includes cherts other than black chert, indurated mudstones and silcretes.

7.5.3 Distribution of artefact materials

The study is divided into three areas for the purpose of this discussion: the northwest coast of mainland Tasmania, Hunter Island and Three Hummock Island.

-The northwest corner of Tasmania

My site data for the distribution of spongolite artefacts agree with the distribution described by Sutherland from museum collections (1972a:10) (Figure 7.10). Artefacts of this material are found along the north coast in small amounts but are a very conspicuous component of stone artefact records between Mount Cameron West and Sandy Cape. To the south, spongolite artefacts are still found at Trail Harbour and Ocean Beach, but they are not common this far from the reported quarry sites shown in Figure 7.10.

The distribution map for black chert artefacts is similar to that for spongolite (Figure 7.10). Black chert artefacts are occasionally found on the coast of Bass Strait, but their main concentration is from Mount Cameron West to slightly south of Sandy Cape. Occasionally black chert pieces have been transported as far as Ocean Beach.

Quartz artefacts are likely to be underrepresented in my records, because I only noted quartz artefacts if there was unquestionable evidence of flaking. According to the proportion diagrams presented by Sutherland, quartz is an insignificant component of west coast artefact collections (1972a:10), but the artefacts examined by Sutherland were all collected unsystematically by amateurs. There is, however, one large sample collected under controlled conditions from Jones' excavation at site 118 (West Point midden). In the top complex of about 1m depth of midden, 95% of the artefacts were spongolite (1966:6). This indicates that quartz was indeed an unimportant material at this site, possibly because a preferred material was available nearby.

Quartzite is so widely available on the northern and western coasts that the widespread distribution of quartzite artefacts is not surprising. Of the 20 quadrats on the mixed coast type between Suicide Bay and Ocean Beach, quartzite artefacts were observed in 19. It is on Hunter Island, however, that quartzite is the dominant raw material.

-Hunter Island

Sutherland stated that 95% of his collections from middens on the west coast of Hunter Island and a 'large stranded sea-cave on the east coast' (presumably Cave Bay Cave) were of quartzite derived from local Precambrian rocks (1972a:46). He also stated that waterworn surfaces on many of the artefacts indicated their origin as pebbles on the shore. Bowdler made a similar observation (1974:6). From Bowdler's published excavation results, it is evident that although exact numbers are not given, the majority of artefacts was of quartz or quartzite.

In my survey of six quadrats on Hunter Island a total of 33 sites was recorded containing stone artefacts. In 23 sites the most numerous stone material was quartzite. For 10 sites quartz was the most common. If all observations of stone material are counted, quartzite was observed in 26 sites and quartz in 20 sites. Neither black chert nor spongolite was found in my sample. For these materials to have reached Hunter Island would have required them to have been carried across the 4.6km wide passage between Woolnorth Point and the island.

-Three Hummock Island

Quartz artefacts were predominant on Three Hummock Island. In contrast to Hunter Island, which is formed of relatively unmetamorphosed sedimentary rocks, Three Hummock is granite except for a small area of basalt. No quartz or quartzite was noted in outcrops during my work on the island and the island's residents were not aware of any such outcrops (W. Alliston pers. comm.). All artefacts must therefore have either been transported to the island or derived from quartz beach pebbles. Only two artefacts of materials from the Tasmanian mainland were recorded, both of black chert, from Ranger Point and East Telegraph Bay.

Of the 14 sites recorded with artefacts, 12 contained only quartz. One site contained mostly quartz, along with a few pieces of quartzite and one piece of black chert. One site consisted of an isolated flake of black chert. These data show a knowledge of local material sources and a preference for the use of local material rather than transport of raw materials or completed artefacts across water.

This shows that the people making such crossings were prepared to carry at least a few stone tools as well as the necessary firestick. Although it may be possible to swim from island to island, it is not possible to carry a lighted firestick and a handful of stone artefacts in this way. Once on the islands, people were able to use stone materials which were available locally. So we see by the analysis of stone artefact materials that even though the islands were linked to the mainland economic system, the transport links were becoming tenuous by the time people reached Three Hummock Island. My systematic spatial data has supported the earlier models of an integrated economic system of the northwest which included use of the adjacent islands.

7.6 INLAND SITES

7.6.1 Introduction

My interest in inland sites developed slowly during this project. Very early in the project, when I was still unsure of how far inland middens would be found, I surveyed my first transect at Hill 49 by examining the eroded vehicle track for any sign of cultural material. There was no evidence of shell middens, but artefacts were found up to 1 km from the coast.

As a result I wanted to know if artefact sites could be found in an undisturbed situation and so examined a recently burnt area of heathland which I have called the Doctors Creek quadrat. Even though the surface of the ground was clearly visible, no artefacts were found, so I returned to selecting eroded areas for study.

The Balfour track which runs inland from the Sandy Cape track offered an ideal transect from 1.25 to 3.5 km inland. Once again artefacts were found on its eroded surface.

I was beginning to wonder how far inland such sites could

extend when I was invited to join Dr Keith Corbett and Dr Eric Colhoun to look at recently mapped artefact sites in the Queenstown area. The artefacts were of local rocks - quartz from adjacent outcrops, quartzite from nearby glacier deposits and a vitric tuff of local origin.

After the initial visit, two sample quadrats and one transect were surveyed near Queenstown in the foothills of the West Coast Range, 25km inland from the west coast (see Figure 7.12). The quadrats were 200 and 300m above sea level and the transect ranged from 400m to 1146m in altitude. As in all my inland sampling, I needed an area where ground surface visibility was good, even if disturbance was so severe that sites would no longer be in situ. I also hoped to collect data which would make it possible to compare the landform associations of inland sites with those of the coast.

The area is presently bare of soil and vegetation, with weathered bedrock forming the surface (see Plate 7.3). Artefacts have been left behind as a lag deposit when the soil eroded away after the vegetation was killed by sulphurous fumes from nearby smelters. The terrain is extremely rugged and is deeply dissected by gullies. Hill slopes are as steep as 30-40%.

7.6.2 Results

The first of these quadrats (East Queen River 1) was 200m above sea level, with a ground surface visibility of around 90%. That is, only about 10% of the surface was obscured by vegetation or leaf litter. Nine scatters of worked stone and one isolated find were located and recorded. The second quadrat (East Queen River 2) was higher, at about 300m above sea level, but was otherwise essentially the same as the first in its environmental character. In this quadrat there was more regeneration of scrub vegetation, so ground surface visibility was considerably less, at about 40%. Three scatters of worked stone and two isolated artefacts were found. Allowing for the lower ground surface visibility in this second quadrat, it is likely that the density of sites in the two quadrats is similar.

At the largest scatter (site 157), a surface collection was made to calculate the total number of artefacts on the site and to sample the types of artefact materials present (Figure 7.13). 1m x

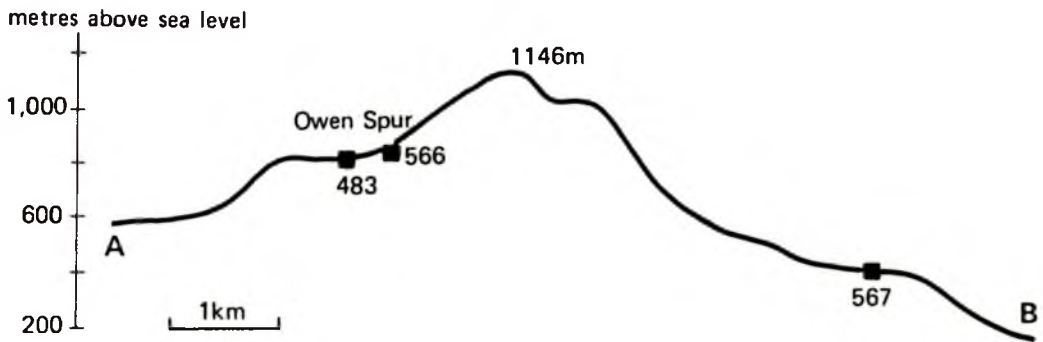
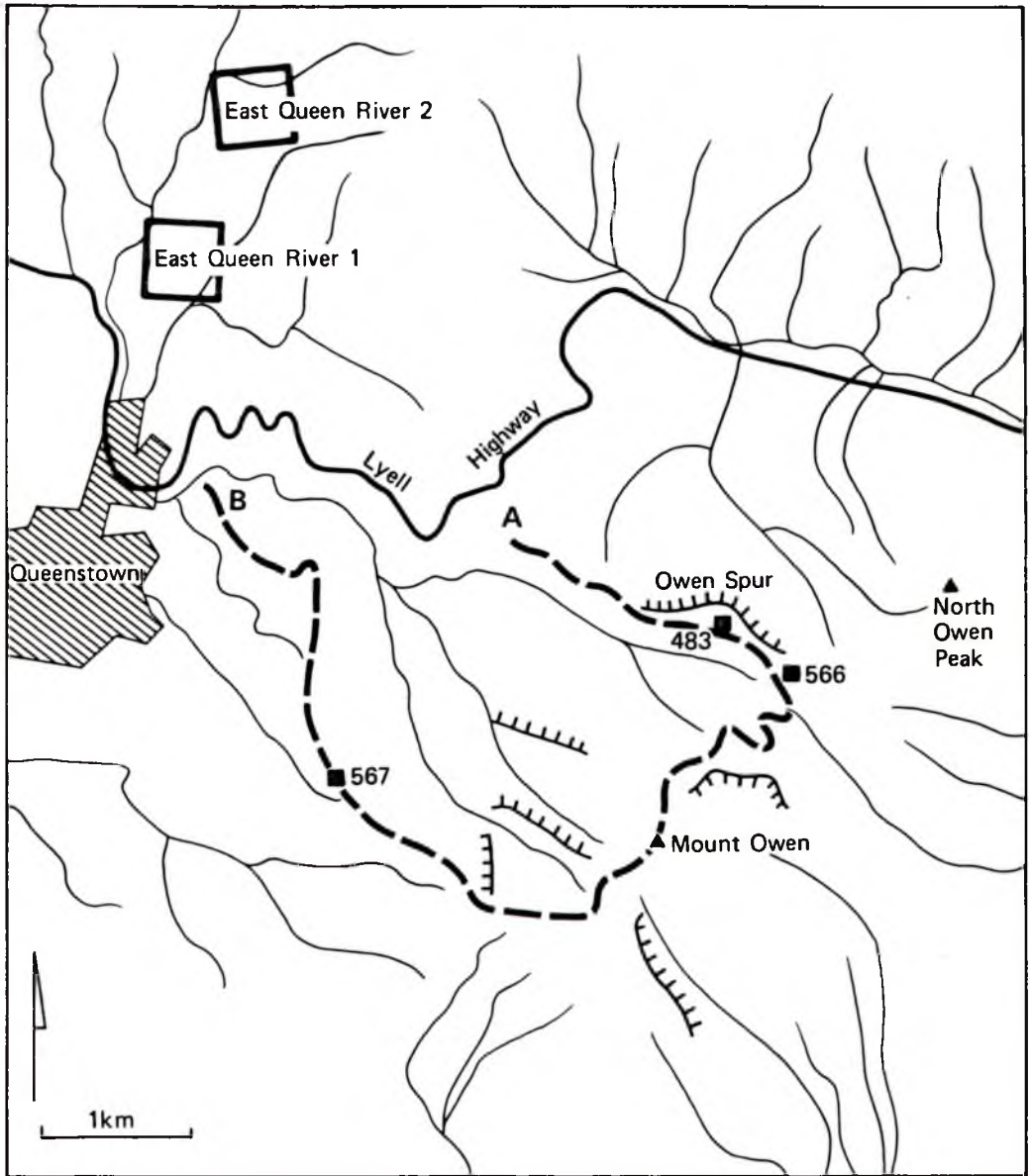


Figure 7.12 Plan and schematic profile of the Mount Owen transect.

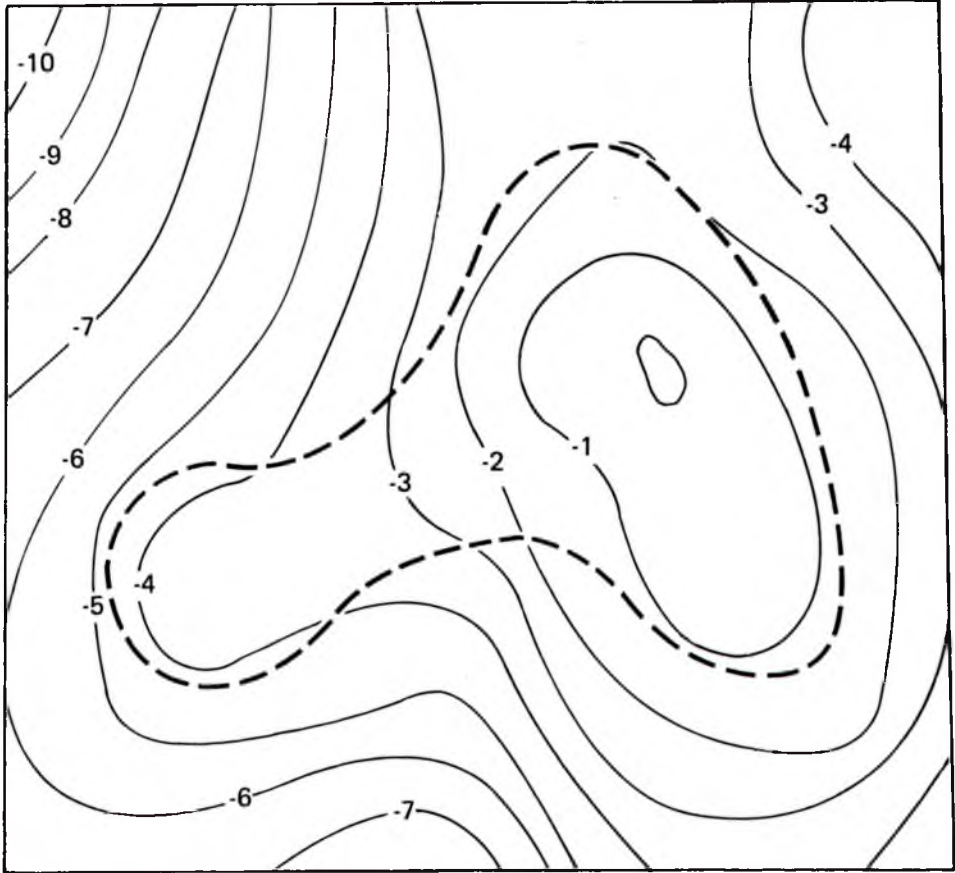


Figure 7.13

Site 157, a typical scatter of artefacts in the East Queen River quadrats.

Plate 7.3 The denuded hills around Queenstown were covered by mixed forests before the fumes from copper smelting killed the vegetation. The high rainfall of 3m per year removed the top soil.

Site 153 is typical of the scatters of artefacts which lie on the exposed bedrock of hilltops and ridge tops. The stumps are eucalypts, probably Eucalyptus nitida.



1m sampling quadrats were laid out randomly within the boundary of the scatter of artefacts and all pieces of worked stone were collected until the total number exceeded 100. As it took seven sampling quadrats to produce 102 pieces, the average per sq. m was 14. The estimated total area of the scatter was 792 sq. m, so the estimated total number of artefacts in the scatter was 11,088. The method of calculation was crude and my sample area was only 0.9% of the total site, but the result does give an indication of the large number of artefacts which occur in these sites.

Of the 102 pieces of worked stone, 94 are quartz. Quartz crops out a short distance away, but it would need to have been transported uphill to get on to the site. The quartz artefacts could not have got up to the site through natural geomorphological processes. The remaining eight pieces are flakes of quartzite. None shows retouch or use wear.

The sample of sites does not provide a good enough basis from which to generalise but several observations can be offered. As was found with coastal sites, most of these sites occur on the tops of landforms. In this area, this is not surprising as most of the terrain is steeply sloping and the tops of ridges and hills are the only level places. My impression is that the larger artefact scatters are on the ends of ridges, just above the point where they plunge into the steep sided river valleys. The rainfall is very high, in excess of 2,500mm, and the area is dissected by numerous creeks, so water was always available nearby. No black chert, spongolite or other alien rock was found. This use of local materials points to the people's knowing the area well enough to find them, and hints that they are not "in transit" from a coastal location. If these sites were used as transitory camps, they should not be so widely scattered and some artefacts of the materials which are common in coastal sites would be expected.

Shattered quartz of natural origin lies over much of the surface, so it would have been extremely difficult to spot isolated quartz artefacts. As a result they are probably under-recorded in my observations.

Lastly, I walked two of the ridges of Mt. Owen, which towers up to 1146m just south of Queenstown (Figure 7.12). There were several pieces of flaked quartzite (site 483) on a level section of Owen Spur near the Telecom towers at some 600m above sea level. Two

isolated artefacts were found on another ridge. These finds show that artefacts can be expected in this area up to at least 600m in altitude. All of the finds in the transects were on flatter parts of the major ridges.

7.7 CONCLUSIONS

The West Point area has been used to illustrate some aspects of the archaeology of the west coast which could be examined more effectively in one large area rather than in dispersed quadrats. Little historical information relating to the area was found, but a general description of the landscape at contact serves to show how the area has changed. It appears that the heathland looked much the same in prehistoric times as it does today, but that the restabilised marram grass dunes to the south of West Point were originally covered with native grasses. Out of a total of 105 middens in the area, only five had hut depressions and three of these had only a single depression. The literature on the archaeology of the west coast has emphasised hut depressions, which this analysis of the findings of a systematic survey has shown to be a numerically minor part of the overall site pattern. Similarly, rock shelters have claimed a large share of the attention, but in this sample only one very small shelter was found. Small midden dumps were the most common type of midden. This is a midden type which has not yet been excavated in northwest Tasmania.

Although ten shellfish types were recorded in the middens, only a few could be regarded as common or as making a regular contribution to the diet. The most frequently observed species were Subnivalia undulata, Notohaliotis ruber, Dicathais spp., Austrocochlea spp., and Cellana solida.

An examination of the volume of middens in relation to their distance from rock platforms showed a trend for large sites to be close to the platforms. Small sites were distributed from close to the rock platforms to 440m inland. Shellfish were not transported inland for anything like the distances they were taken along the coast as illustrated in Chapter 5. In combination, these data indicate a linear foraging zone for shellfish. Information on the volume of middens within a quadrat in relation to the length of platform within a certain radius was presented for the west coast.

This analysis showed that there was no simple relationship between the length of coast available for foraging and the volume of middens on the adjacent coast.

There is little difference in the placement of middens and non-midden sites in relation to slope, shelter and view. Differences were found in the choice of landform. Middens are considerably more common on pebble banks and dunes, while artefact sites are more likely on flat areas, on outcrops of bedrock, on the edges of swamps and streams and on hill or ridge slopes. There were marked differences in the vegetation patterns recorded on the two types of sites. Herbaceous vegetation was most common on middens, while more than half the artefact sites were on bare surfaces and most of the remainder had a cover of shrubs. Middens were distributed close to the coast but were often a considerable distance from drinkable water. In contrast, artefact sites were not limited to the coastal fringe but spread across the sampling area. They also tended to be closer to drinkable water than middens.

The most important conclusion from this exercise is the inescapable fact that evidence of prehistoric activity was found on every landform and in every vegetation type available in the sample area. The results of the transects at Hill 49 and Possum Creek show that artefact sites are to be found on the hills several kilometres from the coastal fringe; the two East Queen River quadrats continue this pattern into the foothills at the very base of the West Coast Range.

Despite all of the problems of dealing with artefact sites, this analysis has shown that they are an important part of the picture of the prehistoric use of northwest Tasmania. A preoccupation with middens would suggest people were sitting on the coast and looking out to sea watching the incoming swell, waiting for low tide to collect shellfish or for an exhausted seal to come ashore. Contrary to the picture presented by the literature, by sampling inland and recording non-midden sites a different and more subtle pattern emerges. There are artefacts scattered right across the landscape, but they are not clustered into the discrete 'sites' of the archaeologist's mind, so we have ignored them in the past. The apparent randomness of the distribution of these sites will cause problems not only in their description but in the interpretation of their settings and of the activities with which

they were associated. What is clear at this stage is that if all these "insignificant" events were summed together, they would rival the importance of the spectacular localised coastal middens.

Attempts to study inland stone artefact sites pose many problems. One approach used here was to examine the types of raw materials used in stone artefacts throughout the northwest.

Distinct regional patterns in the types of raw materials were found in the records of the survey and from published sources. On the northwest coast, black chert and spongolite were the most common, although quartz and quartzite were a regular but minor component. On Hunter Island, the locally available quartzite was the most common rock type, while on Three Hummock Island it was the quartz from the island's beaches which was most common. On both islands there were a few stone artefacts of materials which must have come from the Tasmanian mainland, demonstrating that the exploitation of the islands was probably part of a broader northwest economic system.

The only inland region to be surveyed in detail in this study was in the foothills of the West Coast Range in the vicinity of Queenstown. There are two problems posed by the sites found near Queenstown. Firstly, all sites so far located by Corbett and myself consist of scattered artefacts lying in unstratified surface lag deposits. No sites have been found with any potential for dating. The Aboriginal occupation could date from any time in the last 23,000 years, and during that time the area has seen conditions ranging from periglacial to temperate maritime. However, on the basis of what is now known of the climatic history and archaeology of the area (Goede and Murray 1977; Goede *et al.* 1978; Murray 1978; Murray *et al.* 1980; Colhoun 1978; Jones 1981b), it is likely that the people who left these artefacts were present during the last ice age. Between 10,000 and 20,000 years ago the climate was certainly colder than today, but the vegetation was more open and it was probably also drier (Colhoun 1978:1). Two limestone caves at Beginners Luck in the Florentine Valley and Fraser Cave in the Franklin Valley have been described with occupation materials dating to this period.

Secondly, but related to the first point, this evidence forces a re-evaluation of the distribution of Aboriginal sites. Jones' work on Tasmanian ethnography (1974) and my own early fieldwork had

argued that the Western Ranges had not been occupied during the ethnographic period (1980). This new evidence puts Aboriginal people in the foothills of those ranges, not just as casual visitors, but for either long periods or frequently enough to create large and numerous sites. The recent finds near the Gordon and Franklin Rivers continue this pattern into areas that are presently rainforest (Jones 1981b; Kiernan et al. in press). Further east towards the centre of the island, there are quarry sites above 1,200m on Mt Rufus where the western ranges meet the Central Plateau. If this transect is continued towards the east, the major features are the Plateau, the Midlands Valley, the eastern ranges and then the east coast. Sites occur in all of these landscapes. The small gap in this transect on the west coast ranges where sites have not been recorded will almost certainly be filled in by future workers. We are rapidly approaching a situation where a sites map for Tasmania will show sites over the entire surface of the island.

I would now like to return to the question of the cultural implications of stone artefact sites. Partly because of the scarcity of Pleistocene materials in Cave Bay Cave, Bowdler (1977; 1981b) proposed a model of the coastal colonisation of Australia which required its immigrants to spread around the coast and then up the major river and lake systems. Horton (1981:22) has already commented on the ambiguity of the Australian mainland data used to support this thesis. In the model, the paucity of archaeological material in Cave Bay Cave between 18,000 and 22,000 years BP was used to suggest that the site was 'a somewhat transient hunting camp, rather than a base camp occupied for long periods of time' (Bowdler 1981:12). The question which was never addressed is whether the cave was ever used as anything but a transient camp, even during the midden phases. This question has been studied at the archaeologically and environmentally similar caves of Rocky Cape. Meehan (1975:246) estimated on the basis of the amount of energy which was represented by the food remains in the North Cave that it could have been used by a group of 14 people for an average of 11 days per year for the 4,000 years which the occupation spanned. Even in these intensively occupied sites, the evidence suggests that they were probably no more than transient camps.

The other line of Bowdler's (1981b:12) argument is that there is a 'general dearth of Pleistocene occupation sites in Tasmania',

so people must have been living around the coast doing coastal things on sites now drowned under the sea. This latter idea was first proposed by Jones (1968:200). There are now four widely scattered locations with archaeological materials which are clearly of Pleistocene age. In the southeast there is Old Beach (Sigleo and Colhoun 1975) and in the southwest there is Beginners Luck (Goede et al. 1978) and Fraser Cave (Jones 1981b). In addition, there is some material from Palana on Flinders Island which is dated to around 10,000 years BP (Orchiston and Glennie 1978). In such a small area as Tasmania, this number of sites must be considered significant

I would like to speculate that the presence of stone artefact sites not associated with shell midden material could be interpreted as marking inland type activities of whatever age, or in the spirit of the parody jargon of Horton (1981:23) 'heath economy' or 'forest economy'. Since these artefact sites were found right up to the coastal fringe, it could be argued that here we have evidence of inland adaptation extending from the edge of the sea into the hinterland.

To continue with this line of speculation, if the artefact sites of the Queenstown area do pre-date the encroaching forest, and on the basis of our present archaeological and ethnographic models this is reasonable, then we have Pleistocene inland open sites scattered on almost every available flat area.

So much for a hypothesis, but how can it be tested? The problem with the inland open sites in the Queenstown area was that none occurred in dateable contexts. Although Corbett and I have looked for stratified sites in the denuded landscape in the vicinity of Queenstown, the geology is not suitable for the formation of shelters.

The sites to test the inland adaptation model proved to be in a limestone area which was still forested. Fraser Cave has now been firmly dated to between 19,000 and 15,000 BP (Jones 1981b and pers. comm.; Kiernan et al. in press). If it is as rich in archaeological materials as preliminary analysis suggests, with in the order of 80,000 flakes per cubic metre (1981b:55), then we now have an inland Pleistocene site of regular use and intense activity. A number of other sites has been found in the Gordon Limestone and it will be interesting to see if they overlap the Pleistocene activity of Fraser Cave. If they do, then we are faced with a glut of

Pleistocene sites to explain, rather than a paucity.

There is one more speculative line to which I would like to return: if the artefacts from the Pleistocene shelters of the Gordon Limestone can be correlated with the scattered artefacts of the Queenstown hills, then an additional aspect will be added to this prehistoric scenario, with not only a long duration but a wide dispersal of activities across the landscape.

Even without speculation, it has been clearly demonstrated that there are a number of Pleistocene sites in Tasmania. They were well inland from the sea at that period, and so the people who were there were practising an inland economy. If this is true, then why is my oldest date for occupation of the west coast only 4,000 BP? Is it because dense rainforest vegetation came close to the sea, squeezing out a people who did not know how to cope with rainforest? Can we really suppose that the Tasmanians did not burn these encroaching forests until 4,000 years ago? Did they lack watercraft with which to cross the major rivers which flowed to the west coast? This appears unlikely if they were able to exploit the Gordon and Franklin basins during late glacial times when these rivers would have been swollen by glacial melt waters. Is the problem an artefact of the limitations of the field data? It is worth noting that all my dates come from open middens, so perhaps it is time to look at shelter sites such as the huge cavern in Valley Bay near Cape Grim. In such shelter sites there is every likelihood that archaeological materials will be found dating from the time the sea reached its present level and perhaps much earlier. I have to leave these questions at this point, but my systematic regional survey has served to make the problem of the initial colonisation of the west coast more clear.

8.1 INTRODUCTION

Having presented the analysis of a mass of quantitative data, I would now like to turn to a qualitative model of a problem which has been crucial to mankind for most of its existence: where shall we camp? Following this I will look at a regional midden-location model, and then at various ways of estimating the prehistoric population of northwest Tasmania.

The formal analysis ends with this discussion on population but I would like to close the dissertation with a review of the advantages and liabilities of surface survey and the landscape approach to archaeology in Australia.

This project was carried out under near-ideal conditions, with plenty of time for design and analysis and excellent support facilities, but could it have been improved? Many projects of this nature are being carried out in Australia and elsewhere as part of cultural resource management operations, but they have often escaped a serious assessment of their effectiveness either in meeting their management goals or in their contribution to archaeology. What discussion there has been has generally adopted a partisan viewpoint and has often confused the objectives of cultural resource management operations with other styles of archaeological investigation.

8.2 A MODEL OF BASE CAMP LOCATION

8.2.1 Base camps

Can biophysical and ethnographic data from Tasmania be used to decide which sites were 'base camps' as opposed to 'dinnertime camps' or 'processing sites' (terminology after Meehan 1975)? This is a recurrent problem in archaeology, as it affects the ways in which archaeologists use archaeological data to describe prehistoric life styles (for example see MacNeish 1978). An alternative term for a base camp could be a 'preferred site', which is defined as occupied for a long period or repeatedly (Higgs and Jarman 1975:Glossary). This is counterpointed by the 'transit site' which is fleetingly occupied (Ibid). I prefer Meehan's threefold division, because it was developed to describe a shellfish-using culture and because it makes

an implicit statement that some shell middens are not overnight occupation sites but may be used for only a few hours during the day.

I have set out this problem as a decision-making game. Many of the variables cannot be quantified, but the most important needs can be classified as regular or daily needs, and foods. Foods may be either highly predictable, with the input gained for energy output being reliable, or a certain activity may be less likely to be successful. I will not be dealing with intermittent needs such as stone for artefacts, shells for necklaces or ochre for body decoration. Such items were obtained from special locations but are small in bulk and weight and not perishable and so may be transported or traded over considerable distances.

I have divided the foraging area of a west coast band into four zones: sublittoral-littoral, shore, land margin and hinterland. Sublittoral-littoral is taken as the area below extremes of high tide (Dakin 1976:48.) The maximum depth to which the Tasmanians could have dived would have been about 4m. This provides the lower boundary of the exploitation zone. The shore is the zone between the littoral and the start of terrestrial vegetation. The latter is typically a narrow strip of salt and wind tolerant plants. This narrow strip I have termed the land margin. Beyond this is the hinterland of terrestrial vegetation proper.

I have tabled the major needs of a west coast group by the variables of resource predictability and location (Table 8.1).

A discussion of these major needs follows, but first it is necessary to examine some of the theoretical requirements necessary for a model of base camp location.

Underlying assumptions are:

1. the prospective occupants have a total knowledge of the area and all its resources. They are intimately familiar with their environment and its ecology;
2. the pursuit of mobile resource (eg wallabies, seals) which are available in the neighbourhood can be given a probability of success. These operate as stochastic variables and can therefore be incorporated into the model with some sort of risk-to-return equation. Also, as a group will incorporate several options in its procurement strategies, the combined probability of success becomes more consistent. For example, some members of the group

FORAGING ZONE	DAILY NEEDS (and therefore close to camp)	HIGH PREDICTABILITY OF SUCCESS (near camp)	LOWER PREDICTABILITY OF SUCCESS (can be further away)
sublittoral and littoral		shellfish rock lobster kelp	
shore			seals sea birds
land margin		plant foods small animals	sea birds
hinterland (inc. swamps and creeks)	water firewood shelter materials	plant foods small animals	land mammals land birds aquatic birds

Table 8.1 Factors affecting the location of base camps on the west coast.

may hunt for shellfish while others hunt for wallabies (Meehan 1975);

3. the society operates to minimise the effort required to obtain critical resources. Therefore, people place their base camps near critical resources. This assumption rests on the premise that minimisation-maximisation (minimax) behaviour is characteristic of human populations (Southwest Anthropological Research Group 1974:111).

This is an example of the Principle of Least Effort: 'a person in solving his immediate problems will view these against his probable future problems, as estimated by himself...[and]...will strive to solve his problems in such a way as to minimise the total work he must expend in solving both his immediate and his probable future problems' (Zipf 1949:1). That is, people will attempt to get maximum return for minimum effort. Effort is required in this model to obtain foods, water and firewood. It is also possible to include 'information flow' from group to group as something requiring effort. For example, the interacting settlements of a culture will be placed so as to facilitate information flow between them. The SARG project included an hypothesis on information flow, but it is so difficult to account for in the prehistory of a hunting culture that I have not included it here.

It was shown in the analysis, however, that there was a very strong preference for camping on elevated locations with a view in all directions. It was suggested that one reason for this was that good soil drainage made for a more comfortable spot. There may also have been an information aspect in this choice of elevated locations. Of all the human senses, sight reaches furthest. By being elevated the Aborigines could continually scan their surroundings and use this information in the scheduling of their daily activities.

Tasmania was composed of distinct regional groups which were regularly warring with each other (for examples see Plomley 1966:181,219). Intergroup raids may find their modern analogy in football clashes. There is certainly an element of scheduling in some of the raids (Plomley 1966:618). By choosing elevated locations, the risk of being surprised was lessened i.e. a group was more likely to observe a potential raid and take evasive action or defensive preparation. Elevated locations also offered defensive advantages for

people who relied on hand-thrown stone missiles and spears. Although these factors cannot be discounted in the choice of a base camp location, they are difficult to integrate into a decision making model and will not be considered as 'essential' factors in the choice of a base camp location.

8.2.2 Reliable resources

Everyday needs include dead wood for fires and water for drinking, so we would expect to find these resources close to a base camp. Dead wood can be found throughout the west coast heathland but is particularly abundant if the heath has been burnt during the last few years. Water is also available along the coast, most commonly in swamps but also in streams and springs. During the winter rainy season surface water is abundant, but during summer only the largest swamps and streams contain drinkable water. Base camps can be expected to be near a source of drinkable water, and summer base camps to be adjacent to the most reliable water sources. Vegetation will be required for building shelters. The use of grass, leafy branches and strips of bark is described in ethnographic accounts. As forest trees with suitable bark do not generally grow near the west coast, heathy bushes or tussock grass will be exploited. These are available along the land margin and hinterland.

The availability of vegetable foods is generally predictable in terms of their location and season of availability, especially as the plants left behind in the ground may be collected at a later date. Because of this, it is likely that they will exert more attraction than their calorific contribution to the diet would suggest. In addition, if plant collecting is the job of the women, then it is likely that base camps will be placed near plant food as the women's foraging radius is generally smaller than that of men.

Very little is known about the vegetable foods of the Tasmanian diet (Cane et al. 1979). From an incomplete study by Mark Noble and the author, it would appear that the greatest diversity and quantity of plant foods occur along the land margin and the immediate hinterland. Preliminary observations suggest that plant foods are common and abundant along the length of the metamorphic rocks coast. There may be a lower volume of plant food available in granite and basalt areas, but this remains to be tested. Kelp was eaten by the Aborigines, and this is abundant along the coast. Another source of

plant food was the grass obtained from the gut contents of wallabies (Plomley 1966:168). The algae in the gut of shellfish was also eaten.

Small land and aquatic animals (crustaceans, reptiles, mammals) tend to be a reliable resource. Although they are small in body mass, they are more numerous than large bodied animals, so contact between predator and prey is more likely and their capture does not generally require elaborate technology or large energy output. However, small animals tend to be distributed evenly through their available habitat and so do not provide a focal point around which to place a base camp.

Shellfish are another very reliable resource and on the west coast they were collected by women. They would be more difficult to obtain during periods of high tide or storms, but these conditions can be easily observed and strategies altered accordingly. The gross meat to weight ratio of shellfish is very low so they will either be processed near the source and only the meat brought back to camp, or the base camp will be located adjacent to the shellfish beds. It has been shown that on the west coast the economically important shellfish are limited to the areas of rocky bottom. This contrasts to the southern Australian situation where Plebidonax deltoides occurs along sandy surf beaches, making it impossible to extrapolate midden distribution patterns from one side of Bass Strait to the other.

Rock lobsters were another meat source hunted by the women, but lobsters are a more difficult prey. With their quick movement, spiny carapace and ability to wedge in crevices, they would represent a less reliable resource than shellfish. Like shellfish, however, lobsters are found in areas of rocky coast.

It has been demonstrated previously (Section 5.1.3) that the presence of shellfish and rock lobster resources was not a sufficient condition for the development of shell middens. The resources also had to be accessible to the Aborigines. A mixed coast type with rocky and sandy stretches offered both the habitat for the resources and sufficient safety of access to make exploitation feasible.

I have now described the locations of the reliable resources, which collectively represent a scenario containing heathland with some dead wood and a reliable source of drinkable water. The adjacent shore will contain both rocky and sandy stretches. The predicted home base location can now be tested against the landscape associations of archaeological sites.

During this study I recorded twelve middens which contained hut depressions. Examining the landscape attributes of these middens, they conform to the scenario described for home base locations, i.e. all are on the mixed coast type and have firewood and drinking water nearby. This supports the hypothesis that middens with hut sites are home bases or base camps (see also J.F. Jones 1947; R. Jones 1966; Bowdler 1979 and Ranson 1978).

8.2.3 Risky resources

I would now like to consider the stochastic elements, for which there is a greater risk that a given amount of energy on the part of the hunter may not produce any reward. In general this applies to more mobile and larger food sources, such as land and sea mammals and avifauna. Do these have an influence on base camp location?

Land mammals such as Pademelons and Red-necked Wallabies are a less reliable food resource, although Robinson's journals record how rarely hunters returned empty handed. These animals are found throughout the heathlands of the west coast and so would be equally available from any location. Therefore they would not exert a localising effect on base camp location. Possums were an important inland food but are not common on the unforested coast.

Avifauna was highly prized by the Tasmanians but appears to have made a minor contribution to the west coast diet (Coleman 1966:Table 18). It is possible that mutton birds did play a seasonal role by attracting people to camp near their rookeries, but the definitive 'mutton bird kill site' is yet to be described (Gaughwin 1978:37). Penguins are also likely to have been minor but predictable contributors to the menu. They are seasonal in their abundance but do not localise themselves into large rookeries as do mutton birds.

Seals present a problem in this model for several reasons. Firstly, a number of species is involved, with differing biological and behavioural patterns. Secondly, although I have been able to reconstruct the distribution of breeding colonies at contact, it is impossible to reconstruct accurately the range and dispersal patterns of seals throughout the year. What we do know are two decisive facts. Firstly, numerous seal remains are found in middens all along the length of the northwest coast. Secondly, in the West Point midden (site 118) for which data are available, seals contributed about 50% of the meat in the diet (Coleman 1966:62). It would therefore appear

that seals were a major but unlocalised resource which could be acquired along the northwest coast.

Therefore, of this less reliable group of resources, land mammals, avifauna (except mutton birds) and seals were not localised resources. It appears as if they were available along the length of the coast. Mutton birds, on the other hand, are both localised in their nesting behaviour and seasonal in their presence and so could attract people to reside in the vicinity of their rookeries. At this stage, however, the results of excavations and surveys have failed to show muttonbirds as the major part of the diet at any site.

As a result, all of these seasonal or less reliable resources either do not seem to have been important in the diet or were generally available all along the coast. Therefore the critical variables in the decision as to where to place a base camp were the availability of the reliable resources: firewood, water, shellfish and plant foods.

From this a hypothesis can be constructed. Base camps will not occur in locations which do not have firewood or quantities of drinking water, e.g. Albatross Island. This does not prevent these areas from being used for foraging purposes. As a result of foraging activities we could expect 'dinnertime camps' and 'processing sites'. We are now in a position to test the implications of this second hypothesis; that base camps are different from foraging camps. By implication base camps would be expected to contain a wider range of dietary and artefactual remains. The study of landscape data derived from ethnographic records and surveys has led to the establishment of an hypothesis which lends itself to testing by excavation and the analysis of micro-components. This demonstrates the complementary nature of the various approaches used in archaeology and the fact that all approaches share the same focus - the study of people in prehistory.

8.2.4 Regional locational models

Locational models developed by human geographers have been based on agricultural and industrial societies (e.g. Haggett *et al.* 1977, Losch 1954), but some of the underlying principles are relevant to prehistoric problems, in particular, the Principle of Least Effort. From this principle, movement-minimisation models can be developed, for example the von Thünen concentric rings model.

In its simplest form this model assumes that the landscape is a flat homogeneous plain. Within this landscape there is a single economic centre (e.g. township) and the use of the surrounding landscape is based on the relative economic needs of the town. The items which cost the most to transport will be produced in the nearest ring and the least expensive in the furthest. In a coastal situation, the areas of economic activity become semicircles rather than circles (Rutherford et al. 1966:46). Other landscape attributes such as soil and water availability can rapidly disrupt the symmetry of this model, but they do not lessen its intrinsic value.

The 'site catchment' approach of Higgs and Jarman (1975) shares many of the underlying principles and assumptions of von Thünen's ring model, but site catchment looks at the equation in the reverse direction. It starts with a site, then draws perimeters around this point on an assumption that there is an effective maximum foraging radius. A site catchment approach then tries to assess what prehistoric resources were available within the perimeter of the foraging zone. Finally, the resources may be compared with the materials which were found in the site. In the first attempts to define such areas the emphasis was placed on distance, but the criterion of time was substituted once it became obvious that broken country would produce boundaries departing markedly from the ideal circular shape (Vita-Finzi 1978:26). Here again we find the Principle of Least Effort in the underlying assumption that to forage further afield is too costly in terms of time and effort. There are no generally accepted formulae for this foraging radius as conditions will vary with the nature of the culture and environment. A few examples from the literature will serve to show that there is a surprising degree of consistency in the size of the foraging zone of hunting cultures. The original proposition for hunters and gatherers was a 10 km radius, but this was later changed to a 2 hour walking distance (Vita-Finzi 1978:24-28). This was proposed by the Cambridge school as a working 'rule of thumb' for the collection of food resources. Lee's (1968:31) study of an African desert culture suggested a foraging zone of 10 km. Gould (1969:12) estimated an 8-10 km radius for a group of Australian desert Aborigines. On the coast of Arnhem Land Meehan (1975:71) recorded that people often travelled 20 km or more in a day's foraging, giving a radius of about 10 km. Nearer to Tasmania, Gaughwin (pers. comm.) has found that

ethnographic accounts of the people of Mornington Peninsula in Victoria suggest a foraging radius of 8-10 km. There is a surprising agreement in all these examples for a foraging range of about 10 km.

In a site catchment approach the location of the site is taken as given, and the formula is used to describe the resource zones which surround it. What we need for the west coast is a slight recasting of the problem: the landscape and its resources are given, but where were sites placed in relation to these?

Jochim (1976) has attempted to construct a general model of the economic behaviour of hunters and gatherers by codifying observed cross-cultural regularities in economic goals and behaviour. Although there is a definite need for generalised models such as this to help explain general patterns, they are intrinsically limited by their generality.

By combining the patterns of midden distribution which I have described for the west coast and West Point, I have produced a synthetic model of midden distribution in relation to key attributes of the coast. This is illustrated in Figure 8.1. The vertical axis corresponds to the trend in the volume estimates recorded as one moves inland away from the mixed coast. The horizontal axis shows the volume recorded as one moves parallel to the shore along a sandy beach away from the mixed coast.

The axes are scaled in different units in order to clarify this very narrow linear pattern by spreading it out. The 'contour lines' represent the volume of midden found in each situation.

The locational model shows that at the mixed coast the volume of midden rises quickly to a peak as one moves away from the shore and then declines steadily. The highest volume of midden is found between 20 and 40m from the shore. This is also the location of site 118 (West Point), which increases the local concentration to in excess of 1,000 cu. m and is shown as the small circle in the figure. Such a location can be considered a base camp or a preferred site.

There is a steady decrease in volume of midden as one moves away from the rock platforms along a sandy beach. This decline continues for several kilometers, whereas the inland decline near rock platforms takes only about 110 m. Thus on the two axes we have a differential decline in the use of the same resources with an inland to along-beach ratio in the order of 1:30.

By an inversion of the von Thünen model of circular rings discussed earlier it could have been predicted that the ratio would have been similar and the contour lines more circular. The von Thünen model discusses land use around a town. Here I am trying to look at site placement in relation to a given land use i.e. shellfish gathering.

Site catchment analysis implies that a resource may be used if it is within a certain radius of effort e.g. a distance or a walking time from the site. Is the ratio of effort in transporting shellfish along the beach versus inland different by a ratio of 30:1? Moving along a beach is certainly easier than moving through dense heathland, but the Aborigines had well developed systems of paths and tracks (for examples see Plomley 1966:160,166,186,192,205) which could have made inland transport require little more effort than was required for walking along the beach.

The explanation of this pattern is to be found in cultural and ecological reasons rather than theoretical considerations. At least part of the Tasmanian economy was focussed on the narrow coastal strip. The synthetic coastal model has emphasised the role of shellfish as it is based on midden volumes, but other variables which are important for camp location have been outlined in the preceding section. These include the availability of firewood, drinking water, vegetable food, sea and land mammals and avifauna. Of these, seals were especially important, and it has been shown that they were available all along the west coast. A preference for foraging along the coastline which includes sandy beaches may well demonstrate a preference for foraging where seals will be found. Shellfish then become a secondary resource, used as a less desirable option if seals are not found. In such a scheme, seals are a high-return-for-low-effort resource which has a low probability of success. This is particularly true if the Aborigines were dependent on sick, tired or dead seals washed up on the beach. If seals were not found while the Aborigines were beachcombing, an alternative or backup strategy could come into operation with effort put into collecting other coastal resources such as shellfish and coastal food plants. These are low yield resources, but the return for a given effort is predictable.

In this way the locational pattern of middens shown in Figure 8.1 can be explained using a combination of biophysical information

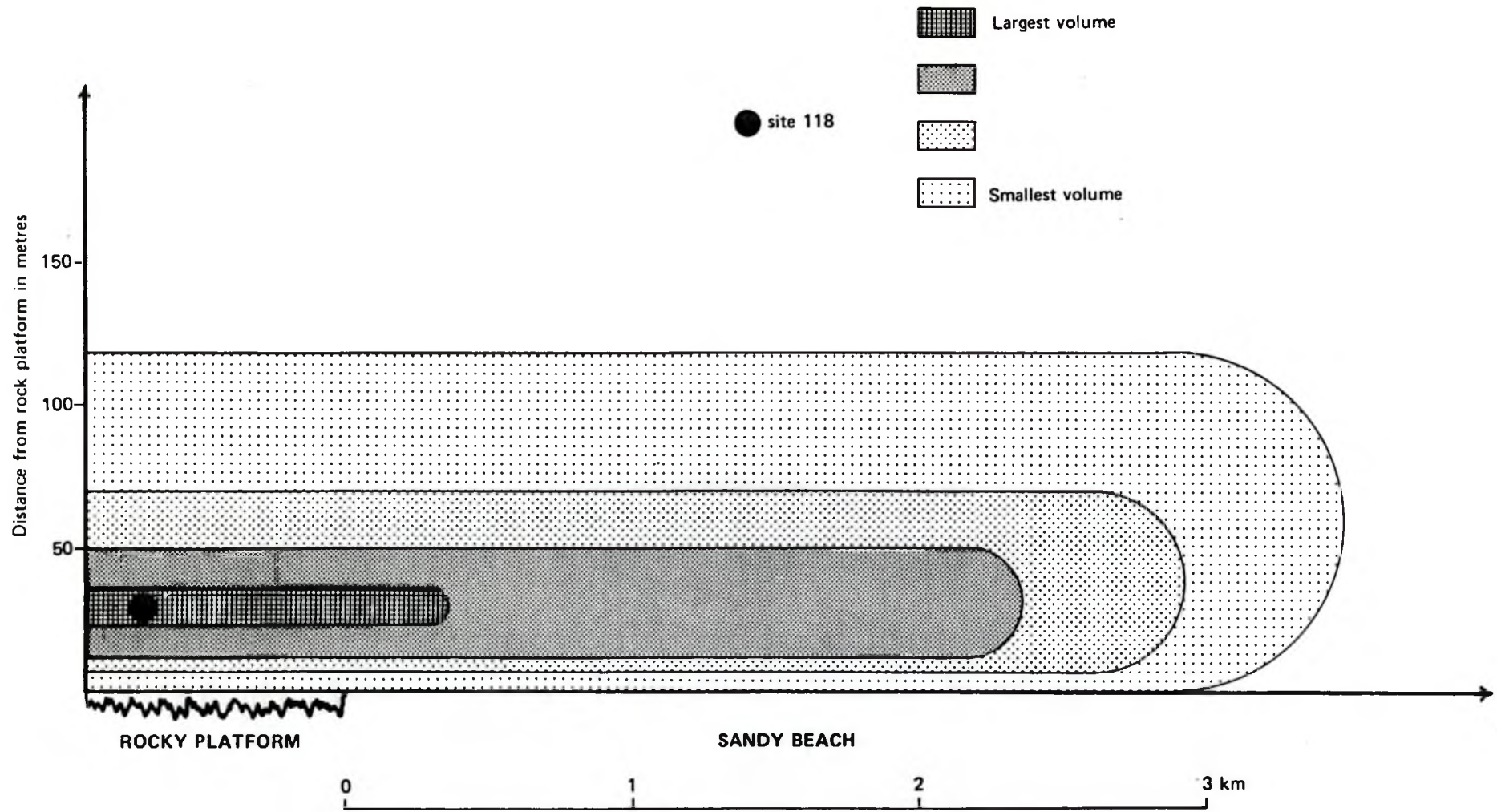


Figure 8.1 A schematic model of shell midden distribution.

and the economics of effort required. The biophysical information is used to describe the location of the main food resources. The transport of the food resources to the midden site represents the energy outputs or economic cost of the foraging activities. Camp location, which is assumed to be shown by shell midden concentrations, will be decided by the interaction of the cost of obtaining food resources (energy expenditure) as against the nutritional value of the foods (energy input). Some resources will be highly predictable in their return for effort and can therefore be used as backup strategies, while first line strategies may involve a higher risk of failure but higher reward.

The conclusion of this examination of regional midden patterns is that camp sites (as shown by middens) had a definite tendency to be placed near the low yield but highly predictable shellfish resources. The foraging zone was not a semi-circle as von Thünen's theory or a site territory approach would suggest, but linear, reflecting the linear distribution of the most important resources in the prehistory of the northwest coast.

8.3 POPULATION

8.3.1 Introduction

In the preceding section I outlined the development of a model of the distribution of Aboriginal activity as revealed through a study of middens. I would now like to turn to the problem of estimating the number of people on the northern half of the west coast, using the same survey data on shell middens and building on earlier analyses.

A variety of formulae has been devised for calculating prehistoric populations. The three most common approaches use ethnography, the number of households and the volume of rubbish.

Jones (1974) used ethnographic information to reconstruct the distribution of the population of Tasmania at the time of European colonisation. This provided an estimate of the number of people living in Tasmania at that time and showed how they were distributed across the landscape.

8.3.2 Population by the number of households

The number of households provides another way to calculate the population of an area (Schacht 1981:125-126). In this procedure it is necessary to define an archaeologically detectable yet culturally meaningful residential unit such as a free standing house or hut. It has already been demonstrated that the hut depressions of the west coast meet this requirement. The next difficulty is to estimate the number of residents associated with the residential unit. In the study area such a figure can be derived from ethnographic sources. Robinson (Plomley 1966:168,170) suggested that the average hut contained some ten people. Jones (1971a:278) from a review of Robinson's journals describes huts as containing 'anything from about six to twelve people'. I will use the figure given by Robinson for my central estimate and those of Jones as examples of the upper and lower range. These figures provide the necessary data on which to estimate the population.

It has been demonstrated that hut depressions have only been found in areas of mixed coast (Section 5.2.13). Therefore, in estimating the total number of hut depressions in the northern half of the west coast, I will limit my extrapolation to data from the 17 quadrats on the 163 km of mixed coast. In these quadrats a total of 24 hut depressions was recorded. However, 54% of middens were deflated to some extent (Section 4.7.2) and it will be assumed that 54% of the original number of hut depressions shared this fate, giving an adjusted estimate of 52 hut depressions for the 17 quadrats. By the methods described in Section 2.2.4, the length of the shoreline in each mixed coast quadrat was measured from the quadrat maps shown in Appendix 2. The average length of shoreline per quadrat was estimated to be 950m. Since these measurements were made on large scale quadrat maps, the result will be overestimated in relation to the total coast length of mixed coast as estimated from smaller scale 1:100,00 sheets (Galloway and Bahr 1979). This provides an element of conservativeness in the following calculations. If a quadrat is taken as representing an average of 950m of coast, then it is possible to estimate that the total number of hut depressions along the northwest coast was of the order of 500!

Robinson estimated that the average hut contained 10 residents. If all the huts were occupied simultaneously, this puts the total population for the northern half of the west coast at 5,000 people.

Using Jones's estimate of six to twelve persons per hut gives an estimate of between 3,000 and 6,000 people. I have presented these obviously absurd figures to highlight the problem of estimating the population of northwest Tasmania on the basis of the number of dwellings.

Firstly, there is no control over when the huts were used - some may be fossils of considerable age. Even though many of the hut depressions are still very distinct, we know that all of them must be at least 150 years old and it now appears that many of them are considerably older. Secondly, the ethnography hints that it was the custom for a group to have several huts spread throughout its territory. The result would be that a band might well have three or four residences in regular use each year. A combination of these two factors can explain the ridiculous result obtained but there is an additional factor which should be noted. I have demonstrated in Section 5.2.13 that middens with hut depressions are only a very small part of the archaeological residue of the west coast occupation pattern. Such a pattern could lead one to expect that people also camped in the open without huts for shelter, although they may have used a simple windbreak as was found in other parts of Tasmania.

It is possible to accommodate the likely population of the west coast many times over in the estimated number of huts. In fact, there are suddenly far too many huts and it is their abundance, not their scarcity, which must be accounted for.

8.3.3 Population from volume of rubbish

Another approach to estimating population uses the volume of rubbish as an index of the number of people. From the survey results the average volume of midden per quadrat can be calculated and then a total midden volume for the northern half of the west coast estimated. Sandy and hard rock coasts have been shown to have only minor quantities of shell midden and will be excluded from these calculations. The Thornton River quadrat is also excluded because it faces onto a beach, even though it is within a few hundred metres of mixed rocky coast. For the remaining 17 quadrats of the mixed coast, the average volume of midden was 302 cu. m. As the average mixed quadrat contained 950m of coastline, the average volume of midden per kilometer of mixed coast was 317 cu. m. The total length of mixed coast was estimated to be 163 km.

This gives a total volume for the northern half of the west coast of 51,671 cu. m of midden.

Meehan estimated that a band of about 40 people living partly by hunting and gathering on the coast in tropical Northern Australia, generated eight cubic metres of midden in one year (1975:238-239). Although the cultures, ecological settings and the like are very different, there are similarities between this group and the Tasmanians. Both groups were hunting for their total meat diet and both regularly ate shellfish. Meehan (1977:502-505) calculated from four typical months that shellfish contributed between 6 and 20% of the total meat diet of the Anbara. Coleman (1966:Table 18) estimated that between 49 and 37% of the total meat weight in the West Point midden (site 118) came from shellfish. Although differences in the weight of meat per unit volume of shell are to be expected between the two areas, let us for the moment ignore these differences and suggest that from these figures it would seem that shellfish were more important in the west coast diet, with the proportional contribution of shellfish being about twice that of the Anbara situation. As shellfish are the main bulk of a midden, these figures suggest that a Tasmanian band would generate twice the volume of the Anbara, so producing about 16 cu. m per year. Some midden was deposited within reach of storm waves and therefore disappeared within a few years (Meehan 1975:170). Jones estimates that 30% of the Anbara midden is lost in this way (pers. comm.). By adding this correction factor to the total volume estimate for the northwest coast, it is increased to 74,000 cu. m. These figures give an estimate of 4600 band-years at a rate of 16 cu. m per band per year for the accumulation of this volume of midden.

A variety of times in the prehistoric past can be taken as the baseline at which the accumulation of midden material started, and so the number of bands required to generate this volume of midden can be calculated. The sea level stabilised at its present position around 6,000 BP (Davies 1959, 1961; Chappell and Thom 1977). If occupation is assumed to have started around this time, it would require only 0.7 bands to accumulate the middens. Although occupation may well have started so early or even earlier, the oldest west coast site dated so far is only 4,000 years old. If this is taken as the baseline, then 1.1 bands would have been required to create the estimated total midden volume. This is still a very small number of people for this

length of coast.

Upon reexamining the near-basal dates for middens along the northern half of the west coast, I found that there were very few early sites, with the bulk of sites being first occupied between 1,000 and 500 years ago (Figure 8.2). The median near-basal date can be taken as around 750 years BP. This median can also be taken as a baseline, indicating the point in time by which half of the middens had started to form. This gives an estimate of 6.1 bands, or a population of 180 to 240 Aborigines.

Working from the ethnography, Jones estimated that there were seven bands in the northern half of the west coast (1974:327, Figure 1). Thus Jones' and my estimates are in very close agreement. Because of the exponential scale used for volume measurement, all my volume estimates are minima. Equally, some midden material will have decayed, been buried or eroded away. These factors would tend to make my calculations underestimate the original population.

The results show that it is possible to work from data on coast type and average midden volume back to an order of magnitude statement about population densities, even though there are a number of variables which can only be given approximate values.

The estimate of 180 to 240 people is based on a stronger methodology than the hut-based estimate and is in general agreement with Jones (1974:327) estimate of 7 bands (= 210 to 280 people) from ethnographic sources. If we accept the refuse method estimate of 180 to 240 people and the adjusted estimate of 500 hut depressions on the west coast with an average of 10 persons per hut, then there are sufficient huts to accommodate 21 to 28 times the population. Even if we assume that a band may operate from four different home bases during the year, creating new huts each time, there are sufficient huts for this to have been done for 5 to 7 years, without the need to reuse a previous hut site.

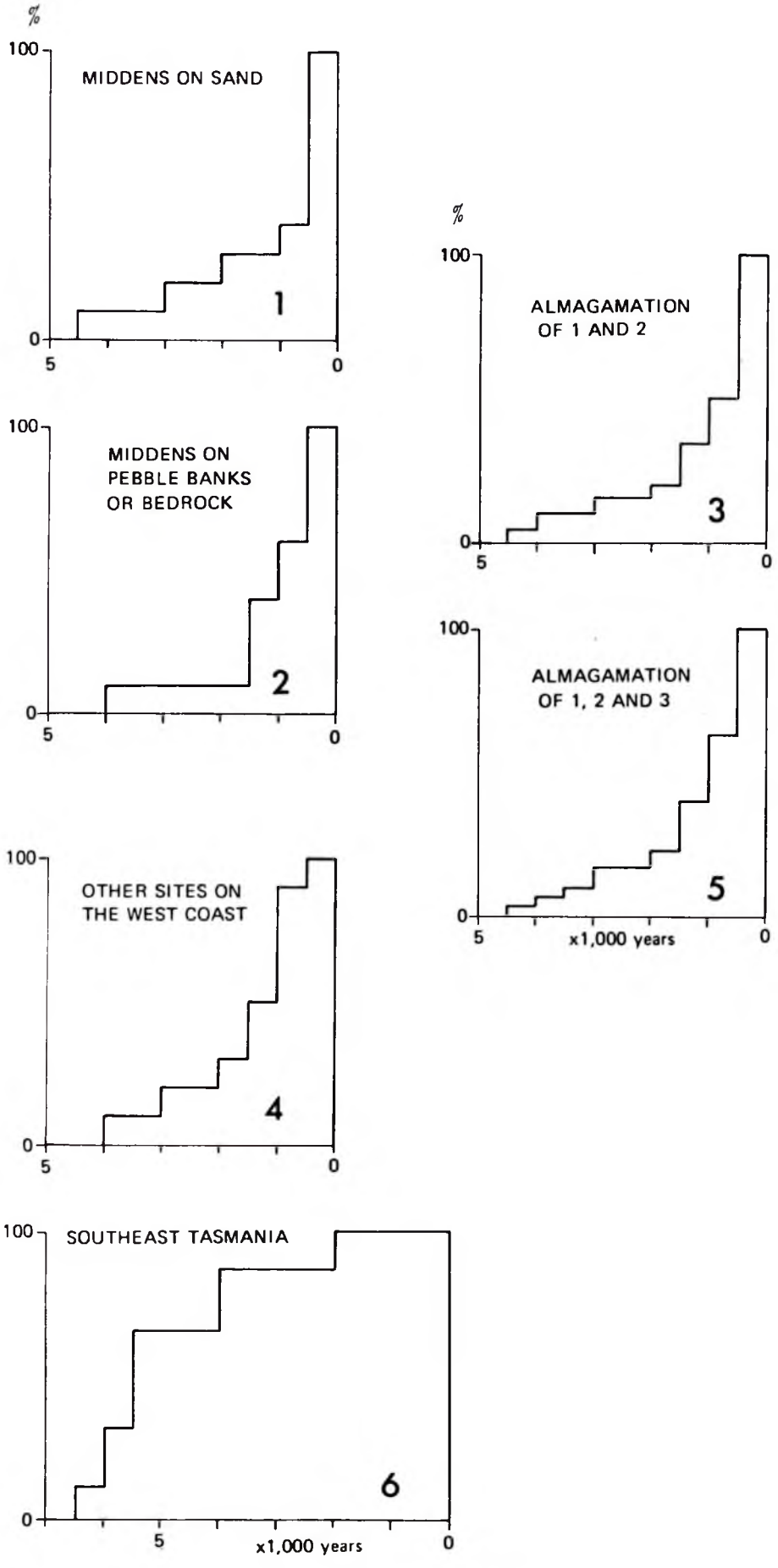


Figure 8.2 Near basal ages of shell middens

8.4 POPULATION CHANGES OVER TIME

There is another perspective in the study of populations. It is not only the number of people which is important but whether they are increasing or decreasing in number over time. The antiquity of west coast shell middens was discussed in Section 7.4. It was shown that the oldest midden dated so far was some 4,000 years old, but that most sites were considerably younger. It was also demonstrated that even very small volumes of midden could last for up to 1,000 years. Do these sites represent only the last remnants of what were originally larger middens? Has surface erosion and chemical attrition of the shells been steadily reducing the volume of these sites?

To tackle this problem I propose to investigate the data in a slightly different way and to look at the near-basal dates which indicate when a site first began to be used. Initially this was done with 20 middens from the northern half of the west coast.

As site survival may be related to the sort of substrate on which the site rests, middens on sand were separated from middens on the potentially more stable substrate of pebble banks and bedrock. The near-basal dates of the two groups were then plotted as cumulative frequencies (Figures 8.2 graphs 1 and 2). If middens on sand were in fact more prone to destruction, then a greater proportion should have fallen in the most recent time zones, i.e. there would be proportionally fewer older middens. The graphs show that there is some tendency for this to happen, but overall the distributions are remarkably similar, at the 0.05 level of significance by the Kolmogorov-Smirnov test. Therefore, I propose to combine the two samples on the assumption that they have the same rates of survival. The result is shown in graph 3. In contrast, Hughes and Lampert (1982) did not include middens on sand landforms in their calculations of an increase in population in coastal NSW during the Holocene, as they felt that most of the sand landforms had only formed during the Holocene.

The combined sample (graph 3) shows that the earliest middens date to around 4,000 BP. There is a slow increase in the number of sites occupied for the first time up to 2,000 years ago, but after 2,000 BP the rate at which new middens are formed increases rapidly.

Several writers have suggested that the coastal population of Australia had increased over the last few thousand years (Hughes and

Lampert 1982; Megaw 1974). Could a similar trend be occurring in Tasmania in spite of its physical and cultural isolation? Before examining this hypothesis, it is necessary to consider alternative explanations.

1. The increase in the number of sites is related to changes in the productivity of the coast.

As was discussed earlier, the coast reached its present level some 6,000 years ago and has been relatively stable since that time. Minor reshaping could be expected as headlands were cut back and bays trapped sand to form beaches. Sand moving onto the land would form dunes and sandsheets.

We have some information on the ecology of Bass Strait at the end of the post-glacial transgression from the dated animal remains in the midden of the Rocky Cape South Cave. These remains include a range of marine fauna, all of which still occur in the vicinity of the Cape, with the exception of seals which have not recovered from a period of colonial exploitation. Seals are, however, regularly sighted further east at North Point. These materials suggest that the marine ecology of 8,000 years ago was largely similar to that of today. By extrapolation, I would expect the nearby west coast had a marine ecology similar to that which it supports today.

By looking at these archaeological data, no evidence for drastic change within the last 8,000 years can be found and therefore the increase in the number of sites cannot be linked to a change in marine productivity. If any such change did occur, it should have occurred shortly after 8,000 years ago, a period for which there are presently no known sites on the west coast.

Interestingly, an increase in the number of sites could be the result of two different ecological processes. If a key resource such as seals became scarce, then people might have concentrated more on shellfish, hence producing more middens. Alternatively, more productive seas may have increased the growth rates of shellfish, so shellfish collecting became a more profitable activity and more middens were formed.

2. There are fewer old middens because they have been destroyed by physical erosion.

To address this hypothesis it is necessary to look at the antiquity of middens from other parts of Tasmania. At Rocky Cape, on the shores of Bass Strait, three large cave middens have been dated to between 5,500 and 8,000 BP. These sites, with excellent preservation conditions, all have basal antiquities in excess of the oldest open west coast midden.

For a variety of reasons, middens in rock shelters and caves have better preservation potential than open sites, so the antiquity of these shelter sites cannot be uncritically compared with that of open sites. The problem of sand deflation in the historic period was discussed in Section 2.5. The same processes were operating in prehistoric times, but we can only guess at the frequency. By extrapolation of the modern rates of deflation, however, it is probable that middens on Quaternary sediments have suffered something like twice the rate of deflation as those on metamorphic rock.

Sixteen of the 20 sites used in this discussion come from West Point, which has metamorphic rocks and an apparently stable surface. Therefore physical action alone does not seem to be a sufficient reason for there being no middens older than 4,000 BP in the 16 sites dated at West Point. Looking at the west coast as a whole, however, it can be expected to have been a major consideration in the removal of middens from the landscape, and from first principles it can be argued that the older a site, the more likely it is to have been eroded away.

I would have expected such a process to be more or less constant over time, thus producing a linear rate of decline in the number of old middens. However, the observed decline is exponential, so although physical erosion can be expected to be one of the factors causing a scarcity of old sites, it cannot be accepted as the sole determinant of the apparently exponential curve.

3. Old shell middens have disappeared due to chemical attrition of the shells.

West coast soils, being largely derived from quartzites, are often moderately acidic with a pH about 6. Surface water is often very acidic (pH 5-6). Unless sufficient midden is deposited to form a large enough alkaline environment which can buffer the shells and bones contained within it, then the long term prospects of shell preservation will not be good (cf. Hughes and Lampert 1982). In

contrast to middens in rock shelters, open sites are more exposed to vadose water movement.

The acid reacts with the carbonate of the shell and gradually the shells disappear. At present, it is impossible to calculate the rate at which this has occurred, but I have two observations to offer. Firstly, the shells from the oldest samples I have dated look no different from those which are only a few hundred years old. From this it would appear that if there is a critical volume of midden present, then chemical attrition is very slow.

Secondly, two very small middens with volumes of 0.1 and 0.5 cu. m are in excess of 1,000 years old, showing that even very small volumes can survive chemical attack for a considerable period. On closer examination, however, it becomes apparent that both of these middens are on extremely well drained surfaces, where the effects of groundwater would be minimal. Therefore, it appears probable that chemical attack may be part of the reason for the lack of old middens. As with physical erosion, however, chemical attrition would be expected to produce a linear rate of decay. The actual rate is clearly exponential, so chemical attrition cannot be accepted as the main cause of the lack of old sites.

4. When people first arrived on the coast they lived in large villages, and so produced fewer but larger middens; these were later abandoned in favour of numerous small sites.

I have tackled this problem in several ways. Firstly, the near-basal ages and volumes of 20 middens were prepared as a scattergram. As with other calculations which involve volumes, there was a very wide range of values from 0.1 to 1,500 cu. m, so the volume axis was prepared as a log scale. The product moment correlation coefficient between age and volume was 0.55, with the probability of obtaining this result by chance less than 0.01. The coefficient may not be very high in statistical terms but it is archaeologically important. It shows that there was a definite tendency for larger sites to have older near basal dates.

The second question was 'Are these large sites only occupied for a short time and then abandoned?' This is a more difficult problem to assess as there are only two middens with sizeable volumes for which both near top and near basal dates are available. These are site 77 (100 cu. m) and site 86 (80 cu. m). The near top date for the former

is 770 ± 87 BP, for the latter 310 ± 78 BP. So for these two large sites, it can be said that they were first occupied between 2,500 and 3,500 years ago but their last use was very recent.

Depth age curves such as those used by Hughes and Djohadze (1980) are not available for any of the open sites on the west coast of Tasmania. If it can be assumed that the period between first and last use of these sites saw intermittent occupation, then we have a picture of occasional but repeated use by a transient group. Such a pattern is in keeping with our general picture of Tasmanian prehistory. More importantly, these large sites show that once a site was used, it was likely to be re-used.

Finally, even though the older large sites were still being used during the last 1,000 years, many new small sites were also being formed. The net result was that as many new sites were coming into use for the first time in the last 1,000 years as had been formed in the preceding 3,000 years.

5. There was an increase in population along the northwest coast during the last 1,000 years.

Having examined and discarded alternative hypotheses, it is now time to return to the population hypothesis. I have concluded that the rate at which midden sites were coming into use had increased exponentially, with the sharpest change in gradient occurring between 2,000 and 1,000 BP.

Was this change occurring elsewhere in Tasmania, or was it limited to the northwest coast? A further 10 near-basal dates are available for open middens on the west coast and the adjacent islands. These sites are Louisa River 1, Louisa River 3, Louisa River cave, Maatsuyker Island (Vanderwal 1978:119); Mount Cameron West (R. Jones pers comm.); Muttonbird Midden, Little Duck Bay (Bowdler 1979:309,315); Cape Sorell and Woolnorth Point (Reber 1967:436); and the Mainwaring River (Zakharov 1981:24). One midden of this group is in a small shelter, where optimum survival conditions would be expected. Even so, it is first used only 800 years ago. The age distribution of these sites is shown in graph 4 of Figure 8.2 This graph is slightly different from graph 3, perhaps reflecting the tendency of excavations to concentrate on deeper, and therefore possibly older, middens. It does, however, show the same overall tendency for there to be few sites older than 1,500 BP, with a sudden

increase after that time in the number of sites being used for the first time. Comparison of graph 4 with graphs 1 and 2 by the Kolmogorov-Smirnov test shows them to be similar at the 0.05 level of significance. Therefore, as argued above for graphs 1 and 2, there are sufficient grounds to combine the three samples, which produces the distribution shown in graph 5.

Graph 5 shows that the oldest middens date from about 4,000 years ago. There is a slow but persistent increase in the number of new sites until about 2,000 years ago, when suddenly the number of sites being used for the first time increases dramatically. The overall distribution shows an exponential increase.

Southeast Tasmania is the only other part of Tasmania where a number of midden dates is available. Graph 6 shows the distribution of nine near-basal dates from Alum Cliffs (Stockton and Wallace 1979:83), Carlton Bluff (Neale 1981:24), Dennes Point (2 sites) (Reber 1967:435), Fishers Hill (Stockton and Wallace 1979:83), Jordan River (Healy and Stockton 1980:147), Kellys Point (Reber 1964:265), opposite Dogshear Point (Reber 1965:266) and Shag Bay (Vanderwal 1977:167). I have not included Reber's early date for Carlton Bluff of $8,700 \pm 200$ BP as it was not duplicated by a recent determination (Neale 1981:24).

The distribution is very different from all the graphs for the west coast. Occupation began much earlier, with over half the middens having started to form before the oldest midden on the west coast was first occupied. In marked contrast to the west, no sites have basal dates of younger than 2,000 years BP. These data convey an impression of very early settlement of the east coast, but did these sites continue to be used up to the contact period?

Top dates are available for two sites. The shelter site of Shag Bay has a top date which is slightly younger than its base date, so for my purposes I will assume that its occupation was only for a brief period. The open midden at Jordan River has a top date of about 400 BP, showing that some activity occurred on the site in the very recent past. The evidence is therefore contradictory, with Shag Bay suggesting a brief period of occupation and then abandonment, while Jordan River indicates an Aboriginal presence only a few hundred years ago. This problem will not be resolved until more top dates are available, or ideally when depth-age curves are prepared for some of the deeper sites.



The lack of late basal dates within the sample suggests that the area was not experiencing the same demographic changes as the west coast. In fact, the population of the southeast may have been declining. If this were so, then we may have an example of an adaptation by prehistoric peoples which is not expressed in technological change but in spatial change. After a period of intense occupation along the sheltered waterways of the southeast, something may have happened which caused a depletion of the resource base or some other change which led to a decline in the number of people who could live in the area. In response to this people may have moved in increasing numbers onto the west coast, so producing the relatively fast growth in the number of middens which were occupied for the first time. I would tentatively date this demographic shift to around 2,000 BP. This was also the time when the importation of west coast spongolite to Rocky Cape began (see Section 7.5). This shows that the north coast people were in regular direct or indirect contact with the west coast by about 2,000 years ago.

Archaeology must now look for the reasons for this change. There is no evidence from the archaeological record to demonstrate major changes in the material culture around 2,000 years ago. Vanderwal (1978d) has argued that the Tasmanian watercraft were a recent development and that they allowed access to previously unavailable resources on offshore islands. These islands are often very rich in sea mammals and birds, so although the additional area of exploitation may have been small, the rewards would have been considerable. Similarly, Bowdler (1981b:14) has suggested that Hunter Island had to be abandoned when it became an island after about 6,000 years ago, and if this is true then it implies that the maritime abilities of the Tasmanians were very poor. They must have improved this capability by about 2,000 BP, for people are once again camping in Cave Bay Cave, apparently commuting from Tasmania. Although Vanderwal's 'watercraft hypothesis' may explain one of the cultural mechanisms by which the Tasmanians expanded their physical universe, particularly where there are offshore islands, this does not explain their apparent inability to exploit the mainland west coast before 4,000 BP.

The contents and distribution of early and recent west coast middens are similar. In the same way, the contents and landscape associations of middens on offshore islands mimic the mainland

patterns. This is perhaps the clue to the Tasmanian mentality over the last few thousand years. Arguments about the cessation of fish eating and bone toolmaking are diversions from the demographic changes which were occurring.

The overwhelming trend of Tasmanian prehistory is cultural continuity. There is now substantial evidence for an increase in the number of middens being formed on the west coast in the last 1,000 years, and by implication the population on the west coast would appear to be increasing. People began to use offshore islands. Whether this was in response to population pressure forcing people to go to the islands, or to the Aborigines gaining access to a wider resource base with the result that the population could increase, is not clear. The lag in time between gaining access to islands and the rapid increase in the number of middens suggests that population began to rise after the resource base expanded.

This is not to imply that the availability of food is the sole determinant of prehistoric population densities. Like many predators, hunting peoples maintain population densities at levels which are far lower than their theoretical maximum. The availability of food and space, however, are important parameters in determining the potential population density. It may have been that the European explorers found a vigorous culture which was expanding its physical horizons, but the process of adaptation did not find expression in the ways in which bone and stone tools were made. This expansion was expressed in demographic change.

8.5 RETROSPECT

It is now three years since this project began and with the benefit of hindsight I can see some of the lessons which were learnt the hard way. What I actually did during this study differed only slightly from my original proposal (Stockton 1979f), but on rereading that original proposal I can identify a few omissions. My proposed division of the coast into hard and soft shore was immediately shown to miss the most important coast type, a mixed coast with both hard and soft components.

Some of my proposed tasks proved to be unnecessary. For example, mapping the locations of shellfish beds proved to be unnecessary as these were identical to areas with rocky substrate. The quadrat size

adopted was 0.25 sq.km. It proved to be an ideal size for this study but may not be applicable to other areas. It is time that a set of formal criteria for the choice of quadrat sizes was developed for archaeology, perhaps along the lines developed for biological studies (Kershaw 1973). The diversion into the inland area of Queenstown generated more problems and questions than it solved but did help to link the findings of this study to research questions being asked by others.

Even though the sampling proportion was not large, the project generated an enormous amount of new quantitative data. We have had little experience with this type of data in Australia. In this situation there was a temptation to become preoccupied with the analysis of the descriptive data and lose interest in higher order questions. This criticism is still true to some extent, but I cannot see how higher order questions can be tackled until the archaeological and biophysical landscapes are described.

Although computers have been used for archaeological analyses for some time, their introduction to Australia has been relatively recent. In particular, their application to the analysis of survey data was only just beginning when this project was started. Their successful use here was possible because package programs such as SPSS were available which did not require the operator to be a programmer. In fact, package programs have been readily available for everything I have wanted to do, which promises an expanding future for the use of computers in archaeology.

The field recording system using fixed columns with mnemonic codes was easy to code and read back as well as being compact. The worst problem was the need to create some new terms, for example landform terms to describe features which are not usually considered landforms, such as the West Point 'rock outcrops'. Although such terms might be upsetting to a purist, they answered the requirements of this study for explicit descriptions of typical features of the landscape.

Another mistake was potentially more serious. When I returned from my last field trip and began to try different methods of analysis, I was enticed into a statistical forest to wander in a maze of non-metric multi-dimensional scaling and other forms of cluster analysis in search for the elusive 'answer'. Because one has data on a computer, there is a very real attraction to try elaborate and

complex techniques such as principal component analysis, which may very well be inapplicable to both the data and the research questions. In retrospect, the four weeks spent in the enchanted statistical forest were interesting but achieved very little.

My original study design did not include an intensive large area sample such as that carried out at West Point, nor did it include transects. These tactics were adopted in the field when confronted with particular questions. Looking back to my early research design, I think I was overly concerned with formal sampling and rigid quadrats at the start when I was trying to work out how to use a quadrat system along a convoluted coast. I still think quadrats are the most effective approach to areal sampling, but concede that there is a place for transects and reconnaissance data in a large study such as this.

The original study proposal outlined three options for the direction of the second season of field work. One of these was to intensify sampling within the northwest as was actually done. I did not, however, propose to sample on the Hunter Islands, Bass Strait or the Derwent estuary. One of the problems of working exclusively within one region is that the pattern of that region becomes the norm. By sampling, even briefly, in other biophysical regions the contrasts and comparisons made the west coast patterns just that much clearer. The lesson to me was that, although an analysis cannot simply end with regional comparisons, the comparative process does facilitate the identification of the distinctive features which characterise the archaeological patterns of an area and leads to the question of why the patterns differ.

8.6 SURVEYS AND CULTURAL RESOURCE MANAGEMENT

I would like to end this thesis by raising several questions relevant to the present state of archaeology in Australia. For some of these questions there may be no easy solution. The majority of archaeological surveys being conducted in Australia at present are part of what has come to be termed cultural resource management (CRM). To understand why such surveys are considered desirable it is necessary to examine the philosophy of CRM as it has developed in Australia and elsewhere. Under a bewildering variety of legislations, large development projects are now generally required to prepare an

environmental impact statement before permission to proceed is granted (for examples see McKinlay and Jones 1979). The variability from state to state within Australia in legislative requirements and administrative structure is not discussed here (see McKinlay and Jones 1979). Although it is an obvious area in need of standardisation, under the present federal structure of Australia standardisation is probably impossible.

While contract research in archaeology may not be new to North America (Schiffer and House 1977:44), it is novel in Australia, and for better or for worse Australian archaeologists have often looked to America for models of how such projects should be designed and conducted. Ideally, within this statement there should be 'a high level of up-to-date information on the nature, extent and significance of resources in areas which may be directly or indirectly affected by proposed actions - and this includes archaeological resources' (Schiffer and House 1977:43).

In practical terms this information is simply not available. Therefore public and private groups are contracting with archaeologists to provide the data. Hence the proliferation of archaeological surveys.

So if an ideal CRM survey should include high level information on the nature, extent and significance of archaeological resources, what can actually be achieved? At this point it is salutary to introduce the concept of the client, i.e. the company or department which actually pays for the archaeologist's services by funding the impact assessment research. Their involvement in archaeology will be governed by the legal and moral requirements which have obliged them to fund archaeological studies. Companies will be involved not only because it is in their long term financial interest but also because it is perceived by them to be to their social and public relations benefit. There is a need for a much greater dialogue between companies and archaeologists if CRM is to be seen as a reasonable and worthwhile endeavour. The goals and means have to be communicated to the client.

The task of enforcing the legislation falls to government departments or statutory authorities. This means that in many cases the consultant archaeologist usually has little chance of direct communication with the client, but rather deals with a public service institution which is acting as a broker. Once these public agencies

have been established, it is in their interest to perpetuate and increase their functions by either expanding their regulatory role or by acquiring land which contains relics. By the latter process they may become land management agencies and require additional staff. Since the management agencies often lack clear policies and operating guidelines, the whole process can become very confusing for the client. Part of the problem stems from the conflicting demands which the management agencies face. Two of these pressures come from development organisations and academics. The client requires quick and efficient service to meet legal requirements. On the other hand, there is also pressure from the academic world where the research value of sites is stressed along with their heritage value. In a country where so little archaeological work has been done, many academic archaeologists are looking to CRM surveys to provide data for further research.

But let us return to what the survey should provide: information on the nature, extent and significance of archaeological resources.

Defining the nature of sites and relics from the past has been what archaeologists have been doing since archaeology evolved away from its antiquarian beginnings.

Defining the extent of archaeological materials has proved more difficult. Probably the most common questions raised by those who receive or review archaeological survey reports centre on the effectiveness of the survey in locating relics. In spite of the development of survey methodology in archaeology, many projects do not use any form of sampling and still seem to be preoccupied with finding what are perceived to be the best sites to dig. The underlying reason for this is the concept of significance.

It should be possible to describe the nature and extent of archaeological relics by both new and well-tested methods. Definitions of significance do not lend themselves to such a rigorous and testable approach. A decision on what is significant and what is not will affect everything from the design of the survey through to the interpretation of the nature and extent of archaeological relics. As a result it would appear that a preoccupation with significance should come last in any project. The first priority should be to define the archaeological universe as fully as possible. If decisions of a significance ranking are required this should be a subsequent task. Such decisions are usually required about which sites will be

salvaged, avoided or destroyed without further research. The criteria for these should be relevant to the nature, location and contents of the local archaeological sites. Statewide significance criteria are inherently self-defeating because they cannot accommodate regional variability (for example see Godfrey 1980:21-22). What is perhaps truly significant about such schemes of determining the significance of a site is that they are usually formulae of bureaucratic or political convenience.

Following the lead from North America, Bowdler (1981:129) suggests that significance 'should be assessed according to 'timely and specific research questions' on the one hand and representativeness on the other.'

Within this context I would like to return to one of the problems experienced in this study. In the West Point area I attempted to record the landscape association of every isolated artefact or scatter of stone artefacts found. The criterion for considering artefacts as clustered or associated was that they lay within 20m of each other. Although this criterion now appears to have been too gross, I still recorded some 160 artefact sites and attempted to present an analytical summary of their distribution. There is obvious room for improvement here but when I started, I had no idea of their potential research significance. Water rolled pebbles were a similar problem. Although obviously moved from their source of origin, I was not aware of a mechanism which would explain their transport and seemingly random distribution. It was tempting to speculate that they were manuports, but what is the significance of individual manuports? It was only during later study of the ethnography that I found a cultural mechanism which could account for this 'insignificant' form of archaeological site i.e. the use of pebbles as missiles. Individually the pebbles may not contain great archaeological significance, but as part of the overall prehistoric exploitation of the West Point heathland they help to fill in the detail of the archaeological picture.

What then becomes the boundary of the culturally or archaeologically significant area? Do boundaries such as this really matter in CRM, or are they artificially determined by the nature of the development project? For example, projects such as electricity transmission line surveys necessarily become transects. How does this affect the way an archaeologist perceives the significance of any

particular archaeological site? For example, is the boundary of what is archaeologically significant equal to the perimeter of site 118, the spectacular West Point midden excavated by Jones in 1963 and 1964? Does it include some of the 104 smaller middens which were subsequently recorded nearby? What about the stone features, artefact sites and pebbles on other parts of the landscape? Surely what is important is the total complex of archaeological sites and their landscape setting.

Taking the long view of archaeology, it is impossible to define the timely and specific research questions of the future. Furthermore, even if we can define the most pressing research questions of the present, can we justify asking our clients to fund such work? When a professional forester is asked to assess the environmental impact of a road construction project on a forest, he is not being asked to address the most recently fashionable question in forestry research. Rather, the forester will be asked to assess:

1. How many trees are in the path of the road?
2. Would an alternate route affect fewer or less important trees?
3. Is the wood suitable for milling logs or pulping for paper making?
4. Can this be done, and if so, what is the most efficient way to go about it?
5. Does the project affect sensitive or valuable ecological resources?

The archaeological equivalent would run something like this:

1. What types of archaeological sites may be directly or indirectly affected by the road?
2. Would an alternate route affect fewer sites?
3. Are the sites which will be affected duplicated elsewhere in the region, or are the sites unique or extremely important?
4. Are the sites on the road suitable for study by archaeological techniques to provide information about the prehistory of the region?

5. If so, what is the most efficient way of going about it?

The client is not approaching the archaeologist with an offer to fund timely and specific research questions. On the other hand, by the time we reach question 4, we would expect the archaeologist to be proposing research designs relevant to local prehistory. These designs should allow for the maximum possible use to be made of the sites and it is at this point that the archaeologist may wish to tackle fashionable research questions.

It seems to me that the problem centres on the definition of the objectives. There are three points of view involved, each with their own objective.

1. The client - who wants to get on with his own business.
2. The regulatory authority, whose objective is to curate the archaeological resource for the sake of the public heritage.
3. The consultant - who operates on a type of minimax logic: firstly to assist the client to have minimum difficulty in meeting the local legislative requirements by minimising the effects a project may have on archaeological sites; secondly, to extract the maximum potential from sites which must suffer impact because it is unavoidable. In the future it is likely that the consultant will become the point of liaison between the client and the regulating authority. Such a role will demand that the consultant be able to provide both parties with an objective assessment of not only the nature and distribution of archaeological relics, but also their significance. Once again, the problem of significance becomes central to the discussion.

One solution which would satisfy the needs of all three would be the development of predictive regional models.

In this conclusion I have posed some of the unanswered, and perhaps unanswerable, questions of archaeology in Australia at present. This thesis has, however, attempted to find solutions to some of these problems and explored some of the ways in which predictive models can be developed. The first step towards this was the acquisition of as much information as possible, describing the nature, content and landscape associations of archaeological sites. The acquisition of these data has prompted methodological advances

not only in survey design but in landscape data analysis. As models are developed and tested in the future, there will be feedback on their effectiveness and further refinement in methods and theory. I feel that this thesis has been successful in demonstrating the potential of survey information to tackle higher order questions.

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- ATAS = Australian Institute of Aboriginal Studies.
- AJMFR = Australian Journal of Marine and Freshwater Research.
- ANH = Australian Natural History.
- ANU = Australian National University.
- ANZAAS = Australian and New Zealand Association for the Advancement of Science.
- APA0 = Archaeology and Physical Anthropology in Oceania.
- CSIRO = Commonwealth Scientific and Industrial Research Organisation.
- J Arch Sci = Journal of Archaeological Science
- JPRSocNSW = Journal of the Proceedings of the Royal Society of New South Wales
- NPWS Tas = National Parks and Wildlife Service, Tasmania.
- PPRSocT = Papers and Proceedings of the Royal Society of Tasmania.
- PRSocV = Proceedings of the Royal Society of Victoria.
- RQVM = Records of the Queen Victoria Museum, Launceston.
- RSPacS = Research School of Pacific Studies
- SWTRS = South West Tasmania Resources Survey.
- Tas Nat = The Tasmanian Naturalist.
- Vic Nat = Victorian Naturalist.
- WA = World Archaeology.

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APPENDIX 1 MAPS USED IN THIS STUDY

Series Maps

Geological Atlas 1:63,360 series. Tasmania Dept. of Mines

Zone 7, Sheet No.50, Zeehan, 1962

Zone 7, Sheet No.22, 8016-5 II and III, Table Cape, 1966

Zone 7, Sheet No.42, 7814 N, Pieman Heads, 1969

Zone 7, Sheet No.30, 8215N, Beaconsfield, 1971

Geological Atlas 1:50,000 series. Tasmania Dept. of Mines

Sheet No.7913 N, Strahan, 1977

Geological Atlas 1:250,000 series. Tasmania Dept. of Mines

Sheet SK 55-1 and SK 55-2, King Island and Flinders Island, 1978

Sheet SK 55-3, Burnie, 1973

Sheet SK 55-4, Launceston, 1975

Sheet SK 55-5, Queenstown, 1975

Sheet SK 55-8, Hobart, 1975

NATMAP 1:100,000 topographic series

Sheet 7814, Conical Rocks, 1969

Sheet 7815, Sandy Cape, 1976

Sheet 7816, Welcome, 1973

Sheet 7817, Three Hummock, 1973

Sheet 7913, Cape Sorell, 1978

Sheet 7914, Pieman, 1973

Sheet 7915, Arthur River, 1977

Sheet 7916, Circular Head, 1975

Sheet 8015, Hellyer, 1975

Sheet 8016, Table Cape, 1969

Sheet 8115, Forth, 1970

Sheet 8215, Tamar, 1970

Sheet 8311, Dentreasteaux, 1974

Sheet 8312, Derwent, 1974

Sheet 8416, Cape Portland, 1970

King Island Special, Parts of Sheets 7617, 7618, 7717, and 7718, 1976

Other Maps - Published

Carte de la Terre de Van Diemen 1822 Drawn by G.W. Evans

Chart of Van Diemen's Land 1824 by Thomas Scott from the best authorities and from actual surveys and measurements. 69 1/2 British Statute miles to a degree

Chart of Van Diemen's Land 1826 'Compiled from the most authentic documents extant' by G. Auckley, map seller and publisher, 38 Rudgate Street, St Pauls, London

Chart of Van Diemen's Land 1833 Compiled from the most authentic documents extant. Published by Joseph Crofts, London

North West Coast, Map of the North West Quarter of Van Diemen's Land to accompany the Third Annual Report of the V.D.L. Co. One inch to 9 miles. c.1828. Archives of Tasmania no. VDL/343/5

Tasmania or Van Diemen's Land n.d.

Tasmania or Van Diemen's Land 1849 Published by J. Arrowsmith

Tasmania 1884 Compiled and drawn by Leventhorpe Hall, Lands Department, Hobart. 15 miles to an inch

Tasmania Map Sheet 1 1971 Statistical Divisions, Tasmania, 1971 Census. 1:1,000,000

Van Diemen's Land 1828 Drawn by (?)Sidney Hall. Published by Longman, Rees, Orme, Brown and Green

Van Diemens Land 1834 by J. Arrowsmith. This map is with permission copied from the original m.s. surveys in the Colonial Office, and in the Van Diemen's Land Company's Office. English miles 91 1/2 = one degree. Published by J. Arrowsmith, London

Van Diemen's Land 1839 This map of Van Diemen's Land dedicated to the land holders of the colony by their faithful servant George Frankland, Surveyor General(?), Sole(?) Commissioner of Crown Lands. Published by J. Cross, London

Van Diemen's Land 1847 Divided into Police districts showing population, house accommodation, number of children under 14 years of age, number of government schools, number of schools

aided by the government, with the number of scholars in each police district

APPENDIX 2 MAPS, VEGETATION TRANSECTS AND INFORMATION
SUMMARIES FOR QUADRATS AND TRANSECTS

"The most precise expression of geographic knowledge is found in the map, an immemorial symbol." C.O. Sauer, The Morphology of Landscape (Sauer 1963:317)

OR

"Don't commit your field season to a mapping stint unless you know it is demanded by a real and present problem. Time consuming precision of location, limit and area is rarely needed ; sketch maps of type situations, cartograms at reduced scales, serve most of our purposes." C.O. Sauer, The Education of a Geographer (Sauer 1963:402-3).

The purpose of this appendix is to present maps, vegetation transects and information summaries of the areas surveyed as quadrats or transects in this study. These are arranged with the map on the left hand page and the vegetation transect and summary table on the right. The quadrats are listed in alphabetical order, followed by the transects.

DESCRIPTION OF TERMS USED IN QUADRAT SUMMARY TABLES

-Rainfall

The climate of coastal Tasmania is fairly uniform, largely because of the ocean's influence. The most variable aspect is the annual rainfall, which is given for each quadrat.

-Land system

Because a land system description integrates numerous biophysical variables in order to map classes of land surfaces, it provides a powerful descriptive tool for a landscape study. The land system description used in this study is based on the work of Richley (1978) who has divided the northwest of Tasmania into 93 land

systems. For each land system he tabulated data on climate, geology, topography, vegetation, soils, land use and hazards along with a brief reference to the distribution of the land system. Nine of Richley's 93 land systems occur on the west coast. Of these, three are present for very short distances, and one for about 12 km. These four were not sampled in this study. On the west coast, the Temma, Granite Creek, Thornton River, Strahan, and Bluff Point land systems were sampled. Within Macquarie Harbour one quadrat was surveyed on the Strahan land system. Inland from Macquarie Harbour, two quadrats were completed in the Rosebery system near Queenstown. Summaries of the major features of these land systems were presented in Section 2.2.3.

Land system maps for Three Hummock and Hunter Island have not been published. From my observations, I would say that Hunter Island is comprised of the Temma and Thornton River systems. Three Hummock Island is different from any of the west coast systems.

-Geology

Under the geology heading in the summary table each quadrat is described for bedrock type, topography, soil type and shore type. The bedrock description is taken from published geological maps. The topography description is a general statement of the nature of the land surface. The soil description is a very brief description of the most common soil type in the quadrat. The shore type description is based on the system used to stratify the coast for sampling.

-Vegetation description

The vegetation is described by a schematic transect which illustrates the relationship between topography and the distribution of species (Kershaw 1973:7). The vegetation transects are descriptions of vegetation change along an environmental gradient, or in relation to some marked feature of topography. For the coastal quadrats, they are orientated to run from the coast inland. In the diagrams, the coastal end of the transect is always to the left side. The location of each vegetation transect is shown by a dashed line on the quadrat map. The vegetation symbols are presented in Figure A2.2. The density of symbols on the transect reflects the density of the vegetation on the ground.









-Prehistoric midden volume

The prehistoric midden volume figure is the total volume of all the middens recorded for the quadrat.

-Present land use

A brief description of present land use was incorporated because the pattern of exploitation of an area today reflects the combination of all the biophysical properties of the quadrat. It also demonstrates the sorts of activities that are now occurring in the area.

Topographic features

-  shoreline
-  off-shore rocks
-  river and creeks
-  cliff
-  remnant dune
-  pebble bank
-  swamp
-  spring
-  quadrat boundary

Cultural features





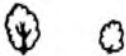
-  142 midden and site number
-  isolated artefact or scatter of worked stone
-  engraving
-  stone arrangement

Figure A2.1 Key to the quadrat and transect maps.



Eucalyptus spp. ; mature, spar, mallee

Nothofagus cunninghamii



Banksia marginata, Leptospermum glaucescens,
Leptospermum laevigatum and Leucopogon parviflorus



Leptospermum scoparium and Melaleuca squarrosa



Melaleuca ericifolia



Acacia spp. , A. Melanoxyton



Casuarina spp.



Gahnia spp.



Gymnoschoenus sphaerocephalus



Ammophila arenaria



Lomandra longifolia



tussock grasses

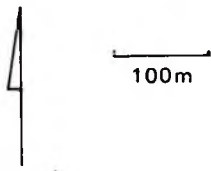
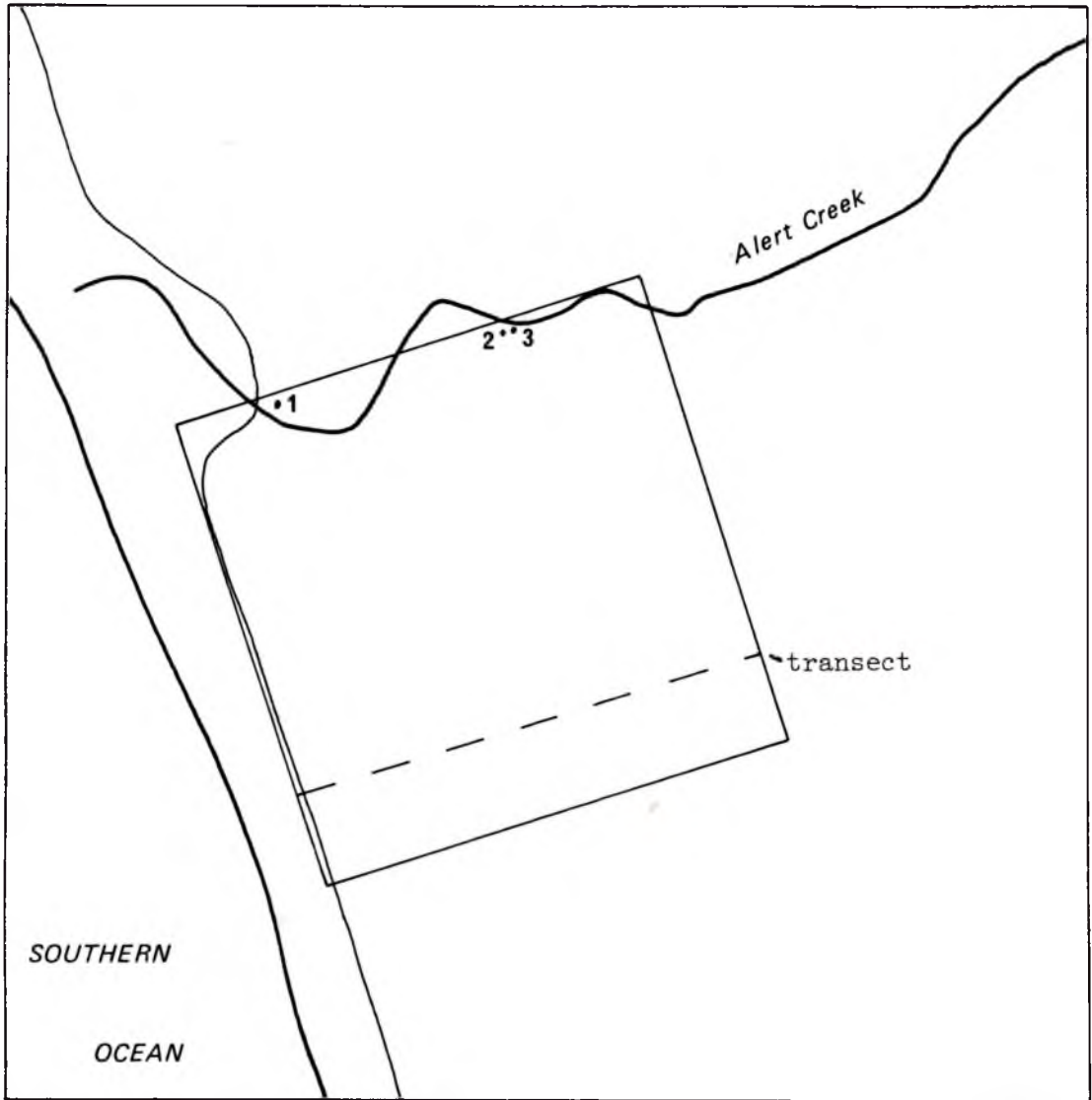


herbs or sedges, forming a low dense cover

Figure A2.2 Key to species in vegetation transects.







Drawn from Lands Department air photograph Project F 472 - Coastal Photography, Run 26, T790 - 45, 1.2.79, at 1 : 40,000

Figure A2.3 Alert Creek quadrat

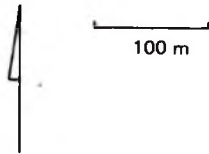
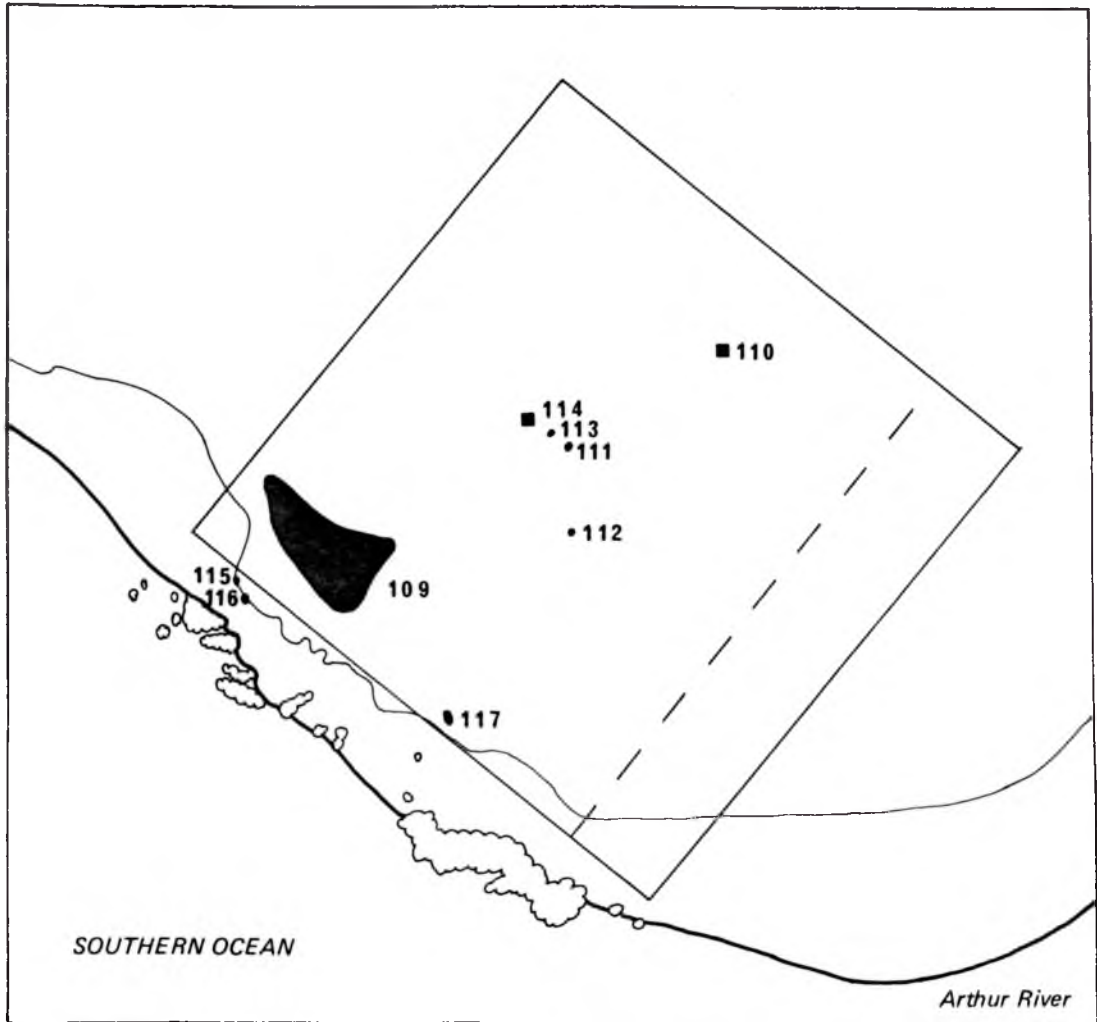
QUADRAT: Alert Creek



Drawn from measurements with tape, compass and clinometer.

	average annual rainfall	1,000-1,250 mm	
LAND SYSTEM	Temma		
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	Quaternary sands undulating calcareous, and loamy sand soft		
VEGETATION -STRUCTURE -ASSOCIATION	open heath and tussock grassland dominated by <u>Leptospermum laevigatum</u> with scattered <u>Lomandra longifolia</u> , <u>Acacia sophorae</u> , <u>Leucopogon parviflorus</u> , tussock grass and <u>Pteridium esculentum</u>		
PREHISTORIC MIDDEN VOLUME	0.3m ³	PRESENT LAND USE	grazing and recreation

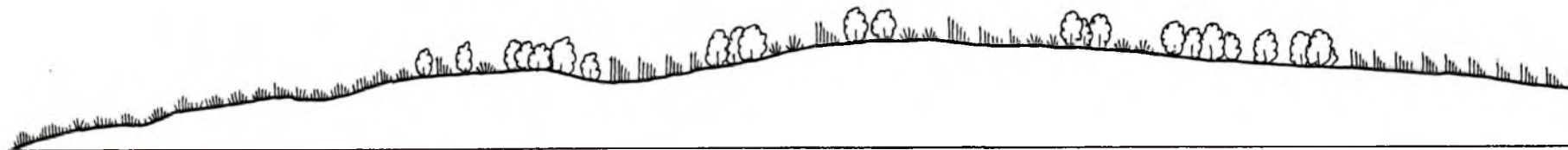




Drawn from enlargement at 1:10,000 of Lands Department air photograph
Project F 472 - Coastal Photography, Run 26, T 790-45, 1.2.79, at 1:40,000

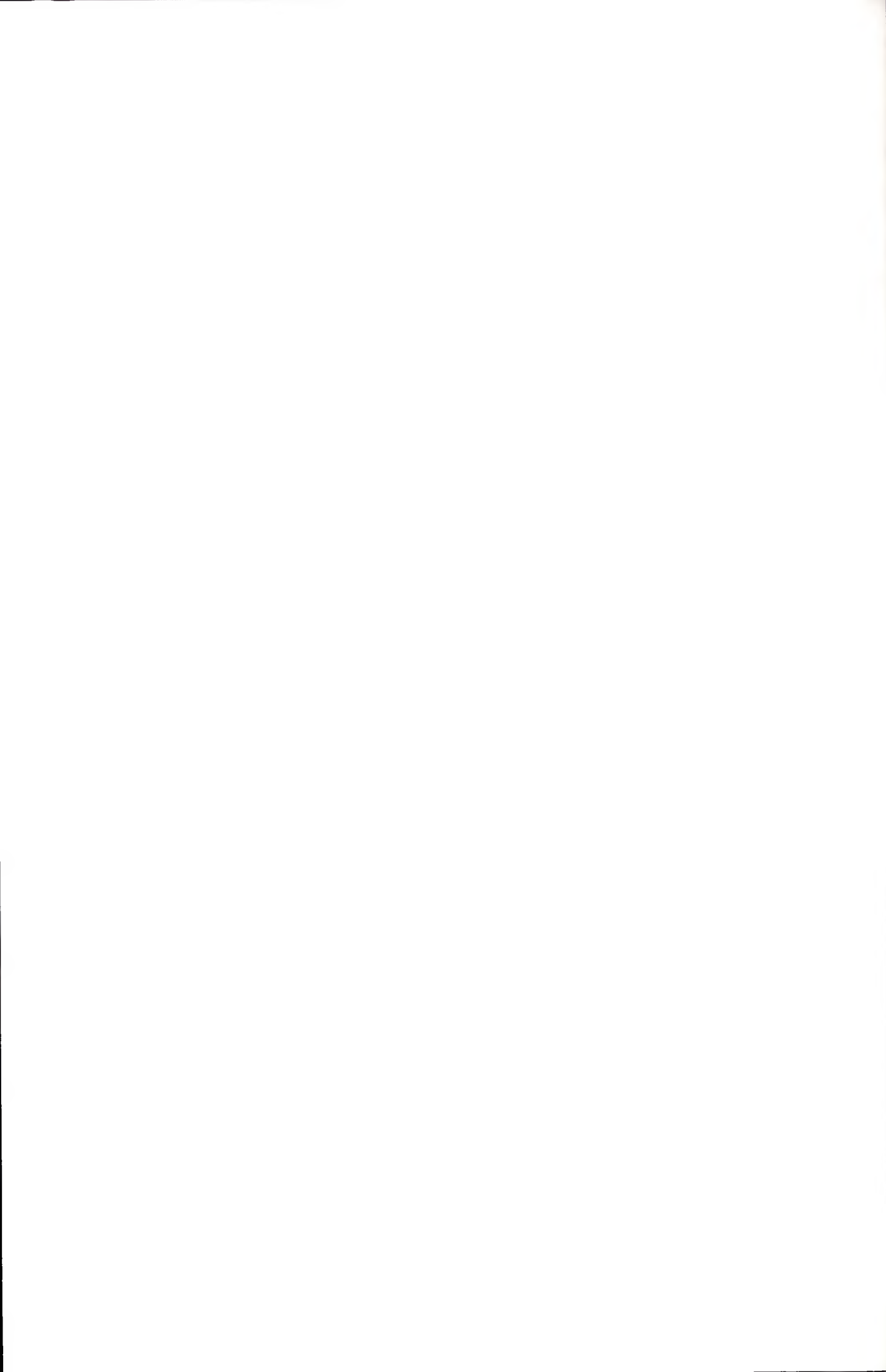
Figure A2.4 Arthur River Bridge quadrat

QUADRAT: Arthur River Bridge

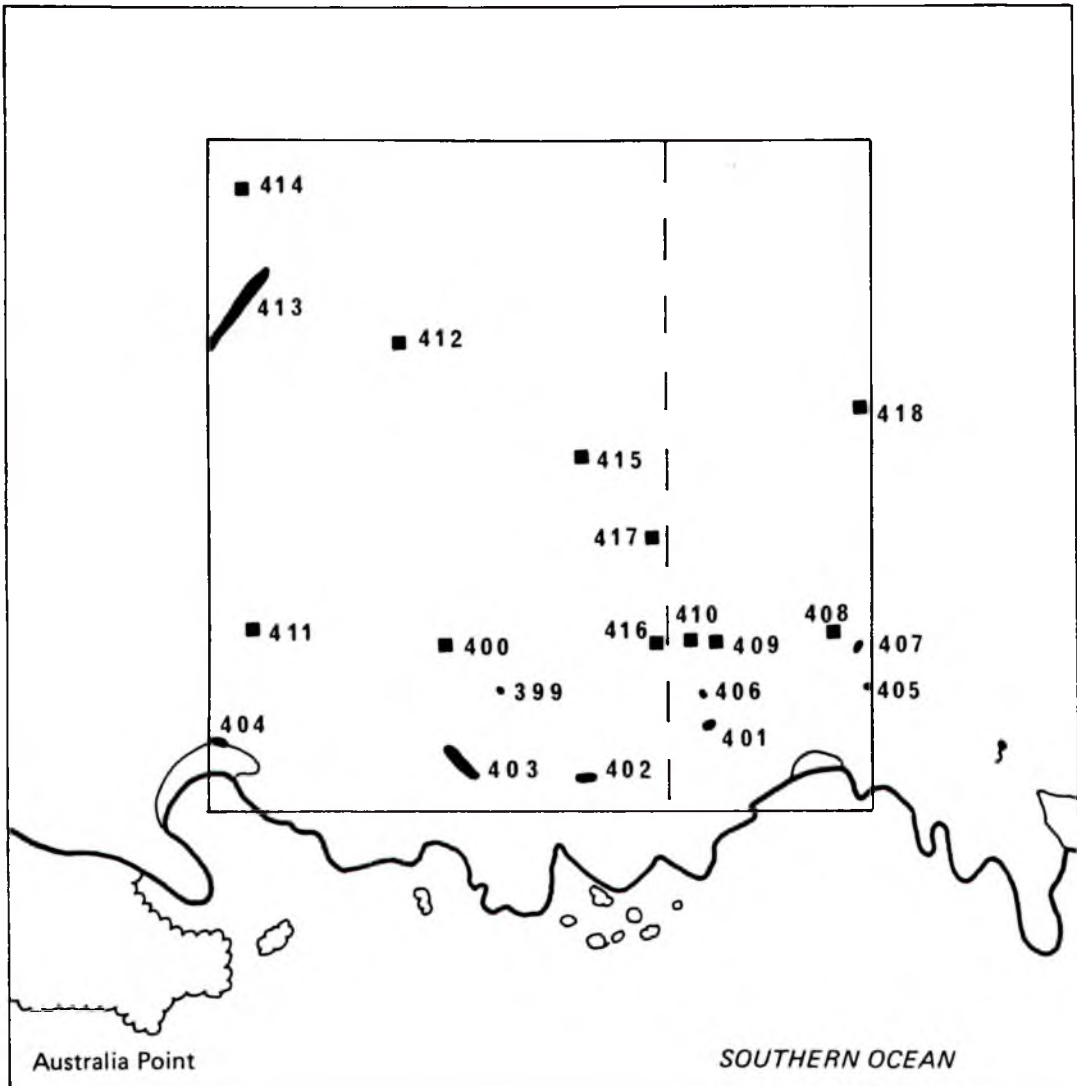


Drawn from elevations calculated by clinometer and measurements taken from enlargement at 1:10,000 of Lands Department air photograph Project F472-Coastal Photography, Run 26, T790-44/45, 1.2.79, at 1:40,000

	average annual rainfall 1,000-1,250mm
LAND SYSTEM	Temma
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	relatively unmetamorphosed sedimentary rocks undulating sand podsol mixed
VEGETATION -STRUCTURE -ASSOCIATION	closed tussock grassland and patches of closed scrub dominated by <u>Lomandra longifolia</u> and <u>Leptospermum laevigatum</u> , with <u>Ammophila arenaria</u> on the foredunes
PREHISTORIC MIDDEN VOLUME	700m ³
PRESENT LAND USE	grazing and recreation



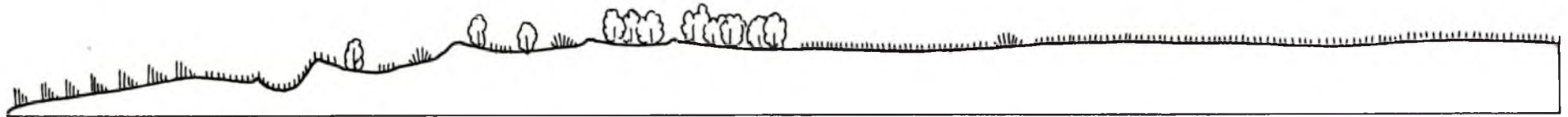




Drawn from enlargement at 1:5700 of Lands Department air photograph
 Project F 472 - Coastal photography, Run27, T 790-44, 1.2.79 at 1:40,000

Figure A2.5 Australia Point quadrat

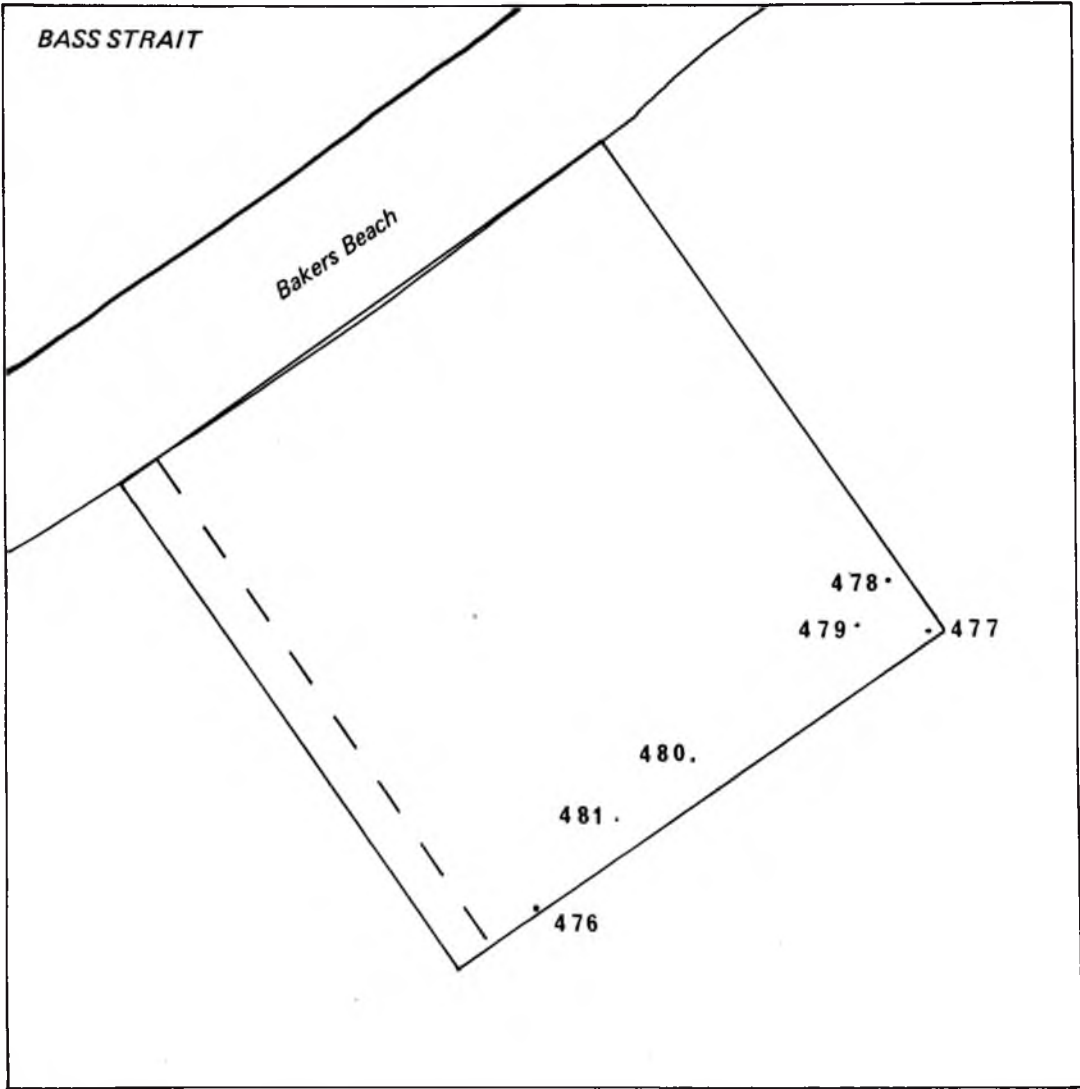
QUADRAT: Australia Point



Drawn from measurements from enlargement at 1:5,700 of Lands Department air photograph Project F472-Coastal Photography, Run 26, T790-44, 1.2.79 at 1:40,000 and elevations calculated by clinometer.

	average annual rainfall	1,000 - 1,250 mm
LAND SYSTEM	Temma	
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	relatively unmetamorphosed sedimentary rocks overlain by Quaternary sand undulating sandy podsoles with scattered rocky outcrops mixed	
VEGETATION -STRUCTURE -ASSOCIATION	mosaic of very dense tall shrubs and grassland shrubs dominated by <u>Leptospermum laevigatum</u> and <u>L. glaucescens</u> , grasslands dominated by introduced pasture species	
PREHISTORIC MIDDEN VOLUME	138 m ³	PRESENT LAND USE
		grazing



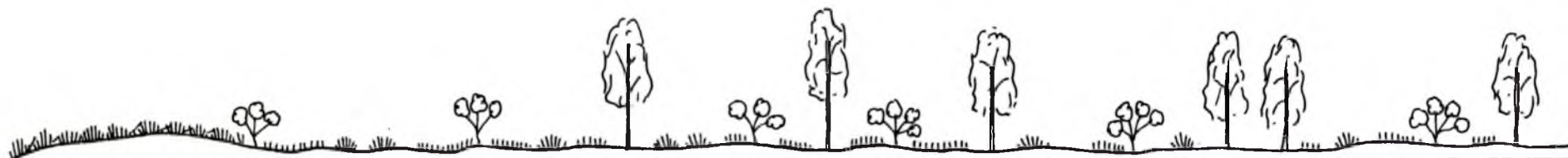


100m

Drawn from enlargement at 1:4200 of Lands Department air photograph
Project F563 - Forth, Run 2, T745-236, 19.2.78 at 1:30,000

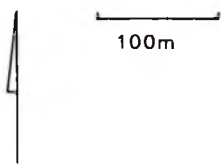
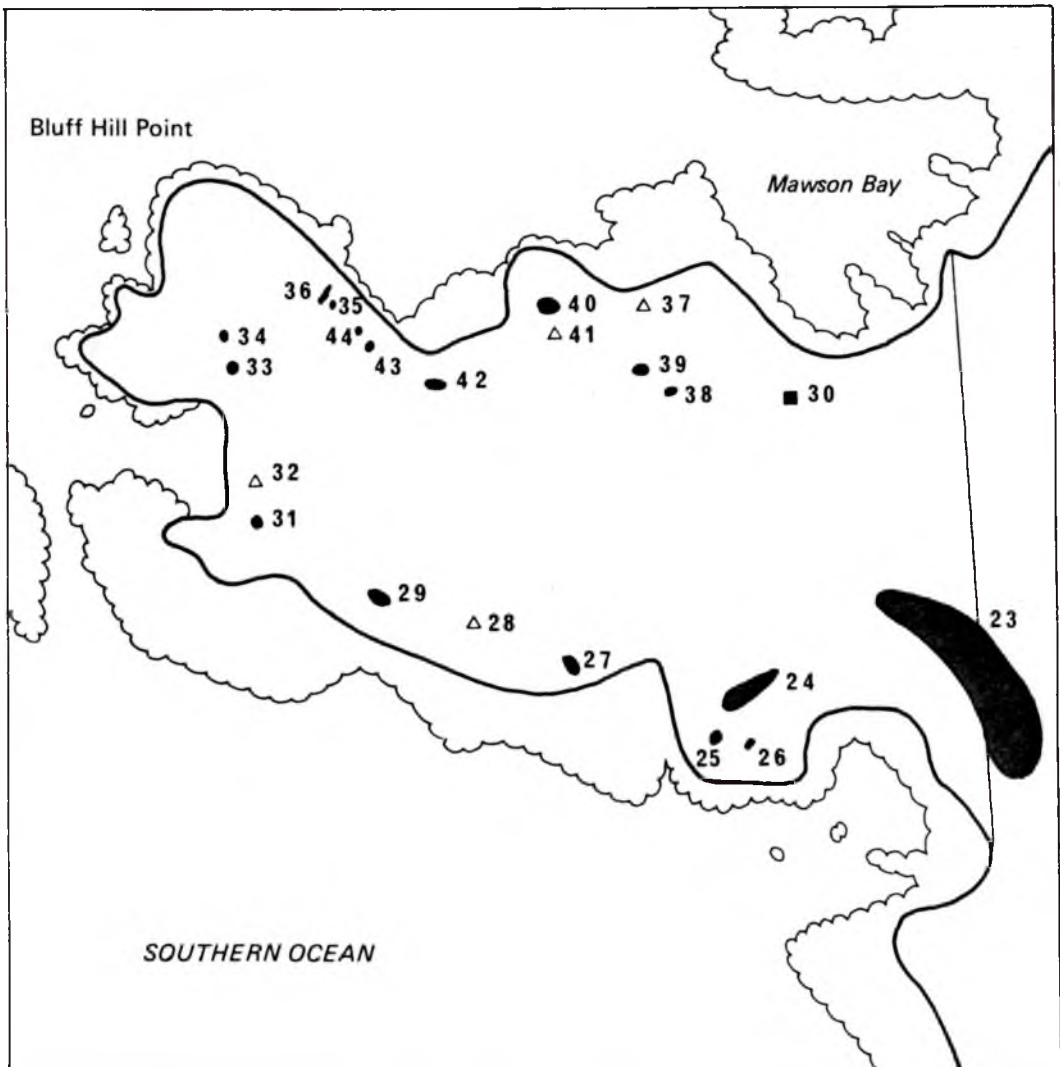
Figure A2.6 Bakers Beach quadrat

QUADRAT: Bakers Beach



Drawn from measurements from enlargement at 1:4,300 of Lands Department air photograph Project F563 - Forth, Run 1, T745-326, 19.2.78 at 1:30,000 and elevations calculated by clinometer.

	average annual rainfall	800 - 900 mm
LAND SYSTEM	Binalong Bay	
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	Quaternary - recent calcareous sands undulating dunes calcareous sandy soils soft	
VEGETATION -STRUCTURE -ASSOCIATION	coastal heath with woodland with scrub understory inland foredunes dominated by <u>Acacia sophorae</u> , merging with <u>Eucalyptus viminalis</u> woodland	
PREHISTORIC MIDDEN VOLUME	0 m ³	PRESENT LAND USE
		nature conservation



Drawn from enlargement at 1:7200 of Lands Department air photograph
 Project F472 - Coastal Photography, Run 26, T790-44, 1.2.79 at 1:40,000

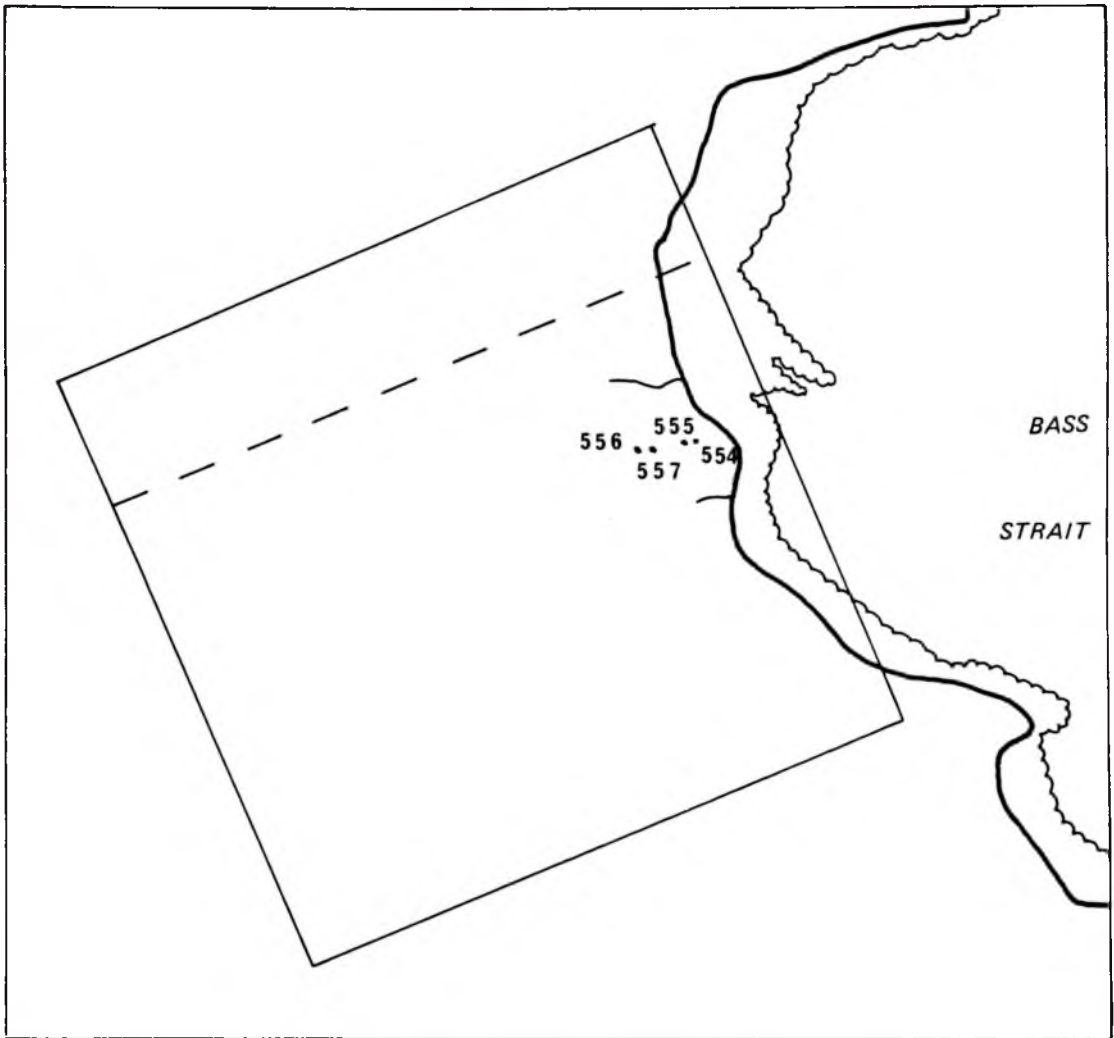
Figure A2.7 Bluff Hill Point quadrat

QUADRAT: Bluff Hill Point



Drawn from elevations calculated by clinometer and measurements from Lands Department air photograph Project F472-Coastal Photography, Run 25, T790-44, 1.2.79 at 1:40,000

	average annual rainfall	1,000-1,250mm	
LAND SYSTEM	Temma		
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	relatively unmetamorphosed sedimentary rocks undulating sandy podsol mixed		
VEGETATION -STRUCTURE -ASSOCIATION	open heath dominated by <u>Calytrix tetragona</u> , with scattered <u>Leptospermum glaucescens</u> , <u>Acacia verticillata</u> , <u>Leptospermum scoparium</u> and <u>Banksia marginata</u>		
PREHISTORIC MIDDEN VOLUME	1185m ³	PRESENT LAND USE	grazing and recreation

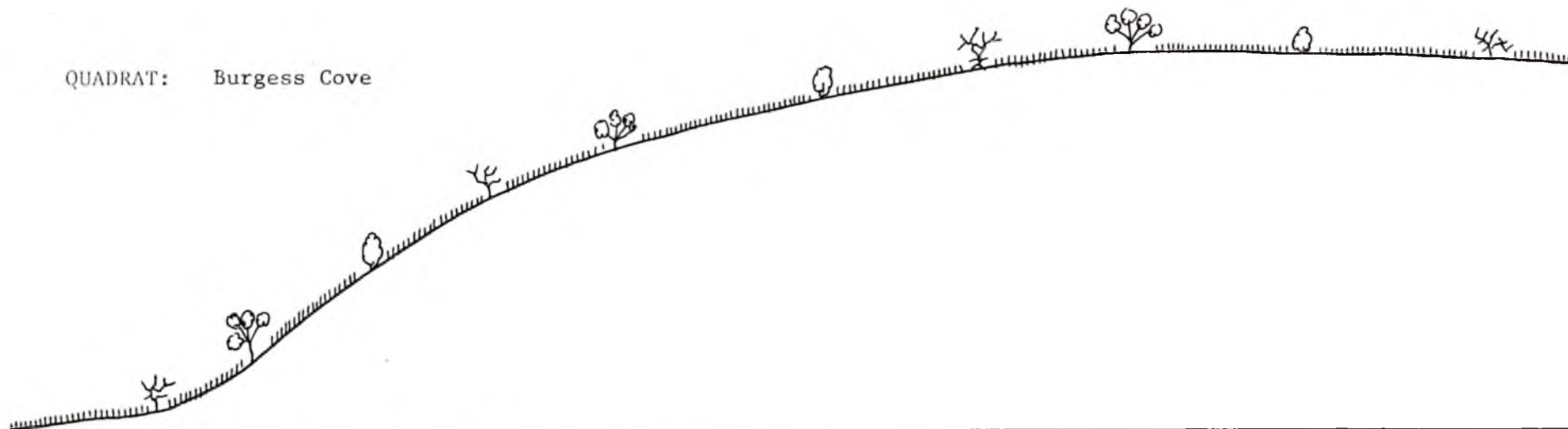


100m

Drawn from enlargement at 1:5700 of Lands Department air photograph
Project M-88 North West, Run 2, T808-41, B.1.80 at 1:40,000

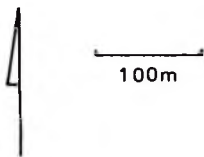
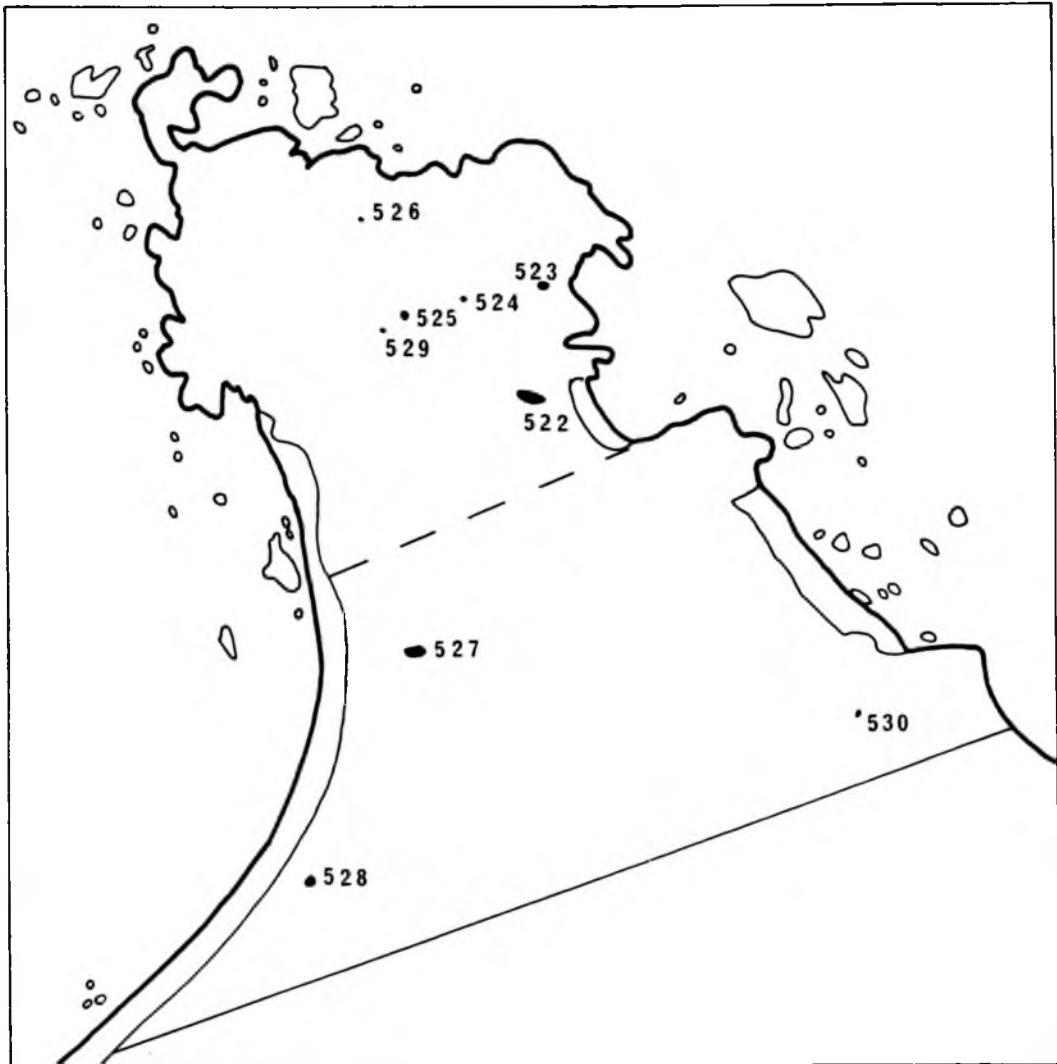
Figure A2.8 Burgess Cove quadrat

QUADRAT: Burgess Cove



Drawn from published 1:100,000 Table Cape sheet 8016

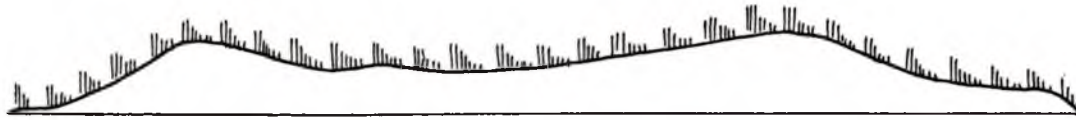
	average annual rainfall	900-1,000 mm
LAND SYSTEM	Rocky Cape	
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	Precambrian quartzite gentle foot slopes, moderate slopes and crests sandy to gravelly, rock outcrops common mixed	
VEGETATION -STRUCTURE -ASSOCIATION	dense low shrubs near the shore, sedgeland heath inland <u>Pultenaea daphnoides</u> near the shore, with a mixture of <u>Leptospermum scoparium</u> , <u>Epacris impressa</u> and other shrubs inland.	
PREHISTORIC MIDDEN VOLUME	6 m ³	PRESENT LAND USE
		recreation



Drawn from enlargement at 1:4500 of Lands Department air photograph Project F1603 - North West, Run 2, T501-23, 12.2.68, at approximately 1:31,500

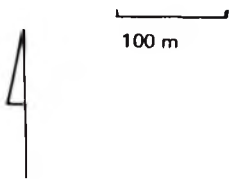
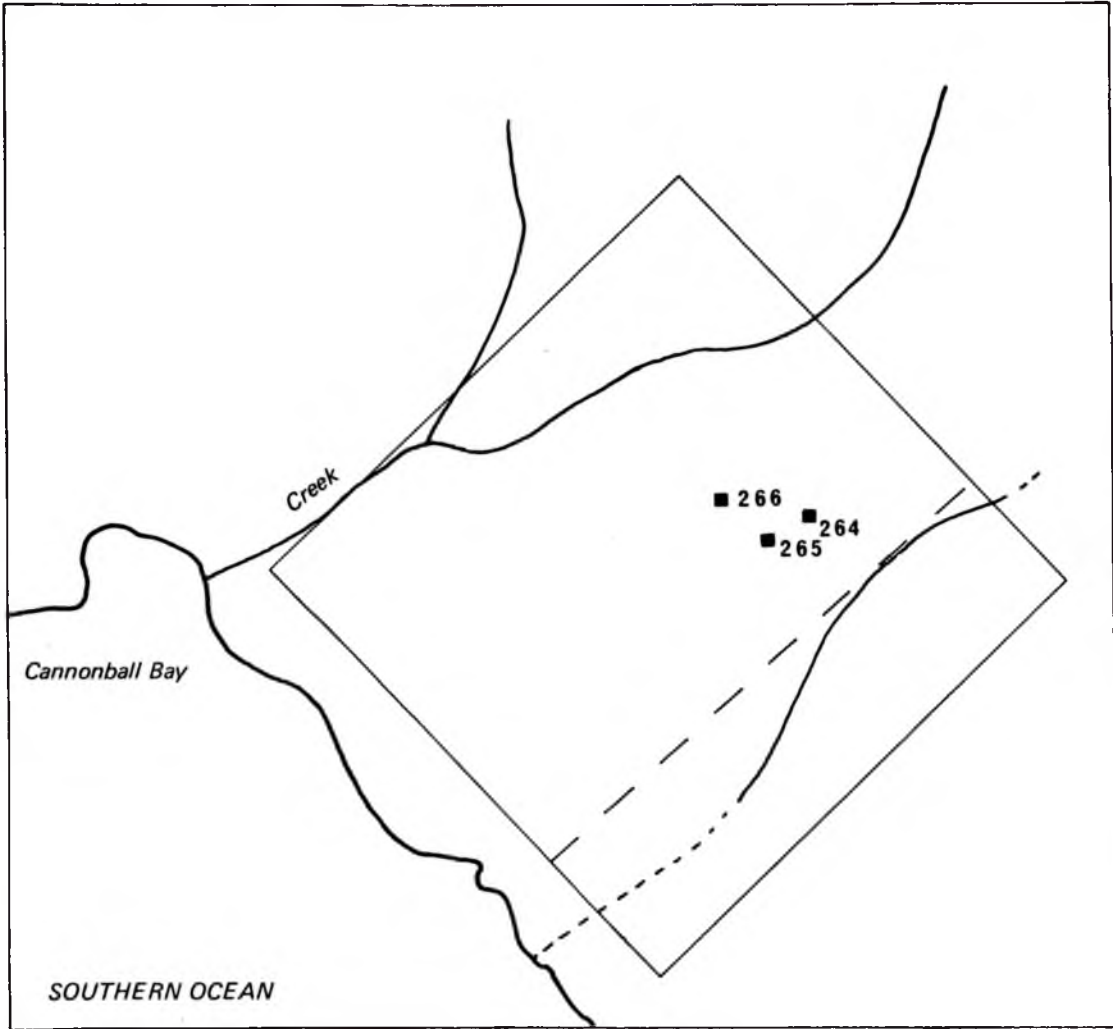
Figure A2.9 Burgess Point quadrat

QUADRAT: Burgess Point



Drawn from measurements from enlargement at 1:4,500 of Lands Department air photograph Project 1603-North West, Run 2, T501-21, 12.1.68 at 1:31,500 and elevations calculated by clinometer

	average annual rainfall 750 - 1,000 mm
LAND SYSTEM	
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	granite undulating fossil dunes sandy podsol mixed
VEGETATION -STRUCTURE -ASSOCIATION	closed tussock grassland, probably heath before 1800 dominated by tussock grasses
PREHISTORIC MIDDEN VOLUME 13 m ³	PRESENT LAND USE grazing and nature conservation

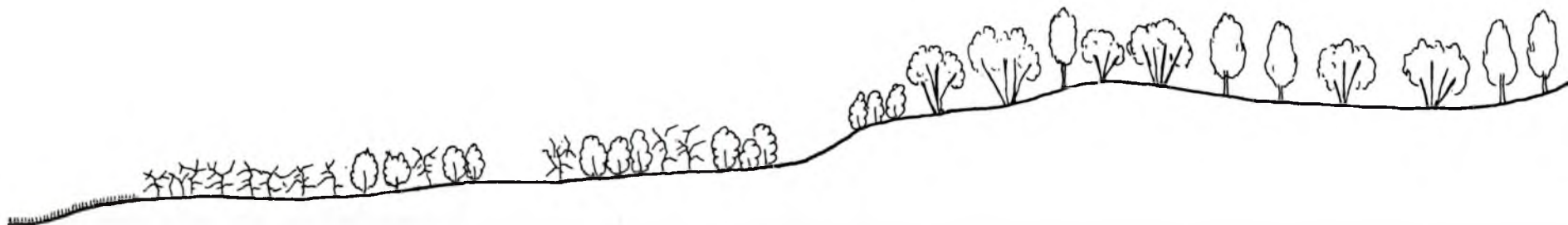


Drawn from enlargement at approximately 1:6500 of Lands Department air photograph Project F423— Conical Rocks—Sophia, Run 6, T679-29, 17.4.75 at 1:40,000

Figure A2.10 Cannonball Bay quadrat

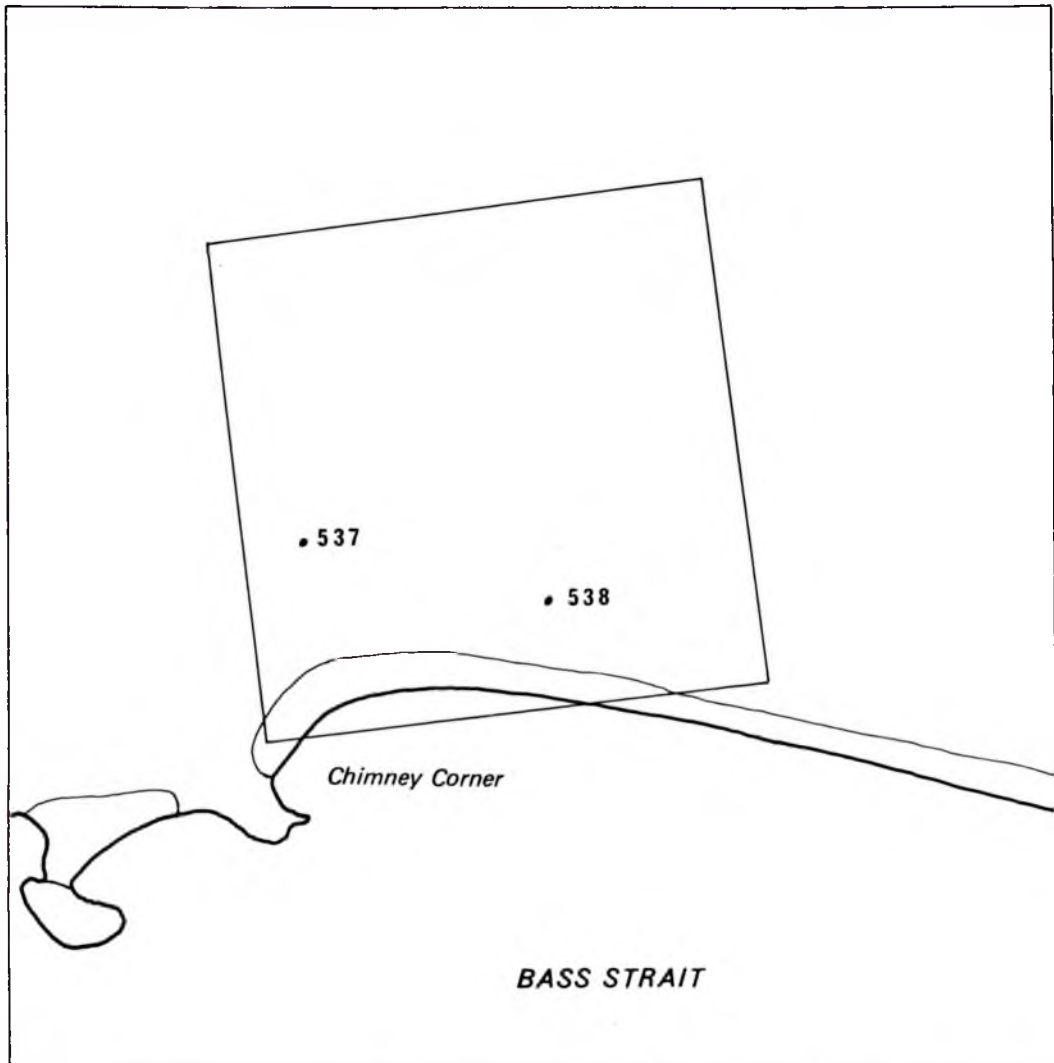
QUADRAT:

Cannonball Bay



Drawn from unpublished Lands Department M-plot Zeehan 3 at 15,840 and enlargement at 1:7,800 air photograph
Project 423-Conical Rocks Sophia, Run 6, T679-29

	average annual rainfall	1,750-2,000
LAND SYSTEM	Granite Creek	
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	granite with basalt at inland edge of quadrat undulating peaty sand with clay loam at inland edge of quadrat hard	
VEGETATION -STRUCTURE -ASSOCIATION	closed shrubland dominated by <u>Leptospermum scoparium</u> in poorly drained areas and <u>Eucalyptus nitida</u> in better drained areas.	
PREHISTORIC MIDDEN VOLUME	0m ³	PRESENT LAND USE nil



Drawn from Lands Department air photograph Project 1603 – North west, Run 2, T 501-23, 12.2.68 at approximately 1:31,500

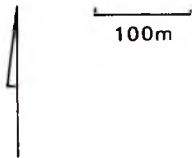


Figure A2.11 Chimney Corner east quadrat

QUADRAT: Chimney Corner East

Drawn from Lands Department air photograph Project 1603 - North West, Run 2, T501-23, 12.2.68 at approximately 1:31,500.

	average annual rainfall 750 - 1,000 mm
LAND SYSTEM	
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	granite gently sloping hills sandy mixed
VEGETATION -STRUCTURE -ASSOCIATION	closed tussock grassland, probably heath before 1800 dominated by introduced pasture grasses
PREHISTORIC MIDDEN VOLUME 2 m ³	PRESENT LAND USE grazing



Drawn from Lands Department air photograph Project 1603 -- North west, Run 2, T501-23, 12.2.68. at approximately 1:31,500

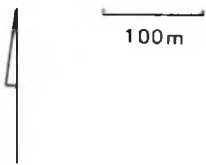
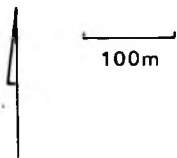
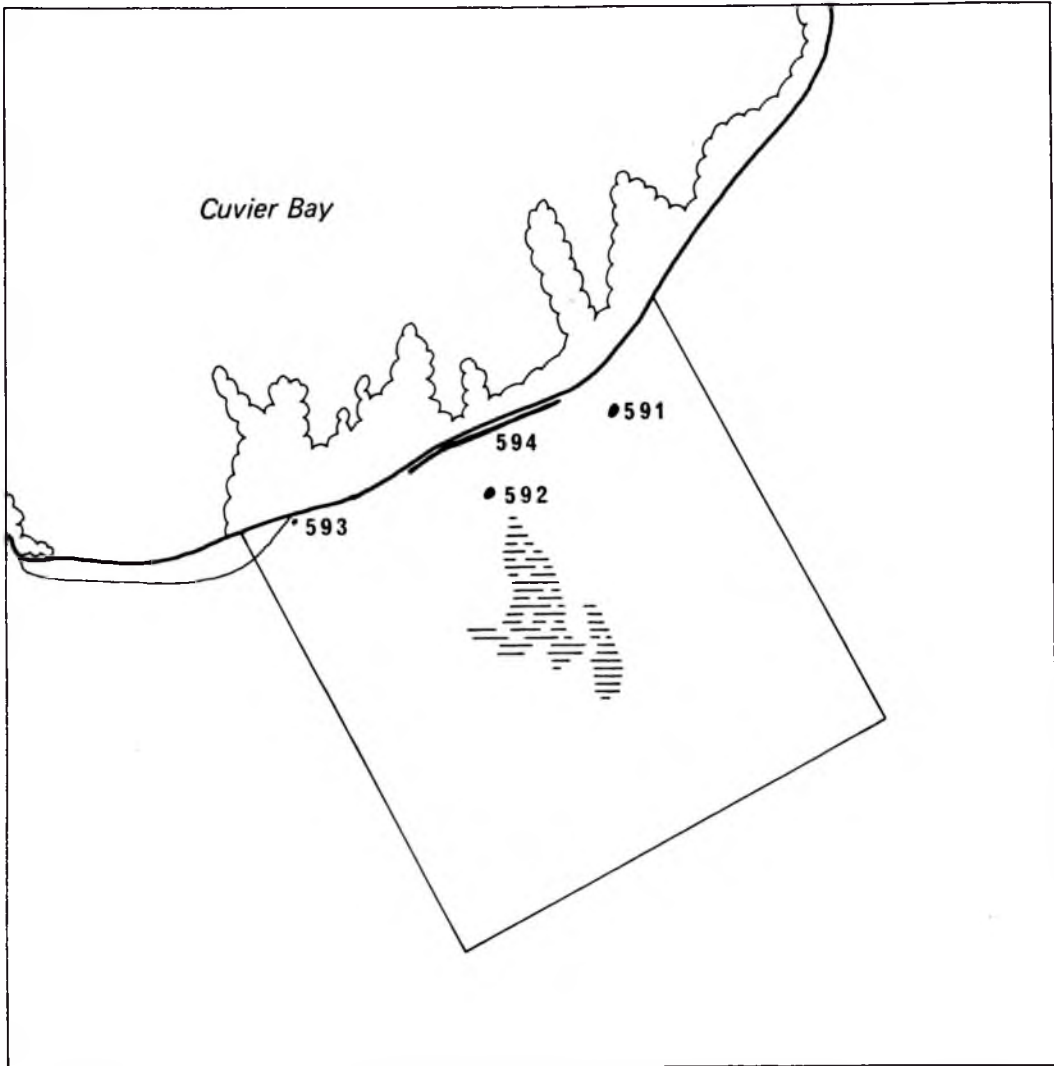


Figure A2.12 Chimney Corner west quadrat

QUADRAT: Chimney Corner West

Drawn from Lands Department air photograph Project 1603 - North West, Run 2, T501-23, 12.2.68 at approximately 1:31,500.

	average annual rainfall	750 - 1,000 mm
LAND SYSTEM		
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	granite gently sloping hills sandy mixed	
VEGETATION -STRUCTURE -ASSOCIATION	closed tussock grassland, probably heath before 1800 dominated by introduced pasture grasses	
PREHISTORIC MIDDEN VOLUME	0 m ³	PRESENT LAND USE grazing



Drawn from enlargement at 1:8,000 of Lands Department air photograph
Project F 472 - Coastal Photography, Run 9, T810- 133, 8.1.80 at 1:40,000

Figure A2.13 Cuvier Bay east quadrat

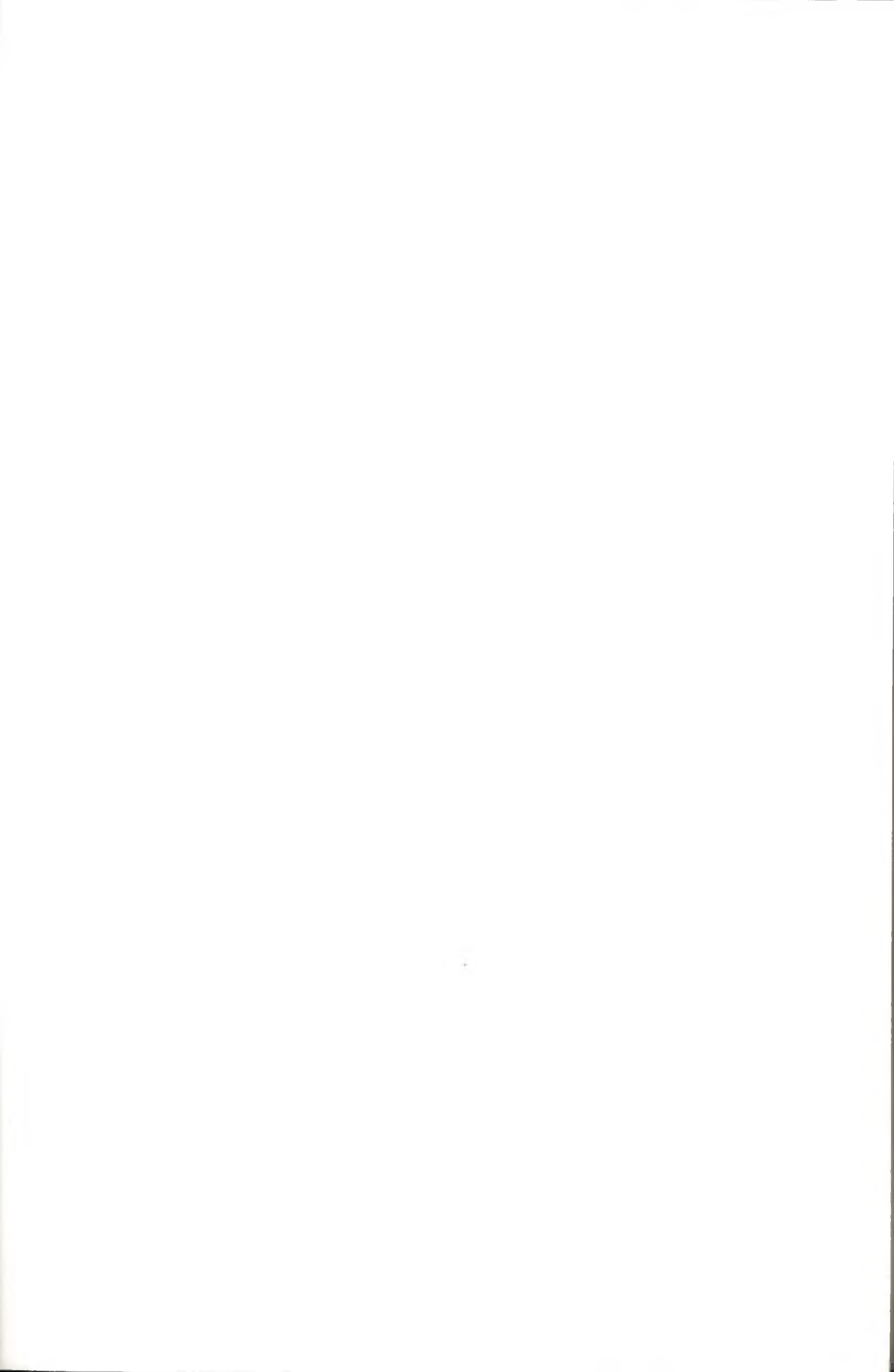
QUADRAT: Cuvier Bay East

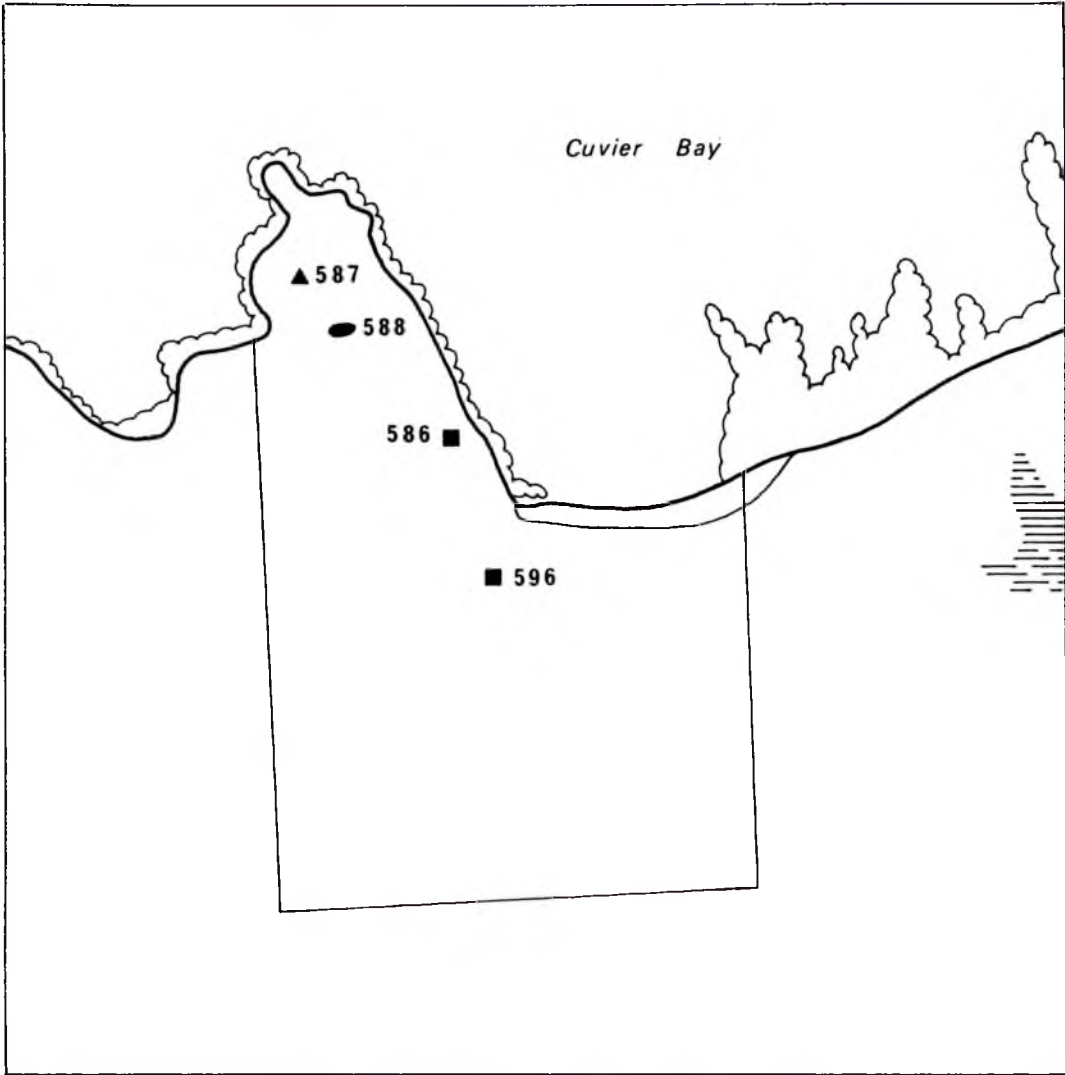


Drawn from measurements from enlargement at 1:8,000 of Lands Department air photograph Project F472-Coastal Photography, Run 9, T810-133, 8.1.80 at 1:40,000 and elevations calculated by clinometer.

	average annual rainfall	750 - 1,000 mm
LAND SYSTEM		
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	relatively unmetamorphosed sedimentary rocks undulating sand dunes backed by a flat to gently sloping sandsheet sandy podsols mixed	
VEGETATION -STRUCTURE -ASSOCIATION	open low shrubs on the dunes and a variety of structures inland. scattered <u>Leptospermum parviflorus</u> on the dunes, with <u>Melaleuca ericifolia</u> and <u>Eucalyptus nitida</u> inland on swamps and slopes respectively	
PREHISTORIC MIDDEN VOLUME	1 m ³	PRESENT LAND USE
		grazing







Drawn from enlargement at 1:8,000 of Lands Department air photograph
Project F 472 - Coastal Photography, Run 9, T810-133, 8.1.80 at 1:40,000

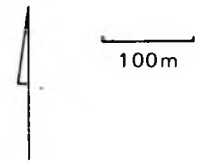
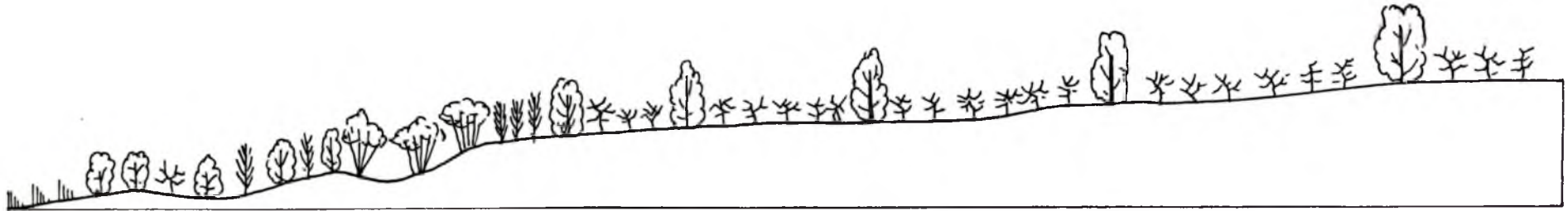


Figure A2.14 Cuvier Bay west quadrat

QUADRAT:

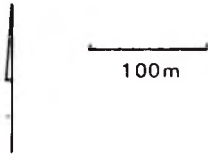
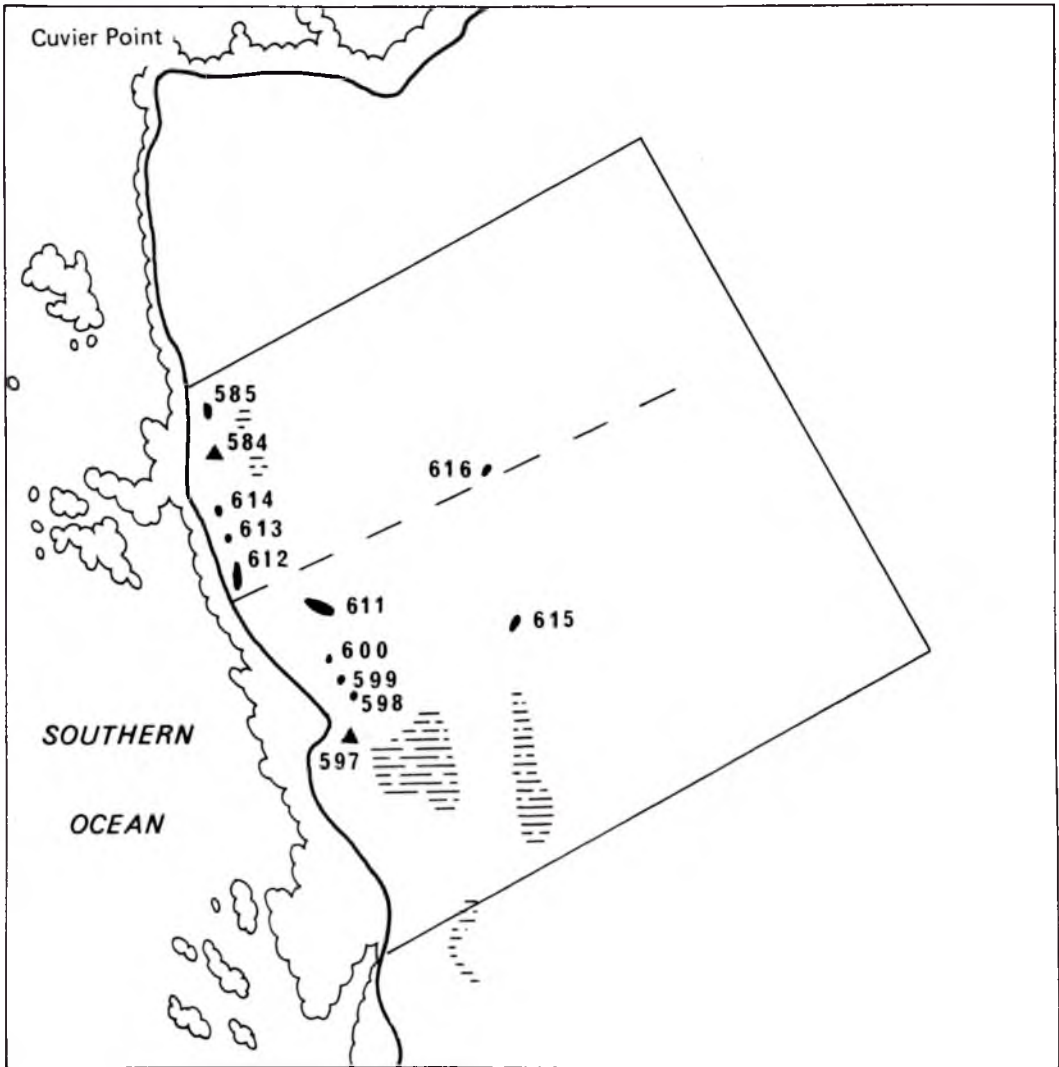
Cuvier Bay West



Drawn from measurements from enlargement at 1:8,000 of Lands Department air photograph Project F472-Coastal Photography, Run 9, T810-133, 8.1.80 at 1:40,000 and elevations calculated by clinometer

	average annual rainfall	750 - 1,000 mm
LAND SYSTEM		
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE		relatively unmetamorphosed sedimentary rocks moderate slopes, with small cliffs shallow sandy podsols, with bedrock outcrops mixed
VEGETATION -STRUCTURE -ASSOCIATION		zones parallel to the coast with low shrubs, dense low trees, and open tall shrubs zones are dominated by <u>Banksia marginata</u> , <u>Eucalyptus nitida</u> and <u>B. marginata</u> respectively.
PREHISTORIC MIDDEN VOLUME	1m ³	PRESENT LAND USE
		grazing





Drawn from enlargement at 1:8000 of Lands Department air photograph
 Project F472 - Coastal photography, Run 9, T810-133, 8.1.80 at 1:40,000

Figure A2.15 Cuvier Point north quadrat

QUADRAT: Cuvier Point North

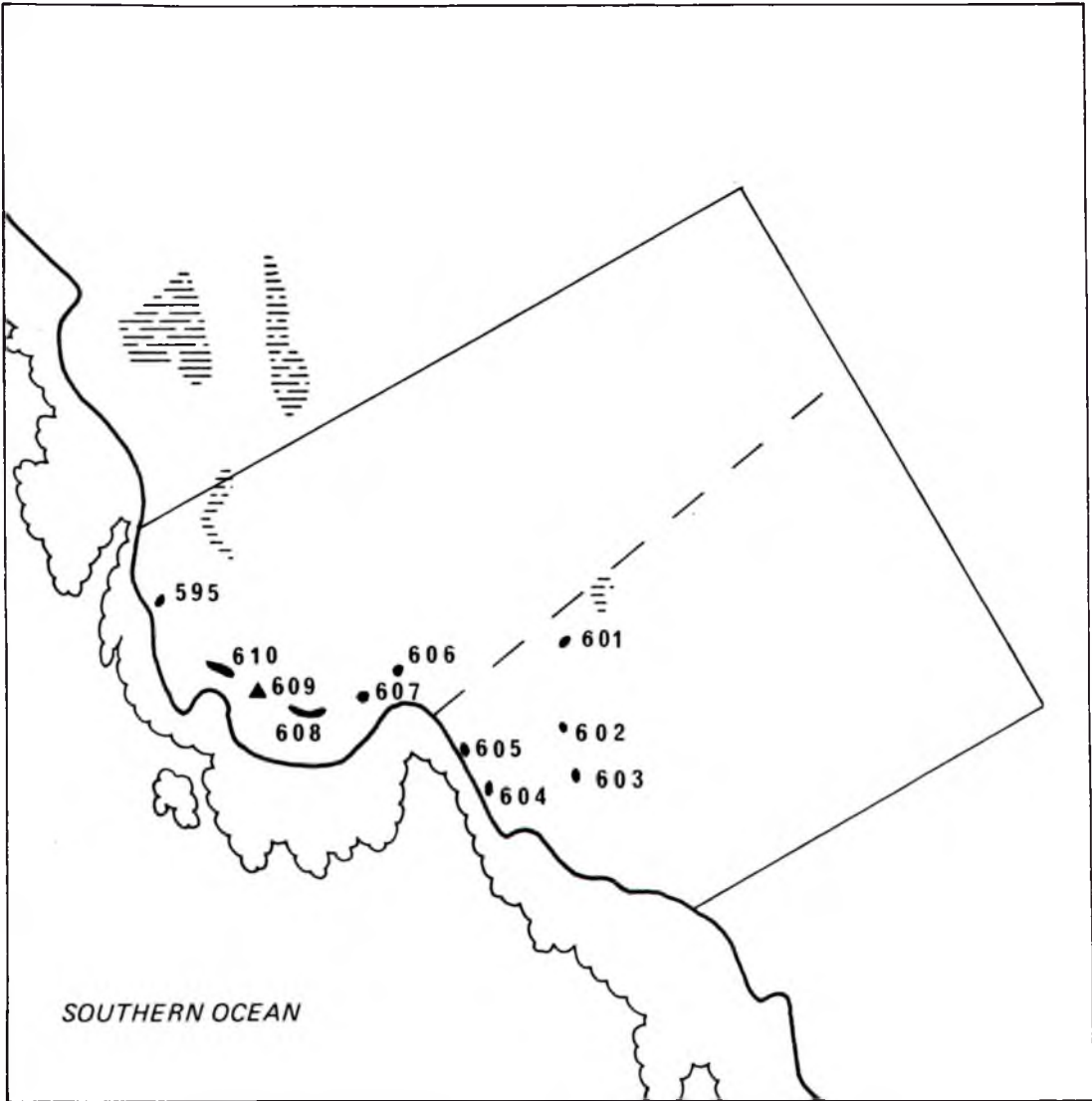


Drawn from measurements from enlargement at 1:8,000 of Lands Department air photograph Project F472-Coastal Photography, Run 9, T810-133, 8.1.80 at 1:40,000 and elevations calculated by clinometer.

	average annual rainfall	750-1,000 mm
LAND SYSTEM		
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	relatively unmetamorphosed sedimentary rocks overlain by an aeolian sandsheet undulating sandy podsols mixed	
VEGETATION -STRUCTURE -ASSOCIATION	very open low shrubs scattered <u>Leucopogon parviflorus</u> shrubs in a grassland dominated by introduced pasture species.	
PREHISTORIC MIDDEN VOLUME	34 m ³	PRESENT LAND USE
		grazing







100m

Drawn from enlargement at 1:8000 of Lands Department air photograph
Project F472 - Coastal photography, Run 9, T810-133, 8.1.80 at 1:40,000

Figure A2.16 Cuvier Point south quadrat

QUADRAT: Curvier Point South

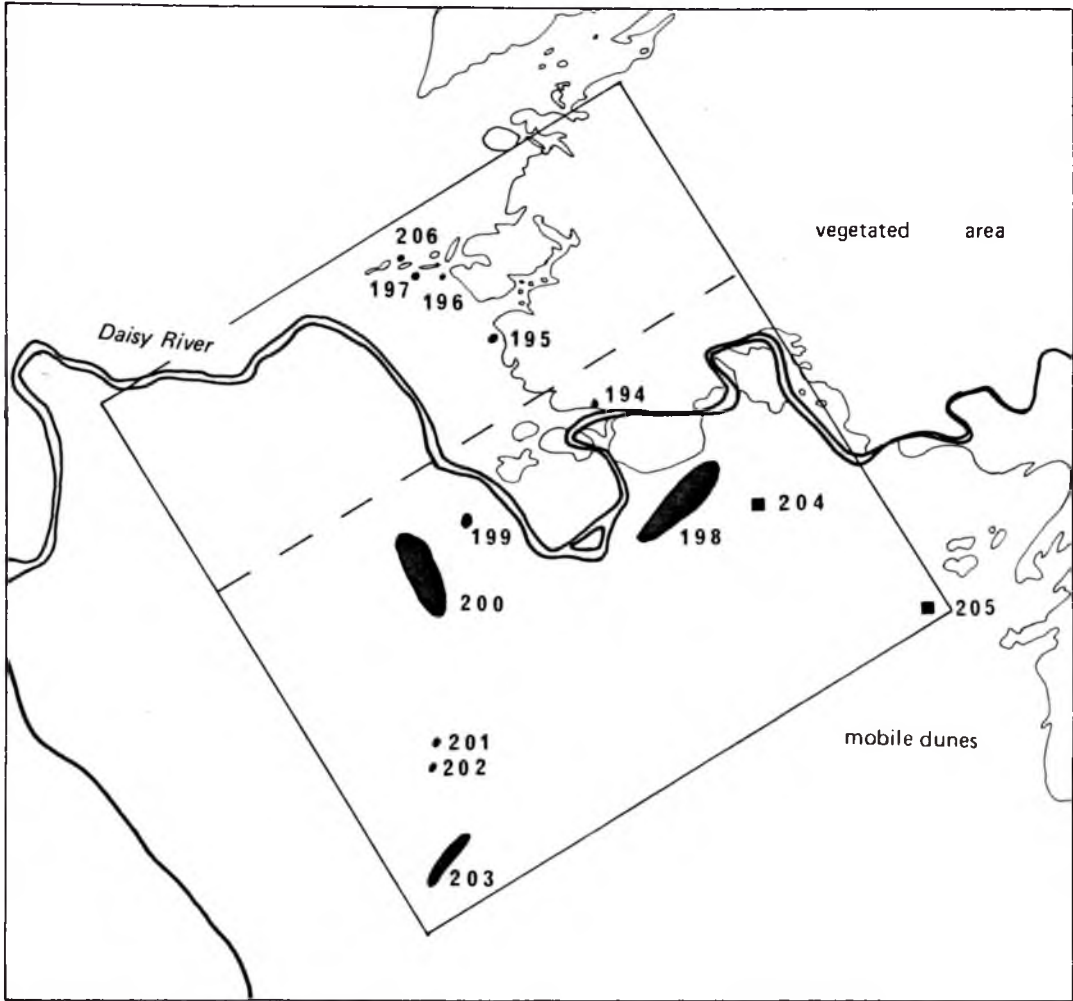


Drawn from measurements from enlargement at 1:8,000 of Lands Department air photograph Project F472- Coastal Photography, Run 9, T810-133, 8.1.80 at 1:40,000 and elevations calculated by clinometer.

	average annual rainfall	750 - 1,000 mm
LAND SYSTEM		
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	relatively unmetamorphosed sedimentary rocks overlain by an aeolian sandsheet undulating sandy podsols mixed	
VEGETATION -STRUCTURE -ASSOCIATION	very open low shrubs scattered <u>Leucopogon parviflorus</u> shrubs in a grassland dominated by introduced pasture species.	
PREHISTORIC MIDDEN VOLUME	33m ³	PRESENT LAND USE
		grazing







100 m

Drawn from enlargement at 1:5,700 of Lands Department air photograph
Project F 472 - Coastal Photography, Run 26, T 790-53, 1.2.79; at 1:40,000

Figure A2.17 Daisy River quadrat

QUADRAT: Daisy River

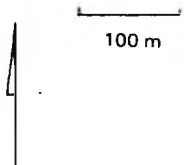
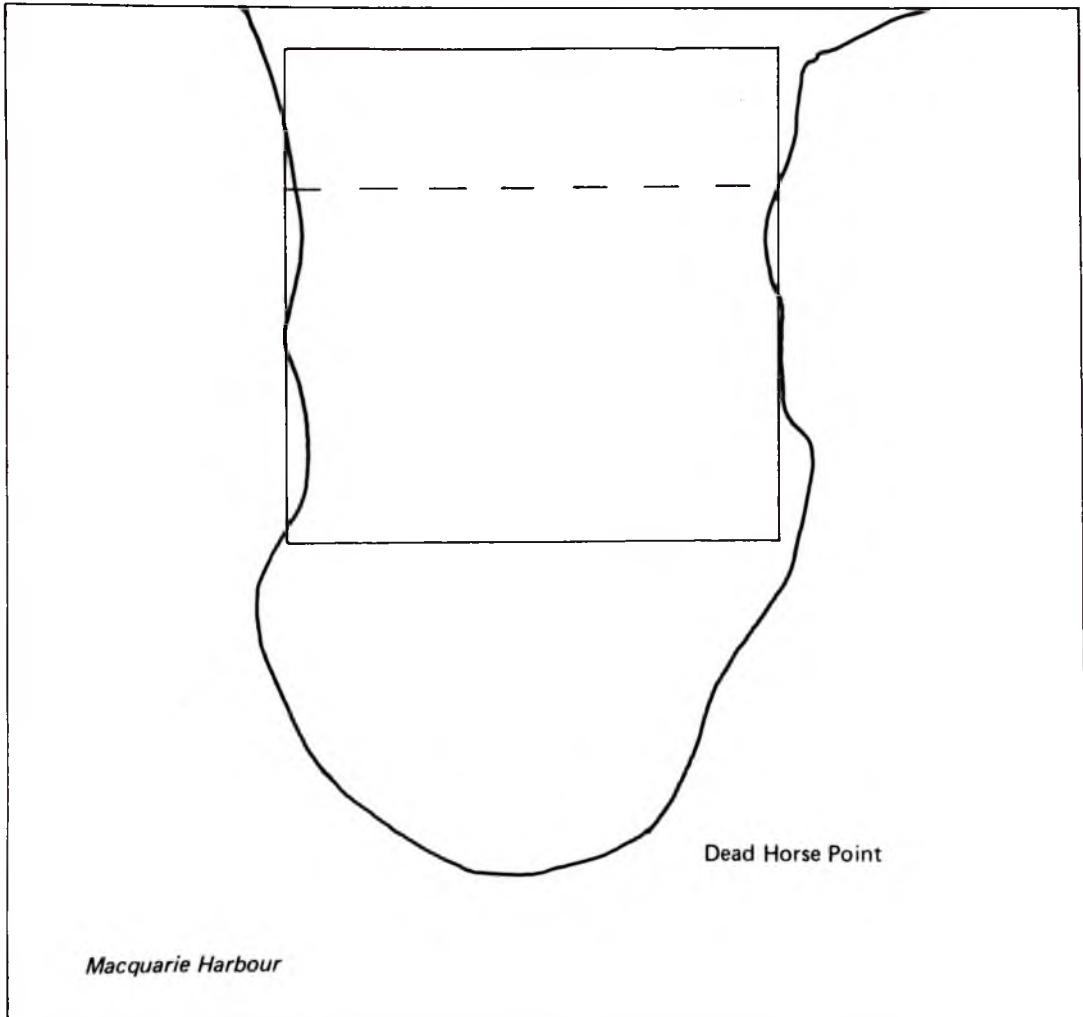


Drawn from enlargement at 1:5,700 of Lands Department air photograph Project F472-Coastal Photography, Run 26, 1.2.79 at 1:40,000 and elevations calculated by clinometer.

	average annual rainfall	1,250-1,500 mm
LAND SYSTEM	Tenna	
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	Quaternary sands undulating sandy podsols soft	
VEGETATION -STRUCTURE -ASSOCIATION	closed tall shrubs dominated by <u>Leptospermum laevigatum</u>	
PREHISTORIC MIDDEN VOLUME	171m ³	PRESENT LAND USE grazing



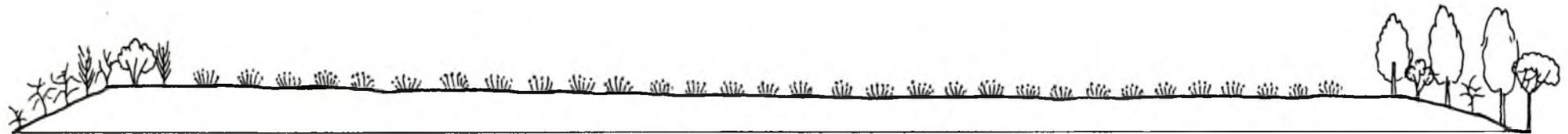




Drawn from enlargement at 1:4400 of Lands Department air photograph
Project F351 - Strahan-Zeehan, Run 10, T631-210, 11.1.73 at 1:12,000

Figure A2.18 Dead Horse Point quadrat

QUADRAT: Dead Horse Point

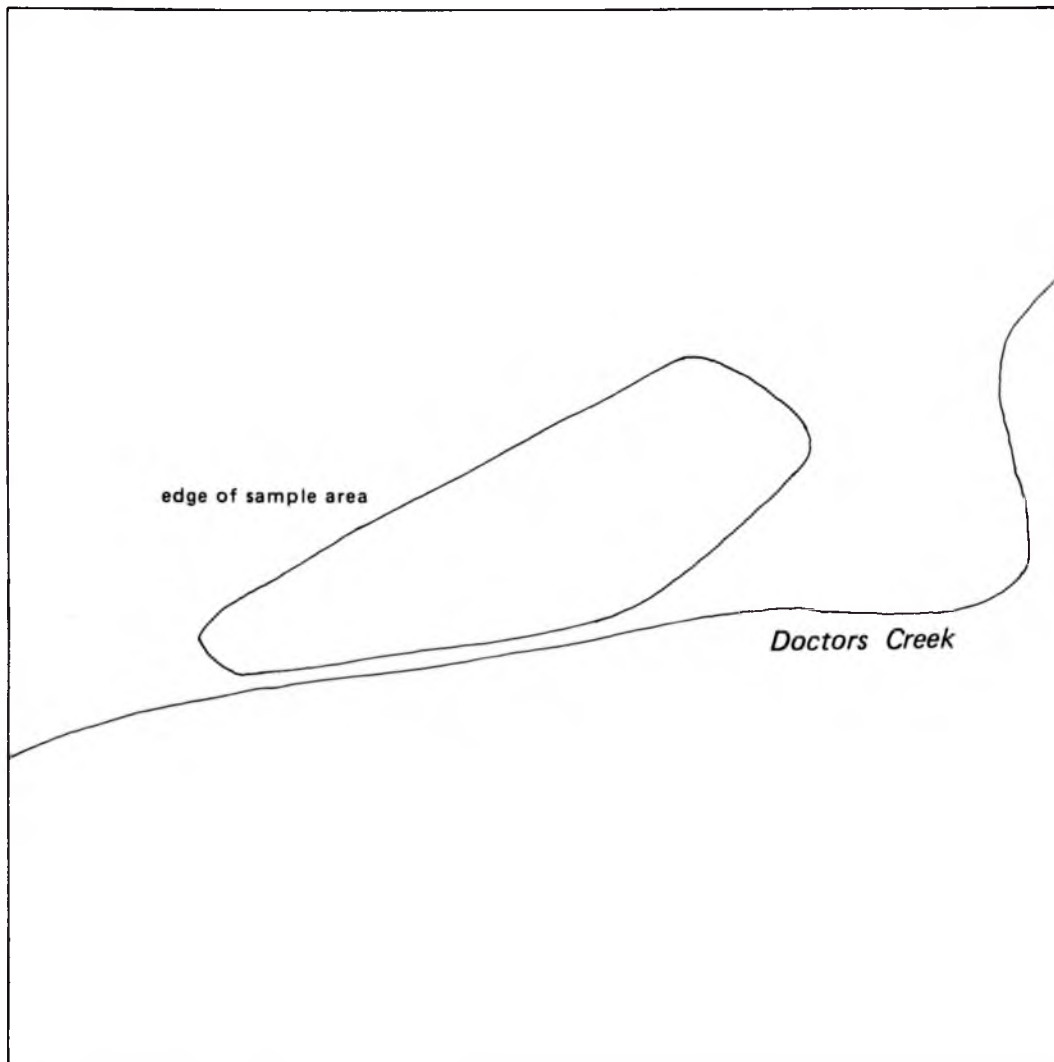


Drawn from enlargement at 1:4464 of Lands Department air photograph Project F351-Strahan Zeehan, Run 10, T613-210 with elevations calculated by clinometer.

	average annual rainfall 1,500-1,750mm
LAND SYSTEM	Macquarie Harbour
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	interbedded sandstone, siltstone, clay and conglomerate with lignite scarps and foot slopes sandy peat mixed, fresh water diluted
VEGETATION -STRUCTURE -ASSOCIATION	closed sedgland dominated by <u>Gymnoschoenus sphaerocephalus</u> , with <u>Eucalyptus nitida</u> <u>Leptospermum scoparium</u> , <u>Melaleuca ericifolia</u> and <u>Acacia verticillata</u> on the slopes
PREHISTORIC MIDDEN VOLUME	0m ³
PRESENT LAND USE	nil





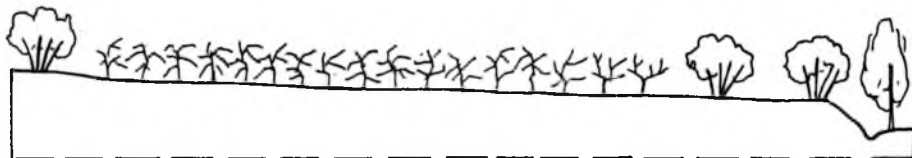


100m

Drawn from Lands Department air photograph Project
F - 472 - Coastal Photography, Run 26, T790 - 41,
1.2.79 at 1:40,000

Figure A2.19 Doctors Creek quadrat

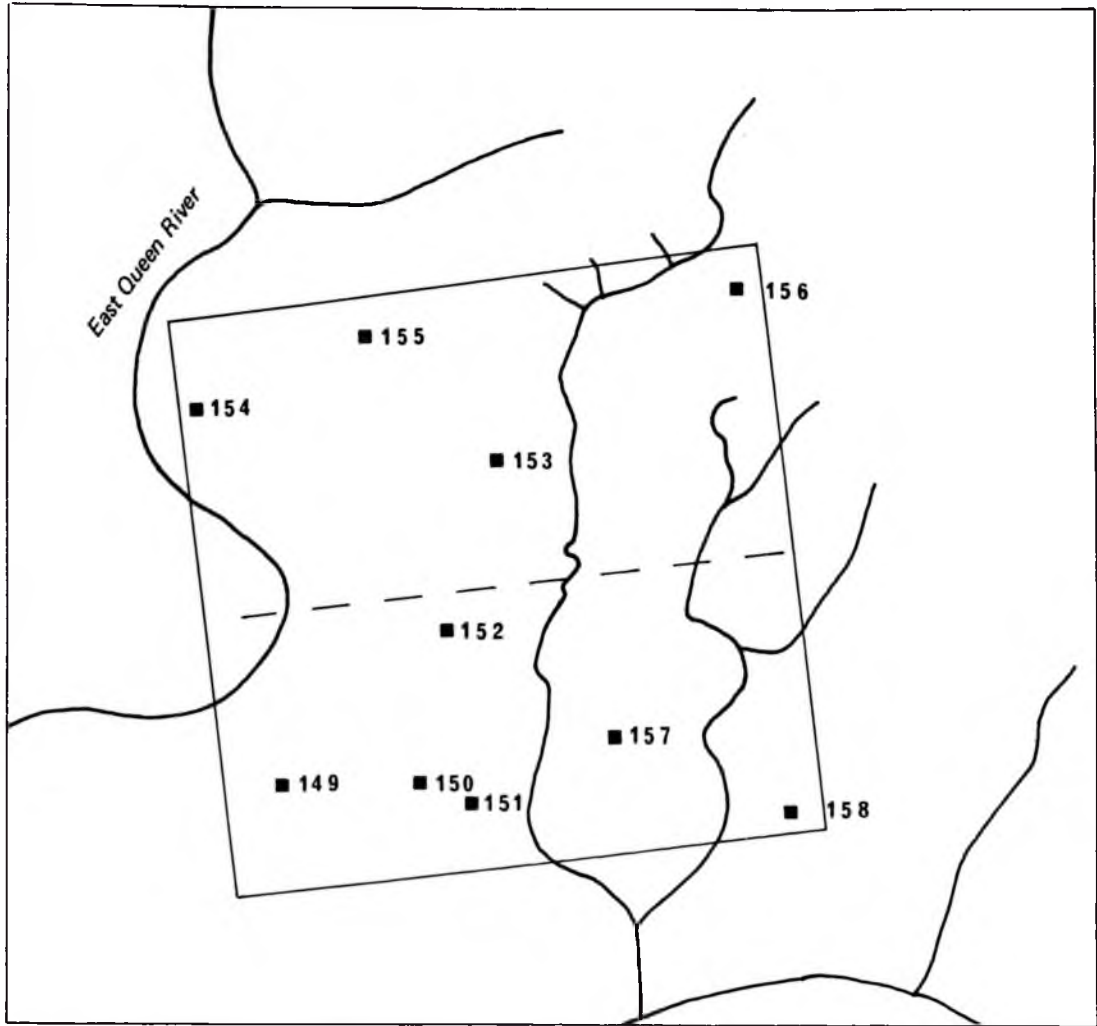
QUADRAT: Doctors Creek



	average annual rainfall	1,000-1,250mm
LAND SYSTEM	Temna	
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	relatively unmetamorphosed sedimentary rocks gentle slopes sandy podsol n/a	
VEGETATION -STRUCTURE -ASSOCIATION	open scrubland on flat and open woodland along creek dominated by <u>Leptospermum scoparium</u> and <u>Melaleuca squarrosa</u> with <u>Eucalyptus</u> sp. along creek	
PREHISTORIC MIDDEN VOLUME	n/a	PRESENT LAND USE
		grazing







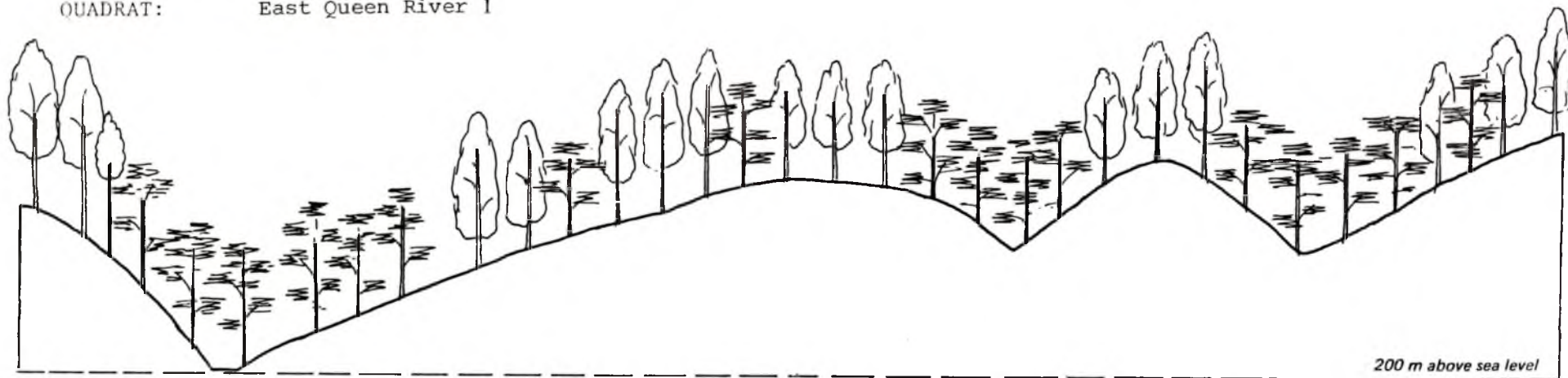
100 m

Drawn from Lands Department air photograph Project F 424 King, Franklin, Gordon, Run 2, T 649-61, 24.1.74, at 1:20,000

Figure A2.20 East Queen River 1 quadrat

QUADRAT:

East Queen River 1

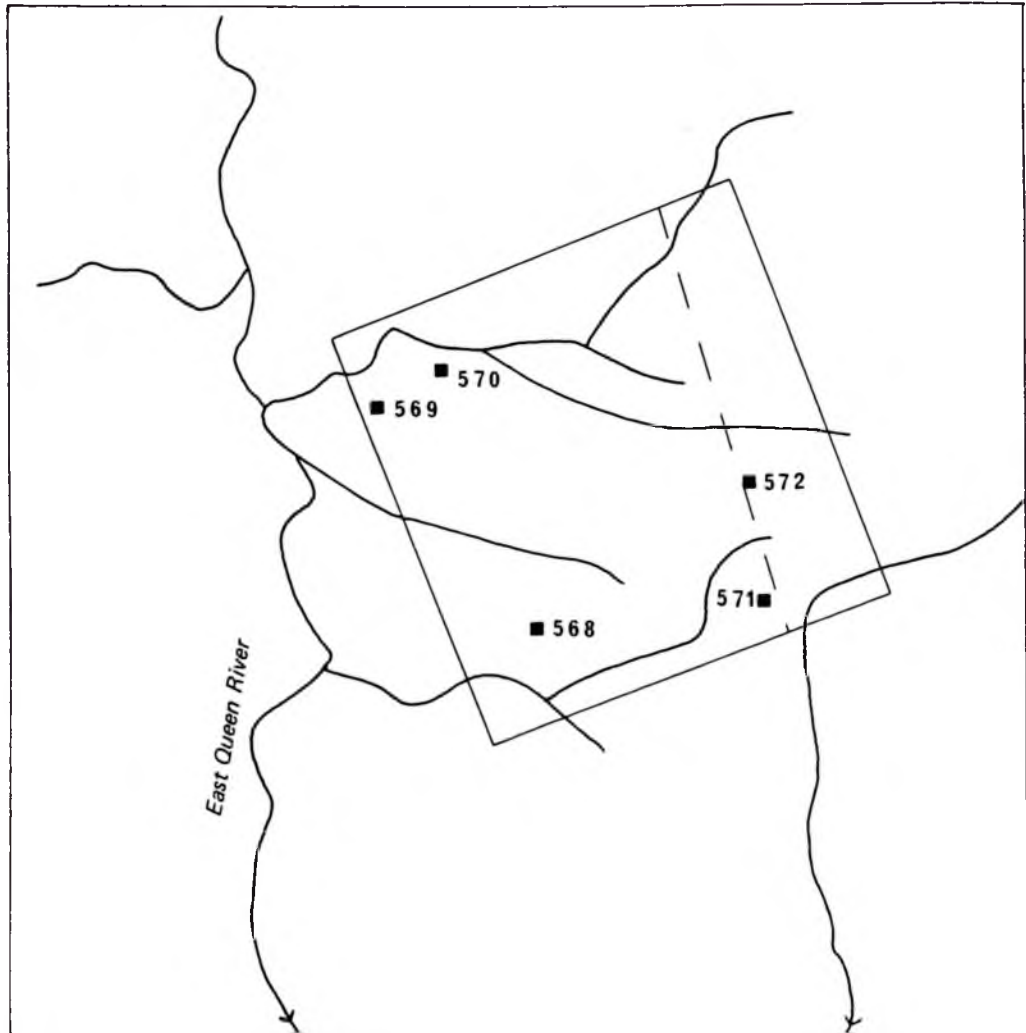


Drawn from published 1:100,000 Franklin sheet and Lands Department air photograph Project F424-King Franklin Gordon series, Run 2, T649-61, 24.1.74, at 1:20,000

	average annual rainfall	2,500-2,750 mm
LAND SYSTEM	Rosebury	
GEOLOGY	mixed volcanics	
-BEDROCK	rugged foothills with steep slopes	
-TOPOGRAPHY	mixed	
-SOIL	n/a	
-SHORE TYPE		
VEGETATION	mixed tall forest (before European settlement)	
-STRUCTURE	overstorey dominated by <u>Eucalyptus nitida</u> on the ridges and <u>Nothofagus cunninghamii</u> in the gullies	
-ASSOCIATION		
PREHISTORIC MIDDEN VOLUME	n/a	PRESENT LAND USE
		Mining







100m

Drawn from Lands Department air photograph Project F424 – King, Franklin, Gordon, Run 2, 24.1.74, at 1:20,000

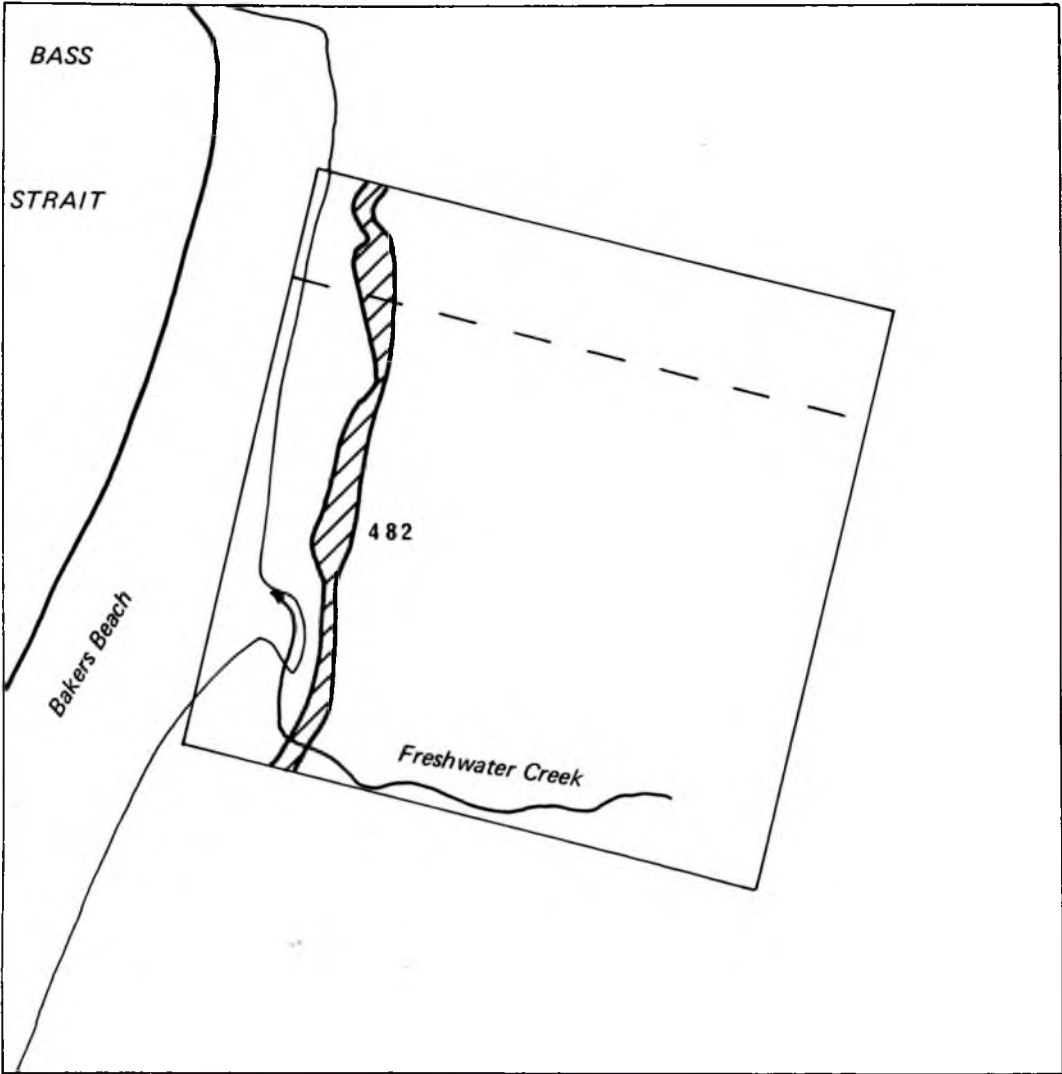
Figure A2.21 East Queen River 2 quadrat

QUADRAT: East Queen River 2



Drawn from measurements from Lands Department air photograph Project F424 - King Franklin Gordon, Run 2, T649-61, 24.1.74 at 1:20,000 and elevations calculated by clinometer.

	average annual rainfall 2,500 - 2,700 mm	
LAND SYSTEM	Rosebury	
GEOLOGY	mixed volcanics	
-BEDROCK	rugged foothills with steep slopes	
-TOPOGRAPHY	mixed	
-SOIL	n/a	
-SHORE TYPE		
VEGETATION	mixed tall forest	
-STRUCTURE	overstorey dominated by <u>Eucalyptus nitida</u> on the ridges and <u>Nothofagus cunninghamii</u> in the gullies	
-ASSOCIATION		
PREHISTORIC MIDDEN VOLUME	n/a	PRESENT LAND USE mining

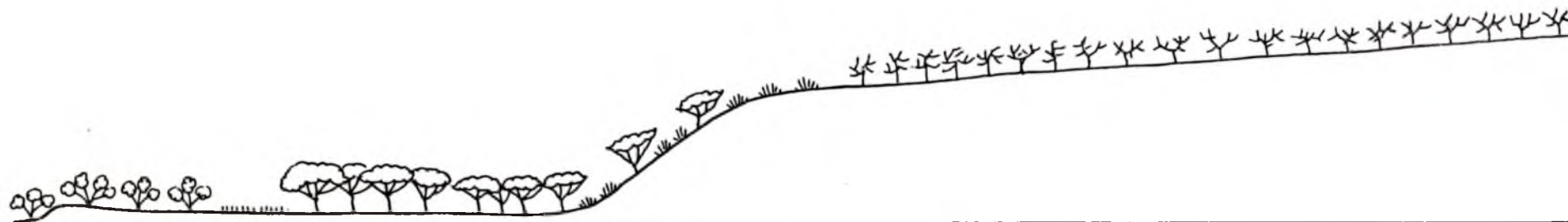


100m

Drawn from enlargement at 1:4200 of Lands Department air photograph
Project F563 - Forth, Run 1, T745-326, 19.2.78, at 1:30,000

Figure A2.22 Freshwater Creek quadrat

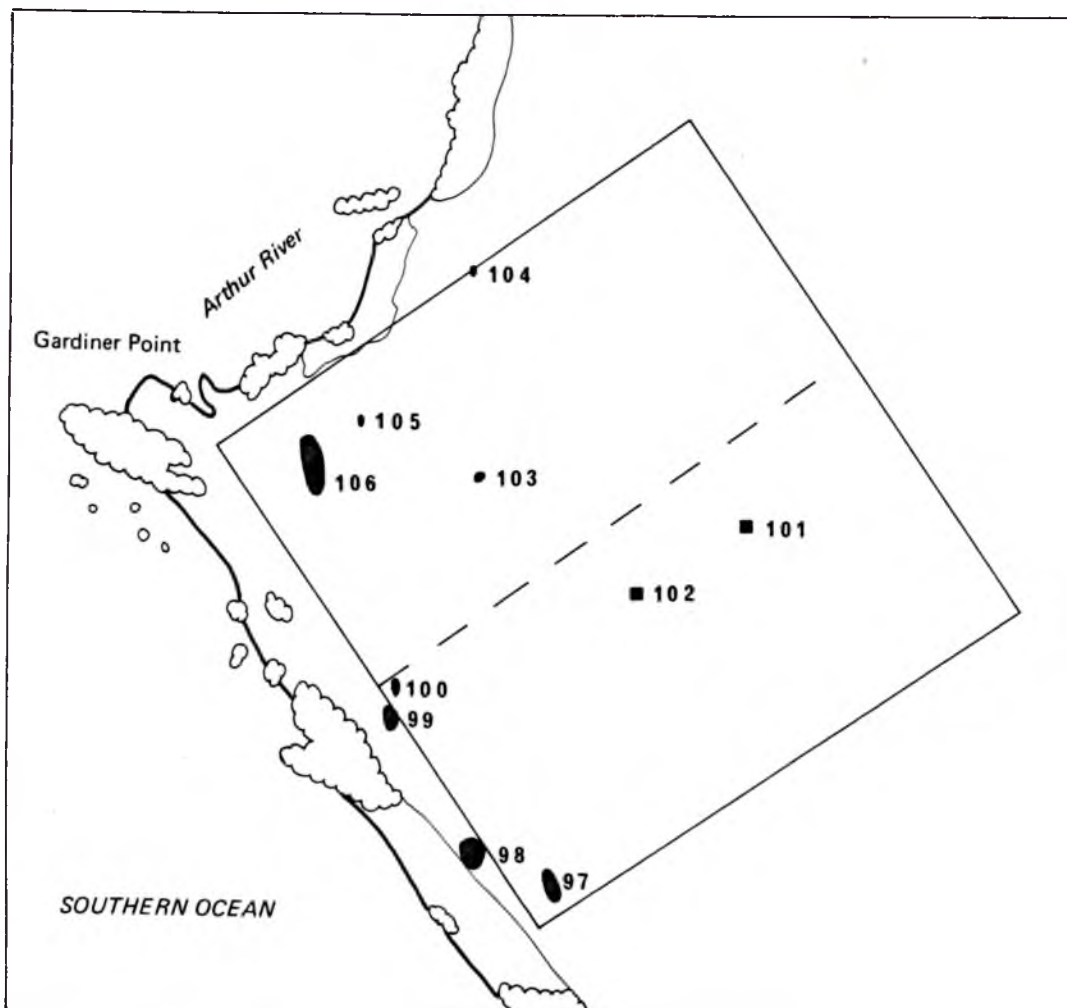
QUADRAT: Freshwater Creek



Drawn from published 1:100,000 Tamar sheet and enlargement at 1:4,300 of Lands Department air photograph Project F563-Forth, Run 1, T 745-236, 19.2.78 at 1:30,000.

	average annual rainfall 800 - 900 mm
LAND SYSTEM	Binalong Bay/Asbestos Range
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	Quaternary - recent sands/Precambrian quartzites and phyllites undulating dunes/steep hill slopes calcareous sandy soils/brown gravelly loam mixed
VEGETATION -STRUCTURE -ASSOCIATION	coastal heath/closed heathland <u>Acacia sophorae</u> and <u>Melaleuca ericifolia</u> / <u>Leptospermum scoparium</u>
PREHISTORIC MIDDEN VOLUME 200 m ³	PRESENT LAND USE nature conservation



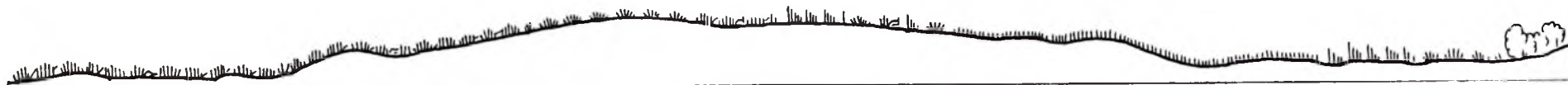


100 m

Drawn from enlargement at 1:10,000 of Lands Department air photograph
Project F 472 - Coastal Photography, Run 26, T 790-45, 1.2.79, at 1:40,000

Figure A2.23 Gardiner Point quadrat

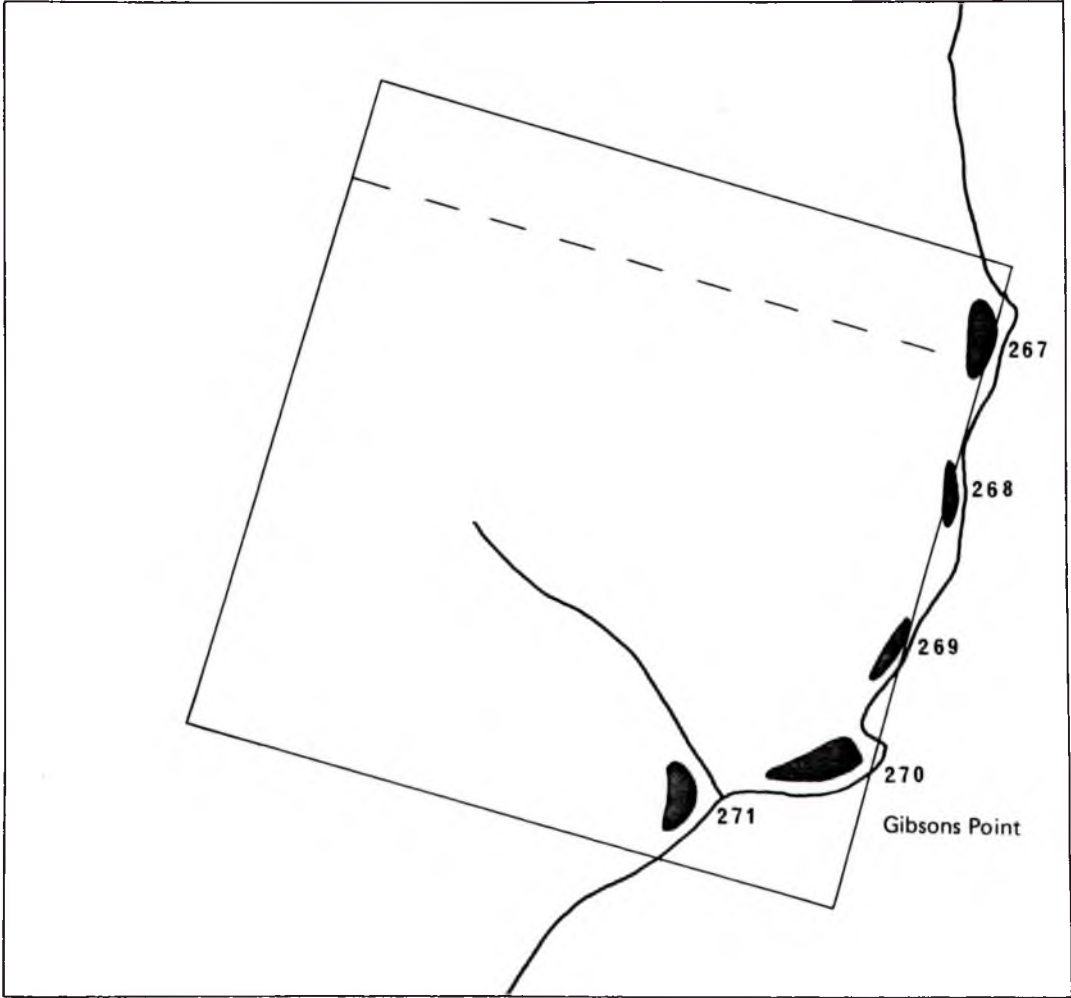
QUADRAT: Gardiner Point



Drawn from elevations calculated by clinometer and measurements from enlargement at 1:10,000 of Lands Department air photograph Project F472-Coastal Photography, Run 26, T790-45, 1.2.79 at 1:40,000

	average annual rainfall	1,000-1,250 mm	
LAND SYSTEM	Temma		
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	relatively unmetamorphosed sedimentary rocks undulating sandy podsoils soft		
VEGETATION -STRUCTURE -ASSOCIATION	closed tussock grassland and closed grassland dominated by <u>Lomandra longifolia</u> and pasture grasses respectively		
PREHISTORIC MIDDEN VOLUME	132m ³	PRESENT LAND USE	grazing and recreation





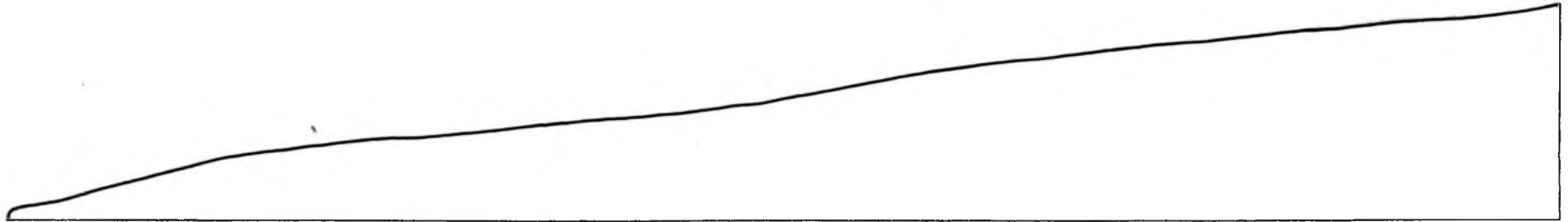
100m

Drawn from unpublished Lands Department compilation map at 1:15,000

Figure A2.24 Gibsons Point quadrat

QUADRAT:

Gibsons Point

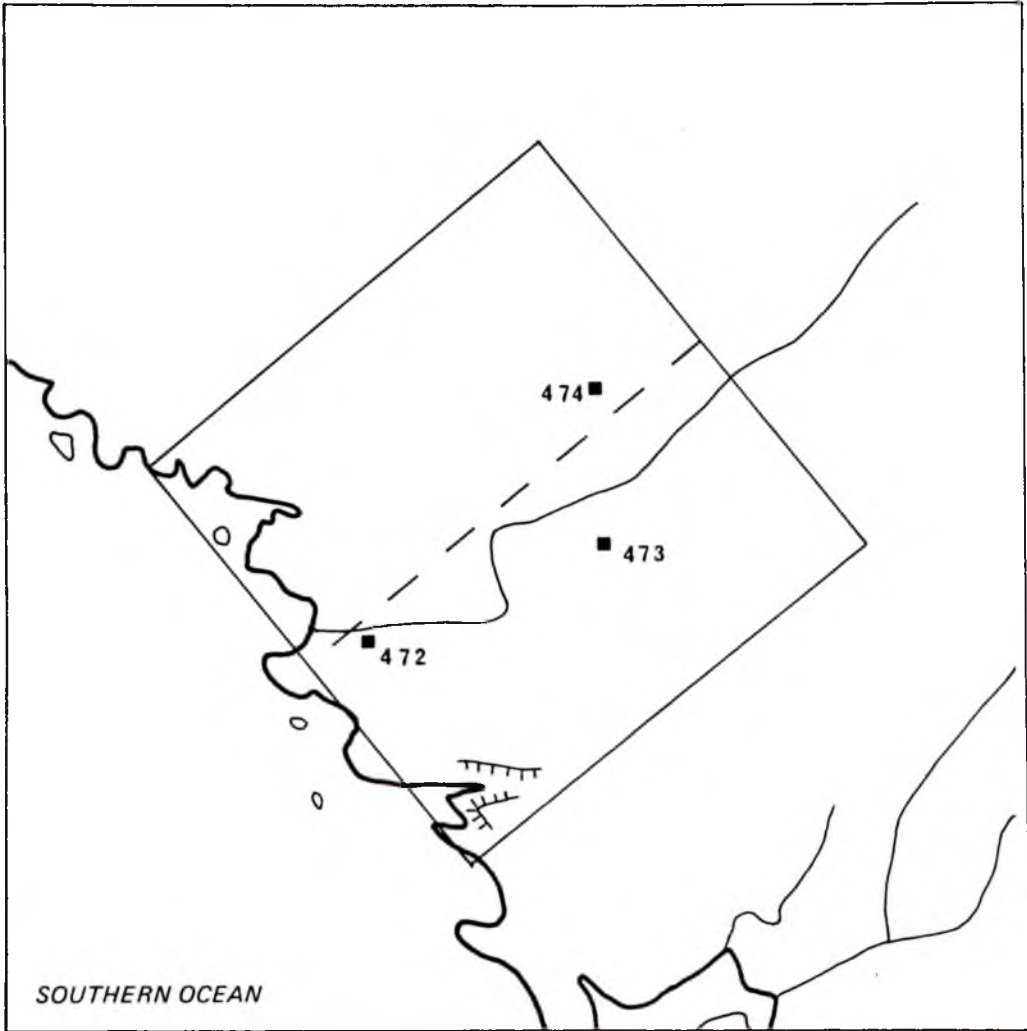


Drawn from unpublished Lands Department map at 1:15,000

	average annual rainfall
LAND SYSTEM	
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	dolerite hillslopes with beach cliffs mixed
VEGETATION -STRUCTURE -ASSOCIATION	n/a n/a
PREHISTORIC MIDDEN VOLUME	540m ³
PRESENT LAND USE	agriculture





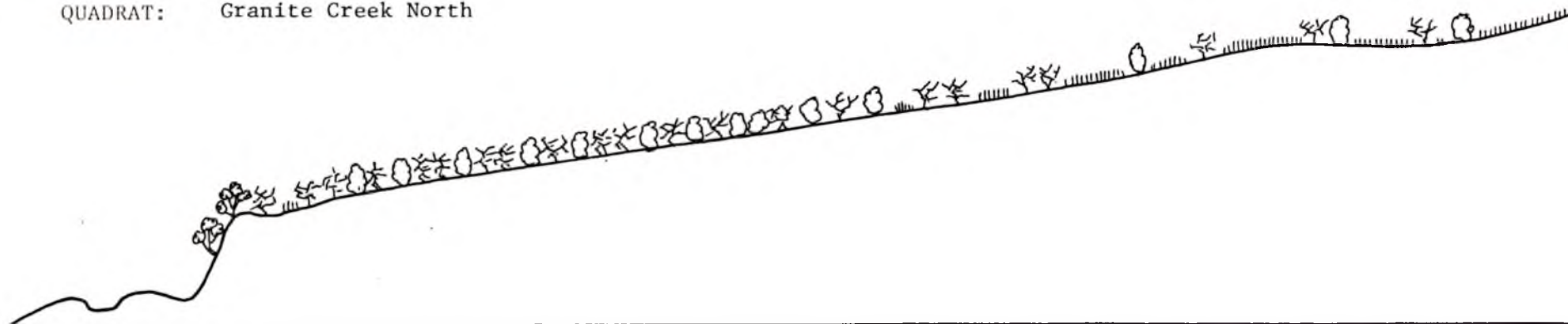


100m

Drawn from enlargement at 1:7100 of Lands Department air photograph
Project F 617 - South West, Run 4, T 793-69, 20.2.79, at 1:50,000

Figure A2.25 Granite Creek north quadrat

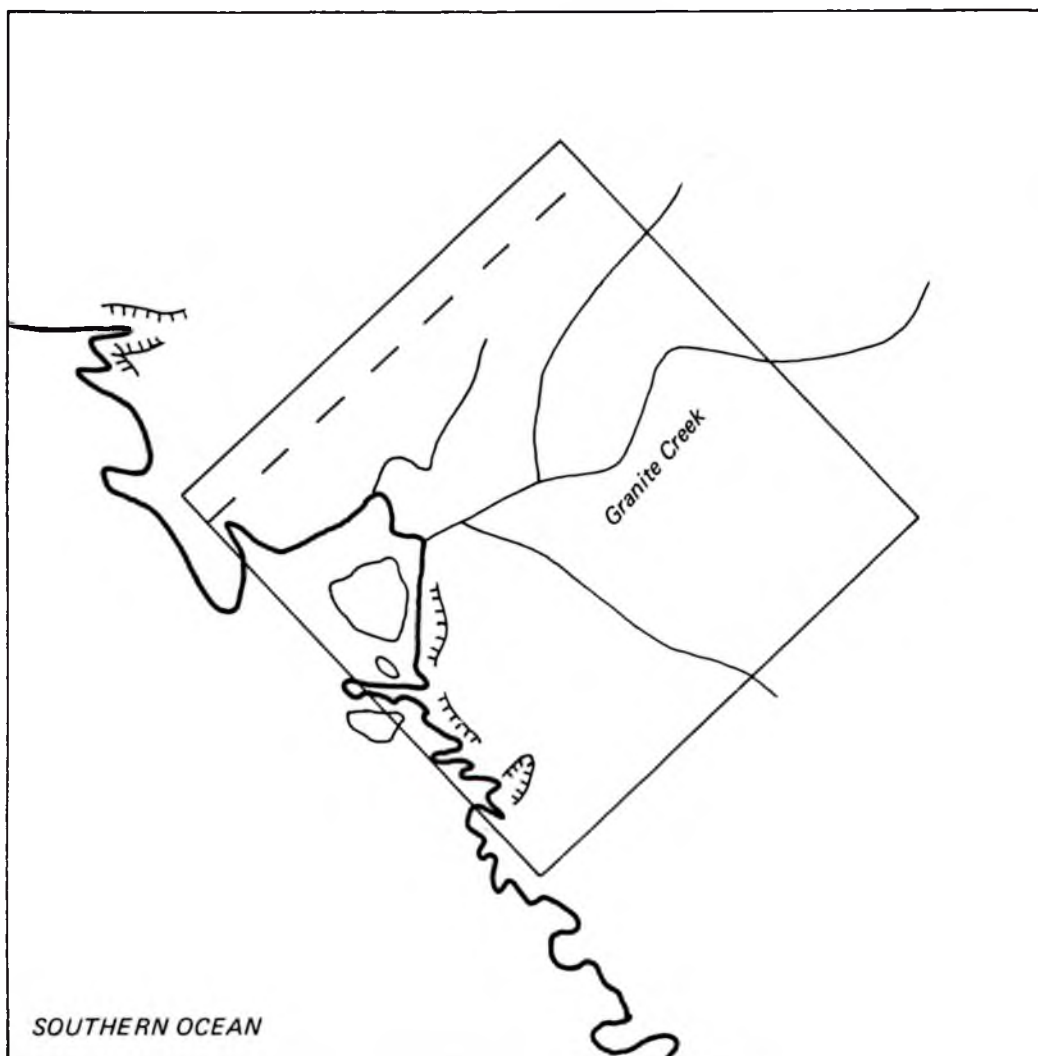
QUADRAT: Granite Creek North



Drawn from measurements from enlargement at 1:7,100 of Lands Department air photograph Project F617, T793-69, 20.2.79 at 1:50,000 and elevations from published Pieman 1:100,00 sheet.

	average annual rainfall	1,750 - 2,000 mm
LAND SYSTEM	Granite Creek	
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	granite coastal scarp backed by rolling slopes deeply dissected by gullies very gravelly dark grey organic soil hard	
VEGETATION -STRUCTURE -ASSOCIATION	sedgeland heath mixed sedges with low shrubs of <u>Leptospermum scoparium</u> and <u>Banksia marginata</u> .	
PREHISTORIC MIDDEN VOLUME	0 m ³	PRESENT LAND USE nil

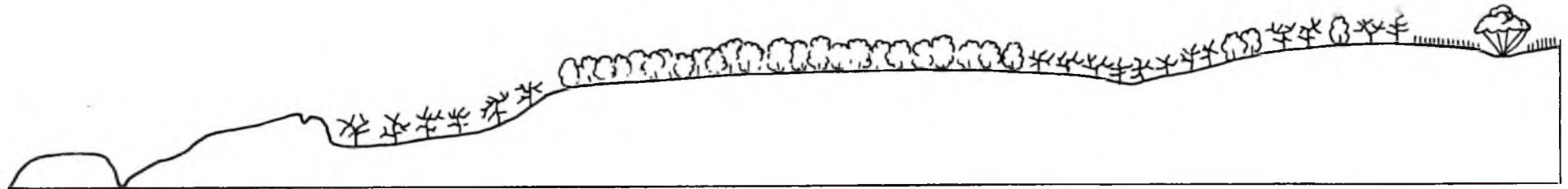




Drawn from enlargement at 1:7100 of Lands Department air photograph
Project F 617 - South West, Run 4, T 793 - 69, 20.2.79, at 1:50,000

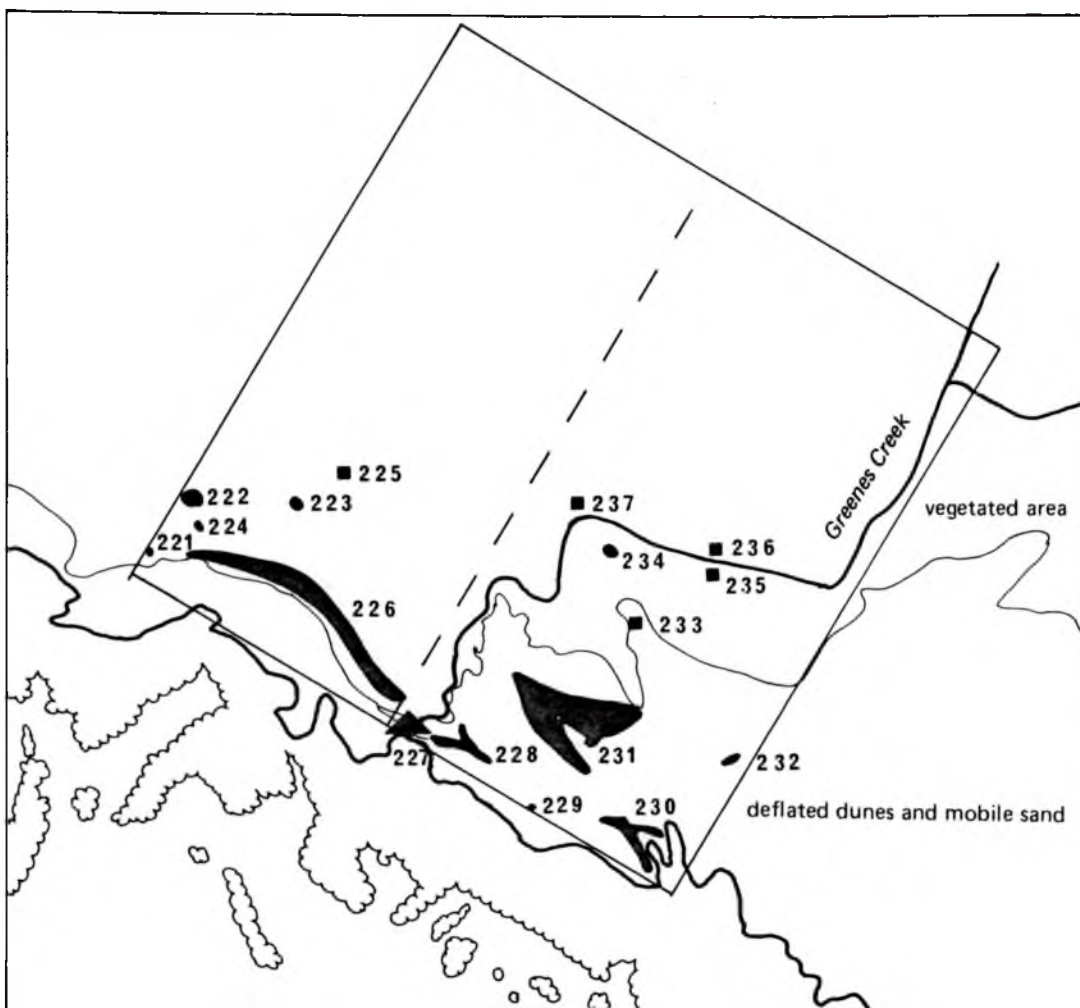
Figure A2.26 Granite Creek south quadrat

QUADRAT: Granite Creek South



Drawn from measurements from enlargement at 1:7,100 of Lands Department air photograph Project F617, T793-69, 20.2.79 at 1:50,000 and elevations from published Pieman 1:100,000 sheet.

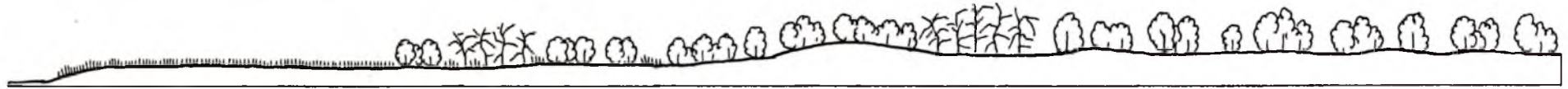
	average annual rainfall	1,750 - 2,000 mm
LAND SYSTEM	Granite Creek	
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	granite coastal scarp backed by rolling slopes, deeply dissected by gullies very gravelly dark grey organic soil with patches of clay loam hard	
VEGETATION -STRUCTURE -ASSOCIATION	sedgeland heath sedges mixed with low shrubs of <u>Leptospermum scoparium</u> , <u>Banksia marginata</u> and <u>Leptospermum glaucescens</u> .	
PREHISTORIC MIDDEN VOLUME	0 m ³	PRESENT LAND USE nil



Drawn from enlargement at 1:5,700 of Lands Department air photography
 Project F 472 - Coastal Photography, Run 26, T790-53, 1.2.79 at 1:40,000

Figure A2.27 Greenes Creek quadrat

QUADRAT: Greenes Creek

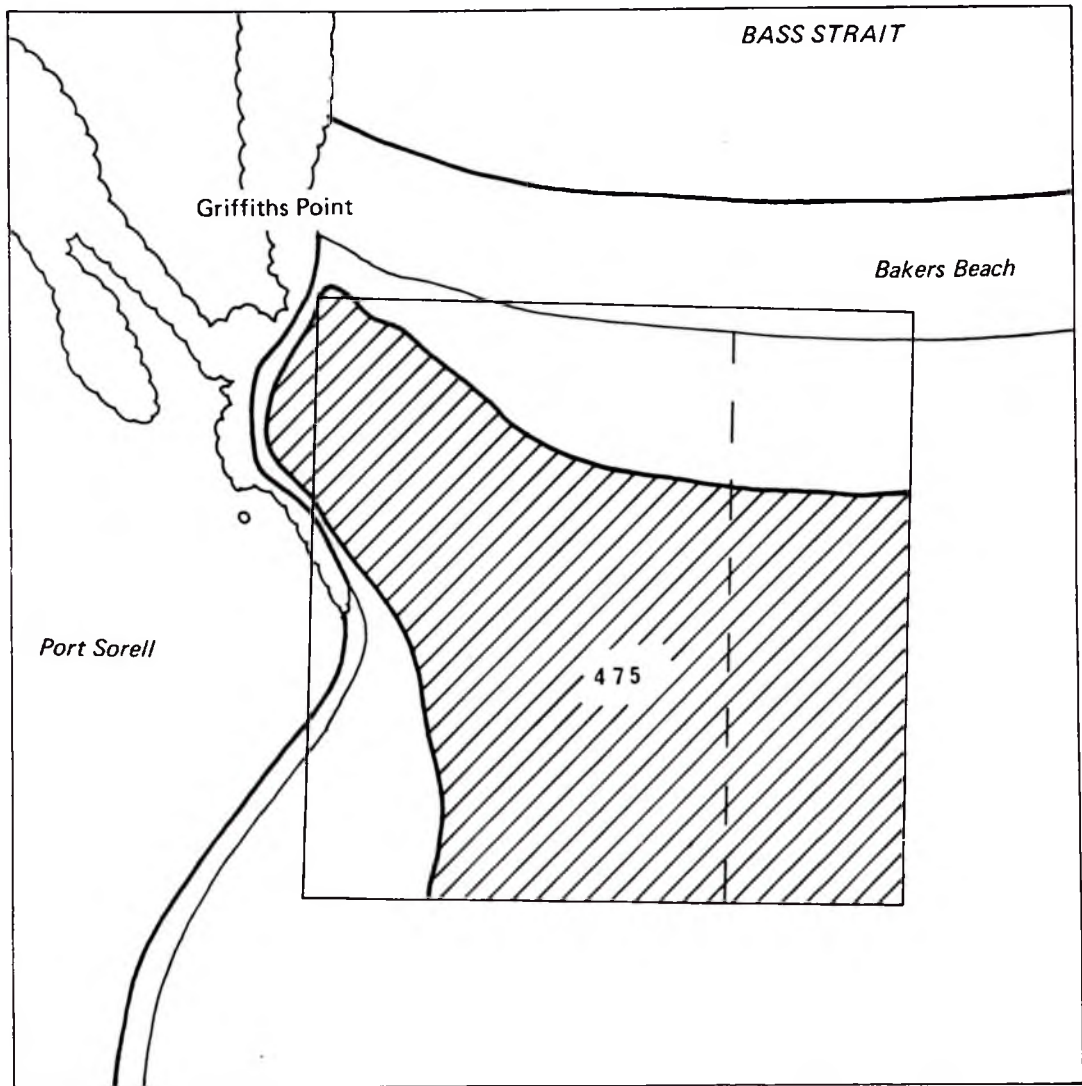


Drawn from enlargement at 1:5,700 of Lands Department air photograph Project F472-Coastal Photography, Run 26, T790-53 at 1:40,000 with elevations calculated by clinometer

	average annual rainfall	1,250-1,500mm
LAND SYSTEM	Temma	
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	relatively unmetamorphosed sedimentary rocks undulating sandy podsoles and peaty sands mixed	
VEGETATION -STRUCTURE -ASSOCIATION	open heath, with outcrops of bare rock dominated by <u>Leptospermum glaucescens</u> with patches of <u>Leptospermum squarrosa</u> in poorly drained areas	
PREHISTORIC MIDDEN VOLUME	727m ³	PRESENT LAND USE
		grazing and recreation







100m

Drawn from enlargement at 1:4200 of Lands Department air photograph
Project F563 - Forth, Run 1, T745-232, 19.2.78 at 1:30,000

Figure A2.28 Griffiths Point quadrat

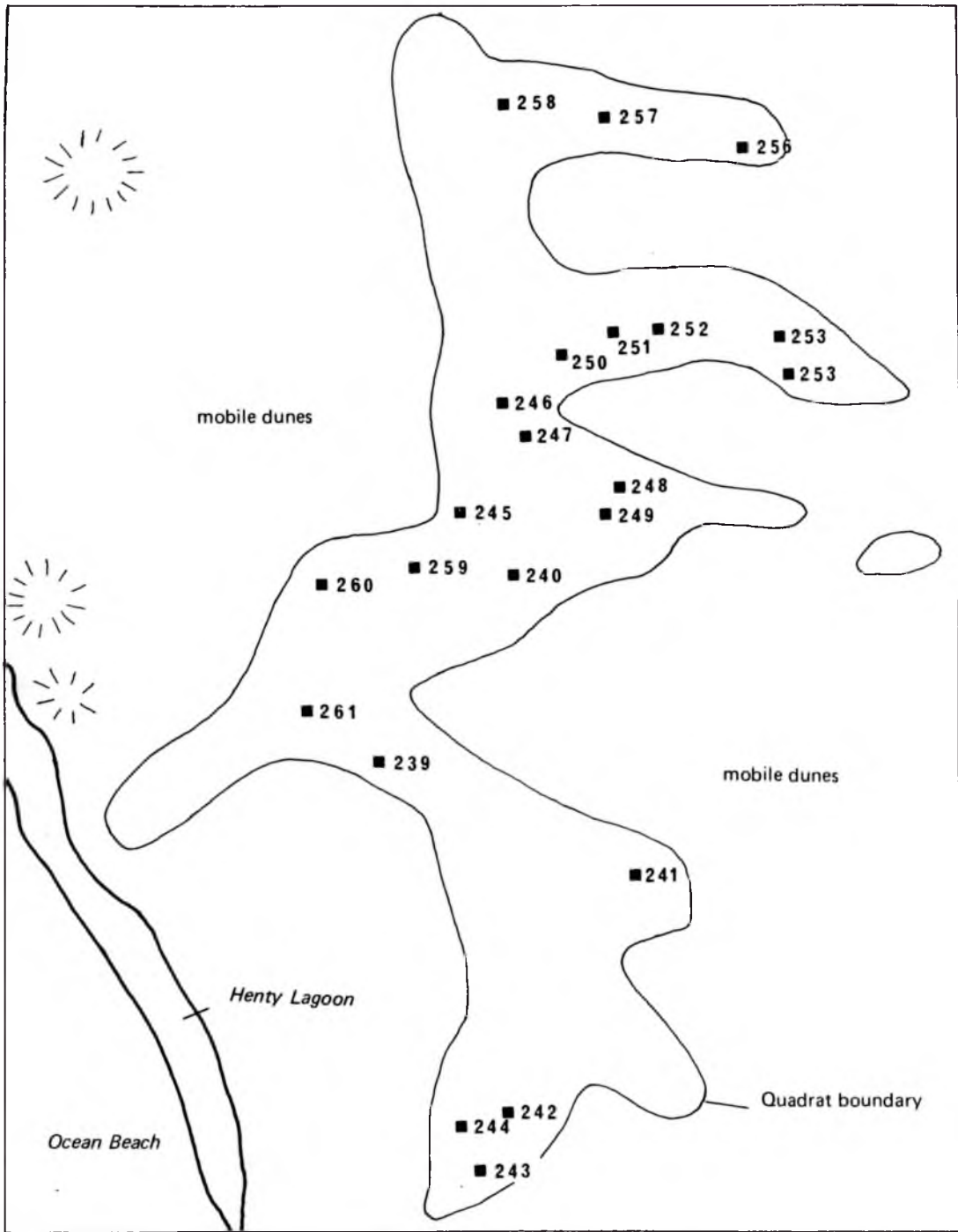
QUADRAT: Griffiths Point



Drawn from measurements from enlargement at 1:4,300 of Lands Department air photograph Project F563-Forth, Run 2, T750-125, 19.2.78 at 1:40,000 and elevations calculated by clinometer.

	average annual rainfall 800 - 900 mm
LAND SYSTEM	Binalong Bay
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	Quaternary - recent calcareous sands overlying dolerite undulating dunes calcareous sandy soils mixed
VEGETATION -STRUCTURE -ASSOCIATION	coastal heath on foredunes, with woodland with scrub understory inland foredunes dominated by <u>Acacia sophorae</u> , merging with <u>Eucalyptus viminalis</u> woodland
PREHISTORIC MIDDEN VOLUME	500 m ³
PRESENT LAND USE	nature conservation





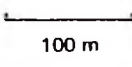
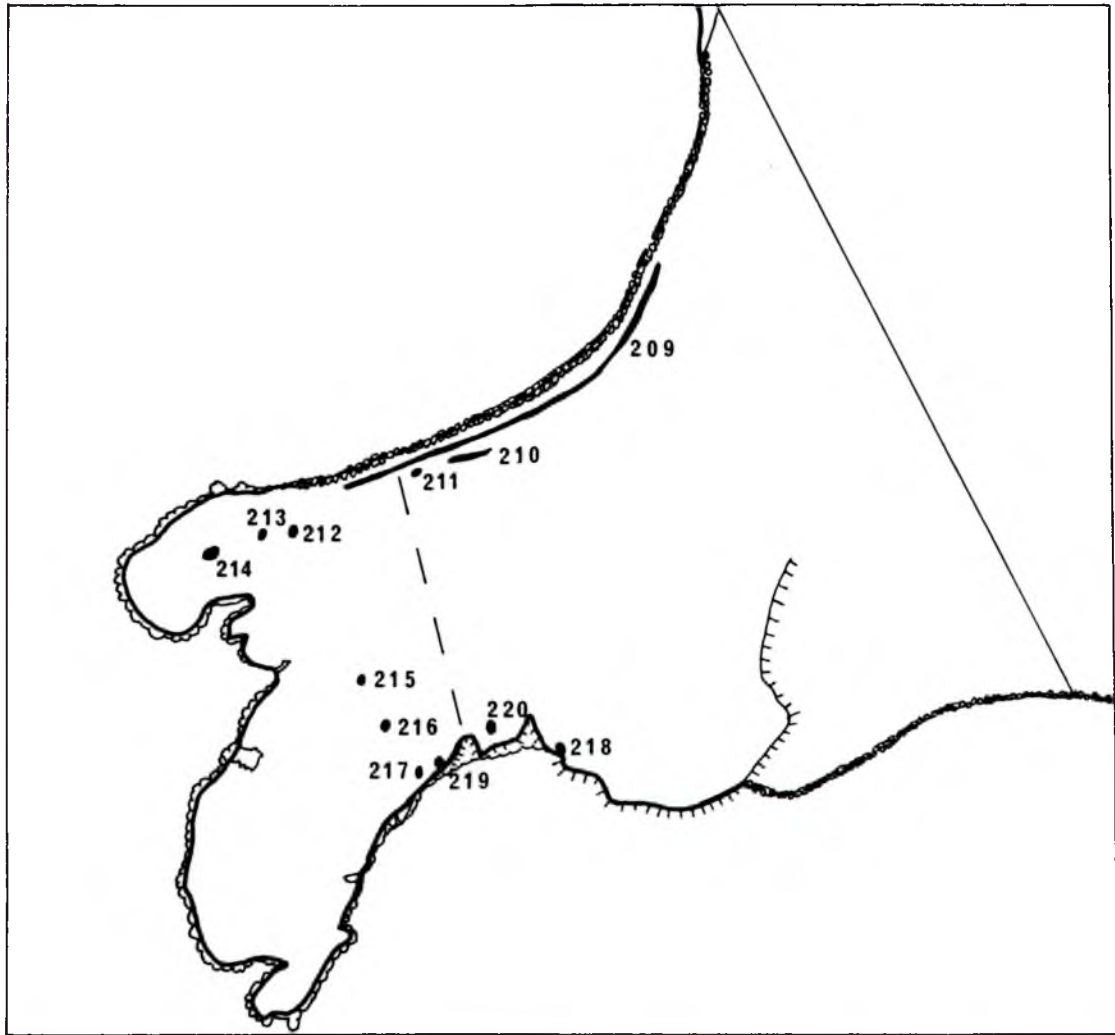
Drawn from enlargement at 1:5,700 of Lands Department air photograph
 Project F 472 - Coastal Photography, Run 27/28, T 668-158, 3.2.75, at 1:40,000

Figure A2.29 Henty Dunes quadrat

QUADRAT: Henty Dunes

	average annual rainfall	1,750-2,000mm	
LAND SYSTEM	Strahan		
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	Quaternary sands deflated dunes ? sandy podsols soft		
VEGETATION -STRUCTURE -ASSOCIATION	non existent, but was probably similar to the Ocean Beach quadrat		
PREHISTORIC MIDDEN VOLUME	0m ³	PRESENT LAND USE	nil

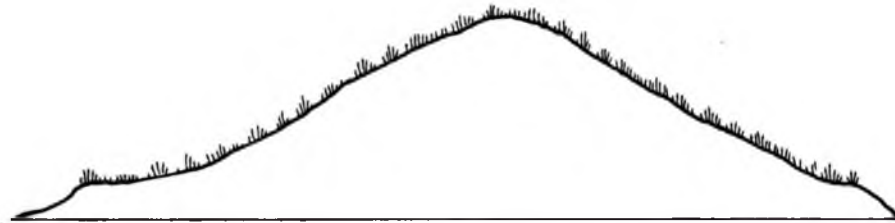




Drawn from enlargement at 1:5,700 of Lands Department air photograph
Project F 472 - Coastal Photography, Run 25, T790-33, 1.2.79, at 1:40,000

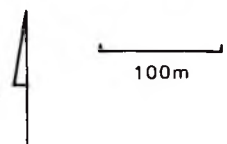
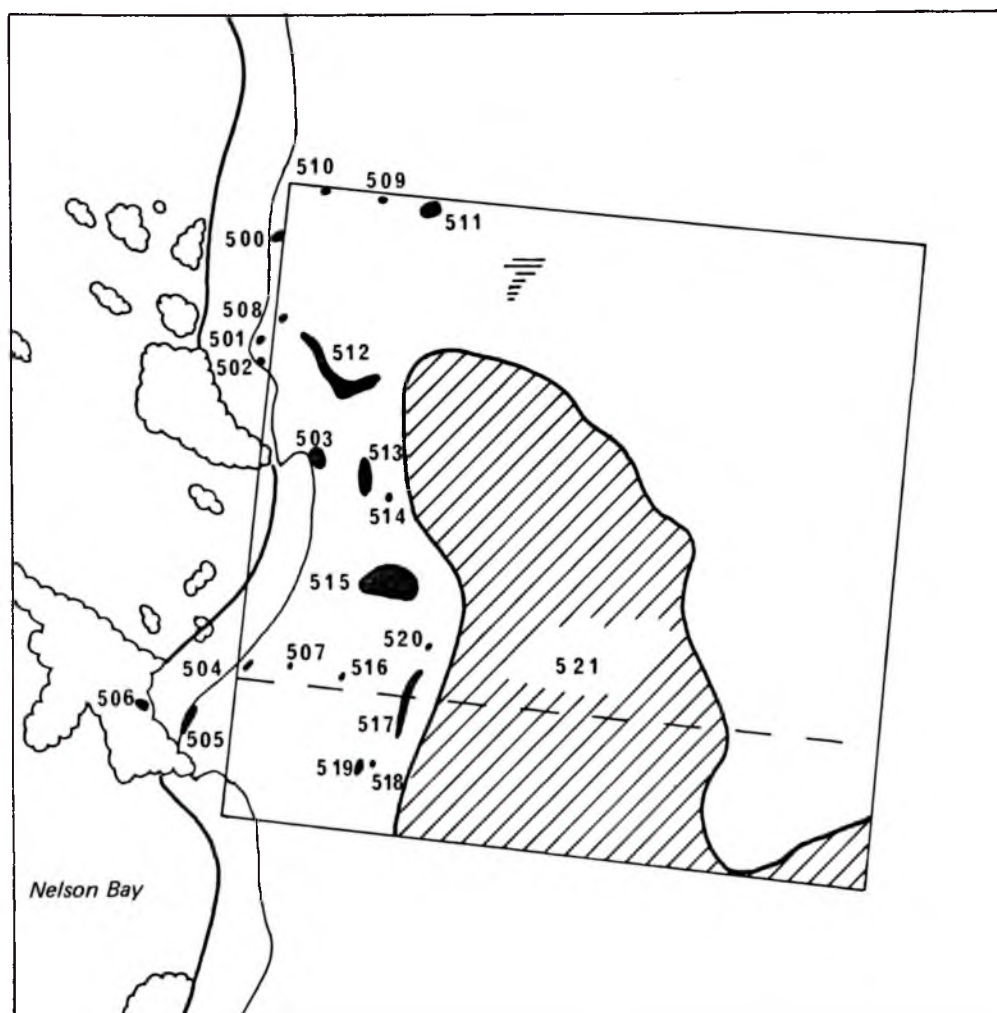
Figure A2.30 Mount Cameron West quadrat

QUADRAT: Mount Cameron West



Drawn from published 1:100,000 Welcome sheet and enlargement at 1:5,700 of Lands Department air photograph Project F472-Coastal Photography, Run 25, T790-33, 1.2.79 at 1:40,000

	average annual rainfall	1,000-1,250
LAND SYSTEM	Bluff Point	
GEOLOGY		
-BEDROCK	basalt	
-TYPOGRAPHY	seaward scarps backed by plateau and slopes	
-SOIL	clay loam	
-SHORE TYPE	mixed	
VEGETATION		
-STRUCTURE	closed tussock grassland and patches of windpruned closed shrubland	
-ASSOCIATION	dominated by tussock grasses and <u>Melaleuca ericifolia</u> respectively	
PREHISTORIC MIDDEN VOLUME	140m ³	PRESENT LAND USE
		grazing



Drawn from enlargement at 1:5500 of Lands Department air photograph
 Project F 472 - Coastal photography, Run 26, T 790-47, 1.2.79 at 1:40,000

Figure A2.31 Nelson Bay quadrat

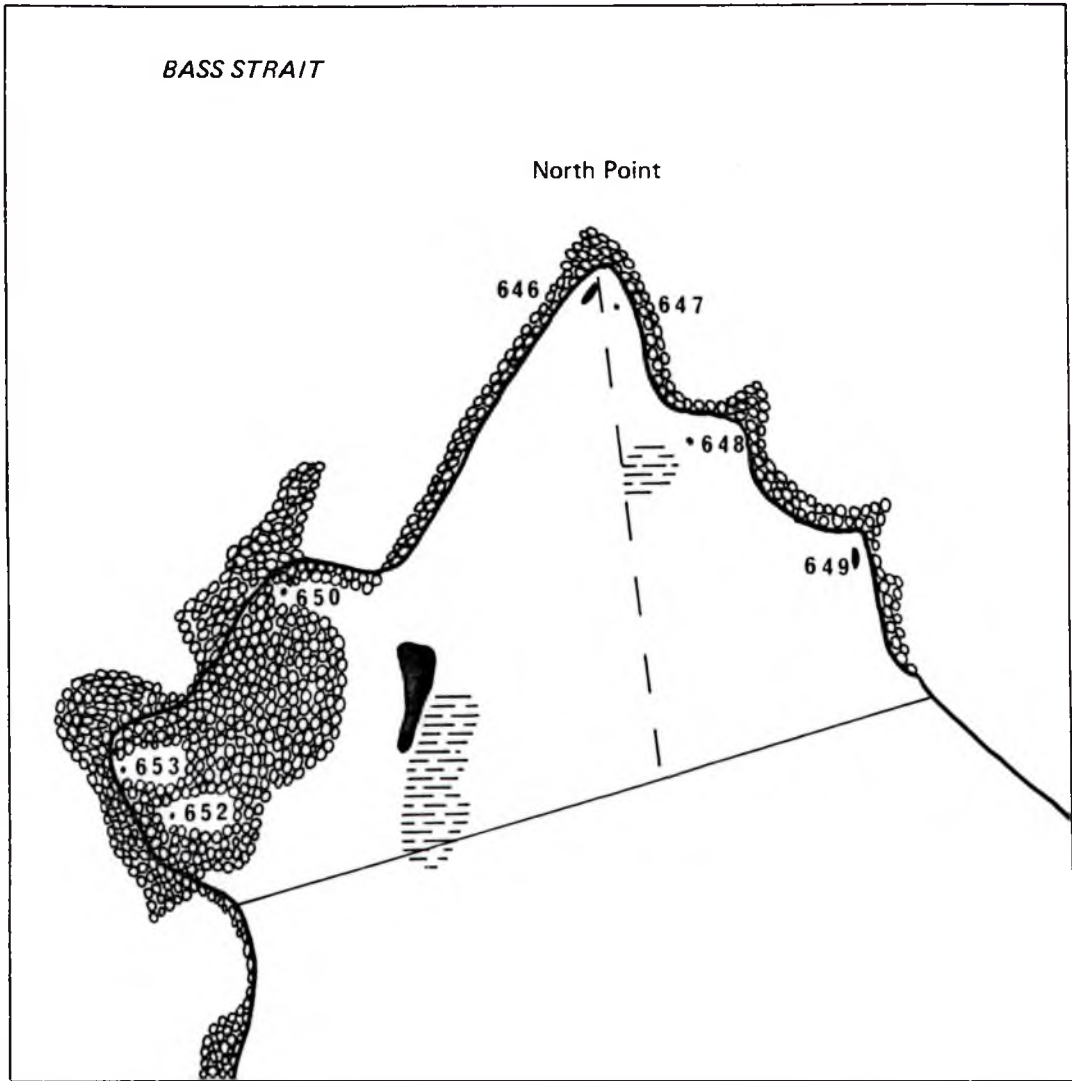
QUADRAT: Nelson Bay



Drawn from measurements from enlargement at 1:5,500 of Lands Department air photograph Project F472-Coastal Photography, Run 26, T790-47 at 1:40,000 with elevations calculated by clinometer.

	average annual rainfall 1,000 - 1,250 mm
LAND SYSTEM	Temma
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	relatively unmetamorphosed sedimentary rocks undulating sandy podsols mixed
VEGETATION -STRUCTURE -ASSOCIATION	open low shrubs on the dunes with dense tussock grass and dense tall shrubs inland dominated by <u>Lomandra longifolia</u> on dunes and hind dune areas, with <u>Melaleuca ericifolia</u> in the drainages.
PREHISTORIC MIDDEN VOLUME 93 m ³	PRESENT LAND USE grazing





BASS STRAIT

North Point

646

647

• 648

649

• 650

653

• 652



100m

Drawn from enlargement at 1:5700 of Lands Department air photograph
Project F472 - Coastal photography, Run 24, T731-290, 1.2.79 at 1:40,000

Figure A2.32 North Point quadrat

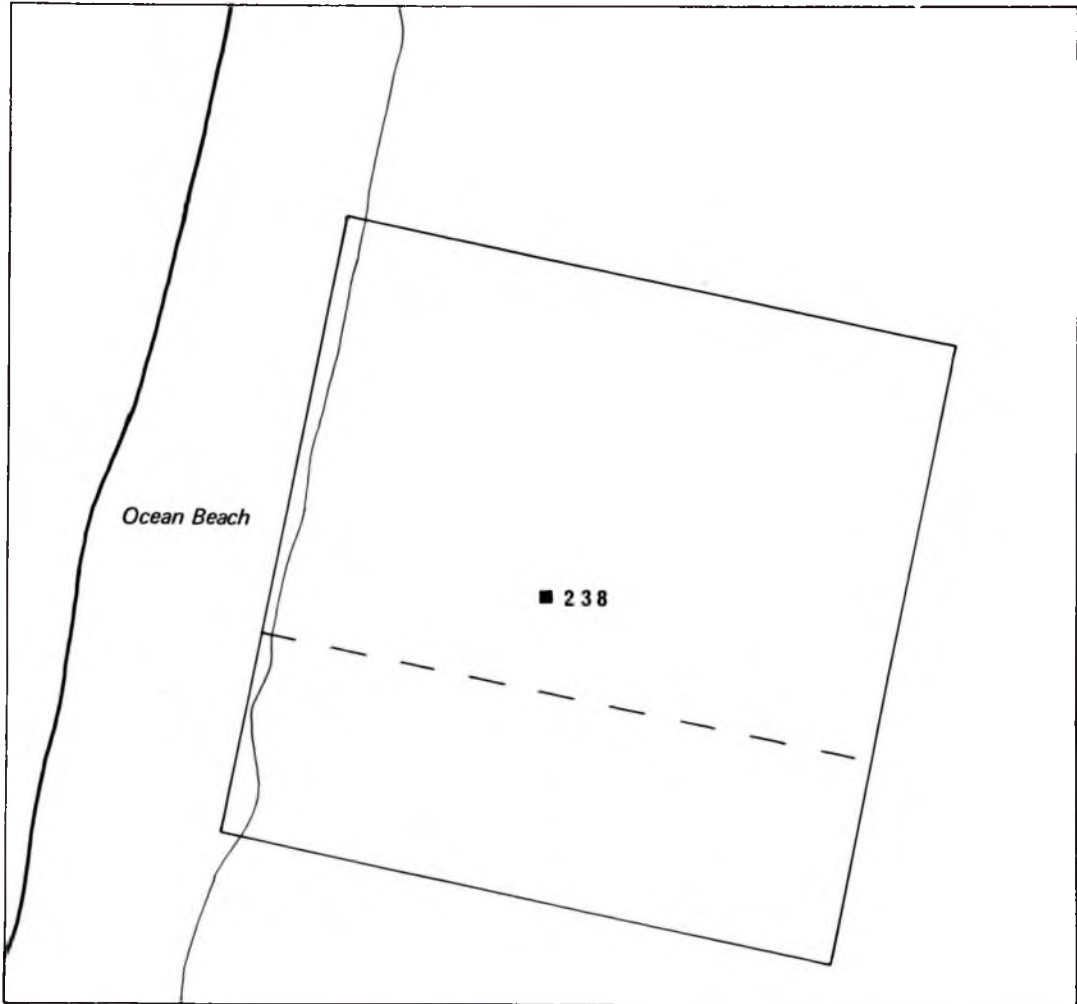
QUADRAT: North Point



Drawn from enlargement at 1:5,700 of Lands Department air photograph Project F472-Coastal Photography, Run 24, T731-290, 1.2.79 at 1:40,000 and elevations calculated by clinometer.

	average annual rainfall	900 - 1,000 mm
LAND SYSTEM	Plains	
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	basalt, overlain by an aeolian sandsheet gently undulating plains sand and peaty sand mixed	
VEGETATION -STRUCTURE -ASSOCIATION	? now under pasture	
PREHISTORIC MIDDEN VOLUME	4 m ³	PRESENT LAND USE intensive grazing



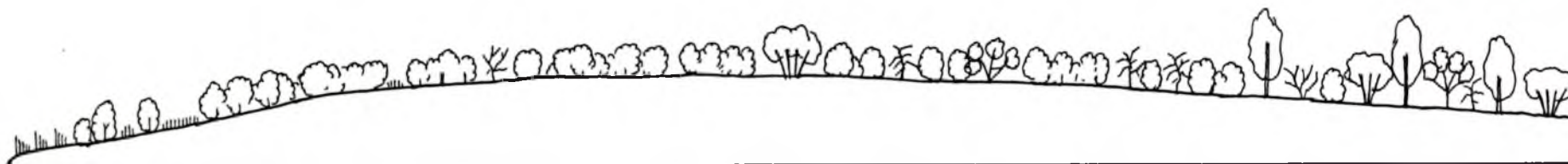


100 m

Drawn from enlargement at 1:5,700 of Lands Department air photograph
Project F 472 - Coastal Photography, Run 29, T668-151, 3.2.75, at 1:40,000

Figure A2.33 Ocean Beach quadrat

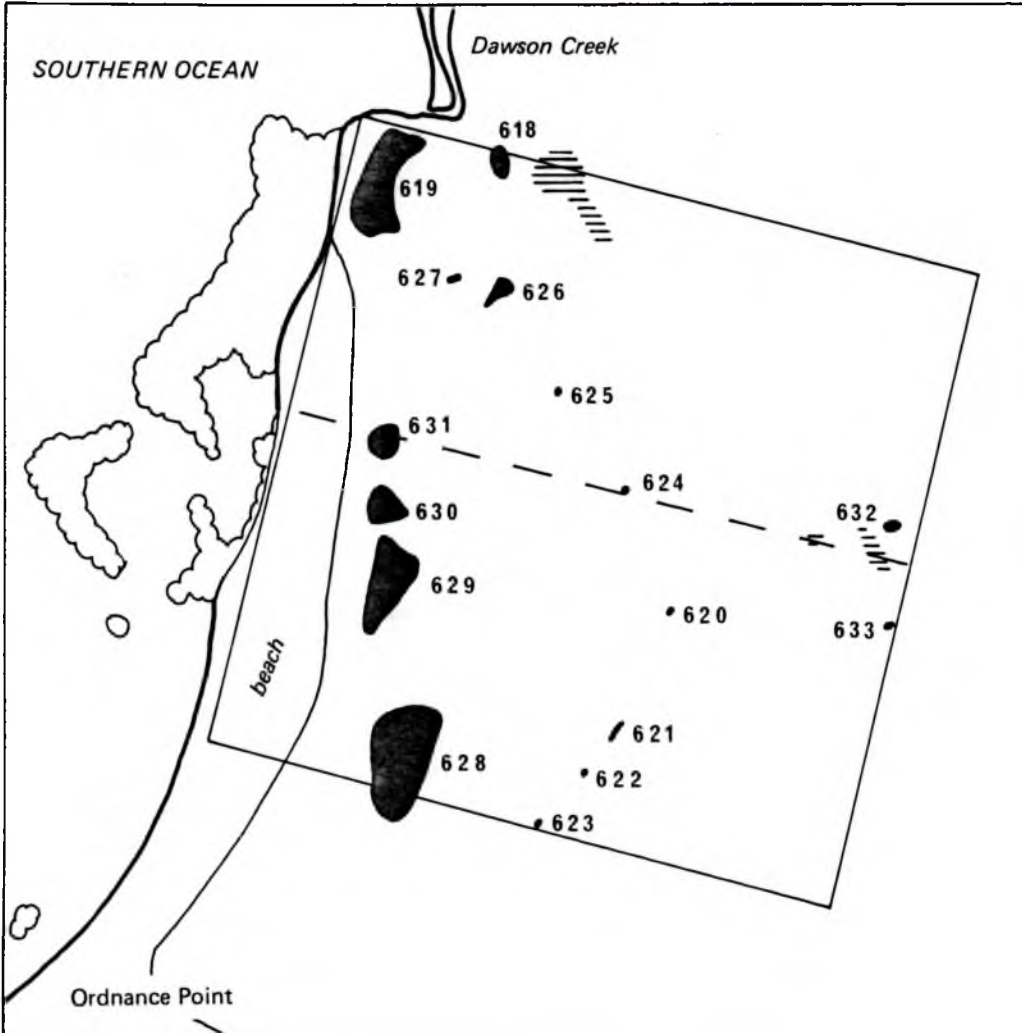
QUADRAT: Ocean Beach



Drawn from enlargement at 1:5,700 of Lands Department air photograph Project F472-Coastal Photography, Run 29, T668-151 at 1:40,000 and contour elevations from published Cape Sorell 1:100,000 sheet.

	average annual rainfall 1,750-2,000mm
LAND SYSTEM	Strahan
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	Quaternary sands undulating sandy podsoles and peaty sands soft
VEGETATION -STRUCTURE -ASSOCIATION	open low heath dominated by <u>Pultenaea daphnoides</u> , with scattered <u>Banksia marginata</u> , <u>Leptospermum scoparium</u> , <u>Acacia sophorae</u> , and <u>Eucalyptus nitida</u>
PREHISTORIC MIDDEN VOLUME	0m ³
PRESENT LAND USE	grazing





Drawn from enlargement at 1:5700 of Lands Department air photograph
 Project F 472 - Coastal photography, Run 26, T790-53, 1.2.79 at 1:40,000

Figure A2.34 Ordnance Point quadrat

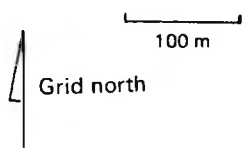
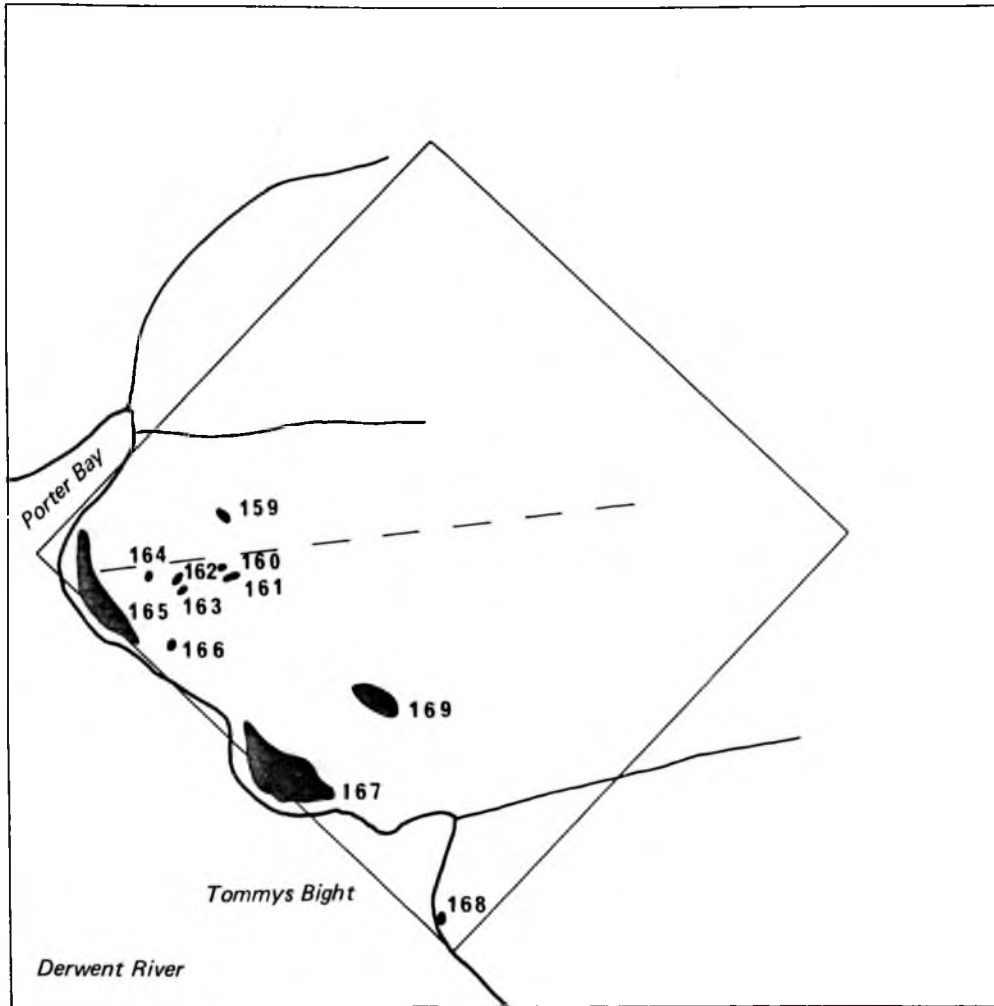
QUADRAT: Ordnance Point



Drawn from measurements from enlargement at 1:5,700 of Lands Department air photograph Project F472-Coastal Photography, Run 26, T790-53, 1.2.79 at 1:40,000 and elevations calculated by clinometer.

	average annual rainfall 1,250 - 1,500 mm
LAND SYSTEM	Temma
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	relatively unmetamorphosed sedimentary rocks undulating dunes near the beach backed by flat areas of impeded drainage sandy podsols mixed
VEGETATION -STRUCTURE -ASSOCIATION	dense low shrubs on dunes with a complex mosaic of hummock grasses, tall shrubs and low trees inland. <u>Leucopogon parviflorus</u> dominates the dunes, with areas of unidentified hummock grass and <u>Melaleuca ericifolia</u> inland
PREHISTORIC MIDDEN VOLUME	289m ³
PRESENT LAND USE	grazing

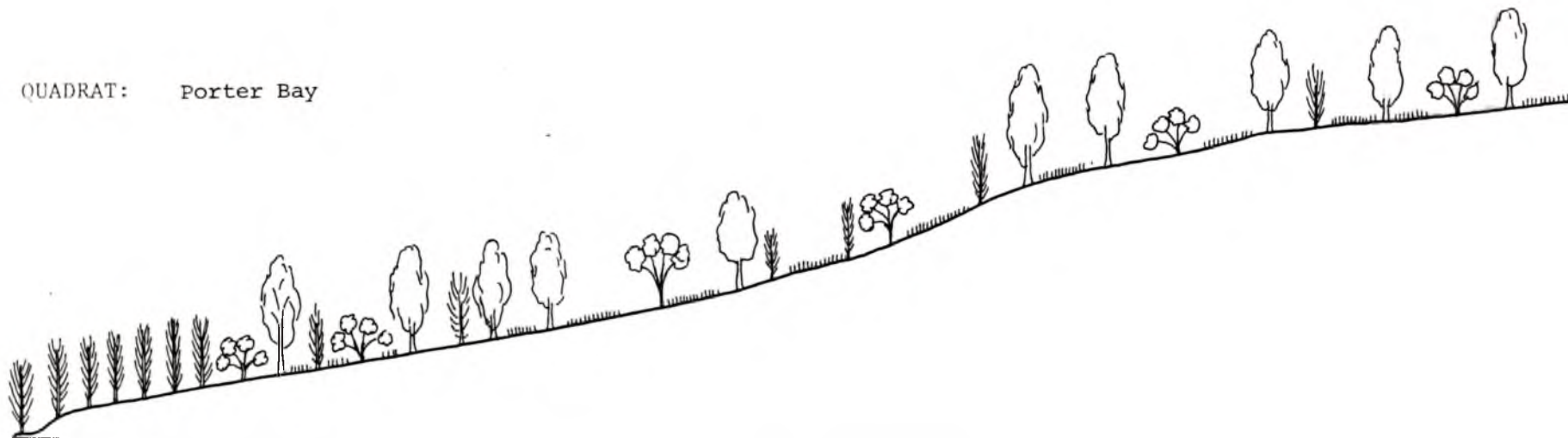




Drawn from Hobart Planning Authority unpublished map at 1:2,400

Figure A2.35 Porter Bay quadrat

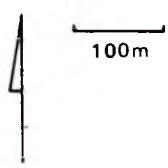
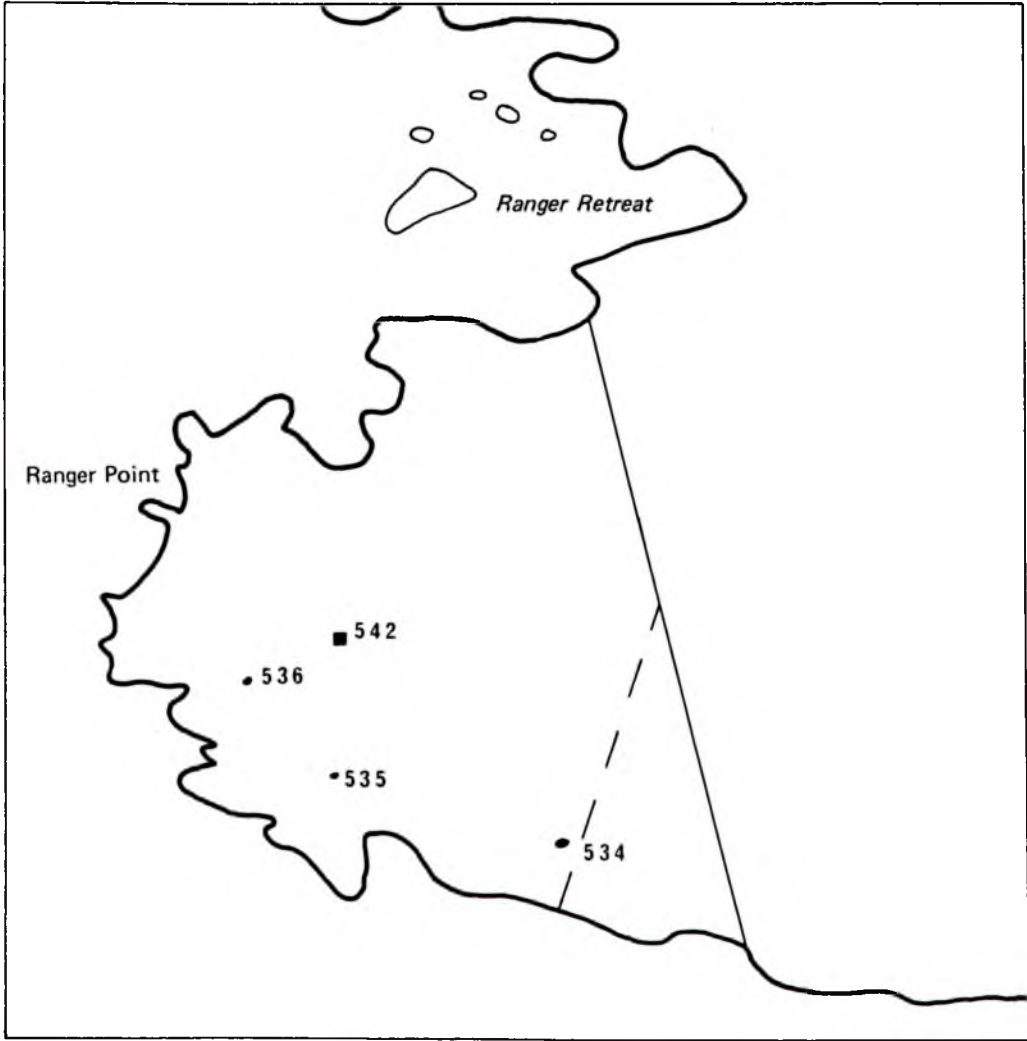
QUADRAT: Porter Bay



Drawn from unpublished map by Hobart Planning Authority at 1:2,400

	average annual rainfall
LAND SYSTEM	
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	siltstone dissected hill slopes sandy loam mixed, low energy
VEGETATION -STRUCTURE -ASSOCIATION	open woodland overstorey <u>Eucalyptus</u> spp, understory <u>Casuarina littoralis</u> and <u>Dodonaea viscosa</u>
PREHISTORIC MIDDEN VOLUME	1232m ³
PRESENT LAND USE	recreation





Drawn from Lands Department air photograph Project 1603 - North west, Run 1, T496 - 1, 12.2.68, at Approximately 1:31,000

Figure A2.36 Ranger Point quadrat

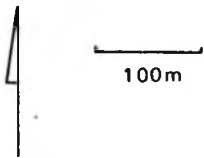
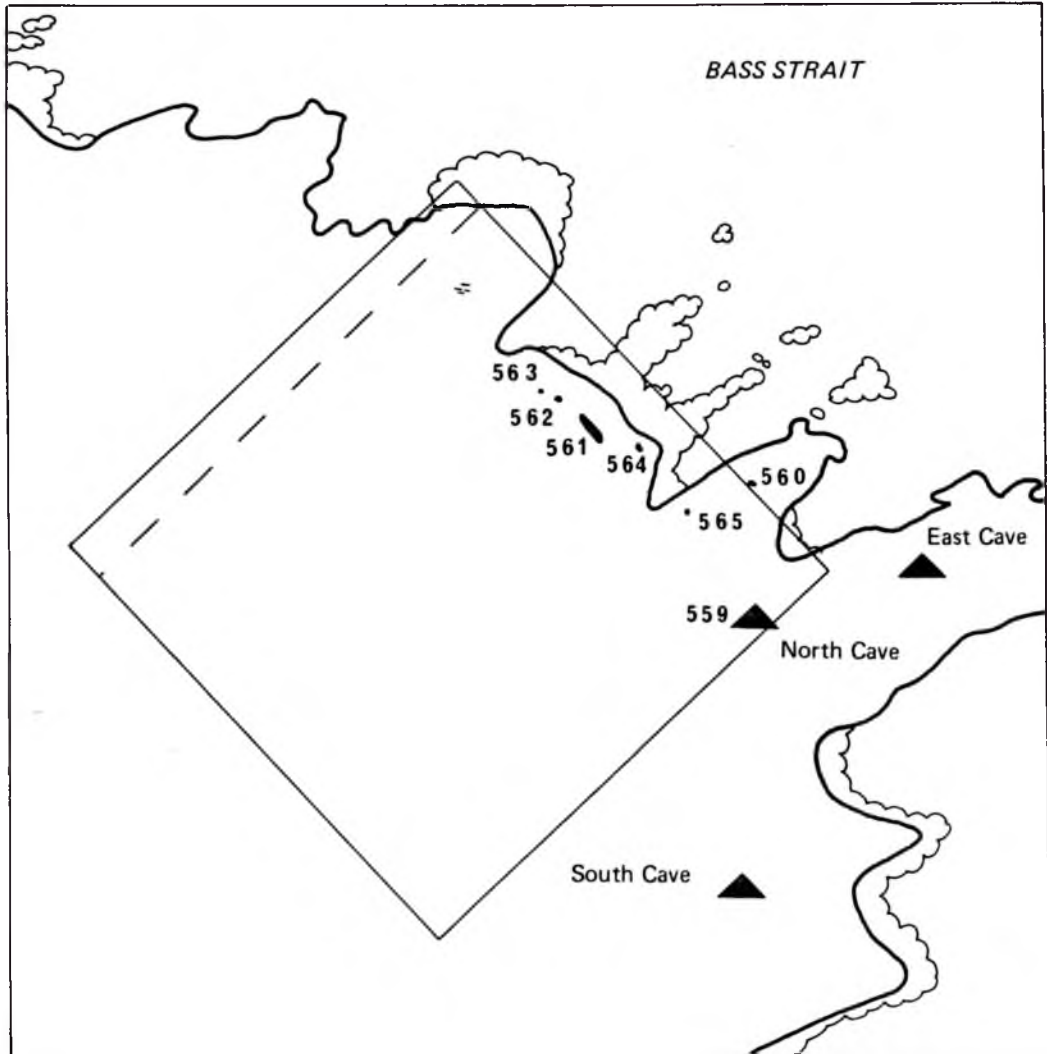
QUADRAT: Ranger Point



Drawn from measurements from Lands Department air photograph Project 1603 - North West, Run 1, T496-1, 12.2.68 at 1:31,600 and elevations calculated by clinometer.

	average annual rainfall	750 - 1,000 mm
LAND SYSTEM		
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	granite gentle slopes sandy podsol mixed	
VEGETATION -STRUCTURE -ASSOCIATION	closed tussock grassland dominated by tussock grasses	
PREHISTORIC MIDDEN VOLUME	1.3 m ³	PRESENT LAND USE nature conservation and muttonbirding

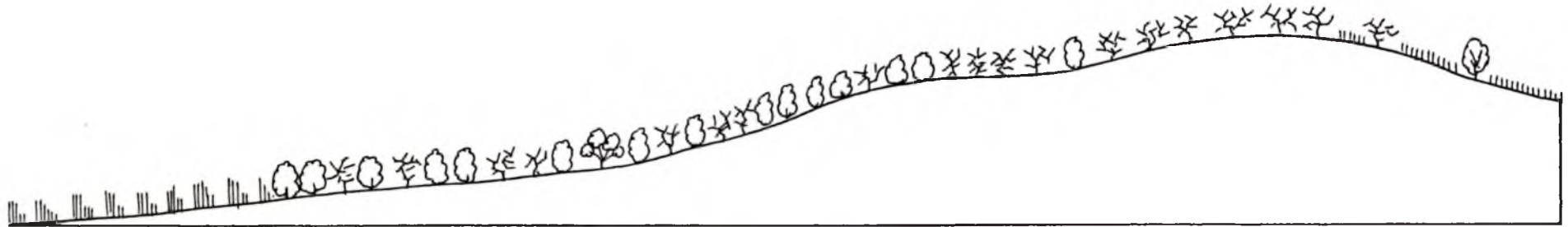




Drawn from enlargement at 1:5700 of Lands Department air photograph
Project M88 - North West, Run 2, T808-41, 8.1.80 at 1:40,000

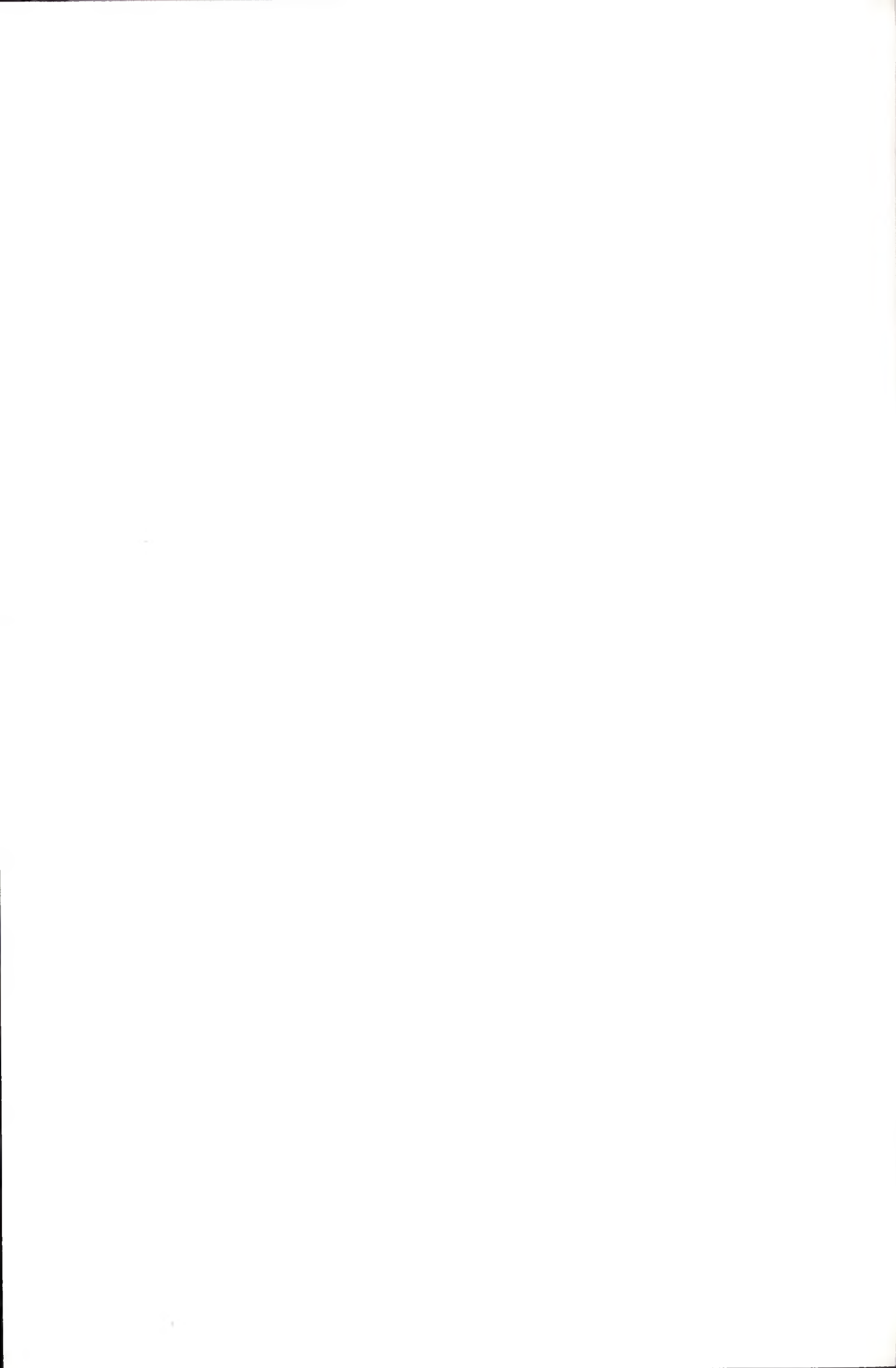
Figure A2.38 Rocky Cape quadrat

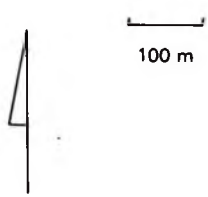
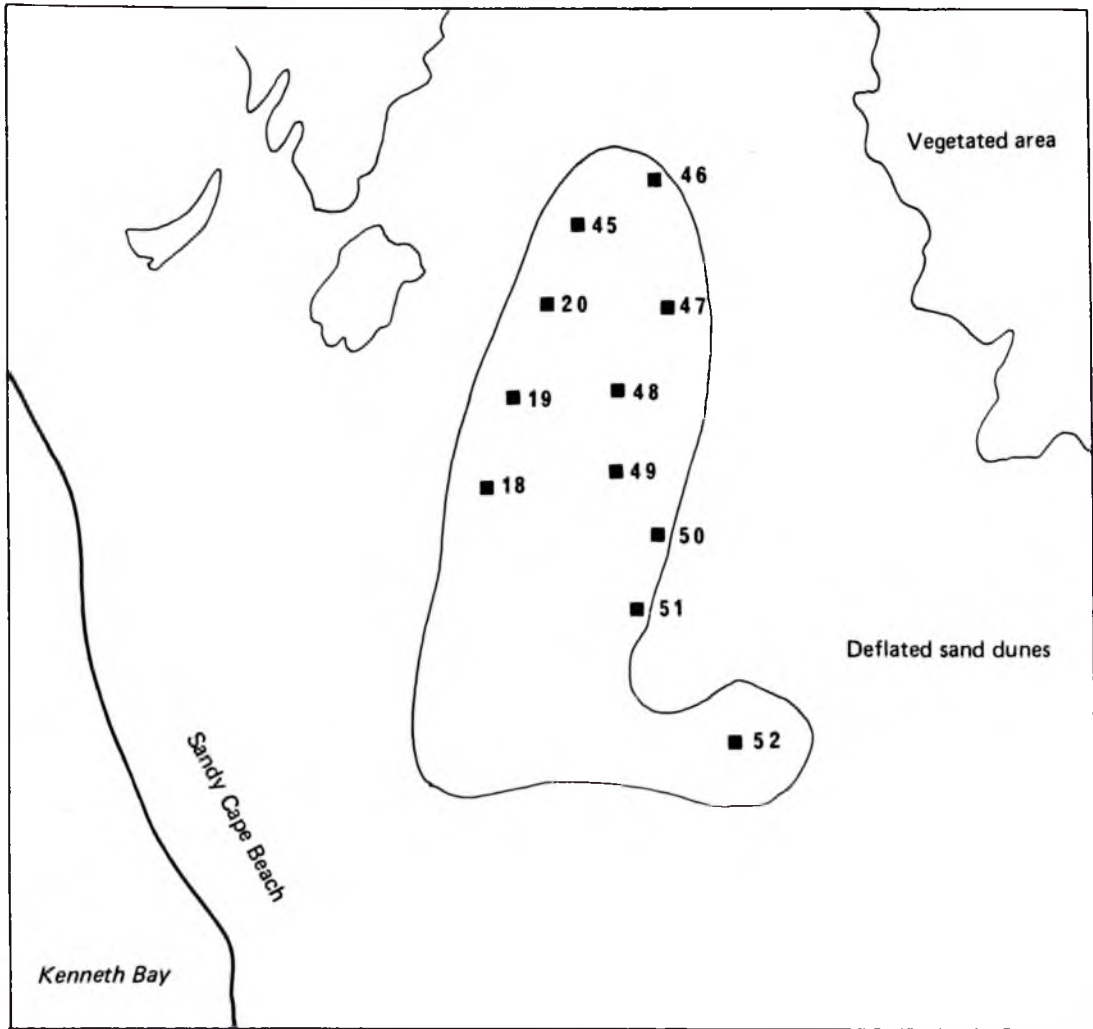
QUADRAT: Rocky Cape



Drawn from contours of published 1:100,000 Table Cape sheet 8016

	average annual rainfall	900 - 1,000 mm
LAND SYSTEM	Rocky Cape	
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	Precambrian quartzite undulating hill slopes sandy to gravelly, rock outcrops common mixed	
VEGETATION -STRUCTURE -ASSOCIATION	mosaic of dense low shrubs and sedgland heath <u>Banksia marginata</u> , <u>Leptospermum scoparium</u> , <u>Acacia sophorae</u> and <u>Leptospermum glaucescens</u>	
PREHISTORIC MIDDEN VOLUME	400 m ³	PRESENT LAND USE recreation





Drawn from Lands Department air photograph Project F472 Coastal Photography, Run 26, T790 - 55, 1.2.79 at 1:40,000

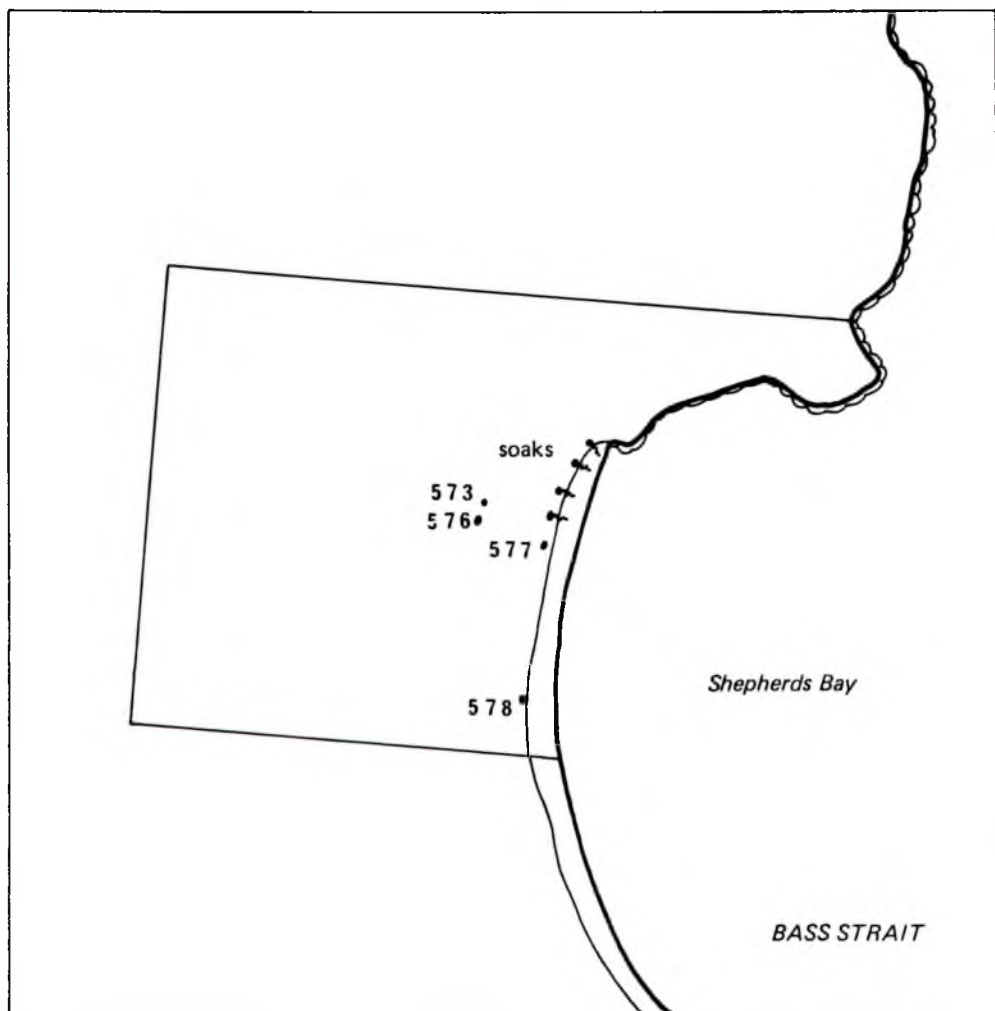
Figure A2.37 Sandy Cape Beach quadrat

QUADRAT: Sandy Cape Beach

	average annual rainfall 1,250-1,500 mm
LAND SYSTEM	Temma
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	Quaternary sands Deflated dunes ? sandy podsols soft
VEGETATION -STRUCTURE -ASSOCIATION	non-existent but was probably similar to Wild Wave River quadrat
PREHISTORIC MIDDEN VOLUME 0.5m ³	PRESENT LAND USE nil







100m

Drawn from enlargement at 1:7600 of Lands Department air photograph
Project F472 - Coastal photography, Run 9, T810-133, 8.1.80 at 1:40,000

Figure A2.39 Shepherds Bay east quadrant

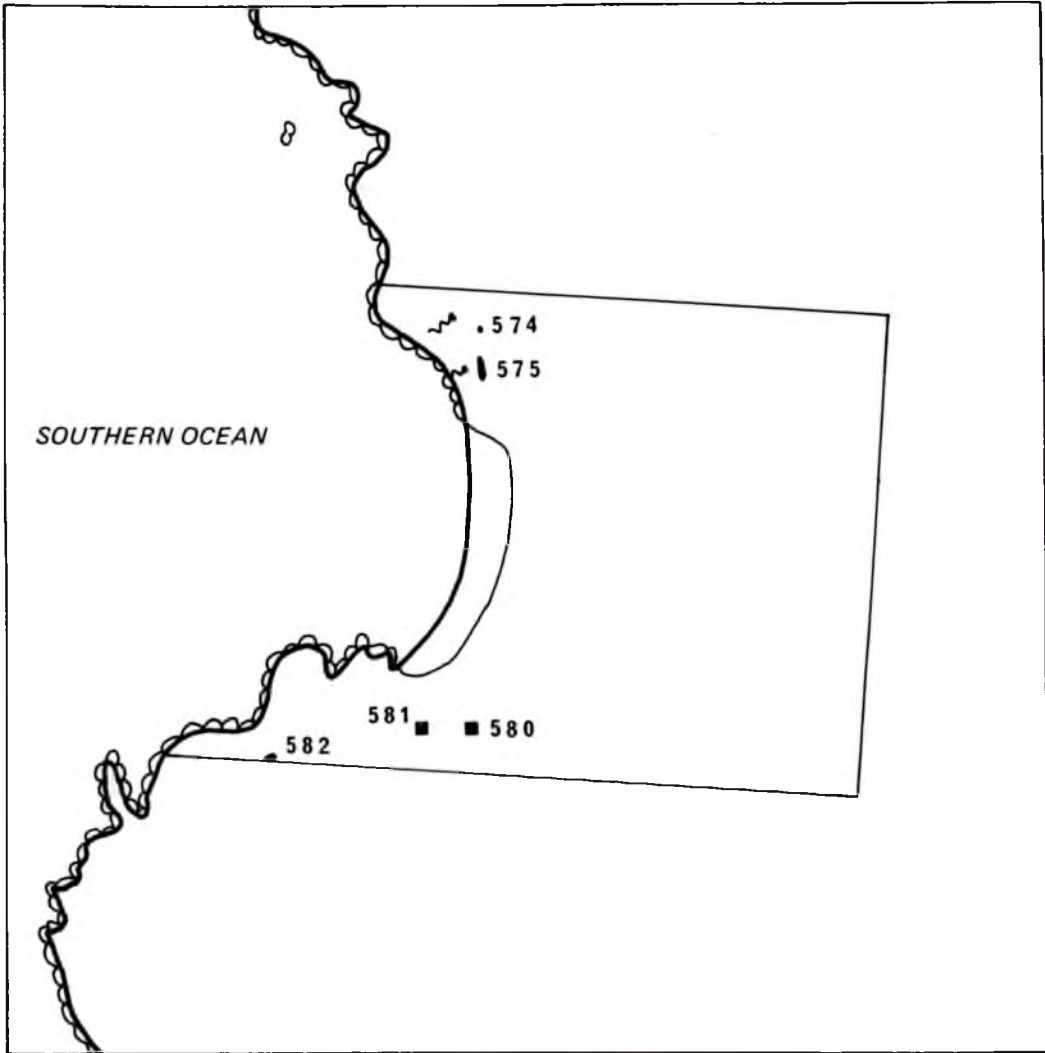
QUADRAT: Shepherds Bay East



Drawn from measurements from enlargement at 1:7,660 of Lands Department air photograph Project F472-Coastal Photography, Run 9, T810-133, 8.1.80 at 1:40,000 and elevations calculated by clinometer.

	average annual rainfall	750 - 1,000 mm
LAND SYSTEM		
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE		relatively unmetamorphosed sedimentary rocks undulating sandy podsols mixed
VEGETATION -STRUCTURE -ASSOCIATION		open shrubland clumps of <u>Leptospermum laevigatum</u> and <u>Banksia marginata</u> shrubs separated by areas of tussock grass and herbs.
PREHISTORIC MIDDEN VOLUME	3 m ³	PRESENT LAND USE grazing



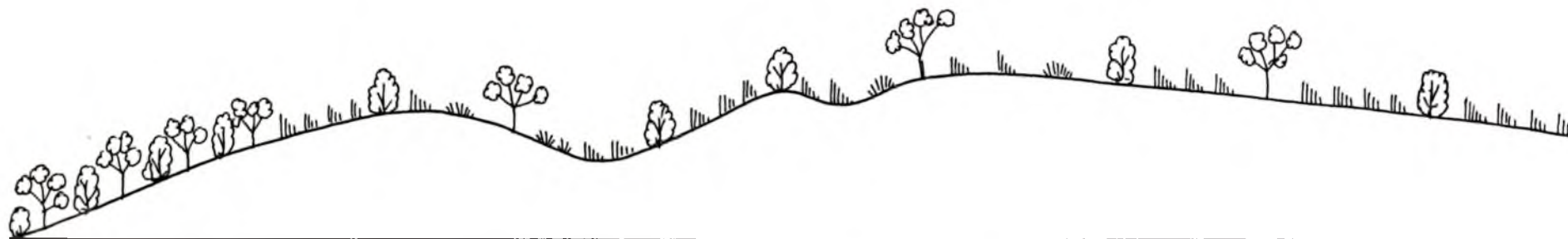


100m

Drawn from enlargement at 1:7600 of Lands Department air photograph
Project F472 - Coastal photography, Run 9, TB10-133, 8.1.80 at 1:40,000

Figure A2.40 Shepherds Bay west quadrat

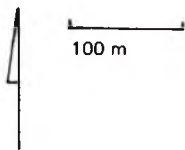
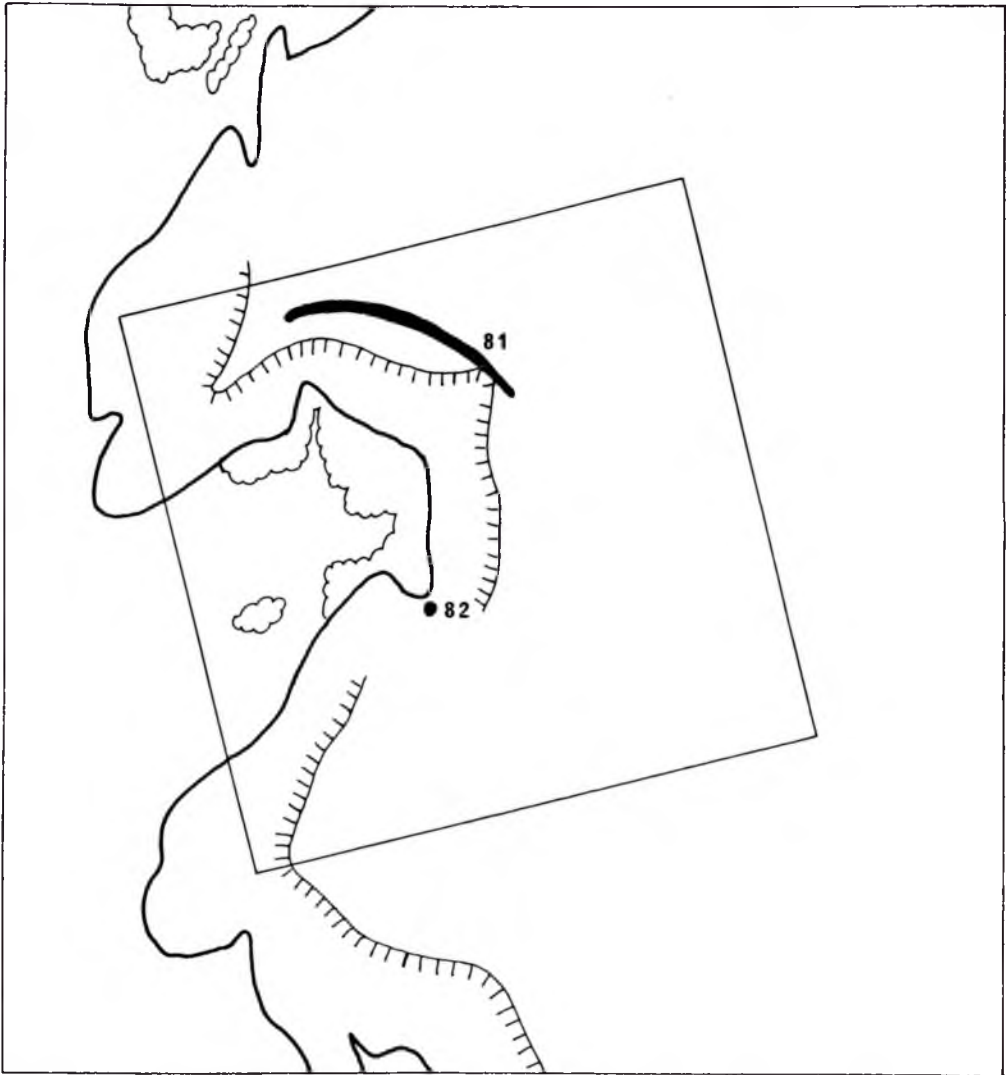
QUADRAT: Shepherds Bay West



Drawn from measurements from enlargement at 1:7,600 of Lands Department air photograph Project F472-Coastal Photography, Run 9, T810-133, 8.1.80 at 1:40,000 and elevations calculated by clinometer.

	average annual rainfall 750 - 1,000 mm
LAND SYSTEM	
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	relatively unmetamorphosed sedimentary rocks undulating sandy podsols mixed
VEGETATION -STRUCTURE -ASSOCIATION	open shrubland clumps of <u>Leucopogon parviflorus</u> and <u>Acacia sophorae</u> shrubs separated by areas of tussock grass and herbs
PREHISTORIC MIDDEN VOLUME 10 m ³	PRESENT LAND USE grazing



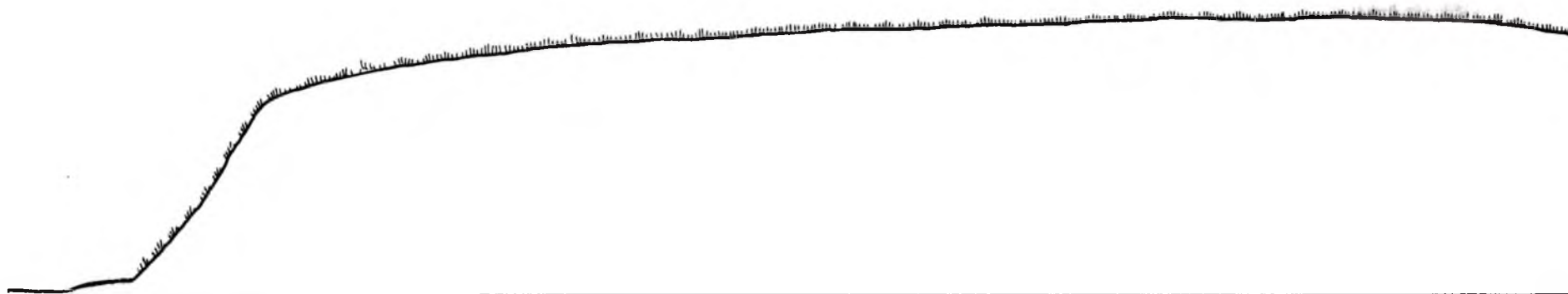


Drawn from unpublished Lands Department M - plot, Cape Grim East at 1:15,800

Figure A2.41 Suicide Bay quadrat

QUADRAT:

Suicide Bay

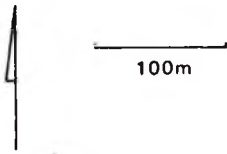
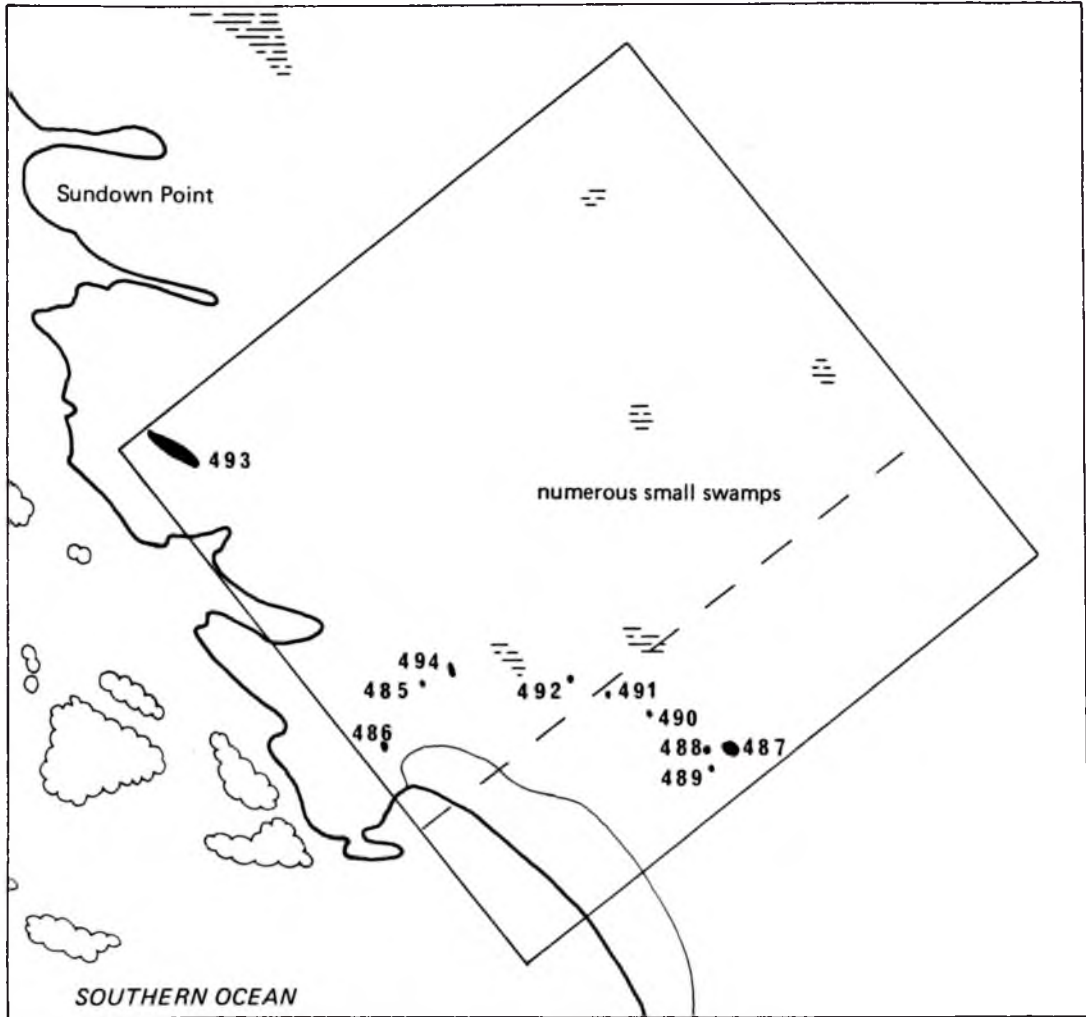


Drawn from Lands Department air photograph Project F472-Coastal photography, Run 25, T790- 27/28, 1.2.79 at 1:40,000 and published 1:100,000 Welcome sheet

	average annual rainfall	750-1,000mm	
LAND SYSTEM	Bluff Point		
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	volcanic breccia seaward scarp backed by plateau clay loam mixed		
VEGETATION -STRUCTURE -ASSOCIATION	closed tussock grassland and pasture grassland dominated by tussock grassland and introduced herbs		
PREHISTORIC MIDDEN VOLUME	100m ³	PRESENT LAND USE	grazing



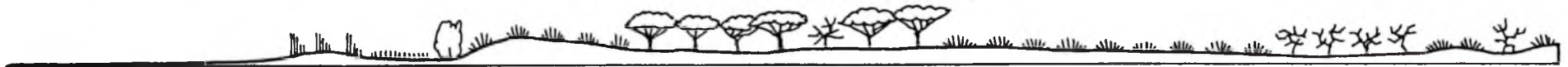




Drawn from enlargement at 1:5500 of Lands Department air photograph
 Project F472 - Coastal Photography, Run 26, T790-47, 1.2.79 at 1:40,000

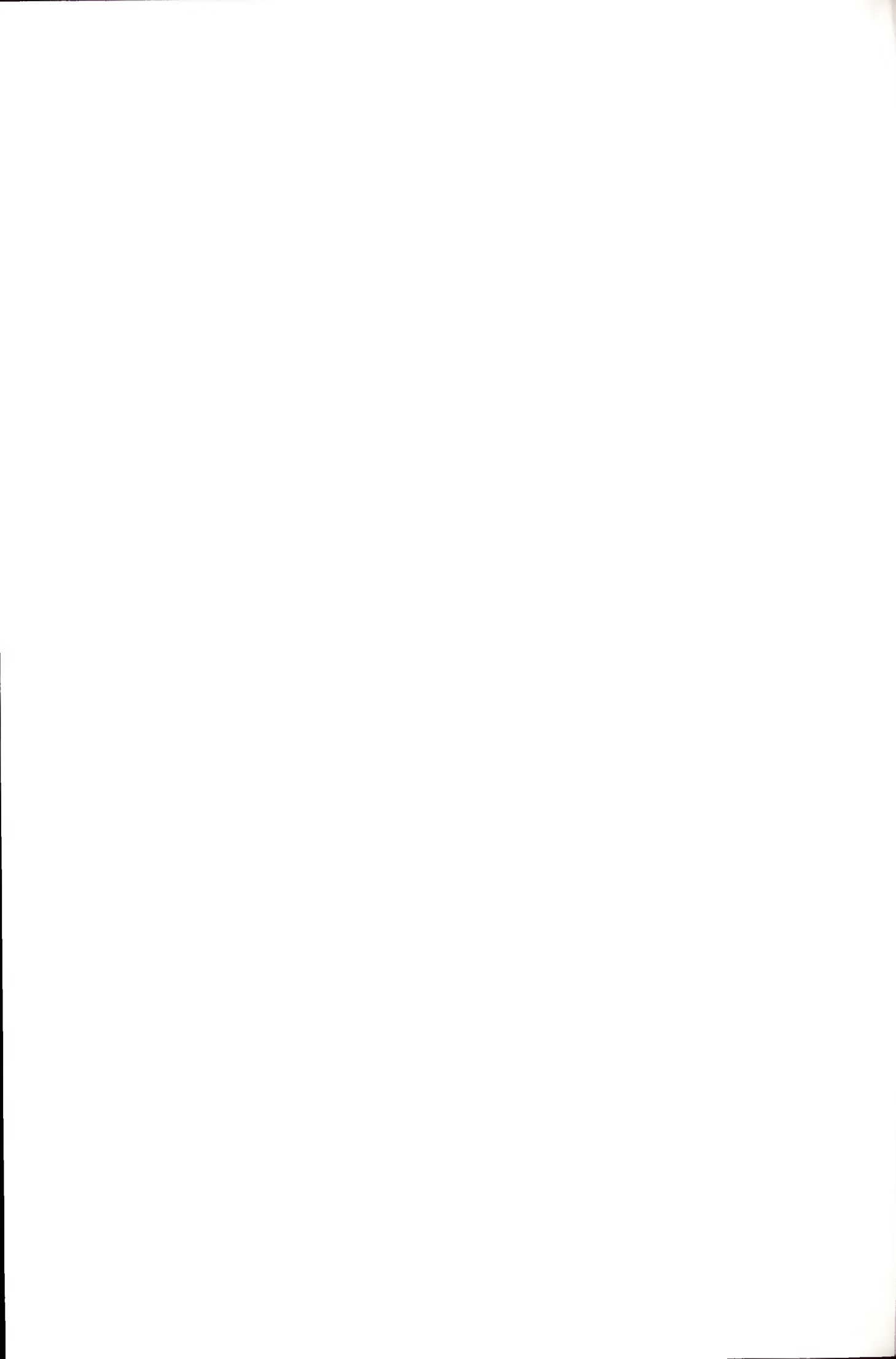
Figure A2.42 Sundown Point quadrat

QUADRAT: Sundown Point

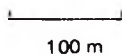
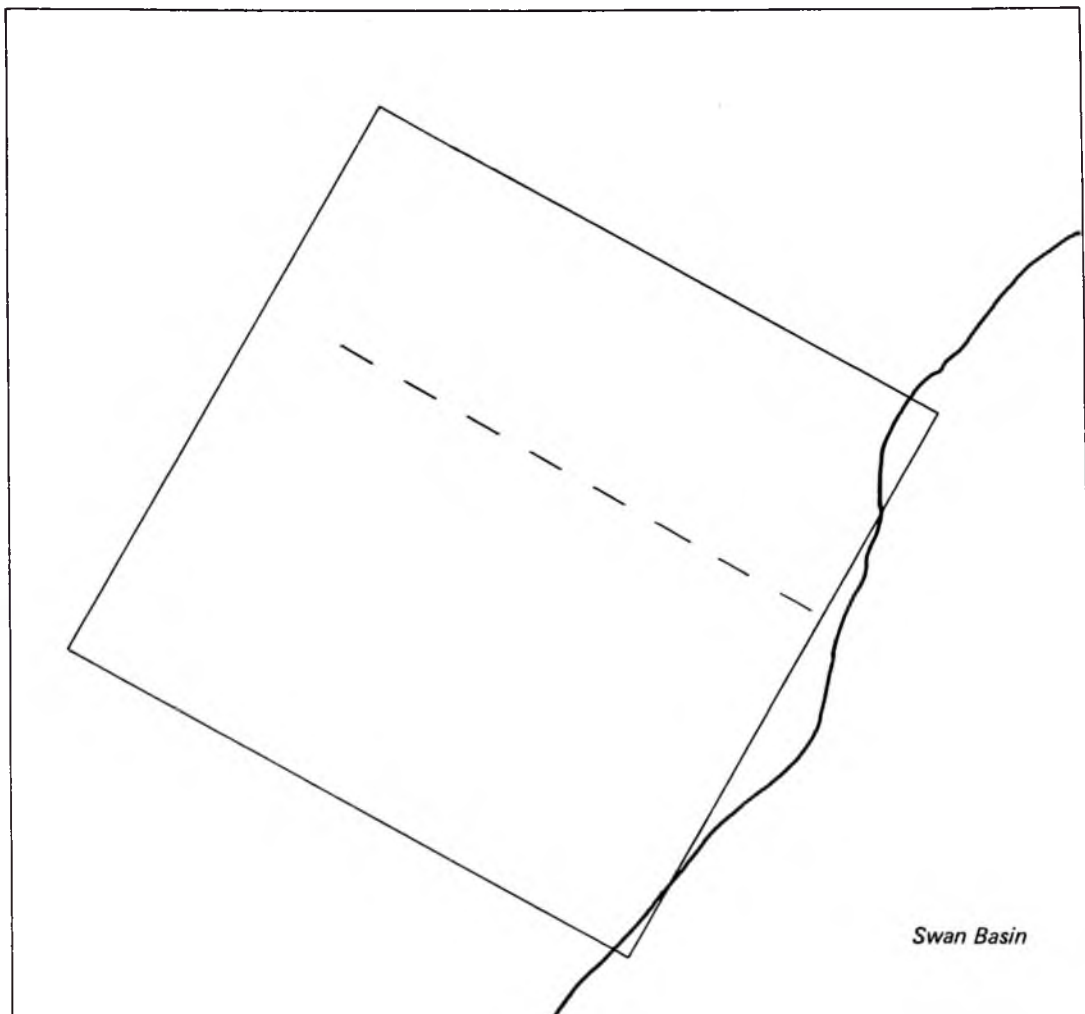


Drawn from measurements from enlargement at 1:5,500 of Lands Department air photograph Project F472-Coastal Photography, Run 26, T790-47, 1.2.79 at 1:40,000 and elevations calculated by clinometer.

	average annual rainfall	1,000 - 1,250 mm
LAND SYSTEM	Temma	
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	relatively unmetamorphosed sedimentary rocks undulating sandy podsols mixed	
VEGETATION -STRUCTURE -ASSOCIATION	open low shrubs on the dunes and patches of dense low shrubs inland scattered <u>Banksia marginata</u> in a <u>Lomandra longifolia</u> tussock grassland on the dunes backed by tussock grass and <u>Melaleuca ericifolia</u> shrubs inland	
PREHISTORIC MIDDEN VOLUME	59 m ³	PRESENT LAND USE
		grazing



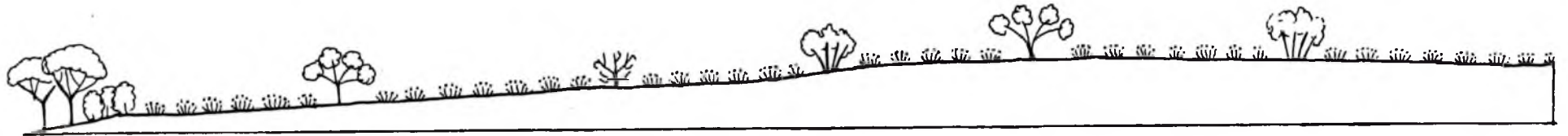




Drawn from enlargement at 1:5700 of Lands Department air photograph
Project F420 - Cape Sorell - Franklin, Run 4, T638-158, 9.1.74 at 1:40,000

Figure A2.43 Swan Basin quadrat

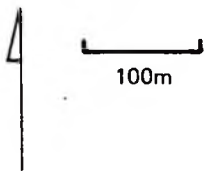
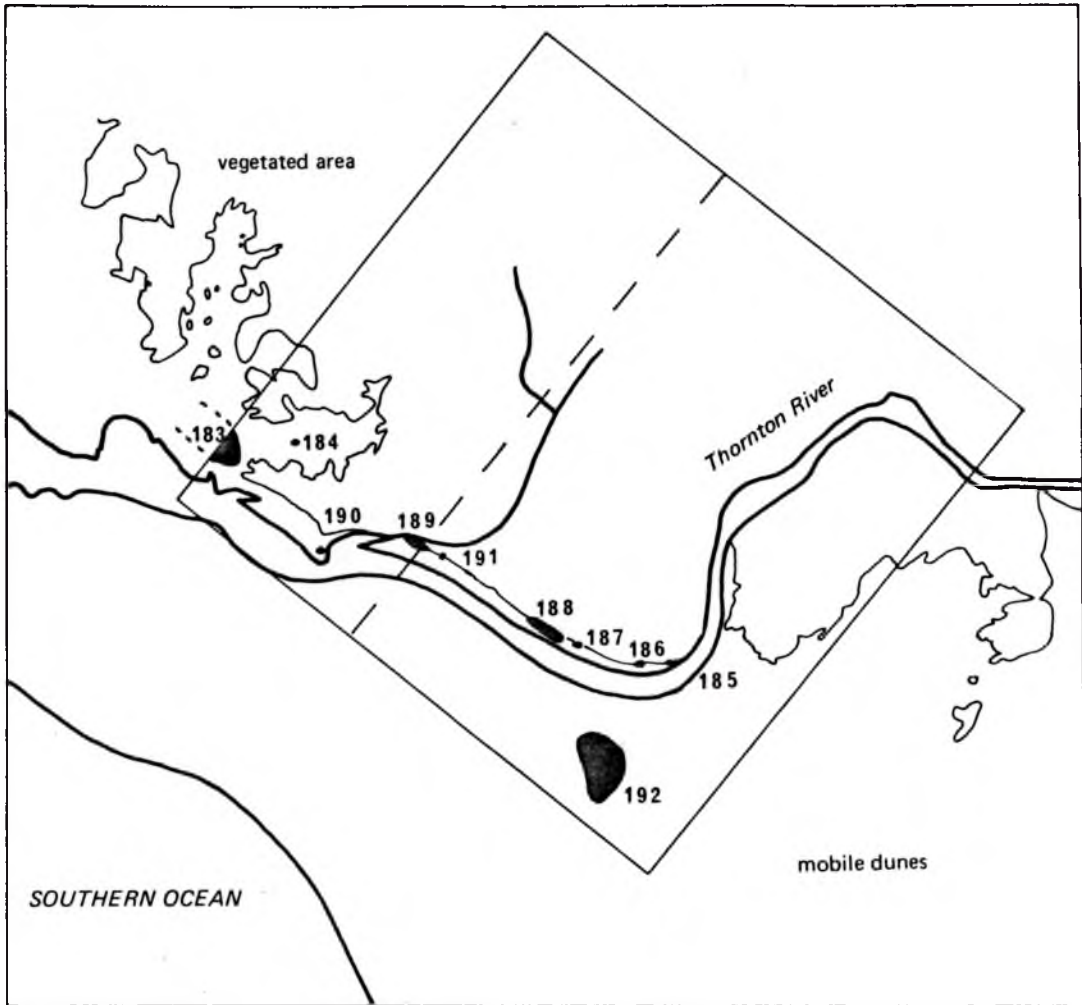
QUADRAT: Swan Basin



Drawn from enlargement at 1:6,500 of Lands Department air photograph Project F420-Cape Sorell-Franklin, Run 4, T638-185 with elevations from published 1:100,000 Cape Sorell sheet

	average annual rainfall	1,750-2,000 mm
LAND SYSTEM	Macquarie Harbour	
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	interbedded sandstone, siltstone, clay and conglomerate with lignite horizons gentle slopes sandy peat soft	
VEGETATION -STRUCTURE -ASSOCIATION	closed sedgland with scattered shrubs dominated by <u>Gymnoschoenus sphaerocephalus</u> , with <u>Leptospermum ericifolia</u> along the shore and scattered <u>Acacia sophorae</u> , <u>Casuarina monilifera</u> and <u>Banksia marginata</u>	
PREHISTORIC MIDDEN VOLUME	0m ³	PRESENT LAND USE
		nil





Drawn from enlargement at 1:5,700 of Lands Department air photograph
Project F 472 - Coastal Photography, Run 26, T790-53, 1.2.79, at 1:40,000

Figure A2.44 Thornton River quadrat

OUADRAT:

Thornton River

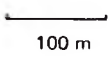
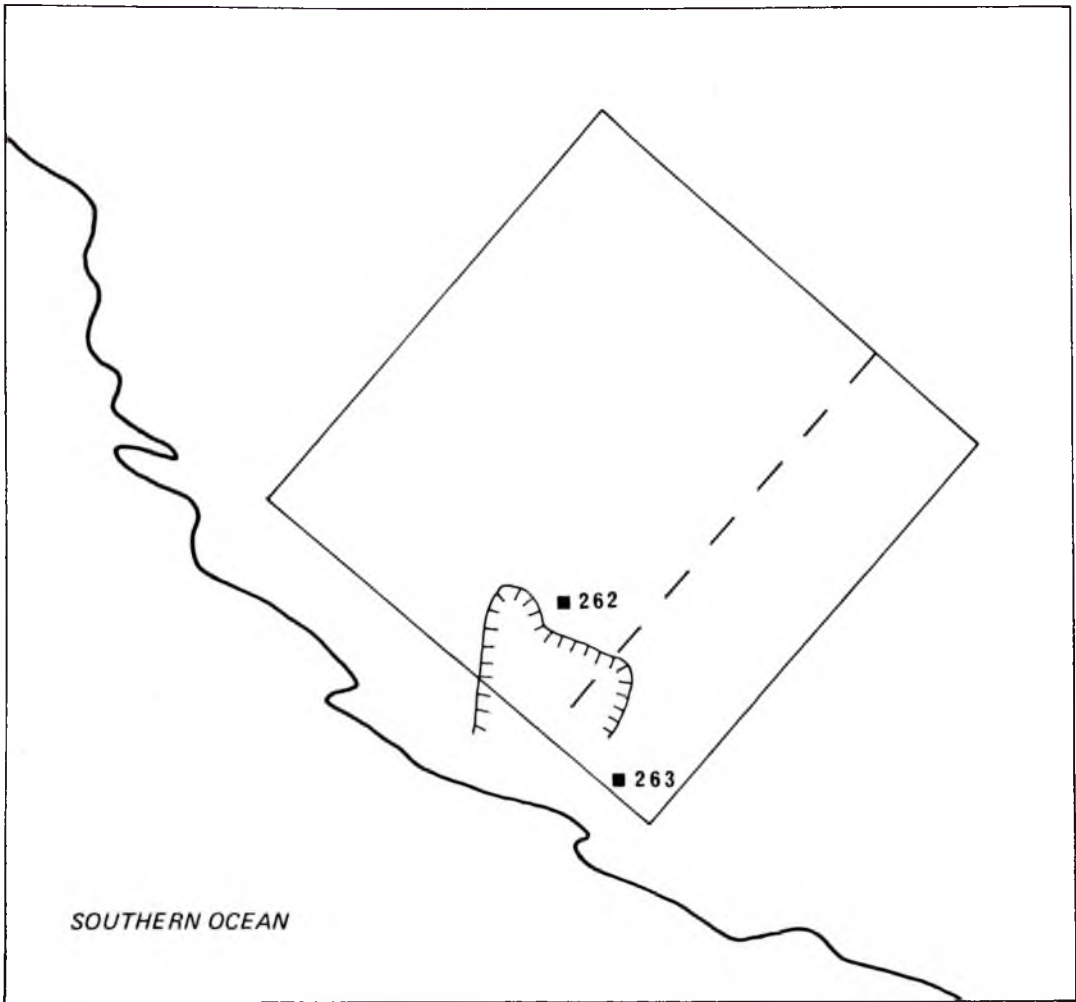


Drawn from enlargement at 1:5,700 of Lands Department air photograph Project F472-Coastal Photography, Run 26, T790-55, 1.2.79 at 1:40,000 and published 1:100,000 Sandy Cape sheet.

	average annual rainfall	1,250-1,500 mm
LAND SYSTEM	Temma	
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	relatively unmetamorphosed sedimentary rocks undulating sandsheet sandy podsols mixed	
VEGETATION -STRUCTURE -ASSOCIATION	dense scrubland dominated by <u>Leptospermum scoparium</u> and <u>Melaleuca squarrosa</u> with scattered <u>Banksia marginata</u> and <u>Casuarina monilifera</u>	
PREHISTORIC MIDDEN VOLUME	550m ³	PRESENT LAND USE
		grazing



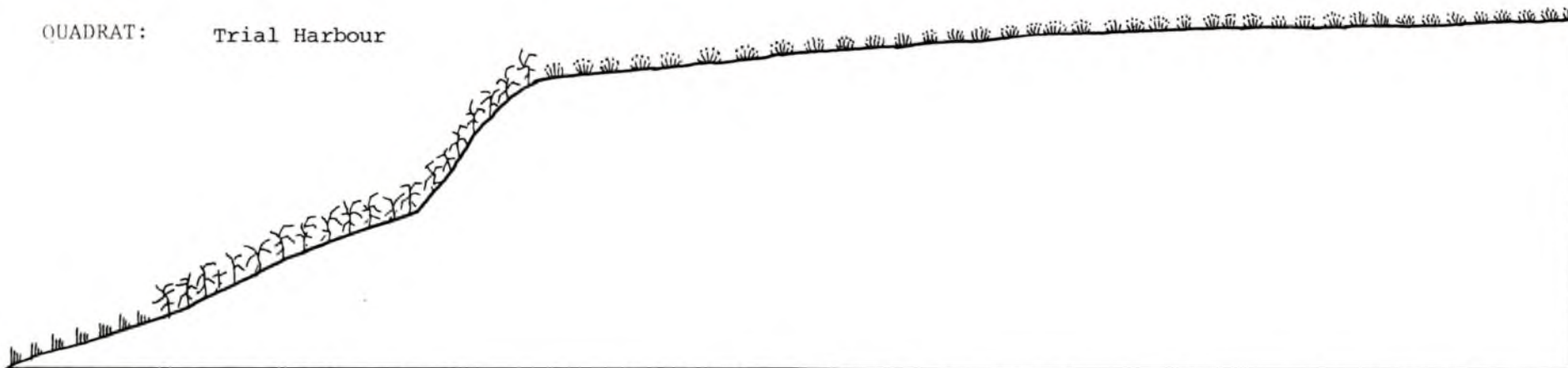




Drawn from enlargement at 1:7,142 of Lands Department air photograph
Project F 617 - South West, Run 5, T793-106, 20.2.79 at 1:50,000

Figure A2.45 Trial Harbour quadrat

QUADRAT: Trial Harbour

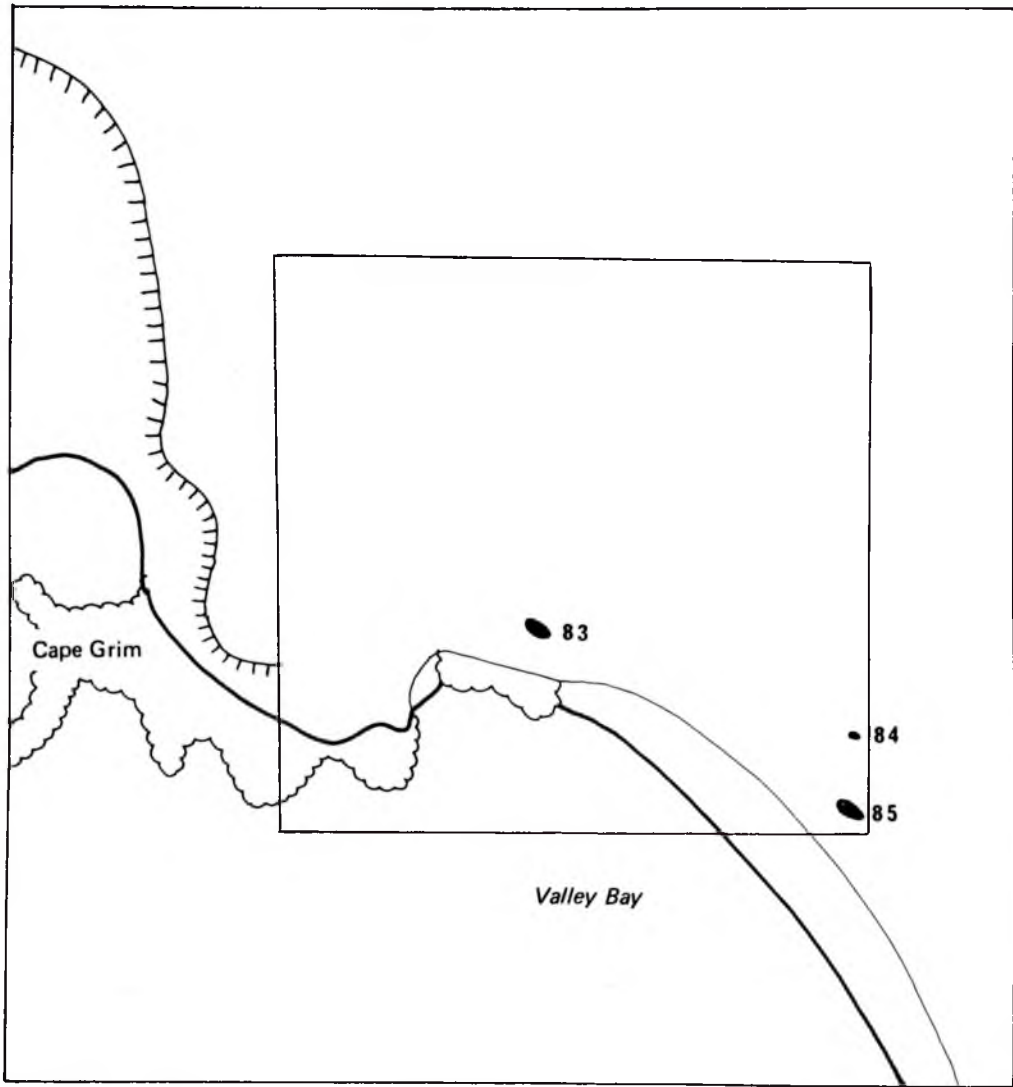


Drawn from unpublished Lands Department M-Plot Zeehan 2 at 1:15,840 and enlargement at 1:7,142 of Lands Department air photograph Project F617-South West, Run 5, T793-106, 20.2.79 at 1:50,000

	average annual rainfall 1,750-2,000mm
LAND SYSTEM	Granite Creek
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	granite coastal scarp backed by rolling plain peat hard
VEGETATION -STRUCTURE -ASSOCIATION	closed sedgland with patches of heath dominated by <u>Gymnoschoenus sphaerocephalus</u> on the plain and <u>Leptospermum scoparium</u> on the scarp slope.
PREHISTORIC MIDDEN VOLUME	0m ³
PRESENT LAND USE	nil



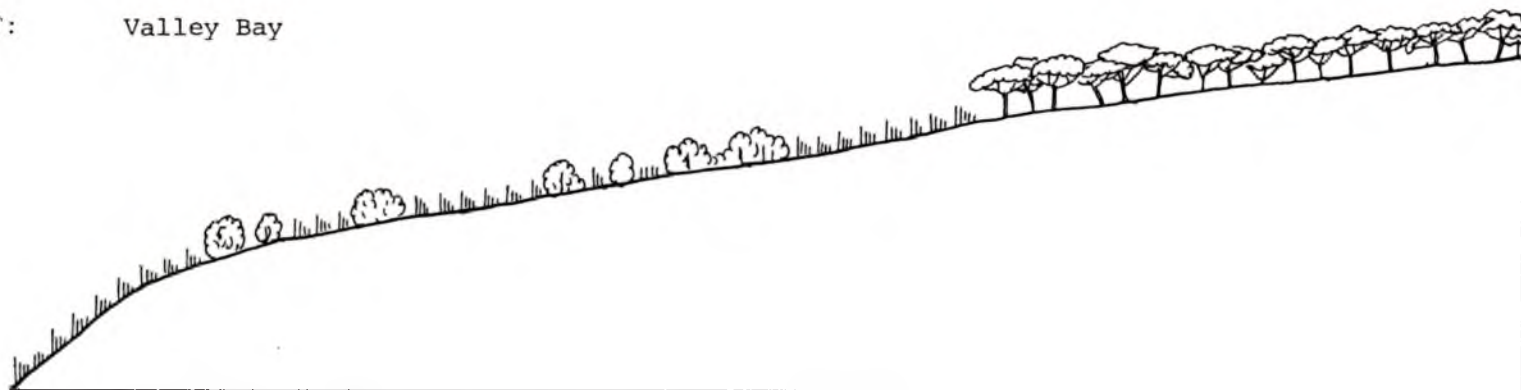




Drawn from unpublished Lands Department M-plot Cape Grim East at 1:15,800

Figure A2.46 Valley Bay quadrat

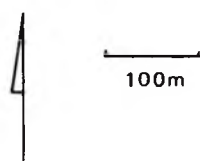
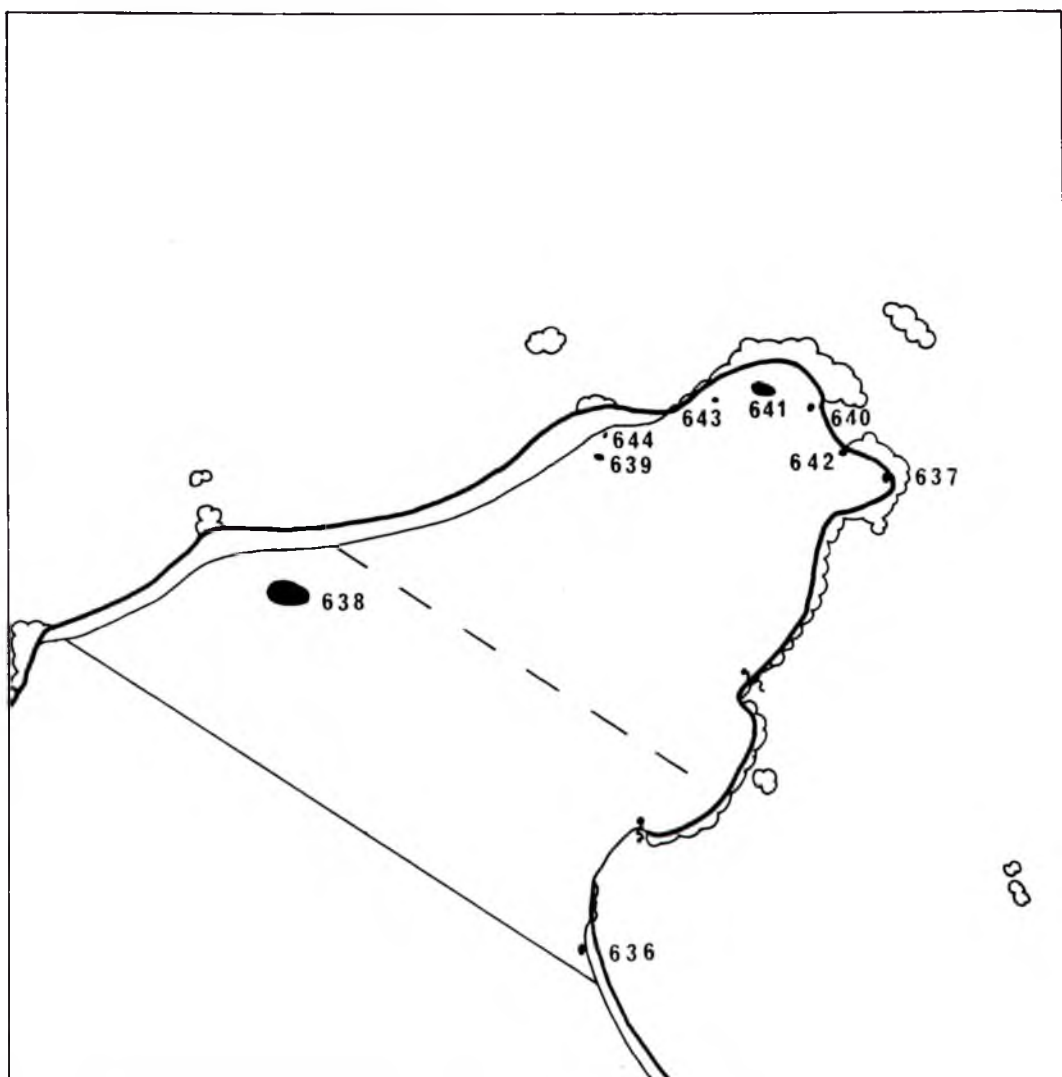
QUADRAT: Valley Bay



Drawn from contours on published 1:100,000 Welcome Sheet 7816

	average annual rainfall	750-1,000mm
LAND SYSTEM	Bluff Point	
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	volcanic breccia seaward scarp backed by plateau clay loam mixed	
VEGETATION -STRUCTURE -ASSOCIATION	closed tussock grassland and patches of windpruned shrubland dominated by tussock grasses and <u>Melaleuca ericifolia</u>	
PREHISTORIC MIDDEN VOLUME	0.1m ³	PRESENT LAND USE
		grazing

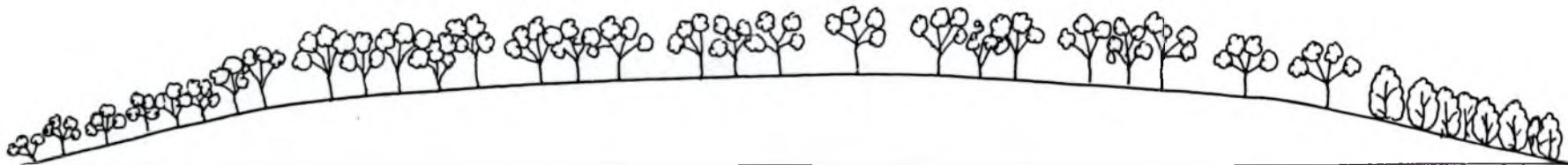




Drawn from enlargement at 1:5700 of Lands Department air photograph
Project F472- Coastal Photography, Run 16, T701-66, 8.12.76 at 1:40,000

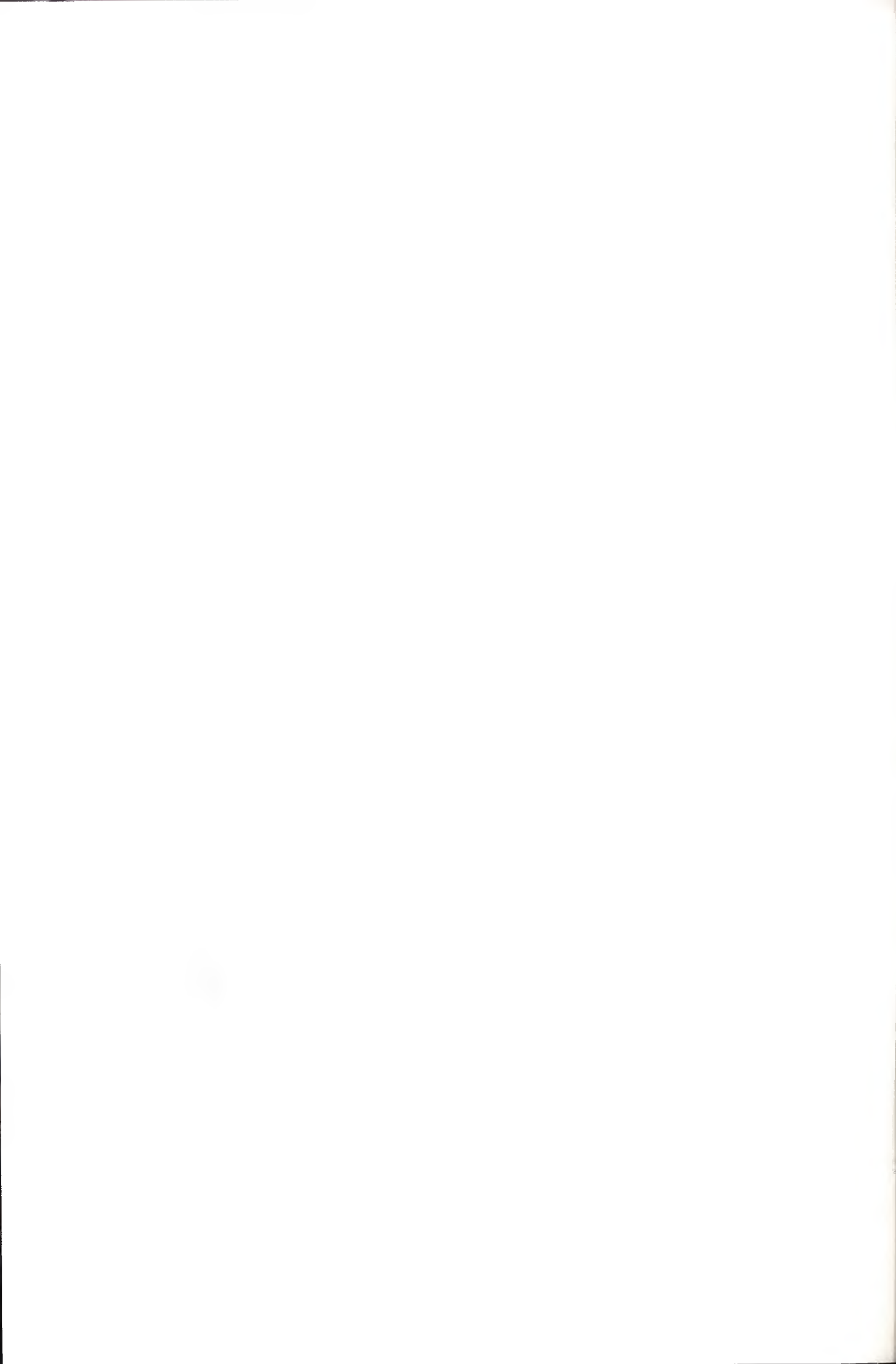
Figure A2.47 Waterhouse Point quadrat

QUADRAT: Waterhouse Point



Drawn from contours of published Lands Department 1:100,000 Cape Portland sheet 8416.

	average annual rainfall	600 - 800 mm
LAND SYSTEM	Blackmans Lookout (Pinkard 1980:53)	
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	granite overlain by recent aeolian calcareous sand deposits undulating calcareous sandy soils mixed	
VEGETATION -STRUCTURE -ASSOCIATION	very dense tall shrubs dominated by <u>Acacia sophorae</u>	
PREHISTORIC MIDDEN VOLUME	17 m ³	PRESENT LAND USE recreation



QUADRAT: West Point 1,2,3,4,5 and 6



Drawn from elevations calculated by clinometer and measurements taken from enlargement at 1:5,700 of Lands Department air photograph Project F472-Coastal Photography, Run 26, T790-42, 1.2.79 at 1:40,000

	average annual rainfall 1,000-1,250 mm
LAND SYSTEM	Thornton River
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	relatively unmetamorphosed sedimentary rocks undulating sandy podsol mixed
VEGETATION -STRUCTURE -ASSOCIATION	open heath of open and closed tall and low shrublands and bare rock outcrops mixed <u>Melaleuca squarrosa</u> and <u>Leptospermum scoparium</u> and <u>Leptospermum glaucescens</u> , with scattered <u>Banksia marginata</u> .
PREHISTORIC MIDDEN VOLUME 58,19,8,29,1024,436m ³	PRESENT LAND USE grazing



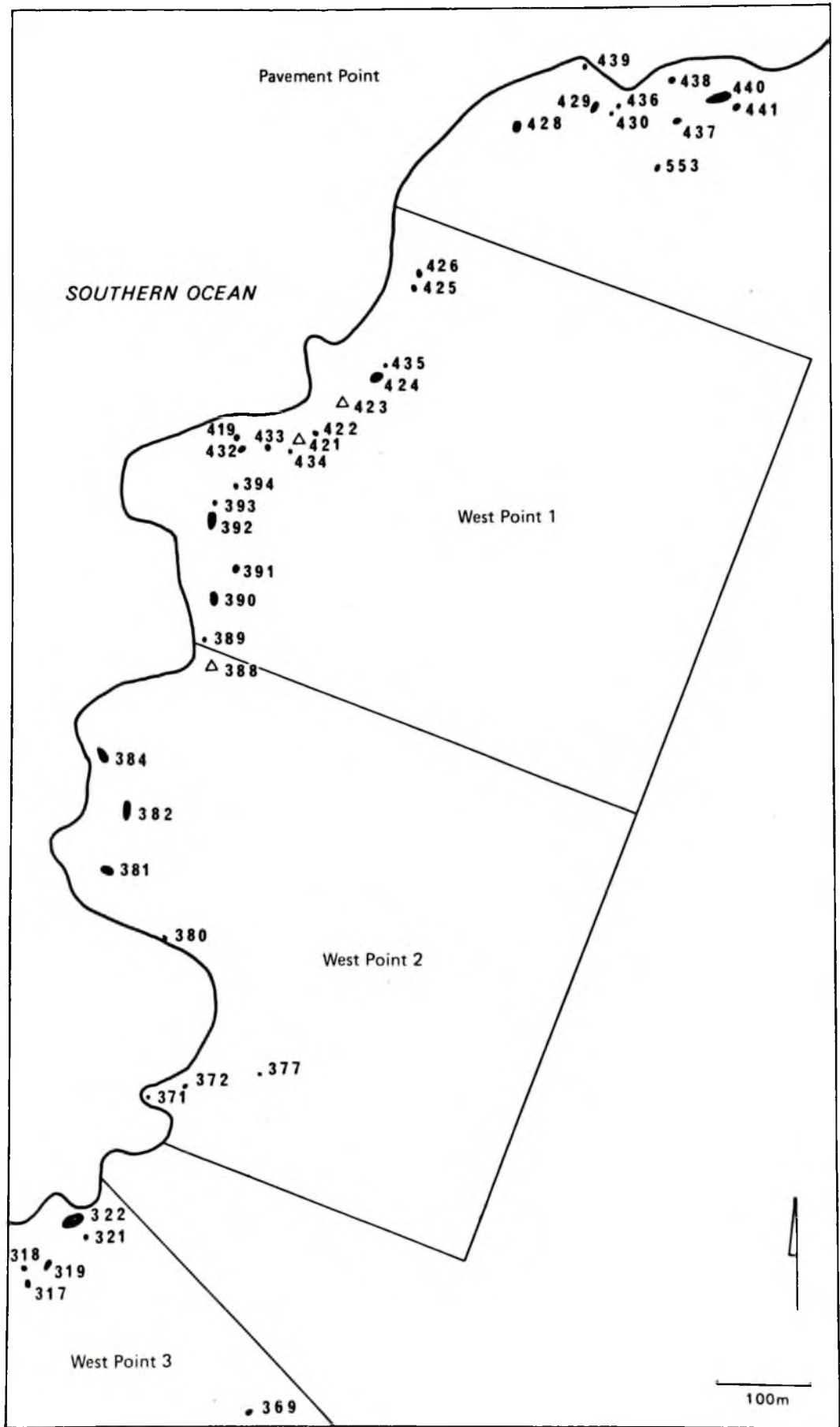


Figure A2.48 West Point middens - northern part



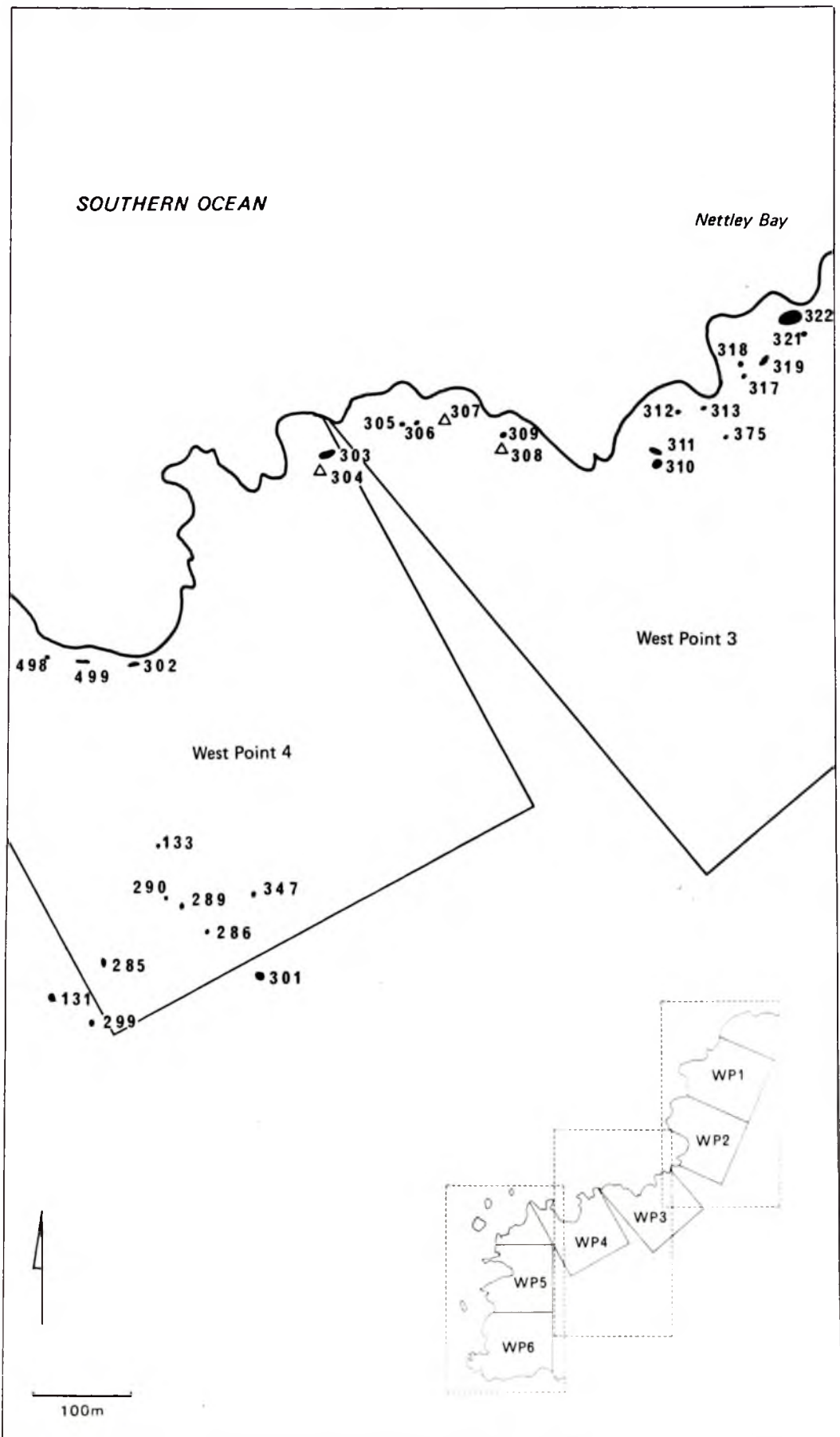


Figure A2.49 West Point middens - central part



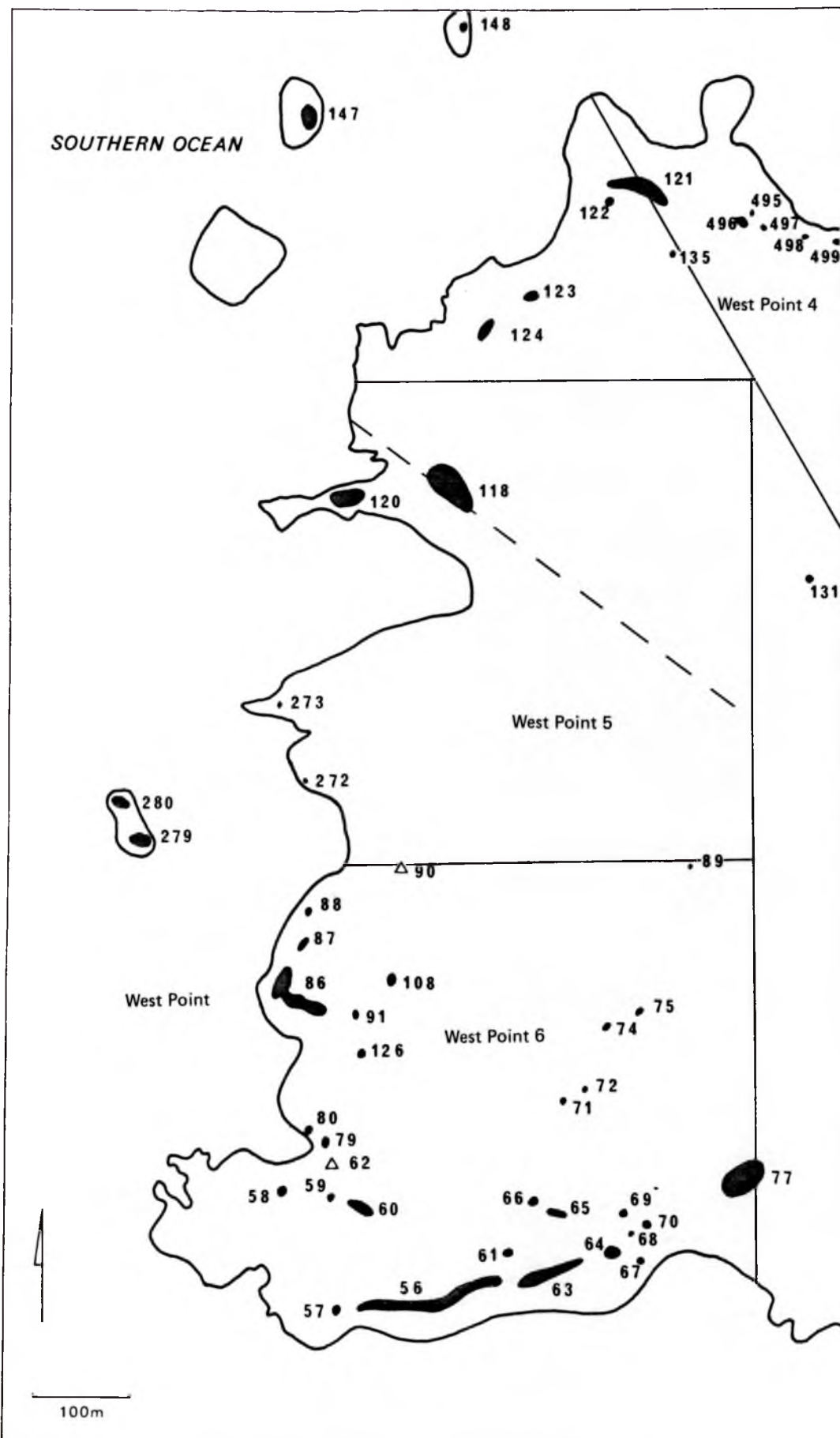


Figure A2.50 West Point middens - southern part



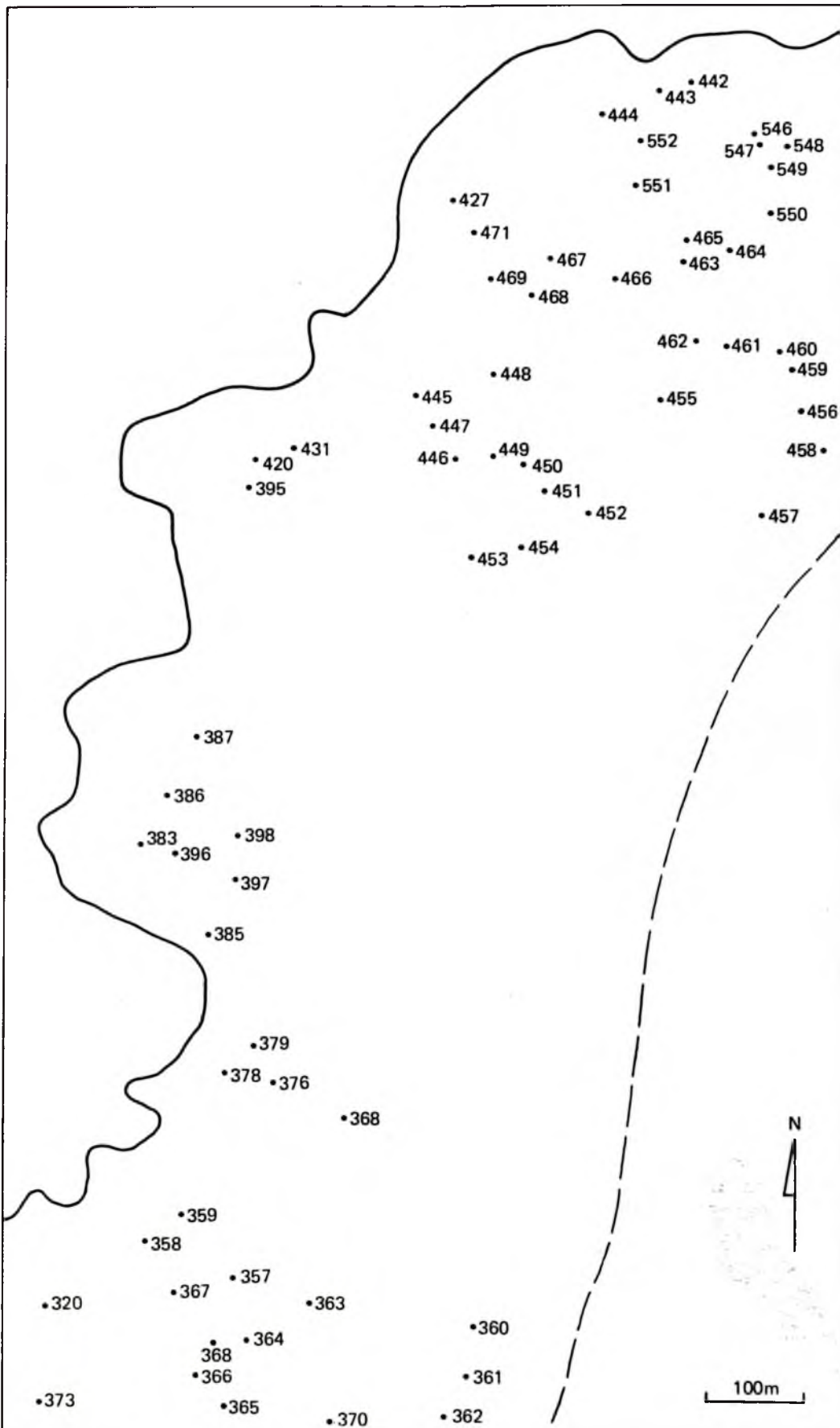


Figure A2.51 West Point artefact sites - northern part



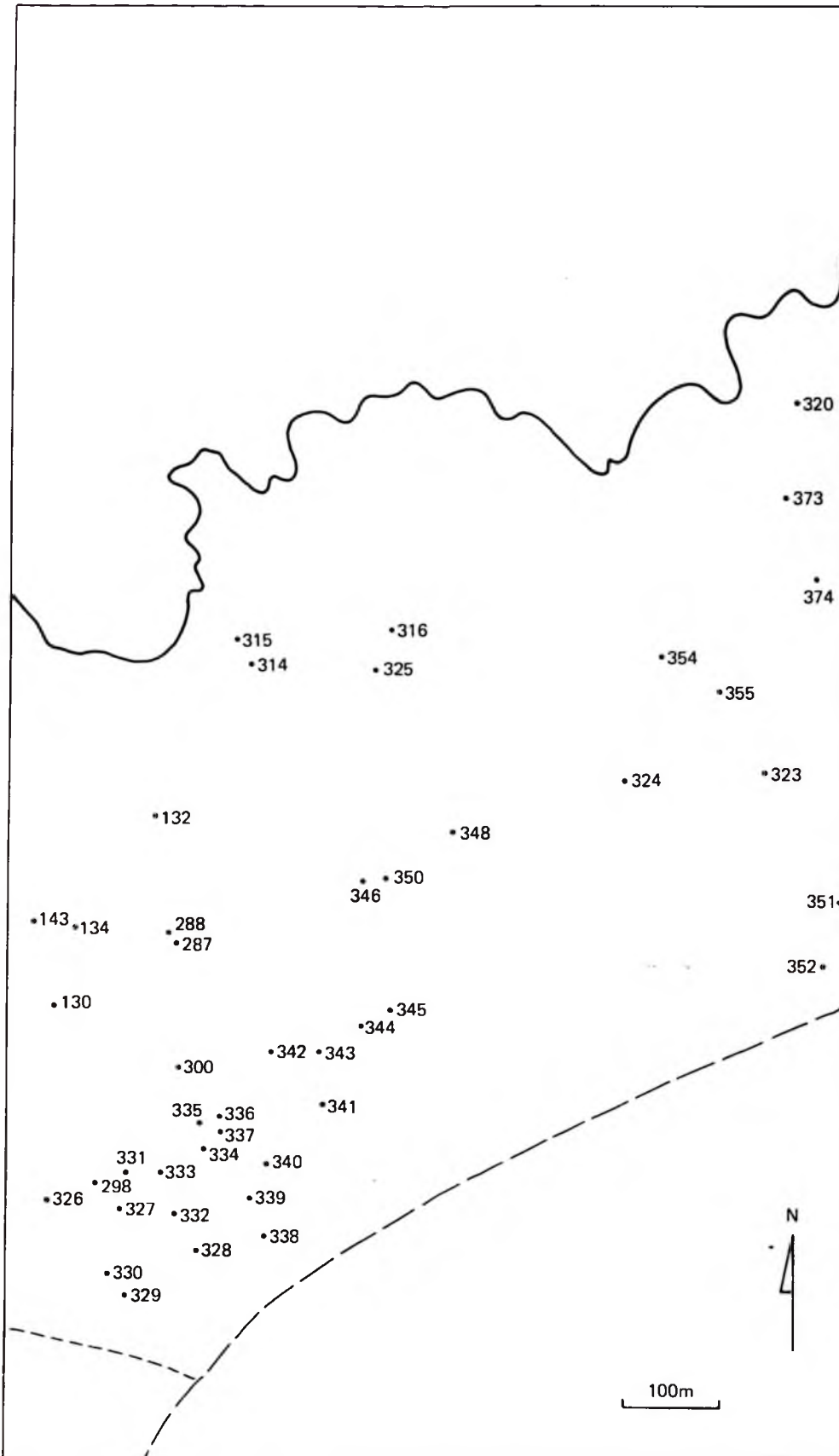


Figure A2.52 West Point artefact sites - central part



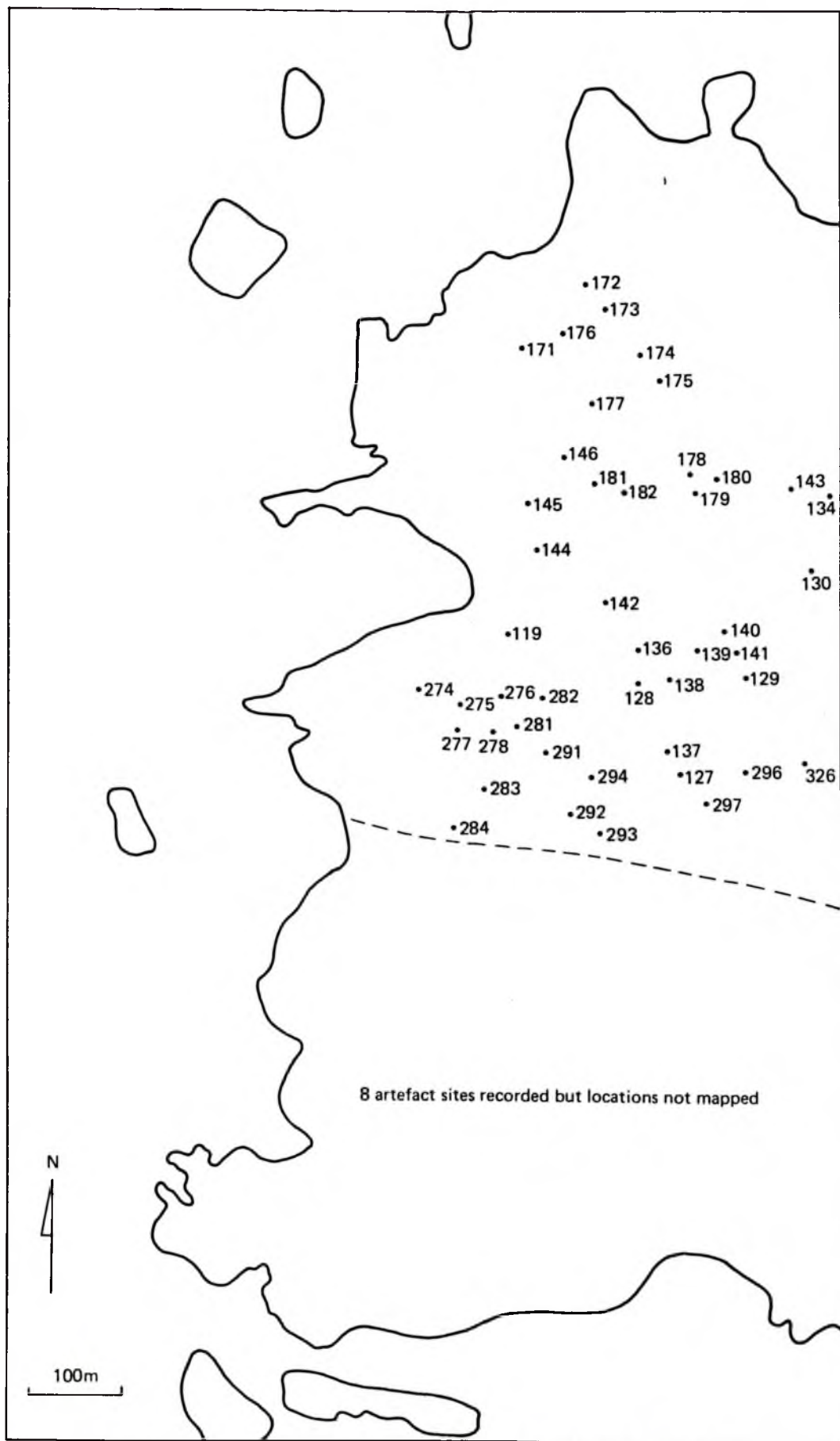
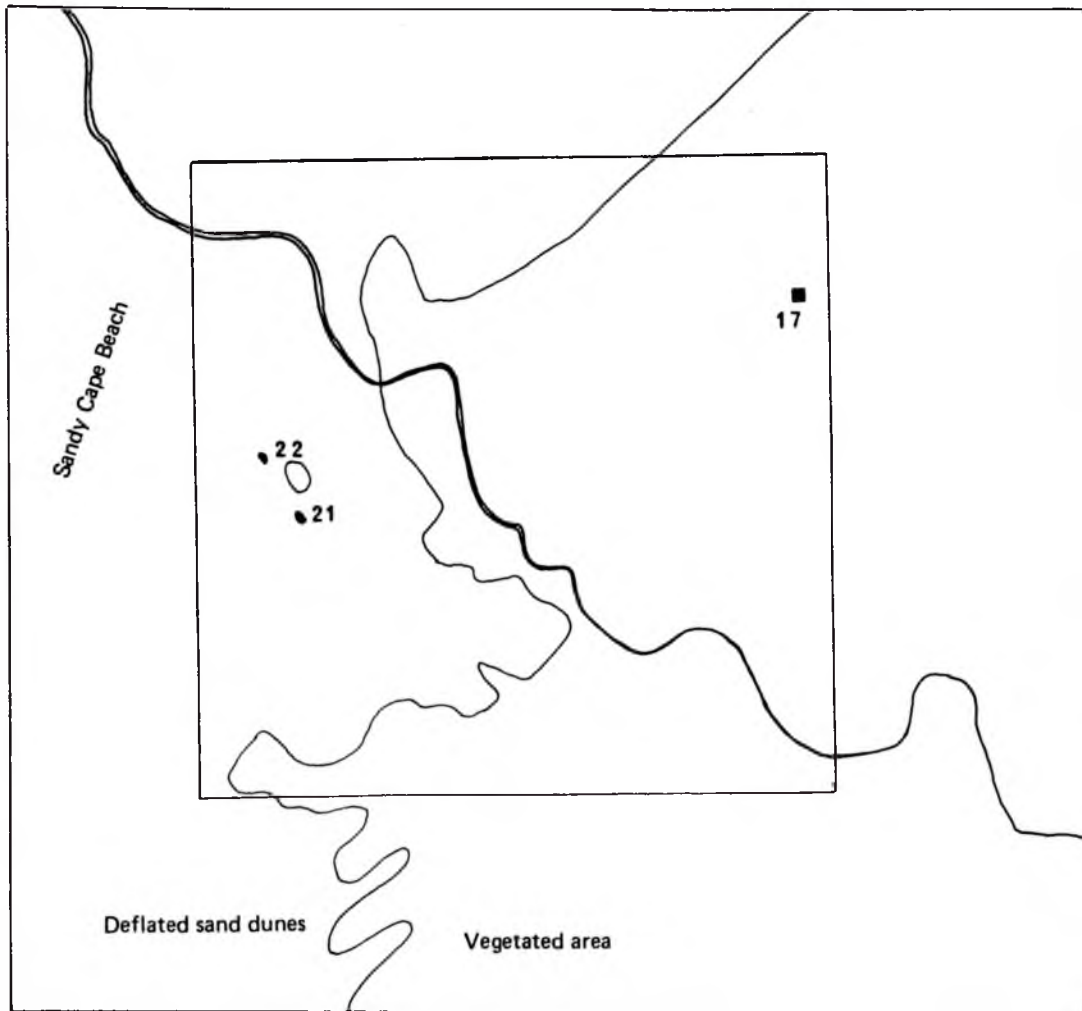


Figure A2.53 West Point artefact sites - southern part



100m

Drawn from Lands Department air photograph Project F 472 Coastal Photography, Run 26, T790 - 55, 1.2.79 at 1:40,000

Figure A2.54 Wild Wave River quadrat

QUADRAT: Wild Wave River



Drawn from Lands Department air photograph Project F472-Coastal photography, Run 26, T790-55, 1.2.79 at 1:40,000 with elevations calculated by clinometer

	average annual rainfall 1250 - 1500mm
LAND SYSTEM	Temna
GEOLOGY -BEDROCK -TOPOGRAPHY -SOIL -SHORE TYPE	Quaternary sands undulating calcareous, peaty and loamy sand soft
VEGETATION -STRUCTURE -ASSOCIATION	open heath and closed scrub dominated by <u>Leptospermum laevigatum</u> with <u>Acacia sophorae</u> and <u>Melaleuca ericifolia</u> along the river
PREHISTORIC MIDDEN VOLUME 1M ³	PRESENT LAND USE grazing and recreation

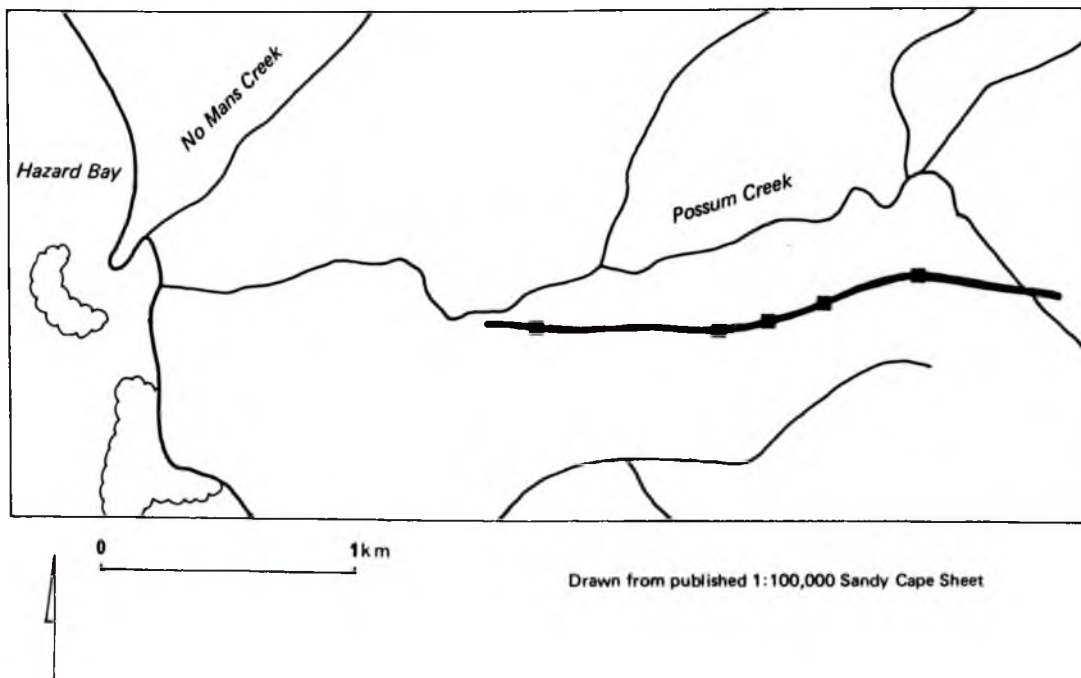
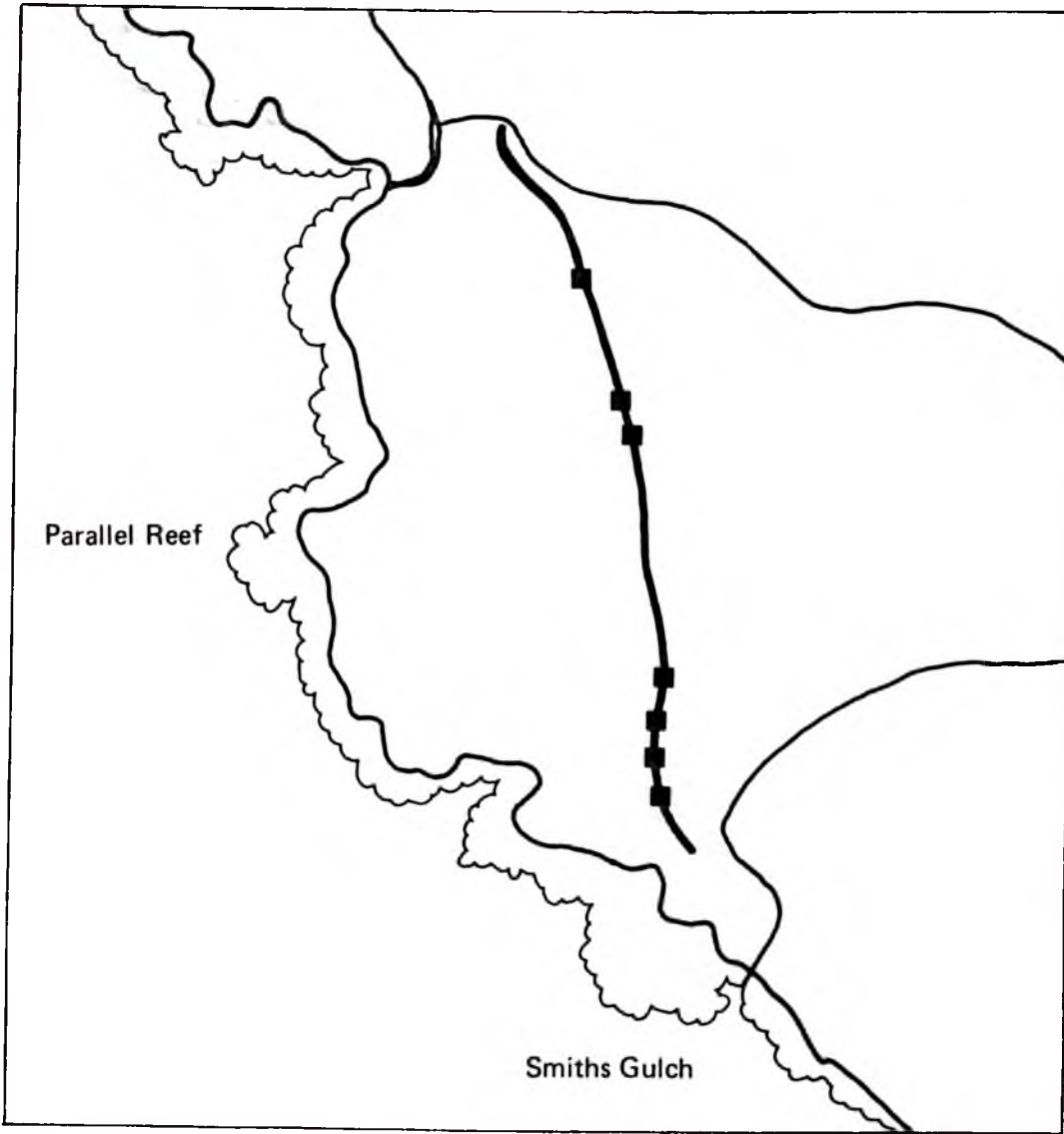


Figure A2.55 Balfour track transect



0 1km



Drawn from published 1:100,000 Sandy Cape Sheet

Figure A2.56 Hill 49 transect

APPENDIX 3 STONE WALL FISH TRAPS

A3.1 Introduction

Over the last few years a number of coastal fish traps have been noted in Tasmania by the author and other researchers (Jones, Green, Saunders pers. comm.) and Colhoun and Piper (1981) have described one such set. This Appendix synthesises the information presently available about their location, origin, construction, mode of operation and catch potential. This is done with a view to assessing their possible use in prehistoric times.

A3.2 Location

Figure A3.1 shows the fish trap locations I am aware of. Often two or three traps are found close together. None have been found in inland rivers or lakes, but this is not surprising as before the acclimatisation of trout there were no sizeable fish in the inland waters. The main concentration is along the centre of the north coast where the tide range is the greatest in Tasmania. There is one exception to this pattern. At Cooks Beach, Freycinet Peninsula, two small fish traps have been recorded close together (Colhoun and Piper 1981).

Stone walled fish traps are found throughout northern Australia and the Pacific. The southern most coastal example from mainland eastern Australia of which I am aware is from Broughton Island near Port Stephens (Campbell 1978:123). Campbell also describes other examples between Port Stephens and the Clarence River. Recently, a fish trap has been described in the estuarine reach of the north arm of the Richmond River estuary in northern New South Wales (K. Barz pers. comm.). A roughly circular walled trap has been described in south east Queensland, but its origin remains uncertain (Stockton 1975). On the coast north of Cooktown a large number of complex fish traps have been recorded during aerial reconnaissance work (J. Campbell pers. comm.). Stephens (1945:1-2) and Campbell (1979:20) described a stone fish trap made by Aborigines on Hinchinbrook Island. On some major inland rivers of Australia, fish traps have been recorded (for examples see Maynard n.d.:102; Flecker 1951:1-2; Sturt 1834:72; Lang 1865:19-20). The most famous examples are a complex of walls at Brewarrina on the lower Barwon River (Franklin 1898:202;

Fraser 1883:202-203; Newland 1889:6-7). Stone arrangements in lakes and swamps of Victoria have been identified as a method for catching eels (Lourandos 1980:251-252). Coutts et al. (1978) have described complex stone walled races and traps in the Western District of Victoria which were used to catch fish. Dix and Meagher (1976) have described fish traps in southwest Western Australia.

Walled fish traps may also be made of stakes and brush (for examples see Petrie 1975:72-73; Flinders in Steele 1972:19; Dix and Meagher 1976). These would decay quickly to leave little or no archaeological evidence.

A3.3 Origin

When the first Tasmanian fish trap was noted at Rocky Cape in 1963-4 by Jones, he suspected that it might be of prehistoric origin, because none of the residents in the area could recall its first construction. It was well known however, that the walls had been rebuilt (Jones pers. comm.). The possibility that these enclosures were the source of the fish remains found archaeologically in the nearby cave sites became less likely when fish were found to disappear from the Tasmanian diet about 3,500 years ago (Jones 1978). It seemed improbable that the low stone walls could have survived that long in a coastal environment.

Finally, historical evidence favours a recent origin. In a letter by Braddon written in 1878, two fish traps near Leith were described. In the design of one the operator "...encompasses with a rough stone wall a small strip of the shore that is washed by the sea and left dry when the tide is out...." (Bennet 1980: 211). Although I have not looked for evidence of these fish traps, the location is between the traps at Penguin and Hawley Beach.

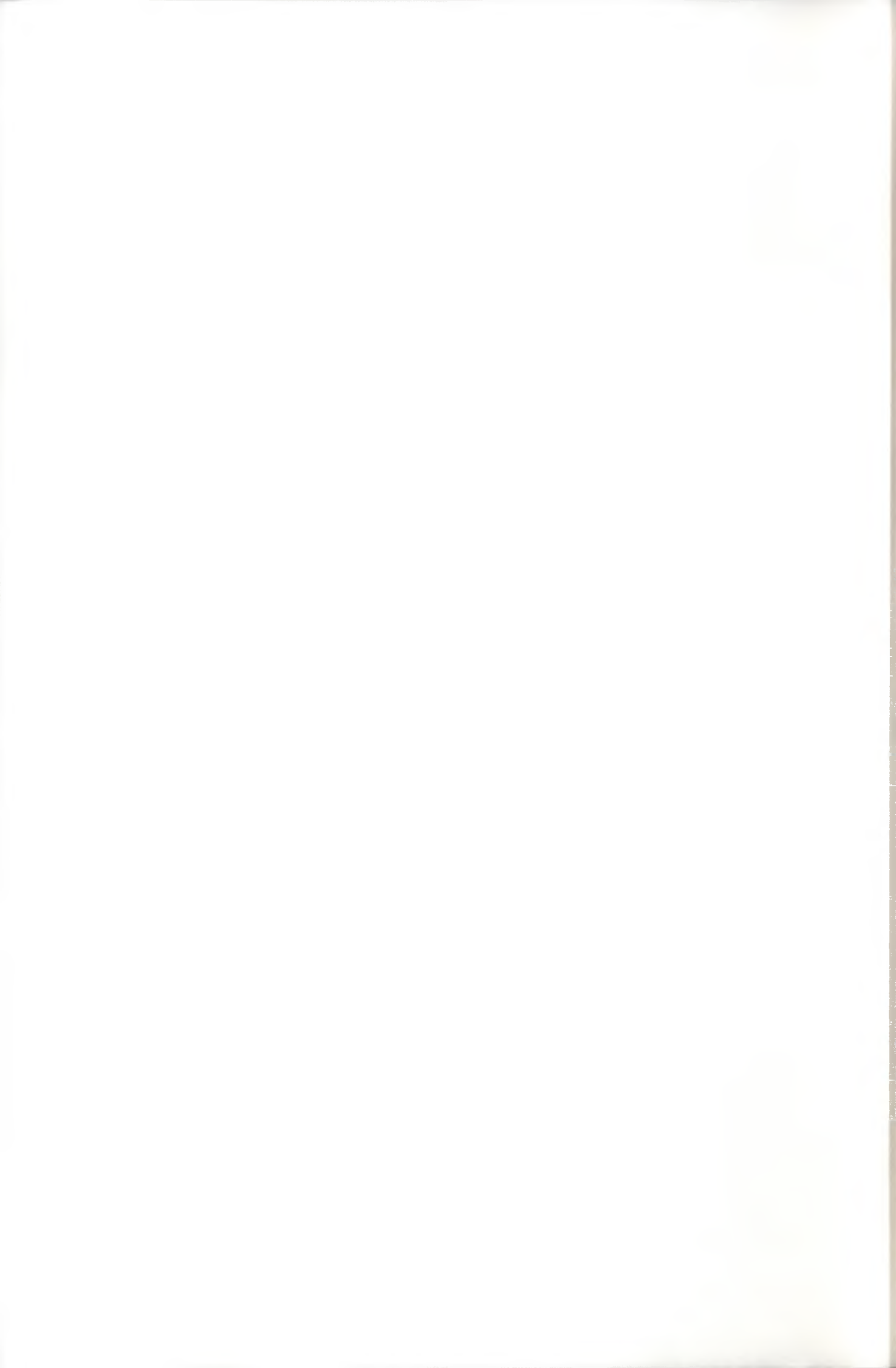
In 1981 in response to an article in a provincial newspaper (Circular Head Chronicle, 11th March 1981), I was able to locate Mr. G. Paine, who had built several fish traps in the Burnie area about 30 years ago, and who was able to provide information on their construction, maintenance and catch.

A3.4 Construction

All the fish traps are of similar construction, having walls of loosely piled boulders (plate A3.1). Some take advantage of sea bed

Plate A3.1 A large fish trap with dividing walls
near the town of Penguin.





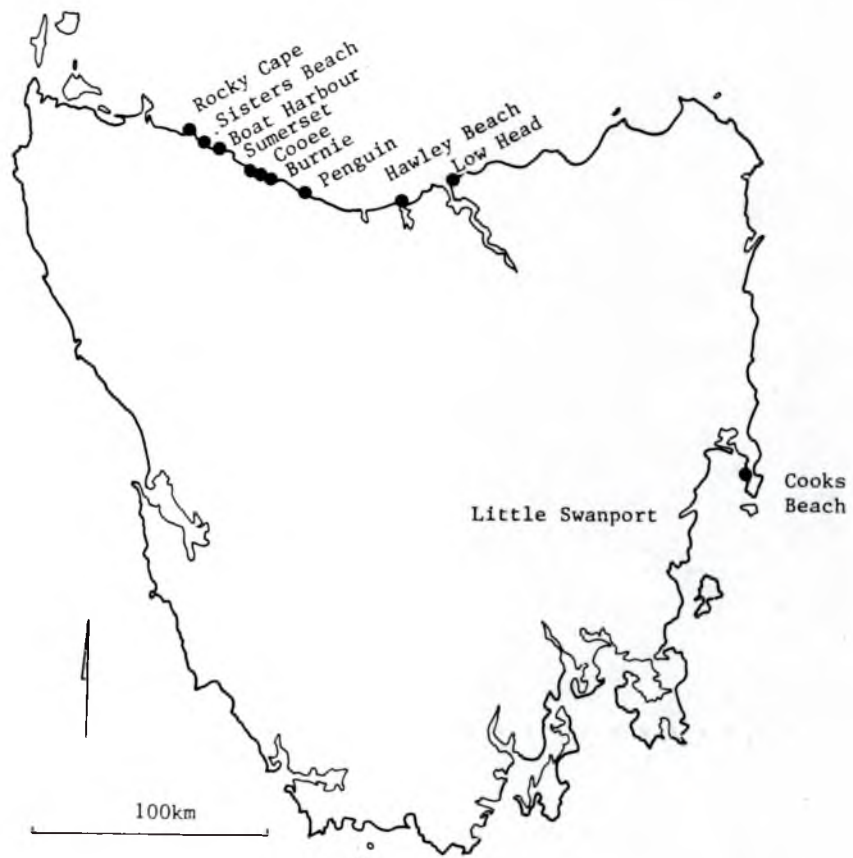


Figure A3.1 Fish traps in Tasmania, and locations named in text.



features and include lengths of natural rock outcrop in the wall design. A sketch plan of one example is shown in Figure A3.2. Much more complex designs are found throughout Oceania (Reinman 1967:126-127; Stokes 1909). These involve elaborate systems of walls to funnel the fish into small enclosures. The trap at Rocky Cape which was in operation in 1967 (R. Jones pers. comm.) includes a section of riveted iron pipe through the base of the wall, presumably to facilitate the flow of water out of the enclosure. In one case recalled by Mr. Paine, a group of six youths were able to complete the construction of a trap in one low tide. No major reconstruction was normally required, although after violent seas sections of the wall might need to be restacked (pers. comm. G. Paine). The trap at Hawley Beach and one of the group at Penguin have low internal walls, which make it easier to catch any fish trapped behind the main wall.

A3.5 Mode of operation

All the stone wall traps work with the rise and fall of the tide. At high tide the walls are submerged and fish move into the area to feed. As the tide ebbs, the walls become exposed, trapping any fish which are still inside. As the tide drops further the water runs out through the walls until the fish can be collected in the remaining shallow pools. The fish need to be collected regularly. If not collected sea birds are likely to take the fish, or the fish will escape with the next high tide, or someone else will collect them!

A3.6 Catch

Previous studies on the kinds of archaeological remains likely to result from different fishing strategies have not considered stone walled fish traps (Kefous 1977:55, Coleman 1980:63-4). However, it is likely that stone wall traps are the most unselective means of catching fish as they retain all the sizes and types of fish that come into the area. Mr. Paine was able to list 19 fish and two molluscs (octopus and squid) species caught in these traps, and notes there were probably others which he could not recall. Other observers have noted similar diversity (C. Turner and R.H. Green pers. comm.).

On 8th April 1981 I collected three species of fish from traps near the town of Penguin. These were:



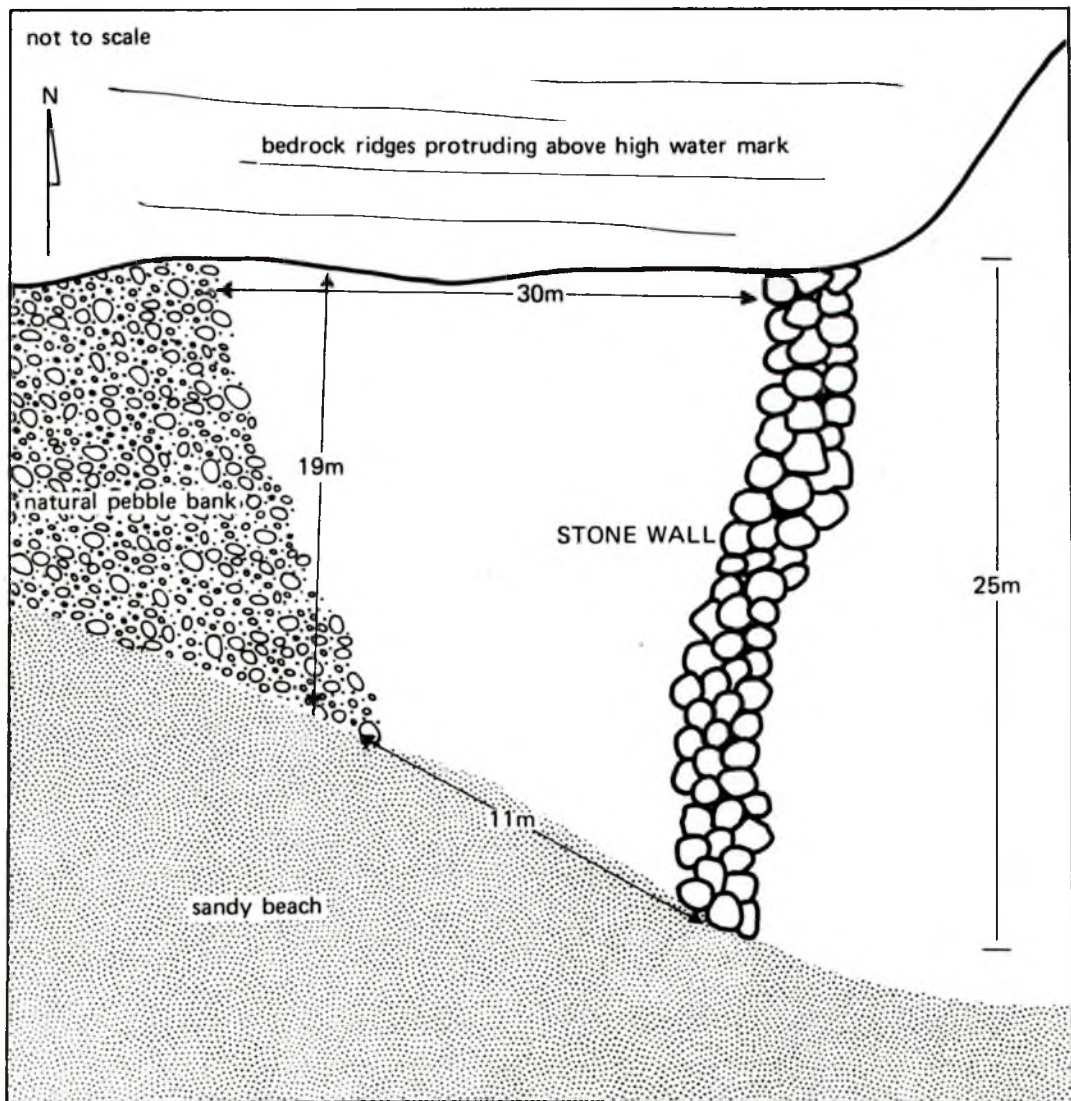
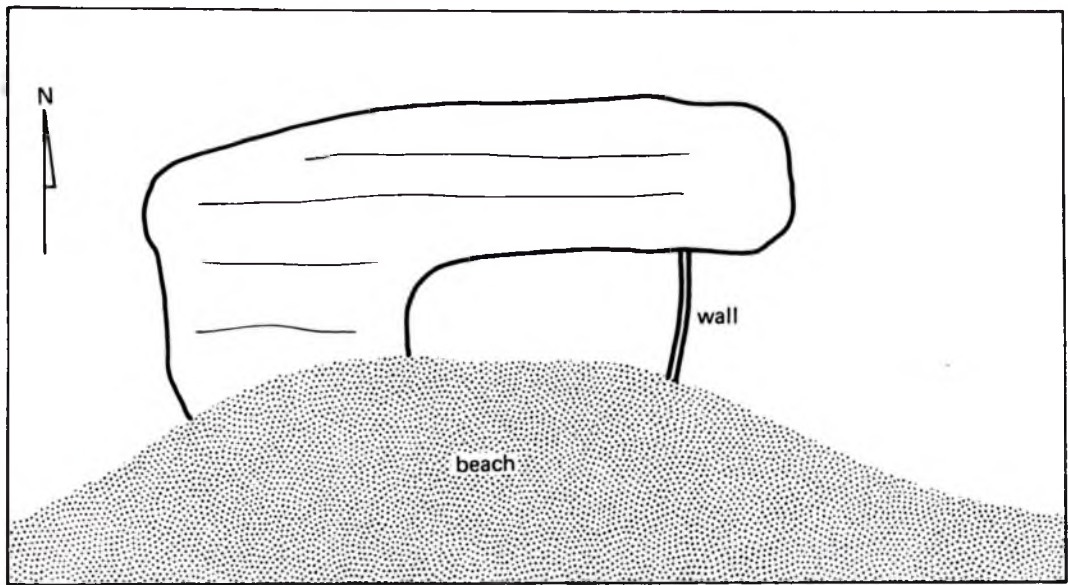


Figure A3.2 Sketch plan of a typical fish trap (not to scale).
This trap is opposite the Burnie High School.



Garfish Hemiramphus melanochir

Yellow-eyed or Freshwater Mullet Aldrichetta forsteri

Yellowtail Scad Prachurus mccullochi

A3.7 Discussion

The distribution of fish traps is concentrated on the central part of the north coast of Tasmania where the tide range is largest, generally in excess of 2m. The area also has a high population in a series of towns dotted along the coast, which may be important in terms of disposing of the catch. Construction does not require a great deal of skill or effort. After storms some maintenance may be required, but this is not difficult. Historical records describe the use of fish traps in the 1870's. Although all the traps considered here are probably of European origin, it is worth considering whether fish traps could have been the method by which the Tasmanian Aborigines caught fish.

Jones has described the fish bones excavated from Rocky Cape (1978:27). Of a total of 3196 bones, representing a minimum of 500 fish, all but four were Pseudolabrus (Labridae). The other four being unidentifiable. Three species of Pseudolabrus are found in Tasmania. They are all shallow water species, living on molluscs, small crustaceans and general scavenging. P. fucicola is the species most likely to be living off Rocky Cape. The local term for this group is "parrot fish". At Cave Bay Cave, Hunter Island, Bowdler recovered a total of only two fish. One was unidentifiable, the other a parrot fish (1979:152). At Little Duck Bay one fish, a Labrid, was recovered (1979:375). Although Mr. Paine recalls parrot fish being caught in stone fish traps at Burnie, Mr. Turner does not recall them at Rocky Cape.

In contrast to the northwest pattern, at Little Swanport on the east coast Lourandos found a minimum of 13 Monocanthids (leatherjacket) and no other types of fish (1970:42). Leatherjackets may also be caught in fish traps (G. Paine pers. comm.).

In the two prehistoric sites with reasonable samples, each set of fish remains are dominated by one family. At Rocky Cape it is Labridae and at Little Swanport Monocanthidae.

Leaving aside the difficult question of whether Aborigines preferred to eat one type of fish more than others, it seems likely that if the Aborigines had used fish traps a wide range of species

would be found in the archaeological sites. Therefore the evidence suggests some other methods of catching fish must have been used. It is interesting to note then that parrot fish are by far the most common species caught in baited wire mesh box traps in the southwest of Tasmania (pers. obs.). Coleman (1980:62) describes the use of box traps for leatherjacket and snapper on the northern New South Wales coast.

In the absence of fish hooks and the lack of a convincing argument for Tasmanian bone points having been used as fish spear points (Jones 1971:521) the possibility that baited box traps were used should be tested. Experiments with such traps could be instructive. From the evidence reviewed, stone wall fish traps do not appear to have been used by the Aborigines of Tasmania, and so an historical origin is indicated for these structures.



APPENDIX 4 SUMMARY OF CODES USED ON SITE DATA CODING SHEETS.

For a copy of the site data coding sheet see Figures 4.3 and 4.4 .

SITE DESCRIPTION

No. 0001 etc. - 4 figure system in order of recording

Map sheet reference - a 4 figure reference

Grid reference - a 6 figure reference, east then north

Site type - a 3 figure code to represent site type

LIM	linear midden, or cluster of point sites
SMD	small midden dump, less than 5m diameter
MMD	medium-sized midden dump
DOM	doughnut midden
WPM	large 'West Point' type midden
QRY	quarry
SWS	scattered worked stone, but no shell present
DEM	deflated midden, original structure indeterminate
ISF	isolated stone artefact find
ENG	engraving
STA	stone arrangements
OTH	other
RSM	rock shelter midden

QUANTIFYING FACTORS

Preservation. The state of the deposit in terms of recent human and other disturbance.

G	good
F	fair (some disturbance, but at least some deposit intact)
P	poor (most of the deposit disturbed or destroyed)

Type of disturbance

D	deflated by wind
W	water erosion, e.g. stream cutting, gullyng
H	human, e.g. vehicles, road cutting, construction
O	other
S	sea erosion

- X no disturbance
 C cattle or wallaby pad (as from 25/12/80, TWCAS 325)
 V vehicles, road erosion (as from 25/12/80, TWCAS 325)

SITE PARAMETERS

Aspect - which direction has the best view?

- 3 figure magnetic bearing towards the direction the site faces.
- 999 if no aspect.

Dimensions (all measures in cm)

length, width, depth, area and volume and height above sea level
 These measurements are given by 2 figures to indicate in cm the upper limit of the decile and the power of 10 to which this must be raised. Height above sea level in centimetres, as for other dimensions.

e.g. 10 = 1cm (1 sq. cm, 1 cu. cm)

15 = 1km

99 = 9,000,000,000 units

CONTENTS OF DEPOSIT

Shell: shell types listed in a 12 figure combination. The first 6 figures list in order the three dominant species, the last 6 figures list other species present.

- AU Austrocochlea concamerata
 and
Austrocochlea constricta
 BR Brachidontes rostratus
 CA Cabestana spengleri
 CE Cellana solida
 CH chiton, sp. not known
 CO Cominella lineolata
 DI Dicathais spp.
 GL Schismotis laevigata
 HI Hipponix conicus
 MY Mytilus planulatus
 NM Notoacmea mayi



NC	<u>Notoacmea corrosa</u>
NO	<u>Notohaliotis ruber</u>
OS	<u>Ostrea angasi</u>
OT	other, sp. not known
PA	<u>Patellanax peronii</u>
PE	<u>Pecten meridionalis</u>
PL	<u>Pleuroploca australasia</u>
SC	<u>Scutus antipodes</u>
SU	<u>Subninella undulata</u>
TR	<u>Trichomya hirsutus</u>
TF	<u>Tucetona flabellatus</u>
XE	<u>Xenostrobus securis</u>
XX	None

Bone:

One figure to represent the presence of:

L	land mammal bone
S	sea mammal bone
B	bird bone
F	fish bone
U	unidentified
X	no bone
M	land and sea mammal
A	land mammal and bird bone
C	sea mammal and bird bone
E	land and sea mammal and bird bone

Stone:

A 2 figure symbol to indicate lithology:

SP	spongolite
BC	chert
QI	quartzite
QZ	quartz
OT	other
XX	none
VT	vitric tuff
OC	owen conglomerate

Up to 3 stone types may be listed in decreasing abundance.

Matrix:

A 3 figure symbol to indicate the matrix of the deposit.

PEB pebbles (gravel and coarser)
 SAN sand
 FIN fines (silt and clay)
 SOI soil
 NIL nil matrix means an ISF or SWS is lying on bare rock

LOCATION DESCRIPTION

Substrate:

A 3 figure symbol to indicate the substrate on which the deposit rests.

As for matrix, plus the symbol.

BER bedrock

Landform:

A 3 figure symbol to indicate:

CLF cliff top
 CLB cliff bottom (also at the base of a rock outcrop,
 eg. TWCAS 377)
 ESC escarpment
 SLP hillslope, ridgeslope (as opposed to a dune slope)
 TOP hilltop, ridgetop (as opposed to a dune top)
 BCH beach
 FDN foredune complex
 BDN back-dune complex
 DNE dune complex, not better described as BDN or FDN
 FLT flat, this is not really a landform, but the term coined
 to describe the locations of some of the sites
 at West Point which occurred on level areas
 which typically had a thin mantle of sandy soil
 over the relative unmetamorphosed sedimentary
 groundrock.

SSH	sandsheet, including clifftop accumulations (old stabilised sheets which lie inland)
BRG	beach ridge system, pebble bank
EST	estuarine shoreline
RBK	riverbank
FPN	flood plain
ISL	island
CBK	creekbank
SBK	swampbank
RCK	rock outcrop
RTP	rock outcrop top
RSL	on rock outcrop slope

Vegetation:

XXXXXX etc. if no vegetation present, eg. for STAs
 A 2 figure symbol description of vegetation density in the vicinity of the site. In deflated areas, the vegetation of remnants if extant.

Density:

VD	very dense, 70-100% cover by dominant stratum
DE	dense, 30-70%
OP	open, 10-30%
VO	very open, less than 10%

Vegetation form:

A 2 figure symbol description of vegetation form of the dominant stratum in the vicinity of the site.

TT	tall trees, higher than 30m
TR	trees, 10-30m
LT	low trees, 5-10m
TS	tall shrubs, 2-8m
LS	low shrubs, 0-2m
HG	hummock grasses, 0-2m
TG	tussock grasses, 0-2m
HE	herbs



Dominant species:

A 4 figure symbol of the dominant species, i.e. greatest % cover on the actual site (in contrast to density and form which is for the vicinity). The first 2 figures are the first 2 letters of the genus name, and the last 2 are the first letters of the species name.

Code	Species name
ACSO	<u>Acacia</u> <u>sophorae</u>
ACVE	<u>Acacia</u> <u>verticillata</u>
ALBU	<u>Alyxia</u> <u>buxifolia</u>
AMAR	<u>Ammophila</u> <u>arenaria</u>
ATCI	<u>Atriplex</u> <u>cinerea</u>
BAMA	<u>Banksia</u> <u>marginata</u>
CABR	<u>Calocephalus</u> <u>brownii</u>
CALI	<u>Casuarina</u> <u>littoralis</u>
CAMO	<u>Casuarina</u> <u>monilifera</u>
CAST	<u>Casuarina</u> <u>stricta</u>
COBA	<u>Corria</u> <u>backhousiana</u>
DIAU	<u>Disphyma</u> <u>australe</u>
DOVI	<u>Dodonaea</u> <u>viscosa</u>
EUNI	<u>Eucalyptus</u> <u>nitida</u>
EUOB	<u>Eucalyptus</u> <u>obliqua</u>
EURI	<u>Eucalyptus</u> <u>risdoni</u>
EUSI	<u>Eucalyptus</u> <u>simmondsii</u>
JUNC	<u>Juncus</u> sp.
LECO	<u>Leucopogon</u> <u>collinus</u>
LEGL	<u>Leptospermum</u> <u>glaucescens</u>
LELA	<u>Leptospermum</u> <u>laevigatum</u>
LEPA	<u>Leucopogon</u> <u>parviflorus</u>
LESC	<u>Leptospermum</u> <u>scoparium</u>
MEER	<u>Melaleuca</u> <u>ericifolia</u>
MESQ	<u>Melaleuca</u> <u>squarrosa</u>
POAP	<u>Pomaderris</u> <u>apetalum</u>
PTES	<u>Pteridium</u> <u>esculentum</u>
PUDA	<u>Pultenaea</u> <u>daphnoides</u>
SPHI	<u>Spinifex</u> <u>hirsutus</u>
SPIC	<u>Sprengelia</u> <u>incarnata</u>

Additional descriptions are:

HERB herbs cover most of the site
 DONO don't know, but sample taken for identification
 TUSS tussock grasses
 BARE surface is greater than 50% bare rock or sand (if DEM, the vegetation of remnants is given, even if now less than 50% of surface cover)
 MIXF mixed forest of Eucalyptus sp. overstorey with rainforest understorey

Slope: measured in degrees (2 figures).

Position: relative to shelter from prevailing winds, offered by a dune, headland or cliff. A 3 figure symbol, two

figures representing 8 directional coordinates in combinations of N, S, E, W with NS if protected in all directions. One figure for type of shelter.

D dune

H headland, cliff, hill

R if protected by rock outcrop of the West Point type

P pebble bank/beach ridge

XXX if this factor is not applicable

VAR for lumped point sites in a LIM

Water: the distance in metres from drinkable (fresh or slightly brackish) water.

The value 999 = more than 1km

000 = can't be established (e.g. in deflated sand dunes)

Source: A 3 figure symbol indicating the local source of drinking water:

CRK creek, surface runoff

SWP swamp, ponded water

RKH rock hole, spring

SPG seepage through sand, alluvium

XXX it can't be established

PLATFORM DESCRIPTION

The nature of rocky platforms or reefs nearby.

XXXXX etc. if this does not apply.

Distance: distance in metres to nearest rock platform or reef area.
999 = greater than 1km

Length: the length of the edge of the platform within a 500m radius uncovered at low tide measured from maps or air photographs.
000 if not withing 1km
999 if more than 1000m of platform is within 500m

Form: a single feature symbol to indicate the surface erosional form of the platform:
S smoothly eroded (e.g. granite)
J jointed, cracked, etched, honeycombed, etc. (e.g. relatively unmetamorphosed sedimentary rocks)
L level, differentially eroded to discrete surfaces (e.g. Porter Bay or the basalts of Suicide Bay)
B for beach, if no rockplatforms within 1km
P for pebbles, eg. North Point
X if not applicabile

Bedrock:

The type of bedrock shown for the area on the published geological map.

BA basalt
BR Slaughter Bluff volcanic breccia
SA sand
BH Badger Head group (sandstone, slate, and phyllite)
CA marine limestone (calcarenite)
US comparatively unmetamorphosed sedimentary rocks
MR metamorphic rocks
MS mudstone-sandstone
MU mudstone
OR orthoquartzite (original sandstone plus cementing)

QT quartzwacke turbidite (like sandstone, but darker minerals,
poorly sorted and moderately cemented)
GR granite
SU serpentinite (complex, highly metamorphosed with characteristic
mafic materials)
ME metaquartzite (totally recrystallised)
AL ash flows, agglomerates, tuffs, lavas
DO dolerite
AN andesite intrusives
OC owen conglomerate
SY syenite

FILING

Film: A 4 figure reference for roll numbers, first 2 figures for
B/W roll, last 2 figures for color slide roll.
9999 if not applicable.

Notebook reference: A 3 figure reference for book number and page
number. The first digit for notebook number,
the last two for page number.

Nearest map name: Nearest map name on the 1:100,000 sheet.

NOTE for missing data not attainable have used X for alphabetic and
9 for numerics.

APPENDIX 5 HISTORIC AND MODERN VEGETATION PATTERNS

This list refers to Figure 2.10 of Section 2.5.

1. Big Duck Bay to Perigo Point, Hunter Island.
 Past veg: low grassy sandhills with clumps of honeysuckle trees - good feed for sheep (1832).
 Present veg: Pasture grasses with scattered Eucalyptus sp. and Banksia marginata trees.
 Obs. and ref: Robinson (Plomley 1966:657).

2. Trefoil Island.
 Past veg: beautiful pasture (1830).
 Present veg: Poa tussock grassland.
 Obs. and ref: Robinson (Plomley 1966:175).

3. Woolnorth Point.
 Past veg: a rich grass pasture on the coast, with heath inland (c. 1824).
 Present veg: introduced pasture species.
 Obs. and ref: Hardwicke (1861:2).

4. Woolnorth Point to Studland Bay.
 Past veg: good sheep land (c. 1828).
 Present veg: introduced pasture species.
 Obs. and ref: VDL/343/5

5. Cape Grim to Arthur River.
 Past veg: nearly all the country is grassy sandhills, and excellent sheep walks (1832).
 Present veg: too varied to describe, see references 7 to 32.
 Obs. and ref: Robinson (Plomley 1966:616).

6. Cape Grim to Mount Cameron West - coastal strip.
 Past veg: abundance of feed for sheep (1828).
 Present veg: as for 5.
 Obs. and ref: Wedge (1861:3).

7. Cape Grim and vicinity.
 Past veg: good sheep land with the exception of a low plain which is suitable for cattle (1826).
 Present veg: Cultivated areas of pasture grasses and areas of closed scrub of Melaleuca ericifolia.
Poa tussock grassland on hillslopes.
 Obs. and ref: Goldie (1861:6).

8. Cape Grim.
 Past veg: luxuriant grass, fine country for sheep (1828).
 Present veg: as for 7.
 Obs. and ref: Wedge (1861:3).

9. Cape Grim(?)
 Past veg: grassy hills (1830)
 Present veg: as for 7.
 Obs. and ref: Robinson (Plomley 1966:175).

10. Flat Topped Bluff.
 Past veg: grass and stunted tea tree (1830).
 Present veg: as for 7.
 Obs. and ref: Robinson (Plomley 1966:174).
11. SW of Welcome Inlet.
 Past veg: extensive forest of tea tree and light and black wood (1834).
 Present veg: Low forest of very dense low trees dominated by Melaleuca ericifolia with scattered Acacia melanoxylon.
 Obs. and ref: Robinson (Plomley 1966:365).
12. W of Welcome Inlet.
 Past veg: tea tree and heathy swamp land (1832).
 Present veg: mainly an open heath and sedgland comprising Melaleuca squarrosa, M. ericifolia and Leptospermum scoparium.
 Obs. and ref: Robinson (Plomley 1966:656).
13. Studland Bay.
 Past veg: good sheep land (1826).
 Present veg: bare mobile sand blows.
 Obs. and ref: Goldie (1861:6).
14. Inland from Studland Bay.
 Past veg: good sheep pasture (1832).
 Present veg: as for 13.
 Obs. and ref: Robinson (Plomley 1966:656).
15. Mount Cameron West.
 Past veg: covered with grass and large gum and peppermint trees, an open forest of clear walking (1830).
 Present veg: Tussock grassland with areas of very dense Melaleuca ericifolia scrub. On the southern slopes is Eucalyptus woodland with a heath understorey.
 Obs. and ref: Robinson (Plomley 1966:174).
16. View from Mount Cameron West.
 Past veg: broad extensive plains covered with grass and small grassy hills, and small belts of open forest interspersed throughout (1830).
 Present veg: Sand blows and restabilised areas with marram grass.
 Obs. and ref: Robinson (Plomley 1966:174).
17. Mount Cameron West vicinity (?N side).
 Past veg: heath and swamp (1826).
 Present veg: as for 16.
 Obs. and ref: Goldie (1861:6).
18. Mount Cameron West
 Past veg: very good feed (1826).
 Present veg: Pasture grasses on flat areas, and tussock grassland with areas of very dense Melaleuca ericifolia scrub on slopes.
 Obs. and ref: Goldie (1861:6).

19. Mount Cameron West and the adjacent coastal strip.
 Past veg: luxuriant pasturage (1828).
 Present veg: as for 18.
 Obs. and ref: Wedge (1861:3).
20. N, E and S of Mount Cameron West
 Past veg: good sheep land (C.1828)
 Present veg: Restabilised sand blows with marram grass along the coastal fringe, with heath or Eucalyptus woodland with a heath understory in inland areas.
 Obs. and ref: VDL/343/5
21. Mount Cameron West to West Point.
 Past veg: narrow strip of good land with forest inland (1828).
 Present veg: The coastal strip is now a complex pattern of marram grass restabilised dunes, pasture covered relict dunes, and coastal heath on areas of quartzite bedrock. The forest areas are now cleared and sown to pasture.
 Obs. and ref: Wedge (1861:3).
22. Port Hills.
 Past veg: same as Mount Cameron West - very good feed (1826).
 Present veg: introduced pasture species.
 Obs. and ref: Goldie (1861:6).
23. West Point c. 3km inland.
 Past veg: wet heathy plains and tea tree knee deep in water (1826).
 Present veg: heath dominated by Leptospermum scoparium - Melaleuca squarrosa association and swamps with M. ericifolia.
 Obs. and ref: Goldie (1861:6).
24. West Point.
 Past veg: small quantities of land adapted for sheep (1828).
 Present veg: grassland on the coastal fringe, with heath inland.
 Obs. and ref: Wedge (1861:3).
25. West Point
 Past veg: an extensive heathy plain (1832).
 Present veg: as for 24.
 Obs. and ref: Robinson (Plomley 1966:653).
26. West Point (? S of the point).
 Past veg: miles of grassy sandhills ... an excellent sheep walk (1832).
 Present veg: sand blows restabilised with marram grass.
 Obs. and ref: Robinson (Plomley 1966:616).
27. West Point to Bluff Hill Point.
 Past veg: grassy hills covered with honeysuckle trees (1830).
 Present veg: At West Point and Bluff Hill Point there are remnant stable dune landforms with vegetation similar to the reference. Elsewhere the coastal strip is sand blows restabilised with marram.
 Obs. and ref: Robinson (Plomley 1966:172).

28. Coastal strip 1.5km wide from 8km S of West Point to the Arthur River.
 Past veg: good sheep land (c. 1828).
 Present veg: marram grass on restabilised dunes with coastal heath inland.
 Obs. and ref: VDL/343/5.
29. C. 8km S of West point.
 Past veg: a rich grass pasture on the coast with heath inland (c. 1824).
 Present veg: as for 28.
 Obs. and ref: Hardwicke (1861:2).
30. Australia Point to Temma.
 Past veg: grassy hills with dwarf gum and honeysuckle trees (1828).
 Present veg: Recently mobile sand blows near the coast have been stabilised with marram grass. Inland dunes which have remained intact are covered with Lomandra longifolia tussock grassland, introduced pasture grasses and clumps of Leptospermum laevigatum and Acacia sophorae.
 Obs. and ref: Wedge (1861:3).
31. Arthur River mouth.
 Past veg: The banks are high and hilly and covered with grass (1830).
 Present veg: as for 30.
 Obs. and ref: Robinson (Plomley 1966: 171-2).
32. Arthur River, 1-2km inland.
 Past veg: heath with clumps of scattered gum trees (1834).
 Present veg: as described in reference.
 Obs. and ref: Robinson (Plomley 1966:849).
33. Coastal strip 1.5km wide from 3km S of the Arthur River to 11km S of the Pieman River.
 Past veg: good sheep land (c. 1828).
 Present veg: This strip is mostly unvegetated mobile sand blows and marram restabilised dunes. Inland of the sandsheets is coastal heath on quartzite bedrock.
 Obs. and ref: VDL/343/5.
34. Sundown Point to Sandy Cape.
 Past veg: honeysuckle and other trees and copses are interspersed over the country with clear heathy plains and hills ...
 good sheep walks (1833).
 Present veg: Remnant dune areas have pasture grasses with scattered trees and shrubs, but most dune areas have become unstable sand blows. Some of the sand blows have been restabilised by marram grass. Non-dune landforms on the quartzite bedrock have coastal heath.
 Obs. and ref: Robinson (Plomley 1966:790).
35. 2km N of Temma to Thornton River.
 Past veg: the whole extent of the country is clear of wood, with undulating grassy patches and heathy hills, and has the appearance of a park (1830).
 Present veg: as for 35.
 Obs. and ref: Robinson (Plomley 1966:170).

36. Pedder River, c. 2km inland.
 Past veg: good grassy meadows, each one enclosed with honeysuckle and tea tree (1830).
 Present veg: areas of tussock grass and other herbs, with clumps of shrubs, mostly Leptospermum laevigatum, and Acacia sophorae, Melaleuca ericifolia dominates in damp areas.
 Obs. and ref: Robinson (Plomley 1966:168).
37. Sandy Cape.
 Past veg: plains and small grassy hills (1830).
 Present veg: mobile unvegetated sand blows and marram grass restabilised dunes.
 Obs. and ref: Robinson (Plomley 1966:168).
38. 16km S of Sandy Cape to (?) Sandy Cape.
 Past veg: a fine belt of grassy hills commencing 16km S of Sandy Cape, well adapted for a sheep walk (1833).
 Present veg: Huge unvegetated mobile sand dunes are the dominant landform. Behind some areas of rocky headland are remnants of stable dune landforms vegetated by grassland and coastal heath.
 Obs. and ref: Robinson (Plomley 1966:789).
39. N of Lagoon River.
 Past veg: resembles in appearance a park with extensive grassy hills with honeysuckle trees (1830).
 Present veg: mobile unvegetated sand blows and stable dune areas with vegetation of grassland with scattered shrubs of Banksia marginata and Leucopogon parviflorus.
 Obs. and ref: Robinson (Plomley 1966:166).
40. S of Lagoon River.
 Past veg: extensive plains with grassy hills (1830).
 Present veg: mobile sand blows.
 Obs. and ref: Robinson (Plomley 1966:166).
41. W foothills of North Heemshirk Spur, Mount Heemshirk and Cumberland Hill.
 Past veg: the land covered with heath and fine shrubs for several miles
 the land covered with heath and a few shrubs (1830) moor and heathy land (1833).
 Present veg: mixed heath and sedgland communities, of which the principal species are Leptospermum nitidum, Epacris lanuginosa, Banksia marginata and Leptospermum scoparium.
 Obs. and ref: Robinson (Plomley 1966:160;760).
42. Ocean Beach.
 Past veg: a sandy beach 800m in width in the rear of which are sandy hills (1830).
 Present veg: About half this strip is mobile sand blows. The remainder is stable sand dune landforms with an open scrub. Principal species are Acacia mucronata, A. sophorae and Leptospermum scoparium.
 Obs. and ref: Robinson (Plomley 1966:160).



APPENDIX 6 FIELD EQUIPMENT

The choice of equipment was to some extent determined by weight and volume. Standard equipment was the following:

- data code booklet
- field notebook
- coding sheets and air photo folder
- graph paper
- photo board and spare numbers
- binoculars
- clinometer
- compass
- plastic bags
- 30m tape
- two cameras
- spare film
- map sheet
- trowel
- field stereoscope
- flagging tape
- 2m ranging pole
- auger

The data code booklet contained a summary of all codes and their meanings, together with any comments relevant to variable coding. The field notebook is a duplicate carbon page notebook. The folder for data sheets and air photographs was made from plywood with a flexible hinge, data sheets and air photos being held by rubber bands. The more windy the day, the more rubber bands were used! Graph paper was also carried in the folder for preparation of maps, sections, vegetation transects etc. The photo board was a Movitex brand plastic board with holes for inserting characters. Binoculars were generally useful, particularly if there was a high point in the quadrat from which to look over the area. The clinometer was a Suunto PM-5 clinometer, used for slope and elevation calculations. Various compasses were tried before a Silva Type 4 was chosen. Its simplicity of operation enables sighting and plotting to be carried out by the one instrument. It contains a small magnifying

glass which was surprisingly useful and a metric scale which was used for grid reference and other map and air photograph measurements. Plastic bags of various sizes were used to collect samples which were sealed by tying off with lengths of flagging tape. The 30m tape was obviously for measurements. One camera contained black and white film, the second colour slide film. The map sheets used were the Natmap 1:100,000 series, to which field observations were grid referenced. The trowel was used for any clearing or testing of sites. The field stereoscope allowed the examination of air photos in stereo in the field. Flagging tape was used to mark sites, boundaries, and other strategic points such as corners of quadrats. The above items were carried in a Karrimore 'Shorty' rucksack and the total weight of the pack was only 8kg.

Carried by hand were a 2m ranging pole, and a probe auger. The auger warrants detailed description (Figure A6.1). It was designed by Roger Luebbers when at the Department of Prehistory, RSPacS, ANU. It consisted of a 1m shaft of 10mm diameter high tensile steel, welded at 90° into a 30cm long handle of 25mm diameter mild steel. The end of the probe was machined to a dull point for ease of penetration into the ground. Along the side of the shaft an offset slot 3mm wide and deep was machined. The operation of the auger was very simple. It was inserted into the ground, given a clockwise twist, and removed. The slot collected a sample which with practice could be read for soil type and the thickness of shell midden. The accuracy of deposit measurements and speed of operation compared to conventional augers meant that a number of depth measurements could be taken at each site, enhancing the accuracy of volume estimates.

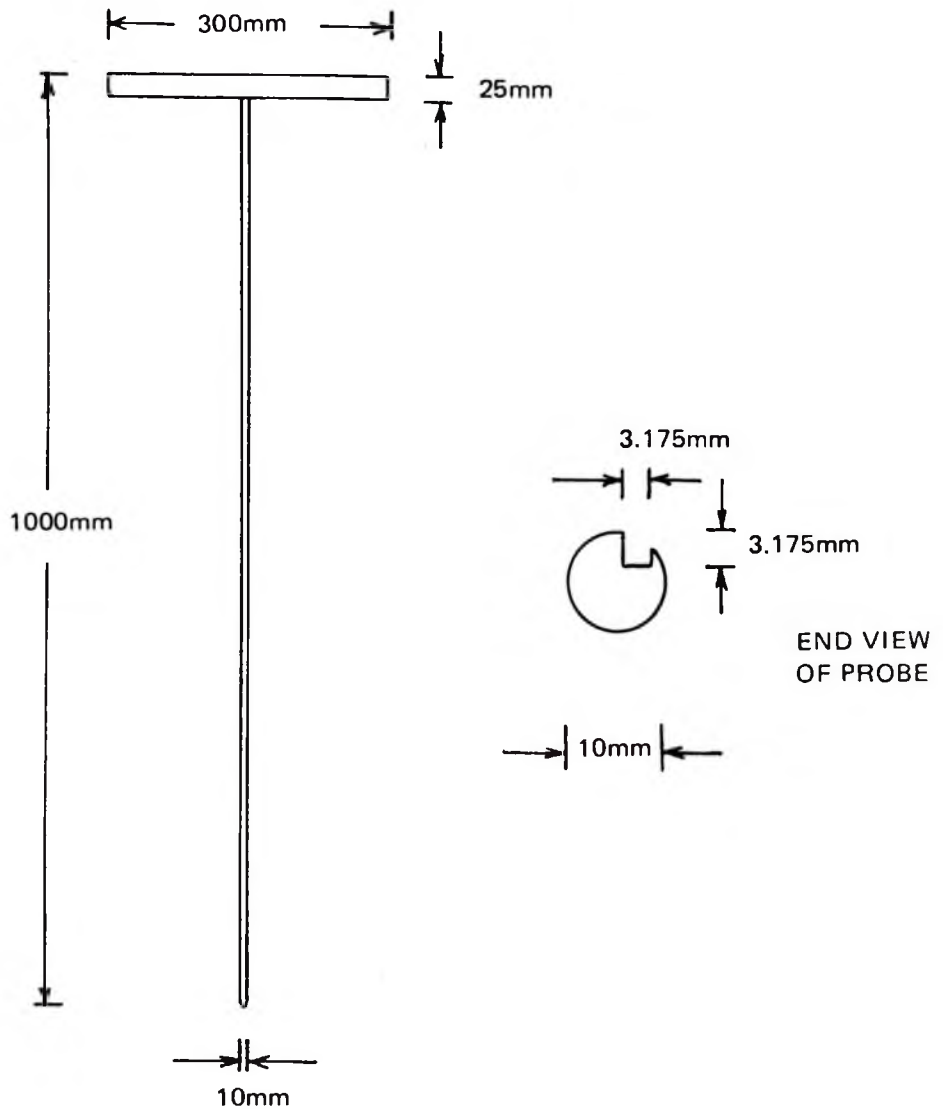


Figure A6.1 The probe auger

APPENDIX 7 EXAMPLE OF SITE DATA FILE

NO.	LOCATION	TYPE	STATE	AND	SIZE	CONTENTS	LOCATIONAL DESCRIPTION	PLATFORM	FILING	NEAREST MAP NAME
00011	7815045495	SMD	PW250222211343552			BRSUNOXXXXXXXXBCXXXXSAN	SANFDNDEHEHERBOONED00800012CRK	999000BSA	0253118	ALERT CREEK
00021	7815047495	DEM	PW999414110131313			SUNODIXXXXXXXXXBCXXXXSAN	SANBDNOPLSHERBOONS00500022CRK	999000BSA	0253118	ALERT CREEK
00031	7815047495	DEM	PW999000000000013			SUXXXXXXXXXXXLBCOTXXSAN	SANBDNOPLSHERBOONS00300032CRK	999000BSA	0253999	ALERT CREEK
00041	7815097258	SWS	PH999000000000043			XXXXXXXXXXXXXXXXBCXXXXSAN	BERTOPOPLSLEGL00XXX20000042CRK	900999JUS	9999122	GANNET POINT
00051	7815097257	SWS	PH999000000000043			XXXXXXXXXXXXXXXXBCSPXXSAN	BERSLPOPLSLEGL00XXX15000052CRK	900999JUS	0253122	GANNET POINT
00061	7815098254	SWS	PH210000000000023			XXXXXXXXXXXXXXXXBCQIXXSAN	BERCBKVDTSMSQ00XXX00100062CRK	500999JUS	9999122	GANNET POINT
00071	7815098253	ISF	PH999000000000023			XXXXXXXXXXXXXXXXQIXXSAN	BERSLPOPTSEUN100XXX08000072CRK	500999JUS	9999122	GANNET POINT
00081	7815098252	SWS	PH999000000000023			XXXXXXXXXXXXXXXXBCXXXXSAN	BERSLPOPTSEUN100XXX05000082SPG	300999JUS	9999122	SMITHS GULCH
00091	7815098251	SWS	PH999000000000023			XXXXXXXXXXXXXXXXBCSPQISAN	BERSLPOPTSEUN100XXX07000092CRK	300999JUS	9999122	SMITHS GULCH
00101	7815098250	SWS	PH999000000000013			SUXXXXXXXXXXXLBCSPQISAN	BERTOPDETSLEGL00XXX20000102CRK	200999JUS	9999122	SMITHS GULCH
00111	7815098249	SWS	PH999000000000013			XXXXXXXXXXXXXXXXQIQZXXSAN	BERTOPVDLSLELA00XXX20000112CRK	200999JUS	9999122	SMITHS GULCH
00121	7815098249	SWS	PH999000000000013			XXXXXXXXXXXXXXXXBCXXXXSAN	BERTOPVDLSLELA00XXX20000122CRK	200999JUS	9999122	SMITHS GULCH
00131	7815097259	SWS	PH999000000000043			XXXXXXXXXXXXXXXXBCQZXXSAN	SANSSHVOLSLLELA00XXX60000132CRK	700999JUS	9999122	PARALLEL REEF
00141	7815097260	SWS	PH999000000000033			XXXXXXXXXXXXXXXXQZBCSPSAN	BERSLPDELSLESC00XXX50000142CRK	600999JUS	9999122	PARALLEL REEF
00151	7815095264	SWS	PH999000000000023			XXXXXXXXXXXXXXXXQIQZBCSAN	BERSLPDELSLESC00XXX10000152CRK	200999JUS	9999122	DAWSON BAY
00161	7815093268	ISF	PH999000000000013			XXXXXXXXXXXXXXXXBCXXXXSAN	BERSLPVDTSEUS100NSH05000162CRK	300999JUS	9999122	DAWSON BAY
00171	7815146176	ISF	GX999000000000023			XXXXXXXXXXXXXXXXSPXXXXSAN	SANSSHDETSLELA00NSH25000172CRK	999000BSA	0556210	WILD WAVE RIVER
00181	7815145180	DEM	PD999000000000072			SUNOXXXXXXXXXXBCOTXXSAN	SANSSHXXXXXXXXX00XXX72000182CRK	999000BSA	0556212	SANDY CAPE BEACH
00191	7815141181	DEM	PD999322220641582			SUNOXXXXXXXXXXBCOTXXSAN	SANSSHXXXXXXXXX00XXX60000192CRK	999000BSA	0556212	SANDY CAPE BEACH
00201	7815146181	DEM	PD999000000000013			SUNOXXXXXXXXXXBCSPXXSAN	SANSSHXXXXXXXXX00XXX52000202CRK	999000BSA	9999212	SANDY CAPE BEACH
00211	7815143177	DEM	PD999131310858552			NOSXXXXXXXXXXABCQZXXSAN	SANFDNDELSELA00XXX15000212CRK	999000BSA	0253132	WILD WAVE RIVER
00221	7815143177	DEM	PD999135210555552			NOSXXXXXXXXXXEQZSPXXSAN	SANFDNDELSELA00XXX15000222CRK	999000BSA	0253132	WILD WAVE RIVER
00231	7815993568	DEM	PD999243321671952			SUNODIBRSUCECQIBCOTSAN	SANFDNXXXXXXXXX00XXX05000232SWP	040999JUS	0455156	BLUFF HILL POINT
00241	7815992570	LIM	GX999939211868713			XXXXXXXXXXXXXXXXXXXXSAN	SANFDNVDGTUSS00XXX05000242SWP	040999JUS	0455157	BLUFF HILL POINT
00251	7815992570	MMD	GX999231361662742			SUDIXXXXXXXXXXXXXXXXSAN	SANFDNVDEHEHERBOONND10000252SWP	030999JUS	0455159	BLUFF HILL POINT
00261	7815992569	SMD	GX310222211444512			SUNOXXXXXXXXXXXXXXXXSAN	PEBBCHVDHEHERBO0SSH10000262SWP	010999JUS	0455161	BLUFF HILL POINT
00271	7815991570	MMD	GX999131351561752			SUNOBRXXXXXXXXXXXXXXXXSAN	PEBBRGVDLSCABR00XXX05000272SWP	040999JUS	0455162	BLUFF HILL POINT
00281	7815990571	STA	GX999000000000052			XXXXXXXXXXXXXXXXXXXXPEB	PEBBRGXXXXXXXXX00XXX10000282SWP	050999JUS	0455163	BLUFF HILL POINT
00291	7815989571	LIM	GX999131311141552			SUXXXXXXXXXXXXXXXXXXXSAN	PEBBRGVDHEHERBO0XXX10000292SWP	040999JUS	0455163	BLUFF HILL POINT
00301	7815993573	SWS	GH080000000000052			XXXXXXXXXXXXXXXXBCOTXXSAN	SANSLPOPLSHERB10WWHO3000302SWP	070999JUS	9999164	MAWSON BAY
00311	7815987573	MMD	GX999131361562752			SUDINOCEXXXXLXXXXXXSAN	PEBBRGVOLSHERBO0XXX05000312SWP	030999JUS	0455165	BLUFF HILL POINT
00321	7815988573	STA	GX999000000000052			XXXXXXXXXXXXXXXXXXXXPEB	PEBBRGXXXXXXXXX00XXX05000322SWP	030999JUS	0455166	BLUFF HILL POINT
00331	7815988574	LIM	GX999131361161772			SUDINOAUXXXXXXXXXXXXSAN	PEBBRGVDHEHERBO0XXX03000332SWP	020999JUS	0455168	BLUFF HILL POINT
00341	7815988574	LIM	GX050522250155572			SUDINOXXXXXXXXXXXXXXXXSAN	PEBBRGVDHEHERBO0WNC04000342SWP	020999JUS	0455168	BLUFF HILL POINT
00351	7815989575	RSM	GX110134251452792			SUNODIBRCAXXXXXXXXXXSAN	BERCLBVOLSHERBO0WNC07000352SWP	020999JUS	0455170	BLUFF HILL POINT
00361	7815989575	LIM	GX999135211552613			SUNOXXXXXXXXXXXXXXXXSAN	BERTOPVOLSHERBO0XXX06000362SWP	020999JUS	0456171	BLUFF HILL POINT
00371	7815994573	STA	GH999000000000032			XXXXXXXXXXXXXXXXXXXXPEB	PEBBRGXXXXXXXXX00XXX05000372SWP	020999JUS	0456176	MAWSON BAY

APPENDIX 8 LOCATIONS OF MIDDENS CONTAINING SEAL BONES IN
NORTHWEST TASMANIA

This list refers to Figure 5.14 of Section 5.3.2.

LOCATION	OBSERVER
1. Cuvier Point	pers. obs.
2. Little Duck Bay	Bowdler (1979:311)
3. Suicide Bay	pers. obs.
4. Valley Bay	Jackson (pers. comm.), pers. obs.
5. Studland Bay	Lourandos (1970: Appendix 6.3)
6. Calm Bay	Jackson (pers. comm.)
7. Maxies Point	Lourandos (1970: Appendix 6.3), Jackson (pers. comm.)
8. Green Point	Lourandos (1970: Appendix 6.3), Jackson (pers. comm.), pers. obs.
9. West Point (Nettley Bay)	Jones (1966:7), pers. obs.
10. West Point (south)	Jones (1966:8), Jackson (pers. comm.), pers. obs.
11. Bluff Hill Point	Jackson (pers. comm.), pers. obs.
12. Sundown Point	Ranson (pers. comm.), Jackson (pers. comm.), pers. obs.
13. Nelson Bay	pers. obs.
14. Rebecca	Jackson (pers. comm.)
15. Gannet Point/ Hazard Bay	Jackson (pers. comm.)
16. Ordinance Point	Pulleine (1929: 311), Jackson (pers. comm.), pers. obs.
17. Thornton River	pers. obs.
18. Daisy River	pers. obs.
19. Wild Wave River	pers. obs.
20. Sandy Cape Beach	pers. obs.
21. Sandy Cape/ Venables Corner	Pulleine (1929:312), Legge (1929:327), Jackson (pers. comm.) Ranson (pers. comm.), pers. obs.

- | | | |
|-----|---|-----------------------------------|
| 22 | Sea Devil Creek | pers. obs. |
| 23. | Johnson Bay | Jackson (pers. comm.) |
| 24. | Italian Creek | pers. obs. |
| 25. | Italian Creek
(south) | pers. obs. |
| 26. | Lagoon River | pers. obs. |
| 27. | Lagoon River
(first creek to
south) | pers. obs. |
| 28. | Interview River
(north and south) | pers. obs. |
| 29. | Ford Creek | pers. obs. |
| 30. | Rupert Point | Jackson (pers. comm.), pers. obs. |
| 31. | Conical Rocks | Jackson (pers. comm.) |
| 32. | Ahrberg Bay | Jackson (pers. comm.) |
| 33. | Trial Harbour | Cane (pers. comm.) |
| 34. | Sloop Rocks | Jackson (pers. comm.) |
| 35. | Ranger Point | pers. obs. |
| 36. | Burgess Point | pers. obs. |
| 37. | Homestead Lagoon
(Stockyard site) | Bowdler (1979: 304) |
| 38. | North Point | pers. obs. |
| 39. | Rocky Cape | Jones (1966: 6), pers. obs. |
| 40. | Lee Archer | Jones (pers. comm.) |
| 41. | Sisters Creek | Jones (1966: 6). |



APPENDIX 9 RADIOCARBON DATES FOR ARCHAEOLOGICAL SITES IN
TASMANIA

Archaeologists working in Tasmania rely heavily on C14 dating for estimating the ages of deposits. Suitable materials for other dating methods such as tree ring, archaeomagnetic and fission track dating have not been found in archaeological sites. Relative dating chronologies based on changes in stone tool type have not emerged.

A relative chronological sequence, based on the presence or absence of bone tools, has been proposed by Jones (1966:497-502) from his analysis of the sequence at Rocky Cape. He has argued that bone tools were in use only before about 3,500 BP and that after this date they were not used at all. A similar age for the disappearance of bone tools is described for Little Swanport on the east coast of Tasmania (Lourandos 1970:50). Bowdler has described an assemblage of bone tools from the Pleistocene to 4,000 BP for Cave Bay Cave on Hunter Island (1979:295). These are seen as changing slightly typologically through time, with the Pleistocene examples resembling mainland Pleistocene examples. The bone tools disappear from the Cave Bay Cave sequence around 4,000 BP. A possible exception to the general pattern is Vanderwal's recovery of a bone point from Louisa Bay, southwest Tasmania, for which he gives a date of less than 3,000 BP (1978:110). This age estimate is based on a date of $2,970 \pm 200$ BP (ANU-1771) for an organically enriched soil sample some 50cm below the bone point. As no bone tools were found in this study, this could be interpreted as evidence that none of the sites are older than 3,500 years. It should be noted however, that bone tools are generally so uncommon that their usefulness as a chronological marker is limited, and that some sites may be older even though bone tools were not found. The richest site for bone points was South Cave at Rocky Cape, where 35 points were recovered from units 5,6 and 7, which had a combined volume of approximately 10 cu. m (Jones 1971b:489-490; 207-211). It is therefore possible to calculate that the recovery rate was approximately 3.5 bone points per cubic metre of midden.

Similarly, a presence/absence sequence for fish bones before and after 3,500 has been demonstrated by Jones on the basis of his excavations at Rocky Cape (1978). The sparse fish remains from Cave Bay Cave support this sequence (Bowdler 1979:373). There are a few

exceptions: one fish vertebra was found in the post 3,500 BP deposits of North Cave at Rocky Cape (Jones 1978) and there is at least one fish recorded at Little Duck Bay on Hunter Island which dates to around 1,000 BP (Bowdler 1979:309). At West Point, where use of the site is estimated to have begun at about 2,000 BP, there are at least four or five fish bones (Jones 1966:7) and Vanderwal (pers. comm.) found a few fish bones at Maatsuyker Island in sites which date to around 400 to 500 BP (Vanderwal 1978:119). Fish bones have been recorded only in coastal sites, and as with bone tools, are relatively uncommon finds, making them of limited usefulness as chronological markers. Rocky Cape South Cave is the site where the greatest numbers of fish bones have been found. In units 5,6 and 7 of this site which have a combined volume of 10 cu. m, there were a total of 2,967 fish bones (Jones 1978:28). Even in the richest site there were only 296 fish bones per cubic metre of midden. A similar calculation can be made on the basis of the weight of bone from figures given in Jones (1978:29), with the result that there was only 86.95 grams of bone per cubic metre. Besides being relatively uncommon, fish bones were small and inconspicuous. No fish bones were found in the present study supporting the idea that most of the sites recorded are less than 3,500 years old.

Materials and methods

Samples of both charcoal and shell were used for C14 dating in this study. All shell dates were taken on Subninaella undulata, and from all of these the derived environmental correction factor for marine reservoir effects of 450 \pm 35 years must be subtracted as recommended by Gillespie and Polach (1979) and Gillespie and Temple (1977:31). In the discussions in the text these dates are given in their corrected form, but they are listed in the following table as they were communicated by Mr John Head of the Radiocarbon Laboratory.

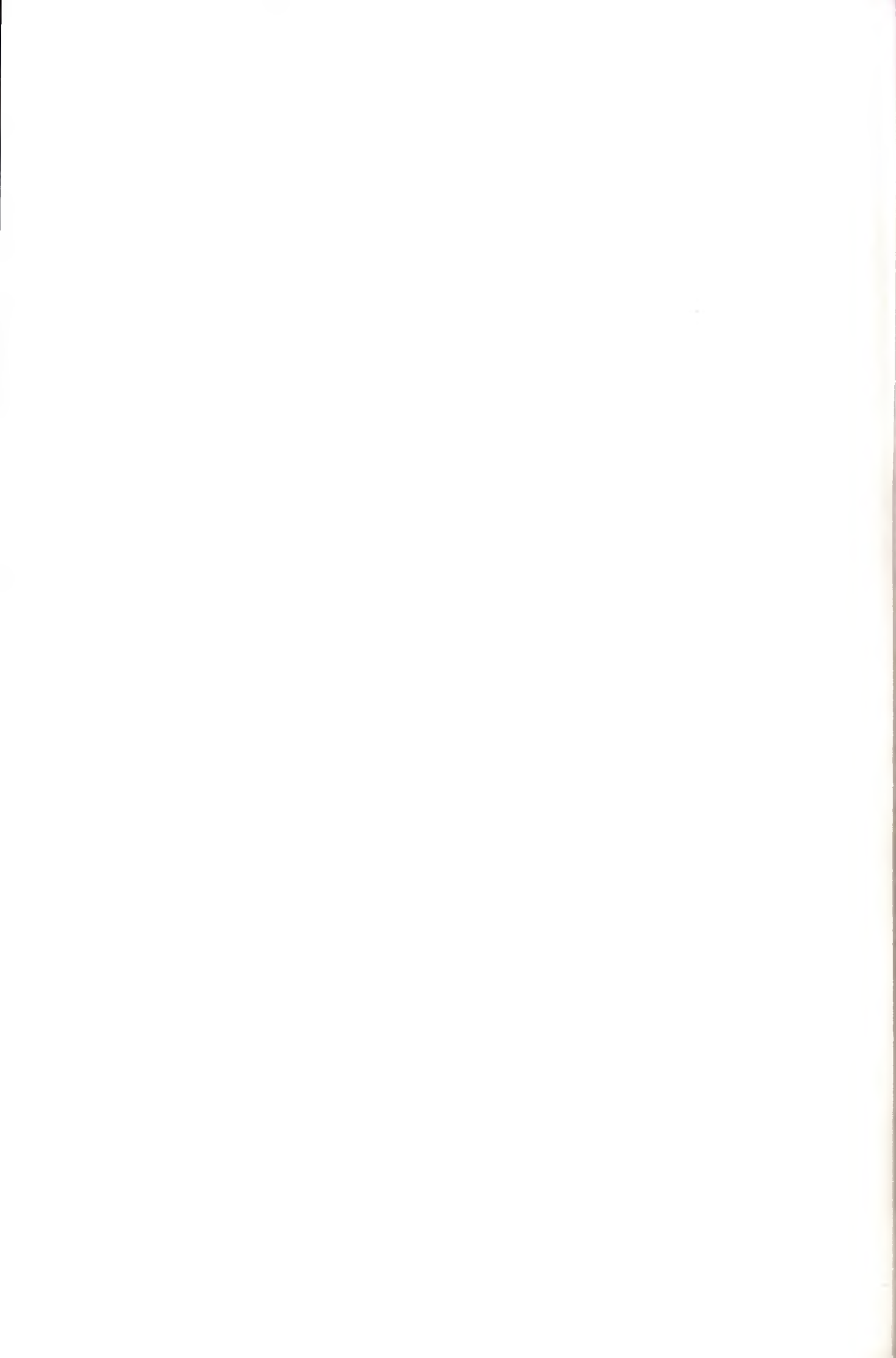


Numbers in brackets refer to my site numbers.

SITE NAME	C14 AGE	S.D.	LAB. NO.	REFERENCE	KEYWORDS
ALUM CLIFFS	3,875	160	SUA-599	STOCKTON ET AL 1979:83	MIDDEN BASE
ARTHUR RIVER (109)	4,050	240	ANU-2493	STOCKTON IN PREP.	MIDDEN BASE
ARTHUR RIVER?	1,560	70	V-19	REBER 1967:436	MIDDEN
BAY OF FIRES	750	100	ANU-2297	JONES PERS. COMM.	STONE ALIGNMENT
BEGINNERS LUCK	12,600	200	R 5001/4	GOEDE ET AL 1977:7	CAVE
BEGINNERS LUCK	20,650	1,790	GAK-7081	GOEDE ET AL 1978:141	ARTEFACTS CAVE
BEGINNERS LUCK	14,450	250	R 5001/3	GOEDE ET AL 1977:7	BONE CAVE
CAPE SORELL	1,120	70	V-20	REBER 1967:436	MIDDEN BASE
CARLTON BLUFF	8,700	200	I-323	REBER 1965:266	MIDDEN BASE
CARLTON BLUFF	5,760	130	BETA-2854	NEAL 1981:24	MIDDEN BASE
CARLTON BLUFF	7,560	70	BETA-2855	NEAL 1981:24	DUNE UNDER MIDDEN
CAVE BAY CAVE	14,760	390	ANU-1852	BOWDLER 1979:81	CAVE
CAVE BAY CAVE	15,400	330	ANU-1613	BOWDLER 1979:81	HEARTH CAVE
CAVE BAY CAVE	20,850	290	ANU-1612	BOWDLER 1979:81	HEARTH CAVE
CAVE BAY CAVE	22,750	420	ANU-1498	BOWDLER 1979:82	HEARTH CAVE
CAVE BAY CAVE	19,520	300	ANU-1774	BOWDLER 1979:82	LITHICS
CAVE BAY CAVE	2,580	70	ANU-1362	BOWDLER 1979:80	MIDDEN CAVE
CAVE BAY CAVE	18,550	600	ANU-1361	BOWDLER 1979:80	ARTEFACTS CAVE
CAVE BAY CAVE	990	90	ANU-1616	BOWDLER 1979:80	MIDDEN CAVE
CAVE BAY CAVE	3,330	100	ANU-1615	BOWDLER 1979:80	MIDDEN CAVE
CAVE BAY CAVE	3,960	110	ANU-1614	BOWDLER 1979:80	HEARTH MIDDEN CAVE
CAVE BAY CAVE	7,180	90	ANU-1552	BOWDLER 1979:80	MIDDEN CAVE
CAVE BAY CAVE	14,850	190	ANU-1772	BOWDLER 1979:81	CAVE
CAVE BAY CAVE	6,600	90	ANU-1773	BOWDLER 1979:81	CAVE
CAVE BAY CAVE	6,640	100	ANU-1797	BOWDLER 1979:81	CAVE
CONINGHAM	515	135	SUA-1018A	WALLACE PERS. COMM.	HUMAN BONE APATITE
CONINGHAM	445	80	SUA-1018B	WALLACE PERS. COMM.	HUMAN BONE COLLAGEN
CONINGHAM	840	95	SUA-626	WALLACE ET AL:	MIDDEN SKELETON
CROWN LAGOON	4,170	80	ANU-279	LOURANDOS 1977:221	LUNETTE HEARTHS TOP
CROWN LAGOON	4,860	96	ANU-278	LOURANDOS 1977:221	LUNETTE HEARTHS BAS
DENNES POINT	5,270	90	R1250/3	REBER 1967:435	MIDDEN BASE
DENNES POINT	5,220	200	R1520/2	REBER 1967:435	MIDDEN
DENNES POINT	1,987	90	R1520/1	REBER 1967:435	MIDDEN BASE
DENNES POINT	5,235	280	GXO-419	REBER 1965:264	MIDDEN BASE
FISHERS HILL	5,890	90	ANU-1090B	STOCKTON ET AL 1979:83	MIDDEN BASE
FLAT TOPPED BLUF	1,500	150	I-317	REBER 1965:266	MIDDEN
FRASER CAVE	19,780	840	ANU-2785	JONES PERS. COMM.	CAVE
GLENFIELD	210	80	SUA-303	SIGLEO ET AL IN PRESS	HEARTH
GLENFIELD	1,245	80	SUA-304	SIGLEO ET AL IN PRESS	HEARTH
GLENFIELD	2,055	120	SUA-305	SIGLEO ET AL IN PRESS	HEARTH
GREENES POINT(226)	MOD		ANU-2494	STOCKTON IN PREP.	MIDDEN
HUON POINT	1,860	110	GXO-265	REBER 1965:267	MIDDEN
JORDAN RIVER	400	90	SUA-1112	HEALEY ET AL 1980:147*	MIDDEN TOP
JORDAN RIVER	3,620	260	SUA-1113	HEALEY ET AL 1980:147*	MIDDEN BASE
KELLYS POINT	6,050	350	I-316	REBER 1965:265	MIDDEN BASE
LITTLE DUCK BAY	900	900	ANU-1618	BOWDLER 1979:309	MIDDEN TOP
LITTLE DUCK BAY	1,000	60	ANU-1778	BOWDLER 1979:309	MIDDEN BASE
LITTLE DUCK BAY	MOD		ANU-1619	BOWDLER 1979:309	ANOMOLY MIDDEN
LITTLE SWANPORT	4,490	120	ANU-365	LOURANDOS 1977:220	MIDDEN BASE
LITTLE SWANPORT	3,700	150		LOURANDOS 1970:53 CITED IN NEAL 1981:26	



LOUISA CREEK 1	1,250	100	GAK-5989	VANDERWAL 1978:118	MIDDEN
LOUISA RIVER 1	2,970	200	ANU-1771	VANDERWAL 1978:110	SOIL MIDDEN BASE
LOUISA RIVER 3	630	90	GAK-6599	VANDERWAL 1978:110	MIDDEN BASE
LOUISA RIVER CAV	870	90	GAK-5990	VANDERWAL 1978:118	MIDDEN CAVE BASE
MAATSUYKER IS. 1	570	100	GAK-5987	VANDERWAL 1978:119	MIDDEN TOP
MAATSUYKER IS. 1	400	90	GAK-5988	VANDERWAL 1978:119	MIDDEN BASE
MAINWARING RIVER?	740	100	ANU-2846	ZAKHAROV 1981:24	MIDDEN BASE HUT
MEGS MIT SHELTER	MOD		ANU-2287	JONES PERS. COMM.	TOP, SPIT 2
MEGS MIT SHELTER	420	280	ANU-2288	JONES PERS. COMM.	SPIT 9A
MEGS MIT SHELTER	790	630	ANU-2289	JONES PERS. COMM.	BASE, SPITS 8,9,10
MT CAMERON WEST	4,260	360	ANU-1136	WALLACE 1976:175	CARBON, SKELETON
MT CAMERON WEST	840	100	ANU-337	JONES PERS. COMM.	SOIL ON TOP OF MIDD
MT CAMERON WEST	1,230	80	ANU-338	JONES PERS. COMM.	MIDDEN TOP
MT CAMERON WEST	1,350	200	ANU-339	JONES PERS. COMM.	MIDDEN BASE
MT CAMERON WEST	1,070	110	ANU-341	JONES PERS. COMM.	MIDDEN OVER CARVING
MT CAMERON WEST	840	100	ANU-340	JONES PERS. COMM.	SOIL OVER CARVINGS
MUTTONBIRD MIDDEN	1,610	160	ANU-1363	BOWDLER 1979:315	MIDDEN BASE
MUTTONBIRD MIDDEN	420	70	ANU-1621	BOWDLER 1979:315	MIDDEN TOP
NETTLEY BAY(118)	2,350	150	I-322	REBER 1965:266	MIDDEN MARRAWAH N
NETTLEY BAY(495)	670	80	ANU-2843	STOCKTON THIS STUDY	MIDDEN:SHELL
NETTLEY BAY(123)	1,020	90	ANU-2894	STOCKTON THIS STUDY	MIDDEN:SHELL
NETTLEY BAY(124)	720	80	ANU-2895	STOCKTON THIS STUDY	MIDDEN:SHELL
NETTLEY BAY(131)	1,050	90	ANU-2896	STOCKTON THIS STUDY	MIDDEN:SHELL
NETTLEY BAY(285)	690	80	ANU-2898	STOCKTON THIS STUDY	MIDDEN:SHELL
NETTLEY BAY(121)	1,630	100	ANU-2892	STOCKTON THIS STUDY	MIDDEN TOP:SHELL
NETTLEY BAY(121)	1,580	100	ANU-2893	STOCKTON THIS STUDY	MIDDEN BASE:SHELL
NETTLEY BAY(122)	1,750	80	ANU-2839	STOCKTON THIS STUDY	MIDDEN:SHELL
NETTLEY BAY(289)	560	80	ANU-2840	STOCKTON THIS STUDY	MIDDEN:SHELL
NETTLEY BAY(120)	MOD		ANU-2841	STOCKTON THIS STUDY	MIDDEN TOP:SHELL
NETTLEY BAY(120)	650	90	ANU-2844	STOCKTON THIS STUDY	MIDDEN BASE:SHELL
NETTLEY BAY(496)	1,200	90	ANU-2842	STOCKTON THIS STUDY	MIDDEN:SHELL
NETTLEY BAY(122)	1,750	80	ANU-2839	STOCKTON THIS STUDY	MIDDEN:SHELL
NETTLEY BAY(495)	670	80	ANU-2843	STOCKTON THIS STUDY	MIDDEN:SHELL
OLD BEACH	5,800	130	SUA-306	SIGLEO ET AL 1975:302	HEARTH
OLD BEACH	5,600	100	SUA-307	SIGLEO ET AL 1975:302	HEARTH
OLD BEACH	1,960	105	SUA-308	SIGLEO ET AL 1975:302	HEARTH
OPP DOGSHEAR PT	5,220	110	I-324	REBER 1965:266	MIDDEN BASE
PALANA	9,890	175	SUA-640	ORCHISTON ET AL 1978:130	PALEOSOL
PALANA	7,150	135	SUA-641	ORCHISTON ET AL 1978:131	PALEOSOL
PALANA	6,520	130	SUA-642	ORCHISTON ET AL 1978:131	PALEOSOL
PETRIFIED FOREST	7,670	150	ANU-2189	JONES 1979:89	CHARCOAL
RISDON COVE	5,205	85	SUA-1313	LISTER PERS. COMM.	LITHIC SCATTER
ROCKY CAPE NORTH	450	105	V87	JONES 1971:196	MIDDEN CAVE TOP
ROCKY CAPE NORTH	2,420	60	V52	JONES 1971:196	MIDDEN CAVE
ROCKY CAPE NORTH	3,430	95	V88	JONES 1971:196	MIDDEN CAVE
ROCKY CAPE NORTH	5,425	135	V89	JONES 1971:196	MIDDEN CAVE BASE
ROCKY CAPE SOUTH	3,795	100	V83	JONES 1971:198	MIDDEN CAVE TOP
ROCKY CAPE SOUTH	5,075	250	V84	JONES 1971:198	MIDDEN CAVE TOP
ROCKY CAPE SOUTH	6,145	200	V85	JONES 1971:198	MIDDEN CAVE
ROCKY CAPE SOUTH	6,445	80	V51	JONES 1971:198	MIDDEN CAVE
ROCKY CAPE SOUTH	6,745	145	V97	JONES 1971:198	MIDDEN CAVE
ROCKY CAPE SOUTH	7,465	150	V86	JONES 1971:198	MIDDEN CAVE BASE
ROCKY CAPE SOUTH	8,120	165	GXO 266	JONES 1971:198	MIDDEN CAVE BASE
ROOKERY ROCKSHEL	1,370	70	ANU-1699	BOWDLER 1979:324	MIDDEN
ROOKERY ROCKSHEL	4,620	360	ANU-1617	BOWDLER 1979:324	ARTEFACTS
ROOKERY ROCKSHEL	870	70	ANU-1698	BOWDLER 1979:324	MIDDEN TOP
SHAG BAY	5,300	120	GAK-5425	VANDERWAL 1977:167	MIDDEN CAVE BASE
SHAG BAY	4,729	110	GAK-5424	VANDERWAL 1977:167	MIDDEN CAVE TOP
SISTERS CREEK	6,050	88	NSW 17	JONES 1965:196	MIDDEN CAVE BASE



SOUTH ARM	2,080	100 UNKNOWN	REBER 1965:264	MIDDEN
STOCKYARD SITE	760	70 ANU-1620	BOWDLER 1979:302	MIDDEN
SUNDOWN POINT (487) MOD			RANSON PERS. COMM.	MIDDEN
THORNTON RIVER(189) 980		230 ANU-2491	STOCKTON IN PREP.	MIDDEN
VENABLES CORNER(193)MOD		ANU-2490	STOCKTON IN PREP.	MIDDEN TOP
VENABLES CORNER(193)MOD		ANU-2492	STOCKTON IN PREP.	MIDDEN BASE
WEST POINT(118) 1,890		100 V-68	JONES PERS. COMM.	MIDDEN
WEST POINT(118) 1,850		80 V-69	JONES 1971:609	MIDDEN BASE
WEST POINT(118) 1,760		120 V-67	JONES PERS. COMM.	MIDDEN
WEST POINT(118) 1,330		80 V-66	JONES 1971:609	MIDDEN 30CM DOWN
WEST POINT(77) 1,220		80 ANU-2889	STOCKTON THIS STUDY	MIDDEN TOP:SHELL
WEST POINT(77) 2,600		120 GXO-420	REBER 1965:266	MIDDEN MARRAWAH S
WEST POINT(86) 760		70 ANU-2890	STOCKTON THIS STUDY	MIDDEN TOP:SHELL
WEST POINT(86) 3,830		90 ANU-2891	STOCKTON THIS STUDY	MIDDEN BASE:SHELL
WEST POINT(273) 1,580		100 ANU-2897	STOCKTON THIS STUDY	MIDDEN:SHELL
WEST POINT(299) 850		80 ANU-2899	STOCKTON THIS STUDY	MIDDEN:SHELL
WEST POINT(299) 850		80 ANU-2899	STOCKTON THIS STUDY	MIDDEN:SHELL
WEST POINT(272) 550		80 ANU-2845	STOCKTON THIS STUDY	MIDDEN:SHELL
WINDMILL SITE MOD		ANU-2285	JONES PERS. COMM.	TOP
WINDMILL SITE 4,480		140 ANU-2286	JONES PERS. COMM.	BASE
WOOLNORTH POINT 3,890		150 GAK-1220	REBER 1967:436	MIDDEN BASE

* The previously published dates for this site were incorrect due to equipment problems at the University of Sydney Radiocarbon Laboratory.